# NPTEL Courses 2018-2023

# Number of Courses offered: 95

# Number of Students completed: 195

S.No.	Name of the Course	No. of Students Registered and Cleared Exams			
	Details of Jan-Apr 2019 Session				
1.	Computer Organization and Architecture: A Pedagogical Aspect	1			
2.	Problem solving through Programming In C	3			
3.	Programming in Java	7			
4.	Programming, Data Structures and Algorithms using Python	1			
5.	Joy of computing using Python	1			
6.	Electric Vehicles - Part 1	1			
7.	Better Spoken English	1			
8.	Enhancing Soft Skills and Personality	1			
9.	Introduction to Fluid Mechanics	1			
10.	Inspection and Quality Control in Manufacturing	1			
11.	Theory And Practice of Non-Destructive Testing	2			
	Details of Jul-Dec 2019 Session				
12.	An Introduction To Programming Through C++	1			
13.	Data Base Management System	4			
14.	Design Practice	1			
15.	Ethical Hacking	1			
16.	Fluid Machines	1			
17.	7. Fluid Mechanics				
18.	Fundamentals Of Artificial Intelligence				
19.	Introduction to Smart Grid				
20.	Manufacturing Automation				
21.	Problem Solving through Programming in C				
22.	Programming, Data Structures And Algorithms Using Python	1			
23.	Python for Data Science	2			
24.	Refrigeration and air-conditioning	1			
25.	Robotics	1			
26. The Joy of Computing using Python		3			
27. Thermo-Mechanical And Thermo-Chemical Processes		4			
Details of Jan-Apr 2020 Session					
28.	Aircraft Maintenance	1			
29.	Introduction to History of Architecture in India	1			
30.	Problem Solving through Programming in C	2			
31.	Programming in U++	2			
33	Data Mining				
		PRINCIPAL			

GOVT. COLLEGE OF ENGG., SALEM-635 011

72.	Advanced Materials and Processes	1		
70				
	Details of Jul-Dec 2022 Session	<i>W</i> .		
. 1.	Details of Jul Des 2022 Session			
71.	Theory and Practice of Non Destructive Testing	30		
70.	Programming Data Structures And Algorithms Using Patho	n 1		
69	Corrosion - Part I	1		
	Details of Jan-Apr 2022 Session			
68.	Structural Analysis of Nanomaterials	1		
67.	Soil Mechanics Geotechnical Engineering I	2		
66.	Refrigeration and air-conditioning	1		
05.	Materials-II)			
65	Phase Equilibria in Materials (Nature & Properties of	1		
64.	Fundamentals of manufacturing processes	2		
63.	Fundamentals of Additive Manufacturing Technologies	1		
62.	Design of steel structures	1		
61.	Design Of Reinforced Concrete Structures	2		
60.	Computational Fluid Dynamics	1		
59.	Advanced Machining Processes	1		
	Details of Jul-Dec 2021 Session			
58.	Water Supply Engineering	1		
57.	Programming in Java	1		
56.	Problem Solving through Programming in C 1			
55.	Materials Science and Engineering 1			
54.	Kinematics of Mechanisms and Machines       1			
53.	Introduction to Fluid Mechanics	2		
52.	Inspection and Quality Control in Manufacturing	1		
51.	Development and Applications of Special Concretes	1		
50.	Data Analytics with Python	1		
	Details of Jan-Apr 2021 Session			
49.	Soil Mechanics/Geotechnical Engineering I	1		
48.	Fluid Mechanics			
47.	Concepts of Thermodynamics			
46.	Introduction to Embedded System Design			
45.	Understanding Design			
44.	Problem solving through Programming In C	1		
43.	Programming in C++	1		
42.	Data Science for Engineers	1		
41.	Cloud computing	1		
40.	Power System Protection and Switchgear	1		
	Details of Jul-Dec 2020 Session			
39.	Kinematics of Mechanism and Machines	2		
38.	MatLab Programming for Numerical Computation	6		
37.	Control Engineering	4		
36.	Electric Vehicles Part I	1		
35.	Fundamentals of Automotive systems	2		

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73.	Welding science and technology (In Tamil)	8		
74.	Ironmaking and Steelmaking	2		
75.	Automation in Manufacturing	1		
76.	Welding of Advanced High Strength Steels for Automotive Applications	1		
77.	Aircraft Propulsion	1		
78.	River Engineering 1			
79.	Understanding Design	1		
80.	Manufacturing Processes - Casting and Joining	1		
81.	Python for Data Science	1		
82.	Hardware Modeling Using Verilog	1		
Details of Jan-Apr 2023 Session				
83.	Theory and Practice of Non-Destructive Testing	25		
83. 84.	Theory and Practice of Non-Destructive Testing Data Mining	25 1		
83. 84. 85.	Theory and Practice of Non-Destructive Testing Data Mining Materials Science and Engineering	25 1 1		
83. 84. 85. 86.	Theory and Practice of Non-Destructive Testing Data Mining Materials Science and Engineering CMOS Digital VLSI Design	25 1 1 1 1		
83. 84. 85. 86. 87.	Theory and Practice of Non-Destructive TestingData MiningMaterials Science and EngineeringCMOS Digital VLSI DesignIntroduction to Machine Learning (Tamil)	25 1 1 1 1 1		
83. 84. 85. 86. 87. 88.	Theory and Practice of Non-Destructive Testing Data Mining Materials Science and Engineering CMOS Digital VLSI Design Introduction to Machine Learning (Tamil) Programming In Java	25 1 1 1 1 1 2		
83. 84. 85. 86. 87. 88. 89.	Theory and Practice of Non-Destructive Testing Data Mining Materials Science and Engineering CMOS Digital VLSI Design Introduction to Machine Learning (Tamil) Programming In Java Ethical Hacking	25 1 1 1 1 1 2 1		
83. 84. 85. 86. 87. 88. 89. 90.	Theory and Practice of Non-Destructive TestingData MiningMaterials Science and EngineeringCMOS Digital VLSI DesignIntroduction to Machine Learning (Tamil)Programming In JavaEthical HackingManufacturing Process Technology I & II	25 1 1 1 1 1 2 1 1 1		
83. 84. 85. 86. 87. 88. 89. 90. 91.	Theory and Practice of Non-Destructive Testing Data Mining Materials Science and Engineering CMOS Digital VLSI Design Introduction to Machine Learning (Tamil) Programming In Java Ethical Hacking Manufacturing Process Technology I & II Welding Metallurgy	25 1 1 1 1 2 1 1 1 1 3		
83. 84. 85. 86. 87. 88. 89. 90. 91. 92.	Theory and Practice of Non-Destructive Testing Data Mining Materials Science and Engineering CMOS Digital VLSI Design Introduction to Machine Learning (Tamil) Programming In Java Ethical Hacking Manufacturing Process Technology I & II Welding Metallurgy Advanced Computer Architecture	25 1 1 1 1 2 1 1 1 1 3 1		
83. 84. 85. 86. 87. 88. 89. 90. 91. 92. 93.	Theory and Practice of Non-Destructive TestingData MiningMaterials Science and EngineeringCMOS Digital VLSI DesignIntroduction to Machine Learning (Tamil)Programming In JavaEthical HackingManufacturing Process Technology I & IIWelding MetallurgyAdvanced Computer ArchitectureWelding Processes	25 1 1 1 1 2 1 1 1 3 1 1 1		
83. 84. 85. 86. 87. 88. 89. 90. 91. 92. 93. 94.	Theory and Practice of Non-Destructive TestingData MiningMaterials Science and EngineeringCMOS Digital VLSI DesignIntroduction to Machine Learning (Tamil)Programming In JavaEthical HackingManufacturing Process Technology I & IIWelding MetallurgyAdvanced Computer ArchitectureWelding ProcessesIntroduction To Mineral Processing	25 1 1 1 1 2 1 1 1 3 1 1 1 1 1 1 1 1 1 1 1 1 1		

PRINCIPAL GOVT. COLLEGE OF ENGG., SALEM-635 011

# COMPUTER ORGANIZATION & ARCHITECTURE : A PEDAGOGICAL ASPECT

# MULTI FACULTY

TYPE OF COURSE COURSE DURATION EXAM DATE : Rerun | Elective | UG : 4 weeks (18 Jan'21 - 9 Apr'21) : 24 Apr 2021

Intended Audience	: UG CSE, Electrical and Electronics Engineering, Electrical Engineering and Information
Technology.	
Pre-requisites	: Digital Design.
Industries Support	: Processor design industry like Intel, AMD, etc.

# COURSE OUTLINE:

Computer Organization and Architecture (COA) is a core course in the curricula of Computer Sciences as well as Electronics and Electrical Engineering disciplines at the second-year level in most of the Indian universities and technical institutions. This is the first course in COA and the course would provide students with an understanding of the design of fundamental blocks used for building a computer system and interfacing techniques of these blocks to achieve different configurations of an "entire computer system".

This course will be developed and taught with respect to Objectives based on Bloom's Taxonomy. First, we will highlight the main objectives the course is aimed to achieve. Following that, at each module, we will specify the module level objectives and demonstrate how these objectives meet the course level main goals in unison. At the leaf level i.e., the units, we will point the specific objectives of the lecture. Also, it will be demonstrated how the unit level objectives satisfy the parent module level objectives. Further, each module will have a module level problem which needs concepts of all the units therein to solve. Finally, a comprehensive course level problem related to design of "entire computer system" will be discussed which meets all the course level objectives.

# ABOUT INSTRUCTOR

Dr. Santosh Biswasb is an Associate Professor in the Dept. of CSE IIT Guwahati. He has an experience of 8 years in teaching. His research interests are Fault Tolerance, VLSI Testing, Embedded Systems.

Dr. J K Deka is a Professor in the Dept. of CSE IIT Guwahati. He has an experience of more than 20 years in teaching. His research interests are Formal Modelling and Verification, CAD for VLSI and Embedded Systems (Design, Testing and Verification), Data Mining.

Dr. Arnab Sarkar is an Asst. Professor in the Dept. of CSE IIT Guwahati. He has an experience of 3 years in teaching and about 2 years in industry. His research interests Real-Time and Embedded Systems, Computer Architecture, Algorithms.

# **COURSE LAYOUT**

Module 1: Basics: Functional Blocks in a Computer System, Number system and Computer Arithmetic (Week 1)

Module 2: Addressing Modes, Instruction Set and Instruction Execution Flow (Week 2, 3 and 4)

Module 3: Hardware and Micro-program based control Unit Design (Week 5, 6 and 7)

Module 4: Memory Architecture (Week 8, 9)

Module 5: Peripherals and Input-Output (Week 10, 11)

Module 6: Performance Enhancement of Processor (Week 12, 13)



**PROF. ANUPAM BASU** Department of Computer Science and Engineering IIT Kharagpur

**INTENDED AUDIENCE :** BE/BTech in all disciplines BCA/MCA/M. Sc **INDUSTRIES APPLICABLE TO :** All IT Industries

COURSE OUTLINE : This course is aimed at enabling the students to

- · Formulate simple algorithms for arithmetic and logical problems
- Translate the algorithms to programs (in C language)
- Test and execute the programs and correct syntax and logical errors
- Implement conditional branching, iteration and recursion

• Decompose a problem into functions and synthesize a complete program using divide and conquer approach

· Use arrays, pointers and structures to formulate algorithms and programs

Apply programming to solve matrix addition and multiplication problems and searching and sorting problems

• Apply programming to solve simple numerical method problems, namely rot finding of function, differentiation of function and simple integration

#### **ABOUT INSTRUCTOR :**

Prof. Anupam Basu is Professor in the Dept. of Computer Science Engineering, IIT Kharagpur, and has been an active researcher in the areas of Cognitive and Intelligent Systems, Embedded Systems and Language Processing, Presently he is acting as the Chairman and Head of the Center for Educational Technology, IIT Kharagpur. He has developed several embedded system based tools empowering the physically challenged and has led several national projects in the area. He has taught at the University of California, Irvine at the Center for Embedded Systems. He is an Alexander von Humboldt Fellow and a Fellow of the Indian National Academy of Engineering. The awards won by him include the State Award for the Best Contributions in design for the disabled, by National Council for Promotion of Employment of Disabled Persons, India, the National Award for the Best Technology Innovation for the Physically Disabled (2007) and the Da-Vinci Award 2004 from the Engineering Society of Detroit.

