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COURSE BOOK

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PART - 1

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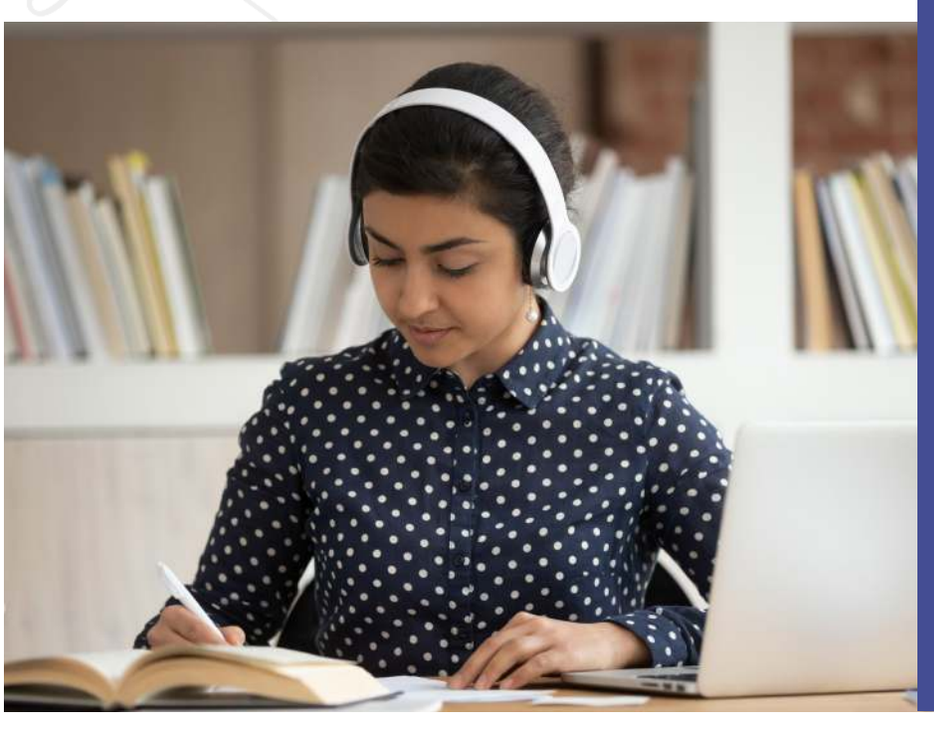

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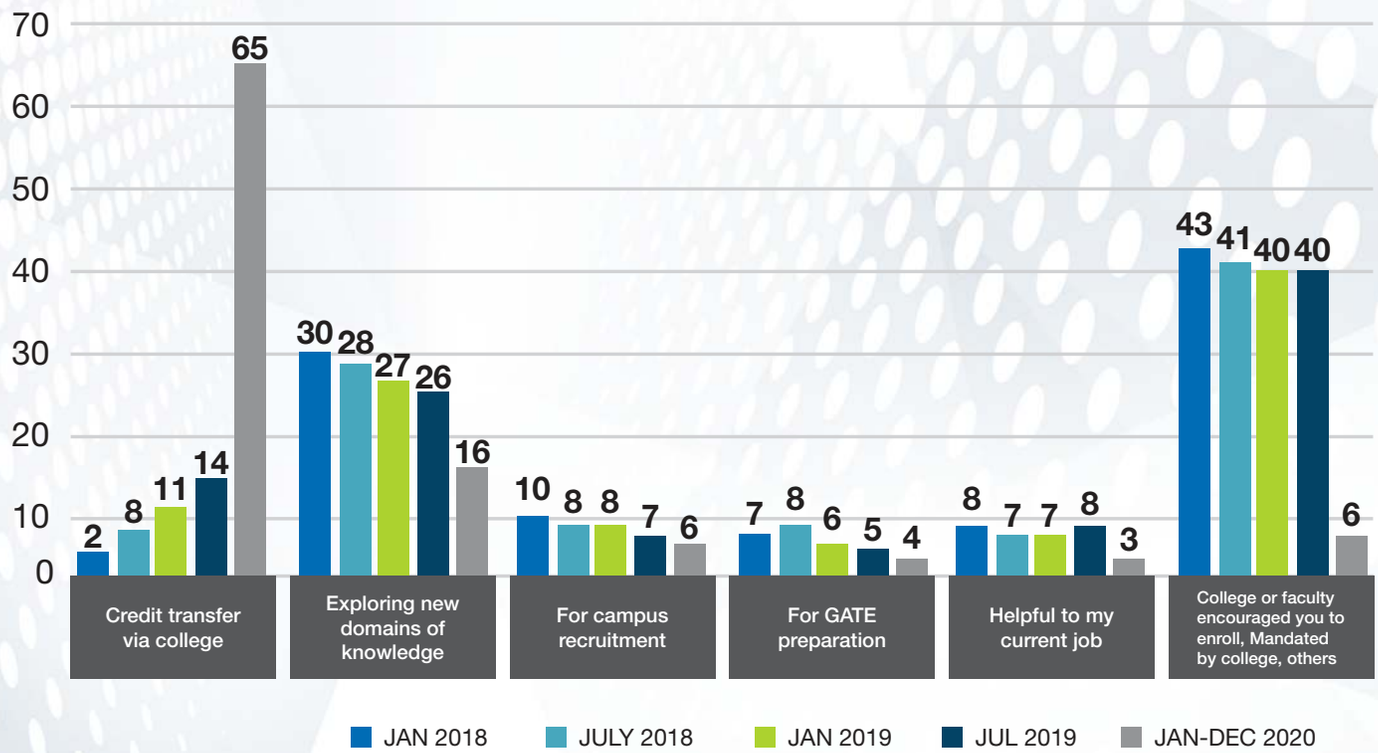

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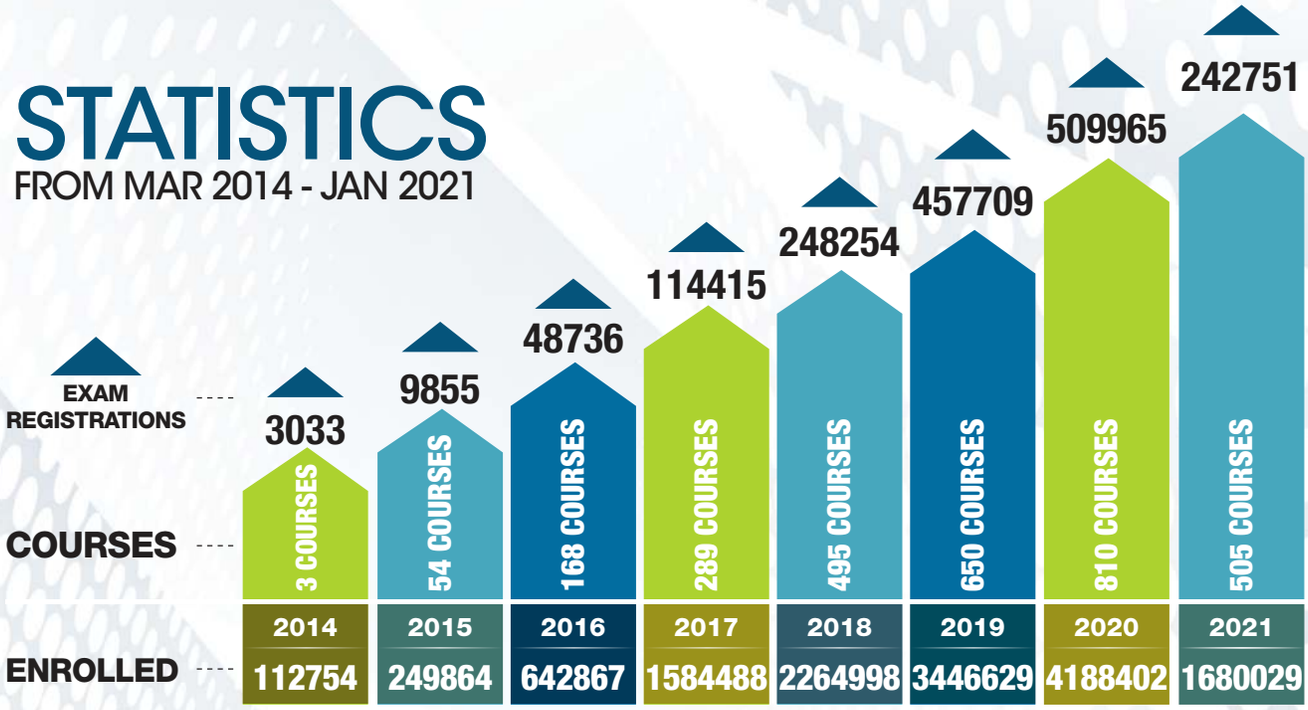

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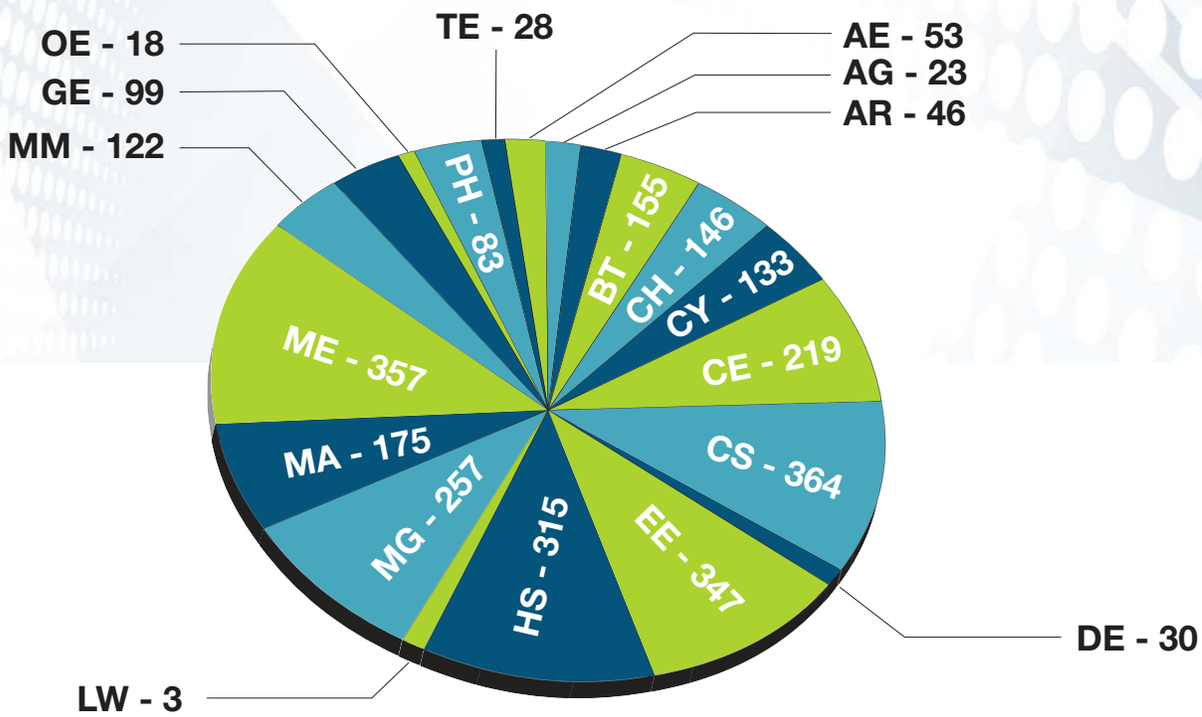

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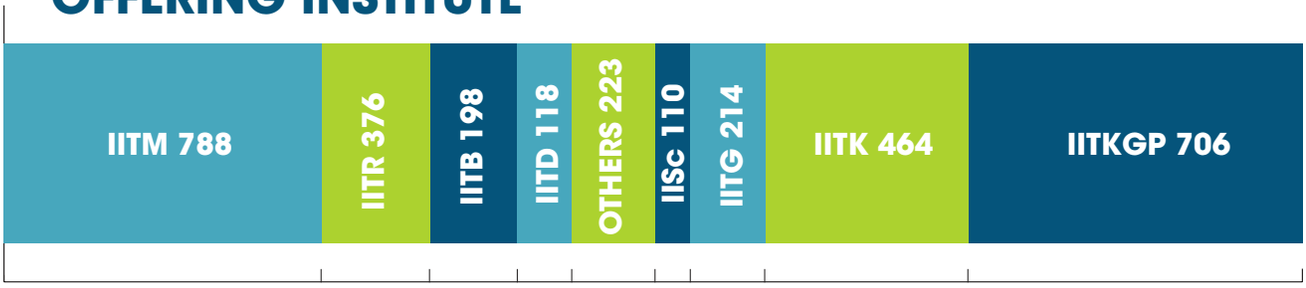

OTHERS - IIT Ropar, IIT Mandi, IIT Patna, IIT Bhubaneswar, IIT Jammu, IIITD, IIITB, IIITH, IISER Pune, IISER Mohali, IISER Bhopal, IIEST Shibpur, University of Hyderabad, University of Delhi, CMI, NIE, NIRT, CDSA, THSTI, DBT, KTH Royal Institute of Technology, Sweden, TU Berlin, IMSc, Kerala School of Mathematics, Texas A&M Univ, IITBHU(Varanasi), EM Strasbourg Business School (University of Strasbourg), Institute of Chemical Technology, Netaji Subhas University of Technology, NIE, NIRT, Google, IBM, Glass Academy, Wipro 3D, Texas Instruments.

INDEX

12 week | 08 week | 04 week

AEROSPACE ENGINEERING

CHEMICAL ENGINEERING

MECHANICAL ENGINEERING

INDEX

12 week | 08 week | 04 week

METALLURGICAL AND MATERIALS ENGINEERING

TEXTILE ENGINEERING

AEROSPACE ENGINEERING

AIRCRAFT STABILITY AND CONTROL

PROF. A.K. GHOSH
Department of Aerospace Engineering
IIT Kanpur

TYPE OF COURSE : Rerun | Core | UG
COURSE DURATION : 12 weeks (26 Jul'21 - 15 Oct'21)
EXAM DATE : 23 Oct 2021

INTENDED AUDIENCE : Core course for UG students
INDUSTRIES APPLICABLE TO : NAL Bangalore, ARDE Pune, ADE Bangalore, ADA Bangalore

COURSE OUTLINE :

This course is designed to understand stability and control aspects of an airplane. This course will also help in creating a background to design an airplane from stability and control aspects

ABOUT INSTRUCTOR :

Prof. A.K. Ghosh is a faculty of Aerospace Engg. Department of IIT Kanpur. He is also the in-charge of the flight laboratory and unmanned aerial vehicle of IIT Kanpur. His research areas include system identification through flight tests using conventional and neural network based methods, design of aircrafts and airborne projectiles, supercavitation, unmanned aerial systems. Before joining IIT Kanpur, he worked as a scientist with Defense Research Development Organization (DRDO). He has published many peer reviewed journal papers and conference papers, guided 13 doctoral students, and 38 masters students. He is also a mentor of multiple aerospace start-up companies, and also been associated with major industry contributions of high speed low drag aircraft bomb, Pinaka Mk-I, 105mm sabot round for tracked vehicles, etc.

COURSE PLAN :

Week 1: Overview of aerodynamics and atmosphere; Wing stall and maximum lift coefficient.; Wing aerodynamic center & pitching moment.; Introduction to static and dynamic stability.; Revision.
Week 2: Introduction to static and dynamic stability.; Wing contribution.; Tail contribution.; Canard and fuselage contribution.; Revision.
Week 3: Power plant contribution & its effect on NP.; Stick fixed neutral point.; Static margin.; Stick fixed : maneuvering point.; Revision.
Week 4: Elevator effectiveness, Elevator angle of trim.; Flight measurement of Xnp.; Elevator hinge moment. Stick forces (trim tab & stick force gradient),; Revision.
Week 5: Stick free neutral point.; Stick free : maneuvering point.; Roll stability and roll control.; Yaw stability and yaw control.; Revision.
Week 6: Newton's second law of rigid dynamics.; Axes system and relevant transforms.; Angular motion equations. Angular motion equations.; Revision.
Week 7: Aerodynamic forces.; Gravitational and thrust forces.; Linearized equations of motion.; Linearized equations of motion: contd.; Revision.
Week 8: Force and moment derivatives.; Force and moment derivatives.; Contribution of aircraft components to aerodynamic derivatives.; Linear model.; Revision
Week 9: Short period approximation.; Long period approximation.; Pure pitching motion.; Flying and handling qualities.; Revision
Week 10: Linearized lateral dynamics.; Lateral motion :Linearized coupled motion.; Roll approximation.; Spiral approximation.; Revision
Week 11: Dutch roll approximation.; Pure rolling.; Pure yawing.; Inertia coupling.; Revision
Week 12: Stability augmentation system: Longitudinal.; Stability augmentation system: Longitudinal.; Stability augmentation system: Lateral.; Stability augmentation system: Lateral.; Revision

INTRODUCTION TO AIRCRAFT DESIGN

PROF. RAJKUMAR S. PANT
Department of Aerospace Engineering
IIT Bombay

TYPE OF COURSE : Rerun I Elective I UG/PG
COURSE DURATION : 12 weeks (26 Jul' 21-15 Oct' 21)
EXAM DATE : 23 Oct 2021

PRE-REQUISITES : Introduction to Aerospace Engineering, Flight Mechanics

INTENDED AUDIENCE : Aeronautical Engineering, Aerospace Engineering, Mechanical Engineering and Automobile Engineering

INDUSTRIES APPLICABLE TO : HAL, NAL, Mahindra Aerospace, ADE, ADA, Airbus, Boeing

COURSE OUTLINE :
This course is designed to provide students an understanding of procedure followed in conceptual design of an aircraft, meeting the user-specified design requirements and safety considerations specified by the aircraft certification agencies. The students will be exposed to types of aircraft and their features, requirements capture, configuration selection, initial sizing, determination of aerodynamic coefficients, constraint analysis, mass break down, types of loads, V-n diagram, Operational issues (noise, emissions, Range-Payload diagram), and life cycle cost analysis. A special feature of this course will be to take the students through a complete exercise in re-sizing and of a baseline civil transport aircraft to meet a specified market requirement. This exercise will be conducted through a series of tutorials which will run all along the course to give the participants a practical feel of conceptual sizing and of an existing civil transport aircraft.

ABOUT INSTRUCTOR :
Prof. Rajkumar S. Pant has Bachelors, Masters and Ph.D. degrees in Aerospace Engineering. His areas of specialization include Aircraft Conceptual Design, Air Transportation, and Optimization. He has been a member of faculty of Aerospace Engineering Department at the Indian Institute of Technology Bombay since December 1989. Prior to that, he worked at HAL for five years in Kanpur (1984-88) and Nasik (1988-89) divisions in the Design & Engg. Department. Prof. Pant has been a Visiting Professor at School of Mechanical and Aerospace Engineering at Nanyang Technological University, Singapore for a year in 2016. He has been a visiting faculty at Department of Aerospace & Ocean Engineering at Virginia Polytechnic Institute and State University in 2010-11, and a visiting researcher at Instituto Tecnol?gico de Aeron?utica, Brazil in 2012, Texas A&M University in 2011, Cambridge University in 2008, and Imperial College London in 2006. Prof. Pant is an alumnus of College of Aeronautics, Cranfield University, UK, where he earned his Ph.D. under Commonwealth Scholarship Scheme, and IIT Madras, where he did his Masters in Aeronautical Engineering.

COURSE PLAN :

Week 1**:** Introduction to Aircraft Design & Requirements Capture

Week 2**:** Design Considerations in Airliners, Cargo, and SST

Week 3**:** Design Considerations in GA and Military Aircraft

Week 4**:** Aircraft Configuration Design

Week 5**:** Aircraft Layout Choices

Week 6**:** Initial Sizing

Week 7**:** Estimation of Lift Coefficient

Week 8**:** Estimation of subsonic parasite drag coefficient

Week 9**:** Constraint Analysis of Military Aircraft

Week 10**:** Constraint Analysis of Transport Aircraft

Week 11**:** Aircraft Loads and V-N Diagram

Week 12**:** Cost Estimation in Aircraft Design

INTRODUCTION TO AIRBREATHING PROPULSION

PROF. ASHOKE DE
Department of Aerospace Engineering
IIT Kanpur

TYPE OF COURSE : Rerun I Both I UG/PG
COURSE DURATION : 12 weeks (26 Jul' 21 - 15 Oct' 21)
EXAM DATE : 24 Oct 2021

PRE-REQUISITES : Fluid Mechanics, Thermodynamics, Basic Compressible flows

INTENDED AUDIENCE : Junior/Senior undergraduate students and postgraduate students of Aerospace, and Mechanical Engineering

INDUSTRIES APPLICABLE TO : Aerospace, Mechanical, Power Generation and Defense Industries

COURSE OUTLINE :
Due to the rapid advance in air transportation as well as military and intelligence missions, aircraft and rocket propulsion has become an essential part of engineering education. Propulsion is the combined aero-thermal science for aircrafts and rockets. Propulsion has both macro and microscales. Macroscale handles the performance and operation of aircrafts and rockets during different missions, while microscale is concerned with component design including both rotary modules (i.e., compressor, fan, pump, and turbine) and stationary modules (i.e., intake, combustor, afterburner, and nozzle). The fundamental knowledge of propulsion is expected to improve the design of the industrial propulsive systems by enhancing the stability, improving the efficiency, and reduction in pollutant formation. In this course, an integrated understanding of theory and practice of propulsion would be covered. The discussion would continue on the design, operation, installation and several inspections, repair, and maintenance aspects of aircraft and rocket engines.

ABOUT INSTRUCTOR :
Prof. Ashoke De is currently working as Associate Professor in the Department of Aerospace Engineering at Indian Institute of Technology Kanpur. He leads large scale initiatives in the modeling of turbulent reacting and non-reacting flows at IIT Kanpur. So far, he has authored more than 130 peer reviewed articles in journals and conferences. His primary research focus is the emerging field of computational mechanics with particular interest in combustion and turbulent flows.

COURSE PLAN :

Week 1: Introduction to Propulsion, Review of basic fluid mechanics and thermodynamics

Week 2: Introduction to compressible flows: 1D steady, isentropic flows, Normal shocks

Week 3: Introduction to gas turbine engines: Thrust, efficiencies and performance parameters

Week 4: Piston Engines and Propellers

Week 5: Performance/cycle analysis: Pulsejet, Ramjet, and Scramjet Engines

Week 6: Performance/cycle analysis: Turbojet, Turbofan, Turboramjet

Week 7: Performance/cycle analysis: Turboprop, Turboshaft, and Propfan

Week 8: Combustors & after burners, intakes, nozzles

Week 9: Industrial Gas Turbines, Introduction to turbo-machinery: basic principles and equations

Week 10: Centrifugal compressor: Principle, performance characteristics, efficiency, stall and surge

Week 11: Axial compressor: Theory, single stage and multi-stage compressor, cascades and losses

Week 12: Axial turbines: Theory of operation, stage and overall performances, turbine and compressor matching, turbine blade cooling; Radial Flow Turbine, Module Matching

INTRODUCTION TO AEROSPACE ENGINEERING

PROF. RAJKUMAR PANT
Department of Aerospace Engineering
IIT Bombay

TYPE OF COURSE : Rerun I Core I UG
COURSE DURATION : 12 weeks (26 Jul'21 - 15 Oct'21)
EXAM DATE :24 Oct 2021

INTENDED AUDIENCE : Any discipline of Engineering, who all are interested in the subject
INDUSTRIES APPLICABLE TO : DRDO, HAL, NAL, IAF

COURSE OUTLINE :
The aim of this course is to provide a general overview of the field of Aeronautical Engineering to interested students. Each Lecture will cover a specific concept or area relevant to the subject. An attempt will be made to cover the contents in an interesting manner, by a judicious use of a mix of powerpoint presentations, in-class activities, quizzes, innovative and hands on assignments that will not only increase the awareness of the students, but also satiate their curiosity and desire to know more about the various concepts related to the subject.

ABOUT INSTRUCTOR :
Prof. Rajkumar S. Pant has Bachelors, Masters and Ph.D. degrees in Aerospace Engineering. His areas of specialization include Aircraft Conceptual Design, Air Transportation, and Optimization. He has been a member of faculty of Aerospace Engineering Department at the Indian Institute of Technology Bombay since December 1989. Prof. Pant is an alumnus of College of Aeronautics, Cranfield University, UK, where he earned his Ph.D. under Commonwealth Scholarship Scheme, IIT Madras, where he did his Masters in Aeronautical Engineering, and PEC Chandigarh where he underwent his undergraduate studies in Aeronautical Engineering. He has also worked for five years in Hindustan Aeronautics Limited in the Design & Engineering Department at Kanpur (3.5 years) and Nasik (1.5 years) Divisions. He has published and presented ~ 220 scientific papers, of which ~ 170 are in international journals and conferences. He has also visited several top ranking institutes and universities all over the world. Prof. Pant was a Visiting Professor at School of Mechanical & Aerospace Engineering at Nanyang Technological University, Singapore in 2015-16, visiting faculty at Department of Aerospace & Ocean Engineering at Virginia Polytechnic Institute and State University in 2010-11, and a visiting researcher at Instituto Tecnolgico de Aeronutica, Brazil in 2012, Texas A&M University in 2011, Cambridge University in 2008, and Imperial College London in 2006. In November 2012, he was appointed as a Special Visiting Researcher under the Science Without Borders program of the Brazilian Government for three years

COURSE PLAN :

Week 1: Atmosphere and its properties

Week 2: Nomenclature of aircraft components

Week 3: Fluid Mechanics – I : Incompressible flow, Bernoulli's Equation, Coanda Effect, and Mach No..

Week 4: Fluid Mechanics –II : Viscous Flow, Boundary Layer, Pressure Measurement

Week 5: Aerodynamics – I : Airfoils, and Lift Generation Theories

Week 6: Aerodynamics – II : Critical Mach no., Types of Drag

Week 7: Propulsion : Types of Aircraft Engines

Week 8: Aircraft Performance - I : Steady Level Flight and Altitude effects

Week 9: Aircraft Performance- II : Glide, Climb, Ceilings, Turn, and Pull up

Week 10: Aircraft Longitudinal Stability,and V-n Diagram

Week 11: Aircraft Performance- III : Takeoff and Landing, Range and Endurance, Range-Payload Diagram

Week 12: Flapping Wing Aerodynamics

INTRODUCTION TO AIRPLANE PERFORMANCE

PROF. A.K.GHOSH
Department of Aerospace Engineering
IIT Kanpur

TYPE OF COURSE : Rerun I Core I UG
COURSE DURATION : 8 weeks (26 July' 21 - 17 Sep' 21)
EXAM DATE : 26 Sep 2021

INTENDED AUDIENCE : UG/PG of B.Tech/BE in any discipline of engineering
PREREQUISITES : NIL
INDUSTRIES APPLICABLE TO : DRDO, HAL, Boeing, Airbus, Bell, McDonnell Douglas, UAV Factory, Lockheed Martin

COURSE OUTLINE :
This course is designed to provide an integrated introductory treatment of airplane performance with flavor of aircraft design and flight testing.

ABOUT INSTRUCTOR :
Prof. A.K. Ghosh is a faculty of Aerospace Engg. Department of IIT Kanpur. He is also the in-charge of the flight laboratory and unmanned aerial vehicle of IIT Kanpur. His research areas include system identification through flight tests using conventional and neural network based methods, design of aircrafts and airborne projectiles, supercavitation, unmanned aerial systems. Before joining IIT Kanpur, he worked as a scientist with Defense Research Development Organization (DRDO). He has published many peer reviewed journal papers and conference papers, guided 13 doctoral students, and 38 masters students. He is also a mentor of multiple aerospace start-up companies, and also been associated with major industry contributions of high speed low drag aircraft bomb, Pinaka Mk-I, 105mm sabot round for tracked vehicles, etc.

COURSE PLAN :

Week 1: General Introduction: Airplane Performance Characteristics, George Cayley: Concept of Lift and Drag, Introduction to airplane and its components, Hansa 3 Aircraft and its Primary Systems, Concept of Lift: Aerofoil, Wing, and Complete Aircraft, Drag Polar

Week 2: Revision, Standard Atmosphere: Description and Modelling, Measuring Instruments: Altimeter, Airspeed Indicator, Equations of Motion: Static Performance, Thrust Required, Power Required: Cruise, Excess Thrust and Power: Climb Angle and Rate of Climb

Week 3: Review, Thrust Required: A Closer Look, Modelling of CL: Dimensional Analysis, A Closer Look: Point Mass Model, Dimensional Analysis, Estimation of Drag Polar Through Flight Test, Estimation of Rate of Climb

Week 4: Revision, Range and Endurance, Range and Endurance(Continued), Gliding Flight, Accelerated Flight, V-n Diagram

Week 5: Revision, V stall: Cruise and Manoeuvre, Flaps: High Lift Devices to Reduce Take off / Landing Distance, Take off: Warm-up Lecture, Take off Performance, Take off Performance (Continued)

Week 6: Revision, Landing Performance, Landing Performance (Continued), Challenges in Take-off and Landing: Single and Twin Engines, Introduction to Static Stability, Positioning of Centre of Pressure for Static Stability

Week 7: Revision, Stability and Control: Designer's Perspective, Stability and Control: Designer's Perspective (Continued), Longitudinal Control: Elevator, Stability: Wing and Tail Contribution, Stability: Wing and Tail Contribution (Continued)

Week 8: Control: Elevator, Control: del_E Required, Control: del_E Required (continued), Design Basics: Wing Loading & Thrust Loading, Design Basics: Sweep & Dihedral, Revision

UAV DESIGN - PART II

PROF. SADERLA SUBRAHMANYAM
Department of Aerospace Engineering
IIT Kanpur

TYPE OF COURSE : Rerun I Elective I UG/PG
COURSE DURATION : 8 weeks (26 July' 21 - 17 Sep'21)
EXAM DATE : 26 Sep 2021

PRE-REQUISITES : Introduction to Aerodynamics/Flight Mechanics and Design of fixed wing Unmanned Aerial Vehicles

INTENDED AUDIENCE :Undergraduate and postgraduate students

INDUSTRIES APPLICABLE TO : DRDO, HAL, Boeing, Airbus, Bell, McDonnell Douglas, UAV Factory, Lockheed Martin

COURSE OUTLINE :

This course introduces the designing and sizing process (Simulation/Experimental) for fixed ? wing UAV technology, integrated with its performance and stability analysis (Static & Dynamic) and prototype testing

ABOUT INSTRUCTOR :

Prof. Subrahmanyam Saderla obtained his B.Tech (Aeronautical Engineering) from JNTU, Hyderabad in 2008, M.Tech and Ph.D (Aerospace Engineering) from IIT Kanpur during 2010 and 2015 respectively. Later he joined as a postdoctoral fellow in the department of aerospace and software engineering at Gyeongsang National University (GNU), South Korea. At present he is working as an assistant professor in the department of aerospace engineering at Indian Institute of Technology Kanpur. His current area of interest lies in real time system identification of unmanned aerial vehicles. His research interests also include design, flight tests and parameter estimation, high angle of attack aerodynamic modelling and dynamic wind tunnel testing as well as experimental flight dynamics, chaotic modelling using Artificial Neural Networks.

COURSE PLAN :

Week 1**:** Review of the concepts covered in first part of the course.

Week 2**:** Understanding the static stability of various UAVs. Significance of location of Neutral point and Centre of gravity for a stable flight

Week 3**:** Approach for wing design and airfoil selection with examples

Week 4**:** Tail sizing, control surface sizing and significance of tail volume ratio with examples

Week 5**:** Developing subroutine for design process

Week 6**:** Design example for conventional takeoff fixed wing UAV for various mission requirements

Week 7**:** Design example for hand launch fixed wing UAV for various mission requirement

Week 8**:** Design example for VTOL fixed wing UAV for various mission requirement

VIBRATION AND STRUCTURAL DYNAMICS

PROF.MIRA MITRA
Department of Aerospace Engineering
IIT Kharagpur

TYPE OF COURSE : Rerun I Core I UG
COURSE DURATION : 8 weeks (26 July'21 - 17 Sep'21)
EXAM DATE : 26 Sep 2021

PRE-REQUISITES : Engineering Mechanics

INTENDED AUDIENCE : Aerospace Engineering students
INDUSTRIES APPLICABLE TO : Automobile, Aerospace, Infrastructure, Wind Turbine Industries

COURSE OUTLINE :

The course aims at imparting fundamentals of vibration and structural dynamics to senior undergraduate and graduate students. The course primarily consists of four modules, namely, single degree of freedom, multi-degree of freedom, continuous system, and analytical methods. The objective of the course is to deliver problem solving capabilities, both for industrial problems and academic research. The course will start from basics of vibrations and gradually deal with more complex problems.

ABOUT INSTRUCTOR :

Prof. Mira Mitra is currently Associate Professor in the Department of Aerospace Engineering, IIT Kharagpur. Prior to joining IIT Kharagpur, she was a faculty member in the Department of Aerospace Engineering, IIT Bombay, between 2007 to 2016. She obtained her PhD and Masters from IISc, Bangalore, both in Aerospace Engineering. She has authored more than 50 papers in International Journals and conferences. She is the recipient of INAE Young Engineering Award, DST-SERB Women Excellence Award, and IIT Bombay Hotch and Lala Excellence in Teaching Award.

COURSE PLAN :

Week 1: Introduction, Equation of motion, Single-Degree of Freedom (SDOF), Undamped and Damped, free vibration of SDOF
Week 2: Examples on free vibration, forced vibration, harmonic loading, Examples on harmonic Loading
Week 3: Response to arbitrary loading: Duhamel's integral, Impulse Loading
Week 4: Multi-degree of freedom (MDOF), Normal modes of vibration, natural frequencies and mode shapes
Week 5: Modal Superposition Theorem, Examples on MDOF
Week 6: Continuous system, Axial vibration in Rod, Natural frequencies & Mode Shapes, forced vibration of rods
Week 7: Flexural vibration in beam, natural frequencies and mode shapes, forced vibration of beams
Week 8: Hamilton's principle, Euler-Lagrange equation

DESIGN OF FIXED WING UNMANNED AERIAL VEHICLES

PROF. SADERLA SUBRAHMANYAM
Department of Aerospace Engineering
IIT Kanpur

TYPE OF COURSE : Rerun | Elective | UG/PG
COURSE DURATION : 8 weeks (23 Aug'21 - 15 Oct'21)
EXAM DATE : 24 Oct 2021

PRE-REQUISITES : Introduction to Aerodynamics
INTENDED AUDIENCE : Undergraduate and postgraduate students

INDUSTRIES APPLICABLE TO : DRDO, HAL, Boeing, Airbus, Bell, McDonnell Douglas, UAV Factory, Lockheed Martin

COURSE OUTLINE :

This course introduces the initial designing and sizing process for rapidly growing fixed – wing UAV technology, integrated with its performance and stability analysis and prototype testing.

ABOUT INSTRUCTOR :

Prof. Subrahmanyam Saderla obtained his B.Tech (Aeronautical Engineering) from JNTU, Hyderabadin 2008, M.Tech and Ph.D (Aerospace Engineering) from IIT Kanpur during 2010 and 2015 respectively. Later he joined as a postdoctoral fellow in the department of aerospace and software engineering at Gyeongsang National University (GNU), South Korea. At present he is working as an Assistant Professor in the Department of Aerospace Engineering at Indian Institute of Technology Kanpur. His current area of interest lies in real time system identification of unmanned aerialvehicles. His research interests also include design, flight tests and parameter estimation, high angleof attack aerodynamic modelling and dynamic wind tunnel testing as well as experimental flight d ynamics, chaotic modelling (of cancer cell growth, seismic data & material properties etc.) using Artificial Neural Networks.

COURSE PLAN :

Week 01 : Introduction to fixed-wing UAVs, Introduction to Design, Basic Design Parameters.
Week 02 : Basic Design Parameters contd., Design Algorithm: Case Study, Design Algorithm: Mission Requirements.
Week 03 : Design Algorithm: Feasible Design Parameters, Configuration Layout: Airfoil Selection Configuration Layout: Planform Geometry selection
Week 04 : Weight and CG EstimationAnalytical Parameter Estimation Analytical Parameter Estimation contd.
Week 05 : Performance and Stability AnalysisPerformance and Stability Analysis contd. Performance and Stability Analysis contd.
Week 06 : Simulation, Detailed Sizing
Week 07 : Estimation of inertial properties using 3D modelling, Prototype Fabrication
Week 08 : Wind Tunnel Testing, Aerodynamic Characterization through Wind Tunnel Testing

CHEMICAL ENGINEERING

HEAT TRANSFER

PROF. SUNANDO DASGUPTA
Department of Chemical Engineering
IIT Kharagpur

TYPE OF COURSE : Rerun | Core | UG
COURSE DURATION : 12 weeks (26 Jul'21 - 15 Oct'21)
EXAM DATE : 23 Oct 2021

INTENDED AUDIENCE : Chemical/Mechanical/Biotechnology/Nanotechnology

PRE-REQUISITES : Undergraduate level courses in Fluid Mechanicsl

INDUSTRIES APPLICABLE TO : Most of the process industries recognize this as a fundamental course dealing with the design of the heat transfer equipment. The fundamental concepts will enhance the lateral thinking capabilities of the students and seamlessly integrate the concepts for their use in a multitude of processes and problems

COURSE OUTLINE :

This is a fundamental subject for Chemical Engineering students and is also important in disciplines as diverse as Mechanical Engineering, Biotechnology and Nanotechnology. This course deals with both the fundamental and applied aspects, starting with the basic concepts and governing equations and evolving into the design of relevant industrial units. The students will be made aware of the core scientific issues and will be encouraged to solve problems on their own.

ABOUT INSTRUCTOR :

Professor Sunando DasGupta is a professor of Chemical Engineering and was the Dean of Sponsored Research at the Indian Institute of Technology Kharagpur. He obtained his Bachelor's degree from the Jadavpur university, Masters from IIT Kanpur and PhD from the Rensselaer Polytechnic Institute, USA in 1992. His research interests are in the fields of microscale transport processes and microfluidics and he has over 140 publications in peer reviewed journals. Prof. DasGupta is a Fellow of the National Academy of Engineering, has received the Herdillia Award by the Indian Institute of Chemical Engineers for excellence in Basic Research in Chemical Engineering and is a Senior Associate of the Abdus Salam International Centre for Theoretical Physics, Trieste, Italy.

COURSE PLAN :

Week 1 : Physical Origins and Rate Equations, Units and Dimensions, Relevance, Analysis of Heat Transfer Problems: Methodology, Introduction to Conduction, The Conduction Rate Equation, The Thermal Properties of Matter,

Week 2 : The Heat Diffusion Equation, Boundary and Initial Conditions, One-Dimensional, Steady-State Conduction, The Plane Wall, Radial Systems,

Week 3 : Conduction with Thermal Energy Generation, Heat Transfer from Extended Surfaces, Introduction to Two-Dimensional, Steady-State Conduction

Week 4 : Transient Conduction, The Lumped Capacitance Method, The Plane Wall with Convection, Radial Systems with Convection, The Semi-Infinite Solid

Week 5 : The Convection Boundary Layers, Local and Average Convection Coefficients, Laminar and Turbulent Flow, Thermal Boundary Layer Equations and Similarity, The Normalized Boundary Layer Equations, Boundary Layer Analogies

Week 6 : External Flow, Convection Calculations, The Flat Plate in Parallel Flow, The Cylinder in Cross Flow, Flow Across Banks of Tubes

Week 7 : Internal Flow, Laminar Flow in Circular Tubes: Thermal Analysis and Convection Correlations for Turbulent Flow in Circular, Non-Circular and Concentric Tube Annulus

Week 8 : Free Convection, The Governing Equations for Laminar Boundary Layers, Laminar Free Convection on a Vertical Surface, The Effects of Turbulence, Empirical Correlations for External Free Convection Flows and Within Parallel Plate Channels, Combined Free and Forced Convection

Week 9 : Boiling and Condensation, Boiling Modes, Forced Convection Boiling, Condensation - laminar and Turbulent Film in Different Geometries, Dropwise Condensation

Week 10 : Heat Exchangers, The Overall Heat Transfer Coefficient, Heat Exchanger Analysis: Use of the Log Mean Temperature Difference, Heat Exchanger Analysis: The Effectiveness–NTU Method, Heat Exchanger Design and Performance Calculations

Week 11 : Radiation, Fundamental Concepts, Blackbody Radiation, Absorption, Reflection, and Transmission by Real Surfaces, Kirchhoff's Law, The Gray Surface

Week 12 : Radiation Exchange Between Surfaces - The View Factor, Blackbody Radiation Exchange, Radiation Exchange Between Opaque, Diffuse, Gray Surfaces in an Enclosure, Radiation Exchange with Participating Media

MASS TRANSFER OPERATIONS - II

PROF. CHANDAN DAS
Department of Chemical Engineering
IIT Guwahati

TYPE OF COURSE : Rerun I Core I UG
COURSE DURATION : 12 weeks (26 Jul'21 - 15 Oct'21)
EXAM DATE : 23 Oct 2021

PRE-REQUISITES : Mass Transfer Operations I

INTENDED AUDIENCE : Under graduate students/Candidates from professional fields

INDUSTRIES APPLICABLE TO : All chemical and design industries like TATA STEEL, Worley Parsons Oman Engineering LLC, Hindalco Industries Limited, Indian Oil Corporation Ltd., Engineers India Ltd, etc.