#### **COURSE PLAN :**

Week 1: Introduction to Problem Solving through programs, Flowcharts/Pseudo codes, the compilation

process, Syntax and Semantic errors, Variables and Data Types

Week 2: Arithmetic expressions, Relational Operations, Logical expressions; Introduction to Conditional

#### Branching

- Week 3: Conditional Branching and Iterative Loops
- Week 4: Arranging things : Arrays
- Week 5: 2-D arrays, Character Arrays and Strings
- Week 6: Basic Algorithms including Numerical Algorithms
- Week 7: Functions and Parameter Passing by Value
- Week 8: Passing Arrays to Functions, Call by Reference

Week 9: Recursion

- Week 10: Structures and Pointers
- Week 11: Self-Referential Structures and Introduction to Lists
- Week 12: Advanced Topics



# PROF. DEBASIS SAMANTA Department of Computer Science and Engineering

IIT Kharagpur

**PRE-REQUISITES** : This course requires that the students are familiar with programming language such as C/C++ and data structures, algorithms.

**INTENDED AUDIENCE :** The undergraduate students from the engineering disciplines namely CSE, IT, EE, ECE, etc. might be interested for this course.

**INDUSTRIES APPLICABLE TO :** All IT companies.

## COURSE OUTLINE :

With the growth of Information and Communication Technology, there is a need to develop large and complex software. Further, those software should be platform independent, Internet enabled, easy to modify, secure, and robust. To meet this requirement object-oriented paradigm has been developed and based on this paradigm the Java programming language emerges as the best programming environment. Now, Java programming language is being used for mobile programming, Internet programming, and many other applications compatible to distributed systems. This course aims to cover the essential topics of Java programming so that the participants can improve their skills to cope with the current demand of IT industries and solve many problems in their own field of studies.

### **ABOUT INSTRUCTOR :**

Prof. Debasis Samanta holds a Ph.D. in Computer Science and Engineering from Indian Institute of Technology Kharagpur. His research interests and work experience spans the areas of Computational Intelligence, Data Analytics, Human Computer Interaction, Brain Computing and Biometric Systems. Prof. Samanta currently works as a faculty member at the Department of Computer Science Engineering at IIT Kharagpur.

#### COURSE PLAN :

Week 1: Overview of Object-Oriented Programming and Java

Week 2: Java Programming Elements

Week 3: Input-Output Handling in Java

Week 4: Encapsulation

Week 5: Inheritance

Week 6: Exception Handling

- Week 7: Multithreaded Programming
- Week 8: Java Applets and Servlets
- Week 9: Java Swing and Abstract Windowing Toolkit (AWT)
- Week 10: Networking with Java
- Week 11: Java Object Database Connectivity (ODBC)
- Week 12: Interface and Packages for Software Development



# PROGRAMMING, DATA STRUCTURES AND ALGORITHMS USING PYTHON

#### **PROF. MADHAVAN MUKUND**

Department of Computer Science and Engineering Chennai Mathematical Institute

**INTENDED AUDIENCE**: Students in any branch of mathematics/science/engineering, 1st year

**PRE-REQUISITES** : School level mathematics.

**INDUSTRIES APPLICABLE TO** : This course should be of value to any company requiring programming skills.

#### **COURSE OUTLINE :**

This course is an introduction to programming and problem solving in Python. It does not assume any prior knowledge of programming. Using some motivating examples, the course quickly builds up basic concepts such as conditionals, loops, functions, lists, strings and tuples. It goes on to cover searching and sorting algorithms, dynamic programming and backtracking, as well as topics such as exception handling and using files. As far as data structures are concerned, the course covers Python dictionaries as well as classes and objects for defining user defined datatypes such as linked lists and binary search trees.

#### **ABOUT INSTRUCTOR :**

Prof. Madhavan Mukund studied at IIT Bombay (BTech) and Aarhus University (PhD). He has been a faculty member at Chennai Mathematical Institute since 1992, where he is presently Professor and Director. His main research area is formal verification. He has active research collaborations within and outside India and serves on international conference programme committees and editorial boards of journals.

He has served as President of both the Indian Association for Research in Computing Science (IARCS) (2011-2017) and the ACM India Council (2016-2018). He has been the National Coordinator of the Indian Computing Olympiad since 2002. He served as the Executive Director of the International Olympiad in Informatics from 2011-2014.

In addition to the NPTEL MOOC programme, he has been involved in organizing IARCS Instructional Courses for college teachers. He is a member of ACM India's Education Committee. He has contributed lectures on algorithms to the Massively Empowered Classroom (MEC) project of Microsoft Research and the QEEE programme of MHRD

#### **COURSE PLAN:**

Week 1:

Informal introduction to programmin, algorithms and data structures viaged Downloading and installing Python gcd in Python: variables, operations, control flow - assignments, condition-als, loops, functions Week 2: Python: types, expressions, strings, lists, tuples Python memory model: names, mutable and immutable values List operations: slices etc **Binary search** Inductive function denitions: numerical and structural induction Elementary inductive sorting: selection and insertion sort In-place sorting Week 3: Basic algorithmic analysis: input size, asymptotic complexity, O() notation Arrays vs lists Merge sort Quicksort Stable sorting Week 4: Dictionaries More on Python functions: optional arguments, default values Passing functions as arguments Higher order functions on lists: map, lter, list comprehension Week 5: Exception handling Basic input/output Handling files String processing Week 6: Backtracking: N Queens, recording all solutions Scope in Python: local, global, nonlocal names Nested functions Data structures: stack, queue Heaps Week 7: Abstract datatypes Classes and objects in Python "Linked" lists: find, insert, delete Binary search trees: find, insert, delete Height-balanced binary search trees Week 8: Effcient evaluation of recursive definitions: memoization Dynamic programming: examples Other programming languages: C and manual memory management Other programming paradigms: functional programming



# THE JOY OF COMPUTING USING PYTHON

#### PROF. SUDARSHAN IYENGAR

Department of Computer Science and Engineering IIT Ropar

#### **INTENDED AUDIENCE** : Any interested audience **PREREQUISITES** : 10th standard/high school

**INDUSTRY SUPPORT**: Every software company is aware of the potential of a first course in computer science. Especially of a first course in computing, done right.

#### COURSE OUTLINE :

A fun filled whirlwind tour of 30 hrs, covering everything you need to know to fall in love with the most sought after skill of the 21st century. The course brings programming to your desk with anecdotes, analogies and illustrious examples. Turning abstractions to insights and engineering to art, the course focuses primarily to inspire the learner's mind to think logically and arrive at a solution programmatically. As part of the course, you will be learning how to practice and culture the art of programming with Python as a language. At the end of the course, we introduce some of the current advances in computing to motivate the enthusiastic learner to pursue further directions.

#### **ABOUT INSTRUCTOR :**

Prof. Sudarshan Iyengar, Associate Professor at the CSE at IIT Ropar has a Ph.D. from the Indian Institute of Science (IISc). An exemplary teacher who has delivered over 350 popular science talks to students of high school and advanced graduate programmes. Prof. Sudarshan has offered more than 100 hours of online lectures with novel teaching methodologies that have reached lakhs of Students. His research interests include Data Sciences, Social Computing, Social Networks, Collective Intelligence, Crowdsourced Technologies and Secure Computation.

#### COURSE PLAN :

- Motivation for Computing
- Welcome to Programming!!
- Variables and Expressions : Design your own calculator
- Loops and Conditionals : Hopscotch once again
- · Lists, Tuples and Conditionals : Lets go on a trip
- Abstraction Everywhere : Apps in your phone
- Counting Candies : Crowd to the rescue
- Birthday Paradox : Find your twin
- Google Translate : Speak in any Language
- Currency Converter : Count your foreign trip expenses
- Monte Hall : 3 doors and a twist
- Sorting : Arrange the books
- Searching : Find in seconds
- Substitution Cipher : What's the secret !!
- Sentiment Analysis : Analyse your Facebook data
- 20 questions game : I can read your mind
- Permutations : Jumbled Words
- Spot the similarities : Dobble game
- Count the words : Hundreds, Thousands or Millions.
- Rock, Paper and Scissor : Cheating not allowed !!
- Lie detector : No lies, only TRUTH
- Calculation of the Area : Don't measure.
- · Six degrees of separation : Meet your favourites
- Image Processing : Fun with images
- Tic tac toe : Let's play
- Snakes and Ladders : Down the memory lane.
- Recursion : Tower of Hanoi
- Page Rank : How Google Works !!



# **ELECTRIC VEHICLES - PART 1**

**PROF. AMIT JAIN** Department of Electrical Engineering IIT Delhi

TYPE OF COURSE EXAM DATE

: Rerun | Elective | UG/PG COURSE DURATION : 4 weeks (21 Feb' 22 - 18 Mar' 22) : 24 Apr 2022

# **PRE-REQUISITES : BE (Electrical)**

**INTENDED AUDIENCE :** Interested Students

# COURSE OUTLINE :

This course will be a first level course on electric vehicle. Students will be able to understand the operation of battery driven electric vehicle. The course will start with introduction section which will enable the students to understand the focus areas that come under the umbrella of electric vehicles. Then the course will start covering this focus areas one by one such as vehicle dynamics, Motors, Power Electronics, Batteries, Charging etc. The most important part of this course will be that each topic will be analyzed and demonstrated through Matlab Simulink, so that the grip of the subject will be strong and the knowledge acquired will be useable in real time applications.

## **ABOUT INSTRUCTOR:**

Amit Kumar Jain is presently working as Associate Professor in Department of ElectricalEngineering, IIT Delhi. He is done his Ph.D and M.S from Department of ElectricalEngineering, I.I.Sc, Bangalore and spend around two years in General Electric GlobalResearch Center before joining IIT Delhi in 2012. He expertise includes electric drives forrenewable and electric vehicle application. He has also started a course on ElectricVehicles in IIT Delhi which is now been converted to NPTEL video course.

## **COURSE PLAN:**

Week 1: Introduction to Electric Vehicle

Week 2: Vehicle Dynamics: Modelling and Simulation

Week 3: Fundamental of Drives and DC Machine Modeling

Week 4: DC Machine Drives and Control of EV Using DC Machine

# Better Spoken English - Video course

# **COURSE OUTLINE**

Why Spoken English – Linguistic Aspects of Mishearing – Fluency - Speaking to Multicultural/Multidisciplinary Audience -Standard Varieties of Spoken English – Tempo of Speech & Phrasal Pause in English – English Rhythm - Stress on Simple and Derived Words in English – Long Vowels in English – Friction Consonants in English – Aspects of Theatre in Spoken Communication – Grooming, Eye Contact, Body Language, Amplitude – Preparing a Presentation : Charts, Graphs, Drawings, Maps, Diagrams, Tables, Etc – Research and Organization – Using Power Point Slides and Other Presentation Aids – Practice and Learning to Improve-Pronunciation of Numbers, Units of Weights, Distance, Etc. – Making Presentations and Self-Evaluation.



# Humanities and Social Sciences

# **Pre-requisites:**

 Ability to speak about familiar things in basic sentences in English.