COURSE OUTLINE :

This course will provide an overview on mass transfer at basic to an intermediate level. This course applies the concepts of diffusion and interphase mass transfer to the analysis of different unit operations such as humidification, drying, adsorption,extraction, leaching, crystallization and membrane processes. The course synthesizes fundamental concepts and analytical skills to understand mass transfer operations and to tackle the sort of complex problems. Information on key topics will be provided in the form of summary of lecture notes, problems and adequate references.

ABOUT INSTRUCTOR :

Prof. Chandan Das is a Professor in Department of Chemical Engineering at IIT Guwahati. His Key research areas are Membrane Separation Technology, Food Science & Technology, Sustainable Material for Corrosion Protection, Heavy metal remediation using Sprirulina pletensis, blue-green micro algae. He has authored 3 books and published articles in reputed journals.

COURSE PLAN :

Week 1: Humidification and air conditioning - I
Week 2: Humidification and air conditioning - II
Week 3: Drying Operations - I
Week 4: Drying Operations - II
Week 5: Liquid Extraction - I
Week 6: Liquid Extraction - II
Week 7: Leaching
Week 8: Membrane Separation Technology - I
Week 9: Membrane Separation Technology - II
Week 10: Adsorption and Ion-exchange - I
Week 11: Adsorption and Ion-exchange - II
Week 12: Crystallization


FLUID AND PARTICLE MECHANICS

PROF. BASAVARAJU
PROF. SUMESH
Department of Chemical Engineering
IIT Madras

TYPE OF COURSE : Rerun I Core I UG
COURSE DURATION : 12 weeks (26 Jul'21 - 15 Oct'21)
EXAM DATE : 23 Oct 2021

INTENDED AUDIENCE: Any interested Learners

INDUSTRIES APPLICABLE TO : Chemical process industries

COURSE OUTLINE :
This course introduces the concepts of fluid and particle mechanics and demonstrates their applications.

ABOUT INSTRUCTOR :

Prof. Madivala G. Basavaraj Before joining IIT-Madras in February 2011, he spent 3 months as visiting fellow at KULeuven (Belgium) in Prof. Jan Vermant's group. he was a postdoctoral researcher with Prof. Norman J. Wagner at the University of Delaware (USA). he studied chemical engineering at SIT, Tumkur (Bangalore University), and received my M.S (Research) from IISc, Bangalore, by working on - the determination of local dispersion coefficient and local holdup in a packed bed using X-rays. his PhD in chemical engineering is from KULeuven, Belgium (Prof. Jan Vermant). his PhD thesis was on - Tailoring colloidal gel rheology in bulk and at interfaces: Exploiting shape and surface chemistry effects.

Prof. Sumesh is interested in understanding soft and living (or active) fluids. This categorisation of matter is relatively recent, but it offers new and exciting physics that often leads to novel and unconventional engineering applications. Now I am working as Assistant Professor at Indian Institute of Technology Madras . 2007-2012 Doctor of Philosophy JNCASR Bangalore 2002-2004 Master of Technology IIT Kanpur. 1998-2002 Bachelor of Technology, Government Engineering College, Thrissur

COURSE PLAN :

Week 1**:** Introduction to Navier Stokes (NS) equations and their exact solutions, Poisuelle flow

Week 2**:** Taylor Couette flow, Rheology

Week 3**:** Dimensional analysis

Week 4**:** Turbulent Flow

Week 5**:** Friction losses, Moody's chart

Week 6**:** Boundary layer theory

Week 7**:** Introduction to Particles, their characterization

Week 8**:** Particulate Phenomena – Brownian motion and phoresis

Week 9**:** Motion of particles in a fluid, terminal velocity, particle separation

Week 10**:** Sedimentation of dilute, concentrated and flocculated dispersions

Week 11**:** Packed and Fluidized Beds

Week 12**:** Filtration

CHEMICAL PROCESS INTENSIFICATION

PROF. SUBRATA KUMAR MAJUMDER
Department of Chemical Engineering
IIT Guwahati

TYPE OF COURSE : Rerun | Elective | PG
COURSE DURATION : 12 weeks (26 Jul'21 - 15 Oct'21)
EXAM DATE : 23 Oct 2021

PRE-REQUISITES : BE/MSc in Chemical Engineering

INTENDED AUDIENCE : Chemical, mechanical Engg graduate/Post graduate/Research Scholar/ Scientist/Academician/ Industrial R&D

INDUSTRIES APPLICABLE TO : Industrial Research and Development Section of Chemical and Mechanical Engineering.

COURSE OUTLINE :

This course covers the developments in a number of intensified technologies, with particular emphasis on their application in chemical processes. The course is intended to be a useful resource for practising engineers and chemists alike who are interested in applying intensified reactor and/or separator systems in chemical industries. It will provide a basic knowledge of chemical engineering principles and process intensification for chemists and engineers who may be unfamiliar with these concepts. It will be a valuable tool for chemical engineers who wish to fully apply their background in reaction and separation engineering to the design and implementation of green processing technologies based on process intensification principles. Students in undergraduate and postgraduate degree programmes, will gain a better understanding of the practical applications in different areas.

ABOUT INSTRUCTOR :

Dr. S. K. Majumder is a Professor in the Chemical Engineering Department, IIT Guwahati, India. His research interests include multiphase flow and reactor development, hydrodynamics in multiphase flow, mineral processing, process intensifications and micro-nano bubble science and technology and its applications. He is a Fellow of the International Society for Research and Development, London, UK. He is also a recipient of various honours and awards. He has authored four books, five book chapters, and has more than 80 publications in several reputed international journals. Presently he is working in the field of Microbubble science and technology and its applications in mineral beneficiation, food processing and arsenic, ammonia and dye removal and process intensifications by developing ejector-induced gas aided extraction process.

COURSE PLAN :

Week 1**:** Introduction on Process Intensification

Week 2**:** Mechanism involved in the process intensification

Week 3**:** Role of Process intensification in sustainable development

Week 4**:** Design Techniques for Process Intensifications

Week 5**:** Stochastic Optimization for Process Intensification

Week 6**:** Process intensification by cavitation

Week 7**:** Process Intensification by monolith reactor

Week 8**:** Interfacial area based PI

Week 9**:** Process intensification in distillation

Week 10**:** Process intensification in extraction

Week 11**:** Process intensification by membrane

Week 12 : Micro process Technology in process intensification

FLUIDIZATION ENGINEERING

PROF. SUBRATA KUMAR MAJUMDAR
Department of Chemical Engineering
IIT Guwahati

TYPE OF COURSE : Rerun I Elective I UG I PG
COURSE DURATION : 12 weeks (26 Jul' 21 - 15 Oct' 21)
EXAM DATE : 23 Oct 2021

PRE-REQUISITES : Nil

INTENDED AUDIENCE : UG and PG students of Electrical and Electronics Engineering/Engineering Physics/Physics

INDUSTRIES APPLICABLE TO : Petroleum industries

COURSE OUTLINE :
This course is intended for learners who find themselves involved ranging from pure academic interest to direct industrial necessity in problems concerning the fluidized state. This course mainly covers the basic principles of fluidization phenomena and introduces the learner to the fundamental and practical aspects of basic fluidization operations for industrial application. This course may also be useful for who are doing research in multiphase system in chemical, metallurgical, and mining engineering programs.

ABOUT INSTRUCTOR :
Prof.S. K. Majumder is a Professor in the Chemical Engineering Department, Indian Institute of Technology Guwahati, India. He completed his Ph.D. in Chemical Engineering from Indian Institute of Technology Kharagpur. His research interests include multiphase flow and reactor development, hydrodynamics in multiphase flow, mineral processing, process intensifications and micro-nano bubble science and technology and its applications. Presently he is working in the field of Microbubble science and technology and its applications in mineral beneficiation, food processing and arsenic, ammonia and dye removal and process intensifications by developing ejector-induced gas aided extraction process.

COURSE PLAN :

Week 1: Introduction: The phenomenon of fluidization; Advantages and disadvantages of fluidized beds; Industrial applications of fluidized beds

Week 2: Introduction: The phenomenon of fluidization; Advantages and disadvantages of fluidized beds; Industrial applications of fluidized beds

Week 3: Characteristics of solids: Classification of solids; Flow characteristics and its outline in the different types of fluidization.

Week 4: Flow pattern of fluidization system: Flow patter, flow pattern transition, flow pattern map, Frictional pressure drop and its model to analyze, Solid movement, mixing, segregation and staging

Week 5: Flow pattern of fluidization system: Flow patter, flow pattern transition, flow pattern map, Frictional pressure drop and its model to analyze, Solid movement, mixing, segregation and staging

Week 6: Gas distribution: Type of gas distributors in small and large scale industries, Design of distributor

Week 7: Bubbling fluidized beds: Gas dispersion and gas interchange in bubbling beds, mixing characteristics

Week 8: Entrainment and elutriation from fluidized beds

Week 9: Attrition: Attrition mechanism and its analysis by model

Week - 10-11: Mass transfer phenomena: Particle to gas mass transfer phenomena and its analysis by model in two and three phase system and modeling

Week - 12: Heat Transfer phenomena: Heat transfer between fluidized beds and surfaces and modeling

Design of fluidized bed reactors: Design for physical operation, catalytic and non-catalytic

CHEMICAL ENGINEERING THERMODYNAMICS

PROF. JAYANT K. SINGH
Department of Chemical Engineering
IIT Kanpur

TYPE OF COURSE : Rerun I Core I UG
COURSE DURATION : 12 weeks (26 Jul'21 - 15 Oct'21)
EXAM DATE : 23 Oct 2021

PRE-REQUISITES : Engineering Thermodynamics.

INTENDED AUDIENCE : Engineering Students/Faculty

INDUSTRIES APPLICABLE TO : All chemical engineering-based industries, Bechtel, UOP, EIL, Reliance, Indian Oil, ONGC, Unilever

COURSE OUTLINE :

This course covers the foundation of classical thermodynamics in the form of postulates, and later their applications to open and close systems, criteria of stability and equilibria, the equation of states, properties of pure fluids and mixtures, theories and model of phase equilibrium, and chemical reaction equilibrium.

ABOUT INSTRUCTOR :

Prof. Jayant K. Singh received his B.Tech from IIT Kanpur in chemical engineering in 1997. He subsequently completed his Masters degree in computer science and engineering and Ph.D. in chemical engineering in the area of molecular simulation from SUNY Buffalo, USA in 2004.
Dr. Singh is currently a professor in the department of chemical engineering at IIT Kanpur. Dr. Singh current research interest is in thermodynamics and statistical mechanics, material modeling, confined fluids and development of molecular simulation tools. Dr Singh has co-authored more than 100 peer reviewed articles in international journals of repute.

COURSE PLAN :

Week 1**:** : The postulates of thermodynamics, Condition of Equilibrium

Week 2**:** The maximum Work Theorem, Carnot Cycle and other cycles

Week 3**:** Generalized Thermodynamic Potential, Maxwell relation, Stability of

Week 4**:** Properties of pure fluids

Week 5**:** Intermolecular forces, Equation of States

Week 6**:** Properties of mixtures-I

Week 7**:** Properties of mixtures-II

Week 8**:** Vapor-liquid equilibrium

Week 9**:** Theories and models of VLE of mixtures-I

Week 10**:** Theories and models of VLE of mixtures-II

Week 11**:** LLE and SLE

Week 12**:** Chemical Reaction Equilibria

FLOW THROUGH POROUS MEDIA

PROF.SOMENATH GANGULY
Department of Chemical Engineering
IIT Kharagpur

TYPE OF COURSE : Rerun I Core_Elective I UG/PG
COURSE DURATION : 12 weeks (26 Jul'21 - 15 Oct'21)
EXAM DATE : 23 Oct 2021

INTENDED AUDIENCE : Any engineering students/Faculty

PREREQUISITES : Background in Fluid Mechanics or equivalent is preferred

INDUSTRY SUPPORT : Chemical Process Industries, Oil & Gas Companies, Environmental Consulatants

COURSE OUTLINE :
A general overview of porous media flow, and introduction to various theoretical tools to characterize and predict the flow is provided in this course. The course is meant for undergraduate students, pursuing degrees in various engineering disciplines, listed above. The course will serve as a refresher course for PG students, who are engaged in research related to porous media flow.

ABOUT INSTRUCTOR :
Prof. Somenath Ganguly teaches at IIT Kharagpur and supervises a research laboratory on Microstructured Porous Media. He performed research work in the area resulting in several sole-author publications in Transport in Porous Media (Springer), Journal of Porous Media, Chemical Engineering Research and Design. Also, he stays abreast with new knowledge in this field by regularly reviewing manuscripts.

COURSE PLAN :

Week 1**:** Introduction, Permeability, Porosity, Various forms of characterizations

Week 2**:** Darcy's Law, Mass Continuity in Cartesian and Cylindrical Coordinates, Pressure Equations

Week 3**:** Reynold's Number for Porous media, Kozeny Carman, and Ergun Equation

Week 4**:** Transport mechanisms: Bulk and Surface Diffusion, Knudsen Transport, Klinkenberg effect, slip flow

Week 5**:** Immiscible displacement, two phase mass continuity, capillary pressure

Week 6**:** Conceptual models of relative permeability and saturation

Week 7**:** Progression of saturation front in two phase flow, Buckley Leverett theory

Week 8**:** Miscible displacement, Diffusion in porous media, Tracer Test

Week 9**:** Introduction to Taylor Aris Dispersion, Dispersion Regimes

Week 10**:** Migration and interception of fine particles

Week 11**:** Introduction to flow through deformable porous media

Week 12**:** Applications, Summary

INTRODUCTION TO INTERFACIAL WAVES

PROF. RATUL DASGUPTA
Department of Chemical Engineering
IIT Bombay

TYPE OF COURSE : New I Elective I PG
COURSE DURATION : 12 Weeks (26Jul 21-15 Oct 21)
EXAM DATE : 23 Oct 2021

PRE-REQUISITES : Introductory Transport Phenomena / Fluid Mechanics

INTENDED AUDIENCE : Chemical & Mechanical Engineering students

INDUSTRIES APPLICABLE TO : Industrial personnel working on two phase flows

COURSE OUTLINE :

The course is an introduction to the rich field of interfacial waves. The first half of the course prepares the student for studying wave phenomena by introducing discrete mechanical analogues of wave phenomena in fluid systems. The basic principles of normal mode analysis are introduced through point-mass systems connected through springs. The second half of the course introduces basics of interfacial waves viz. shallow and deep-water approximations, phase and group velocity, frequency and amplitude dispersion etc.. The fundamental aspects studied in the course will be related to various engineering applications continuously.

ABOUT INSTRUCTOR :

Dr. Ratul Dasgupta is an Associate Professor at the Chemical Engg. Department at IIT Bombay. He completed his Ph.D. at the Jawaharlal Nehru Centre for Advanced Scientific Research in Bangalore and was a postdoctoral fellow subsequently at the Weizmann Institute of Science in Israel. He has been on the faculty at IIT Bombay since 2014. He works on interfacial waves, hydrodynamic stability and the mechanics of amorphous materials employing a combination of theoretical and computational tools and occasionally simple experiments.

COURSE PLAN :

Week-1: Introduction to waves and oscillations, Normal modes of linear vibrating systems with finite degrees of freedom, Eigenmodes (shapes of oscillation) and frequencies

Week-2: Normal modes of a linear, N degree of freedom spring-mass system, continuum limit, linear wave equation and normal modes

Week-3: Nonlinear pendulum: exact solution using elliptic integrals, amplitude dependence of frequency, intro. to perturbation methods: regular and singular, Lindstedt-Poincare technique

Week-4: Damped harmonic oscillator, Duffing oscillator, method of multiple scales

Week-5: Parametric instability and the Kapitza Pendulum, Introduction to Floquet analysis; Capillary-gravity waves on a fluid interface: governing equations and boundary conditions, Normal mode analysis, Deep and shallow water approximations and dispersion relations.

Week-6: Phase and group velocity, Cauchy-Poisson problem for surface waves in deep water: 2D rectilinear and cylindrical geometry, Standing and travelling waves, kinematic interpretation of group velocity; Waves on a fluid cylinder, Rayleigh-Plateau instability, oscillations of a hollow filament.

Week-7: Normal modes of a liquid drop and bubble, Normal modes of compound drops

Week-8: Wind waves and the Kelvin-Helmholtz instability, KH instability as a model for wind wave generation, surface waves in an uniform flow due to an oscillatory pressure source at the surface

Week-9: Stokes wave in deep water, nonlinear travelling wave of constant form, stability of Stokes wave (sideband instability), solitary waves, KdV equation and solitons

Week-10: Faraday instability on a fluid interface, subharmonic response, Floquet analysis, atomization from Faraday waves

Week-11: Particle trajectories in water waves, Stokes drift, long surface gravity waves on inviscid shear flows: Burns dispersion relation

Week-12: Shape and volume oscillations of bubbles, Minnaert frequency, Rayleigh-Plesset equation. (If time permits) Kelvin wave pattern of ship wake in deep water and method of stationary phase, Resonant interactions among water waves

CHEMICAL REACTION ENGINEERING - I

PROF. BISHNUPADA MANDAL
Department of Chemical Engineering
IIT Guwahati

TYPE OF COURSE : Rerun I Core I UG
COURSE DURATION : 12 weeks (26 Jul'21 - 15 Oct'21)
EXAM DATE : 24 Oct 2021

INTENDED AUDIENCE : B.Tech in Chemical Engineering and allied disciplines
INDUSTRIES APPLICABLE TO : Almost all chemical industries including IOCL, OIL, ONGC, etc.

COURSE OUTLINE :
This course will provide an overview of chemical kinetics and reactor design at basic to an intermediate level. This course applies the concepts of reaction rate, stoichiometry and equilibrium to the analysis of chemical and biological reacting systems such as derivation of rate expressions from reaction mechanisms and equilibrium or steady state assumptions and design of chemical and biochemical reactors via synthesis of chemical kinetics, and mass and energy balances. The goal is to provide students with the theoretical/analytical background to understand chemical kinetics and reactor design and to tackle complex problems.

ABOUT INSTRUCTOR :
Dr. Bishnupada Mandal is currently a Professor and Head in the Department of Chemical Engineering at the Indian Institute of Technology Guwahati. Dr. Mandal has over 15 years of teaching and research experience at IIT Guwahati. He was Visiting Research Professor at The Ohio State Engineering, Columbus, USA during May-July 2017. He has served as Vice Chairman as well as Chairman, IIT-JEE for IIT Guwahati Zone. He had been a recipient of the prestigious BOYSCAST fellow award of Department of Science and Technology (DST) Govt. of India. His research interest includes CO2 capture and sequestration; wastewater treatment, etc. He has guided/guiding 21 PhD students. He has published 2 monographs 3 book chapters, 56 research papers in reputed international journals and more than 120 papers in conference proceedings. He has over 2450 citations and h-index is 25. Dr. Mandal has served as the Editorial Board Member of Heliyon (Elsevier) and reviewer of more than 40 ACS, Elsevier and RSC journals. He is serving as the Chairman, IIChE-GRC and Executive Council Member of IIChE. He has served OIL, Duliajan; NTPCL, Netra; GAIL (India) Limited and BHEL, Bangalore as a consultant.

COURSE PLAN :

Week 1**:** Kinetics of Homogeneous Reactions
Week 2**:** Stoichiometry
Week 3**:** Interpretation of Batch Reactor Data
Week 4**:** Ideal Reactor Design
Week 5**:** Design for single reactions
Week 6**:** Design for parallel reactions
Week 7**:** Design for parallel reactions
Week 8**:** Temperature and Pressure Effects
Week 9**:** Temperature and Pressure Effects
Week 10**:** Residence Time Distribution
Week 11**:** Reactor modeling with RTD
Week 12**:** Reactor modeling with RTD

MECHANICAL UNIT OPERATIONS

PROF. NANDA KISHORE
Department of Chemical Engineering
IIT Guwahati

TYPE OF COURSE : Rerun | Core | UG
COURSE DURATION : 12 weeks (26 Jul'21 - 15 Oct'21)
EXAM DATE : 24 Oct 2021

INTENDED AUDIENCE : Chemical Engineering, Biotechnology and Food Engineering

COURSE OUTLINE :
Chemical engineering consists of several unit operations and unit processes. Before the reaction step,the raw materials should be processed through various unit operations and similarly after the reaction step as well the products are passed through various unit operations either for product separation or forpurity. Thus unit operations are very essentially part of the chemical engineering; and hence, basic knowledge about the principles and equipment of solid-solid unit operations and solid-liquid unit operations is mandatory for any professional chemical engineer.

ABOUT INSTRUCTOR :
Dr Nanda Kishore completed PhD from Indian Institute of Technology (IIT) Kanpur in 2008 and presently is a full professor in the Department of Chemical Engineering of IIT Guwahati, India. He was Brunel Research Fellow from Dec. 21, 2009 to March 31, 2011 at School of Engineering Sciences, University of Southampton, UK. He was a visiting researcher of Department of Chemical and Processing Engineering, University of Surrey, Guildford, United Kingdom from June 2016 to July 2016. He received Young Scientist Research Award in 2016 from DAE-BRNS; IEI Young Engineers Award for the year 2015; Young Scientist Research Grant from Science and Engineering Research Board of Department of Science and Technology, Government of India, 2013.

COURSE PLAN :

Week 1**:** Introduction of Particulate Sizes and Shapes

Week 2**:** Screening

Week 3**:** Size Reduction

Week 4**:** Storage and Conveying of Bulk Solids

Week 5**:** Size Enlargement

Week 6**:** Flow past Bluff Bodies

Week 7**:** Flow Through Packed and Fluidized Beds

Week 8**:** Filtration

Week 9**:** Cross Flow Filtration and Membrane Separations

Week 10**:** Gravity Sedimentation

Week 11**:** Centrifugal Separations

Week 12**:** Floatation

INTRODUCTION TO POLYMER PHYSICS

PROF. PRATEEK KUMAR JHA
Department of Chemical Engineering
IIT Roorkee

COURSE DURATION : 12 weeks (26 Jul'21 - 15 Oct'21)
EXAM DATE : 24 Oct 2021

TYPE OF COURSE : Rerun | Core/Elective | UG/PG
INTENDED AUDIENCE : For undergraduate/postgraduate students in Polymer Science and Engineering, Chemical Engineering, Physics, Materials Science and Engineering, and Chemistry.

PRE-REQUISITES : Following courses are desired but not mandatory: Undergraduate courses in computer programming, thermodynamics, fluid mechanics/solid mechanics/continuum mechanics, and engineering mathematics/calculus.

INDUSTRIES APPLICABLE TO : Polymer and plastic Industries.

COURSE OUTLINE :

This course is an introduction to the physics of polymers, designed for senior undergraduate and postgraduate students. We will discuss statistical-mechanical, thermodynamic, and continuum theories for the structure, dynamics, and rheology of polymeric materials. Emphasis will be on developing a conceptual understanding of the theoretical and simulation methods employed in the study of polymers, and their application to specific systems. This course can be of potential interest to students studying in various disciplines including polymer science, chemical engineering, physics, chemistry, and materials science.

ABOUT INSTRUCTOR :

Dr. Prateek Kumar Jha is an Assistant Professor in the Department of Chemical Engineering at IIT Roorkee. He did his PhD in Chemical Engineering at Northwestern University, USA, followed by postdoctoral research at University of Michigan, Ann Arbor, USA. His current areas of research interest are molecular simulations, polymer physics, drug delivery, and charged systems.

COURSE PLAN :

Week 01 : Macromolecules and Life, Molecular flexibility, Classification of polymers, Types of polymerization, Average molecular weights and polydispersity, Concept of universality

Week 02 : Random walk models in polymer physics: 1-D random walk (drunkard walk), 2-D random walk on a lattice, freely jointed chain, modified freely jointed chain, freely rotating chain

Week 03 : Elastic energy of polymer chain, bead-spring model, ideal polymer chain and finite extension models, radius of gyration, pair correlation function, scattering experiments

Week 04 : Review of programming concepts, Monte Carlo simulations of a polymer chain, Importance Sampling, Metropolis criteria, Practical aspects of Monte Carlo simulation

Week 05 : Excluded volume interaction. Flory theory in good solvent, bad solvent, and theta solvent. Monte Carlo simulations in good solvent and bad solvent regime.

Week 06 : Concentrated polymer solutions. Review of Solution thermodynamics: Mixing and phase separation, osmotic pressure, chemical potential, thermodynamic origin of diffusion.

Week 07 : Lattice model of solutions, Flory-Huggins theory of polymer solutions, Definition of partition function and free energy, binodal and spinodal curve, critical point, extension to polymer blends and melt

Week 08 : Brownian motion, Correlation functions, Time translational invariance and time reversal symmetry, Brownian motion of a free particle, Einstein relation

Week 09 : Brownian motion in a potential field, Introduction to Molecular Dynamics and Brownian Dynamics

Week 10 : Rouse model of polymer chain, normalized coordinates and basis functions, Rouse modes, problems with Rouse model

Week 11 : Review of continuum mechanics: equations of motion, stress tensor, deformation tensor, deformation gradient tensor, constitutive relations of solids, liquids, and rubber. Microscopic definition of stress tensor.

Week 12 : Experimental rheology: rheometers, linear viscoelasticity, superposition principle, relaxation modulus, storage modulus, loss modulus.

ASPEN PLUS® SIMULATION SOFTWARE - A BASIC COURSE FOR BEGINNERS

PROF. PRABIRKUMAR SAHA
Department of Chemical Engineering
IIT Guwahati

TYPE OF COURSE : New I Elective I UG/PG
COURSE DURATION : 12 Weeks (26-Jul' 21 - 15-Oct' 21)
EXAM DATE : 24 Oct 2021

PRE-REQUISITES : People having Chemical Engineering background who have passed the following courses: Mass Transfer, Heat Trans fer, Chemical Reaction Engineering, Fluid Mechanics, Chemical Engineering Thermodynamics, and Mechanical Operations.

INTENDED AUDIENCE : Final year UG chemical engineering students and PG students having chemical engineering background. People from chemical process industries may also get benefitted with this course.

INDUSTRIES APPLICABLE TO : All chemical process industries such as Reliance petrochem, Shell, IOCL,etc.

COURSE OUTLINE :

Aspen Plus is a process modeling tool used for process monitoring, optimization and conceptual design, especially by chemical process industries. This is a simple course on Aspen Plus Simulation engine that will teach one how to model the most common unit operations of a chemical plant. Basic unit operations such as Pump, Reactor, Valve, Heater, Distillation Column etc. will be demonstrated which would be helpful for students, teachers, engineers and researchers in the area of R&D and Plant Design/ Operation. The course is didactic, with a lot of applied theory and case studies. At the end of the course one will be able to setup a simulation, run it, get design parameters, optimize and get results. This is highly recommended for those who are willing to take a career in simulation/modeling via software.

ABOUT INSTRUCTOR :

Prof. Prabirkumar Saha received his Bachelors of Engineering degree in Chemical Engineering from Jadavpur University, India in 1992 and his Masters of Technology and Ph. D. degrees in Chemical Engineering from the Indian Institute of Technology Madras, in 1994 and 1998, respectively. His research interest covers process control and liquid membrane based separation process. Prof. Saha is a recipient of Fulbright-Nehru Award for International Education Administrators. He is a Senior Life Member of American Institute of Chemical Engineers.

COURSE PLAN :

Week 1: Basic Process Modelling

Week 2: Basic Process Modelling

Week 3: Basic Process Modelling

Week 4: Process and property analysis

Week 5: Process and property analysis

Week 6: Process and property analysis

Week 7: Case studies

Week 8: Case studies

Week 9: Case studies

Week 10: Case studies

Week 11: Case studies

Week 12: Case studies

TRANSPORT PHENOMENA OF NON-NEWTONIAN FLUIDS

PROF. NANDA KISHORE
Department of Chemical Engineering
IIT Guwahati

TYPE OF COURSE : Rerun I Elective I UG/PG
COURSE DURATION : 12 weeks (26-Jul' 21 - 15-Oct' 21)
EXAM DATE : 24 Oct 2021

PRE-REQUISITES : Fluid Mechanics, Heat Transfer, Mass Transfer

INTENDED AUDIENCE : Chemical Engineering, Biotechnology, Food Engineering, Mechanical Engineering

COURSE OUTLINE :

Non-Newtonian fluids are often encountered in our daily life as well as in many industries. Some of the daily-life applications include personal care products such as cosmetics, gels, pastes; food stuffs such as sandwich spreads, ketchup, chocolate, soups, etc. Some of the industrial applications include processing of many polymers, paints and detergents, degassing of polymeric melts and glasses, use of non-Newtonian polymers in enhanced oil recovery, non-Newtonian fluidized beds, wastewater treatment, production of polymeric alloys and ceramics via liquid routes, pharmaceutical products wherein the polymer thickening agents are used to enhance their stability for extended shelf-life, pulp and paper industries, etc. Because of aforementioned overwhelming applications, it is required for both undergraduate and postgraduate students to acquire enough academic experience related to the momentum, heat and mass transfer phenomena associated with non-Newtonian fluids. Thus, in this course, details of types and mathematical models of non-Newtonian fluids, and their momentum, heat and mass transport phenomena are discussed along with the corresponding boundary layer flows. Problems would be discussed on the cases of engineering applications where combined momentum and heat transfer, combined momentum and mass transfer, combined mass and heat transfer, combined heat and mass transport along with homogenous and/or heterogeneous reactions are involved simultaneously.

ABOUT INSTRUCTOR :

Dr Nanda Kishore completed PhD from Indian Institute of Technology (IIT) Kanpur in 2008 and presently is an Associate Professor in the Department of Chemical Engineering of IIT Guwahati, India, since October, 2018. He has been working in the area of “Transport Phenomena of Bubbles/Drops/Particles in Non-Newtonian Fluids” for last 15 years. He has published over 70 research articles in various international level reputed journals and published 30 papers in national/international conference proceedings and published 06 book chapters. He was a visiting researcher of Department of Chemical and Processing Engineering, University of Surrey, Guildford, United Kingdom from June 2016 to July 2016. He received Young Scientist Research Award in 2016 from DAE-BRNS; IEI Young Engineers Award for the year 2015-2016; Young Scientist Research Grant Award from Science and Engineering Research Board of Department of Science and Technology, Government of India, 2013.

COURSE PLAN :

Week 1 : Introduction to Non-Newtonian Fluids
Week 2 : Rheology Measuring Instruments
Week 3 : Equations of Change
Week 4 : Momentum Transfer of Non-Newtonian Fluids
Week 5 : Momentum Transfer of Non-Newtonian Fluids
Week 6 : Flow of Non-Newtonian Fluids though Porous Media
Week 7 : Heat Transfer Phenomena of Non-Newtonian Fluids
Week 8 : Heat Transfer Phenomena of Non-Newtonian Fluids
Week 9 : Mass Transfer Phenomena of Non-Newtonian Fluids
Week 10 : Simultaneous Heat and Mass Transfer with Chemical Reactions
Week 11 : Mass Transfer Combined with Heat Transfer
Week 12 : Boundary Layer Flows of Non-Newtonian Fluids

POLYMERS: CONCEPTS, PROPERTIES, USES AND SUSTAINABILITY

PROF. ABHIJIT P DESHPANDE
Department of Chemical Engineering
IIT Madras

TYPE OF COURSE : Rerun I Elective I UG
COURSE DURATION : 12 weeks (26 Jul' 21 - 15 Oct' 21)
EXAM DATE : 24 Oct 2021

PRE-REQUISITES : First year courses in Maths, Physics and Chemistry, and Engineering Thermodynamics

INTENDED AUDIENCE : Students, practitioners and researchers who want to learn basics of polymers

INDUSTRIES APPLICABLE TO : Plastics processors, FMCG companies,Automotive companies, Biotech firms

COURSE OUTLINE : Polymers in solar cells, rubbers in soft robot, polymer composite in ISRO launch vehicle –these are some examples of cutting edge applications of polymeric materials. On the other hand, we see other examples of polymeric materials such as plastics and fiber reinforced plastics (FRP) all around us. What is so special about polymers, and why/how can they be used in such diverse applications? This course will introduce basic concepts related to polymeric materials; engineering estimations about their properties; various applications;and their impact on sustainability.

ABOUT INSTRUCTOR : Abhijit P. Deshpande is a Professor of Chemical Engineering at IIT Madras. His research focus is on polymeric systems, more specifically their aggregation and gelation behaviour. In his group, polymeric materials such as hydrogels and membranes are being investigated for applications in electrical, electromehcanical and electrochemical devices. His teaching interests include specialized courses in polymers, fluid mechanics, rheology and continuum mechanics; and core chemical engineering courses such as mass transfer and thermodynamics

COURSE PLAN :

Week 1: What are polymers? What are their unique features? - Why are polymers so common?;Polymers: Molecular structure and synthesis;Polymers: basic terms;Biopolymers;Molecular weight and distribution; Polymerization; Renewable sources

Week 2: Simple concepts related to single macromolecule, Renewable sources for polymers, Polymerization / depolymerization, States of interest, Application based terms, Reuse and repurpose, Molecular conformations, Size, mobility and flexibility, Polyelectrolytes

Week 3: Molecular arrangements and states of polymers, Structures in biopolymers, Amorphous / crystalline states, Orientation, Interactions, Kinetics of crystallization, Glass transition

Week 4: Polymeric systems of different kind, States in environment, Liquid crystalline polymers, Copolymers, Blends

Week 5: Blends, copolymers and composites, Microstructure in polymers, Composites, Stress strain response, Additives for polymeric systems, Blends / composites in recycling, Physical / chemical crosslinking, Mechanical properties

Week 6: Physico-chemical, mechanical and electrical properties of polymers, Physical and chemical aging, Solutions: properties, Conducting polymers, Dielectric response, Plasticity, Properties of composites

Week 7: Viscoelasticity in polymers, Viscoelasticity: introduction, Thermal response, Viscoelasticity: characterization, Viscoelasticity – simple models, Dynamic mechanical analysis, Damping Applications, Time Temperature, superposition, Impact and energy absorption

Week 8: Viscoelasticity in polymers / Interaction of polymers with other materials, Testing for applications, Properties of blends, Biomimetic polymers, Advanced mechanics, Viscoelastic response: examples, Polymer packaging, Porous polymers / membranes, Polymer at interfaces, Diffusion in polymers

Week 9: Interaction of polymers with other materials / Polymers processing and recycling, techniques, Compatibilizers, Biopolymer applications, Adhesives and Paints, Dissolution and recovery, Polymerization kinetics, Polymerization reactors, Polymer processing

Week 10: Polymers processing and recycling techniques, Flow simulations, Processing for recycling, Recycle, up-down cycling, Flow behaviour - rheology, Crosslinking, Conversion of polymers

Week 11: Polymers processing and recycling techniques, Rheology and entanglement, Rheological models, Rheology and processing, Absorption and leaching, Swelling of polymers, Viscosity for polymer processing

Week 12: Polymeric materials in nature, Microplastics, aerosols, sediments, Biodegradation of polymers, Biodegradable polymers

MATERIAL & ENERGY BALANCE COMPUTATIONS

PROF. ARNAB ATTA
PROF. RABIBRATA MUKHERJEE
Department of Chemical Engineering
IIT KGP

TYPE OF COURSE : New I Core I UG
COURSE DURATION : 12 Weeks (26-Jul' 21 - 15-Oct' 21)
EXAM DATE : 24 Oct 2021

INTENDED AUDIENCE : Undergraduate Second Year students in Chemical Engineering, Biochemical Engineering and Biotechnology.

INDUSTRIES APPLICABLE TO : Chemical and Petrochemical Process Industries such as BASF, Tata Chemicals, Reliance Industries, IFFCO, Dr. Reddy's, Haldia Petrochem, etc.

COURSE OUTLINE :

This is an introductory material and energy balance course that plays significant role in the chemical engineering as well in the biological, petroleum, and environmental engineering curriculum. It enables students to be conversant with the engineering approaches for solution of the process–related problems, with and without chemical reactions. The content of this course can be broadly classified into two topics: (1) material balances, and (2) energy balances. The objective of this course is to learn the formulation and interpretation of material and energy balances on various chemical process schemes

ABOUT INSTRUCTOR :

Dr. Arnab Atta is presently an Associate Professor of Chemical Engineering at IIT Kharagpur. After receiving his bachelor and master of Chemical Engineering degrees from the Department of Chemical Engineering at Jadavpur University, Kolkata, he accomplished his Ph.D. in Chemical Engineering from IIT Delhi, New Delhi as a National Doctoral Fellow.

Rabibrata Mukherjee is presently a Professor at the Department of Chemical Engineering at IIT Kharagpur. He obtained his PhD from IIT Kanpur in the year 2007. He is an internationally recognized expert in soft nano patterning and thin film instability, with specific emphasis on ordering and arranging objects by confined self organization at the nano and meso scale. So far he has published 85 international journals papers and holds 7 Indian patents.

COURSE PLAN :

Week 1: Introduction to Engineering Calculations, Processes and Process Variables

Week 2: Material Balance Calculations: Fundamentals & Single Unit

Week 3: Material Balance Calculations: Multiple Units

Week 4: Recycle & Bypass, Introduction to Chemical Reaction Stoichiometry

Week 5: Chemical Reaction Stoichiometry & Reactive Processes

Week 6: Combustion reactions, Introduction to Single- & Multi-phase Systems

Week 7: Introduction to Energy Balance & Basic Concepts

Week 8: Energy Balance without Chemical Reaction

Week 9: Energy Balance without Chemical Reaction

Week 10: Energy Balance with Chemical Reaction

Week 11: Energy Balance with Chemical Reaction

Week 12: Humidity and Psychrometric Chart


PRINCIPLES AND PRACTICES OF PROCESS EQUIPMENT AND PLANT DESIGN

PROF. GARGI DAS
PROF. S. RAY
Department of Chemical Engineering
IITKGP

TYPE OF COURSE : New I Core I UG
COURSE DURATION : 12 Weeks (26-Jul' 21 - 15-Oct' 21)
EXAM DATE : 24 Oct 2021

PRE-REQUISITES : Mass Transfer, Heat Transfer, Fluid Mechanics, Process instrumentation

INTENDED AUDIENCE : UG students of Chemical Engineering, Biotechnology, Agriculture Engineering, Rookie engineers and fresh entrants to process industries

INDUSTRIES APPLICABLE TO : All process industries e.g., oil refineries (IOCL, BPCL, HPCL Reliance, Esser, HMEL), petrochemicals (HPL, Reliance), pharma companies (DRL), etc

COURSE OUTLINE :

The course is expected to impart a holistic approach towards process design i.e. the objective is not to arrive at only the design of individual process equipment, but also to configure it as a complete functional system with its accessories. In other words, it shall deal with process design from the industry perspective. The content will primarily cover the typical mass transfer systems and equipment included in undergraduate curriculum viz. distillation, absorption, adsorption and liquid-liquid extraction along with details of internals in packed and tray columns.

ABOUT INSTRUCTOR :

Prof. Gargi Das is Professor, Department of Chemical Engineering, Indian Institute of Technology Kharagpur, West Bengal. She has been teaching thermodynamics for the past 16 years to the students of Chemical Engg and Biotechnology as a core course. Students from Mechanical Engineering, Agricultural Engineering and Chemistry have opted it as a breadth course. She has contributed to NPTEL through her video based and web based courses on Multiphase Flow and Thermodynamics.

Prof. Subhabrata Ray after superannuating from IIT Kharagpur on 30th June 2020, is currently a fellow (2020-2021) under "Professor B. D. Tilak Visiting Fellowship Endowment" in ICT Mumbai. He is also involved with M/s. Dr. Reddy's Laboratory for assessing their employees, training and R&D activities. He regularly serves as faculty for the training courses for refinery engineers at Rajiv Gandhi Institute of Petroleum Technology, Raebareli. He has co-authored a book on Process Equipment and Plant Design-Principles and Practices published in 2020 by Elsevier.

COURSE PLAN :

Week 1: Introduction to Plant Design (2); Introduction to Mass transfer Equipment (1); Phase Equilibrium (2)

Week 2: Distillation – Fractionation (4); Design Problem (1)

Week 3: Flash Distillation (1); Batch Distillation (3); Design Problem (1)

Week 4: Absorption (2); Adsorption (2); Design Problem (1)

Week 5: Liquid-Liquid Extraction - 3; Column Internals – 2 [Sieve (1), Valve (1)]

Week 6: Column Internals contd. - Bubble Cap (2); Packed column (1); Design Problem (2)

Week 7: Heat Exchanger: Introduction (1); Double Pipe HE (2); S&T HE (2)

Week 8: S&T HE contd. (1); Design Problem (1+2); Heat Exchanger Network (1)

Week 9: Heat Exchanger Network (3); Design Problem (2)

Week 10: Plant hydraulics: Pumps (2) Compressors(2), Pipeline (1)

Week 11: Pressure Vessels (2); Design Problem (2); Process Utilities (1)

Week 12: Safety (2), Process Design Package (3)

NATURAL GAS ENGINEERING

PROF. PANKAJ TIWARI
Department of Chemical Engineering
IIT Guwahati

TYPE OF COURSE : Rerun | Core | Elective | UG/PG
COURSE DURATION : 8 weeks (26 Jul'21 - 17Sep'21) 26
EXAM DATE : Sep 2021

INTENDED AUDIENCE : Under graduate and post graduate students professional practitioner in the discipline of Chemical Engineering. Petroleum Engineering, Mechanical Engineering, Energy
PRE-REQUISITES : Bachelor Degree in any Engineering discipline

INDUSTRIES APPLICABLE TO : Petroleum Industries/companies: ONGC, OIL, GAIL, IOCL, etc.

COURSE OUTLINE :

The field of natural gas engineering is very much important for petroleum engineers specializing in gas processing technology. The course outlines an optimal balance between natural gas production, natural gas processing and gas transportation. An extensive treatise on natural gas engineering, both upstream and gas refining processes with key equipment and facility design will be covered. This course will also highlight the current status of production of natural gas through unconventional sources/technics and the applications of natural gas.

ABOUT INSTRUCTOR :

Dr. Pankaj Tiwari is serving as Assistant Professor in the Department of Chemical Engineering at Indian Institute of Technology Guwahati since Aug 2012. He has received doctoral degree from University of Utah, USA (2012) and Master of Technology from Indian Institute of Technology Kanpur, India (2006). He also worked at General Electric, Plastic division at JFWTC Bangalore (2007) on developing the monomer for high performance polymer (HPP). He has taught Natural Gas Engineering as an elective course to UG, PG and PHD students at IIT Guwahati for three consecutive years (2013, 2014 and 2015).

COURSE PLAN :

Week 01 : Introduction, Gas Production: Upstream, Reservoir- Well Completion
Week 02 : Properties of Natural Gas: Phase Behavior
Week 03 : Well inflow performance relationship (IPR), Skin factor, Productivity Index, Gas well testing Deliverability : Nodal Analysis.
Week 04 : Wellbore Performance: TPR Curve, Single Phase & Multi Phase flow, Choke Performance: CPR Curve, Sonic and Subsonic Flow, Well Deliverability: Nodal Analysis
Week 05 : Natural Gas Production: Downstream, Surface Facilities, Principle of Separator, Design of Separator: Vertical, Horizontal; Two Phase Separation, Three Phase Separation
Week 06 : Natural Gas Processing: Dehydration of Natural Gas, Design of Dehydration, Sweeting Processes, Compressor design and energy calculation
Week 07 : Transportation and Measurement, Pipeline Design
Week 08 : Flow through pipeline, issues and solutions, Unconventional Production of Natural Gas: Shale Gas, Gas Hydrates, Coal bed Methane, Oil Shale, Pyrolysis of Carbonaceous Materials etc..

INTRODUCTION TO POLYMER PHYSICS

PROF.AMIT KUMAR
Department of Chemical Engineering
IIT Guwahati

TYPE OF COURSE : Rerun I Elective I UG/PG
COURSE DURATION : 8 weeks (26 Jul' 21 - 17 Sep' 21)
EXAM DATE : 26 Sep 2021

PRE-REQUISITES : Thermodynamics, Engineering Mathematics

INTENDED AUDIENCE : Undergraduate (preferably final year) and post graduate students; professional practitioners working in the area of polymers

INDUSTRIES APPLICABLE TO : Companies working on polymers/plastics such as Reliance Industries Limited, GAIL, DuPont, Dow, SABIC.

COURSE OUTLINE :

Polymer physics is important to understand the structure-property relation in polymers. An understanding of the structural features and interactions responsible for polymer properties can aid in tuning the desirable properties. This introductory course will discuss the models for ideal polymer chains, and thermodynamics of polymer solutions and blends, focusing on miscibility. The course will also cover the different methods to measure polymer molar mass, which has a strong effect on polymer properties. The physics of branching and network formation will be introduced with reference to branched polymers, dendrimers and cross-linked polymers. The course will also discuss mechanical properties of polymers with focus on viscoelasticity and rubber elasticity. Finally, a brief introduction to polymer dynamics will be provided.

ABOUT INSTRUCTOR :

Dr. Amit Kumar is currently an Associate Professor in the Department of Chemical Engineering at IIT Guwahati. His research interests include molecular modeling and simulation, polymers and polymer nanocomposites, and gas adsorption and transport in porous materials. He completed his BTech from IIT Kharagpur and PhD from University of Delaware, USA in Chemical Engineering. He has been teaching an elective course on Polymer Science and Technology to senior undergraduates, Master's and PhD students at IIT Guwahati for two years.

COURSE PLAN :

Week 1: Introduction To Polymers; Models Of Ideal Polymer Chains; Real Chains And Excluded Volume Effects

Week 2: Thermodynamics Of Polymer Solutions; Flory-Huggins Theory; Phase Behavior, Miscibility And Solubility Parameter

Week 3: Thermodynamics Of Polymer Blends And Block Copolymers; Determination Of Polymer Molar Mass By Osmometry

Week 4: Polymer Molar Mass By Light Scattering; Frictional Properties And Viscometry; Size Exclusion Chromatography

Week 5: Branching, Network Formation And Gelation

Week 6: Crystalline And Amorphous Polymer Phase; Mechanical Properties

Week 7: Viscoelasticity, Maxwell And Voigt Models; Non-Newtonian Behavior And Rheology; Rubber Elasticity

Week 8: Unentangled Polymer Dynamics, Rouse And Zimm Models; Entangled Polymer Dynamics, Reptation

TECHNOLOGIES FOR CLEAN AND RENEWABLE ENERGY PRODUCTION

PROF.P. MONDAL
Department of Chemical Engineering
IIT Roorkee

TYPE OF COURSE : Rerun | Elective | UG/PG
COURSE DURATION : 8 weeks (26 Jul'21 - 17 Sep'21)
EXAM DATE : 26 Sep 2021

INTENDED AUDIENCE : Any interested Students

COURSE OUTLINE :

The course deals with the production of energy from different fossil fuels through cleaner routes as well as from renewable resources. It is intended to help the young scientific professionals to keep their knowledge upgraded with the current thoughts and newer technology options along with their advances in the field of the utilization of different types of energy resources for cleaner energy production.

ABOUT INSTRUCTOR :

Dr. Prasenjit Mondal, is presently working as Associate Professor in the Department of Chemical Engineering, Indian Institute of Technology Roorkee, India. He joined the institute in 2009 as Assistant Professor. He has also worked as Process Engineer in industry for two years and as scientist in Centre for Scientific and Industrial Research, India for three years before joining IIT Roorkee. His area of research is Energy and Environmental Engineering. He has handled number of R & D projects sponsored by Industry, Govt. of India and International Agencies. He has published 1 book and more than 100 papers in international journals and conference proceedings. He is the recipient of NTSE scholarship, MHRD fellowship, Govt. of India .

COURSE PLAN :

Week 1: Introduction, Characterization of coal and conventional routes for energy production from coal

Week 2: Cleaner routes for energy production from coal

Week 3: Characterization of crude oil and conventional routes for crude oil utilization

Week 4: Cleaner routes for energy production form petroleum crude

Week 5: Cleaner energy production from gaseous fuels

Week 6: Solar and wind energy production

Week 7: Production of hydro and geothermal energy

Week 8: Energy production from biomass and wastes and energy conservation

TRACE AND ULTRA TRACE ANALYSIS OF METALS USING ATOMIC ABSORPTION SPECTROMETRY

DR J R MUDAKAVI
Department of Chemical engineering
IISc Bangalore

TYPE OF COURSE : Rerun I Elective I UG/PG
COURSE DURATION : 8 weeks (26-Jul' 21 - 17-Sep' 21)
EXAM DATE : 26 Sep 2021

PRE-REQUISITES : 10+2 +3 years of BE/BSCBasic knowledge of differential calculus and integration

INTENDED AUDIENCE : Chemists and Chemical Engineers, Environmental Engineers, Environmental Scientists, Civil Engineers, Pollution Control Administrators.

COURSE OUTLINE :

This course is useful for the determination of metals as ions in μg, ng, pg levels in aqueous and nonaqueous solutions. It has applicability to air pollution, water and solid waste matrices. An emphasis is laid on fundamentals of atomic structure, spectroscopy, instrumentation, method development and industrial applications. The course will be useful for chemists, chemical engineers, metallurgists, biotechnologists and NGOs.

ABOUT INSTRUCTOR :

Dr J R Mudakavi is a former faculty of Chemical engineering Dept, Indian Institute of Science, Bangalore. He has taught “Modern Instrumental Methods of analysis and Pollution Control” for 36 years. He is an authority on analytical instrumentation. He is the author of 2 books on Air Pollution and Hazardous Waste management. He has published more than 100 papers in National and International Journals, conferences, Symposia etc. He is a member of several expert committees such as CSIR DST MOEF KSPCB etc. He has offered two courses on instrumentation in NPTEL. He is a popular, Science writer and lecturer and environmentalist.

COURSE PLAN :

Week 1: Introduction to pollution control monitoring and Introduction to atomic structure

Week 2: Interaction of electromagnetic radiation with fundamental particles

Week 3: Instrumentation, for flame, flameless and graphite furnace AAS

Week 4: Mechanism of Atomization

Week 5: Design of atomizers, flame, graphite , hydride generation and Instrumentation of AAS & AES – electronics and optics

Week 6: Techniques of flame AAS, Interferences in flame and non flame AAS

Week 7: Interferences in Hydride generation AAS and cold vapor mercury, Applications of AAS to individual elements.

Week 8: Applications of AAS to individual elements continued, pollution monitoring and environmental sampling and conclusion

COLLOIDS AND SURFACES

Prof. Madivala G. Basavaraj
Department of Chemical Engineering
IIT Madras

TYPE OF COURSE : Rerun I Elective I UG/PG
COURSE DURATION : 8 weeks (26 Jul' 21 - 17 Sep'21)
EXAM DATE : 26 Sep 2021

INTENDED AUDIENCE : B.E/M.E/M.Tech/Ph.D
INDUSTRIES APPLICABLE TO : Consumer product industries (HUL, P&G, Paints, food and others)

COURSE OUTLINE :
This course introduces the fundamentals of colloids and nanoparticle science, wherever possible applications of these concepts will be discussed.

ABOUT INSTRUCTOR :
Associate Professor, Department of Chemical Engineering, Indian Institute of Technology- Madras. Before joining IIT-Madras in February 2011, I spent 3 months as visiting fellow at KULeuven (Belgium) in Prof.Jan Vermants group. I was a postdoctoral researcher with Prof. Norman J. Wagner at the University of Delaware (USA). I studied chemical engineering at SIT, Tumkur (Bangalore University), and received my M.S (Research) from IISc, Bangalore, by working on the determination of local dispersion coefficient and local holdup in a packed bed using X-rays. My PhD in chemical engineering is from KULeuven, Belgium (Prof. Jan Vermant). My PhD thesis was on - Tailoring colloidal gel rheology in bulk and at interfaces: Exploiting shape and surface chemistry effects.

COURSE PLAN :

Week 1**:** Introduction to Colloids

Week 2**:** Characterization of Colloids

Week 3**:** van der Waals Interactions

Week 4**:** van der Waals Interactions (continued)

Week 5**:** Colloid-Polymer Interactions

Week 6**:** Electrical Double Layer Interactions

Week 7**:** Electrical Double Layer Interactions (continued)

Week 8**:** Electrokinetics and Particles at Interfaces

CHEMICAL PROCESS CONTROL

PROF.SUJIT JOGWAR
Department of Chemical Engineering
IIT Bombay

TYPE OF COURSE : Rerun I Elective I UG
COURSE DURATION : 8 weeks (23 Aug' 21 - 15 Oct' 21)
EXAM DATE : 24 Oct 2021

PRE-REQUISITES : Material and Energy balances

INTENDED AUDIENCE : Chemical Engineering, System and Control Engineering

COURSE OUTLINE :

In this course, we will begin with the dynamic analysis of chemical engineering systems which will tell us how these systems behave. After knowing their behavior, we will move to controlling this behavior as per our choice with the help of a control system. Lastly, using advanced controller, we will see how this can be achieved in the most intelligent way.

ABOUT INSTRUCTOR :
Prof.Sujit Jogwar, Department of Chemical Engineering, IIT Bombay.

COURSE PLAN :

Week 1: Motivation for process control,Introduction to process dynamics

Week 2: First order dynamic systems

Week 3: Second and higher order dynamic systems

Week 4: Introduction to feedback control

Week 5: Stability analysis

Week 6: Feedback control design

Week 7: Advanced control topics

Week 8: Batch process control

ADIABATIC TWO-PHASE FLOW AND FLOW BOILING IN MICROCHANNEL

PROF. GARGI DAS
Department of Chemical Engineering
IIT Kharagpur

TYPE OF COURSE : Rerun | Elective | UG/PG
COURSE DURATION : 4 weeks (26 July 2021 - 20 Aug 2021)
EXAM DATE : 26 Sep 2021

PRE-REQUISITES : Basic Knowledge of Fluid Mechanics Preliminary knowledge of multi-phase flow desirable

INTENDED AUDIENCE : Elective Course, UG/PG Course, B Tech /M Tech /Ph.D

INDUSTRIES APPLICABLE TO : BARC, DRDO, Automotive Companies, Thermax

COURSE OUTLINE :

The course is designed to provide the participants a basic idea of multiphase flow and flow boiling heat transfer in microchannels. This is pertinent in the current trend of miniaturization as a means of process intensification and is frequently encountered in pharmaceutical and fine chemical industries, microchip cooling and flow through porous medium. The present course discusses the underlying fluid mechanical principles governing multiphase flow in micro vis-a vis macro domain, influence of operating parameters on flow morphology, different experimental techniques and pattern based analysis relevant in this scale as

well as the uniqueness of flow boiling heat transfer in microchannels.

ABOUT INSTRUCTOR :

Gargi Das is Professor, Department of Chemical Engineering, Indian Institute of Technology Kharagpur, West Bengal. Her area of expertise is Multiphase Flow, Transport phenomena, CFD and Process Intensification and her research investigations comprise of both experimental studies and modelling. She

has published over 50 refereed research papers, authored two books and three book chapters. She has contributed to NPTEL through her video based and web based courses on Multiphase Flow and Thermodynamics and has been teaching Multiphase flow as an elective to the undergraduate, post graduate and doctoral students of various departments.

COURSE PLAN :

Week 1**:** Introduction to multiphase flow – macro vs micro domain and importance of two phase flow in microchannels.

Week 2**:** Experimental Investigations of flow morphology - flow visualization and signal

Week 3**:** Influence of operating parameters – Conduit diameter,Influence of operating parameters –

Week 4**:** Flow pattern based modelling and flow boiling in microchannels processing microchannels Part -I,Flow boiling heat transfer in microchannels Part -II,Critical heat flux for boiling in microchannels

MECHANICAL ENGINEERING

ENGINEERING MECHANICS

PROF. K. RAMESH
Department of Applied Mechanics
IIT Madras

TYPE OF COURSE : Rerun I Core I UG
COURSE DURATION : 12 weeks (26 Jul'21 - 15 Oct'21)
EXAM DATE : 23 Oct 2021

PRE-REQUISITES : It is a very basic course

INTENDED AUDIENCE : Any Interested Learners

COURSE OUTLINE :
This is a basic first level course to learn rigid body mechanics covering both statics and dynamics. Statics covers free body diagrams, equilibrium of rigid bodies, analysis of trusses and beams, discussion on friction, virtual work and stability. Dynamics deals with general plane motion of rigid bodies, use of translating and rotating frames of reference for analysis, plane kinetics and 3D kinematics.

ABOUT INSTRUCTOR :
Prof. K. Ramesh is currently a Senior Professor at the Department of Applied Mechanics, IIT Madras; as its Chairman during (2005-2009) and formerly a Professor at the Department of Mechanical Engineering, IIT Kanpur. He received his undergraduate degree in Mechanical Engineering from the Regional Engineering College, Trichy (now NIT, Trichy), Postgraduate degree from the Indian Institute of Science, Bangalore and the Doctoral Degree from the Indian Institute of Technology Madras.

COURSE PLAN :

Week 1: Introduction and Force Systems

Week 2: Equilibrium of Rigid Bodies and Introduction to Trusses

Week 3: Analysis of Trusses and Introduction to Beams

Week 4: Analysis of Beams

Week 5: Virtual work and Energy relations

Week 6: Review so far and Friction

Week 7: Belt friction, Review of particle dynamics, Circular motion

Week 8: Plane kinematics of rigid bodies, absolute motion and relative motion

Week 9: Instantaneous center, Rotating frame of reference

Week 10: Choice of rotating frame and understanding Coriolis acceleration

Week 11: Plane kinetics

Week 12: 3D kinematics

ENGINEERING FRACTURE MECHANICS

PROF. K. RAMESH
Department of Applied Mechanics
IIT Madras

TYPE OF COURSE : Rerun | Core/Elective | UG/PG
COURSE DURATION : 12 weeks (26 Jul'21 - 15 Oct'21)
EXAM DATE : 23 Oct 2021

INTENDED AUDIENCES : Students in Engineering Colleges and working professionals in similar areas
PRE-REQUISITES : Basic course on Strength of Materials. Course on Theory of Elasticity desirable

INDUSTRIES APPLICABLE TO : HAL, Honeywell, GE, GM, NAL, DMRL, DRDO, BEML, Mahindra&Mahindra, Tata Motors, L&T, VSSC, Defense and Atomic energy Laboratories

COURSE OUTLINE :

The course covers the basic aspects of Engineering Fracture Mechanics. Spectacular failures that triggered the birth of fracture mechanics, Modes of loading, Classification as LEFM and EPFM, Crack growth and fracture mechanisms, Energy release rate, Resistance, Griffith Theory of fracture, Extension of Griffith Theory by Irwin and Orowan, R-Curve, Pop-in phenomena, Crack branching. Necessary and sufficient conditions for fracture, Stress and Displacement fields in the very near and near-tip fields, Westergaard, Williams and Generalised Westergaard solutions, Influence of the T-stress and higher order terms, Role of photoelasticity on the development of stress field equations in fracture mechanics, Equivalence between SIF and G, Various methods for evaluating Stress Intensity Factors, Modeling plastic zone at the crack-tip, Irwin and Dugdale models, Fracture toughness testing,Fedderson TMs residual strength diagram, Paris law, J-integral, HRR field, Mixed-mode fracture, Crack arrest methodologies.

ABOUT INSTRUCTOR :

Prof. K. Ramesh is currently a Senior Professor at the Department of Applied Mechanics, IIT Madras; as its Chairman during (2005-2009) and formerly a Professor at the Department of Mechanical Engineering, IIT Kanpur. He received his undergraduate degree in Mechanical Engineering from the Regional Engineering College, Trichy (now NIT, Trichy), Postgraduate degree from the Indian Institute of Science, Bangalore and the Doctoral Degree from the Indian Institute of Technology Madras.

COURSE PLAN :

Week 01 : EFM Course outline and Spectacular Failures
Week 02 : Introduction to LEFM and EPFM, Fatigue Crack Growth Model
Week 03 : Crack Growth and Fracture Mechanisms, Griffith TMs Theory of Fracture
Week 04 : Energy Release Rate
Week 05 : Review of Theory of Elasticity
Week 06 : Westergaard Solution for Stress and Displacements for Mode I, Relationship between K and G
Week 07 : Introduction to multi parameter stress field for Mode I, Mode II and Mixed Modes
Week 08 : SIF for Various Geometries
Week 09 : Modeling Plastic Deformation, Irwin TMs model, Dugdale Model
Week 10 : Fracture Toughness Testing, Paris Law and Sigmoidal curve
Week 11 : Crack Closure, Crack Growth Models, J-Integral
Week 12 : Failure Assessment Diagram, Mixed Mode Fracture, Crack Arrest and Repair Methodologies

MANUFACTURING SYSTEMS TECHNOLOGY I & II

PROF. SHANTANU BHATTACHARYA
Department of Mechanical Engineering
IIT Kanpur

TYPE OF COURSE : Rerun I Core I UG
COURSE DURATION : 12 weeks (26-Jul' 21 - 15-Oct' 21)
EXAM DATE : 23 Oct 2021

INTENDED AUDIENCE : UG/PG of Mechanical Engineering/ Industrial and Production Engineering/ Material Science and Engineering/ Metallurgical Engineering

INDUSTRIES APPLICABLE TO : SMIL (Gurgaon), HAL (Kanpur and Lucknow), Cyeint (Hyderabad), Small and medium scale production industries

COURSE OUTLINE :

This is an introductory level course in Manufacturing Systems Technology and management. For most enterprises, the long term goal is to stay in business, grow and make profits. This is particularly true for manufacturing enterprises, which must understand the dynamic changes that are taking place in business environment and are flexible enough to change at every level. This course is an introductory course for engineering professionals who would like to take up careers in manufacturing and also for professionals who are already in manufacturing careers and would like to see the technological changes that manufacturing paradigm has witnessed in the last 3 decades.

ABOUT INSTRUCTOR :

Prof. Shantanu Bhattacharya is currently an Associate Professor at the Department of Mechanical Engineering at the Indian Institute of Technology Kanpur. Prior to joining IIT Kanpur he was associated with Suzuki Motors in the senior management level and has over 6 years of experience in various production capacities and positions. Prof. Bhattacharya currently takes care of the 4-I laboratory at IIT Kanpur as its coordinator and has also been associated with the TA 202 laboratory as coordinator from 2012 to 2015. Both these laboratories are very high end in terms of offering manufacturing training programs.

COURSE PLAN

Week 1 to 3	:	Manufacturing properties of materials, Computer aided designing
Week 4 to 5	:	Principles and process planning of basic machining processes, Machine tools design.
Week 6	:	Computer aided process planning
Week 7	:	Introduction to CNC part programming, Product design
Week 8	:	Just-in-time manufacturing
Week 9	:	Quality systems engineering
Week 10 to 11	:	Cost of quality and statistical quality control
Week 12	:	Robotic systems planning and designing


HEAT EXCHANGERS: FUNDAMENTALS AND DESIGN ANALYSIS

PROF. PRASANTA KUMAR DAS
Department of Mechanical Engineering
IIT Kharagpur

PROF. INDRANIL GHOSH
Department of Cryogenic Engineering
IIT Kharagpur

TYPE OF COURSE : Rerun | Core/Elective | UG/PG

COURSE DURATION : 12 weeks (26 Jul'21 - 15 Oct'21)

EXAM DATE : 23 Oct 2021

INTENDED AUDIENCE : Mechanical Engineering, Chemical Engineering, Energy Engineering, Cryogenics Engineering, Aerospace Engineering etc.

PREREQUISITES : Thermodynamics, Fluid Mechanics and Heat Transfer (at a very basic level).

INDUSTRY SUPPORT : All the companies generating coal based and nuclear based power (NTPC, different state electricity boards, CPRI, BARC, andNPCL etc.). Companies dealing with the design and fabrication of heat exchangers, auto mobile industries, process industries, oil refineries. Companies dealing with waste heat recovery and renewable. Some specific companies could be BHEL, ALSTOM, HP, HPCL, IOCL, THERMAX, BPCL, GAIL, Reliance, TATA Chemicals etc.

COURSE OUTLINE :

Heat exchangers are extensively used in diverse industries covering power generation, refrigeration and air conditioning, cryogenics, oil refineries and chemical processes, automobiles and other transport devices. The performance of a heat exchanger is very important for the conservation of energy, assurance of product quality, process viability and environmental protection. The present course aims at developing a familiarity with various types of heat exchangers, their construction and applications. Conventional methods of heat exchanger analysis; brief design methodology of typical heat exchangers and synthesis of heat exchanger network. It is planned to develop an appreciation and basic expertise in heat exchanger through description, mathematical analysis and numerical examples.

ABOUT INSTRUCTOR :

Prof. Prasanta Kumar Das is a Professor of Mechanical Engineering and presently the Dean Post Graduate Studies and Research at IIT Kharagpur. He possesses a vast experience in teaching and research. His research interests lie in the broad area of thermal engineering with a special emphasis on two phase flow.

Prof.Indranil Ghosh received his B. Sc. and M. Sc. in Physics from Jadavpur University in 1990 and 1992 respectively, M.Tech and Ph.D. from the Cryogenic Engineering Centre, Indian Institute of Technology, Kharagpur in 1995 and 2005 respectively.

COURSE PLAN :

Week 01 : Background, Application, Classification, Common terminologies
Week 02 : Introduction to Thermal and hydraulic aspects, pressure drop and heat transfer, sizing and rating. F-LMTD and -NTU method.
Week 03 : Tubular Heat Exchangers: different designs, brief description of Shell and Tube Heat Exchangers, Special types.
Week 04 : Compact heat exchangers, enhancement of heat transfer, extended surface or Fin, fundamental of extended surface heat transfer, Fin tube heat exchanger.
Week 05 : Plate Fin Heat Exchangers (PFHE), types, construction, fabrication, design, application. Multistream PFHE.
Week 06 : Multistream PFHE continued. Direct contact heat exchangers, types, application, simple analysis.
Week 07 : Regenerators, types of regenerators, construction, application. Theory of Regenerator, NTU and method.
Week 08 : Heat pipes, construction, working principle, application, analysis. Special heat pipes.
Week 09 : Microscale Heat Exchangers and heat sinks; heat transfer and fluid flow through narrow conduits, special design considerations
Week 10 : Phase change HEX; phase change heat transfer, introduction to evaporators and condensers.
Week 11 : Phase change HEX; phase change heat transfer, introduction to evaporators and condensers.
Week 12 : Heat Exchanger testing, steady state and dynamic methods.

ELEMENTS OF METAL CUTTING, MACHINE TOOLS, GEAR CUTTING AND CNC MACHINING

PROF.ASIMAVA ROY CHOUDHURY
Department of Mechanical Engineering
IIT Kharagpur

TYPE OF COURSE : Rerun I Core I UG/PG
COURSE DURATION : 12 weeks (26-Jul' 21 - 15-Oct'21)
EXAM DATE : 23 Oct 2021

INTENDED AUDIENCE: Undergraduate or postgraduate students of mechanical engineering, manufacturing engg, production engg, diploma and certificate students of mechanical trade

COURSE OUTLINE :

In the course metal cutting and machine tools, gear cutting and CNC machine tools and processes,the students will be made familiar with metal cutting theory including cutting tool geometry, mechanism of chip formation, force analysis in the orthogonal cutting system, measurement of cutting forces – dynamometers, Theory of tool wear and tool life, Study of different machine tools: Lathe and Milling machine. Study of gear cutting on milling machine, gear shaping and gear Hobbing machines. Study of non-traditional machining : LBM, EDM, ECM, USM, AJM, AWJM Study of CNC machining. Study of Gear cutting : Introduction to gears, Different types of gears. Simple gear calculations involving numbers of teeth, rpm etc.Gear cutting on the milling machine with rotary disc type form gear milling cutter : Spur and Helical gear cutting with simple and differential indexing, calculation of change gear ratio Gear cutting on the gear shaper – calculation of speed gear box, feed gear box, index gear box ratios Gear cutting on the gear hobbing machine (both straight spur and helical gears) – calculation of speed gear box, feed gear box, index gear box and lead change gear box Computer numerical control : Introduction, Classification: Point to point and continuous control, open loop and closed loop control.Kinematic structure of CNC machine tools, different types of prime movers used, feedback devices Digital logic and use of digital logic in CNC machines Interpolation in CNC machines: Linear and circular interpolation Programming in CNC machine - programming on the CNC turning centre and machining centre CNC Free form surface machining with ball ended milling cutter on 3 axis machining centre – basic concepts

ABOUT INSTRUCTOR :

Prof. Asimava Roy Choudhury received his B.E, (Mechanical) Degree from Jadavpur University in 1983, M.Tech. (Machine Tools Engg) from IIT Kharagpur in 1984 and Ph.D. (Engg) from IIT Kharagpur in 1999. Asimava Roy Choudhury is at present a professor in the Mechanical Engineering Department of IIT Kharagpur. His interests include: Computer numerical control, Direct slicing in Rapid Prototyping, Non-traditional manufacturing processes and Laser coating of surfaces.

COURSE PLAN :

Week 1: Introduction to metal cutting: Tool geometry
Week 2: Tool geometry, Mechanism of chip formation, orthogonal cutting, forces in metal cutting (orthogonal cutting)
Week 3: Theory of tool wear, machine tools : Lathe and milling machines
Week 4: Lathe and milling machines contd., Gear cutting machines, Non-traditional machining, CNC machining
Week 5: Introduction to gears, simples calculations involving gears
Week 6: Milling of gears, simple and differential indexing
Week 7: Helical gear cutting, gear teeth calculations
Week 8: Gear Shaping and Gear hobbing
Week 9: CNC – basic principals, classification, binary logic
Week 10: Features and devices of CNC machines, prime movers, feedback devices, programming
Week 11: Programming and Interpolation
Week 12: CNC Free form surface machining


FUNDAMENTALS OF CONDUCTION AND RADIATION

PROF. AMARESH DALAL
PROF. DIPANKAR N. BASU
Department of Mechanical Engineering
IIT Guwahati

TYPE OF COURSE : Rerun I Core I UG
COURSE DURATION : 12 weeks (26 Jul' 21 - 15 Oct' 21)
EXAM DATE : 23 Oct 2021

INTENDED AUDIENCE: Undergraduate students of Mechanical Engg. and similar branches; Faculty member associated with Mechanical Engg.; Practicing engineers associated with thermal powerindustries

PREREQUISITES: Heat transfer is a topic of fundamental interest in mechanical engineering and hence any engineering firm &concerned industry should find this course interesting & valuable.

COURSE OUTLINE :

This is introductory course on conduction and radiation heat transfer. This course emphasizes the fundamental concepts and provides detailed solution methodology. This course will provide students with the tools to model, analyze and solve a wide range of engineering applications involving conduction and radiation heat transfer.

ABOUT INSTRUCTOR :

Prof. Amaresh Dalal is currently an Associate Professor in the Department of Mechanical Engineering of the Indian Institute of Technology, Guwahati. He received his PhD degree from Indian Institute of Technology Kanpur in 2009 and he was Post-doctoral Research Associate at Purdue University from Sep 2008 - Dec 2009. He has research interests in the area of Computational Fluid Dynamics and Heat Transfer, Finite Volume Methods and Unstructured Grid Techniques, Multiphase Flows. Dr. Dalal is now profoundly involved in developing a general purpose, versatile and robust computational fluid dynamics solver over hybrid unstructured grid which can solve a wide range of real-life fluid flow, heat transfer, and problems involving transport phenomena over complex geometries.

Dr. Dipankar N. Basu is an Associate Professor in the department of Mechanical Engineering at Indian Institute of Technology Guwahati since June 2012. He received his undergraduate and postgraduate degree from Jadavpur University, Kolkata, and completed his Ph.D. from Indian Institute of Technology Kharagpur in 2011. He served as an Assistant Professor at IIEST Shibpur for nearly four years before joining IIT Guwahati. His principal research interest is in the field of nuclear thermalhydraulics, two-phase flow, supercritical heat transfer, optimization of thermal systems and microchannel heat transfer. He is currently working on computational tool development for simulation of flows with free-surfaces. He has co-authored more than 65 referred journal and conference publications and also a book chapter on supercritical natural circulation loop. He is a regular reviewer of many reputed international journals and also associated with several sponsored projects.

COURSE PLAN :

Week 1: Introduction to Heat Transfer

Week 2: Introduction to Conduction

Week 3: 1-D Steady-state Heat Conduction

Week 4: Special 1-D Heat Conduction Situations

Week 5: Heat Transfer from Extended Surfaces

Week 6: 2-D Steady-state Heat Conduction

Week 7: Transient Heat Conduction

Week 8: Numerical Methods in Conduction

Week 9: Fundamentals of Radiation Heat Transfer

Week 10: Radiative Properties of Real Surfaces

Week 11: Radiation Exchange between Surfaces

Week 12: Radiation Exchange with Participating Media

APPLIED THERMODYNAMICS FOR ENGINEERS

PROF.DIPANKAR N. BASU
Department of Mechanical Engineering
IIT Guwahati

TYPE OF COURSE : Rerun I Core I UG
COURSE DURATION : 12 weeks (26 Jul'21 - 15 Oct'21)
EXAM DATE : 23 Oct 2021

PRE-REQUISITES : Fundamentals of Thermodynamics

INTENDED AUDIENCE : Undergraduate students of Mechanical Engg and similar branches; Faculty members associated with Mechanical Engineering; Practicing engineers associated with Thermal Industries (such as Power, Automobile, Airconditioning etc.).

COURSE OUTLINE:

Thermodynamics is a subject of fundamental interest to Mechanical engineers and therefore is always taught in the 2nd or 3rd semester. Present course can be viewed as the next step, where the thermodynamic principles will be employed to discuss about different power producing & absorbing cycles. Properties of pure substance will be discussed, along with the thermodynamic property relations, thereby enabling the participants to estimate all relevant thermodynamic properties at any particular state of point. Subsequently the gas & vapor power cycles will be analyzed, followed by the principles of cogeneration & combined cycles. Then the refrigeration cycles will be introduced, followed by a discussion on the selection of refrigerants. The properties of gas mixtures and gas-vapor mixtures will also be discussed, leading to psychrometry & psychrometric processes. The course will be completed with a brief introduction to the chemical equilibrium.

ABOUT INSTRUCTOR :

Dr. Dipankar N. Basu is an Associate Professor in the department of Mechanical Engineering at Indian Institute of Technology Guwahati since June 2012. He received his undergraduate and postgraduate degree from Jadavpur University, Kolkata, and completed his Ph.D. from Indian Institute of Technology Kharagpur in 2011. He served as an Assistant Professor at IIEST Shibpur for nearly four years before joining IIT Guwahati. His principal research interest is in the field of nuclear thermalhydraulics, two-phase flow, supercritical heat transfer, optimization of thermal systems and microchannel heat transfer. He is currently working on computational tool development for simulation of flows with free-surfaces. He has co-authored more than 65 referred journal and conference publications and also a book chapter on supercritical natural circulation loop. He is a regular reviewer of many reputed international journals and also associated with several sponsored projects.

COURSE PLAN :

Week 1**:** Review of Thermodynamic Principles
Week 2**:** Thermodynamic Property Relations
Week 3**:** Properties of Pure Substances
Week 4**:** Air Standard Cycles
Week 5**:** Real Cycles for Reciprocating Engines
Week 6**:** Gas Turbine Cycles
Week 7**:** Vapor Power Cycles
Week 8**:** Cogeneration & Combined Cycles
Week 9**:** Refrigeration Cycles
Week 10**:** Gas Mixtures
Week 11**:** Gas-vapor Mixtures
Week 12**:** Chemical Reactions


RAPID MANUFACTURING

DR. JANAKARAJAN RAMKUMAR
Prof. AMANDEEP SINGH
Department of Mechanical Engineering
IIT Kanpur

TYPE OF COURSE : Rerun I Elective I UG I PG
COURSE DURATION : 12 Week (26 Jul 21- 15 Oct 21)
EXAM DATE : 23 Oct 2021

PRE-REQUISITES : The student should have completed two semesters of UG Engineering or Science program

INTENDED AUDIENCE : Students of all Engineering and Science disciplines

INDUSTRIES APPLICABLE TO : HAL, NAL, SAIL, ISRO

COURSE OUTLINE :

In the contemporary dynamic manufacturing era, to produce products that can be easily made and can offer typical competences is of utmost importance. Besides basic manufacturing processes, engineering students and manufacturers needs to bolster their skills in advanced technologies. This course is a step in this direction to make the students to learn design, development, and manufacturing using Rapid Manufacturing technologies. Along with specific Rapid Prototyping techniques, manufacturing concerns such as geometric modelling, design for manufacturing and assembly, developing modular designs, group technology, et cetera are included. Laboratory demonstrations are also induced for practical experience. In the end of this course, students should be able to identify the methods and techniques required to manufacture any model.

ABOUT INSTRUCTOR :

Dr. Janakarajan Ramkumar is Professor of Mechanical Engineering Department, and Design Program, at Indian Institute of Technology, Kanpur. He teaches manufacturing science, micro/nano technology, new product development. He has a bachelors in Production Engineering with his doctorate in Defect quantification in drilling of composites from IIT Madras, India with a best thesis award. Over the years his contribution in teaching and research is remarkable. He has worked for BOSCH group and improved the productivity of the company. His research and teaching focus is on nano technology and inclusive design. He has several international and national patents in his credit and has published more than 100 journal papers.

Dr. Amandeep Singh is working as Research Scientist in the Mechanical Engineering Department, and Design Program, Indian Institute of Technology, Kanpur, India. He holds PhD degree from Indian Institute of Technology Kanpur, India, and a bachelor degree in Production Engineering. Dr. Singh has ten years of industrial and academic experience. His research interests are Sustainable Manufacturing Processes and Systems, Simulation of Manufacturing Systems, Product Design and Manufacturing, Applied Ergonomics and Engineering Metrology. He has traveled in countries like US, Canada, and Australia to present his research in various international conferences organized by reputed bodies like CIRP and IEOM. His research is also published in various international reputed journals.

COURSE PLAN :

Week 1 : Introduction to Rapid Manufacturing (RM)

Week 2 : Product Design Process

Week 3 : Design for Modularity

Week 4 : Reverse Engineering

Week 5 : 3D measurement: laboratory demonstration

Week 6 : Polymerization, and Powder based RM processes

Week 7 : Liquid based, and Sheet stacking RM processes

Week 8 : 3D printing RM processes and laboratory demonstration

Week 9 : Beam Deposition RM processes, and materials in RM

Week 10 : Post-processing and costing in RM

Week 11 : Rapid Product Development (CAD/CAE/CIM)

Week 12 : Rapid Product Development (Software demonstration), and case studies on RM

BASICS OF MATERIALS ENGINEERING

PROF. RATNA KUMAR ANNABATTULA
Department of Mechanical Engineering
IIT Madras

TYPE OF COURSE : Rerun I Core I UG
COURSE DURATION : 12 weeks (26 Jul' 21 - 15 Oct' 21)
EXAM DATE : 23 Oct 2021

Industries that might find this course interesting: Automotive industries, Heavy machinery, Product development and Process industries

PREREQUISITES : Basic strength of materials, Basic Engineering Mathematics (Matrices, Calculus)

INDUSTRIES SUPPORT : Caterpillar India Private Limited,Sundaram Clayton,Mahindra & Mahindra, TVS Motors,Lam Research,Siemens Gamesa

COURSE OUTLINE :

The objective of this course is to introduce the basic concepts of materials science and failure theories for design to undergraduate mechanical engineering students. The course is a first level course and hence various concepts such as structure of crystalline materials, defects and their implications to mechanical behavior, the processing of materials through phase diagrams, a detailed discussion on iron-iron carbide equilibrium diagram and heat treatment of steels will be introduced at the introductory level.