# **Coordinators:**

Shreesh Chaudhary Humanities & Social SciencesIIT Madras

# COURSE DETAIL

SI. No.	Topic/s	
1	Why a course in Spoken English?	
2	Student Presentation : Cycle I : Who I am	
3	Feed Back on Presentation	
4	Aspects of Theatre in Formal Presentation : Grooming, Body Language, Eye Contact, Voice Modulation	
5	Linguistic Aspects of Mishearing	
6	A "Good" Tempo of Speech in English	

7	Announce Topic for Presentation : Cycle II : A Civic Problem in My Place			
8	Research and Organization of Presentation I : Sources of Information			
9	Research and Organization of Presentation II : Tables, Charts, Graphs			
10	Making Power Point Slides and Other Presentation Aid			
11	Criteria for (Self) Evaluation of Presentation			
12	Student Presentation : Cycle II : A Civic problem in My Place I			
13	Student Presentation : Cycle II : A Civic problem in My Place II			
14	Feedback on Presentation Cycle II			
15	Announce Topic for Cycle III : A Managerial Solution			
16	Grammar of Phrasal Pause in English			
17	Rhythm in Spoken English : <i>All I want's a room somewhere/ Far away</i>			
18	Rhythm in Spoken English – II			
19				
1	Phrasal Pause in Spoken English			
20	Phrasal Pause in Spoken English Phrasal Pause in Spoken English – II : Numbers, Units of Weight, Height			

	21	Listening to Units of Time, Weight, Distance, Etc.: <i>Take</i> <i>a Break</i>	
	22	Word Stress in English : Unique Features	
	23	Stress in Simple English Words – I	
	24	Stress in Simple English Words – II	
	25	Stress in Derived Words in English – I	
	26	Stress in Derived Words in English – II	
	27	Student Presentation Cycle III : A Solution – I	
	28	Student Presentation Cycle III : A Solution - II	
	29	Student Presentation Cycle III : A Solution - III	
	30	Feedback on Presentation Cycle III	
	31	Announce Topic for Cycle IV : Improving a Product/a Project	
	32	Listening to a Technical Conversation : Bid for Power	
	33	Preparing for and Presenting a Flow Chart, Diagram, Drawing, Etc.	
	34	Some "Difficult" Sounds in English - I	
,	35	Some "Difficult" Sounds in English – II	
	36	Student Presentation : Cycle IV – I	

37	Student Presentation : Cycle IV - II	
38	Student Presentation : Cycle IV - III	
39	Feed back on Presentation IV	
40	Conclusion of the Course	
References:		
<ul> <li>Chaudhary, Shreesh (1992/2004) Better Spoken English New Delhi : Vikas Publishing.</li> </ul>		
A joint ver	nture by IISc and IITs, funded by MHRD, Govt of India	http://nptel.iitm.ac.in



# ENHANCING SOFT SKILLS AND PERSONALITY

PROF.T. RAVICHANDRAN Department of Humanities and Social Sciences IIT Kanpur TYPE OF COURSE COURSE DURATION EXAM DATE : Rerun | Elective | UG/PG : 8 weeks (21 Feb' 22 - 15 Apr' 22) : 24 Apr 2022

**INTENDED AUDIENCE :** Students, Teachers, Professionals, Trainers, Leaders, Employers **INDUSTRIES APPLICABLE TO :** All industry/companies/organisations will recognize and value this course and recommend this for their employees and trainee programs.

#### COURSE OUTLINE :

The course aims to cause an enhanced awareness about the significance of soft skills in professional and interpersonal communications and facilitate an all-round development of personality. Hard or technical skills help securing a basic position in one's life and career. But only soft skills can ensure a person retain it, climb further, reach a pinnacle, achieve excellence, and derive fulfilment and supreme joy. Soft skills comprise pleasant and appealing personality traits as self-confidence, positive attitude, emotional intelligence, social grace, flexibility, friendliness and effective communication skills. The focus of this course is on interpersonal and management skills. It has been approved for "Faculty Development Programme" by AICTE.

#### ABOUT INSTRUCTOR :

Prof. T. Ravichandran is presently a Professor of English in the Department of Humanities and Social Sciences at the Indian Institute of Technology Kanpur, Uttar Pradesh, India. He has written about fifty research articles/book chapters, supervised six doctoral theses, edited a special issue on Cyberpunk Literature for the Creative Forum Journal, and published a book on Postmodern Identity. He is a recipient of the Fulbright-Nehru Academic and Professional Excellence Fellowship (2014-15) for his research/teaching at Duke University, North Carolina, USA. He is honored with Champa Devi Gangwal Chair Professorship at IIT Kanpur. In his distinguished twenty-five years of teaching career, he has taught various courses in English Language and Literature. His NPTEL Video and Web courses on Communication Skills are well-acclaimed nationally and internationally. His NPTEL MOOC on Developing Soft Skills and Personality became hugely popular and well-received by about fifteen thousand participants from India and abroad.

#### **COURSE PLAN:**

**Week 1**: Highlights of Developing Soft Skills and Personality Course-1-24; Highlights of Developing Soft Skills and Personality Course-25-48; Definitions and Types of Mindset; Learning Mindsets; Secrets of Developing Growth Mindsets

**Week 2**: Importance of Time and Understanding Perceptions of Time ; Using Time Efficiently ; Understanding Procrastination ; Overcoming Procrastination ; Don't Say "Yes" to Make Others Happy!

**Week 3 :** Types of People ; How to Say "No" ; Controlling Anger ; Gaining Power from Positive Thinking-1 ; Gaining Power from Positive Thinking-2

**Week 4 :** What Makes Others Dislike You? ; What Makes Others Like You?-1 ; What Makes Others Like You?-2 ; Being Attractive-1 ; Being Attractive-2

Week 5 : Common Errors-1 ; Common Errors-2 ; Common Errors-3 ; Common Errors-4 ; Common Errors-5

**Week 6 :** Humour in Communication ; Humour in the Workplace ; Function of Humour in the Workplace ; Money and Personality ; Managing Money

**Week 7**: Health and Personality ; Managing Health-1: Importance of Exercise ; Managing Health-2: Diet and Sleep ; Love and Personality ; Managing Love

**Week 8 :** Ethics and Etiquette ; Business Etiquette ; Managing Mind and Memory ; Improving Memory ; Care for Environment ; Highlights of the Course



# **INTRODUCTION TO FLUID MECHANICS**

**PROF. SUMAN CHAKRABORTY** Department of Mechanical Engineering **IIT Kharagpur** 

TYPE OF COURSE EXAM DATE

: Rerun | Core | UG COURSE DURATION : 12 weeks (24 Jan' 22 - 15 Apr' 22) : 24 Apr 2022

**PRE-REQUISITES :** Basic knowledge of Mathematics

# **INTENDED AUDIENCE : Interested students**

INDUSTRIES APPLICABLE TO: Oil Companies (IOCL, SHELL, BPCL and others), Automobile and Aviation companies (GE, AIRBUS, TATA Motors and others)

# **COURSE OUTLINE :**

This is an introductory course in Fluid Mechanics. The subject Fluid Mechanics has a wide scope and is of prime importance in several fields of engineering and science. Present course emphasizes the fundamental underlying fluid mechanical principles and application of those principles to solve real life problems. Special attention is given towards deriving all the governing equations starting from the fundamental principle. 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 fundamental understanding of the basic principles of Fluid Mechanics and will be able to apply the basic principles to analyze fluid mechanical systems.

# **ABOUT INSTRUCTOR :**

Prof. 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, with particular focus on biomedical applications. He has been awarded the Santi Swaroop Bhatnagar Prize in the year 2013, which is the highest Scientific Award from the Government of India.

# **COURSE PLAN:**

- Week 1: Introduction and Basic Principles
- Week 2: Properties of Fluids
- Week 3: Properties of Fluids and Fluid Statics
- Week 4: Fluid Statics
- Week 5: Fluid Kinematics (Part I)
- Week 6: Fluid Kinematics (Part II)
- Week 7: Dynamics of Inviscid Flows (Part I)
- Week 8: Dynamics of Inviscid Flows (Part II)
- Week 9: Integral Forms of Control Volume Conservation Equations (Part I)
- Week 10: Integral Forms of Control Volume Conservation Equations (Part II)
- Week 11: Integral Forms of Control Volume Conservation Equations (Part III); Dynamics of Viscous Flows (Part I)
- Week 12: Dynamics of Viscous Flows (Part II)



# **INSPECTION AND QUALITY CONTROL IN** MANUFACTURING

**PROF. KAUSHIK PAL** Department of Mechanical Engineering **IIT Roorkee** 

TYPE OF COURSE EXAM DATE

: Rerun | Elective | UG/PG COURSE DURATION : 4 weeks (21Feb' 22 - 18 Mar' 22) : 23 Apr 2022

INTENDED AUDIENCE : UG & PG students of Mechanical Engg., Automobile Engg., Welding Engg., Metallurgy, Chemical Engg, Aerospace Engg, Material Science, Manufacturing and Production Engg. etc. R&D personals in industries.

**INDUSTRIES APPLICABLE TO**: Manufacturing based industries: TATA Motors, ISRO, DRDO, Railways,

BHEL, IOCL, Bharat Forge, Larsen and Toubro, Mahindra & Mahindra; etc

## **COURSE OUTLINE :**

In manufacturing, quality control is a process that ensures customers receive products free from defects and meet their requirements. Inspection and measurement is needed during production for quality control because of the inherent variability introduced by the machines, tools, raw materials, and human operators which causes variations in the different quality characteristics (length, diameter, thickness, tensile strength, surface finish etc.) of the product. Inspection and testing is very important in maintaining a certain quality level in the product during production. It helps to control the quality of products by fixing the sources of defects immediately after they are detected. Several non-destructive inspection methods also help to perform in-service inspection to avoid any catastrophic failure and predict the remaining life of the product.

#### **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 1: Introduction, Fundamental Concept of Quality, Role of Inspection and Measurement for Quality Control in Manufacturing, Need of Inspection, Inspection types and Principles, Design for Inspection, Destructive Inspection, Testing of Composite Materials
- Week 2: Non-destructive Inspection-I: Visual Inspection, Dye Penetrant Inspection, Magnetic Particle Inspection, Eddy Current Inspection, Ultrasonic Testing
- Week 3: Non-destructive Inspection-II: Acoustic Emission Inspection, Radiography, Leak Testing, Thermographic Non-destructive Testing, Advanced Non-destructive Techniques, NDT Standards, Safety in NDT
- Week 4: Engineering Metrology: Linear Measurement, Angular Measurement, Measurement of Surface Finish, Screw Thread Metrology, Gear Measurement, Miscellaneous Measurements



# THEORY AND PRACTICE OF NON DESTRUCTIVE TESTING

PROF. RANJIT BAURI Department of Metallurgical and Materials Engineering IIT Madras TYPE OF COURSE: Rerun | Elective | UG/PGCOURSE DURATION: 8 weeks (24 Jan' 22 - 18 Mar' 22)EXAM DATE: 27 Mar 2022

PRE-REQUISITES : BE/Diploma in Engineering Mech/Material Engg)

(Mech/Manufac/Production/Civil/Aerospace/App.

**INTENDED AUDIENCE :** Students, Researchers, Practicing Engineers **INDUSTRIES APPLICABLE TO :** Manufacturing and Automotive Industries

## COURSE OUTLINE :

Nondestructive Testing (NDT) plays an extremely important role in quality control, flaw detection and structural health monitoring covering a wide range of industries. There are varieties of NDT techniques in use. This course will first cover the fundamental science behind the commonly used NDT methods to build the basic understanding on the underlying principles. It will then go on to cover the process details of each of these NDT methods.

## ABOUT INSTRUCTOR :

Prof. Ranjit Bauri is an Professor in the Dept. of Metallurgical and Materials Engineering, IIT Madras. He has more than a decade of experience in teaching NDT theory and practical courses. He is a life member of Indian Society for Non Destructive Testing (ISNT). He is also a seasoned researcher with more than a decade of research experience. His research areas include Composite materials, Al alloys, Friction stir welding and processing, Powder Metallurgy and Microscopy.

## COURSE PLAN :

- **Week 1:** Introduction to NDT, Visual Optical methods, Dye penetrant testing, Basic principle, Types of dye and methods of application, Developer application and Inspection.
- **Week 2:** Magnetic particle testing, Basic theory of magnetism, Magnetization methods, Field indicators, Particle application, Inspection.
- **Week 3:** Eddy current testing, Basic principle; Faraday's law, Inductance, Lenz's law,Self and Mutual Inductance, Impedance plane, Inspection system and probes,System calibration.
- Week 4: Ultrasonic testing: Basics of ultrasonic waves, Pulse and beam shapes, Ultrasonic transducers.
- Week 5: Test method, Distance and Area calibration, Weld inspection by UT.
- **Week 6:** Acoustic emission testing: Basic principle, Sources of acoustic emission, Source parameters, Kaiser-Felicity theory, Equipment and Data display, Source location schemes.
- Week 7: Radiography: X-rays and their properties, X-ray generation, X-ray absorption and atomic scattering.
- **Week 8:** Image formation, Image quality, Digital Radiography, Image interpretation, Radiation Shielding. Comparison and selection of NDT methods, Concluding remarks.