ABOUT INSTRUCTOR :

Prof. (Dr.) Ratna Kumar Annabattula is currently an Associate Professor in the department of Mechanical Engineering at Indian Institute of Technology Madras, Chennai. He received his PhD (micromechanics of materials) in 2011 from the University of Groningen, The Netherlands. He obtained his ME in 2004 from Indian Institute of Science, Bengaluru and BE in 2002 from College of Engineering, Andhra University both in Mechanical Engineering. Prior to starting his PhD, he worked for about a year with General Electric India Technology Center, Bangalore. Before joining as a faculty at IIT Madras, he was a postdoc researcher at Karlsruhe Institute of Technology, Germany. His research interests are in the area of mechanics of stimuli-responsive materials, granular materials and multi physics modeling of materials with applications to lithium ion batteries and nuclear fusion.

COURSE PLAN :

Week 1: Introduction, Crystal Structure

Week 2: Imperfections in solids

Week 3: Imperfections in solids (Contd)
Week 4: Mechanical properties of materials

Week 5: Failure of Materials

Week 6: Failure of Materials (Contd)

Week 7: Basics of Fracture Mechanics

Week 8: Fatigue failure theories
Week 9: Fatigue failure theories (Contd)

Week 10: Phase diagrams
Week 11: Phase diagrams (Contd)
Week 12: Thermal Processing and Heat Treatment of Steels

FUNDAMENTALS OF CONVECTIVE HEAT TRANSFER

PROF. AMARESH DALAL
Department of Mechanical Engineering
IIT Guwahati

TYPE OF COURSE : Rerun I Core I UG I PG
COURSE DURATION : 12 weeks (26 Jul' 21 - 15 Oct' 21)
EXAM DATE : 23 Oct 2021

PRE-REQUISITES : Fundamental knowledge of Mathematics, Heat Conduction and Fluid Mechanics should be sufficient

INTENDED AUDIENCE : Postgraduate and undergraduate students of Mechanical Engineering and similar branches; Faculty members associated with Mechanical Engineering; Practicing engineers associated with fluid and thermal industries.

INDUSTRIES SUPPORT : BHEL, NTPC, Eaton

COURSE OUTLINE :
Convective heat transfer is one of the most important areas of engineering sciences. It is major mode of heat transfer during flowing fluid and it is the most common mode of heat transfer used in industry.

ABOUT INSTRUCTOR :
Prof. Amaresh Dalal is currently Professor in the Department of Mechanical Engineering of the Indian Institute of Technology Guwahati. He received his Ph.D. degree from Indian Institute of Technology Kanpur in 2009 and he was Post-doctoral Research Associate at Purdue University from Sep 2008 - Dec 2009.

COURSE PLAN :

Week 1: Introduction

Week 2: Preliminary Concept

Week 3: Convective heat transfer in external flows - I

Week 4: Convective heat transfer in external flows - II

Week 5: Convective heat transfer in internal flows - I

Week 6: Convective heat transfer in internal flows - II

Week 7: Convective heat transfer in internal flows - III

Week 8: External natural convection

Week 9: Internal natural convection

Week 10: Numerical solution of Navier-Stokes and energy equation

Week 11: Turbulent flow and heat transfer

Week 12: Boiling and condensation

SOLID MECHANICS

PROF. AJEET KUMAR
Department of Mechanical Engineering
IIT Delhi

TYPE OF COURSE : Rerun I Core I UG
COURSE DURATION : 12 weeks (26 Jul' 21 - 15 Oct' 21)
EXAM DATE : 23 Oct 2021

PRE-REQUISITES : 1st year engineering mechanics

INTENDED AUDIENCE : Any Interested Learners

COURSE OUTLINE :
This is the first course where deformation of solid bodies and the underlying concepts are introduced to undergraduate students. The course begins by building foundation of the concepts of stress and strain in three-dimensional deformable bodies. It further uses these concepts to study extension, torsion and bending of beams. The one-dimensional theory of beams are also introduced. We also discuss various theories of failure which are critical for design of machine elements in industry.

ABOUT INSTRUCTOR :
Prof. Ajeet Kumar is currently working as an Associate Professor in the Department of Applied Mechanics at IIT Delhi. He received his PhD from the Department of Theoretical & Applied Mechanics at Cornell University. He primarily works in the field of solid mechanics. His key topics of research are: Theory of continuum and nano rods, Finite deformation elastoplasticity, Computational Mechanics, Molecular modeling, Fluid-structure interaction, etc.

COURSE PLAN :

Week 1: Mathematical preliminaries and notation; Concept of Traction vector; Concept of Stress tensor

Week 2: Stress tensor and its representation in Cartesian coordinate system; Transformation of stress matrix; Equations of equilibrium; Symmetry of stress tensor;

Week 3: State of stress in simple cases ; Principal stress components and principal planes; Maximizing shear component of traction; Mohr's circle

Week 4: Stress invariants; Octahedral Plane; Decomposition of stress tensor; Concept of strain and strain tensor;

Week 5: Longitudinal, shear and volumetric strains; Local infinitesimal rotation; Strain compatibility condition

Week 6: Linear stress-strain relation for isotropic bodies; Relation between material constants

Week 7: Stress and strain matrices in cylindrical coordinate system; Equations of equilibrium in cylindrical coordinate system

Week 8: Axisymmetric deformations: combined extension-torsion-inflation of a cylinder

Week 9: Bending of beams having symmetrical and non-symmetrical cross-section

Week 10: Shear center, Shear flow in thin and open cross-section beams; Euler Bernouli and Timoshenko beam theories; beam buckling

Week 11: Energy methods, Reciprocal relations, Castigliano's theorem, Deflection of straight and curved beams using energy method

Week 12: Various theories of failure and their application


FINITE ELEMENT METHOD: VARIATIONAL METHODS TO COMPUTER PROGRAMMING

PROF. ATANU BANERJEE
PROF. ARUP NANDY
Department of Mechanical ENgineering
IIT Guwahati

TYPE OF COURSE : Rerun | Elective | UG/PG
COURSE DURATION : 12 weeks (26 Jul'21 - 15 Oct'21)
EXAM DATE : 23 Oct 2021

PRE-REQUISITES : Solid Mechanics, Engineering Mathematics: Linear Algebra, Vector Calculus

INTENDED AUDIENCE : Final year Under Graduate Students, First year Post Graduate Students
INDUSTRIES APPLICABLE TO : DRDO, ISRO, BARC, GE, Automobile and Aviation industries

COURSE OUTLINE :
Finite Element Method (FEM) is one of the most popular numerical method to boundary and initial value problems. One distinct feature of FEM is that it can be generalized to the domains of any arbitrary geometry. Theory of FEM is developed on Variational methods.

ABOUT INSTRUCTOR :
Prof. Atanu Banerjee, after obtaining PhD from Department of Mechanical Engineering, IIT Kanpur, joined Department of Mechanical Engineering, IIT Guwahati in 2010. He has taught Solid Mechanics, Finite Element Methods in Engineering, Modelling and Applications of Smart Materials in the same department. His research interest encompasses design and analysis of smart materials (namely, piezoelectric and shape memory alloy) based engineering applications, in which coupled electro-thermo-mechanical models are solved using FE tool.

Prof. Arup Nandy joined IIT Guwahati in July, 2017. He obtained his PhD from Mechanical Engineering department, IISc, Bangalore in 2016. His research interest is FEM formulation in different multiphysics domains like acoustics, structures, electromagnetics, electromagnetic forming. He has taught courses like Advanced Solid mechanics, Continuum mechanics, Finite element method in IIT Guwahati.

COURSE PLAN :

Week 1: : Variational Methods:Functional and Minimization of Functional; Derivation of Euler Lagrange equation

Week 2: One dimensional Finite Element Analysis:Gauss Quadrature integration rules with Computer Programming; Steps involved in Finite Element Analysis; Discrete system with linear springs;Continuous systems.

Week 3: Structural Elements in One dimensional FEM:Bar Element with Computer Programming, Truss Element with Computer Programming

Week 4: Beam Formulation, Boundary Hermite shape functions

Week 5: Frame Element with Computer Programming: Orthogonal matrix, Finite element equation; Element matrices, Assembly, Solution, Post- processing; Numerical example

Week 6: Generalized 1D Finite Element code in Computer Programming,Generalization of Assembly using connectivity data,Generalization of loading and imposition of boundary condition; Generalization of Post-processing using connectivity data.

Week 7: Brief background of Tensor calculus, epsilon-delta identity, Gauss-divergence theorem: different forms

Week 8: Two dimensional Scalar field problems, Computer implementation

Week 9: Two dimensional Vector field problems (Contd)

Week 10: Eigen value problemsAxial vibration of rod (1D), formulation and implementation Transverse vibration of beams (2D), formulation and implementation

Week 11: Transient problem in 1D & 2D Scalar Valued ProblemsTransient heat transfer problems, discretization in time : method of lines and Rothe method, Formulation and Computer implementations

Week 12: Choice of solvers: Direct and iterative solvers

FUNDAMENTALS OF COMPRESSIBLE FLOW

PROF. NIRANJAN SAHOO
Department of Mechancial Engineering
IIT Guwahati

TYPE OF COURSE :Rerun I Elective I UG I PG
COURSE DURATION : 12 weeks (26 Jul' 21 - 15 Oct' 21)
EXAM DATE : 23 Oct 2021

COURSE OUTLINE :

"Gas Dynamics" is a topic of fundamental interest to Mechanical and Aerospace engineers that provides a link between core subjects i.e. "Fluid Mechanics and Thermodynamics". It pertains the basic theory of compressible flow, formation of shock waves and expansion waves, nozzle flows. The treatment of the syllabus becomes the backbone of aerodynamic engineers towards research in the design of high-speed vehicles. The contents of the course starts with fluid and thermodynamic fundamentals followed by governing theories of compressible flow phenomena. Many aerodynamic high-speed facilities and their measurement diagnostics governed by these theories, are also covered in this course.

ABOUT INSTRUCTOR :

Prof. Niranjan Sahoo is affiliated as "Professor" in the Department of Mechanical Engineering, Indian Institute of Technology Guwahati. Having B. Tech Degree in Mechanical Engineering, he has received PhD Degree (in the year 2004) from Department of Aerospace Engineering, Indian Institute of Science Bangalore. Till May 2020, he has 15 years of teaching and research experience at different capacity in Department of Mechanical Engineering, Indian Institute of Technology Guwahati.

COURSE PLAN :

Week 1: Review Concepts of Fluid Mechanics and Thermodynamics:Introduction to fluids, Concepts of continuum, Forces acting on the fluid, Description of fluid motion, Kinematic properties of fluid, Review and fundamental aspects of Thermodynamics

Week 2: Wave Propagation in Compressible Medium: Introduction to compressible flow, Governing equations for one dimensional flow, Acoustic speed and Mach number, Stagnation and characteristics properties, Flow Regimes, Mach waves, Pressure disturbances in compressible fluid, Development of compression and expansion waves

Week 3: Quasi-One Dimensional Isentropic Flow:Governing Equations, Area-velocity relation and isentropic flow through variable area ducts, Concepts of nozzle and diffuser for compressible flow, Convergent-Divergent nozzle, Subsonic flow in a convergent-divergent nozzle

Week 4: Normal Shock Waves: One-dimensional equations for stationary normal shock, Entropy change across a normal shock, Crocco's Theorem, Hugoniot equation, Moving normal shock and reflected shock waves

Week 5: Expansion Waves and Oblique Shocks: Two-dimensional waves, Flow equations for Prandtl-Meyer expansion fan, Equation of motion for straight oblique shock wave, Oblique shock relations, Concepts of attached and detached shock waves

Week 6: Intersection of Shocks and Expansion Waves: Reflections and Intersections of Shocks and Expansion Waves, Supersonic flow in a convergent-divergent nozzle.

Week 7: Compressible Flow with Friction and Heat Transfer: Flow in a constant area duct with friction, Fanno line flow and its working relations, Flow with heating and cooling in a constant area duct, Rayleigh flow and its working relations

Week 8: Measurement Diagnostics and Experimental Facilitates for Compressible Flow: Pressure and temperature measurements, Concepts of flow visualization, Introduction to high speed wind tunnels, shock tubes and shock tunnels

MATHEMATICAL MODELING OF MANUFACTURING PROCESSES

PROF. SWARUP BAG
Department of Manufacturing Engineering
IIT Guwahathi

TYPE OF COURSE : Rerun I Elective I UG I PG
COURSE DURATION : 12 weeks (26 Jul' 21 - 15 Oct' 21)
EXAM DATE : 23 Oct 2021

INTENDED AUDIENCE : Bachelor/Master/PhD students having backgrund in Mechanical/Material Science/Metallurgical engineering/Production Engineering/Manufacturing Technology

COURSE OUTLINE :
The understanding of the basic mechanism such as heat and mass transport with associated fluid flow including metallurgical transformation, distortion and residual stress generation in different manufacturing processes is the focus of this course. Understanding the complex interaction not only helps to develop mathematical model, it makes the foundation for analysis, numerical simulation at different scale and experimentation for different types of manufacturing processes. The development of computational models for a manufacturing process relies on mathematical expression of the governing mechanism. It helps to design relevant experiments and drives to find the data to be obtained. Mutual understanding between analytical/numerical and experimental results leads to better insight of the basic manufacturing processes that impact on the improvement of existing process and directs for the development of new process. However, this course is completely different from statistical or data driven modeling approach.

ABOUT INSTRUCTOR :
Prof. Swarup Bag is currently working as an Associate Professor in the Department of Mechanical Engineering, Indian Institute of Technology Guwahati PhD: Mechanical Engineering (Manufacturing Science): IIT Bombay, Mumbai, India (2006 2009). ME: Mechanical Engineering (Production Engineering): Indian Institute of Engineering Science and Technology, Shibpur, WB, India (2000 2002). BE: Mechanical Engineering: Jalpaiguri Govt. Engg. College, Jalpaiguri, WB, India (1996 2000).

COURSE PLAN :

Week 1: Introduction to Manufacturing processes

Week 2: Physics of manufacturing processes

Week 3: Conventional machining

Week 4: Non-conventional machining

Week 5: Metal forming

Week 6: Welding

Week 7: Welding

Week 8: Casting and powder metallurgy

Week 9: Coating and additive manufacturing

Week 10: Heat treatment

Week 11: Micro/nano scale manufacturing

Week 12: Processing of non-metallic materials

ENGINEERING GRAPHICS AND DESIGN

PROF. NARESH V DATLA
PROF. S.R KALE
Department of Mechanical Engineering
IIT Delhi

TYPE OF COURSE : New I Core I UG
COURSE DURATION : 12 Weeks (26-Jul' 21 - 15-Oct' 21)
EXAM DATE : 23 Oct 2021

INTENDED AUDIENCE : All undergraduate students and other students interested in graphics design and visualization.

INDUSTRIES APPLICABLE TO : All companies across all disciplines work with drawings, hence this course is relevant to all industries of all sizes.

COURSE OUTLINE :
All engineering activities (design/ manufacturing/ operation/ servicing) for any product from any discipline involve a team of people who communicate graphically. Hence, every engineer must have exposure and some competence in presenting ideas as pictures, and be able to unambiguously interpret drawing from others. This course will help develop basic visualization competency as well as ability to representing ideas on both paper and computer.

ABOUT INSTRUCTOR :
Dr. Naresh V Datla is an Associate Professor with the Department of Mechanical Engineering at IIT Delhi.

Professor Sunil R. Kale has been with the Department of Mechanical Engineering at IIT Delhi.

COURSE PLAN :

Week 1**:** Introduction

Week 2**:** Graphical Representation

Week 3**:** Projection Basics

Week 4**:** Orthographics Projections

Week 5**:** Auxilary And Sectional Projections

Week 6**:** Isometric Projections

Week 7**:** Working Drawings

Week 8**:** Introduction To CAD

Week 9**:** Part Modelling 1

Week 10**:** Part Modelling 2

Week 11**:** Assembly

Week 12**:** Design Project

DESIGN OF MECHATRONIC SYSTEMS

PROF. PRASANNA GANDHI
Department of Mechanical Engineering
IIT Bombay

TYPE OF COURSE : New I Elective I UG/PG
COURSE DURATION : 12 Weeks (26-Jul' 21 - 15-Oct' 21)
EXAM DATE : 23 Oct 2021

PRE-REQUISITES : Background of programming of microprocessor, A course in classical automatic control. Basics of mechanics kinematics and dynamics of planar motion.

INTENDED AUDIENCE : PG students, Research Scholars, Final year UG students, faculty teaching mechatronics, Professionals from automation industry

INDUSTRIES APPLICABLE TO : Larsen & Toubro, Eaton, John Deer, other companies in the area of mechatronics products.

COURSE OUTLINE :

This course is geared towards developing skills of candidates towards conceiving new mechatronics products based on raw ideas and develop them. The course focuses on hands-on experience along with a project, and offers a lot of practical tips to make theory work in practice. Furthermore, the course catalyzes integrated thinking in mechanical and electronics domain, which is crucial to successful product design and development.

ABOUT INSTRUCTOR :

Dr Prasanna Gandhi, Professor in mechanical engineering, is also Director of Suman Mashruwala Advanced Microengineering Laboratory. Prasanna's current research focuses on the area of polymer and ceramics 3D micro-printing, control of fluid instabilities for Spontaneous Multiscale Manufacturing (SMM), dynamics and control of ultra-flexible mechanism systems for applications in micro-printing, micro-fluidics, medical robotics, products, and devices.

COURSE PLAN :

Week 1: Introduction: Applications of mechatronics system. Systems like CDROM, scanner opened to see whats there inside and why?.

Week 2: Elements of mechatronics system: Sensor, actuator, plant, and controller.

Week 3: Integrated mechanical-electronics design philosophy. Examples of real life systems.

Week 4: Smart sensor concept and utility of compliant mechanisms in mechatronics

Week 5: Microcontrollers for mechatronics: Interfacing. Getting started with TIVA programming

Week 6: Microcontroller programming philosophy TIVA programming different interfaces.

Week 7: Modeling DC motor, importance of and modeling friction in mechatronic systems.

Week 8: Lagrange formulation for system dynamics, example of 2R manipulator; Selection of sensors and actuators, use of modeling for the same.

Week 9: Representation of systems and control design in linear domain

Week 10: Basics of Lyapunov theory for nonlinear control

Week 11: Basics of sampling of signal, and digitization of system

Week 12: Filters for practical mechatronic system implementation.Research example/ case study of development of novel mechatronics system of 3D micro-printer.


CONCEPTS OF THERMODYNAMICS

PROF. SUMAN CHAKRABORTY
Department of Mechanical Engineering
IIT Kharagpur

PROF. ADITYA BANDYOPADHYAY
Department of Cryogenic Engineering
IIT Kharagpur

TYPE OF COURSE : Rerun | Core | UG
INTENDED AUDIENCE : B.Tech students of all disciplines and teachers of undergraduate thermodynamics
COURSE DURATION : 12 weeks (26 Jul'21 - 15 Oct'21)
EXAM DATE : 24 Oct 2021

COURSE OUTLINE :

Thermodynamics is the basic building block of all of modern day industries (power generation, iron and steel, food processing etc.) and human convenience (refrigeration, engines, air conditioning etc.). Understanding and applying various ideas of thermodynamics is therefore at the heart of progress in science and engineering. The course aims at building strong fundamentals of work and heat interactions for various systems. Through various examples, the ideas of several industrial components and power/refrigeration cycles are further elucidated by addressing the problems from first principles. The ideas are extended to real systems where exergy or equivalently, the availability of a state is analyzed to give a feel of real problems to the students. Uniqueness of this course is a delicate balance between fundamental concepts and applications, in a manner consistent with the recently proposed AICTE Model Curriculum guidelines.

ABOUT INSTRUCTOR :

Dr. Suman Chakraborty is currently a Professor in the Mechanical Engineering Department as well as an Institute Chair Professor of the Indian Institute of Technology Kharagpur, India, and the Head of the School of Medical Science and Technology. He is also the Associate Dean for Sponsored Research and Industrial Consultancy. His current areas of research include microfluidics, nanofluidics, micro-nano scale transport.

Dr. Aditya Bandopadhyay is currently an Assistant Professor in the Mechanical Engineering Department at Indian Institute of Technology Kharagpur, India. His research interests include micro- and nanofluidics, transport through porous media, and electrohydrodynamics. He completed his Dual Degree from IIT Kharagpur (Insitute Silver Medal) in 2012 and received his Ph.D. from IIT Kharagpur in 2015

COURSE PLAN :

Week 01 : Fundamental definitions and concepts in thermodynamics
Week 02 : Properties of pure substances
Week 03 : Work and heat
Week 04 : First law of thermodynamics for closed systems
Week 05 : First law of thermodynamics for open systems – I
Week 06 : First law of thermodynamics for open systems – II
Week 07 : Second law of thermodynamics
Week 08 : Entropy transfer for closed systems
Week 09 : Entropy transfer for open systems
Week 10 : Irreversibility and exergy
Week 11 : Thermodynamic Cycles: Air Standard Cycles, Vapour Power Cycles
Week 12 : Thermodynamic Cycles: Vapour Power Cycles (contd), Refrigeration Cycles

PRINCIPLE OF HYDRAULIC MACHINES AND SYSTEM DESIGN

PROF. PRANAB K. MONDAL
Department of Mechanical Engineering
IIT Guwahati

TYPE OF COURSE : Rerun I Core I UG I PG
COURSE DURATION : 12 weeks (26 Jul' 21 - 15 Oct' 21)
EXAM DATE : 24 Oct 2021

COURSE OUTLINE :

Principle of operation of hydraulic machines and their system design is important from the perspective of their huge applications in different industries. Present course introduces the students to the fundamentals of hydraulic machines. Starting from the operational principle, students will be gradually familiarized with different concepts like velocity triangle, net head developed, finally leading to the design of their system. Important topics such as design of pumping system of two dissimilar pumps, which find practical relevance as well, will also be discussed.

ABOUT INSTRUCTOR :

Dr. Pranab K. Mondal is an Assistant Professor in the department of Mechanical Engineering at Indian Institute of Technology Guwahati since May 2015. He received his undergraduate and postgraduate degree from Jadavpur University, Kolkata, and completed his Ph.D. from Indian Institute of Technology Kharagpur in 2015. He worked as an Research Associate at IIT Khargpur for nearly one years before joining IIT Guwahati. His principal research interest, encompassing the broad area of Microfluidics, has covered various facets of microscale multiphase transport, electrokinetics and microscale transport of heat. He is currently working on stability analysis of flows with free-surfaces, capillary filling of bio-fluids. He has co-authored more than 70 referred journal and conference publications. He is a regular reviewer of many reputed international journals and also associated with several sponsored projects.

COURSE PLAN :

Week-1: Principle of operation of hydraulic machines

Week-2: Radial and axial flow pumps

Week-3: Cavitation in radial flow pump

Week-4: Radial flow pump operational issues

Week-5: Pump Design: Degrees of reaction

Week-6: Pump characteristics and system design

Week-7: Numerical problems of pumps(Radial and Axial flow)

Week-8: Positive displacement pump

Week-9: Hydraulic Turbine: Impulse Turbine

Week-10: Hydraulic Turbine: Reaction Turbine

Week-11: Cavitation in hydraulic reaction turbines

Week-12: Numerical problems of Turbines (Impulse and Reaction)

FUNDAMENTALS OF MANUFACTURING PROCESSES

PROF. D.K. DWIVEDI
Dept. of Mechanical and Industrial Engineering
IIT Roorkee

TYPE OF COURSE : Rerun | Core | UG/PG
COURSE DURATION : 12 weeks (26 Jul'21 - 15 Oct'21)
EXAM DATE : 24 Oct 2021

INTENDED AUDIENCE : Any interested learners

COURSE OUTLINE :

It is proposed to include fundamental of following aspects of manufacturing technology: Understanding Manufacturing: concept of manufacturing, need, scope, advantages, limitation, application, materials and manufacturing, classification of manufacturing, process capabilities, selection, break even analysis of manufacturing processes. Casting: approach, steps, pattern, molding, gate and riser, melt treatment, solidification, casting processes: sand mould, shell mould, permanent mould casting, casting defect and their remedy. Forming: approach, hot and cold forming, rolling, forging, extrusion, drawing, sheet metal forming, press, dies, types of dies and die set sheet metal operations punching, blanking, notching, nibbling. Joining: approach, need, principle of fusion welding, gas welding, thermit welding, arc welding common arc welding processes, resistance welding, weldability of metals, solidification of weld, weld discontinuities and their remedy. Machining: approach, mechanism, classification, cutting tool, tool material, heat generation, cutting fluid, grinding, internal and external surface grinding, centerless grinding designation and selection of grinding wheel, trueing and balancing, honing, reaming, lapping, polishing etc. Improving properties: heat treatment of steel and aluminum alloys, Fe-C diagram, TTT diagram, and CCT diagram, heat treatment processes annealing, normalizing, quenching tempering, surface modification methods namely without change chemistry, changing chemical composition and development of coating and cladding.

ABOUT INSTRUCTOR :

Prof. D.K. Dwivedi obtained BE (mechanical engineering) , in 1993 from GEC Rewa, ME (welding engineering) from Univ. of Roorkee in 1997 and PhD in Met. Engineering from MNIT, Jaipur in 2003. He has about 9 years teaching experience at NIT Hamirpur and 12 years at IIT Roorkee of subjects related with manufacturing at UG level and welding engineering related subjects at PG level.

COURSE PLAN :

Week 01 : Understanding Manufacturing
Week 02 : Selection of manufacturing processes
Week 03 : Metal Casting: Steps of casting processes
Week 04 : Metal Casting: Sand Moulding II
Week 05 : Metal Casting: Cleaning of casting
Week 06 : Metal working processes: Rolling
Week 07 : Metal working processing: Sheet metal operations (Shearing)
Week 08 : Material removal processes: Mechanism of the metal cutting
Week 09 : Material removal processes: Tool materials
Week 10 : Material removal processes: Grinding operations
Week 11 : Joining of metals: Weldability and welding defects
Week 12 : Heat treatment: Tempering

WORK SYSTEM DESIGN

PROF. INDERDEEP SINGH
Department of Mechanical Engineering
IIT Roorkee

TYPE OF COURSE : Rerun | Core | UG/PG
COURSE DURATION : 12 weeks (26 Jul'21 - 15 Oct'21)
EXAM DATE : 24 Oct 2021

INTENDED AUDIENCE : All Engineering Students and Faculty

INDUSTRIES APPLICABLE TO : All the industries using work system theory to improve their productivity and effectiveness.

COURSE OUTLINE :

Work System Design deals with the systematic examination of the methods of doing work with an aim of finding the means of effective and efficient use of resources and setting up of standards of performance for the work being carried out. The systematic examination of work involves what is done? And how it is done? As well as what is the standard time to do the work? This is required to have an in-depth analysis of all the elements, factors, resources and relationships affecting the efficiency and effectiveness of the work being studied. The course also aims at scientifically establishing the time required for a qualified worker to carry out a work element at a defined rate of working. Ergonomic aspects of work system design are also included in the course contents. The scope of this course is not only limited to the manufacturing applications but it is also relevant for service sector industry.

ABOUT INSTRUCTOR :

Dr. Inderdeep Singh is currently working as Associate Professor in Department of Mechanical and Industrial Engineering at Indian Institute of Technology Roorkee. He has taught among others, the industrial engineering courses such as Production Planning and Control, Product Design and Development, Work System Design, Industrial Management and Quality Management.

COURSE PLAN :

Week 01 : Work System Design: Introduction,Introduction and Concept of Productivity, Measurement of Productivity, Productivity Measures, Productivity Measurement Models

Week 02 : Factors Influencing Productivity, Causes of Low Productivity, Productivity Measurement Models, Productivity Improvement Techniques, Numerical Problems on productivity, Case study on productivity.

Week 03 : Work Study: Basic Concept, Steps Involved in Work Study, Concept of Work Content, , Techniques of Work Study, Human Aspects of Work Study.

Week 04 : Method Study: Basic Concept, Steps Involved in Method Study, Recording Techniques, Operation Process Charts, Operation Process Charts: Examples.

Week 05 : Flow Process Charts, Flow Process Charts: Examples, Two-Handed-Process Charts, Multiple Activity Charts, Flow Diagrams.

Week 06 : String Diagrams, Principles of Motion Economy, Micro-Motion Study, Therbligs, SIMO Charts.

Week 07 : Memo-Motion Study, Cycle graph and Chrono-Cycle Graph, Critical Examination Techniques, Development and Selection of New Method, Installation and Maintenance of Improved Methods.

Week 08 : Work Measurement: Basic Concept, Techniques of Work Measurement, Steps Involved in Time Study, Time Study Equipment, Performance Rating.

Week 09 : Performance Rating: Examples, Allowances, Computation of Standard Time, Numerical on Computation of Standard Time, Case Study

Week 10 : Work Sampling: Basics, Procedure of Work Sampling Study, Numerical Problems on work sampling, Introduction to Synthetic Data and PMTS, Introduction to MTM and MOST

Week 11 : Ergonomics: Basic Concept, Industrial Ergonomics, Ergonomics: Anthropometry, Man-Machine System-1, Man-Machine System-2

Week 12 : Case Study of Office Chair, Case Study of Tower Crane Cabin, Case Study of Car Seat, Case Study of Computer System, Case Study of Assembly Line.

THEORY OF PRODUCTION PROCESSES

PROF. PRADEEP KUMAR JHA
Department of Mechanical Engineering
IIT Roorkee

TYPE OF COURSE : Rerun I Core I UG
COURSE DURATION : 12 weeks (26 Jul' 21 - 15 Oct' 21)
EXAM DATE : 24 Oct 2021

PRE-REQUISITES : Introduction to manufacturing technology or manufacturing processes

INDUSTRIES APPLICABLE TO : Manufacturing Industries where casting/forming/welding takes place, for example SAIL, BHEL, Foundry and Forge industries like HEC, Bharat Forge etc.

COURSE OUTLINE :

The course focuses on understanding the science behind technology of primary production processes namely casting, forming and welding. Conventionally, the courses on manufacturing processes deal with study of operational procedures. The course has been divided into three sections namely casting, forming and welding, each being covered in 4 weeks of time. The underlying principles of solidification, fluidity, gating, risering, melting etc. will be covered in casting section whereas mechanics of metalworking, analysis of different metal working processes will be covered in the second section i.e. forming. In the third section i.e. welding, principles of welding processes, thermal effects, weldability etc. will be covered.

ABOUT INSTRUCTOR :

Dr Pradeep K. Jha is presently working as Associate Professor in the Department of Mechanical & Industrial Engineering at IIT Roorkee. He has been teaching the courses related to manufacturing technology and theory of production processes to undergraduate and postgraduate students for more than 12 years. He is actively involved in research work related to production processes, tundish steelmaking process, mold solidification in continuous casting etc.

COURSE PLAN :

Week 1: Theory of casting and solidification, Fluidity of liquid metals

Week 2: Technology of patternmaking and mouldmaking, Pattern allowances, Testing of molding sand, cores

Week 3: Gating system design, Risering Design, different methods of calculating riser volume, Feeding distance calculations

Week 4: Theory of melting and production of ferrous and non-ferrous materials, Casting design, Casting defects

Week 5: Mechanical fundamentals of metalworking: Concept of stress and strain, stress and strain tensors, Hydrostatic and deviatoric stresses, Flow curve

Week 6: Yield criteria for ductile materials, plastic stress strain relationships, classification of metalworking, mechanics of metalworking

Week 7: Analysis and classification of rolling and forging processes, Force calculations in rolling and forging processes

Week 8: Analysis and classification of Extrusion process, Analysis of wire, rod and tube drawing processes, Forming defects

Week 9: Classification of welding processes, Thermal effects in welding, Basic metallurgy of fusion welds, Heat affected zone in welding

Week 10: Principles of welding processes: Arc welding, Gas metal arc welding, Solid state welding, Resistance welding, Soldering, Brazing and adhesive bonding

Week 11: Residual stresses in welding, Methods of measurement of residual stresses in welding, Welding distortion and its types, Methods of reducing residual stresses and distortion in welding

Week 12: Weldability of materials: Introduction and assessment of weldability, Test for weldability, Weldability of ferrous and non-ferrous materials

DYNAMIC BEHAVIOUR OF MATERIALS

PROF. PRASENJIT KHANIKAR
Department of Mechanical Engineering
IIT Guwahati

TYPE OF COURSE : Rerun I Elective I PG
COURSE DURATION : 12 weeks (26 Jul'21 - 15 Oct'21)
EXAM DATE : 24 Oct 2021

PRE-REQUISITES : Solid Mechanics and Materials Science

INTENDED AUDIENCE : Mechanical Engineers, Civil Engineers, Materials Engineers

COURSE OUTLINE :
Study of materials behavior in extreme environments and development of new materials for such environments has become a vital research area for materials scientists and engineers in the 21 st century. Mechanical properties of materials under dynamic loading are considered as an important area of research and development in Defense, Automotive and Aerospace industries. This course will be important to mechanical, materials and civil engineers to understand materials behavior for ballistic applications, explosive forming or welding applications, automotive and aerospace applications.

ABOUT INSTRUCTOR :
Dr. Prasenjit Khanikar is an Assistant Professor of Mechanical Engineering Department at the Indian Institute of Technology, Guwahati. His research interests include development of materials and structures for high strain rate applications, modeling and experimental characterization of materials microstructure and crystalline plasticity. Dr. Khanikar received his PhD in Mechanical Engineering from North Carolina State University, USA. Before joining IIT Guwahati, he was working as a Postdoctoral Research Scientist at Columbia University in the City of New York, USA.

COURSE PLAN :

Week 1: Introduction: Dynamic deformation and failure
Week 2: Introduction to waves: Elastic waves; Types of elastic waves; Reflection, Refraction Interaction of waves
Week 3: Plastic waves and shock waves: Plastic waves of uniaxial stress, uniaxial strain and combined stress; Taylor's experiments; Shock waves
Week 4: Shock wave induced phase transformation; Explosive-material interaction and detonation
Week 5: Experimental techniques for dynamic deformation: Intermediate strain rate tests; Split Hopkinson pressure bar; expanding ring test; gun systems
Week 6: Review of mechanical behavior of materials (especially metals): Elastic and plastic deformation of metals; dislocation mechanics;
Week 7: Plastic deformation of metals at high strain rates: Empirical constitutive equations; relationship between dislocation velocity and applied stress; physically based constitute equations
Week 8: Plastic deformation in shock waves: Strengthening due to shock wave propagation; Dislocation generation; Point defect generation and deformation twinning
Week 9: Strain localization/shear bands: Constitutive models; Metallurgical aspects
Week 10: Dynamic Fracture: Fundamentals of fracture mechanics; Limiting crack speed, crack and dynamic fracture toughness; Spalling and fragmentation
Week 11: Dynamic deformation of materials other than metals: Polymers; Ceramics; Composites
Week 12: Applications: Armor applications; Explosive welding and forming

AIRCRAFT PROPULSION

PROF. VINAYAK N. KULKARNI
Department of Mechanical Engineering
IIT Guwahati

TYPE OF COURSE : Rerun I Core I UG/PG
COURSE DURATION : 12 weeks (26 Jul'21 - 15 Oct'21)
EXAM DATE : 24 Oct 2021

PRE-REQUISITES : Basic UG-level Fluid Mechanics and Thermodynamics

INTENDED AUDIENCE : Undergraduate students of Aerospace and Mechanical Engineering and postgraduate students specializing in Thermofluids/Fluid Mechanics/Automobiles; Industry personnel associated with Aerospace Engineering; Faculty members associated with Mechanical / Aerospace Engineering.

COURSE OUTLINE :

This course deals with gas power cycles for aircraft propulsion. Therefore different types of aircraft engines, their parts and their performance parameters are discussed. Then the cycle analysis and its different attachments for improvisation are also focused upon further, different parts of aircraft engines like compressor, turbines, combustor and nozzle are discussed in detail.

ABOUT INSTRUCTOR :

Dr. Vinayak N. Kulkarni has been an Associate Professor in the Department of Mechanical Engineering at Indian Institute of Technology Guwahati since January 2015. He completed his undergraduate studies in Mechanical Engineering in the Shivaji University, Maharashtra, India. His post graduation and PhD is from Aerospace Engineering Department of Indian Institute of Science Bangalore. His teaching interests are basic and applied thermodynamics, gas dynamics, aircraft propulsion and fluid mechanics. His research interests are experimental and computational compressible flows, IC engines and non-conventional energy.

COURSE PLAN :

Week 1: Introduction to Gas turbines and Aircraft Propulsion
Week 2: Aircraft propulsion
Week 3: Ideal and Real cycle analysis
Week 4: Ideal and Real cycle analysis(contd)
Week 5: Real cycles
Week 6: Real cycles (contd)
Week 7: Engine performance and Engine components
Week 8: Centrifugal Compressors
Week 9: Axial Compressors
Week 10: Axial and Radial Turbines
Week 11: Turbine cooling methods and Component matching
Week 12: Blade design and cascade theory

ADVANCED DYNAMICS

PROF. ANIRVAN DASGUPTA
Department of Mechanical Engineering
IITKGP

TYPE OF COURSE : New I Core I UG/PG
COURSE DURATION : 12 Weeks (26-Jul' 21 - 15-Oct' 21)
EXAM DATE : 24 Oct 2021

PRE-REQUISITES : Undergraduate Mechanics, Dynamics, and Engineering Mathematics

INTENDED AUDIENCE : Mechanical Engineering, Aerospace Engineering, Physics

INDUSTRIES APPLICABLE TO : Automotive, Railway, and Aerospace industry

COURSE OUTLINE :
A study of dynamics is useful not only in determining dynamic forces for design (such as in automotive and aerospace systems, machine tools etc.), but also in understanding the phenomena of tides, cyclonic circulation, precession of tops, flight of boomerangs etc.

ABOUT INSTRUCTOR :
Dr. Anirvan DasGupta is a faculty in Mechanical Engineering at IIT Kharagpur since 1999. His interests are in the mechanics of discrete and continuous systems. He has extensively taught courses at undergraduate and postgraduate levels like Mechanics, Kinematics of Machines, Dynamics of Machines, Vibration Analysis, Wave Propagation in Continuous Media, and Rail Vehicle Dynamics.

COURSE PLAN :

Week 1**:** Coordinate systems, Kinematics of particles, rotating frames, relative motion

Week 2**:** Kinetics of particles, cyclonic circulation, Foucault pendulum

Week 3**:** Integrals of Newton's second law, angular momentum, conservation laws

Week 4**:** Impact, Newton's law of gravitation and tidal dynamics

Week 5**:** Systems with variable mass, systems with flow

Week 6**:** Dynamics of rigid bodies, Newton-Euler equations

Week 7**:** Dynamics of tops, gyroscopes and boomerangs

Week 8**:** Rotation matrix and its parametrization, geometry of rotation

Week 9**:** Introduction to analytical dynamics, configuration space, constraints, generalized coordinates and forces

Week 10**:** Hamilton's principle, Lagrange's equation of motion, constraint forces

Week 11**:** Generalized momentum, cyclic coordinates and conservation laws

Week 12**:** Symmetry and Noether's theorem, Hamiltonian and its conservation

PRODUCTION TECHNOLOGY: THEORY AND PRACTICE

PROF. SOUNAK KUMAR CHOUDHURY
Department of Mechanical Engineering
IIT Kanpur

TYPE OF COURSE : New I Core I UG
COURSE DURATION : 12 Weeks (26-Jul' 21 - 15-Oct' 21)
EXAM DATE : 24 Oct 2021

INTENDED AUDIENCE : UG and PG students; practicing engineers
INDUSTRIES APPLICABLE TO : Machine Tool industries; Automobile manufacturing industries.

COURSE OUTLINE :
This is a fundamental course on Production Technology clarifying some of the basic manufacturing processes including 10 hours of the hands-on laboratory sessions. This course has five modules, namely Materials and their properties, Conventional Machining Processes, Non-Traditional Machining Processes, computer Numerical Controls and Metrology. This is will be helpful for a wide variety of audience including UG students of all Engineering Disciplines and practicing engineers in the manufacturing industries.

ABOUT INSTRUCTOR :
I have completed my Ph.D. in Mechanical Engineering from Moscow, Russia in 1985 followed by post-doctoral at the same university till 1986. From 1986 I am involved in teaching and research in the Mechanical Engineering Department of Indian Institute of Technology Kanpur. My areas of specialization are conventional and non-conventional machining, automatic control, hydraulic control, machine tools and manufacturing automation.

COURSE PLAN :

Week 1: Introduction to the course on Production Technology

Week 2: Metal machining

Week 3: Machining (continued)

Week 4: Friction in metal cutting

Week 5: Cantilever beam, ring structure, octagon, extended octagon

Week 6: Milling operations, broaching operation

Week 7: Grinding wheel wear (continued)

Week 8: Abrasive Jet Machining

Week 9: Major components related to CNC machine tools

Week 10: Laboratory Hands-on Training: Introduction to the Power transmission (PPTs)

Week 11:CNC part programming exercises in PPT – turning, grooving, threading (Continued

Week 12: Various milling cutters, end milling cutter

ENGINEERING METROLOGY

DR. J. RAMKUMAR
Department of Mechanical Engineering
IIT Kanpur

TYPE OF COURSE : Rerun I Elective I UG I PG
COURSE DURATION : 12 weeks (26 Jul'21 - 15 Oct'21)
EXAM DATE : 24 Oct 2021

PRE-REQUISITES : The student should have completed two semesters of UG Engineering or Science program

INTENDED AUDIENCE : Students of all Engineering and Science disciplines.

INDUSTRIES APPLICABLE TO : HAL, NAL, SAIL, ISRO

COURSE OUTLINE :

Engineering metrology is the use of measurement science in manufacturing. The study of metrology is highly valuable for the students and practitioners, specifically from mechanical and allied engineering stream. For a product to be successful, it needs to be manufactured according to metrological specifications, otherwise heavy costs are incurred to comply with the specifications in the later stage. Also, the role played by measurements in the day today life makes it essential to study metrology. This course is designed to impart the knowledge to develop measurement procedures, conduct metrological experiments, and obtain and interpret the results. A laboratory demonstration are also induced to enhance the learning process. The course would be useful in many areasin the traditional and modern high technology viz. manufacturing, industrial, scientific research, defense, and many others.

ABOUT INSTRUCTOR :

Dr. Janakranjan Ramkumar is currently a Professor of Mechanical Engineering Department, and Design Program, Indian Institute of Technology, Kanpur. He teaches manufacturing science, micro/nano technology, new product development.

COURSE PLAN :

Week 1 : Introduction to Engineering Metrology
Week 2 : Introduction to Engineering Metrology
Week 3 : Statistics in Metrology
Week 4 : Linear Measurements
Week 5 : Angular and rotation measurements
Week 6 : Comparators
Week 7 : Optical measurements, and temperature measurements
Week 8 : Screw threads metrology, and gears metrology
Week 9 : Transducers
Week 10: Flow and Pressure measurements, and strain measurements
Week 11: Surface finish metrology, and mechatronics
Week 12: Nano-metrology, and Quality control

FOUNDATIONS OF COMPUTATIONAL MATERIALS MODELLING

PROF. NARASIMHAN SWAMINATHAN
Department of Mechancial Engineering
IIT Madras

TYPE OF COURSE : Rerun I Elective I PG
COURSE DURATION : 12 weeks (26 Jul' 21 - 15 Oct' 21)
EXAM DATE : 24 Oct 2021

PRE-REQUISITES : Basic Materials Science Course at the undergraduate level, MATLAB programming, familiarity with LINUX is preferred.

INTENDED AUDIENCE : All Engineering students

INDUSTRIES APPLICABLE TO : None. This course will be useful for students pursuing research requiring molecular simulations of solids.

COURSE OUTLINE :

This course provides the necessary foundations to (a) build computational samples of crystals (b) Introduce statistical mechanics and its connection to Molecular dynamics (c) Provide enough ground in Molecular dynamics using LAMMPS

ABOUT INSTRUCTOR :

The instructor Dr. Narasimhan Swaminathan is an Associate Professor in the Dept. of Mechanical Engineering at IIT Madras. Prior to this, he was a Post Doctoral Research Associate in the Materials Science and Engineering Department at University of Wisconsin, USA. Dr. Narasimhan obtained his Ph.d. from the Georgia Institute of Technology in 2009. His current research areas include molecular simulations to study radiation damage, polymer mechanics,etc. He also studies stress-diffusion interaction in Li-ion battery electrodes using continuum mechanics.

COURSE PLAN :

Week 1**:** Introduction to Computational Modeling

Week 2**:** Introduction to Crystals

Week 3**:** Symmetry in Crystals

Week 4**:** Plane Groups

Week 5**:** Space Groups

Week 6**:** Construction of 2D and 3D crystals in MATLAB

Week 7**:** Statistical Mechanics

Week 8**:** Statistical Mechanics,cont'd

Week 9**:** Introduction to Molecular Dynamics

Week 10**:** Molecular dynamics using LAMMPS – 1

Week 11**:** Molecular dynamics using LAMMPS -2

Week 12**:** Molecular dynamics using LAMMPS -3 and Closure

INTRODUCTION TO COMPOSITES

PROF. NACHIKETA TEWARI
Department of Mechanical Engineering
IIT Kanpur

TYPE OF COURSE : Rerun I Elective I UG/PG
COURSE DURATION : 12 weeks (26 Jul'21 - 15 Oct'21)
EXAM DATE : 24 Oct 2021

PRE-REQUISITES : Must be enrolled into a B. Tech. program or equivalent and should have completed at least second year of his 4-year program.

INTENDED AUDIENCE : UGs, PGs, professionals in industry who want to learn about basics of sound and acoustics

INDUSTRIES APPLICABLE TO : Automotive, Composites, Aerospace, Sports, Railways, Power Generation and all industry that has to address issues related to noise.

COURSE OUTLINE :

This course is intended for all those who want to conduct experiments in area of NVH. Thus, the course is open to students of engineering and science, and also to all those who from the industry and research organizations – who are working in area of sound, NVH and acoustics. Each lecture will be followed by a quiz, which will help student the concepts better, and gain deeper insights to measurement process. The course is fairly generic so that there is no need for a particular background. Rather, what is needed is openness, and ability to learn and check out new ideas with comfort.

ABOUT INSTRUCTOR :

Dr. Nachiketa Tiwari is an Associate Professor of Mechanical Engineering at IIT Kanpur. He has a PhD in engineering mechanics from Virginia Tech. His doctoral thesis involved nonlinear analysis of composite structures through FE, analytical and experimental methods. Dr. Tiwari also has deep understanding of fundamentals of FEA as he has used several tools in industry for over a dozen years for producing world class products. His current areas of research interest are composite structures, noise, vibrations, and product design. He has established Dhwani, an Acoustics Lab at IITK, which is one of the best in the country.

COURSE PLAN :

Week 1**:** Intro and terminology

Week 2**:** Concept Review

Week 3**:** Fibers

Week 4**:** Matrix materials

Week 5**:** Short fiber composites

Week 6**:** Short fiber composites (Cont'd)

Week 7**:** Orthotropic lamina

Week 8**:** Orthotropic lamina

Week 9**:** Orthotropic lamina (Cont'd)

Week 10**:** Composite laminates

Week 11**:** Composite laminates

Week 12**:** Composite laminates (Cont'd)

THERMODYNAMICS

PROF. ANAND T. N. C
Department of Mechanical Engineering
IIT Palakkad, IIT Madras

TYPE OF COURSE : Rerun I Core I UG
COURSE DURATION : 12 weeks (26 Jul' 21 - 15 Oct' 21)
EXAM DATE : 24 Oct 2021

INTENDED AUDIENCE : Any interested Learners
INDUSTRIES APPLICABLE TO : Any companies working in areas of thermal engineering

COURSE OUTLINE :
This is a first-level course in thermodynamics, aimed at UG first and second year students. The syllabus closely follows the AICTE model syllabus in thermodynamics. At the end of the course, students would be expected to be able to demonstrate an understanding of the laws of thermodynamics and solve problems involving heat and work interactions, with various working substances.

ABOUT INSTRUCTOR :
Anand T.N.C. is an Associate Professor in the Department of Mechanical Engineering at IIT Palakkad, on leave from IIT Madras. He has been teaching various courses related to thermal engineering for over 10 years.

COURSE PLAN :

Week 1**:** Fundamentals - System & Control volume; Property, State & Process; Exact & Inexact differentials; Work - Thermodynamic definition of work; examples;

Week 2**:** Displacement work; Path dependence of displacement work and illustrations for simple processes; electrical, magnetic, gravitational, spring and shaft work.

Week 3**:** Temperature, Definition of thermal equilibrium and Zeroth law; Temperature scales; Various Thermometers- Definition of heat; examples of heat/work interaction in systems

Week 4**:** First Law for Cyclic & Non-cyclic processes; Concept of total energy E ; Demonstration that E is a property; Various modes of energy, Internal energy and Enthalpy

Week 5**:** Definition of Pure substance, Ideal Gases and ideal gas mixtures, Real gases and real gas mixtures, Compressibility charts

Week 6**:** Properties of two phase systems - Const. temperature and Const. pressure heating of water; Definitions of saturated states; P-v-T surface; Use of steam tables and R134a tables; Saturation tables; Superheated tables; Identification of states & determination of properties, Mollier's chart.

Week 7**:** First Law for Flow Processes - Derivation of general energy equation for a control volume;Steady state steady flow processes including throttling; Examples of steady flow devices; Unsteady processes; examples of steady and unsteady

Week 8**:** Second law - Definitions of direct and reverse heat engines; Definitions of thermal efficiency and COP; Kelvin-Planck and Clausius statements; Definition of reversible process; Internal and external irreversibility;

Week 9**:** Carnot cycle; Absolute temperature scale. Clausius inequality; Definition of entropy S ; Demonstration that entropy S is a property; Evaluation of S for solids, liquids, ideal gases and ideal gas mixtures undergoing various processes; Determination of s from steam tables

Week 10**:** Principle of increase of entropy; Illustration of processes in T-s coordinates; Definition of Isentropic efficiency for compressors, turbines and nozzles- Irreversibility and Availability

Week 11**:** Availability function for systems and Control volumes undergoing different processes, Lost work. Second law analysis for a control volume. Energy balance equation and Energy analysis.

Week 12**:** Thermodynamic cycles - Basic Rankine cycle; Basic Brayton cycle; Basic vapor compression cycle and comparison with Carnot cycle.

COMPUTATIONAL FLUID DYNAMICS USING FINITE VOLUME METHOD

PROF. KAMESWARARAO ANUPINDI
Department of Mechanical Engineering
IIT Madras

TYPE OF COURSE :Rerun I Elective I UG I PG
COURSE DURATION : 12 weeks (26 Jul'21 - 15 Oct'21)
EXAM DATE : 24 Oct 2021

PRE-REQUISITES : Courses on linear algebra, numerical methods, incompressible fluid mechanics, and heat transfer

INTENDED AUDIENCE : Bachelors, masters and doctoral students, practicing scientists and engineers from industry.

INDUSTRIES APPLICABLE TO : General Electric, General Motors, ANSYS, ISRO, DRDO

COURSE OUTLINE :

In this course, the discretization and solution of diffusion, convection-diffusion, and incompressible fluid flow equations are discussed. Finite volume method is used to discretize each of the equations. The discretization and solution methods are formulated on structured as well as unstructured meshes. This course involves hand-calculations on simple meshes as well as numerical programming of the algorithms discussed.

ABOUT INSTRUCTOR :

Dr. Kameswararao Anupindi is an Assistant Professor in the Department of Mechanical Engineering at IIT Madras (IITM), Chennai. He obtained his Ph.D. from Purdue University in 2013. Prior to joining IITM, he worked as a post-doctoral researcher at Oak Ridge National Laboratory and at University of Southampton. His research interests include computational fluid dynamics, turbulence modeling and lattice Boltzmann methods.

COURSE PLAN :

Week 1**:** Review of governing equations

Week 2**:** Classification of governing equations

Week 3**:** Overview of numerical solution methods

Week 4**:** Steady diffusion equation on structured meshes

Week 5**:** Unsteady diffusion equation on structured meshes

Week 6**:** Diffusion in unstructured meshes

Week 7**:** Convection and diffusion

Week 8**:** Higher-order schemes

Week 9**:** Convection and diffusion on unstructured meshes

Week 10**:** Linear system solvers

Week 11**:** Incompressible flow field calculation

Week 12**:** Staggered and co-located formulation

FUNDAMENTALS OF ADDITIVE MANUFACTURING TECHNOLOGIES

PROF. SAJAN KAPIL
Department of Mechanical Engineering
IIT Guwahati

TYPE OF COURSE : New I Elective I UG/PG
COURSE DURATION : 12 Weeks (26-Jul' 21 - 15-Oct' 21)
EXAM DATE : 24 Oct 2021

INTENDED AUDIENCE : Bachelor/Master/PhD students having background in Mechanical Engineering/Production Engineering/ Manufacturing Technology

COURSE OUTLINE :

The progress of additive manufacturing processes is ever increasing with the development of the digital platform in the manufacturing sector, which is essential for the growth of modern technologies. This course is primarily designed for fundamental understanding of different additive manufacturing technologies for realizing the metallic and non-metallic objects. The syllabus is oriented to cover from basic understanding to practical applications of this technology to develop the products.

ABOUT INSTRUCTOR :

Dr. Sajan Kapil completed his Bachelor's degree in Mechanical Engineering from G. B. Pant Engineering College Pauri, Master's degree in Computer Assisted Manufacturing from IIT Guwahati & University of Stuttgart and Ph.D. from IIT Bombay. After that, he joined the Department of Mechanical Engineering IIT Guwahati as an Assistant Professor. His areas of research include 3D printing, Manufacturing Automation, and CAD/CAM.

COURSE PLAN :

Week 1: Introduction to Additive Manufacturing
Week 2: Computer Aided Process Planning for Additive Manufacturing
Week 3: Computer Aided Process Planning for Additive Manufacturing
Week 4: Liquid Additive Manufacturing
Week 5: Liquid Additive Manufacturing
Week 6: Sheet Additive Manufacturing
Week 7: Wire Additive Manufacturing
Week 8: Wire Additive Manufacturing
Week 9: Wire Additive Manufacturing
Week 10: Powder Additive Manufacturing
Week 11: Powder Additive Manufacturing
Week 12: Powder Additive Manufacturing


APPLIED THERMODYNAMICS

PROF. NIRANJAN SAHOO
Prof. Pranab K. Mondal
Department of Mechanical Engineering
IITG

TYPE OF COURSE : New I Core I UG
COURSE DURATION : 12 week (26 Jul 21- 15 Oct 21)
EXAM DATE : 24 Oct 2021

COURSE OUTLINE :

"Applied Thermodynamics" is a topic of fundamental interest to Mechanical Engineering and Energy Engineering disciplines. This course provides theoretical and thermodynamic background for steam and gas power cycle, refrigeration cycle, psychometric principles, internal combustion engine and gas turbine engine cycles, aircraft and rocket propulsion cycles. Prior to these topic, few lectures are devoted towards basic engineering thermodynamic fundamentals. The syllabus is framed with respect to guidelines of "Mechanical/Energy Engineering" UG course curriculum for respective engineering disciplines across the country. The methodical online teaching, problem solving approach and online evaluation will help the candidate for credit transfer for their course curriculum.

ABOUT INSTRUCTOR :

Dr. Niranjan Sahoo is affiliated as "Professor" in the Department of Mechanical Engineering, Indian Institute of Technology Guwahati. Having B. Tech Degree in Mechanical Engineering, he has received PhD Degree (in the year 2004) from Department of Aerospace Engineering, Indian Institute of Science Bangalore. Till May 2020, he has 15 years teaching and research experience at different capacity in Department of Mechanical Engineering, Indian Institute of Technology Guwahati. He has taught several courses at undergraduate and postgraduate level in the area of Fluid and Thermal Engineering, such as Fluid Mechanics, Basic and Applied Thermodynamics, Heat and Mass Transfer, Refrigeration and Air Conditioning, Combustion, Gas Dynamics and Aircraft Propulsion.

Dr. Pranab K. Mondal is an Assistant Professor in the department of Mechanical Engineering at Indian Institute of Technology Guwahati since May 2015. He received his undergraduate and postgraduate degree from Jadavpur University, Kolkata, and completed his Ph.D. from Indian Institute of Technology Kharagpur in 2015. He worked as an Research Associate at IIT Khargpur for nearly one years before joining IIT Guwahati.He is currently working on stability analysis of flows with free-surfaces, experimental investigations of capillary filling of bio-fluids and droplet dynamics. He has co-authored more than 70 referred journal and conference publications. He is a regular reviewer of many reputed international journals and also associated with several sponsored projects.

COURSE PLAN :

Week 1**:** Review of Basic Thermodynamics

Week 2**:** Steam Power System

Week 3**:** Steam Power System

Week 4**:** Steam Power System

Week 5**:** Internal Combustion (IC) Engines

Week 6**:** Internal Combustion (IC) Engines

Week 7**:** Internal Combustion (IC) Engines

Week 8**:** Gas Turbine Engines

Week 9**:** Gas Turbine Engines

Week 10**:** Refrigeration and Air-conditioning System

Week 11**:** Refrigeration and Air-conditioning System

Week 12**:** Reciprocating Air Compressor

AUTOMATION IN MANUFACTURING

PROF. SHRIKRISHNA N. JOSHI
Department of Mechancial Engineering
IIT Guwahati

TYPE OF COURSE : Rerun I Elective I UG I PG
COURSE DURATION : 12 weeks (26 Jul'21 - 15 Oct'21)
EXAM DATE : 24 Oct 2021

PRE-REQUISITES : Knowledge of basic electronics and electrical engineering.

INTENDED AUDIENCE : UG, PG students of Mechanical, Production, Industrial Engineering, Mechatronics Engineering. Practicing engineers.

INDUSTRIES APPLICABLE TO : All automobile manufacturing, mobile phone manufacturing industry, aviation industry

COURSE OUTLINE :

Manufacturing industry contributes a major share in the GDP of our country. Application of automated systems is certainly improving the productivity of the manufacturing industry. In view of this, a course on "Automation in Manufacturing" is designed with the primary focus on the design and development of automated systems in the manufacturing. Initially the course introduces various automated systems being used in the manufacturing industry. Then the building blocks of a typical automated system are described. It presents a study on the principle of operation and construction details of sensors/transducers, actuators, drives and mechanisms, hydraulic and pneumatic systems. It also covers up the microprocessor technology, programming and CNC technology. The contents are lucidly presented with real-life examples. Case studies based on manufacturing industry applications are presented.

ABOUT INSTRUCTOR :

Prof. Shrikrishna N. Joshi has completed his doctoral studies in the area of "Intelligent process modeling and optimization of electric discharge machining process" from IIT Bombay, Mumbai, India in 2009. Currently, he is working as an Associate Professor in the Department of Mechanical Engineering at Indian Institute of Technology Guwahati, India. He was a visiting faculty at the Asian Institute of Technology (AIT), Bangkok, Thailand in 2015.

COURSE PLAN :

Week 1**:** Introduction: Importance of automation in the manufacturing industry. Use of mechatronics. Systems required.

Week 2**:** Design of an automated system: Building blocks of an automated system, working principle and examples.

Week 3**:** Fabrication: Fabrication or selection of various components of an automated system. Specifications of various elements. Use of design data books and catalogues.

Week 4**:** Sensors: study of various sensors required in a typical automated system for manufacturing. Construction and principle of operation of sensors.

Week 5**:** Microprocessor Technology: signal conditioning and data acquisition, use of microprocessor or micro controllers. Configurations. Working.

Week 6**:** Drives: electrical drives - types, selection criteria, construction and operating principle.

Week 7**:** Mechanisms: Ball screws, linear motion bearings, cams, systems controlled by camshafts.

Week 8**:** Mechanisms: Electronic cams, indexing mechanisms, tool magazines, and transfer systems.

Week 9**:** Hydraulic systems: hydraulic power pack, pumps, valves.

Week 10**:** Hydraulic systems: designing of hydraulic circuits.

Week 11**:** Pneumatic systems: configurations, compressors, valves, distribution and conditioning.

Week 12**:** CNC technology: basic elements, interpolators and programming.

COMPUTATIONAL CONTINUUM MECHANICS

PROF. SACHIN SINGH GAUTAM
Department of Mechancial Engineering
IIT Guwahati

TYPE OF COURSE : Rerun I Elective I PG
COURSE DURATION : 12 weeks (26 Jul'21 - 15 Oct'21)
EXAM DATE : 24 Oct 2021

PRE-REQUISITES : Introduction to Solid Mechanics I and II, A undergraduate course in Engineering Mathematics. Exposure to undergraduate course on numerical methods will be an added advantage.

INTENDED AUDIENCE : Masters student and research scholars

INDUSTRIES APPLICABLE TO : VSSC, ISRO, Siemens India Limited, Ansys India or any firm involved in R&D involving finite element analysis

COURSE OUTLINE :

Continuum mechanics as a full-fledged course is a very interesting but a challenging subject. Usually,its application within the nonlinear finite element codes is not clear to the student. Computational continuum mechanics tries to bridge this gap. Hence, it can be treated as an applied version of continuum mechanics course. It assumes no prior exposure to continuum mechanics. The course starts with sufficient introduction to tensors, kinematics, and kinetics. Then, the course applies these concepts to set up the constitutive relations for nonlinear finite element analysis of a simple hyperelastic material. This is followed by the linearization of the weak form of the equilibrium equations followed by discretization to obtain the finite element equations, in particular, the tangent matrices and residual vectors is discussed. Finally, the Newton-Raphson solution procedure is discussed along with line search and arc length methods to enhance the solution procedure.

ABOUT INSTRUCTOR :

Dr. Sachin Singh Gautam is currently an Assistant professor in the Department of Mechanical Engineering, IIT Guwahati. He obtained his M.Tech. and Ph.D. from and worked as a postdoctoral fellow in AICES, RWTH Aachen University. His area of research is in nonlinear finite element methods and computational contact-impact problems. He has carried out projects from SERB, DST and VSSC, ISRO. He currently working on the incorporation of a contact module in the ISROs structural analysis software tool FEASTSMT (Indias first commercial FE package which is under Make-In-India). He has guided students on research problems jointly with Siemens R&D and Cummins R&D. He has guided three research scholars and is currently guiding five full-time PhD students, one part-time student. He has guided 17 M.Tech students and currently guiding 7 more. His research group has received various awards and fellowships like the DAAD fellowship and best paper award. He has 15 book chapters, 24 journal papers, and over 60 conference publications.

COURSE PLAN :

Week 1: Introduction - origins of nonlinearity

Week 2: Mathematical Preliminaries -1: Tensors and tensor algebra

Week 3: Mathematical Preliminaries -2: Linearization and directional derivative, Tensor analysis

Week 4: Kinematics - 1: Deformation gradient, Polar decomposition,Area and volume change

Week 5: Kinematics - 2: Linearized kinematics, Material time derivative,Rate of deformation and spin tensor

Week 6: Kinetics - 1 : Cauchy stress tensor, Equilibrium equations,Principle of virtual work

Week 7: Kinetics - 2 : Work conjugacy, Different stress tensors, Stress rates

Week 8: Hyperelasticity - 1: Lagrangian and Eulerian elasticity tensor

Week 9: Hyperelasticity - 2: Isotropic hyperelasticity, Compressible Neo-Hookean material

Week 10: Linearization : Lineation of internal virtual work, Linearization of external virtual work

Week 11: Discretization: Discretization of Linearized equilibrium equations - material and geometric tangent matrices

Week 12: Solution Procedure: Newton-Raphson procedure, Line search and Arc length method

ENGINEERING DRAWING AND COMPUTER GRAPHICS

PROF. RAJARAM LAKKARAJU
Department of Mechanical Engineering
IIT Kha

TYPE OF COURSE : Rerun I Core I UG
COURSE DURATION : 12 weeks (26 Jul'21 - 15 Oct'21)
EXAM DATE : 24 Oct 2021

INTENDED AUDIENCE : Aerospace, Computer Science, Civil, Chemical,, Electronics, Information Technology, Mechanical, Bio-Technology, Production

INDUSTRIES APPLICABLE TO : Various automotive, petro and process industries:TATA Steel, TATA motors, SHELL, ONGC, Reliance, HAL, SAIL, BHEL, BARC, Airbus, GE, almost all the the manufacturing and process industries

COURSE OUTLINE :

All phases of manufacturing a product involve expressing basic ideas into graphical format widely known as engineering drawing and design. The present course prepares the students to learn the basics concepts involved in technical drawing skills and computer graphics.
During this course, the student will develop skills on:
- understanding of engineering drawings used in industries - computer design and development of 3D objects
- exposure to visual aspects of technical drawings

ABOUT INSTRUCTOR :

Presently, Prof. Rajaram Lakkaraju is working as a faculty member at the department of mechanical engineering, IIT Kharagpur since 2015. He has taught courses like fluid mechanics, computational methods for thermal engineers, mathematical methods, and two-phase flows and Engineering Drawing. He had graduated with a Ph.D. degree from the University of Twente, The Netherlands, and MS (Engg.) from JNCASR, India.

COURSE PLAN :

Week 1: Introduction to engineering drawings
Week 2:Conic sections
Week 3:Orthographic projections-I
Week 4: Orthographic projections-II
Week 5: Sections and sectional views
Week 6: Isometric projections
Week 7: Overview of computer graphics-I
Week 8: Overview of computer graphics-II
Week 9: Overview of computer graphics-III
Week 10: Overview of computer graphics-IV
Week 11: Design project-I
Week 12: Design project-II

COMPUTATIONAL FLUID DYNAMICS

Prof. Suman Chakraborty
Department of Mechanical Engineering
IIT Kharagpur

TYPE OF COURSE : Rerun | Core | UG/PG
COURSE DURATION : 12 weeks (26 July 2021 - 15 Oct 2021)
EXAM DATE : 24 Oct 2021

PRE-REQUISITES : Basic knowledge of Mathematics and Fluid Mechanics

INTENDED AUDIENCE : Mechanical Engineering, Chemical Engineering, Civil Engineering, Aerospace Engineering, Mining Engineering, Atmospheric and Ocean Engineering, Physics

INDUSTRIES APPLICABLE TO : Oil Companies (IOCL, SHELL, BPCL and others), Automobile and Aviation companies (GE, AIRBUS, TATA Motors and others) , R&D sectors of different companies

COURSE OUTLINE :

CFD or computational fluid dynamics is a branch of continuum mechanics that deals with numerical simulation of fluid flow and heat transfer problems. The exact analytical solutions of various integral, differential or integro-differential equations, obtained from mathematical modeling of any continuum problem, are limited to only simple geometries. Thus for most situations of practical interest, analytical solutions cannot be obtained and a numerical approach should be applied. In the field of mechanics, the approach of obtaining approximate numerical solutions with the help of digital computers is known as Computational Mechanics whereas the same is termed as Computational Fluid Dynamics for thermo-fluidic problems. CFD, thus, deals with obtaining an approximate numerical solution of the governing equations based on the fundamental conservation laws of mass, momentum and energy.

ABOUT INSTRUCTOR :

Dr. Suman Chakraborty is a Professor in the Mechanical Engineering Department of the Indian Institute of Technology (IIT) Kharagpur, India, and Indian National Academy of Engineering Chair Professor. He is also currently the Head, School of Medical Science and Technology at IIT Kharagpur. He has offered a significant number of video courses through the NPTEL programme. These courses include: Introduction to Fluid Mechanics and Fluids Engineering, Computational Fluid Dynamics, and Microfluidics. He has also taught in an online programme (under NMEICT) titled “Talk to 10 Thousand Teachers”. He has also taught live modular courses in the International Summer Winter Term and Knowledge Dissemination Programme. He has research interests in the area of Microfluidics and Micro/Nano scale transport processes, including their theoretical, computational, and experimental modeling, encompassing the underlying fundamentals as well as bio-medical, bio-technological, chip cooling, and energy related applications. As recognition of his research, he has been awarded the Santi Swarup Bhatnagar Prize in the year 2013. He has also been elected as a Fellow of the Indian National Science Academy (FNA), Indian National Academy of Science (FNASc), Fellow of the Indian National Academy of Engineering (FNAE), Fellow of the American Society of Mechanical Engineers (ASME), recipient of the Indo-US Research Fellowship, Scopus Young Scientist Award for high citation of his research in scientific/technical Journals, and Young Scientist/ Young Engineer Awards from various National Academies of Science and Engineering. He has further been an Alexander von Humboldt Fellow and a Visiting Professor at the Stanford University. He has 350+ International Journal publications.

COURSE PLAN :

Week 1: Introduction to Computational Fluid Dynamics, classification of partial differential equations their physical behavior

Week 2: Fundamentals of discretization

Week 3: Finite Volume approach and discretization of unsteady-state problems

Week 4: Important consequences of discretization of time-dependent diffusion type problems

Week 5: Discretization of time-dependent diffusion type problems (contd.); finite volume discretization of 2-D unsteady state diffusion type problems

Week 6: Solution of systems of linear algebraic equations (Part I)

Week 7: Solution of systems of linear algebraic equations (Part II)

Week 8: Solution of systems of linear algebraic equations (Part III)

Week 9: Solution of systems of linear algebraic equations (Part IV); A finite volume discretization of convection-diffusion equations (Part I)

Week 10: A finite volume discretization of convection-diffusion equations (Part II)

Week 11: A finite volume discretization of convection-diffusion equations (Part III), Discretization of Navier-Stokes equations (Part I)

Week 12: Discretization of Navier-Stokes equations (Part II)

INTRODUCTION TO TURBOMACHINERY

PROF. SUBRATA SARKAR
Department of Mechanical Engineering
IIT Kanpur

TYPE OF COURSE : New I Core I UG/PG
COURSE DURATION : 12 Weeks (26-Jul' 21 - 15-Oct' 21)
EXAM DATE : 24 Oct 2021

PRE-REQUISITES : Basic Thermodynamics and Fluid Mechanics

INTENDED AUDIENCE : UG/PG students, research scholars, and practicing engineers interested in the field of turbomachinery.

INDUSTRIES APPLICABLE TO : HAL/GTRE/NTPC/NHPC/BHEL/GE India etc

COURSE OUTLINE :

The objective of the course is to provide a framework to discuss different kinds of turbomachinery through a unified approach. The material presented is intended for undergraduate and graduate students apart from professional engineers in the industry engaged in the analysis and development of turbomachinery. Coverage begins with the fundamental concepts, the equations of motion in a rotating system, and the Euler equation for turbomachinery. This is followed by the gas turbine cycle, similarity rules, and cascade flow analysis. The reader is then focused on flows through compressors and turbines, including a brief discussion on the secondary flow, tip clearance, blade cooling, surge, and stall. The course will be concluded with a discussion on CFD in the design and analysis of turbomachinery.

ABOUT INSTRUCTOR :

S. Sarkar, Professor of the Department of Mechanical Engineering at the Indian Institute of Technology Kanpur, India, HAL Chair, Convener of Energy Conversion and Computational Turbomachinery Laboratories, received Ph.D. in 1995. He also severed the University of Surrey, UK for two years. Dr. Sarkar is involved in research over the last 25 years and contributed significantly to the fields of Fluid Mechanics, Turbulence, Turbomachinery, CFD, and Large-Eddy Simulation. He is the author of several peer-reviewed technical papers in international journals and conferences, and has guided a number of masters and doctoral students. He has completed many industrial and sponsored projects. He has served as a technical expert on project-review committees of national importance, and also served on numerous academic and administrative committees of the Institute.

COURSE PLAN :

1. Introduction and Classification: Axial flow, radial flow and mixed flow machines, the equations of motion in rotating frame of reference, effects of Coriolis and Centrifugal forces, momentum and energy equation, Euler work, and illustrative examples.[5]

2. Gas Turbine Cycle: Brayton Cycle, regenerative cycle, reheat, inter-cooling, turboprop, turbojet and turbofan engine, thrust augmentation, and illustrative examples. [4]

3. Similarity Analysis: Similarity rules, specific speed, Cordier diagram and illustrative examples.[4]

4. Cascade Analysis: Two-dimensional cascade theory, lift and drag, blade efficiency, estimation of loss, compressor and turbine cascade, blade geometry, and illustrative examples.[5]

5. Axial Flow Compressor: Two-dimensional pitch line design and analysis, h-s diagram, degree of reaction, the effect of Mach number, performance and efficiency, three-dimensional flow, tip clearance, losses, compressor performance, and illustrative examples. [6]

6. Centrifugal Pump and Compressor: Theoretical analysis and design, the effect of circulation and Coriolis forces, reversal eddies, slip factor, head and efficiency, diffuser, introduction to the combustion system, and illustrative examples.[6]

7. Axial Flow Turbine: Two-dimensional pitch line design, stage loading capacity, degree of reaction, stage efficiency, turbine performance, blade cooling, and illustrative examples.[6]

8. CFD Applied to Turbomachinery Flows: Governing equations, numerical methods, and test cases illustrating flow and heat transfer related to turbomachines.

Total Class: 36 (It equivalent to 12 weeks considering 3 classes per week)

ROBOTICS

PROF. D.K. PRATIHAR
Department of Mechanical Engineering
IIT Kharagpur

TYPE OF COURSE : Rerun | Core | UG | PG
COURSE DURATION : 8 weeks (26 Jul'21 - 17 Sep'21)
EXAM DATE : 26 Sep 2021

INTENDED AUDIENCE : Students belonging to all disciplines of Engineering, Researchers and practicing Engineers can take this course

INDUSTRIES APPLICABLE TO : RDCIS, Ranchi CMERI, Durgapur Reliance Industries C-DAC, Kolkata

COURSE OUTLINE :

The course will start with a brief introduction to robots and robotics. The motivation behind keeping robots in modern industries will be discussed. After providing a brief history of robotics, different components of a robotic system will be identified. The method of determining degrees of freedom of a robotic system will be discussed with some examples. After classifying the robots based on certain criteria, workspace analysis of manipulators will be carried out. Applications of robots in different areas like in manufacturing units, medical science, space, and others, will be discussed. Various methods of robot teaching will be explained with some suitable examples. Economic analysis will be conducted to decide whether we should purchase a robot. Both forward and inverse kinematics problems will be solved with the help of some suitable examples. To ensure smooth variation of joint angles of the robot, trajectory planning schemes will be explained. After carrying out velocity analysis with the help of Jacobian matrix, inverse dynamics problems of robots will be solved using Lagrange-Euler formulation. Control scheme used in robots to realize the joint torques will be discussed. Besides manipulators, analysis will be carried out on wheeled and multi-legged robots. The working principles of various sensors used in robots will be explained in detail. The steps to be followed in robot vision will be discussed with some suitable examples. The principles of motion planning algorithms will be explained in detail. Thus, this course will deal with all the issues related to kinematics, dynamics, control schemes and robot intelligence.

ABOUT INSTRUCTOR :

He obtained his Ph.D. from IIT Kanpur, India in 2000. He received University Gold Medal, A.M. Das Memorial Medal, Institution of Engineers' (I) Medal, and others. He completed his post-doctoral studies in Japan and then, in Germany under the Alexander von Humboldt Fellowship Programme. He is working now as a Professor (HAG scale) of IIT Kharagpur, India. He has guided 23 Ph.D.s. I am in editorial board of a few International Journals. I have been elected as FIE, MASME and SMIEEE. I have completed a few sponsored (funded by DST, DAE, MHRD) and consultancy projects. I have filed two patents.

COURSE PLAN :

Week 01 : Introduction to Robots and Robotics
Week 02 : Introduction to Robots and Robotics (contd.); Robot Kinematics
Week 03 : Robot Kinematics (contd.);
Week 04 : Robot Kinematics; Trajectory Planning
Week 05 : Robot Dynamics
Week 06 : Control Scheme; Sensors; Robot Vision
Week 07 : Robot Vision; Robot Motion Planning
Week 08 : Intelligent Robot; Biped Walking; Summary

FOUNDATION OF COMPUTATIONAL FLUID DYNAMICS

PROF. VENGADESAN
Department of Mechanical Engineering
IIT Madras

TYPE OF COURSE : Rerun I Elective I UG
COURSE DURATION : 8 weeks (26 Jul' 21 - 17 Sep' 21)
EXAM DATE : 26 Sep 2021

COURSE OUTLINE :

This is an introductory course in CFD. In this course, students will be exposed to basics of CFD. Students will gain knowledge on FD/ FV strategy, formulation of the problem and solution techniques. Students at the end of the course will get to experience a simple and sample working CFD code and thus develop confidence.

ABOUT INSTRUCTOR :
Prof. Vengadesan did B.E (Hons.) in Mechanical Engineering from NITT, MS (by Research) from IITM and PhD from Kobe University, Japan. He has been teaching various UG and PG courses related to Fluid Mechanics at IITM since 2003. His areas of research interests are CFD, Turbulent flows and modeling, Application of these techniques for different theoretical and industry problems, insect aerodynamics and biofluid dynamics. He had so far guided 3 PhD and 13 MS and currently guiding 5 PhD and 5 MS.

COURSE PLAN :

Week 1: Introduction,Review of basic fluid mechanics,Review of equations and importance of terms,Review of equations (contd.) and non-dimensionalization,Vorticity-Stream function equation, classification of equation and the solution nature, Classification of equations (contd.), types of boundary conditions and description about standard test cases.

Week 2: Steps involved in CFD, Information about Computational domain and grid with illustration

Week 3: Different Approximation Methods

Week 4: FV formulation for diffusion equation 1D

Week 5: Illustration on the performance by different approximation for convection terms

Week 6: Introduction to Turbulent flows

Week 7: Matrix inversion Direct, Iterative procedure

Week 8: Demonstration of a test case with a display of working CFD code and details

ADVANCES IN WELDING AND JOINING TECHNOLOGIES

DR. SWARUP BAG
Department of Mechanical Engineering
IIT Guwahati

TYPE OF COURSE : Rerun I Elective I UG/PG
COURSE DURATION : 8 weeks (26 Jul' 21 - 17 Sep' 21)
EXAM DATE : 26 Sep 2021

PRE-REQUISITES : There are no pre-requisites in educational qualification.

INTENDED AUDIENCE : Bachelor/Master/PhD students having background in Mechanical/Material Science/Metallurgical engineering/ Production Engineering/Manufacturing Technology

INDUSTRIES APPLICABLE TO : No industry support is required

COURSE OUTLINE :

The progress of several welding and joining processes is ever increasing with the development of new materials and their application in modern technologies. The microjoining and nanojoining is even more challenging area with the development of miniature components. This course is primarily designed from fundamental understanding to the most recent advances in welding and joining technologies. The syllabus is oriented to the advancement of the joining technologies which is different from conventional welding and joining processes. The modules cover almost all the direction of joining technologies and it is blended with fundamental development to the recent technologies. Audience will be able to develop fundamental understanding on different perspective and recent development in this field through the lectures and reinforce their knowledge by solving assignments. This course is presented in a lucid and simplified way to make it enjoyable to the beginners.

ABOUT INSTRUCTOR :

Prof. Swarup Bag is currently working as an Associate Professor in the Department of Mechanical Engineering, Indian Institute of Technology Guwahati PhD: Mechanical Engineering (Manufacturing Science): IIT Bombay, Mumbai, India (2006 2009). ME: Mechanical Engineering (Production Engineering): Indian Institute of Engineering Science and Technology, Shibpur, WB, India (2000 2002). BE: Mechanical Engineering: Jalpaiguri Govt. Engg. College, Jalpaiguri, WB, India (1996 2000).

COURSE PLAN :

Week 1**:** Fundamentals of welding and joining

Week 2**:** Laser and electron beam welding

Week 3**:** Solid state welding processes

Week 4**:** Computational welding mechanics

Week 5**:** Microjoining and nanojoining

Week 6**:** Welding metallurgy

Week 7**:** Welding and joining of non-metals

Week 8**:** Metal transfer in welding and metal printing

INTRODUCTION TO MECHANICAL VIBRATION

PROF. ANIL KUMAR
Department of Mechanical Engineering
IIT Roorkee

TYPE OF COURSE : Rerun I Elective I UG
COURSE DURATION : 8 weeks (26 Jul' 21 - 17 Sep' 21)
EXAM DATE : 26 Sep 2021

PRE-REQUISITES : Completed first year of BE/BTech

INTENDED AUDIENCE : It is a Elective Course for UG students of Mechanical, Production, Automobile, Aerospace, Civil Engineering and equivalent.