# AN INTRODUCTION TO PROGRAMMING THROUGH C++

PROF. ABHIRAM G. RANADE Department of Computer Science **IIT Bombay** 

TYPE OF COURSE EXAM DATE

: Rerun | Core | UG **COURSE DURATION** : 12 weeks (24 Jan' 22 - 15 Apr' 22) : 24 Apr 2022

**PRE-REQUISITES :** Standard XII in the Science stream.

**INTENDED AUDIENCE**: First and second year students in degree programs including Engineering and Science degree programs.

**INDUSTRIES APPLICABLE TO**: Basic programming is of value to all. C++ allows you to design very fast programs and access low level machine features, but at the same time its libraries provide a very high level programming model. It can be considered a modern, safer version of the C language.

#### **COURSE OUTLINE :**

This course provides an introduction to problem solving and programming using the C++ programming language. The topics include: Basic programming notions. Control flow, variables and assignments state- ments, conditional execution, looping, function calls including recursion. Arrays and structures. Elementary aspects of classes. Heap memory. Program design. How human beings solve problems manually. Strategies for translating manual strategies to computer programs. Organizing large programs into units such as functions and classes. Introduction to assertions and invariant. Programming applications. Arithmetic on polynomials, matrices. Root finding. Sorting and searching. Design of editors and simulators, including graphical editors. Elementary animation. A rudimentary graphics system will be discussed. Standard Library of C++. The string, vector and map classes.

#### **ABOUT INSTRUCTOR :**

Prof. Abhiram G. Ranade is a Professor of Computer Science and Engineering at IIT Bombay. He obtained a B. Tech. degree in Electrical Engineering from IIT Bombay in 1981. In 1988 he obtained a Ph.D. in Computer Science from Yale University, USA. He was an Assistant Professor of Electrical Engineering and Computer Science at the University of California, Berkeley, USA during 1988-94. Since 1995 he has been a faculty member in IIT Bombay. His research interests are Algorithms, Combinatorial Optimization, Scheduling in Transportation Systems, and Programming Education. He has won Excellence in Teaching Awards of IIT Bombay in 2006-7 and 2010-11.

#### **COURSE PLAN:**

- Week 1: Introduction to computers using graphics. Notions of program organization, control flow.
- Week 2: Basic data types. Variables. Assignment statement. Introduction to program design using examples such as summing infinite series.
- Week 3: Statements of C++ for conditional execution and looping.
- Week 4: Applications such as computing mathematical functions, root finding.
- Week 5: Functions. Parameter passing. Recursion. Correctness issues.
- Week 6: Recursive algorithms and recursive drawings. Breaking larger programs into functions.
- Week 7: Arrays. Basic array processing strategies including passing arrays to functions. Pointers. Applications illustrating use of arrays to store sets and sequences. Iterating over pairs of objects from an array, Selection sort.
- Week 8: Use of arrays to represent textual data. Multidimensional arrays. Command line arguments. Binary search. Merge sort.
- Week 9: Structures. Pointers with structures. Structure examples.
- Week 10: Dynamic memory allocation. Basic mechanisms and pitfalls.
- **Week** 11: Use of the standard library in designing programs. Design of medium size programs.
- Week 12: A program for designing and solving resistive circuits with a graphical user interface.



#### PROF. PARTHA PRATIM DAS

Department of Computer Science and Engineering IIT Kharagpur

#### PROF. SAMIRAN CHATTOPADHYAY

Department of Computer Science and Engineering IIT Kharagpur

**PRE-REQUISITES :** Procedural and / or Object-Oriented Programming (C / C++ / Java / Python), Data Structures, Algorithms

**INTENDED AUDIENCE :** Students from all disciplines can enroll for this course.

**INDUSTRIES APPLICABLE TO**: DBMS is so fundamental that all companies dealing with systems as well as application development (including web, IoT, embedded systems, data mining, machine learning) have a need for the same.These include – Microsoft, Samsung, Xerox, Yahoo, Google, IBM, TCS, Infosys, Amazon, Flipkart, etc.

# COURSE OUTLINE :

Databases form the backbone of all major applications today – tightly or loosely coupled, intranet or internet based, financial, social, administrative, and so on. Structured Database Management Systems (DBMS) based on relational and other models have long formed the basis for such databases. Consequently, Oracle, Microsoft SQL Server, Sybase etc. have emerged as leading commercial systems while MySQL, PostgreSQL etc. lead in open source and free domain. While DBMS's differ in details, they share a common set of models, design paradigms and a Structured Query Language (SQL).

While DBMS's differ in the details, they share a common set of models, design paradigms and a Structured Query Language (SQL). In this background the course examines data structures, file organizations, concepts and principles of DBMS's, data analysis, database design, data modeling, database management, data & query optimization, and database implementation. More specifically, the course introduces relational data models; entity-relationship modeling, SQL, data normalization, and database design. Further it introduces query coding practices using MySQL (or any other open system) through various assignments. Design of simple multi-tier client / server architectures based and Web-based database applications is also introduced.

#### **ABOUT INSTRUCTOR :**

Prof. Partha Pratim Das received his BTech, MTech and PhD degrees in 1984, 1985 and 1988 respectively from IIT Kharagpur. He served as a faculty in Department of Computer Science and Engineering, IIT Kharagpur from 1988 to 1998. In 1998, he joined Alumnus Software Ltd as a Business Development Manager. From 2001 to 2011, he worked for Interra Systems, Inc. as a Senior Director and headed its Kolkata Center. In 2011, he joined back to Department of Computer Science and Engineering, IIT Kharagpur as Professor. Prof. Das has also served as a Visiting Professor with Institute of Radio Physics and Electronics, Calcutta University from 2003 to 2013.

Prof. Das is currently the Head of Rajendra Mishra School of Engineering Entrepreneurship, the Professor-inCharge of the upcoming Research Park of IIT Kharagpur at Rajarhat, Kolkata, and the Joint Principal Investigator of National Digital Library of India project of MHRD.

Prof. Das has taught several courses in Computer Science including Software Engineering, Object-Oriented Systems, Programming and Data Structure, Compiler Design, Design and Analysis of Algorithms, Information System Design, Database Management Systems, Computational Geometry, Principles of Programming Languages, Embedded Systems, and Image Processing. Jointly with 2 others, he has also offered a course on Introduction to Design of Algorithms under the T10KT program of NME-ICT, MHRD (https://www.facebook.com/t10kt.algorithms/) to nearly 7000 teachers. Further, Dr. Das has been offering Programming in C++ and Object-Oriented Analysis and Design in NPTEL-NOC. Both courses are regularly attended by thousands of students.

Prof. Das has published over 40 technical papers in international journals in areas of Digital Geometry, Image Processing, Parallel Computing and Knowledge-based Systems. In 2013 he has co-authored a research monograph titled Digital Geometry in Image Processing (CRC Press). His current interests include Human-Computer Interactions, Computer Analysis of Indian Classical Dance, Object-Oriented Systems Analysis and Design, Software Engineering, Compiler Technology, and Technology Enabled Learning. Dr. Das is a member of Association of Computing Machinery (ACM), The Institute of Electrical and Electronics Engineers (IEEE), and Indian Unit for Pattern Recognition and Artificial Intelligence (IUPRAI).

Prof.Samiran Chattopadhyay obtained his B Tech and M Tech degree in 1987 and 1989 respectively from IIT Kharagpur. He obtained his PhD degree from Jadavpur University in 1993. He served as a faculty in the Department of Computer Science and Engineering, Jadavpur University from 1989 to 1993. In 1993, he moved to industry and joined back the same department in Jadavpur University as an Associate Professor in 1997. Since 2001, he is a Professor of Information Technology in Jadavpur University.

Prof. Chattopadhyay is also a visiting fellow of the University of Northumbria, Newcastle upn Tyne UK. He was an adjunct faculty at IIT Kharagpur for the Distributed Systems course and a visiting faculty member for the MTech course by IIT Kharagpur which was offered in distance learning mode.

Dr. Chattopadhyay has more than two decades of experience of serving reputed Industry houses including Mindware, Computer Associates TCG Software, Interra Systems India Ltd. He is also a project consultant of the prestigious National Digital Library Mission of Government of India.

Pro. Chattopadhyay has taught several courses in Computer Science including Software Engineering, Object-Oriented Systems, Programming and Data Structure, Compiler Design, Design and Analysis of Algorithms, Information System Design, Database Management Systems, Ad hoc Wireless Networks, Cloud Computing. Dr. Chattopadhyay has been a co-faculty in Database Management Systems in NPTEL-NOC.

Prof. Chattopadhyay has published over 60 technical papers in international journals in the areas of Wireless Networks, Network Security, Machine learning applications. He has co- authored a research monograph titled 'Digital Geometry in Image Processing', a textbook titled 'Data Structures through C' and 'Big Data in e-Healthcare'. His current research interests include Network Security, Machine learning, Wireless network and Pervasive computing.

## COURSE PLAN :

- Week 1: Course Overview, Introduction to RDBMS
- Week 2: Structured Query Language (SQL)
- Week 3: Relational Algebra, Entity-Relationship Model
- Week 4: Relational Database Design
- Week 5: Application Development, Case Studies, Storage and File Structure
- Week 6: Indexing and Hashing, Query Processing
- Week 7: Query Optimization, Transactions (Serializability and Recoverability)
- Week 8: Concurrency Control, Recovery Systems, Course Summarization



# **DESIGN PRACTICE**

# **PROF. SHANTANU BHATTACHARYA** Department of Mechanical Engineering IIT Kanpur

TYPE OF COURSE COURSE DURATION EXAM DATE Rerun | Elective | UG/PG
8 weeks (21 Feb' 22 - 15 Apr' 22)
24 Apr 2022

INTENDED AUDIENCE : Students and Faculty of BE/ME/MS/BSc/MSc streas

**INDUSTRY SUPPORT** : SMIL (Gurgaon), HAL Kanpur and Lucknow, Small & 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 : Introduction to Design/Product design

Week 2 : Stanford model of Design thinking/ Stages of engineering design of products/

Introduction to Concurrent engineering

Week 3 : Concurrent engineering in Practice

- Week 4 : Concurrent engineering in Practice
- Week 5 : Product embodiment design(robustness of design/FMEA techniques).
- Week 6 : House of quality, Specifications (Fits and Tolerances), Axiomatic Design, Introduction to

Group Technology, Creating forms and shapes.

Week 7 : Geometric transformation models, Introduction to electronics

Week 8 : Material selection process in design, Applied Ergonomics (work systems design,

Introduction to bio-mechanics)



# **ETHICAL HACKING**

# **PROF. INDRANIL SENGUPTA**

Dept. of Computer Science and Engineering IIT Kharagpur

**INTENDED AUDIENCE :** Computer Science and Engineering / Information Technology / Electronics and Communication Engineering / Electrical Engineering

**PREREQUISITES** : Basic concepts in programming and networking

INDUSTRIES APPLICABLE TO : TCS, Wipro, CTS, Google, Microsoft, Qualcomm

### **COURSE OUTLINE**

Ethical hacking is a subject that has become very important in present-day context, and can help individuals and organizations to adopt safe practices and usage of their IT infrastructure. Starting from the basic topics like networking, network security and cryptography, the course will cover various attacks and vulnerabilities and ways to secure them. There will be hands-on demonstrations that will be helpful to the participants. The participants are encouraged to try and replicate the demonstration experiments that will be discussed as part of the course.

#### ABOUT INSTRUCTOR

Prof. Indranil Sengupta has obtained his B.Tech., M.Tech. and Ph.D. degrees in Computer Science and Engineering from the University of Calcutta. He joined the Indian Institute of Technology, Kharagpur, as a faculty member in 1988, in the Department of Computer Science and Engineering, where he is presently a full Professor. He had been the former Heads of the Department of Computer Science and Engineering and also the School of Information Technology of the Institute. He has over 28 years of teaching and research experience. He has guided 22 PhD students, and has more than 200 publications to his credit in international journals and conferences. His research interests include cryptography and network security, VLSI design and testing, and mobile computing.

He is a Senior Member of IEEE. He had been the General Chairs of Asian Test Symposium (ATS-2005), International Conference on Cryptology in India (INDOCRYPT-2008), International Symposium on VLSI Design and Test (VDAT-2012), International Symposium on Electronic System Design (ISED-2012), and the upcoming Conference on reversible Computation (RC-2017). He had delivered invited and tutorial talks in several conferences in the areas of VLSI design and testing, and network security.