COURSE OUTLINE :
Vibration is a common phenomenon occurring in a mechanical system. For example, vibration of a rotor due to unbalanced mass, vibration of a vehicle engine at varying speed. The study of a dedicated course is required to understand the fundamental and advance concepts of mechanical vibrations for engineers and designers. This course is of basic level. It introduces fundamentals of vibration, vibration of single Degree of Freedom (DoF) system, 2-DoF and multi-DoF systems, continuous systems such as bars and beams, and whirling of shafts.

ABOUT INSTRUCTOR :
Dr Anil Kumar works as an Assistant Professor faculty in the Department of Mechanical and Industrial Engineering at IIT Roorkee for more than three years. He teaches subjects like, Automatic Control, Machine Design, Vibrations and Noise, etc. to UG students. His research area belongs to semi-active rail suspension, modal identification of structures, testing of piping joints, pedestrian-structure interaction modelling.

COURSE PLAN :

Week 1: Fundamental of Vibrations

Week 2: Free Vibration of Single Degree of Freedom Systems

Week 3: Forced Vibration of Single Degree of Freedom Systems

Week 4: Forced Vibration of Single Degree of Freedom Systems.

Week 5: Vibration Measuring Instruments.

Week 6: Vibration of Two Degree of Freedom Systems.

Week 7: Vibration Absorbers and Critical Speed of Shafts.

Week 8: Vibration of Multi Degree of Freedom Systems.

REFRIGERATION AND AIR-CONDITIONING

PROF. RAVI KUMAR
Department of Mechanical and Industrial Engineering IIT Roorkee

TYPE OF COURSE : Rerun | Core | UG
COURSE DURATION : 8 weeks (26 Jul' 21 - 17 Sep' 21)
EXAM DATE : 26 Sep 2021

INTENDED AUDIENCE : UG & PG students of Mechanical & Civil Eng. and Architecture students
INDUSTRIES APPLICABLE TO : All HVAC Industries

COURSE OUTLINE :
This course provides a simple understanding of Refrigeration and Air-conditioning fundamentals. Ideally suited to those with a little or no knowledge of the subject. The course consists of different refrigeration cycles and understanding of psychrometry and psychrometric processes used for the purpose of air-conditioning. Further, the comfort air-conditioning and indoor environment health are also addressed in this course.

ABOUT INSTRUCTOR :
Dr. Ravi Kumar is a Professor in the Department of Mechanical & Industrial Engineering, Indian Institute of Technology Roorkee. He has been teaching thermal engineering courses in the Department and is actively involved in the research related with Solar Energy. He is a member of ASME, ASHRAE and IIFIIR.

COURSE PLAN :

Week 01 : Recapitulation of Thermodynamics, Introduction to Refrigeration, Air Refrigeration Cycle, Aircraft Refrigeration Cycles.

Week 02 : Aircraft Refrigeration Cycles, Vapour Compression Cycle, P-h Charts, Actual Vapour Compression Cycle.

Week 03 : Actual Vapour Compression Cycle, Compound Compression with Intercooling, Multiple Evaporator and Cascade System, Problem Solving.

Week 04 : Refrigerants, Vapour Absorption Systems.

Week 05 : Introduction to Air-conditioning, Properties of Moist Air, Psychrometric Chart, Psychrometric Processes.

Week 06 : Psychrometric Processes, Infiltration Design Conditions, Cooling Load.

Week 07 : Cooling Load, Air Distribution System, Problem Solving, Air-Conditioning Systems.

Week 08 : Human Physiology, Thermal Comfort, Indoor Environmental Health, Problem Solving.

POWER PLANT ENGINEERING

PROF. RAVI KUMAR
Department of Mechancial Engineering
IIT Roorkee

TYPE OF COURSE : Rerun I Core I UG
COURSE DURATION : 8 weeks (26 Jul' 21 - 17 Sep' 21)
EXAM DATE : 26 Sep 2021

INTENDED AUDIENCE : UG students of Mechanical Engineering
INDUSTRIES APPLICABLE TO : All power plant industries

COURSE OUTLINE :
This course provides a simple understanding of the power plant engineering. The course contains the details of steam and gas thermal power plants, hydro power plants, nuclear power plants, along with solar, wind and geothermal energy power systems in addition to the direct energy conversion. The economics of power generation and the environmental aspect of power generation are also being addressed in this course.

ABOUT INSTRUCTOR :
Dr. Ravi Kumar is a Professor in the Department of Mechanical & Industrial Engineering, Indian Institute of Technology Roorkee. He has been teaching thermal engineering courses in the Department and is actively involved in the research related with Solar Energy. He is a member of ASME, ASHRAE and IIFIIR.

COURSE PLAN :

Week 1: The energy scenario, steam power plants, fuel handling, ash handling, chimney draught

Week 2: Fossil fuel steam generators, high pressure boilers, performance of boilers, fuels and combustion, steam turbines

Week 3: Impulse turbines, reaction turbines, feed water treatment, steam condensers, problem solving

Week 4: Condensate feed water system, circulating water system, gas turbine cycles, combined cycles, hydro-electric, power plants

Week 5: Classification of hydro-plants , hydraulic turbines, hydro plant controls, problem solving

Week 6: Principles of nuclear energy, thermal fission reactors and Power Plants, Fast breeder reactors, solar energy, solar thermal energy

Week 7: Solar thermal energy, direct energy conversion, wind energy, geothermal energy, energy from oceans

Week 8: Energy storage, economics of power generation, environmental aspect of power generation, problem solving

PRINCIPLES OF METAL FORMING TECHNOLOGY

PROF. PRADEEP KUMAR JHA
Dept. of Mechanical and Industrial Engineering
IIT Roorkee

TYPE OF COURSE : Rerun | Core | UG/PG
COURSE DURATION : 8 weeks (26 Jul' 21 - 17 Sep' 21)
EXAM DATE : 26 Sep 2021

INTENDED AUDIENCE : Any interested Learners
PRE-REQUISITES : Introduction to manufacturing technology or manufacturing processes.
INDUSTRIES APPLICABLE TO : Manufacturing Industries where forming takes place, for example SAIL, BHEL, Foundry and Forge industries like HEC, Bharat Forge etc.

COURSE OUTLINE :

The course focuses on understanding the science and technology of different forming processes. Most of the metallic objects undergo at least one of the metal forming operations, except the cast ones. Understanding basic principles of metal forming and further being applied by engineers and metallurgists directly contribute towards improvement in production in the industries. The concept of stress, deformation and failure, mechanics of metalworking and analysis of different metal working processes will be covered during the whole course. Introduction and working principle of powder metallurgy forging will be presented in the end. The course will enable the students be conversant with working principles so that they can use the knowledge gained towards increasing the productivity of manufacturing industries in the long run.

ABOUT INSTRUCTOR :

Dr. Pradeep K. Jha is presently working as Associate Professor in the Department of Mechanical & Industrial Engineering at IIT Roorkee. He has been teaching the courses related to manufacturing technology and theory of production processes to undergraduate and postgraduate students for more than 12 years. He is actively involved in research work related to production processes, tundish steelmaking process, mold solidification in continuous casting

COURSE PLAN :

Week 01 : Introduction and classification of metalworking processes, Behavior of materials
Week 02 : Concept of stress and strain, Hydrostatic and deviatoric stresses
Week 03 : Flow curve Yield criteria for ductile materials, plastic stress strain relationships
Week 04 : Yielding and ductility during instability, Effect of strain rate and temperature on flow properties
Week 05 : mechanics of metalworking, Analysis methods, Hot and cold working
Week 06 : Introduction, classification and analysis of forging and rolling operations
Week 07 : Defects in rolled and forged components, Analysis of extrusion process
Week 08 : Classification and analysis of wire and tube drawing and sheetmetal working, Powder metallurgy forming

STEAM POWER ENGINEERING

PROF.VINAYAK N. KULKARNI
Department of Mechanical Engineering
IIT Guwahati

TYPE OF COURSE : Rerun I Core I UG
COURSE DURATION : 8 weeks (26 Jul' 21 - 17 Sep' 21)
EXAM DATE : 26 Sep 2021

PRE-REQUISITES : Basic UG-level Thermodynamics

INTENDED AUDIENCE : Undergraduate students of Mechanical Engineering Industry personnel associated from Thermal power plant; Faculty members associatedwith Mechanical /Chemical/ Automobile Engineering.

COURSE OUTLINE :
This course deals with steam power plants. One part of the course is about Simple steam power cycle, reheat, regeneration and superheating. Further actual cycle with component efficiencies would also be discussed. Then each component of the plant is discussed in detail. Initially, types of steam generators and their parts are highlighted. Then steam turbine, its type, efficiency and arrangements are focused. Thus this course would provide an understanding on electricity generation or transportation application using steam as working medium.

ABOUT INSTRUCTOR :
Prof. Vinayak N. Kulkarni is an Associate Professor in the Department of Mechanical Engineering of Indian Institute of Technology, Guwahati since January 2015. He completed his undergraduate studies in Mechanical Engineering from the Shivaji University, Maharashtra, India. His post graduation and PhD is from Aerospace Engineering Department of Indian Institute of Science Bangalore. His teaching interests are Basic and Applied thermodynamics, Gas Dynamics, Aircraft propulsion and fluid mechanics. His research interests are Experimental and computational compressible flows, IC engines and non-conventional energy.

COURSE PLAN :

Week 1: Vapour Power Cycles: Carnot cycle, Rankine cycle, reheat cycle

Week 2: Vapour Power Cycles: Regenerative cycle, steam cycles for nuclear power plant, back-pressure and extraction turbines and cogeneration

Week 3: Vapour Power Cycles: Low temperature power cycles, ideal working fluid and binary/multi-fluid cycles

Week 4: Steam Generator: Subcritical and supercritical boilers, fluidized bed boilers, fire-tube and watertube boilers, mountings and accessories

Week 5: Steam Turbine: Impulse and reaction stage, degree of reaction, velocity triangle,

Week 6: Steam Turbine: efficiencies Velocity and pressure compounding,

Week 7: Steam Turbine: Reheat factor and nozzles

Week 8: Cooling Tower: Hygrometry and psychrometric chart

BASICS OF FINITE ELEMENT ANALYSIS - I

PROF. NACHIKETA TIWARI
Department of Mechanical Engineering
IIT Kanpur

TYPE OF COURSE : Rerun I Elective I UG I PG
COURSE DURATION : 8 weeks (26 July' 21 - 17 Sep' 21)
EXAM DATE : 26 Sep 2021

PRE-REQUISITES : Must be enrolled into a B. Tech. program or equivalent and should have completed second year of his 4-year program

INTENDED AUDIENCE :UGs, PGs, professionals in industry who want to learn about basics of sound and acoustics

INDUSTRIES APPLICABLE TO : Automotive, NVH, Acoustics, Railways, Power Generation and all industry that has to address issus related to noise.

COURSE OUTLINE :
This course is intended for all those who want to learn FEA from an application standpoint. Currently, many users of FEA have limited understanding of theoretical foundation of this powerful method. The consequence is that quite often they use commercial codes inaccurately, and do not realize that their results may be flawed. The course is intended to address this limitation by making the student aware of the underlying mathematics in easy to understand format. The course is open to all engineering students who have at the minimum successfully completed two years of their B. Tech (or equivalent) degrees.The course is also open to all professionals in industry who wish to learn fundamentals of FEA in a semi-formal but structured setting, and plan to use this knowledge in their workplace.

ABOUT INSTRUCTOR :
Prof. Nachiketa Tiwari is an Associate Professor of Mechanical Engineering at IIT Kanpur. He has a PhD in engineering mechanics from Virginia Tech. His doctoral thesis involved nonlinear analysis of composite structures through FE, analytical and experimental methods. Dr. Tiwari also has deep understanding of fundamentals of FEA as he has used several tools in industry for over a dozen years for producing world class products. His current areas of research interest are composite structures, noise, vibrations, and product design. He has established Dhwani, an Acoustics Lab at IITK, which is one of the best in the country.

COURSE PLAN :

Week 1 : Intro & concepts

Week 2 : Mathematical concepts

Week 3 : 1-D BVP problems of 2nd order

Week 4 : Applications: heat transfer/solid mechanics

Week 5 : Beams

Week 6 : Errors & convergence

Week 7 : Time dependent problems

Week 8 : Eigen value problems and closure


FLUID DYNAMICS AND TURBOMACHINES

PROF. DHIMAN CHATTERJEE
PROF. SHAMIT BAKSHI
Department of Mechanical Engineering
IIT Madras

TYPE OF COURSE : Rerun I Elective IUG I PG
COURSE DURATION : 8 weeks (26 Jul' 21 - 17 Sep' 21)
EXAM DATE : 26 Sep 2021

PRE-REQUISITES : 1. Basic Engineering Mathematics 2. Engineering Mechanics 3. Basic Engineering Thermodynamics

INTENDED AUDIENCE : 1. Undergraduate students 2. Practicing engineers (refresher course)

INDUSTRIES APPLICABLE TO : Pump and turbine industry

COURSE OUTLINE :
The first part of the course introduces important concepts of fluid dynamics which forms the theoretical foundation for the second portion of the course on turbomachines. The course is intended for advanced B. Tech/B. E. students as well as a refresher course for practicing engineers working in the field of pump and turbine industries.

ABOUT INSTRUCTOR :
Prof. Dhiman Chatterjee is currently an Associate Professor in the department of Mechanical Engineering, IIT Madras. He teaches Incompressible Fluid Flow and Turbomachines. His research specialization includes turbomachines and cavitation.

Prof. Shamit Bakshi is currently an Associate Professor in the department of Mechanical Engineering, IIT Madras. He teaches Incompressible Fluid Flow and IC Engines. His research specialization includes droplet/spray processes and I.C. Engine flows.

COURSE PLAN :

Week 1**:** Introduction to fluid flows

Week 2**:** Integral approach for analyzing fluid flow

Week 3**:** Differential approach for analyzing fluid flow

Week 4**:** Incompressible viscous internal and external flow

Week 5**:** Introduction to turbomachines

Week 6**:** Principle of turbomachines

Week 7**:** Performance of pump and hydraulic turbine

Week 8**:** Performance of steam and gas turbine

FLUID MACHINES

PROF. SUMAN CHAKRABORTY
Dept. of Mechanical Engineering
IIT Kharagpur

TYPE OF COURSE : Rerun | Core | UG
COURSE DURATION : 8 weeks (23 Aug'21 - 15 Oct'21)
EXAM DATE : 23 Oct 2021

PRE-REQUISITES : Basic knowledge of Fluid Mechanics
INDUSTRY SUPPORT : G.E., I.O.C.L, G.A.I.L., O.N.G.C, Shell

INTENDED AUDIENCE : Any interested Learners

COURSE OUTLINE

This is an introductory course in Fluid Machines. The subject Fluid Machines has a wide scope and is of prime importance in almost all fields of engineering. The course emphasizes the basic underlying fluid mechanical principles governing energy transfer in a fluid machine and also description of the different kinds of hydraulic and air machines along with their performances. There is a well balanced coverage of physical concepts, mathematical operations along with examples and exercise problems of practical importance. After completion of the course, the students will have a strong foundation on Fluid Machines and will be able to apply the basic principles, the laws, and the pertinent equations to engineering design of the machines for required applications.

ABOUT INSTRUCTOR

Dr. Suman Chakraborty is currently a Prof essor in the MechanicalEngineering Department as well as an Institute Chair Professor of theIndian Institute of Technology Kharagpur, India, and the Head of th eSchool of Medical Science and Technology. He is also the AssociateDean for Sponsored Research and Industrial Consultancy. His cu rrentareas of research include microflu idics, nanofluidics, micro-nano scaletransport, with particular focus o n biomedical applications. He has beenawarded the Santi Swaroop Bhatnagar Prize in the year 2013, which isthe highest Scientific Award from the Government of India. He has beenelected as a Fellow of the American Physical Society, Fellow of the RoyalSociety of Chemistry, Fellow of ASME, Fellow of all the Indian NationalAcademies of Science and Engineering, recipient of the Indo-USResearch Fellowship, Scopus Young S cientist Award for high citation ofhis research in scientific/ technical Journals, and Young Scientist/ YoungEngineer Awards from various National Academies of Science and Engineering

COURSE PLAN

Week 1 : Introduction and basic principles

Week 2 : Hydraulic Impulse Turbine

Week 3 : Hydraulic Reaction Turbine Part I

Week 4 : Hydraulic Reaction Turbine Part II and Hydraulic Pump Part I

Week 5 : Hydraulic Pump Part II

Week 6 : Hydraulic Pump Part III

Week 7 : Air Compressor Part I

Week 8 : Air Compressor Part II

WELDING APPLICATION TECHNOLOGY

PROF. PANKAJ BISWAS
Department of Mechanical Engineering
IIT Guhawati

TYPE OF COURSE : New I Core I UG/PG
COURSE DURATION : 8 Weeks (23-Aug' 21 - 15-Oct' 21)
EXAM DATE : 23 Oct 2021

INTENDED AUDIENCE : Students (UG and PG); Participant from any manufacturing industry

PREREQUISITES : BE/BTECH IN MECHANICAL/PRODUCTION/ MANUFACTURING SCIENCES/POWER PLANNT ENGG/ NAVAL AND ARCITUCTURE ENGG

COURSE OUTLINE : The name of the course is Welding Application Technology. As the name implies in this course I will try to cover the fundamental overview of the traditional/ industrial welding technology especially those welding processes which are widely used in manufacturing industries. I will also try to cover the detail concepts of design and analysis of welding joints, heat treatment and weld induced residual stresses & distortions and its measurement. This will help the participants to understand and apply this knowledge of welding in practice for various industrial applications. It will also encourage academic participants to increase the research interest in the field of welding. In this present course the primary focus is on basic fundamental of welding and its importance in industries.

The brief overview of the course content can be stated like; this course will cover the industrial relevance of welding processes. It will give the fundamental knowledge of various important welding processes which includes most of the important fusion welding, solid state welding (i.e. Friction Welding, FSW etc.) and solid-liquid state welding (i.e. Shouldering and Brazing). It will also cover the importance and applications of all these welding techniques. This course will highlight the safety precautions to be followed in different welding techniques.

ABOUT INSTRUCTOR :

I, Dr. Pankaj Biswas, am a Professor in the Dept. of Mechanical Engineering, IIT Guwahati. I am working in the area of welding technology and forming by line heating for the past 15 years. My areas of research are on computational weld mechanics, similar and dissimilar friction stir welding, friction stir welding of steel, hybrid welding technology, Finite Element analysis of weld induced distortion and residual stresses, Analysis of large welding structure, forming by line heating and modelling of welding processes using soft computing techniques. I guided 02 PDF, 7 PhD scholars in the area of welding. Currently I am guiding 01 PDF and 7 PhD students in the welding and line heating areas. I already published about 75 journal articles, 70 conference proceedings, 22 book chapters and 3 patents. I worked in ten sponsored / consultancy projects. I got IEI Young Engineers Award 2013- 2014' in Mechanical Engineering discipline.

COURSE PLAN :

Week 1: Basics of welding residual stresses & distortions and its mitigation
Week 2: Measurement & analysis of welding residual stresses and distortions
Week 3: Measurement of welding residual stresses and distortions
Week 4: Different type of welding methods and its details (PAW,FCAW, RSW)
Week 5: Different type of welding methods and its details (RW, Thermit, FSW)
Week 6: Different type of welding methods & its details (Brazing, Soldering)
Week 7: Design & analysis of butt and fillet welds joints
Week 8: Design & analysis of weld joints for different static loading conditions

MECHANICS AND CONTROL OF ROBOTIC MANIPULATORS

PROF. SANTHAKUMAR MOHAN
Department of Mechanical Engineering
IIT Palakkad

TYPE OF COURSE : New I Elective I UG/PG
COURSE DURATION : 8 Weeks (23-Aug'21-15-Oct'21)
EXAM DATE : 23 Oct 2021

INTENDED AUDIENCE : Undergraduate/graduate students interested in robotics and manipulators
INDUSTRIES APPLICABLE TO : Most of the robotic and service oriented industries will recognize and give a value to this course

COURSE OUTLINE :
Learn algorithmic approaches, mathematical models, and computational and motion control methods applicable to robotic manipulator systems; Recognize and analyze the basic mechanical and electrical systems concerning robots; Analyze and design the basic robotic systems; Implement and investigate the performance of various control techniques to the robotic manipulators

ABOUT INSTRUCTOR :

Dr. Santhakumar Mohan is an Associate professor in the department of Mechanical Engineering, Indian Institute of Technology Palakkad. He has more than 10 years of professional experience in teaching and research. He has been teaching the course on Wheeled mobile robots (shortly mobile robotics) for the last 7 years for both undergraduate and postgraduate students. He is active in the design and development of mobile robots for field applications and has 4 patents filed in India. For more details please visit the webpage(https://iitpkd.ac.in/people/santhakumar).

COURSE PLAN :

Week 1: Introduction: Effector: locomotion, and manipulation. Serial and parallel manipulators. Descriptions, Transformations and homogeneous transformation matrix.

Week 2: Manipulator (serial manipulator) kinematics: Kinematic parameters, different notations, Denavit-Hartenberg (DH) representation, arm matrix. Forward and inverse kinematics. Analytical and numerical solutions. Examples

Week 3: Differential kinematics: Differential (velocity) kinematics, velocity propagation, forward differential kinematics and inverse differential kinematics.

Week 4: Jacobian matrix and Manipulator statics: Mapping between configuration-space to operational-space. Jacobian matrix and Pseudo inverse concepts.Introduction to workspace singularities.Manipulator statics: Conservation of energy or power, the mapping between operation-space to configuration-space inputs examples

Week 5: Manipulator dynamics: Motion dynamics: Forward and inverse dynamics. Lagrangian (Lagrange-Euler) and Newton-Euler formulations. Examples

Week 6: Dynamic simulation: Dynamic modeling of robotic manipulators and computer-based numerical simulations.

Week 7: Trajectory generation: Path and Trajectory. Configuration (joint) space trajectory and operational (task) space trajectory generations.

Week 8: Control of robotic manipulators: Joint space and task-space control schemes.

JOINING TECHNOLOGIES FOR METALS

PROF. D . K . DWIVEDI
Department of Mechanical & Industrial Engineering
IIT Roorkee

TYPE OF COURSE : Rerun | Core | UG
COURSE DURATION : 8 weeks (23 Aug'21 - 15 Oct'21)
EXAM DATE : 24 Oct 2021

INTENDED AUDIENCE : It is a core course for UG/PG students, practicing engineers.

COURSE OUTLINE :

It is proposed to include following joining technologies of commercial importance under different groups of processes. Fundamentals of Metal Joining Technologies: mechanisms for obtaining metallic continuity: fusion, deformation, diffusion, chemical interactions. Fusion based processes: principle of fusion welding processes, oxy-fuel has welding, common arc welding processes, laser beam welding, spot welding processes, newer variants of fusion welding processes.Solid-liquid joining processes: brazing and soldering, braze welding, cold metal transfer welding,Solid state joining processes: diffusion bonding, ultrasonic welding and explosive welding.

ABOUT INSTRUCTOR :

Prof. D. K. Dwivedi Department of Mechanical & Industrial Engineering , Indian Institute of Technology Roorkee obtained BE (mechanical engineering) , in 1993 from GEC Rewa, ME (welding engineering) Univ. of Roorkee in 1997 and PhD in Met. Engineering from MNIT, Jaipur in 2003. He has about 9 years teaching experience at NIT Hamirpur and 12 years at IIT Roorkee of subjects related with manufacturing at UG level and welding engineering related subjects at PG level. He has published more than 95 research papers in SCI/SCIE indexed journals and undertaken 16 sponsored research and 48 industrial consultancy projects. Instructor has authored one book entitled "Production and Properties of Cast Al-Si Alloys with New Age International, New Delhi (2013).

COURSE PLAN :

Week 1: Introduction: Manufacturing and Joining Fundamental Mechanisms of joining, heat and pressure in joining Classification of joining processes,Heat generation and power density concept in welding Protection of the weld metal approaches, effect of gases on weld properties

Week 2: Principle of fusion welding processes, oxy-fuel gas welding Fundamentals of welding: type of weld, types of joint, welding position, arc heat generation Physics of welding arc: arc initiation, maintenance, shielded metal arc welding Electrode melting rate, effect of electrode polarity and welding parameters Gas tungsten arc welding: electrode, shielding gases, Introduction of gas metal arc welding

Week 3: Variants of Gas tungsten arc welding: GTAW, Hot wire GTAW, Flux assisted GTAW Variants of Gas metal arc welding: Pulse GMAW, CMT welding
Submerged arc welding Electro-slag and Electro-gas welding processes Laser beam welding

Week 4: Brazing Soldering and Braze welding, Fundamentals of resistance welding Resistance welding processes: spot, seam welding Flash butt welding

Week 5: Adhesive joining, Welding bonding, Solid state joining technologies: Fundamentals Ultrasonic joining, Diffusion bonding

Week 6: Explosive welding, Magnetic pulse welding, Weld thermal cycle, Heat affected zone and weld thermal cycle: I, Heat affected zone and weld thermal cycle: II

Week 7: Solidification of weld metal, Fundamentals of weldability of metals, Weldability of carbon & alloy steels: Fe-C, CCT, Weldability of stainless steels: schaeffler diagram, Metallurgical transformation in weld and heat affected zone of steels

Week 8: Weldability of aluminium alloys: porosity, HAZ softening, PMZ issues, Solidification cracking and their control, Residual stresses in weld joints: effect on joint performance, and control of residual stress, Cracking of welded joints: solidification and liquation cracks, Cracking of welded joint: cold cracking

ADVANCED MACHINING PROCESSES

PROF. MANAS DAS
Department of Mechanical Engineering
IITGuwahati

TYPE OF COURSE : Rerun I Elective I UG I PG
COURSE DURATION : 8 weeks (23 Aug' 21 - 15 Oct' 21)
EXAM DATE : 24 Oct 2021

INTENDED AUDIENCE : Intended for UG and PG students who plan to take up this subject as their future research area. Also, for practitionerin industries who want to implement new development ortechnologies in advanced machining to their factory.

INDUSTRIES APPLICABLE TO : Bharat Heavy Electricals Limited (BHEL), Hindustan Aeronautics Limited (HAL), Defense Research and Development Organization (DRDO), Die manufacturing industries, Automobile Industries, Machine Tool Industries, Precision medical equipment manufacturing industries, High precision optics and semiconductor industries

COURSE OUTLINE :

There is a need for machine tools and processes which can accurately and easily machine the most difficult-to-machine materials and workpieces with intricate and accurate shapes. In order to meet these challenges, a number of newer material removal processes have now been developed to the level of commercial utilization. These newer methods are also called unconventional in the sense that conventional tools are not employed for metal cutting. Instead, energy in its direct form is used to remove the material from the workpiece. This course aims at bringing the students up-to-date with the latest technological developments and research trends in the field of unconventional / nontraditional / modern machining processes.

ABOUT INSTRUCTOR :

Prof. Manas Das is an Assistant Professor in the Department of Mechanical Engineering, Indian Institute of Technology Guwahati, India since 2012. He received his Masters and Ph.D. degree from Mechanical engineering Department, IIT Kanpur. His research areas include Advanced Finishing and Nano-finishing Processes, Magnetorheological Finishing (MRF) Process, Advanced/Non-traditional Machining Processes, Micromachining processes. Dr. Das has published more than 20 papers in reputed journal and conferences. He has also written 2 book chapters in the area of surface finishing. Presently, he is supervising 5 Ph.D. students in the broad area of manufacturing.

COURSE PLAN :

Week 1: Introduction to advanced machining processes and their classification, Ultrasonic machining and its modelling and analysis

Week 2: Abrasive jet machining (AJM), Water jet cutting (WJC) and Abrasive water jet machining (AWJM), Magnetic abrasive finishing (MAF) and its modelling

Week 3: Abrasive flow finishing (AFF) and its modelling, Magnetorheological finishing (MRF)

Week 4: Magnetorheological abrasive flow finishing (MRAFF) and its modelling and analysis

Week 5: Electric discharge machining (EDM):Principle, applications, process parameters, and modelling. Electric Discharge Grinding (EDG),Electric Discharge Diamond Grinding (EDDG), and Wire Electric Discharge Machining (W EDM)

Week 6: Laser beam machining (LBM), Plasma arc machining (PAM), Electron Beam Machining (EBM)

Week 7: Electro chemical machining (ECM):Principle, applications, and process parameters and modelling

Week 8: Electrochemical Grinding (ECG),Electrostream Drilling (ESD),Shaped Tube Electrolytic Machining (STEM), Chemical machining (ChM)

DESIGN PRACTICE - II

PROF. SHANTANU BHATTACHARYA
Department of Mechanical Engineering
IIT Kanpur

TYPE OF COURSE : Rerun I Elective I UG/PG
COURSE DURATION : 8 weeks (23-Aug' 21 - 15-Oct' 21)
EXAM DATE : 24 Oct 2021

INTENDED AUDIENCE : Students of BE/ME/MS/BSc/MSc stream

INDUSTRIES APPLICABLE TO : SMIL (Gurgaon), HAL Kanpur and Lucknow, Small and medium scale production industries

COURSE OUTLINE :

The course is intended for beginners in post graduate studies in Design. It can also serve well for aspiring professionals in industry who will be willing to undertake careers in the field of design.

ABOUT INSTRUCTOR :

Prof. Shantanu Bhattacharya is currently as Associate Professor at the Department of Mechanical Engineering at the Indian Institute of technology Kanpur. Prior to joining the department he has been associated at a senior management level at Suzuki Motors and has over 6 years of experience in various production capacities and positions. Prof. Bhattacharya currently takes care of the 4-I laboratory at IIT Kanpur as its coordinator and has also been associated with the TA202 laboratory as coordinator between 2012-2015. Both these laboratories are very high end in terms of offering manufacturing training programs

COURSE PLAN :

Week 1 : Geometrical Transformations

Week 2 : 3-D shapes/ solid modelling

Week 3 : Micro-electro Mechanical Systems (MEMS)/ Sensors and actuators

Week 4 : Rapid Prototyping (3-D printing)/ Rapid tooling

Week 5 : Creating forms and their geometric transformation models

Week 6 : Strength and Stiffness of Structural Elements/ Mechanisms

Week 7 : Mechatronics/ Introduction to Control

Week 8 : Intelligent Product Design

BIOMECHANICS OF JOINTS AND ORTHOPAEDIC IMPLANTS

PROF. SANJAY GUPTA
Department of Mechanical Engineering
IIT KGP

TYPE OF COURSE : New I Elective I UG/PG
COURSE DURATION : 8 Weeks (23 Aug 21-15 Oct 21)
EXAM DATE : 24Oct 2021

PRE-REQUISITES : Engineering Mechanics, Solid Mechanics

INTENDED AUDIENCE : B.Tech / M.Tech / PhD students of Mechanical, Civil, Engineering Design, Biomedical Engineering and Medical students (with special interest)

INDUSTRIES APPLICABLE TO : Global Implant manufacturing companies like DePuy Johnson & Johnson, Zimmer, Stryker, Biomet, Smith & Nephew. Sports Authority of India and organizations requiring knowledge on Human Movement Science.

COURSE OUTLINE :

Biomechanics is a subject that seeks to understand the mechanics of living system. This subject helps to understand the relationship between structure and function of human joints, predict changes due to alterations, and propose methods of artificial interventions. This course is designed for B.Tech / M.Tech / PhD students who are likely to be benefited by learning the fundamental concepts of Biomechanics, joint kinetics and kinematics, tissue mechanics, implants design and analysis, as well as state-of-the-art techniques of modelling and simulation of biomechanical systems.

ABOUT INSTRUCTOR :

Professor Sanjay Gupta earned his Ph.D. degree from the Delft University of Technology, The Netherlands, in the year 2002 for his research on shoulder biomechanics. Subsequently, he worked as Senior Research Fellow in University of Southampton, UK and as Research Associate in Imperial College London, UK, where he was involved in a variety of research projects in Orthopaedic Biomechanics and Implant Design. His primary research areas are bone and joint mechanics, pre clinical analysis of implant design and tissue engineering. He completed his Bachelor's degree in Mechanical Engineering from Bengal Engineering College, University of Calcutta in 1989 and Masters degree in Mechanical Engineering from Jadavpur University, Calcutta in 1992. He has developed Biomechanics Laboratory in the department and has successfully completed sponsored research projects, funded by national and international agencies.

COURSE PLAN :

Week 1: Introduction Musculoskeletal system Bone, Muscle, Ligament, Tendon, Cartilage and Meniscus – structure and function Anatomy of Synovial Joints – Hip, Knee, Shoulder, Elbow

Week 2: Biomechanics of Human Joints: (a) Hip Joint; (b) Knee Joint; (c) Shoulder Joint; (d) Elbow Joint

Week 3: Biomechanics of Gait cycle Gait Analysis Measurement techniques 3-D Motion analysis system – markers, cameras and force platform Lower extremity – hip musculoskeletal forces

Week 4: Joint Kinematics Principle of Forward and Inverse Dynamics Calculations on joint forces and moments Calculations on muscle forces Model-based estimation of musculoskeletal forces during movements

Week 5: Concepts of Stresses and Strain Bone structure - Cancellous and Cortical Bone Mechanical Behaviour of Bone Adaptation and Viscoelasticity Bone Anisotropy.

Week 6: Biomechanics of Joint Replacement – Hip, Knee, Shoulder, Spine Cemented and Cementless fixation Failure mechanisms of implants Implant Design Considerations

Week 7: Biomechanical modelling techniques and analysis Finite Element Analysis of bone and implant Bone Remodelling – formulation, algorithm, simulation Experimental validation of numerical models

Week 8: Bone Fracture Healing Tissue Differentiation Mechanoregulatory principle Mechanobiology based simulation of bone ingrowth around implants – acetabular and femoral components

PRODUCT DESIGN AND DEVELOPMENT

PROF. INDERDEEP SINGH
Department of Mechanical Engineering
IIT Roorkee

TYPE OF COURSE: Rerun | Elective| UG/PG
COURSE DURATION : 4 weeks (26 Jul'21 - 20 Aug'21)
EXAM DATE : 26 Sep 2021

PRE - REQUISITES :No-prerequisite, any student enrolled for a UG/PG degree in any discipline of humanities, management, science and engineering can complete the course.

INDUSTRY SUPPORT : All industries where products are being conceptualized, designed and developed in order to satisfy the human needs and requirements.
INTENDED AUDIENCE: It is a core course for UG and PG

COURSE OUTLINE :

It has been established worldwide that the most successful economies are based on innovation and creativity led entrepreneurship. The government is focusing on putting concerted efforts to produce job creators. The current MOOC on Product Design and Development is conceptualized and planned in such a way that it helps both job creators as well as job seekers. The main objective of the course is to acquaint the learners/students with the practical knowledge regarding conceptualization, design and development of a new product.

ABOUT INSTRUCTOR :

Prof. Inderdeep Singh is currently working as Associate Professor in Department of Mechanical and Industrial Engineering at Indian Institute of Technology Roorkee. He has taught among others, the industrial engineering courses such as Production Planning and Control, Product Design and Development, Work System Design, Industrial Management and Quality Management. He has been actively involved in the National Mission Project on Education Through ICT (NME-ICT) of Government of India. He has completed three video and one web course under the National Programme on Technology Enhanced Learning (NPTEL). He has developed suitable pedagogical methods for two under-graduate courses of Mechanical Engineering.

COURSE PLAN :

Week 1 : Introduction to course, Product life-cycle, Product policy of an organization. Selection of a profitable product, Product design process, Product analysis.

Week 2 : Value engineering in product design; Advantages, Applications in product design, Problem identification and selection, Analysis of functions, Anatomy of function. Primary versus secondary versus tertiary/unnecessary functions, Functional analysis: Functional Analysis System Technique (FAST), Case studies.

Week 3 : Introduction to product design tools, QFD, Computer Aided Design, Robust design, DFX, DFM, DFA, Ergonomics in product design.

Week 4 : DFMA guidelines, Product design for manual assembly, Design guidelines for metallic and non-metallic products to be manufactured by different processes such as casting, machining, injection molding etc., Rapid prototyping, needs, advantages, working principle of SLA, LOM and SLS

FOUNDATIONS OF COGNITIVE ROBOTICS

PROF. BISHAKH BHATTACHARYA
Department of Mechanical Engineering
IIT Kanpur

TYPE OF COURSE : Rerun I Elective I PG
COURSE DURATION : 4 weeks (26 Jul' 21 - 20 Aug' 21)
EXAM DATE : 26 Sep 2021

INTENDED AUDIENCE : Students and industry experts

PREREQUISITES : School level science courses

INDUSTRIES APPLICABLE TO : Robotics Industry, Neuroscientists, Psychologists, Research scholars in the field of Social Robots

COURSE OUTLINE :

With the rapidly advancing process of inclusion of robots from Industry to the Social Arena, the functional requirement of the robots and corresponding human expectations have increased tremendously. However, in order to fully comprehend the complexities of such robot design, one needs to possess an over-all idea of the field. The objective of this course is to introduce students, researchers to this new field of robotics with the help of illustrative models, facts and relevant theories. The course has been designed by carefully maintaining a balance between biology, engineering and control system design so that it can attract a broad group of people interested in the interdisciplinary field.

ABOUT INSTRUCTOR :

Prof. Bishakh Bhattacharya is currently Professor at the Department of Mechanical Engineering and Head, Cognitive Science and Technology, IIT Kanpur. His research interest primarily lies in vibration control, structural health monitoring, energy harvesting system, intelligent system design, cognition and Child-Reconfigurable Robot Interaction. He is the coordinator of Space Technology Cell, IIT Kanpur and head of the SMSS (Smart Materials, Structures and Systems) Laboratory.

COURSE PLAN :

Week 1: Introduction
- Module 1: Introduction to Cognitive robotics and Human Robot Interaction
- Module 2: Smart materials-I
- Module 3: Smart materials-II
- Module 4: Smart materials-III

Week 2: Brain physiology and neural signal transmission
- Module 1: Architecture of the Brain
- Module 2: Architecture of the Brain (Contd.)
- Module 3: Nerve cells

Week 3: Neural modeling
- Module 1: Introduction to Synchronization Models
- Module 2: Synchronization Models (Contd.)
- Module 3: Electroencephalography (EEG)

Week 4: Intelligence architecture
- Module 1: Theories of Intelligence-I
- Module 2: Theories of Intelligence-II
- Module 3: Kuramoto Model
- Module 4: Child-Robot Interaction

PRINCIPLES OF VIBRATION CONTROL

PROF. BISHAKH BHATTACHARYA
Department of Mechanical Engineering
IIT Kanpur

TYPE OF COURSE : Rerun I Elective I PG I UG
COURSE DURATION : 4 weeks (26 Jul' 21 - 20 Aug' 21)
EXAM DATE : 26 Sep 2021

PRE-REQUISITES : Basics of Mechanical Vibrations

INTENDED AUDIENCE : B.Tech/M.Tech/PhD

INDUSTRIES APPLICABLE TO : Oil, Space, Manufacturing industries

COURSE OUTLINE :
Vibration is undesirable in most engineering systems. The adverse effects of vibration include fatigue failure, severe damages due to resonance, malfunctioning of sensitive instruments/systems, loss of accuracy of work-piece due to vibration of machine tools, etc. This course will give a brief overview about the various strategies to control such vibrations in systems and principle behind them.

ABOUT INSTRUCTOR :
Prof. Bishakh Bhattacharya is Professor at the Department of Mechanical Engineering and currently heading the Cognitive Science programme, IIT Kanpur. His research interest primarily lies in vibration control, structural health monitoring, energy harvesting system, intelligent system design and Child-Reconfigurable Robot Interaction.He is the coordinator of Space Technology Cell, IIT Kanpur and head of the SMSS (Smart Materials, Structures and Systems) Laboratory.

COURSE PLAN :

Week 1**:** Introduction to Vibration control

Week 2**:** Dynamic Properties and Selection of Materials

Week 3**:** Dynamic Vibration Absorbers

Week 4**:** Principles of Active Vibration Control

POLYMER ASSISTED ABRASIVE FINISHING PROCESSES

PROF. M. RAVI SANKAR
Department of Mechanical Engineering
IIT Guwahati

TYPE OF COURSE : Rerun I Elective I UG/PG
COURSE DURATION : 4 weeks (26-Jul' 21 - 20-Aug' 21)
EXAM DATE : 26 Sep 2021

INTENDED AUDIENCE : BE/B.Tech, ME/M.Tech, PHD (Mechanical Engineering, Production Engineering). Faculty who teaches manufacturing

INDUSTRIES APPLICABLE TO : Oil India Ltd., ONGC, TATA motors, ISRO, BARC, DRDL, NTPC, CMTI, CMERI, CGCRI, Grind Master, NRL

COURSE OUTLINE :

Micro and Nano finishing is one of the basic courses for the mechanical undergraduate students. This process comes under the subtractive manufacturing processes where in material is removed in micro to nano range. This course gives the basic understanding of the various polymer assisted abrasive micro to nano finishing processes and its physics. The mentioned syllabus is systematic order to understand gradually, what is the importance of surface finish, how the polymers supports the abrasive particles to finish the workpiece surface to nano level. This course mostly deals with abrasive flow finishing process where polymer rheological abrasive medium/fluids are used achieve nano surface roughness. This course also gives emphasis on polymer rheology and its effect on nano finishing. This course is systemically arranged and taught in smooth as well as clear way so that students understand easily.

ABOUT INSTRUCTOR :

Dr. Mamilla Ravi Sankar is currently an Assistant Professor in the Department of Mechanical Engineering, IIT Guwahati. He did his B.Tech from Sri Venkateswara University, Tirupati, and M.Tech as well as PhD from IIT Kanpur. His research group is focus on Sustainable Manufacturing, Eco-friendly Cutting fluids, Coatings, Advanced Manufacturing, Tribology and Rheology. MRS Lab also involves in development of lab scale Innovations to Commercial Manufacturing Products. He has published over 30 research articles in internationally reputed journals, 2 Patents, 2 Edited Books and 6 Book chapters. He is recipient of prestigious awards such as Institution of Engineers India (IEI) Young Engineers Award-2015 in Production Engineering, Indian Society for Advancement in Materials and Process Engineering (ISAMPE)-2011 and finalist of Indian National Academy of Engineering (INAE) Young Engineer Award-2014. Apart from academic awards, he is also received Institute Blues (Outstanding Sports Personality) of IIT Kanpur for the year 2009.

COURSE PLAN :

Week 1 : Introduction to Polymer Assisted Abrasive Finishing Processes, Importance of Mirco to Nano Finishing and Surface roughness representation, Finishing with polymer grinding wheels and polymer medium for vibratory bowl finishing

Week 2 : Polymer abrasive medium for vibratory bowl finishing and Pitch Polishing, Polymer Pad and Chemo-mechanical Polishing, Elastic Emission and Elasto Abrasive Finishing

Week 3 : Abrasive Flow Machining and Finishing, Polymer Rheological Abrasive Medium/ Fluids for Finishing: Rheology and Tribology, Active abrasive particles and finishing forces during finishing using Polymer assisted Abrasives

Week 4 : Advances in Abrasive Flow Finishing: DBGAFF, Spiral Polishing, CFAAFM, R-AFF, Micro AFF, Vibrations assisted AFF, Electro AFF process, Modeling of Polymer rheological abrasive medium for finishing, Finishing of Bio Implants: Knee implant, Hip implants.


RAC PRODUCT DESIGN

PROF. SANJEEV JAIN
Department of Mechanical Engineering
IIT Delhi

Prof. Bhupinder Godara
Department of Mechanical Engineering
IIT Delhi

TYPE OF COURSE : Rerun I Elective I UG/PG
COURSE DURATION : 4 weeks (26-Jul' 21 - 20-Aug' 21)
EXAM DATE : 26 Sep 2021

PRE-REQUISITES : Applied Thermodynamics and Basic Heat and Mass Transfer.

INTENDED AUDIENCE : Students pursuing BE/ME/Ph.D. in Mechanical Engg. and Design Engineers working in Industries.

INDUSTRIES APPLICABLE TO : Refrigeration and Air Conditioning Industries such as Carrier, Trane, LG, Samsung, Voltas, Blue star, Emerson, Danfoss etc.

COURSE OUTLINE :

This course will lead to an understanding of refrigeration and air-conditioning products, the components within these products, familiarity with selection parameters for the components and an appreciation of environmental impact of design choices. The course includes a case study to illustrate the process of design leading to a successful product in market.

ABOUT INSTRUCTOR :

Sanjeev Jain is a Professor of Mechanical Engineering at IIT Delhi, India. He worked in industry for a few years before joining IIT Delhi faculty in 1996. His research interest include Solar cooling, Building energy efficiency, natural refrigerants, decentralized energy systems,
recent interest in understanding of mind and cognition.

Bhupinder Godara graduated in Mechanical Engineering from IIT Delhi in 1987. He completed his M.Tech in Thermal Engineering in 1989 from IITD and has Industry experience of over 25 years in leading Refrigeration and AC companies like Carrier, Danfoss & Fedders Lloyd. He has managed several design programs from concept to market and the products designed successfully continue to meet customer needs in diverse applications like Railway Coaches, Residences, Commercial and Telecom.

COURSE PLAN :

Week 1: Introduction to the design process in general and for Ref. & AC in particular. Applied Thermodynamics as a design tool. Refrigerants and their properties, energy efficiency and environmental considerations, Practical aspects

Week 2: Ref. system Components & their types :- compressors, condensers, evaporators, expansion devices. Working principle of the components and unique features

Week 3: Selection of components for an intended design. Balancing the diversity of design objectives and optimization. Appreciation of the diverting in operating parameters in real applications and incorporation of controls and safety components

Week 4: Product design - New product launch – Performance testing, reliability, safety, Case studies etc.

METALLURGICAL & MATERIALS ENGINEERING

PHYSICS OF MATERIALS

PROF. PRATHAP HARIDOSS
Department of Metallurgical & Materials Engineering
IIT Madras

TYPE OF COURSE : Rerun | Elective | UG |PG
COURSE DURATION : 12 weeks (26 Jul' 21 - 15 Oct' 21)
EXAM DATE : 23 Oct 2021

PRE-REQUISITES : First Year under graduate level of physics and mathematics will be beneficial but is not absolutely necessary.

INTENDED AUDIENCE : Any interested Learners

COURSE OUTLINE

Materials display properties. What is the physics behind these properties? Starting from an electronic or atomic level, how can we arrive at the properties of the materials? These are the questions this course will attempt to answer. Focus will be on electronic properties, but other properties will also be looked at.

ABOUT INSTRUCTOR

Prof. Prathap Haridoss is a Professor in the Department of Metallurgical and Materials Engineering at IIT Madras. He works in the areas of Fuel Cell and Carbon nanomaterials. He has a B.Tech in Metallurgical Engineering from IIT Madras, and a PhD in Materials Science and Engineering from the University of Wisconsin-Madison, USA. Before he joined as a faculty at IIT Madras, he served as a Senior Scientist at Plug Power, a Fuel Cell company in New York. He has 3 US patents, several International Journal publications, and has published a book titled "Physics of Materials, Essential Concepts of Solid State Physics.

COURSE PLAN

Week 01 : Properties of materials, thermal expansion
Week 02 : DC and AC techniques to measure electronic conductivity, free electron gas,
Week 03 : Drude model for electronic conductivity and for thermal conductivity; Successes and Limitations of the Drude model –
Week 04 : The Wiedemann Franz Law; Statistical Mechanics, Maxwell-Boltzmann statistics; history of quantum mechanics; Drude
Week 05 : Sommerfeld model, Fermi-Dirac Statistics; Confinement and quantization; calculating density of available states for electrons;
Week 06 : Fermi Energy, Fermi Surface, Fermi Temperature; Reciprocal space ; Wigner seitz cells Brillouin zones;
Week 07 : Calculating allowed and forbidden energy levels; Description of tight binding approximation, impact of inter atomic spacing on band gaps.
Week 08 : Comparison of free electron approximation and tight binding approximation. Efect of pressure on band gaps;
Week 09 : Direct Band gap, indirect Band gap semiconductors; Magnetic properties; Electron compounds/ Hume Rothery phases.
Week 10 : Phonons, Optoelectronic properties;
Week 11 : Superconductivity, Bose-Einstein Statistics;
Week 12 : Physics of nano scale materials.

ADVANCED MATERIALS AND PROCESSES

PROF. JAYANTA DAS
Department of Metallurgical and Material Science
IIT Kharagpur

TYPE OF COURSE : Rerun | Elective | PG
COURSE DURATION : 12 weeks (26 Jul' 21 - 15 Oct' 21)
EXAM DATE : 23 Oct 2021

INTENDED AUDIENCE : Metallurgical & Materials Engineering; Materials Science; Physics
PRE-REQUISITES : Physical Metallurgy, Mechanical Metallurgy, Phase transformation, Solidification Processing

COURSE OUTLINE :

Introduction and classification of structural and functional materials; High Temperature Materials: Structure, Processing, mechanical behaviour and oxidation resistance of Stainless Steels, Ni- and Co- Based Superalloys, Aluminides and Silicides, Carbon-Carbon and Ceramic Composites; Shape-Memory Alloys: Mechanisms of One-way and Two-way Shape Memory Effect, Reverse Transformation, Thermoelasticity and Psuedoelasticity, Examples and Applications; Bulk Metallic Glass: Criteria for glass formation and stability, Examples and mechanical behaviour; Nano-materials: Classification, size effect on structural and functional properties, Processing and properties of nanocrystalline materials, thin films and multilayered coatings, single walled and multiwalled carbon nanotubes; Soft and hard magnetic materials for storage devices: Design and Processing; Piezoelectric Materials: Processing and Properties; Advanced Processes applied for Advanced Materials: Single Crystal Growth, Rapid Solidification, Inert Gas Condensation, Physical and Chemical Vapour Deposition of Thin Films

ABOUT INSTRUCTOR :

Dr. Jayanta Das is working as a faculty member since 2010 at IIT Kharagpur. His research activities have mainly encompassed the areas of alloy design, processing of bulk metallic glasses and their composites by rapid solidification and mechanical alloying, high entropy alloys and synthesis of bulk nanostructured alloys by cryo-rolling, their characterization, structure-property correlations, micromechanics of deformation of these advanced metastable alloys. Dr. Das has to his credit more than 120 research publications in peer-reviewed journals of international repute, which were cited more than 4000 times and has contributed 3 book chapters. He was the recipient of DAAD Fellowship in 2002, and Marie Curie Fellowship in 2004. He has been awarded Institute Silver Medal and Greaves Foseco Cash Prize of IIT Kharagpur in 2003, Young Scientist Award of German Society of Materials Research in 2006, Deutsche Bank Junior Award in 2009 (IFW Dresden, Germany), and IEI Young Engineers Award of Institution of Engineers India in 2012.

COURSE PLAN :

Week 01 : Introduction to metastable and functional alloys
Week 02 : Bulk Metallic glasses Part I: Fundamental concepts
Week 03 : Bulk Metallic glasses Part II: Mechanical and Functional properties
Week 04 : Shape memory alloys and Pseduelasticity
Week 05 : Shape memory alloys: Applications and case studies
Week 06 : Introduction to high temperature materials
Week 07 : Superalloys: Alloy design, Microstructure and Properties
Week 08 : Nano-materials Part I
Week 09 : Nano-materials Part II
Week 10 : Soft and hard magnetic materials
Week 11 : Non-equilibrium Processes, Single Crystal Growth, Rapid Solidification, Inert Gas Condensation
Week 12 : Advanced Functional Alloys


ENERGY CONSERVATION AND WASTE HEAT RECOVERY

PROF. PRASANTA KUMAR DAS
Department of Mechanical Engineering
IIT Kharagpur

PROF. ANANDAROOP BHATTACHARYA
Department of Mechanical Engineering
IIT Kharagpur

TYPE OF COURSE PRE-REQUISITES : Rerun | Elective | UG | PG
: Basic Thermodynamics

COURSE DURATION : 12 weeks (26 Jul' 21 - 15 Oct' 21)
EXAM DATE : 23 Oct 2021

INTENDED AUDIENCE : Energy Science and Engineering,Mechanical Engineering,Electrical Engineering students

INDUSTRIES APPLICABLE TO : BHEL, NTPC, CESC, WBSEB, DVC and other power companies, GE, Siemens, Alstom

COURSE OUTLINE :

Estimates from analyses and audits from various industries suggest that 20 to 50% of industrial energy input is lost as waste heat. This waste heat can be in the form of hot exhaust gases, water/fluid streams (from condensers in power plants) or heat lost from hot equipment and surfaces. As the world strives for higher energy efficiencies, it is imperative that along with better equipment we focus on recovering the energy stored in this "waste heat" and utilize it for useful purposes.The proposed course introduces us to various methods of Waste Heat Recovery that has been employed by the industry to harness the energy stored in waste heat and use it for generation of additional electric power.

ABOUT INSTRUCTOR :

Prof. Prasanta Kumar Das is a Professor of Mechanical Engineering and presently the Dean PG Studies and Research at IIT Kharagpur. His research interests lie in the broad area of thermal engineering with special emphasis on two phase flows. He possesses a vast experience in teaching and research.

Prof. Anandaroop Bhattacharya is an Associate Professor of Mechanical Engineering at IIT Kharagpur. His research interests lie in the areas of electronics cooling, transport in porous media and gas turbine heat transfer. Prior to joining IIT, Anandaroop spent 12 years in the industry in USA and India working at Intel, General Motors and General Electric Research Centers.

COURSE PLAN :

Week 01 : Introduction to Waste Heat, Importance of Waste Heat Recovery, Review of Thermodynamics – Introduction to First and Second Laws
Week 02 : Review of Thermodynamics – Entropy, Entropy Generation, First and Second Law efficiency
Week 03 : Power Plant Cycles - Energy Cascading, Rankine Cycle, modification of Rankine cycle, examples
Week 04 : Gas Turbine Cycle, Combined Cycle, Combined Gas Turbine-Steam Turbine Power Plant, Heat Recovery Steam Generators
Week 05 : Thermodynamic cycles for low temperature application, Cogenerations, Introduction to Heat Exchangers, Analysis – LMTD and ε-NTU method
Week 06 : Analysis of Heat Exchanger – continued, Problem solving, Special Heat Exchangers for Waste Heat Recovery, Synthesis of Heat Exchanger Network
Week 07 : Heat pipes & Vapor Chambers, Direct conversion technologies – Thermoelectric Generators.
Week 08 : Direct conversion technologies – Thermoelectric Generators (contd.), Thermoionic conversion, Thermo-PV, MHD
Week 09 : Heat Pump; Heat Recovery from Incinerators, Energy Storage – Introduction.
Week 10 : Energy Storage Techniques – Pumped hydro, Compressed Air, Flywheel, Superconducting Magnetic storage
Week 11 : Energy Storage Techniques – Thermal storage (Sensible & Latent), Battery, Chemical Energy Storage, Fuel cells.
Week 12 : Energy Economics

X-RAY CRYSTALLOGRAPHY & DIFFRACTION

PROF. RANJIT KUMAR RAY
PROF. S.SANKARAN
Department of Metallurgical and Materials Engineering IIEST Shibpur & IIT MADRAS

TYPE OF COURSE : Rerun I Core I UG
COURSE DURATION : 12 weeks (26 Jul' 21 - 15 Oct' 21)
EXAM DATE : 23 Oct 2021

INTENDED AUDIENCE : Undergraduate students of Metallurgical and Materials, Physics, Chemistry and biological sciences

INDUSTRIES APPLICABLE TO : All the Metallurgical and automotive industries will be interested in this course

COURSE OUTLINE :

The properties of any crystalline material are very much functions of its crystal structure and internal arrangement of atoms. X-ray diffraction is an elegant method to determine crystal structure and related parameters. This course provides a glimpse of how X-ray diffraction can be used to solve various crystallographic problems of both single and polycrystalline materials, starting from an elementary level.

ABOUT INSTRUCTOR :

Professor R. K. Ray is presently a Visiting Professor in the MN Dastur School of Materials Science and Engineering, IIEST Shibpur. Previously he was a Professor of Materials and Metallurgical Engineering in IIT Kanpur and a Visiting Scientist and Consultant in the R&D Division of Tata Steel Jamshedpur. His research interests are crystallographic textures of materials, advanced high strength steels, structure and properties of materials, etc.

Prof. S. Sankaran is currently a Professor in the Department of Metallurgical and Materials Engineering at Indian Institute of Technology Madras. His research interests are deformation processing of materials, mechanical behavior of materials and electron microscopy. He is also presently the faculty in-charge of central electron microscopy of IIT Madras.

COURSE PLAN:

Week 1: Geometry of Crystals
Week 2: Reciprocal Lattice, Stereographic Projection
Week 3: Point Groups and Space Groups
Week 4: Point Groups and Space Groups (Cont'd), Basics of X-Rays, Production and Detection of X-Rays
Week 5: Principles of X-Ray Diffraction, X-Ray Diffraction Methods, Debye Sherrer Camera, Diffractometer Measurements
Week 6: Intensity of Diffracted Beams
Week 7: Determination of Crystal structures, Precise Lattice Parameter Determination, XRD - Lab Demonstration
Week 8: Phase Diagram Determination, Ordered Disordered Transformation
Week 9: Qualitative Phase Analysis, Quantitative Phase Analysis 1, Precise Lattice Parameter Determination 1
Week 10: Chemical Analysis by X-Ray Flourescence, Chemical Analysis by X-Ray Absorption, Effect of Crystallite Size on Diffracted X-Ray Intensity
Week 11: Texture Determination by XRD, Particle Size Determination by XRD, Effect of Crystallite Size on Diffracted X-Ray Intensity
Week 12: Determination of Single Crystal Orientation by X-Rays, Stress Analysis by X-Rays, Factors Contributing to Peak Broadening, Residual Stress Measurement by X-Rays

ELECTROCHEMICAL ENERGY STORAGE

PROF. SUBHASISH BASU MAJUMDER
Department of Materials Science Center
IIT KGP

TYPE OF COURSE : New I Elective I UG/PG
COURSE DURATION : 12 Weeks (26-Jul' 21 - 15-Oct' 21)
EXAM DATE : 23 Oct 2021

PRE-REQUISITES : High school knowledge in Chemistry, Physics and Mathematics are required. Knowledge on undergraduate level electrochemistry is a plus.

INTENDED AUDIENCE : 3rd or Final year UG and 1st Semester PG/Ph.D students studying Matallurgical and Materials Engineering/Materials Science/Ceramic Technology/Electrical Engineering/Energy Science/Nanotechnology (as one of the open elective courses)

INDUSTRIES APPLICABLE TO : Tata Steel R&D,Tata Motors,Amara Raja Batteries Limited,Various CSIR Labs

COURSE OUTLINE :

This course illustrates the diversity of applications for secondary batteries and the main characteristics required of them in terms of storage. The introductory module introduces the concept of energy storage and also briefly describes about energy conversion. A module is also devoted to present useful definitions and measuring methods used in electrochemical storage. Subsequent modules are devoted to teach students the details of Li ion batteries, sodium ion batteries, supercapacitors, lithium – air, and lithium - sulphur batteries. Separate modules are also devoted to describe lithium reserves, extraction and recycling of Li ion batteries. Finally, other types of batteries including redox – flow batteries are described in a separate module. The course is divided into twelve modules each contains five half an hour lectures. Each module lectures is self contained to encourage student understanding and reinforce key concepts. Carefully designed problem set will help students to grasp the underlying concepts taught in the course.

ABOUT INSTRUCTOR :

Dr Subhasish Basu Majumder is presently working as a Professor at the Materials Science Center, IIT Kharagpur. He completed his B. Tech in Ceramic Technology from the Government College of Engineering and Ceramic Technology, Kolkata in the year 1988. Subsequently he obtained his M. Tech and Ph.D degree in Materials Science from IIT Kanpur in the year of 1990 and 1997 respectively. He worked as a postdoctoral fellow and subsequently as a research faculty at the University of Puerto Rico, San Juan, USA. As an Alexander von Humboldt fellow, he has also worked at RWTH Aachen, Germany.

COURSE PLAN :

Week 1: Introduction to electrochemical energy storage and conversion
Week 2: Definitions and measuring methods
Week 3: Lithium batteries
Week 4: Basic components in Lithium – ion batteries: Electrodes, Electrolytes, and collectors
Week 5: Characteristics of commercial lithium ion cells
Week 6: Sodium ion rechargeable cell
Week 7: Introduction to battery pack design
Week 8: Advanced materials and technologies for supercapacitors
Week 9: Li – Air batteries
Week 10: Li – Sulphur batteries
Week 11: Li resources and recycling of Li ion batterie
Week 12: Other types of batteries

TEXTURE IN MATERIALS

PROF. SOMJEET BISWAS
Department of Metallurgical and Materials
IIT KGP

TYPE OF COURSE : New I Elective I UG/PG
COURSE DURATION : 12 Weeks (26-Jul' 21 - 15-Oct' 21)
EXAM DATE : 23 Oct 2021

PRE-REQUISITES : Students should have completed three years of the BE/BTech in Metallurgical, Mechanical, Materials Engg/Science; Physical metallurgy; Physics of Materials

INTENDED AUDIENCE : UG, PG, and PhD, industry/R&D professionals

INDUSTRIES APPLICABLE TO : BARC Mumbai; DMRL-DRDO Hyderabad; IGCAR Kalpakkam; ISRO; National Metallurgical Laboratory Jamshedpur; Tata Steel; JSW Steel; ArcelorMittal

COURSE OUTLINE :

Dr. Somjeet Biswas is Associate Professor in Dept. of Metallurgical & Materials Engineering, Indian Institute of Technology, Kharagpur. He specializes in mechanics of plastic deformation in ultra-fine and nanocrystalline materials through polycrystalline plasticity simulations with specific applications in aerospace, automobile and degradable/permanent bio-medical implant applications. He has used microstructure engineering techniques like severe plastic deformation, thermo-mechanical processing and recrystallization to modify the morphological characteristics, texture and grain boundary to obtain ultra-fine grain metals and alloys that possess both improved strength and ductility and hold 35 publications and 04 patents. His thrust areas of research include the development of advanced lightweight and high strength Mg, Ti, Al alloys and steels. He and his team in the 'Light Metals and Alloys Research Lab, MME, IITKGP' is working on deciphering the effect slip/twin induced deformation behaviour, dynamic recovery and recrystallization on the evolution of dislocations, microstructure, texture and grain boundaries in order to improve specific properties based upon application.

ABOUT INSTRUCTOR :

Dr. Somjeet Biswas is Associate Professor in Dept. of Metallurgical & Materials Engineering, Indian Institute of Technology, Kharagpur. He specializes in mechanics of plastic deformation in ultra-fine and nanocrystalline materials through polycrystalline plasticity simulations with specific applications in aerospace, automobile and degradable/permanent bio-medical implant applications. He has used microstructure engineering techniques like severe plastic deformation, thermo-mechanical processing and recrystallization to modify the morphological characteristics, texture and grain boundary to obtain ultra-fine grain metals and alloys that possess both improved strength and ductility and hold 35 publications and 04 patents. His thrust areas of research include the development of advanced lightweight and high strength Mg, Ti, Al alloys and steels. He and his team in the 'Light Metals and Alloys Research Lab, MME, IITKGP' is working on deciphering the effect slip/twin induced deformation behaviour, dynamic recovery and recrystallization on the evolution of dislocations, microstructure, texture and grain boundaries in order to improve specific properties based upon application.

COURSE PLAN :

Week 1**:** Introduction to crystallographic orientation or texture

Week 2**:** Fundamentals of crystal structure and stereographic projections

Week 3**:** X-ray diffraction phenomena, Pole figures and inverse pole figures

Week 4**:** Three-dimensional texture analysis

Week 5**:** Principles of texture measurements by X-ray diffraction

Week 6**:** Microtexture measurements using EBSD technique in SEM

Week 7**:** Grain boundary Classifications, character and energy

Week 8**:** Texture evolution during solidification and phase transformation

Week 9**:** Theory of deformation texture and microstructure evolution

Week 10**:** Texture in FCC, BCC and HCP materials

Week 11**:** Theory of annealing texture evolution

Week 12**:** Application: Case study

TECHNIQUES OF MATERIAL CHARACTERIZATION

PROF. SHIBAYAN ROY
Department of Metallurgical and Materials Engineering
IIT KGP

TYPE OF COURSE : New I Core I UG/PG
COURSE DURATION : 12 Weeks (26-Jul' 21 - 15-Oct' 21)
EXAM DATE : 24 Oct 2021

INTENDED AUDIENCE : Final year UG and PG students and PhD research scholars from various disciplines like Materials and Metallurgical Engineering, Ceramic Engineering,Nanoscience and Nanotechnology, Physics, Chemistry,Materials Science etc.

PRE-REQUISITES : Any introductory courses on Materials Science and Engineering

INDUSTRY SUPPORT : Industries dealing with metal making and processing (e.g. steel or Aluminum industries), semiconductor device making, biomedical applications etc.

COURSE OUTLINE :

The objective of the course is to provide a broad overview about different techniques available for structural characterization of various materials systems. It is an amalgamation of the science behind these characterization techniques and their application in material systems. The course is divided into two segments dealing with two major aspects of material structures and characterization; initial part will focus on imaging the microstructure by various microscopy techniques while the later part will deal with understanding the internal structure by diffraction phenomena.For this, the first set of lectures will introduce the fundamental issues of image formation and its inherent attributes and proceed towards details about specific imaging techniques e.g. light/optical microscopy and electron microscopy. Afterwards, the course will cover the basics of diffraction phenomena and related techniques using electron and X-ray sources. At all times, while dealing with these characterization techniques, their importance in materials research and application to real problem solving will be emphasized.

ABOUT INSTRUCTOR :

Dr. Shibayan Roy is currently an Assistant Professor in the Materials Science Center of Indian Institute of Technology IIT-Kharagpur in India. He has joined the institute from November 2015 and continuing till date. Previously, Dr. Roy was a post-doctoral research associate at Materials Science and Technology Division in Oak Ridge National Laboratory, Oak Ridge, Tennesse, USA from November, 2013 to October 2015. Forewords, he worked as a post-doctoral researcher at Institute für Werkstoffwissenschaft und Werkstofftechnik (IWW), Fakultät für Maschinenbau, Chemnitz University of Technology, Chemnitz, Germany from February 2012 to September, 2013.

COURSE PLAN :

Week 1: Introduction to microscopy, Optical microscopy

Week 2: Various modes of optical microscopy

Week 3: General concepts of electron microscopy

Week 4: Transmission electron microscopy (TEM), Electron diffraction in TEM

Week 5: Electron diffraction in TEM

Week 6: Scanning electron microscopy (SEM)

Week 7: Basic components of SEM

Week 8: Chemical analysis in SEM, Imaging and contrast generation in SEM

Week 9: X-ray production

Week 10: ntensities of diffracted beams

Week 11: Intensities of diffracted beams

Week 12: X-ray diffraction profile and analysis

MECHANICAL BEHAVIOR OF MATERIALS

PROF. S. SANKARAN
Department of Metallurgical and Materials Engineering
IIT Madras

TYPE OF COURSE : New I Core I UG/PG
COURSE DURATION : 12 weeks (26-Jul' 21 - 15-Oct' 21)
EXAM DATE : 24 Oct 2021

PRE-REQUISITES : None

INTENDED AUDIENCE : Students undergoing any degree course in the branches of Metallurgical/Materials/Mechanical/Materials Science or its allied discipline

INDUSTRIES APPLICABLE TO : Automotive and metal forming industries

COURSE OUTLINE : This course deals with fundamentals of mechanical behavior of broad class of materials. The primary focus is on the load bearing ability, types of loading and respective failure modes. The course also addresses mechanical properties sensitive as well as insensitive to the microstructure of the materials. The course attempts to capture the microstructure mechanical behavior correlations in materials.

ABOUT INSTRUCTOR :
Prof. S. Sankaran, joined as a faculty member in the Department of Metallurgical and Materials Engineering, IIT Madras, in 2007. His teaching and research interests are in the field of Mechanical behavior-microstructure correlation in structural alloys/materials, Deformation processing of materials and Electron microscopy.

COURSE PLAN :

Week 1: Introduction, overview of the subject and fundamentals of the atomic structure and types of bonding in different classes of materials and its relation to the physical and mechanical properties

Week 2: Elasticity - Analysis of stress, State of stress at a point, Normal and shear stress components, Stress components on an arbitrary plane, Principal stresses, Plane stress & Plane strain,

Week 3: Generalized Hooke's law, Atomic equivalent of Hooke's law, Elastic behavior of anisotropic and isotropic materials.

Week 4: Plastic deformation in single & polycrystalline, semi crystalline materials, strengthening mechanisms in solids, Work hardening

Week 5: Solid solution strengthening, Grain boundary strengthening, Particle hardening, High temperature deformation of amorphous; crystalline materials

Week 6: Mechanical testing- A review, Common states of stress in real life, Tension, Indentation, Compression, Torsion, Bending.

Week 7: Fracture of solids/Fracture mechanics - Linear elastic stress field in cracked bodies – Crack deformation modes, - Singular stress field and displacement fields

Week 8: Stress intensity factor solutions - Crack growth based on energy balance - Griffith's criterion for brittle fracture - Strain energy release rate, Stress intensity factor equivalence - Crack stability, R curves

Week 9: J integral concepts – Critical stress intensity factor fracture criterion -Fracture criterion - Experimental determination of fracture toughness (K IC)- Non-linear fracture - Toughening mechanisms (in ceramics).

Week 10: Creep, mechanisms of creep, Creep of pure metals, solid solutions, MMCs, Creep of ceramics and polymers, creep asymmetry. Superplasticity in materials

Week 11: Fatigue of engineering materials - Characteristics of fatigue fracture -Fatigue crack propagations laws , Strain controlled fatigue

Week 12: Fatigue failure models - Fatigue life calculations, High cycle fatigue design- Surface fatigue failure models- dynamic contact

POWDER METALLURGY

PROF. RANJIT BAURI
Department of Metallurgical Engineering
and Materials Sciences
IIT Madras

TYPE OF COURSE : Rerun I Elective I UG I PG
COURSE DURATION : 12 weeks (26 Jul'21 - 15 Oct'21)
EXAM DATE : 24 Oct 2021

PRE-REQUISITES : Basics of Materials Science & Engineering

INTENDED AUDIENCE : Any Interested Learners

INDUSTRIES APPLICABLE TO : Saint Gobain, Murugappa, Ashok Leyland, BHEL, Sandvik Asia Ltd, Avartana Metal Powders

COURSE OUTLINE :

Powder Metallurgy is a very useful manufacturing process which is being practiced in variety of industries for decades. It is a versatile process that can produce a solid, a component or a product in net shape or near net shape staring from a loose mass of powder. This course will not only provide a broad overview of the P/M process but will also deal with the relevant concepts in detail. The objective is to learn about the process and understand it in a scientific and systematic manner.

ABOUT INSTRUCTOR :

Dr. Ranjit Bauri is a Professor in the Dept. of Metallurgical and Materials Engineering, IIT Madras. He has more than a decade of experience in teaching and research. The broad areas of his expertise include Powder Metallurgy, Ceramics, Composite materials, Energy Materials, Aluminum alloys, Friction stir welding and processing, and Microscopy.

COURSE PLAN :

Week 1**:** Introduction to Powder Metallurgy, Definition, Why Powder Metallurgy

Week 2**:** Powder Fabrication: Mechanical & Chemical fabrication

Week 3**:** Powder Fabrication: Electrolytic fabrication & Atomization

Week 4**:** Microstructure control, Powder Characterization

Week 5**:** Powder Characterization: Particle size measurement, BET surface area, Interparticle friction

Week 6**:** Powder packing, mixing and blending

Week 7**:** Shaping and Compaction

Week 8**:** Slurry techniques, Cold Isostatic Pressing (CIP)

Week 9**:** Sintering: Sintering theory, Solid state sintering

Week 10**:** Activated and Liquid phase Sintering

Week 11**:** Full density processing

Week 12**:** Hot Isostatic Pressing (HIP), Spark Plasma Sintering (SPS)

AQUEOUS CORROSION AND ITS CONTROL

PROF. V. S. RAJA
Department of Metallurgical Engineering and Materials Sciences
IITBombay

TYPE OF COURSE : Rerun I Elective I UG I PG
COURSE DURATION : 12 weeks (26 Jul'21 - 15 Oct'21)
EXAM DATE : 24 Oct 2021

INTENDED AUDIENCE : Metallurgical Engineering and Materials Science, but is open to other engineering branches

INDUSTRIES APPLICABLE TO : Oil and Gas Industries, Manufacturing

COURSE OUTLINE :

Corrosion failures of components cuts across all the industries and cost a national about 3.5% of its GDP. In addition, it affects environments, scant resources, safety and reliability of components. Effective control of corrosion requires basic understanding of electrochemical principles, metallurgical aspects and a clear perspective of the industrial problem. This course comprehensively addresses these aspects.

ABOUT INSTRUCTOR :

Prof. V. S. Raja taught several courses related to corrosion over the last 32 years. He published a book on Corrosion Failure Analysis: basics, Case Studies and Solutions. Also edited a book on Stress Corrosion Cracking: Theory and Practice. He is passionate about teaching & recipient of the Prof. SP. Sukhatme award for excellence in teaching.

COURSE PLAN :

Week 1: Introduction to the course and Importance of corrosion

Week 2: Can we predict of corrosion of a metal? Electrochemical Equilibrium and Thermodynamics of corrosion. Pourbaix diagrams and identification of stability regions

Week 3: Concepts of Electrochemical Kinetics, exchange current density charge transfer and diffusion controlled

Week 4: What determines the corrosion rates? Mixed Potential theory Passivity and Application of mixed potential theory for prediction of corrosion. Application of electrochemical kinetics for corrosion rate determination and mechanisms of corrosion

Week 5: Uniform corrosion and the factors affecting them and the control measures, concept of localized corrosion

Week 6: Galvanic Corrosion: Mechanism, factors affecting galvanic corrosion, prevention methods, typical industrial problems and methods of evaluation

Week 7: Crevice Corrosion: Mechanism, factors affecting crevice corrosion, prevention methods, typical industrial problems and methods of evaluation

Week 8: Pitting Corrosion: Mechanism, factors affecting pitting corrosion, prevention methods, typical industrial problems and methods of evaluation

Week 9: Intergranular Corrosion: Mechanism, factors affecting intergranular corrosion, weld decay, knife line attack. Role of welding techniques, parameters and other material conditions on weld decay

Week 10: Industrial problems of weld decay, intergranular corrosion of other alloys, test methods and selection rationale

Week 11: Dealloying: Mechanism, factors affecting alloying prevention methods, typical industrial problems Flow assisted Corrosion, Erosion Corrosion, Cavitation damage: Mechanism, factors affecting these corrosion, prevention methods, typical industrial problems

Week 12: Environmentally assisted cracking: Stress corrosion cracking and Hydrogen Damage Mechanism, factors affecting cracking of metals, prevention methods, typical industrial problems and methods of evaluation

Week 13: Continuation of the above, Microbial Corrosion, Corrosion Control Philosophy and Management

NANOMATERIALS AND THEIR PROPERTIES

PROF. KRISHANU BISWAS
Department of Materials Science and Engineering
IIT Kanpur

TYPE OF COURSE : New I Elective I UG/PG
COURSE DURATION : 12 Weeks (26-Jul' 21 - 15-Oct' 21)
EXAM DATE : 24 Oct 2021

PRE-REQUISITES : Knowledge of thermodynamics and atomic structure

INTENDED AUDIENCE : Materials, Chemical, Mechanical, Physics, Chemistry

COURSE OUTLINE :

The present course will deal with the nanomaterials and their unique properties. The nanomaterials are ubiquitous in various fields of science and engineering. Almost, every field uses nanomaterials in research as well as applications. Hence, it is important to know the basic concepts related to properties of nanomaterials. The course will also deliberate on the structure, surface energy of nanomaterials and their correlation with properties. The unique properties of nanomaterials will be connected with structure (atomic, microstructure at nanoscale) and connected to basic concepts.

ABOUT INSTRUCTOR :

Prof Krishanu Biswas, is currently working at the Department of Materials Science and Engineering of IIT Kanpur. He research area comprises of nanomaterials, phase transformation, multicomponent materials, materials for energy applications etc. He extensively teaches in the institute. He has developed several courses in NPTEL forum. Two courses have been developed as MOOC and others as VIDEO courses.

COURSE PLAN :

Week 1**:** Introduction, Overview of nanostructures nanomaterials

Week 2**:** Multiscale hierarchial nanostructures

Week 3**:** Thermodynamics of Nanomaterials

Week 4**:** Thermodynamics of Nanomaterials

Week 5**:** Surfaces and interfaces in nanostructures

Week 6**:** Surfaces and interfaces in nanostructures

Week 7**:** Properties of nanomaterials

Week 8**:** Properties of nanomaterials

Week 9**:** Properties of nanomaterials

Week 10**:** Properties of nanomaterials

Week 11**:** Properties of nanomaterials

Week 12**:** Properties of nanomaterials


UNDERGROUND MINING OF METALLIFEROUS DEPOSITS

PROF. BIBHUTI BHUSAN MANDAL
PROF. KAUSHIK DEY
Department of Mining Engineering
IITKGP

TYPE OF COURSE : New I Core I UG/PG
COURSE DURATION : 12 weeks (26-Jul' 21 - 15-Oct' 21)
EXAM DATE : 24 Oct 2021

INTENDED AUDIENCE : Students of Mining Engineering, Mining Machinery, Mineral Processing, Earth Sciences (Geology/geophysics etc.)
INDUSTRIES APPLICABLE TO : All the Mining and allied industries

COURSE OUTLINE :

Introduction to Metalliferous mineral deposits, exploration, deposit characterizations, understanding cut-off grade, dilution, optimum recovery, financial impacts etc.; Access to mineral deposits: Types of access and selection criteria, location, size and shape; Adits, Inclines, Declines, Shafts; Conventional and special methods of excavation, lining, deepening and widening.; Lateral and inclined development of openings to mineral blocks; Levels, Drive, Drift, Crosscuts, Raising and Winzing etc,Classification and choice of stoping methods, Methods of stoping: open stoping, supported stoping – breast, underhand and overhand stoping, shrinkage stoping, cut and fill stoping method, sub-level stoping; Introduction to caving methods: top slicing, sub-level caving, block caving; Stope mechanization and level interval,Support: Rock bolting, Cable Bolting, Pillar Design; Backfilling: preparation, transportation of mill tailings and filling operation,Safety, Environmental issues and Case studies.

ABOUT INSTRUCTOR :

Bibhuti Bhusan Mandal is an Associate Professor in the Department of Mining Engineering, Indian Institute of Technology, Kharagpur, India. He holds a Bachelor,Äôs Degree in Mining Engineering, M. Tech (Mining Engineering) and Ph.D. (ESE). He also holds the Mine Manager,Äôs First Class Certificate of Competency issued by the Directorate General of Mines Safety. Dr. Mandal has 22 years of experience in underground mechanized metal mining. Prior to joining I. I. T. KGP, Dr. Mandal worked in Hindustan Copper Limited (HCL/ICC) as Manager (Mines) and in Sikkim Mining Corporation as Deputy General Manager (Tech) and also as Deputy Director in the National Institute of Miners,Äô Health, Nagpur (under Ministry of Mines, GoI) conducting and coordinating research on environmental and occupational health of mining community. In India, he has conducted pioneering research on equipment induced human vibration and widely published his research on noise and vibration. He currently teaches underground metal mining and Economics of mining enterprises at IIT Kharagpur.

Kaushik Dey is an Assistant Professor, Department of Mining Engineering Indian Institute of Technology, Kharagpur, India. He has obtained B.E. (Mining), M. Tech (Opencast Mining) and Ph.D. (Mining) prior to work in the field of Tunneling and Mining sector for few years. Prior to join I. I. T. Kharagpur, Dr. Kaushik Dey was an Assistant Professor in Department of Mining Engineering at National Institute of Technology, Rourkela and at Indian School of Mines, Dhanbad. His research area includes excavation of rock by blasting or by mechanical cutting, mining operations, surface mining, whole body vibration etc. He has published around thirty five research papers in different journals apart from many others presented in the national/international conferences.