#### **COURSE PLAN**

Week 1: Introduction to ethical hacking. Fundamentals of computer networking. TCP/IP protocol stack.

Week 2: IP addressing and routing. TCP and UDP. IP subnets.

Week 3: Routing protocols. IP version 6.

**Week 4:** Installation of attacker and victim system. Information gathering using advanced google search, archive.org, netcraft, whois, host, dig, dnsenum and NMAP tool.

**Week 5:** Vulnerability scanning using NMAP and Nessus. Creating a secure hacking environment. System Hacking: password cracking, privilege escalation, application execution. Malware and Virus. ARP spoofing and MAC attack.

Week 6: Introduction to cryptography, private-key encryption, public-key encryption.

Week 7: Cryptographic hash functions, digital signature and certificate, applications.

Week 8: Steganography, biometric authentication, network-based attacks, DNS and Email security.

**Week 9:** Packet sniffing using wireshark and burpsuite, password attack using burp suite. Social engineering attacks and Denial of service attacks.

Week 10: Elements of hardware security: side-channel attacks, physical inclinable functions, hardware trojans.

Week 11: Different types of attacks using Metasploit framework: password cracking, privilege escalation, remote code execution,

etc.Attack on web servers: password attack, SQL injection, cross site scripting.

Week 12: Case studies: various attacks scenarios and their remedies.



# **FLUID MACHINES**

**PROF. SUMAN CHAKRABORTY** Dept. of Mechanical Engineering IIT Kharagpur TYPE OF COURSE COURSE DURATION EXAM DATE

: Rerun | Core | UG : 8 weeks (23 Aug'21 - 15 Oct'21) : 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 the School of Medical Science and Technology. He is also the AssociateDean for Sponsored Research and Industrial Consultancy. His currentareas of research include microflu idics, nanofluidics, micro-nano scaletransport, with particular focus on biomedical applications. He has beenawarded the Santi Swaroop Bhatnagar Prize in the year 2013, which is the 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 of his 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



#### **PROF. SUBASHISA DUTTA**

Department of Civil Engineering IIT Guwahati

#### COURSE OUTLINE :

Fluid Mechanics is an inter-disciplinary course covering the basic principles and has applications in Civil Engineering, Mechanical Engineering and Chemical Engineering. The students will have new problem solving approaches like control volume concept and streamline patterns which are now a days required to solve the real-life complex problems. The visualization of the fluid-flow problems will be demonstrated to enhance student's interest on the subject.

# ABOUT INSTRUCTOR :

Prof. Dutta has more than 15years experience of teaching in IIT Guwahati for both undergraduate and postgraduate students the Fluid Mechanics course in undergraduate level was instructed five times by Prof. Dutta. Besides this, he has developed an NPTEL web course on Fluid Mechanics for undergraduate students. As a part of research and consultancies work Prof Dutta has done mathematical modeling of different rivers like the Brahmaputra. In this course, some of the real life problems will be discussed.

#### **COURSE PLAN :**

Week-1: Introduction And Basic Concepts

- Week-2: Properties Of Fluids
- Week-3: Pressure And Fluid Statics
- Week-4: Fluid Kinematics

Week-5: Mass, Bernoulli, And Energy Equations

Week-6: Momentum Analysis Of Flow Systems

Week-7: Dimensional Analysis And Modeling

Week-8: Flow In Pipes

- Week-9: Differential Analysis Of Fluid Flow
- Week-10: Approximate Solution Of Navier Stokes Equation
- Week-11: Drag And Lift
- Week-12: Introduction To Open Channel Flow



PROF.SHYAMANTA M. HAZARIKA Department of Mechanical Engineering IIT Guwahati

# **PRE-REQUISITES** : Basic Course in Probability and Linear Algebra

# **INTENDED AUDIENCE :** Final Year B.Tech/M.Tech and PhD students **COURSE OUTLINE :**

What does automatic scheduling or autonomous driving have in common with web search, speech recognition, and machine translation? These are complex real-world problems that span across various practices of engineering! Aim of artificial intelligence (AI) is to tackle these problems with rigorous mathematical tools. The objective of this course is to present an overview of the principles and practices of AI to address such complex real-world problems. The course is designed to develop a basic understanding of problem solving, knowledge representation, reasoning and learning methods of AI.

# ABOUT INSTRUCTOR :

Prof. Shyamanta M Hazarika is a Professor of Mechanical Engineering at IIT Guwahati and leads the Biomimetic Robotics and Artificial Intelligence Lab. His research interest is in Rehabilitation Robotics. This translates into interest in Artificial Intelligence, Biomimetic Robotics and Robotic Neurorehabilitation. Prior to joining IIT Guwahati, he was with the Department of Computer Science and Engineering, Tezpur University. He has been a Vertretungsprofessur of Cognitive Systems and NeuroInformatics, University of Bremen, Germany. Prof. Hazarika holds a B.E. in Mechanical Engineering from Assam Engineering College, Guwahati, India; M.Tech. in Robotics from Center for Robotics, IIT Kanpur, India. He completed his PhD in Artificial Intelligence (Knowledge Representation and Reasoning) from School of Computing, University of Leeds, England.

# COURSE PLAN :

Week 1: AI and Problem Solving by Search

Week 2: Problem Solving by search

Week 3: Problem Solving by search (contd)

Week 4: Knowledge Representation and Reasoning

Week 5: Knowledge Representation and Reasoning (Contd)

Week 6: Knowledge Representation and Reasoning (contd)

Week 7: Reasoning under uncertainty

Week 8: Planning

Week 9: Planning and Decision Making

Week 10:Machine Learning

Week 11: Machine Learning (contd)

Week 12: Machine Learning (contd)



**PROF. N.P. PADHY** Department of Electrical Engineering IIT Roorkee

**PROF. PREMALATA JENA** Department of Electrical Engineering IIT Roorkee

**INTENDED AUDIENCE :** UG/PG/PhD students, Industries and academic professionals

**PRE-REQUISITES** : Basic Understanding of Power System and Power Electronics Engineering

**INDUSTRY SUPPORT :** State Power Transmission and Distribution companies, DISCOMs, TRANSCO, POWER GRID, Private sector: ABB, Schneider, Siemens, etc.

# **COURSE OUTLINE :**

This course covers the fundamental aspects of the smart grid and its application to the existing power system. It introduces state-of-the-art smart grid technologies like electric vehicles, AC/DC microgrids, energy storage, phasor measurement unit, cyber security, etc. In addition, the course talks about the trends, modeling, planning, operation, and control of energy storage technologies. Further, it discusses the architecture, operation, and control strategy of AC, DC, and hybrid AC-DC microgrids. This course also emphasizes on renewable energy sources integration into the present grid and microgrids, and further explores its operation, analysis, management, control, protection, and monitoring issues. The laboratory-scale demonstrations have been provided to validate a few concepts covered in this course.

# **ABOUT INSTRUCTOR:**

Prof. Narayana Prasad Padhy received the Ph.D. degree in power systems engineering from Anna University, Chennai, India, in 1997. He is working as Professor (HAG) with the Department of Electrical Engineering, Indian Institute of Technology (IIT) Roorkee, Roorkee, India. He is currently the Director of the Malaviya National Institute of Technology (MNIT), Jaipur, India and the mentor director of the Indian Institute of Information Technology (IIIT) Kota. Earlier he has served as Dean of Academic Affairs, Institute, NEEPCO, 92 Batch and Ravi Mohan Mangal Institute Chair Professors at IIT Roorkee. He is the National lead of many national and international projects such as DSIDES, ID-EDGe, and HEAPD. He is also part of other international projects, namely Indo-US UI-ASSIST and Indo-UK ZED-I. He has published more than 200 research articles in reputed international journals and conference proceedings. His research interests include power system analysis, demand-side management, energy market, network pricing, AC–DC smart grid, and application of machine learning techniques in power systems. Dr. Padhy is also a Fellow of the Indian National Academy of Engineers (INAE), Fellow Institution of Electronics and Telecommunication Engineers, India, Fellow Institution of Engineering and Technology, UK, and Fellow of Institution of Engineers, Relia. He was the recipient of the IEEE smart cities jury award 2022, IEEE PES Outstanding Engineers Award 2018, Boyscast Fellowship and the Humboldt Experienced Research Fellowship in the year 2005 and 2009, respectively.

Prof. Premalata Jena (Senior Member IEEE, Young Associate, INAE) received the M. Tech and Ph. D degree in Power System Engg. from the Department of Electrical Engineering, Indian Institute of Technology Kharagpur, Kharagpur, India, in 2006 and 2011 respectively. She is currently working as an Associate Professor in the Department of Electrical Engineering, Indian Institute of Technology, Roorkee, India since 2012. She has executed various sponsored research projects sanctioned by DST, SERB, CPRI, MHRD and THDC INDIA Ltd. She has published several research articles in reputed international journals and conference proceedings. Dr. Jena is a recipient of SERB POER Fellowship from SERB, DST in 2022. Dr. Jena is a recipient of the Women Excellence Award-2017 from DST, New Delhi. Dr. Jena is a recipient of the Young Engineer Award, Indian National Academy of Engineering, and POSOCO Power System Award, Power Grid Corporation of India Ltd., India, in 2013. Her research interest includes power system protection, Electric Vehicle, Grid Integration issues of Electric Vehicle, Optimal sizing and placement of batteries, Cybersecurity issues in Smart Grid, AC, DC, and Hybrid AC-DC microgrid protection issues due to the integration of renewable sources and electric vehicles with the existing power grid.

# **COURSE PLAN:**

#### Week 1:

- Introduction to Smart Grid-I.
- Introduction to Smart Grid-II.
- Architecture of Smart Grid system
- Standards for Smart Grid system
- Elements and Technologies of Smart Grid System-I

#### Week 2:

- Elements and Technologies of Smart Grid System-II
- Distributed Generation Resources-I
- Distributed Generation Resources-II
- Distributed Generation Resources-III
- Distributed Generation Resources-IV

#### Week 3:

- Introduction to energy storage devices
- Different types of energy storage technologies
- Analytical modelling of energy storage devices
- Optimal sizing and siting of storages
- Battery management system (BMS)

#### Week 4:

- Wide area Monitoring Systems-I
- Wide area Monitoring Systems-II
- Phasor Estimation-I
- Phasor Estimation-II
- Digital Relays for Smart Grid Protection

#### Week 5:

- Islanding Detection Techniques-I
- Islanding Detection Techniques -II
- Islanding Detection Techniques -III
- Smart Grid Protection-I
- Smart Grid Protection-II

#### Week 6:

- Smart Grid Protection-III
- Smart Grid Protection-IV
- Modelling of storage devices
- Modelling of DC smart grid components
- Operation and control of AC Microgrid-I

#### Week 7:

- Operation and control of AC Microgrid -II
- Operation and control of DC Microgrid -I
- Operation and control of DC Microgrid -II
- Operation and control of AC-DC hybrid Microgrid -I
- Operation and control of AC-DC hybrid Microgrid -II

#### Week 8:

- Phasor measurement unit placement
- Cyber security and resiliency
- Virtual inertia and ancillary support
- Demand side management of smart grid
- Demand Response Analysis of smart grid

#### Week 9:

- Demonstration of solar power generation
- Demonstration of wind power generation
- Demonstration of Battery Management System
- Demonstration of EV charging system
- Hierarchical control techniques in hybrid ac-dc microgrid

#### Week 10:

- Simulation and case study of AC Microgrid
- Simulation and case study of DC Microgrid
- Simulation and case study of AC-DC Hybrid microgrid
- Demonstration of parallel inverter operation in AC microgrid
- Harmonic effects and its mitigation techniques

#### Week 11:

- Energy management
- Design of Smart Grid and Practical Smart Grid Case Study-I
- Design of Smart Grid and Practical Smart Grid Case Study-II
- System Analysis of AC/DC Smart Grid
- Demonstration of grid-connected DC microgrid

#### Week 12:

- Demonstration of energy management in microgrid
- Demonstration of PHIL experimentation for symmetric and asymmetric fault analysis of grid-connected DFIG wind turbine.
- Demonstration of ancillary support from virtual synchronous generator
- Demonstration on peak energy management using energy storage system.
- Conclusions



# MANUFACTURING AUTOMATION

**PROF. SOUNAK KUMAR CHOUDHURY** Department of Mechanical Engineering **IIT Kanpur** 

TYPE OF COURSE EXAM DATE

: Rerun | Elective | UG COURSE DURATION : 4 weeks (24 Jan' 22 - 18 Feb' 22) : 27 Mar 2022

## **PRE-REQUISITES :** Basic Engineering Courses

INTENDED AUDIENCE : Mechanical Engineering, Metallurgy, Aerospace Engineering, Production Engineering **INDUSTRIES APPLICABLE TO** : All Manufacturing industries, Machine tool manufacturing industries, Automobile Industries and aeronautical assembly industries **COURSE OUTLINE :** 

The course will basically deal with the following topics: Introduction: Definition; Types of automation; Reasons for automating; Automation strategies.Detroit type automation : Automated flow lines: types and their selection; Methods of workpart transport; Transfer mechanisms; Controlling of automated flow lines. Analysis of automated flow lines: System aspects of designing and running the line; Average production time and production rate; Line efficiency; Analysis of transfer lines without storage - upper bound and lower bound approach; Partial automation.Automated assembly systems: Historical developments of the assembly process; Choice of assembly methods: Design for automated assembly: Transfer systems; Vibratory bowl feeders - its analysis; Non-vibratory feeders and their analysis; Analysis and design of part orienting devices, feed tracks and part placing mechanisms. Orientation of parts in automatic assembly: In-Bowl and Out-of-Bowl Toolings; Typical Orienting Systems: Wiper Blade, Pressure Break, slot in the track; Analysis of Part Orienting Systems; Examples of Out-of-Bowl Toolings; Feed Tracks: Analysis of Horizontal Delivery Feed Track; "ON-OFF" Sensors; Reliability of Feeding.

# **ABOUT INSTRUCTOR :**

Prof. Sounak Kumar Choudhury 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 :Definition; Discussion on Pros and Cons of Automation; Benefits of Automation; Types of automation: Fixed automation, programmable automation, and Flexible automation-Typical Features and examples; Reasons for automating; Automation strategies; Automated flow lines: the objectives of the use of flow line automation; General forms of Work Flow - criteria for selection; Methods of work part transport: Continuous, intermittent and asynchronous: types and their selection; Transfer Mechanisms; Examples of transfer mechanisms for linear travel and rotary transfer mechanisms; Buffer Storage;

Week 2 : Flow line Performance Analysis: Average production time and production rate; Mean time per cycle when machine breakdown occurs; Flow line Performance Analysis: Line efficiency; Cost per item produced;Partial automation:Reasons for using, Advantages and drawbacks;Production and Throughput: Examples; Effect of machine Jamming; Component Quality Control; Choice of assembly methods: Cost, Production Rate, Availability of Labour, and Market Life of the Product; Advantages of Automatic Assembly; Design for automated assembly; Components of automatic Assembly Machines;

Week 3 :Transfer systems; Assembly Machines: In-Line, Rotary; Continuous and Intermittent Transfer;Indexing Machines:Factors affecting the choice; Various Indexing Mechanisms;Vibratory bowl feeders: Mechanics of Vibratory Conveying - its analysis; Effect of Frequency, Track Acceleration and Vibration Angle; Effect of Track Angle and Coefficient of Friction; Summary of Bowl Feeder Design; Spiral Elevators; General Requirements of Part Feeders; Non-vibratory feeders : Reciprocating Tube Hopper Feeder – its analysis; General Features. Centerboard Hopper Feeder: Analysis: Maximum Track Inclination, Total Cycle Time, Mean Feed Rate;

Week 4 :Reciprocating Tube Hopper Feeder: Principle of Operation; External Gate Hopper Feeder: Its Analysis: Maximum Peripheral Velocity, Mean Feed rate; Rotary Disk Feeder: Indexing and Rotary Disk Feeder with continuous drive and their analysis:Load sensitivity, Efficiency and Mean Feed Rate;Orientation of Parts in Automatic Assembly:In-Bowl and Out-of-Bowl Tooling's;Typical Orienting Systems: Wiper Blade, Pressure Break, slot in the track; Analysis of Part Orienting Systems; Examples of Out-of-Bowl Toolings; Feed Tracks: Analysis of Horizontal Delivery Feed Track;"ON-OFF" Sensors; Reliability of Feeding.



**PROF. ANUPAM BASU** Department of Computer Science and Engineering IIT Kharagpur

**INTENDED AUDIENCE :** BE/BTech in all disciplines BCA/MCA/M. Sc **INDUSTRIES APPLICABLE TO :** All IT Industries

COURSE OUTLINE : This course is aimed at enabling the students to

- · Formulate simple algorithms for arithmetic and logical problems
- Translate the algorithms to programs (in C language)
- Test and execute the programs and correct syntax and logical errors
- Implement conditional branching, iteration and recursion

• Decompose a problem into functions and synthesize a complete program using divide and conquer approach

· Use arrays, pointers and structures to formulate algorithms and programs

Apply programming to solve matrix addition and multiplication problems and searching and sorting problems

• Apply programming to solve simple numerical method problems, namely rot finding of function, differentiation of function and simple integration

#### **ABOUT INSTRUCTOR :**

Prof. Anupam Basu is Professor in the Dept. of Computer Science Engineering, IIT Kharagpur, and has been an active researcher in the areas of Cognitive and Intelligent Systems, Embedded Systems and Language Processing, Presently he is acting as the Chairman and Head of the Center for Educational Technology, IIT Kharagpur. He has developed several embedded system based tools empowering the physically challenged and has led several national projects in the area. He has taught at the University of California, Irvine at the Center for Embedded Systems. He is an Alexander von Humboldt Fellow and a Fellow of the Indian National Academy of Engineering. The awards won by him include the State Award for the Best Contributions in design for the disabled, by National Council for Promotion of Employment of Disabled Persons, India, the National Award for the Best Technology Innovation for the Physically Disabled (2007) and the Da-Vinci Award 2004 from the Engineering Society of Detroit.

#### **COURSE PLAN :**

Week 1: Introduction to Problem Solving through programs, Flowcharts/Pseudo codes, the compilation

process, Syntax and Semantic errors, Variables and Data Types

Week 2: Arithmetic expressions, Relational Operations, Logical expressions; Introduction to Conditional

#### Branching

- Week 3: Conditional Branching and Iterative Loops
- Week 4: Arranging things : Arrays
- Week 5: 2-D arrays, Character Arrays and Strings
- Week 6: Basic Algorithms including Numerical Algorithms
- Week 7: Functions and Parameter Passing by Value
- Week 8: Passing Arrays to Functions, Call by Reference

Week 9: Recursion

- Week 10: Structures and Pointers
- Week 11: Self-Referential Structures and Introduction to Lists
- Week 12: Advanced Topics



# PROGRAMMING, DATA STRUCTURES AND ALGORITHMS USING PYTHON

#### **PROF. MADHAVAN MUKUND**

Department of Computer Science and Engineering Chennai Mathematical Institute

**INTENDED AUDIENCE**: Students in any branch of mathematics/science/engineering, 1st year

**PRE-REQUISITES** : School level mathematics.

**INDUSTRIES APPLICABLE TO** : This course should be of value to any company requiring programming skills.

#### **COURSE OUTLINE :**

This course is an introduction to programming and problem solving in Python. It does not assume any prior knowledge of programming. Using some motivating examples, the course quickly builds up basic concepts such as conditionals, loops, functions, lists, strings and tuples. It goes on to cover searching and sorting algorithms, dynamic programming and backtracking, as well as topics such as exception handling and using files. As far as data structures are concerned, the course covers Python dictionaries as well as classes and objects for defining user defined datatypes such as linked lists and binary search trees.

#### **ABOUT INSTRUCTOR :**

Prof. Madhavan Mukund studied at IIT Bombay (BTech) and Aarhus University (PhD). He has been a faculty member at Chennai Mathematical Institute since 1992, where he is presently Professor and Director. His main research area is formal verification. He has active research collaborations within and outside India and serves on international conference programme committees and editorial boards of journals.

He has served as President of both the Indian Association for Research in Computing Science (IARCS) (2011-2017) and the ACM India Council (2016-2018). He has been the National Coordinator of the Indian Computing Olympiad since 2002. He served as the Executive Director of the International Olympiad in Informatics from 2011-2014.

In addition to the NPTEL MOOC programme, he has been involved in organizing IARCS Instructional Courses for college teachers. He is a member of ACM India's Education Committee. He has contributed lectures on algorithms to the Massively Empowered Classroom (MEC) project of Microsoft Research and the QEEE programme of MHRD

#### **COURSE PLAN:**

Week 1:

Informal introduction to programmin, algorithms and data structures viaged Downloading and installing Python gcd in Python: variables, operations, control flow - assignments, condition-als, loops, functions Week 2: Python: types, expressions, strings, lists, tuples Python memory model: names, mutable and immutable values List operations: slices etc **Binary search** Inductive function denitions: numerical and structural induction Elementary inductive sorting: selection and insertion sort In-place sorting Week 3: Basic algorithmic analysis: input size, asymptotic complexity, O() notation Arrays vs lists Merge sort Quicksort Stable sorting Week 4: Dictionaries More on Python functions: optional arguments, default values Passing functions as arguments Higher order functions on lists: map, lter, list comprehension Week 5: Exception handling Basic input/output Handling files String processing Week 6: Backtracking: N Queens, recording all solutions Scope in Python: local, global, nonlocal names Nested functions Data structures: stack, queue Heaps Week 7: Abstract datatypes Classes and objects in Python "Linked" lists: find, insert, delete Binary search trees: find, insert, delete Height-balanced binary search trees Week 8: Effcient evaluation of recursive definitions: memoization Dynamic programming: examples Other programming languages: C and manual memory management Other programming paradigms: functional programming



# PROF. RAGHUNATHAN RENGASAMY

Department of Chemical Engineering IIT Madras

# **PRE-REQUISITES** : Knowledge of basic data science algorithms

## **INTENDED AUDIENCE :** Final Year Undergraduates

#### **COURSE OUTLINE :**

The course aims at equipping participants to be able to use python programming for solving data science problems

## **ABOUT INSTRUCTOR :**

Prof. Rengaswamy was a professor of Chemical Engineering before joining at IIT Madras as a professor and Co-Director of the Process Control and Optimization Consortium at Texas Tech University, Lubbock, USA. He was also a professor and associate professor at Clarkson University, USA and an assistant professor at IIT Bombay. His major research interests are in the areas of fault detection and diagnosis and development of data science algorithms for manufacturing industries.

# COURSE PLAN :

#### Week 1:

#### **BASICS OF PYTHON SPYDER (TOOL)**

- Introduction Spyder
- Setting working Directory
- Creating and saving a script file
- File execution, clearing console, removing variables from environment, clearing environment
- Commenting script files
- Variable creation
- Arithmetic and logical operators
- Data types and associated operations

# Week 2:

#### Sequence data types and associated operations

- Strings
- Lists
- <u>Arrays</u>
- Tuples
- Dictionary
- SetsRange

# NumPy

ndArray

# Week 3:

Pandas dataframe and dataframe related operations on Toyota Corolla dataset

- 1. Reading files
- 2. Exploratory data analysis
- 3. Data preparation and preprocessing
- Data visualization on Toyoto Corolla dataset using matplotlib and seaborn libraries
  - 1. Scatter plot
  - 2. Line plot
  - 3. Bar plot
  - 4. Histogram
  - 5. Box plot
  - 6. Pair plot
- Control structures using Toyota Corolla dataset
- 1. if-else family
- 2. for loop
- 3. for loop with if break
- 4. while loop
- 5. Functions

# Week 4: CASE STUDY

Regression

- 1. Predicting price of pre-owned cars
- Classification 1. Classifying personal income



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

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 :**

Prof. 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**: Recapitulation of Thermodynamics, Introduction to Refrigeration, Air Refrigeration Cycle, Aircraft Refrigeration Cycles.

Week-2: Aircraft Refrigeration Cycles, Vapour Compression Cycle, P-h Charts, Actual Vapour Compression Cycle

**Week-3 :** Actual Vapour Compression Cycle, Compound Compression with Inter-cooling, Multiple Evaporator and Cascade System, Problem Solving

Week-4: Refrigerants, Vpour Absorption Systems.

Week-5: Introduction to Air-conditioning, Properties of Moist Air, Psychrometric Chart, Psychrometric Processes.