COURSE PLAN :

Week 1**:** Introduction to Metal Mining, their importance, financial impact etc
Week 2**:** Exploration, understanding cut-off grade, dilution, recovery etc
Week 3**:** Access to mineral deposits
Week 4**:** Development of openings
Week 5**:** Development of openings (continued)
Week 6**:** Choice of Stoping methods – qualitative and quantitative analysis
Week 7**:** Stoping methods
Week 8**:** Stoping methods (continued)
Week 9**:** Stoping methods (continued)
Week 10**:** Support technology
Week 11**:** Filling of stopes
Week 12**:** Safety, Environment and Case studies

SURFACE MINING TECHNOLOGY

PROF. KAUSHIK DEY
Department of Mining Engineering
IIT KGP

TYPE OF COURSE : New I Core I UG/PG
COURSE DURATION : 12 Weeks (26-Jul' 21 - 15-Oct' 21)
EXAM DATE : 24 Oct 2021

INTENDED AUDIENCE : UG and PG Mining Engineering students
INDUSTRIES APPLICABLE TO : All mining companies including CIL, SAIL, NALCO, HZL, HCL, CEMENT SECTORS etc

COURSE OUTLINE :
Surface mining is the most popular mining technology. However, it is being challenged due to dearth of near surface deposits and socio-environmental constraints. With the invention of large scale equipment, innovative technologies and strategic planning surface mining can be carried out at a larger depth also with profit. Basic knowledge of surface mining is thus important for the mining engineers. This course is thus designed to provide the basic surface mining technology to the students.

ABOUT INSTRUCTOR :

Kaushik Dey is an Assistant Professor, Department of Mining Engineering Indian Institute of Technology, Kharagpur, India. He has obtained B.E. (Mining), M. Tech (Opencast Mining) and Ph.D. (Mining) prior to work in the field of Tunneling and Mining sector for few years. Prior to join I. I. T. Kharagpur, Dr. Kaushik Dey was an Assistant Professor in Department of Mining Engineering at National Institute of Technology, Rourkela and at Indian School of Mines, Dhanbad. His research area includes excavation of rock by blasting or by mechanical cutting, mining operations, surface mining, whole body vibration etc. He has published around thirty five research papers in different journals apart from many others presented in the national/international conferences.

COURSE PLAN :

Week 1: Introduction to Surface Mining, Current status and challenges, Understanding rocks, minerals and deposits

Week 2: Cut off grade, Surface mining phases and surface mining systems, Surface mining Excavations and unit operations.

Week 3: Drilling and blasting for surface mines

Week 4: Shovel and dumper operation for surface mining excavations

Week 5: Operation of Dozer and dragline

Week 6: Operation of continuous surface miner

Week 7: Operation of bucket wheel excavator and bucket chain excavator

Week 8: Transportation system for surface mines and expit transportation

Week 9: Design and maintenance of haul roads

Week 10: Stability assessment of pit slopes and dump designs

Week 11: Sea bed mining, dimensional stone mining

Week 12: Safety Environment and mine closure

An Introduction to Materials: Nature and Properties (Part 1: Structure of Materials)

Prof. Ashish Garg
Metallurgical and Materials Engineering
IITK

TYPE OF COURSE : Rerun | Core | UG/PG
COURSE DURATION : 8 weeks (26 Jul' 21 - 17 Sep' 21)
EXAM DATE : 26 Sep 2021

PREREQUISITES: 12th standard science background

INTENDED AUDIENCE: UG and PG students of science and engineering of non-materials related background.

INDUSTRY SUPPORT: Materials related companies

COURSE OUTLINE :

The course is first part of the broader course on Introduction to Nature of materials and would be suitable for undergraduate and postgraduate students of every branch of science and engineering. The first part of this course will focus on essentials of crystallography, crystal structures of different classes of materials, structure determination and defects in materials

ABOUT INSTRUCTOR :

Ashish Garg is Professor of Materials Science and Engineering at IIT Kanpur. Details of his research and teaching can be accessed on home.iitk.ac.in/~ashishg.

COURSE PLAN :

Week 1 : Introduction and Basic crystallography

Week 2 : Symmetry

Week 3 : Crystal Systems, Bravais Lattices and Miller Indices, Interstices

Week 4 : Structure of Metals and Alloys

Week 5 : Structure of Ceramics

Week 6 : Structure of Polymers

Week 7 : Structure Determination: X-ray diffraction

Week 8 : Defects in Materials

PHASE EQUILIBRIA IN MATERIALS (NATURE & PROPERTIES OF MATERIALS-II)

PROF. ASHISH GARG Department of
Materials Science and Engineering
IIT Kanpur

TYPE OF COURSE : Rerun I Elective I UG/PG
COURSE DURATION : 8 weeks (26-Jul' 21 - 17-Sep' 21)
EXAM DATE : 26 Sep 2021

PRE-REQUISITES : 12th standard, Science Background

INTENDED AUDIENCE : UG students of any branch of engineering and sciences, PG students engaged in materials related research

INDUSTRIES APPLICABLE TO : Materials related companies

COURSE OUTLINE :

The course is second part of the broader course on Nature and Properties of materials and would be suitable for undergraduate and postgraduate students of every branch of science and engineering. This course will focus on essentials of thermodynamics, thermodynamic basis of phase diagrams, free energy composition diagrams, phase equilibrium, phase diagrams in unary, binary and ternary systems and correlation of phase diagrams with microstructure evolution. The course will enable a beginner in Materials to understand the phase diagrams.

ABOUT INSTRUCTOR :

Ashish Garg is Professor of Materials Science and Engineering at IIT Kanpur. Details of his research and teaching can be accessed on http://home.iitk.ac.in/~ashishg

COURSE PLAN :

Week 1 : Introduction, Thermodynamic aspects of phase formation and phase equilibrium, Mixing of atoms

Week 2 : Thermodynamics of mixing in binary solutions: Ideal and Regular Solutions, Real Solutions

Week 3 : Systems with intermediate phases, Equilibrium in Heterogenous systems, Free energy composition diagrams and their use in determining phase diagrams

Week 4 : Types of Phase diagrams and reactions, Gibbs phase rule and its applications to phase diagrams, Invariant reactions, Tie-line and Lever rule

Week 5 : Binary Phase Diagrams: Applications of tie-line and lever rules to determine phase compositions and fractions, Microstructure evolution under equilibrium and non-equilibrium cooling conditions, Examples of Phase diagrams and their correlations with microstructures in common alloy systems.

Week 6 : Examples of Phase diagrams and their correlations with microstructures in common alloy systems: Fe-C, Cu-Zn systems

Week 7 : Experimental determination of phase diagrams, Ternary phase diagrams

Week 8 : Ternary Phase diagrams and Course summary

DEFECTS IN CRYSTALLINE SOLIDS (PART-I)

PROF. SHASHANK SHEKHAR
Department of Metallurgical and Materials Engineering
IIT Kanpur

TYPE OF COURSE : Rerun I Core I UG
COURSE DURATION : 8 weeks (26 Jul' 21 - 17 Sep' 21)
EXAM DATE : 26 Sep 2021

PRE-REQUISITES : Under graduate level mathematics, thermodynamics

INTENDED AUDIENCE : Undergraduate Students and first year graduate students of following discipline: Materials Engineering, Mechanical Engineering, Metallurgical Engineering, Industrial Engineering, Electrical Engineering

INDUSTRIES APPLICABLE TO : Manufacturing Companies, Iron and Steel companies, Automobile companies, Equipment manufacturers,

COURSE OUTLINE :
At the end of the course, the student should be able to
Have a broad understanding of defects in materials and their role in determining properties of materials
Have a thorough understanding of the structure of dislocations in various crystals and their elastic fields
Have an overview of plastic deformation mechanisms and the role of dislocations in plasticity, fracture, fatigue and creep

ABOUT INSTRUCTOR :
Prof. Shashank Shekhar is an assistant professor at IIT Kanpur. He joined IITK in 2010 and has since taught manufacturing related courses to 2nd year, 3rd year as well as 4th year UG students. His research interest lies in thermomechanical processing, particularly severe plastic deformation using techniques like machining and constrained groove pressing.

COURSE PLAN :

Week 1 : Introduction to Point defect, Defect structure, Energy andConcentration of Point defect

Week 2 : Intrinsic and Extrinsic defect, Defect reaction and its thermodynamics,

Week 3 : Interstitial and Substitutional Diffusion,

Week 4 : Fundamentals of dislocation, Dislocation model and Dislocation circuit

Week 5 : Stress and strain field around dislocation, Force and energy on dislocation

Week 6 : Image force, Dislocation motion, Slip system, Peierl Nabarro stress, Critical resolved shear stress

Week 7 : Glide, climb and Cross-slip to create steps, Dislocation intersection

Week 8 : Strain and strain rate due to dislocation motion, Dislocation in FCC and BCC, Thompson's Tetrahedron

CORRUSION FAILURES AND ANALYSIS

PROF. KALLOL MONDAL
Department of Materials Science and Engineering
Indian Institute of Technology Kanpur

TYPE OF COURSE : New I Elective I UG
COURSE DURATION : 8 Weeks (26-Jul' 21 - 17-Sep' 21)
EXAM DATE : 26 Sep 2021

PRE-REQUISITES : Chemical Thermodynamics, Phase transformation and Electrochemistry

INTENDED AUDIENCE : Bachelor and Master students; Industry people, where corrosion is a problem; PhD student working in corrosion

INDUSTRIES APPLICABLE TO : Oil companies, Chemical companies and Power sector, construction

COURSE OUTLINE :
The course will focus on citing failures of component due to corrosion and analysis of the corrosion events, which have led to the failures. It will take examples from different fields and industries such as (i) Household, (ii) Construction, (iii) Petrochemical, (iv) Naval structures and (v) Medical. The course will also discuss the possible protection philosophies on the basis of (i) Materials, (ii) Change of environment, (iii) Design, (iv) Coatings, (v) Inhibitors.

ABOUT INSTRUCTOR :
Kallol Mondal is an associate professor in the department of Materials Science and Engineering, IIT Kanpur. His specializations are phase transformations of metals and alloys, corrosion and oxidation behavior and multi-phase steel development.

COURSE PLAN :

Week-1: Introduction

Week-2: Corrosion failures

Week-3: Corrosion failures

Week-4: Corrosion failures

Week-5: Protection of Metals and Alloys

Week-6: Protection of Metals and Alloys

Week-7: Protection of Metals and Alloys

Week-8: Choice of protection route for preventing corrosion failure


THERMO-MECHANICAL AND THERMO-CHEMICAL PROCESSES

PROF.VIVEK PANCHOLI
Department of Metallurgy and Material Science
IIT Roorkee

PROF.S. R. MEKA
Department of Metallurgy and Material Science
IIT Roorkee

TYPE OF COURSE : Rerun I Elective I PG I UG
COURSE DURATION : 8 weeks (23 Aug' 21 - 15 Oct' 21)
EXAM DATE : 23 Oct 2021

INTENDED AUDIENCE: Final year B.Tech., M.Tech. and PhD scholars in Metallurgical Engineering or Materials Engineering. Practicing engineers in steel and aluminum industries.

PRE-REQUISITES : Mechanical Metallurgy, Physical Metallurgy, Basic Thermodynamics

INDUSTRIES APPLICABLE TO : SAIL, TATA steel, Essar Steel, BHEL, JSW steel, Hindalco, TataMotors, Larsen & Toubro

COURSE OUTLINE :

Microstructural features like grain size, phase fraction and size distribution can be tailored by understanding and optimizing thermo-mechanical and thermo-chemical processes i.e. coupling the heat treatment either by introduction of mechanical energy into solids or by altering the chemistry of solids. Accordingly, several Thermo-Mechanical and Thermo-Chemical processes/treatments have been developed by the researchers. This course is designed to provide the fundamental science behind these processes so that optimal utilization of these processes is possible. Course will cover the utilization of flow stress data from hot deformation experiments to develop constitutive equations and processing maps, the interrelationship between microstructure and deformation features with the thermo-mechanical deformation processes. Important thermo-chemical processes such as nitriding, carburizing, carbonitriding, nitrocarburizing and boriding will be covered.

ABOUT INSTRUCTOR :

Prof. Vivek Pancholi obtained BE (Industrial and Production Engg.) in 1995 from G.S.I.T.S. Indore, M.Tech.(Industrial Tribology) from IIT Delhi in 1997 and PhD in Metallurgical Engineering from IIT Bombay, in 2005. He joined IIT Roorkee as a faculty member in the Department of Metallurgical and Materials Engineering in 2006. He has about 12 years teaching experience at IIT Roorkee.

Prof. Sai Ramudu Meka is working as a faculty in the Department of Metallurgical and Materials Engineering, IIT Roorkee. He obtained his bachelor of engineering degree in Metallurgy from NIT, Surathkal in the year 2002. Then he served as a Junior Manager for Jindal Vijayanagara Steels Ltd. (JVSL), Toranagallu, Bellary, Karnataka. In 2004 he left JVSL to pursue his master's studies in Metallurgy and Materials science at IIT Kanpur.

COURSE PLAN :

Week 1: Introduction, Hot deformation processes I & II, Flow curves as a function of strain rate and temperature, Stress, strain, strain rate sensitivity

Week 2: Microstructural evolution, Recovery,Recrystallization ,Dynamic recrystallization, DDRX,CDRX, GDRX

Week 3: Texture, Deformation texture (BCC), Deformation texture (FCC), Recrystallization texture (BCC), Recrystallization texture (FCC)

Week 4: Constitutive analysis, Low strain rate , Medium strain rate, High strain rate case study

Week 5: Deformation maps, Processing maps, Different models, Interpretation, Processing maps micro structure correlation

Week 6: SPD based thermo-mechanical processes, Friction stir Processing, Equal Channel Angular Processing, High pressure torsion case study.

Week 7: Introduction to Thermo-chemical surface treatments, Thermodynamics of gas/solid interaction.

Week 8: Phase transformations and consequent surface property enhancement during nitriding of iron based alloys.

FUNDAMENTALS OF MATERIAL PROCESSING - I

PROF. SHASHANK SHEKHAR
Department of Metallurgical
and Materials Engineering
IIT Kanpur

TYPE OF COURSE : Rerun I Core I UG
COURSE DURATION : 8 weeks (23 Aug' 21 - 15 Oct' 21)
EXAM DATE : 24 Oct 2021

PRE-REQUISITES : Under graduate level mathematics, thermodynamics

INTENDED AUDIENCE : Undergraduate Students and first year graduate students of following discipline: Materials Engineering, Mechanical Engineering, Metallurgical Engineering, Industrial Engineering, Electrical Engineering

INDUSTRIES APPLICABLE TO : Manufacturing Companies, Iron and Steel companies, Automobile companies, Equipment manufacturers

COURSE OUTLINE :
The aim of the course is to acquaint students with the fundamentals involved in the processing of materials. Various materials processes are used in variety of industries to create and form materials for wide range of applications. There are some commonalities behind all these processes and the aim of this course is to go through these fundamental physics and materials science behind these processes so as to be able to understand, design and predict the outcome of these methods. At the end of this course, students should be able to answer the following questions: (a) What are the various fundamental material processing techniques and the science behind it; (b) What processing method to use for a given material and a given application.
This course is offered in two parts of 20 hours each. First part of the course deals with Solidification and Powder Metallurgy, while the second part deals with Metal processing and Thin film fabrication.

ABOUT INSTRUCTOR :
Prof. Shashank Shekhar is an assistant professor at IIT Kanpur. He joined IITK in 2011 and has since taught manufacturing related courses to 2nd year, 3rd year as well as 4th year UG students. His research interest lies in thermomechanical processing, particularly severe plastic deformation using techniques like machining and constrained groove pressing.

COURSE PLAN :

Week 1:
Introduction to Solidification, Thermodynamics and Kinetics (Homogeneous Nucleation)

Week 2:
Heat Flow (Single Crystal; Unidirectional Heat flow)

Week 3:
Composition Variation- Plane Front Solidification

Week 4:
Composition Variation- Cellular solidification in Single phase alloys

Week 5:
Plane front solidification of polyphase alloys; Fluid Flow

Week 6:
Introduction to Powder Processing; Powder characterization

Week 7:
Powder Characterization; Powder Fabrication; Powder Consolidation

Week 8:
Powder compaction; Sintering

WELDING OF ADVANCED HIGH STRENGTH STEELS FOR AUTOMOTIVE APPLICATIONS

PROF. MURUGAIYAN AMIRTHALINGAM
Department of Metallurgical and Materials Engineering
IIT Madras

TYPE OF COURSE : Rerun | Elective | PG
COURSE DURATION : 4 weeks (26 Jul'21 - 20 Aug'21)
EXAM DATE : 26 Sep 2021

INTENDED AUDIENCE : Final year bachelors and masters students in Metallurgy, Mechanical, Automobile and Production Engineering. Industrial personnel working in automotive and steel making industries.

PRE-REQUISITES : Final year B.E/B.Tech students or Graduates of Metallurgical/Mechanical/Automobile/ Production Engineering,Basic knowledge of steel physical metallurgy and welding processes.

INDUSTRIES APPLICABLE TO : All automotive manufacturers and their OEMs and Steel plants.

COURSE OUTLINE :

The use of advanced high strength steels (AHSS) is increasingly preferred in automotive applications due to improved crash energy management and enhanced strength-ductility combinations, resulting in greener and safer vehicles. The weldability of AHSS is generally poorer than conventional steels due to the high alloying contents required to obtain multi-phase microstructure. This course is aimed to discuss the (i) role of alloying elements in stabilizing multi-phase microstructures of AHSS, (ii) effect of weld thermal cycles on the evolution of microstructures and (iii) weldability of AHSS.

ABOUT INSTRUCTOR :

Prof. Murugaiyan Amirthalingam is currently working as an Assistant Professor in IIT-Madras. His research interests include welding metallurgy, welding processes development, steel product development and additive manufacturing

COURSE PLAN :

Week 01 : Introduction to physical metallurgy of advanced high strength steels

Week 02 : Introduction to welding processes in automotive industries (Advanced Gas Metal Arc, Resistance Spot and Laser Welding Processes).

Week 03 : Welding metallurgy of advanced high strength steels – Effect of weld thermal cycles on the stability of phases, solidification behaviour, segregation and hot cracking susceptibility.

Week 04 : Mechanical properties of advanced high strength steel weldments – Tensile shear testing, HAZ softening characteristics, role of modified weld thermal cycles (post pulsing and post weld heat treatments) to improve the mechanical properties.

STRUCTURAL ANALYSIS OF NANOMATERIALS

PROF. KAUSHIK PAL
Department of Mechanical and Industrial Engineering
IIT Roorkee

TYPE OF COURSE : Rerun | Elective | UG | PG 4
COURSE DURATION : weeks (26 Jul' 21 - 20 Aug' 21)
EXAM DATE : 26 Sep 2021

INTENDED AUDIENCE : UG & PG students of Metallurgy, Nano Science & Nanotechnology, Chemical Engg, Chemistry, Physics, Aerospace Engg, Material Science and Mechanical Engg.etc. , R&D personals in industries
INDUSTRIES APPLICABLE TO : Nanotech based industries: Nanoshel; Adnano Technologies; Mittal Enterprises; Ultrananotech; Reinste Nano Ventures; etc.

COURSE OUTLINE :

Structural analysis of nanomaterials is an important part of Materials Science and Nanoscience & Nanotechnology which deals with the study of crystal structure of materials and their defects. It is a prerequisite for the understanding of properties of nanomaterials to have a detailed knowledge of the structure from the atomic/ molecular (local) level to the crystal structure and to the microstructure (mesoscopic scale and defect structure). The primary goal of structural analysis of nanomaterials is aiming at both investigating the structure-property relationship and discovering new properties, in order to achieve relevant improvements in current state-of-the art materials.

ABOUT INSTRUCTOR :

Prof. Kaushik Pal is an Associate Professor in Department of Mechanical and Industrial Engineering, IIT Roorkee since 2012. He has obtained his Ph.D Degree (2009) from IIT, Kharagpur and then joined to Gyeongsang National University, South Korea for pursuing Post-Doc research. His fields of interests are surface modification of nano-materials and use of such materials in different electronic, mechanical and bio-medical applications. Currently, he is acting as reviewer of several internationally known journals and an active member of National Academy of Sciences, American Chemical Society (ACS) and Royal Society of Chemistry (RSC). Also, he is the recipient of Brain Korea (BK-21) fellowship award and DAAD fellowship award.

COURSE PLAN :

Week 01 : Introduction: Fundamental concepts of atomic structure and interatomic bonding, Structure of materials, Defects in structure of materials, Phase diagram: Determination of phases, Transformation of phases.

Week 02 : Basic properties: Metals, Basic properties: Ceramics , Basic properties: Polymers, Selection of nanomaterials, Structure property relationship of advanced nanomaterials.

Week 03 : Introduction to X-Ray Spectroscopy, Diffraction direction and methods of XRD, Determination of crystal structures by XRD Pattern, Precise parameter measurements, Orientation of single crystals.

Week 04 : Qualitative analysis by diffraction, Quantitative analysis by diffraction, Microscopic structural analysis of nanomaterials-I, Microscopic structural analysis of nanomaterials-II, Other characterization used.


ELEMENTARY STEREOLOGY FOR QUANTITATIVE METALLOGRAPHY

PROF. SANKARAN
PROF. SANDEEP SANGAL
Department of Metallurgical and Materials Engineering
IIT Madras & IIT Kanpur

TYPE OF COURSE : Rerun I Elective I UG/PG
COURSE DURATION : 4 weeks (26 Jul' 21 - 20 Aug' 21)
EXAM DATE : 26 Sep 2021

PRE-REQUISITES : None

INTENDED AUDIENCE : Anyone who is interested in the quantification of microstructures

INDUSTRIES APPLICABLE TO : All materials related industries and Pathologists, Bio technologists

COURSE OUTLINE :
Quantitative metallography or stereology is concerned with the measurement of microstructural features such as grain size, and the size and spatial distribution of second phase particles from the observations made on 2-D sections through optical, scanning and transmission electron microscopy. In all cases a small sample section or thin slice of material is observed in order to derive the microstructural characteristic of a bulk material. Stereology is therefore concerned with geometrical probability.

ABOUT INSTRUCTOR :
Dr. S. Sankaran is presently Professor in the department of Metallurgical and Materials Engineering, IIT Madras. His research interests are deformation processing of materials, mechanical behavior of materials and electron microscopy. He is also presently the faculty in-charge of central electron microscopy of IIT Madras.

Prof. Sandeep Sangal is Professor at Department of Materials Science and Engineering, IIT Kanpur and his research interests are Structure-Property Correlations, Microstructural Characterization, Stereology, Image Processing, Development of Web-Based Educational Aids

COURSE PLAN :

Week 1: 1.Method of Stereology 2.Geometrical Probability - I 3.Geometrical Probability – II

Week 2: 4.Probability Distributions 5.Basic Stereological Parameters

Week 3: 6.Counting of grains and particles 7.Description of Polycrystalline Microstructures – derived measures

Week 4: 1.Size distribution of particles 2.Other applications of the Disector

FUNDAMENTALS OF ELECTRONIC DEVICE FABRICATION

PROF. PARASURAMAN SWAMINATHAN
Department of Metallurgy and Material Science
IIT Madras

TYPE OF COURSE : Rerun I Elective I UG/PG
COURSE DURATION : 4 weeks (26 Jul' 21 - 20 Aug' 21)
EXAM DATE : 26 Sep 2021

INTENDED AUDIENCE : Engineering and Science students at the UG and PG level

INDUSTRIES APPLICABLE TO : Semiconductor device fabrications companies such as TSMC and Applied Materials will value this course

COURSE OUTLINE :

The course is intended to provide an understanding of current fabrication practices used in the semiconductor industry, along with the challenges and opportunities in Device Fabrication. It caters to UG and PG students from diverse backgrounds such as Chemical, Electrical, Mechanical, Metallurgy, Materials Science, Physics, and Chemistry. The course provides an overview on integrated circuit fabrication along with practices and challenges to continue to satisfy Moore's law.

ABOUT INSTRUCTOR :

Prof. Parasuraman Swaminathan is an Associate Professor in the Department of Metallurgical and Materials Engineering (MME), IIT Madras. He joined the institute in 2013. He has a B. Tech and M. Tech dual degree in MME from IIT Madras, and a PhD in Materials Science from the University of Illinois at Urbana-Champaign, USA. He then did a post doc in Johns Hopkins University and National Institute of Standards and Technology (NIST), USA on microelectronics device fabrication. He also worked in Intel Corp. for two years, primarily in their development fab facility. His research group is called the Electronic Materials and Thin Films group and they work in the area of printed electronics and thin film deposition. His research page can be accessed at https://mme.iitm.ac.in/swamnthn. Dr. Parasuraman has been offering this online course since 2016. He has published a textbook in this topic.

Link to the YouTube Channel: https://www.youtube.com/channel/UCYP3gjCN8-VNUL439PSGxjw/

COURSE PLAN :

Week 1**:** Introduction and Overview of Semiconductor Device Fabrication

Week 2**:** Fabrication Operations: Oxidation, Doping, and Lithography

Week 3**:** Fabrication Processes: Etching and Growth. Process Evaluation

Week 4**:** Process Yield, Clean Room Design, and IC logic and packaging

TEXTILE ENGINEERING

SCIENCE OF CLOTHING COMFORT

PROF. APURBA DAS
Department of Textile Technology
IIT Delhi

TYPE OF COURSE : Rerun | Elective | UG/PG
COURSE DURATION : 12 weeks (26 Jul' 21 - 15 Oct' 21)
EXAM DATE : 23 Oct 2021

INTENDED AUDIENCE : UG and PG Students of Textile, Clothing and fashion technology, Material science etc.
PRE-REQUISITES : Basic courses on Textiles

COURSE OUTLINE :

Clothing comfort is one of the most important attributes of textile materials. A basic understanding of comfort aspects of textile materials would be extremely useful for fibre, yarn and fabric manufacturer, researcher, garment designer, processing industries, garment houses, users of the fabrics for speciality applications and all others related with textile and garment industries. The multidisciplinary nature of the subject, encompassing various concepts of physics, neurosciences, psychological science, material sciences, ergonomics, instrumentation and textile engg. would stimulate the minds for innovation, product design and development and material characterization with scientific approaches.

ABOUT INSTRUCTOR :

Prof. Apurba Das is Professor in the Department of Textile Technology, Indian Institute of Technology, Delhi. He has completed his Ph.D. from the same department in the year 1994. He has joined Indian Institute of Technology, Delhi in 2002 as a faculty after serving in the textile industries and in research organization for about 11 years. He has guided many Ph.D., M. Tech., B. Tech. students and presently guiding several Ph.D., M. Tech. and B. Tech. students. He has published more than 260 research papers in journals and conferences, authored and edited 05 books and written chapters in 18 books.He has successfully completed many research and consultancy projects from industries and government funding agencies. He has filed several patent applications. He has developed several instruments for characterization of textile materials.

COURSE PLAN :

Week 01 : Introduction to Clothing Comfort
Week 02 : Psychology and Comfort
Week 03 : Neurophysiological Processes in Clothing Comfort
Week 04 : Tactile Aspects of Clothing Comfort (contd)
Week 05 : Tactile Aspects of Clothing Comfort (contd)
Week 06 : Thermal Transmission (contd)
Week 07 : Thermal Transmission (contd)
Week 08 : Moisture Transmission (contd)
Week 09 : Moisture Transmission (contd)
Week 10 : Moisture Transmission (contd)
Week 11 : Dynamic Heat and Mass Transmission
Week 12 : Garment Fit and Comfort

TEXTILE FINISHING

PROF. KUSHAL SEN
Department of Textile Engineering
IIT Delhi

TYPE OF COURSE : Rerun I Core I Elective I PG I UG
COURSE DURATION : 12 weeks (26 Jul' 21 - 15 Oct' 21)
EXAM DATE : 23 Oct 2021

PRE-REQUISITES : Should have knowledge of fibres, preferably of preparatory processes and dyeing

INTENDED AUDIENCE : Students of first year B.Sc (Physics / Mathematics) and first year B.E courses.
INDUSTRIES APPLICABLE TO : Textile Industry, Particularly Chemical Processing Industry

COURSE OUTLINE:
This course would cover the Science and Application of various finishing processes based on the need and Chemistry of the Fibres, Cellulose based, Protein based and Synthetics. Fundamentals of the techniques and the Chemistry finishing agents, Mechanisms applicable to various finishing techniques. Some introduction to relevant machines and characterization of finished fabrics would also be covered.

ABOUT INSTRUCTOR :
Currently a Professor in the Department of Textile Technology, IIT Delhi. Areas of specialization include textile chemical processing, texturing, and structure-property correlations.

COURSE PLAN :

Week 1**:** Introduction , General classification of finishes, Mechanical finishing; Sanforization

Week 2**:** Wrinkle-resist finishing, Need, General approach for obtaining finished product

Week 3**:** Cross-linking agents, Catalysts needed, Process and Evaluation

Week 4**:** Stiffeners and Softeners

Week 5**:** Waterproof, Water repellent, Waterproof breathable finishing

Week 6**:** Flame retardants and Finishing thereof

Week 7**:** Antimicrobial finishing ; Bio-polishing

Week 8**:** Soil repellency and Soil release finishing

Week 9**:** Finishing of wool; Milling, setting, Shrink-resistant finishing, Special finishing of silk

Week 10**:** Energy efficient technology; Low liquor application and foam finishing

Week 11**:** Finishing of synthetics; Heat setting , Antistatic and other special finishing

Week 12**:** Mangles, driers and Stenters

YARN MANUFACTURE I : PRINCIPLE OF CARDING AND DRAWING

PROF. R CHATTOPADHYAY

Department of Textile Technology
IIT Delhi

TYPE OF COURSE : Rerun | Core | UG
COURSE DURATION : 12 weeks (26 Jul' 21 - 15 Oct' 21)
EXAM DATE : 23 Oct 2021

INTENDED AUDIENCE : Undergraduate students of Textile Technology

COURSE OUTLINE :

Carding and drawing are two fundamental process in yarn manufacture. In carding the fibre tufts are opened, cleaned and separated thoroughly by fast moving pinned surfaces and then reassembled to form a nice 2D array of fibres which is subsequently transformed into an uniform sliver. Drawframe is essentially a stretching device for sliver used to improve mass irregularity of sliver and parallelization of fibres.

ABOUT INSTRUCTOR :

Prof. R. Chattopadhyay, is working as professor in the department of Textile Technology, IIT Delhi. He has been teaching in the department for last thirty years and has keen interest in yarn manufacturing process, mechanics of yarn structure, process control, application of statistics in textile industry and textile product design.

COURSE PLAN :

Week 01 : Objectives of carding process, carding actions, working principle of carding machine, Card feed system, lap and continuous feed systems, design feature of taker-in/ licker-in, waste extraction, opening intensity.

Week 02 : Design feature of cylinder section, construction, design and working of flats, analysis of carding theory, carding force, fibre shedding, Transfer of fibres from cylinder to doffer, Technological significance of doffing arc, doffing of web, web condensation, Package formation: Forms of packaging, coiling, analysis of can drive.

Week 03 : Motion transfer in card, draft and production calculations, card setting, significance of setting.

Week 04 : Card clothing: licker-in, cylinder, doffer clothing; card tooth geometry, Operational load on cylinder, fibre transfer efficiency, carding process.

Week 05 : Autoleveller in card: principle of autolevelling, type of autoleveller, type of autoleveller, correction length, Fibre configuration in card sliver, mechanism of fibre hook and nep formation, cloudy web, Drawframe: Fundamentals of drafting, draft, ideal drafting, geometrical analysis of fibre movement in drafting.

Week 06 : Objectives of drawing, Design features and working mechanism of drawframe. Drafting unit, drawing rollers, Drafting roller arrangement and its significance, package formation, Autoleveller in drawframe, Sliver irregularity and its control.

Week 07 : Theory of drafting, Vasileff's model of drafting, drafting wave, Drafting force , draft vs drafting force, Roller setting: analysis of roller setting, influence of roller setting.

Week 08 : Drawing process and its influence on fibre configuration in sliver, Draft and production calculation.

SCIENCE AND TECHNOLOGY OF WEFT AND WARP KNITTING

PROF. BIPIN KUMAR
Department of Textile Engineering
IIT Delhi

TYPE OF COURSE : Rerun I Core I PG I UG
COURSE DURATION : 12 weeks (26 Jul'21 - 15 Oct'21)
EXAM DATE : 24 Oct 2021

INTENDED AUDIENCE : Students, Lecturer, Researchers, Designer, Industry Experts

INDUSTRIES APPLICABLE TO : Voltas Pvt. Ltd.(Textile Machinery Division),Laxmi Industries High Performance Textiles Private Limited,Texzium International Private Limited, Vertex Machinery Works, Elex India

COURSE OUTLINE :

This course introduces the process of "weft and warp knitting" including its Science, Engineering, Technology and Design. The contents of the lectures have been systematically arranged to start from the basics of simple knit design, and then progressing towards Engineering of Advanced knitted structures and their Technologies.

ABOUT INSTRUCTOR :

Dr. Bipin Kumar is currently working as an Assistant Professor in The Department of Textile Technology at IIT Delhi. Prior to joining IIT Delhi, he worked as Research Assistant Professor (2016-2017) at The Hong Kong Polytechnic University, Hong Kong. He graduated from IIT Delhi, with a PhD in Textile Engineering in 2013. After PhD., he served as Postdoctoral Scholar at The Hong Kong Polytechnic University (2013-2014) and The University of California Davis (2014-2016). He is the first recipient from India to be selected for the Fulbright Postdoctoral Program (2013-14) in the field of textiles. His main research focuses on Textile Fabric Structures and Mechanics. He has over 30 publications in leading refereed SCI journals of materials, textiles and medical fields, 4 Patents, 2 Authored book, 10 book chapters, and over 30 conference proceedings. He holds editorial membership of several international referred journals including AATCC Journal of Research, JEFF, FTEE and CTFTTE.For his outstanding contribution in research and teaching, he received several prestigious awards including IIT Delhi Teaching Excellence Award (2018), IEI Young Engineer Award (2018-19), ACP outstanding Material Scientist Award (2014), DST INSPIRE Faculty Award (2016), and Award for Excellence in Postdoctoral Research (2016). Currently, he is involved in several start-up ventures in commercializing smart e-textile products for healthcare applications.

COURSE PLAN :

Week 1**:** Introduction to Knitting

Week 2**:** Single Bed Weft Knitting Technology (Flat & Circular)

Week 3**:** Double Bed Weft Knitting Technology (Flat & Circular)

Week 4**:** Weft Knit Constructions and their Notation

Week 5**:** Weft Knit - Fabric Design and Structure-property Analysis

Week 6**:** Knitting Calculation

Week 7**:** Advanced Weft Knit Designs and Technology

Week 8**:** Introduction to Warp Knitting

Week 9**:** Warp Knit Constructions - Lapping Diagram and Plan

Week 10**:** Swinging and Shogging Motion Control in Warp Knitting

Week 11**:** Warp Knit Fabrics - Design and Structure-property Analysis

Week 12**:** Technical Applications of Weft and Warp Knit Structures

TECHNICAL TEXTILES

PROF. APURBA DAS
Department of Textile Technology
IIT Delhi

TYPE OF COURSE : Rerun I Core I UG/PG
COURSE DURATION : 12 weeks (26 Jul'21 - 15 Oct'21)
EXAM DATE : 24 Oct 2021

PRE-REQUISITES : Suitable of 4th Year UG Textile or PG Textile;Basic textile courses

INTENDED AUDIENCE : UG and PG Students of Textile, Clothing and fashion technology, Material science etc.

COURSE OUTLINE :

Technical textiles are defined as textile materials and products used primarily for their technical performance and functional properties rather than their aesthetic or decorative characteristics. This course targets the specific areas of technical textiles depending on the product characteristics, functional requirements and end-use applications. The learner at the end of the course will be able to appreciate the vast scope of technical textiles in various sectors of geotextiles, sports textiles, protective wear, textile reinforced composites, filter fabric, compression bandage, automotive textiles, UV protective textiles and nonwoven hygiene textiles.

ABOUT INSTRUCTOR :

Prof. Apurba Das is Professor in the Department of Textile Technology, Indian Institute of Technology, Delhi. He has completed his Ph. D. from the same department in the year 1994. He has joined Indian Institute of Technology, Delhi in 2002 as a faculty after serving in the textile industries and in research organization for about 11 years. He has guided many Ph.D., M. Tech., B. Tech. students and presently guiding several Ph.D., M. Tech. and B. Tech. students. He has published more than 260 research papers in journals and conferences, authored and edited 05 books and written chapters in 18 books. He has successfully completed many research and consultancy projects from industries and government funding agencies. He has filed several patent applications. He has developed several instruments for characterization of textile materials. His main areas of teaching and research interest are clothing comfort, sports textiles, nonwovens and technical textiles, filter fabrics, geotextiles, medical bandage, textile composites, and instrumentation. He has international research collaborations with universities from different countries like, Germany, Poland, Hungary, Slovenia, Italy, Portugal, China, South Korea, Australia, UK, Hong Kong, Croatia etc.

COURSE PLAN :

Week 1**:** Introduction to Technical Textiles

Week 2**:** Textile reinforced composites

Week 3**:** Textile reinforced composites contd.

Week 4**:** Textile reinforced composites contd.

Week 5**:** Filter Fabrics

Week 6**:** Geotextiles

Week 7**:** Extreme cold and heat protective clothing

Week 8**:** Extreme cold and heat protective clothing contd.

Week 9**:** Sports Textiles;UV Protective Textiles

Week 10**:** Ballistic Protective Textiles

Week 11**:** Compression bandages

Week 12**:** Automotive Textiles;Nonwoven Hygiene Product

PRINCIPLES OF COMBING,ROVING PREPARATION & RING SPINNING

PROF. R CHATTOPADHYAY
Department of Textile Engineering
IIT Delhi

TYPE OF COURSE : Rerun I Core I UG
COURSE DURATION : 12 weeks (26 Jul' 21 - 15 Oct' 21)
EXAM DATE : 24 Oct 2021

INTENDED AUDIENCE : Undergraduate students of Textile Technology

COURSE OUTLINE :

The course will focus on three processes i.e. combing , roving preparation and ring spinning. The construction , design features and working principles of the machines will be looked into. The role of machine and process parameters on process performance will be explained. The interaction between technology and machine design will be discussed. Emphasis will be on "know why" rather than "know how".

ABOUT INSTRUCTOR :

Dr. R Chattopadhyay, is working as professor in the department of Textile Technology, IIT Delhi, India. He has been teaching in the department for last thirty years and has keen interest in yarn manufacturing processes, mechanics of yarn structure, process control, application of statistics in textile industry and textile product design.

COURSE PLAN :

Week 1: Flow chart of combed spinning process, objectives of combing , consequence of short fibres in cotton , segregation principle of short fibres from longer ones, Combing operations and its classification, sequence of operation, Timing diagram

Week 2: Pre-combing operation, Comber lap formation, Design features and working principle sliver lap & ribbon lap machines, Draft and its influence on lap quality. Structure and design feature of combing machine. Working principle , Design features of combing machine elements (lap feed roller, cylinder comb, top comb, nipper assembly, detaching roller, sliver table, drafting rollers, coiling arrangement)

Week 3: Mechanism for lap feed, nipper assembly movement, detaching roller movement, and cylinder comb Web structure , condensation, sliver guidance & drafting process

Week 4: Theory of noil extraction fro forward and backward feed machines, Influence of process parameters on combing efficiency Production and draft calculation

Week 5: Objects of roving frame, Machine configuration, working principle Drafting system, drafting elements (cradle, aprons, condenser etc.)

Week 6: Flyer construction, presser , twisting , flyer top , twist diameter count relationship Bobbin geometry , Operation for bobbin building, Winding process, winding equation, Bobbin leading vs flyer leading frame, ,

Week 7: Variable speed drive, Differential gear Building motion: function and working

Week 8: Drive analysis, motion flow,Ring frame : machine configuration, various components, working principle

Week 9: Drafting, Drafting elements, drafting angle, Difference between speed frame and ring frame drafting system, break draft and main draft distribution Twisting and winding principle, twisting winding equation, twist flow, winding tension

Week 10: Bobbin building : bobbin geometry, Nature of ring rail movement, winding and binding layer, Formation of base and conical bottom. Ring and traveler: types , purpose, traveler number

Week 11: Spindle : construction, drive, Spinning geometry, spatial location of elements ,

Week 12: Balloon mechanics, Tension in balloon yarn, balloon size, End breaks, non uniformity, causes & remedies

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