Week-6: Psychrometric Processes, Infiltration Design Conditions, Cooling Load.

Week-7: Cooling Load, Air Distribution System, Problem Solving, Air-Conditioning Systems

Week-8: Human Physiology, Thermal Comfort, Indoor Environmental Health, Problem Solving

# ROBOTICS



**PROF. DILIP KUMAR PRATIHAR** Department of Mechanical Engineering

IIT Kharagpur

**INTENDED AUDIENCE** : Students belonging to all disciplines of Engineering, Researchers and practicing

Engineers can take this course **INDUSTRIES APPLICABLE TO**: 1.RDCIS, Ranchi 2. CMERI, Durgapur 3. Reliance Industries 4.C-DAC, Kolkata and others

# **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 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 :**

Prof. Dilip Kumar Pratihar received BE (Hons.) and M. Tech. from REC (NIT) Durgapur, India, in 1988 and 1994, respectively. I obtained my Ph.D. from IIT Kanpur, India, in 2000. I received University Gold Medal, A.M. Das Memorial Medal, Institution of Engineers' (I) Medal, and others. I completed my post-doctoral studies in Japan and then, in Germany under the Alexander von Humboldt Fellowship Programme. I received Shastri Fellowship (Indo-Canadian) in 2019, INSA Teachers' Award 2020, New Code Of Education 2021 Award, Distinguished Alumnus Award 2021 of NIT Durgapur. I received World's Top 2% Scientists honor in a survey carried out by Stanford University, USA, in 2020, 2021; Outstanding Researcher 2021 (h-index and award) reported by www.research.com. I am working now as a Professor (HAG scale) of IIT Kharagpur, India. My research areas include robotics, soft computing and manufacturing science. I have published more than 300 papers and book-chapters. I have written the textbooks on "Soft Computing" and "Fundamentals of Robotics", co-authored another textbook on "Analytical Engineering Mechanics", edited a book on "Intelligent and Autonomous Systems", co-authored reference books on "Modeling and Analysis of Six-legged Robots"; "Modeling and Simulations of Robotic Systems Using Soft Computing"; "Modeling and Analysis of Laser Metal Forming Processes by Finite Element and Soft Computing Methods" and "Multibody Dynamic Modeling of Multi-legged Robots". My textbook on "Soft Computing" had been translated into Chinese language in 2009. I have guided 24 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, and applied for one Copyright.

# **COURSE PLAN :**

- Week 1 : Introduction to Robots and Robotics
- Week 2 : Introduction to Robots and Robotics; Robot Kinematics
- Week 3 : Robot Kinematics
- Week 4 : Robot Kinematics; Trajectory Planning
- Week 5 : Robot Dynamics
- Week 6 : Control Scheme; Sensors; Robot Vision
- Week 7 : Robot Vision; Robot Motion Planning
- Week 8 : Intelligent Robot; Biped Walking; Summary



# THE JOY OF COMPUTING USING PYTHON

#### PROF. SUDARSHAN IYENGAR

Department of Computer Science and Engineering IIT Ropar

#### **INTENDED AUDIENCE** : Any interested audience **PREREQUISITES** : 10th standard/high school

**INDUSTRY SUPPORT**: Every software company is aware of the potential of a first course in computer science. Especially of a first course in computing, done right.

#### COURSE OUTLINE :

A fun filled whirlwind tour of 30 hrs, covering everything you need to know to fall in love with the most sought after skill of the 21st century. The course brings programming to your desk with anecdotes, analogies and illustrious examples. Turning abstractions to insights and engineering to art, the course focuses primarily to inspire the learner's mind to think logically and arrive at a solution programmatically. As part of the course, you will be learning how to practice and culture the art of programming with Python as a language. At the end of the course, we introduce some of the current advances in computing to motivate the enthusiastic learner to pursue further directions.

#### **ABOUT INSTRUCTOR :**

Prof. Sudarshan Iyengar, Associate Professor at the CSE at IIT Ropar has a Ph.D. from the Indian Institute of Science (IISc). An exemplary teacher who has delivered over 350 popular science talks to students of high school and advanced graduate programmes. Prof. Sudarshan has offered more than 100 hours of online lectures with novel teaching methodologies that have reached lakhs of Students. His research interests include Data Sciences, Social Computing, Social Networks, Collective Intelligence, Crowdsourced Technologies and Secure Computation.

#### COURSE PLAN :

- Motivation for Computing
- Welcome to Programming!!
- Variables and Expressions : Design your own calculator
- Loops and Conditionals : Hopscotch once again
- · Lists, Tuples and Conditionals : Lets go on a trip
- Abstraction Everywhere : Apps in your phone
- Counting Candies : Crowd to the rescue
- Birthday Paradox : Find your twin
- Google Translate : Speak in any Language
- Currency Converter : Count your foreign trip expenses
- Monte Hall : 3 doors and a twist
- Sorting : Arrange the books
- Searching : Find in seconds
- Substitution Cipher : What's the secret !!
- Sentiment Analysis : Analyse your Facebook data
- 20 questions game : I can read your mind
- Permutations : Jumbled Words
- Spot the similarities : Dobble game
- Count the words : Hundreds, Thousands or Millions.
- Rock, Paper and Scissor : Cheating not allowed !!
- Lie detector : No lies, only TRUTH
- Calculation of the Area : Don't measure.
- · Six degrees of separation : Meet your favourites
- Image Processing : Fun with images
- Tic tac toe : Let's play
- Snakes and Ladders : Down the memory lane.
- Recursion : Tower of Hanoi
- Page Rank : How Google Works !!


# 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

**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 10 years teaching experience at IIT Roorkee. He taught UG core courses like Structural Metallurgy, Phase transformation and Heat treatment, Welding and Casting and, Mechanical Behavior of Materials. He also taught M.Tech. core course on Materials Characterization.. He has published more than 35 research papers in SCI/SCIE indexed journals and completed 05 sponsored research projects. Under his guidance four PhD research scholars completed their thesis and five are working.

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. In 2007 he started with his doctoral studies at Max Planck Institute (MPI) for Metals Research, Stuttgart, Germany and obtained his Ph.D in the year 2011. Thereafter he worked as a research scientist at MPI, Stuttgart. He has extensively worked on fundamental understanding of gaseous nitriding of steels. He has published more than 35 peer reviewed research papers and currently actively working on thermodynamics and kinetics of thermos-chemical processes.

- 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.

# NPTEL SYLLABUS

NATIONAL PROGRAMME ON TECHNOLOGY ENCHANCED LEARNING

Aircraft Maintenance Aerospace Engineering

Instructor Name: Prof. A.K. Ghosh Institute: IIT Kanpur Department: Aerospace Engineering

**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.

Pre Requisites: : Introduction to Airplane Performance Core/Elective: : Core UG/PG: : Both Industry Support : DRDO HAL, Boeing Airbus Bell

**Industry Support** : DRDO, HAL, Boeing, Airbus, Bell, McDonnell Douglas, UAV Factory, Lockheed Martin, Cessna.

**Course Intro:** : This course offers the introduction to the aircraft systems like hydraulics system, landing gear, flue system, electrical systems, 50,100,200,500 hours inspection, etc.

SL.NO	Week	Module Name
1	1	Indian aircraft rules, Civil aviation
		requirement, CAR 66, Aircraft System
2	2	Hydraulic system, Fuel system,
		Electrical system, Landing gear
3	3	Aircraft structure, Aircraft Inspection,
		Special Inspection, Daily Inspection
4	4	50 hours inspection, 100 hours
		inspection, 200 hours inspection, 500
		hours inspection, 5 year inspection





# INTRODUCTION TO HISTORY OF ARCHITECTURE IN INDIA

PROF.PUSHKAR SOHONI Department of Humanities and Social Sciences IISER Pune TYPE OF COURSE: Rerun | Core | UGCOURSE DURATION: 4 weeks (24 Jan' 22 - 18 Feb' 22)EXAM DATE: 27 Mar 2022

**PRE-REQUISITES :** Any student who is interested in architecture or cultural history.

#### COURSE OUTLINE :

The history of architecture in India is a material narrative of aspirations, polities, and societies in the region. From the Indus Valley Civilization to the modernism of B.V. Doshi, architecture has defined periods, peoples, and regions across India. This course is a brief introduction to a history of five thousand years of architecture in India, and provides a broad perspective on one aspect of material expression.

#### ABOUT INSTRUCTOR :

Prof. Pushkar Sohoni trained as a professional architect from the University of Pune, after which he received an MS in Historic Preservation from the University of Pennsylvania. His doctoral research was on late medieval and early modern architecture, and he received his PhD from the University of Pennsylvania, followed by a post-doctoral position at the University of British Columbia. He has authored many articles and books on architectural history and other aspects of material culture.

- Week 1: i. Introduction to History of Architecture
  - ii. Indus Valley Civilisation
  - iii. Early Historic Period -Wooden and Cave Architecture
- Week 2: i. Beginnings of the Temple
  - ii. Medieval Temples iii. Islamic Architecture
- Week 3: i. Sultanate Architecture
  - ii. Mughals and Rajputs
    - iii. Princely States
- Week 4: i. Neo-Classical, Indo-Saracenic, Revivial Gothic
  - ii. Art Deco, Modern
  - iii. International and Contemporary



**PROF. ANUPAM BASU** Department of Computer Science and Engineering IIT Kharagpur

**INTENDED AUDIENCE :** BE/BTech in all disciplines BCA/MCA/M. Sc **INDUSTRIES APPLICABLE TO :** All IT Industries

COURSE OUTLINE : This course is aimed at enabling the students to

- · Formulate simple algorithms for arithmetic and logical problems
- Translate the algorithms to programs (in C language)
- Test and execute the programs and correct syntax and logical errors
- Implement conditional branching, iteration and recursion

• Decompose a problem into functions and synthesize a complete program using divide and conquer approach

· Use arrays, pointers and structures to formulate algorithms and programs

Apply programming to solve matrix addition and multiplication problems and searching and sorting problems

• Apply programming to solve simple numerical method problems, namely rot finding of function, differentiation of function and simple integration

#### **ABOUT INSTRUCTOR :**

Prof. Anupam Basu is Professor in the Dept. of Computer Science Engineering, IIT Kharagpur, and has been an active researcher in the areas of Cognitive and Intelligent Systems, Embedded Systems and Language Processing, Presently he is acting as the Chairman and Head of the Center for Educational Technology, IIT Kharagpur. He has developed several embedded system based tools empowering the physically challenged and has led several national projects in the area. He has taught at the University of California, Irvine at the Center for Embedded Systems. He is an Alexander von Humboldt Fellow and a Fellow of the Indian National Academy of Engineering. The awards won by him include the State Award for the Best Contributions in design for the disabled, by National Council for Promotion of Employment of Disabled Persons, India, the National Award for the Best Technology Innovation for the Physically Disabled (2007) and the Da-Vinci Award 2004 from the Engineering Society of Detroit.

#### **COURSE PLAN :**

Week 1: Introduction to Problem Solving through programs, Flowcharts/Pseudo codes, the compilation

process, Syntax and Semantic errors, Variables and Data Types

Week 2: Arithmetic expressions, Relational Operations, Logical expressions; Introduction to Conditional

#### Branching

- Week 3: Conditional Branching and Iterative Loops
- Week 4: Arranging things : Arrays
- Week 5: 2-D arrays, Character Arrays and Strings
- Week 6: Basic Algorithms including Numerical Algorithms
- Week 7: Functions and Parameter Passing by Value
- Week 8: Passing Arrays to Functions, Call by Reference

Week 9: Recursion

- Week 10: Structures and Pointers
- Week 11: Self-Referential Structures and Introduction to Lists
- Week 12: Advanced Topics





**PROF. PARTHA PRATIM DAS** Department of Computer Science and Engineering IIT Kharagpur TYPE OF COURSE: Rerun | Core | UG/PGCOURSE DURATION: 8 weeks (26 Jul' 21 - 17 Sep' 21)EXAM DATE: 26 Sep 2021

**PRE-REQUISITES** : Basic Knowledge of Programming, Data Structure, C Programming Attending a course on OOP/OOAD with this course will help

#### **INTENDED AUDIENCE :** BCA, MCA, B.Tech., M.Tech.

INDUSTRIES APPLICABLE TO : Programming in C++ is so fundamental that all companies dealing with systems as well as application development (including web, IoT, embedded systems) have a need for the same. These include -Microsoft, Samsung, Xerox, Yahoo, Google, IBM, TCS, Infosys, Amazon, Flipkart, etc.

#### COURSE OUTLINE :

There has been a continual debate on which programming language/s to learn, to use. As the latest TIOBE Index for May 2019 indicates - Java (16%), C (14%), C++ (8%), C#(4%), and Python (8%) together control nearly half the programming community. Given this, it is still important to learn C and C++ because of the efficiency they offer. While we appreciate that Java is good for applications, for graphics; and we acknowledge that Python is appropriate for portable software, engineering problem solving, and graphics; it is worth bearing in mind that the JVM and Python interpreter are indeed written in C++, making C++ the father of all languages today.

#### ABOUT INSTRUCTOR :

Prof. Partha Pratim Das received his BTech, MTech and PhD degrees in 1984, 1985 and 1988 respectively from IIT Kharagpur. He served as a faculty in Department of Computer Science and Engineering, IIT Kharagpur from 1988 to 1998. In 1998, he joined Alumnus Software Ltd as a Business Development Manager. From 2001 to 2011, he worked for Interra Systems, Inc as a Senior Director and headed its Kolkata Center. In 2011, he joined back to Department of Computer Science and Engineering, IIT Kharagpur as Professor. Dr. Das has also served as a Visiting Professor with Institute of Radio Physics and Electronics, Calcutta University from 2003 to 2013.

- Week 1: Programming in C++ is Fun : Build and execute a C program in C++, Write equivalent programs in C++
- Week 2: C++ as Better C : Procedural Extensions of C
- Week 3: Overview of OOP in C++ : Classes and basic Object-Oriented features (encapsulation)
- Week 4: Overview of OOP in C++ : More OO features, overloading, namespace and using struct and union
- Week 5: Inheritance : Generalization / Specialization of Object Modeling in C++
- Week 6: Polymorphism : Static and Dynamic Binding
- Week 7: Type Casting & Exceptions : C++ cast operators; C++ Exceptions & standard exception classes
- Week 8: Templates & STL Function and Class templates and using STL like containers, algorithms



## PROF. DEBASIS SAMANTA Department of Computer Science and Engineering

IIT Kharagpur

**PRE-REQUISITES** : This course requires that the students are familiar with programming language such as C/C++ and data structures, algorithms.

**INTENDED AUDIENCE :** The undergraduate students from the engineering disciplines namely CSE, IT, EE, ECE, etc. might be interested for this course.

**INDUSTRIES APPLICABLE TO :** All IT companies.

#### COURSE OUTLINE :

With the growth of Information and Communication Technology, there is a need to develop large and complex software. Further, those software should be platform independent, Internet enabled, easy to modify, secure, and robust. To meet this requirement object-oriented paradigm has been developed and based on this paradigm the Java programming language emerges as the best programming environment. Now, Java programming language is being used for mobile programming, Internet programming, and many other applications compatible to distributed systems. This course aims to cover the essential topics of Java programming so that the participants can improve their skills to cope with the current demand of IT industries and solve many problems in their own field of studies.

#### **ABOUT INSTRUCTOR :**

Prof. Debasis Samanta holds a Ph.D. in Computer Science and Engineering from Indian Institute of Technology Kharagpur. His research interests and work experience spans the areas of Computational Intelligence, Data Analytics, Human Computer Interaction, Brain Computing and Biometric Systems. Prof. Samanta currently works as a faculty member at the Department of Computer Science Engineering at IIT Kharagpur.

#### COURSE PLAN :

Week 1: Overview of Object-Oriented Programming and Java

Week 2: Java Programming Elements

Week 3: Input-Output Handling in Java

Week 4: Encapsulation

Week 5: Inheritance

Week 6: Exception Handling

- Week 7: Multithreaded Programming
- Week 8: Java Applets and Servlets
- Week 9: Java Swing and Abstract Windowing Toolkit (AWT)
- Week 10: Networking with Java
- Week 11: Java Object Database Connectivity (ODBC)
- Week 12: Interface and Packages for Software Development





PROF. PABITRA MITRA Department of Computer Science and Engineering IIT Kharagpur TYPE OF COURSE: Rerun | Elective | UGCOURSE DURATION: 8 weeks (21 Feb' 22 - 15 Apr' 22)EXAM DATE: 23 Apr 2022

**INTENDED AUDIENCE** : Any engineering discipline and mathematics, physics. **INDUSTRIES APPLICABLE TO** : TCS, Infosys, CTS, Accenture

#### COURSE OUTLINE :

Data mining is study of algorithms for finding patterns in large data sets. It is an integral part of modern industry, where data from its operations and customers are mined for gaining business insight. It is also important in modern scientific endeavors. Data mining is an interdisciplinary topic involving, databases, machine learning and algorithms. The course will cover the fundamentals of data mining. It will explain the basic algorithms like data preprocessing, association rules, classification, clustering, sequence mining and visualization. It will also explain implementations in open source software. Finally, case studies on industrial problems will be demonstrated.

#### **ABOUT INSTRUCTOR :**

Prof.Pabitra Mitra is an Associate Professor of Computer Science and Engineering at Indian Institute of Technology Kharagpur. He did his BTech in Electrical Engineering from IIT Kharagpur and PhD from ISI Calcutta. He was a Scientist at Centre for Artificial Intelligence and Robotics, Bangalore and an Assistant Professor at IIT Kanpur. He received the INAE Young engineer Award, IBM Faculty Award and Yahoo Faculty Award. He has authored a book on Data mining and about 50 papers in international journals.

#### COURSE PLAN :

Week 1: Introduction, Data Preprocessing

- Week 2: Association Rule Mining, Classification Basics
- Week 3: Decision Tree, Bayes Classifier, K nearest neighbor
- Week 4: Support Vector Machine, Kernel Machine
- Week 5: Clustering, Outlier detection
- Week 6: Sequence mining
- Week 7: Evaluation, Visualization
- Week 8: Case studies



**PROF. SOUMYA KANTI GHOSH** Department of Computer Science and Engineering IIT Kharagpur

### **PRE-REQUISITES :** Basics of Computer Architecture and Organization, Networking

INTENDED AUDIENCE : CSE, ECE, EE

**INDUSTRIES APPLICABLE TO :** IT industries

#### COURSE OUTLINE :

Cloud computing is a scalable services consumption and delivery platform that provides on-demand computing service for shared pool of resources, namely servers, storage, networking, software, database, applications etc., over the Internet. It is a model for enabling ubiquitous, on-demand access to a shared pool of configurable computing resources, which can be rapidly provisioned and released with minimal management effort. This course will introduce various aspects of cloud computing, including fundamentals, management issues, security challenges and future research trends. This will help students (both UG and PG levels) and researchers to use and explore the cloud computing platforms.

#### **ABOUT INSTRUCTOR :**

Prof. Soumya K. Ghosh received the Ph.D. and M.Tech. degrees from Department of Computer Science and Engineering, Indian Institute of Technology (IIT), Kharagpur, India. Presently, he is a Professor with Department of Computer Science and Engineering, IIT Kharagpur. Before joining IIT Kharagpur, he worked for the Indian Space Research Organization in the area of satellite remote sensing and geographic information systems. He has more than 200 research papers in reputed journals and conference proceedings. His research interests include spatial data science, spatial web services and cloud computing.

- Week 1: Introduction to Cloud Computing
- Week 2: Cloud Computing Architecture
- Week 3: Service Management in Cloud Computing
- Week 4: Data Management in Cloud Computing
- Week 5: Resource Management in Cloud
- Week 6: Cloud Security
- Week 7: Open Source and Commercial Clouds, Cloud Simulator
- Week 8: Research trend in Cloud Computing, Fog Computing
- Week 9: VM Resource Allocation, Management and Monitoring
- Week 10: Cloud-Fog-Edge enabled Analytics
- Week 11: Serverless Computing and FaaS Model
- Week 12: Case Studies and Recent Advancements



# FUNDAMENTALS OF AUTOMOTIVE SYSTEMS

PROF. C. S. SHANKAR RAM Department of Design Engineering **IIT Madras** 

TYPE OF COURSE EXAM DATE

: Rerun | Core | UG/PG COURSE DURATION : 12 weeks (24 Jan' 22 - 15 Apr' 22) : 23 Apr 2022

PRE REQUISITES: Rigid Body Dynamics (done in 1st year BE), Thermodynamics, Fluid Mechanics

INTENDED AUDIENCE: 3rd/4th year undergraduate and 1st year M.Tech./M.S./Ph.D. students

# **COURSE OUTLINE :**

The objective of this course is to provide a fundamental understanding of the various systems of a typical automobile.

Course Outcomes: At the end of this course, the participant should be able to:

1. acquire fundamental knowledge of the various systems of an automobile,

2. associate the functions of each system with its design and layout, depict the various systems using simple schematics, and apply concepts learnt in core undergraduate courses to synthesize mathematical models of the various systems.

# **ABOUT INSTRUCTOR:**

Prof. C. S. Shankar Ram is currently a professor in the Department of Engineering Design, Indian Institute of Technology Madras, Chennai, India. He received his Bachelor of Engineering (B. E.) in Mechanical Engineering from Motilal Nehru Regional Engineering College, Allahabad, India, and his M. S. and Ph. D. from Texas A&M University, USA. His research interests are in the areas of dynamics and control with applications to automotive and transportation systems. He teaches courses on Control Systems, Fundamentals of Automotive Systems and Control of Automotive Systems at IIT Madras

# **COURSE PLAN:**

Week 1 : Course Overview, Classification of Internal Combustion Engines, Engine Components, **Operation of Four Stroke Engines** 

- Week 2 : Two Stroke Engines, Engine Cycles
- Week 3 : Engine Performance, Supercharging, Combustion in Spark Ignition Engines
- Week 4 : Combustion in Compression Ignition Engines, Carburetion, Fuel Introduction Systems
- Week 5 : Engine Emissions, Emission Control Systems, Automotive Powertrain
- Week 6 : Automotive Clutch, Transmission, Powertrain Analysis
- Week 7 : Transmission Matching and Introduction to Brake System
- Week 8 : Components of Brake System, Hydraulic Brake
- Week 9 : Air Brake, Antilock Brake System
- Week 10 : Braking Analysis, Introduction to Steering System, Manual Steering System
- Week 11 : Power Steering System, Wheel Alignment, Introduction to Suspension System

Week 12: Components of Suspension System, Dependent and Independent Suspension, Introduction to Electric and Hybrid Powertrain, Tyres.



# **ELECTRIC VEHICLES - PART 1**

**PROF. AMIT JAIN** Department of Electrical Engineering IIT Delhi

TYPE OF COURSE EXAM DATE

: Rerun | Elective | UG/PG COURSE DURATION : 4 weeks (21 Feb' 22 - 18 Mar' 22) : 24 Apr 2022

# **PRE-REQUISITES : BE (Electrical)**

**INTENDED AUDIENCE : Interested Students** 

#### COURSE OUTLINE :

This course will be a first level course on electric vehicle. Students will be able to understand the operation of battery driven electric vehicle. The course will start with introduction section which will enable the students to understand the focus areas that come under the umbrella of electric vehicles. Then the course will start covering this focus areas one by one such as vehicle dynamics, Motors, Power Electronics, Batteries, Charging etc. The most important part of this course will be that each topic will be analyzed and demonstrated through Matlab Simulink, so that the grip of the subject will be strong and the knowledge acquired will be useable in real time applications.

#### **ABOUT INSTRUCTOR:**

Amit Kumar Jain is presently working as Associate Professor in Department of ElectricalEngineering, IIT Delhi. He is done his Ph.D and M.S from Department of ElectricalEngineering, I.I.Sc, Bangalore and spend around two years in General Electric GlobalResearch Center before joining IIT Delhi in 2012. He expertise includes electric drives forrenewable and electric vehicle application. He has also started a course on ElectricVehicles in IIT Delhi which is now been converted to NPTEL video course.

#### **COURSE PLAN:**

Week 1: Introduction to Electric Vehicle

Week 2: Vehicle Dynamics: Modelling and Simulation

Week 3: Fundamental of Drives and DC Machine Modeling

Week 4: DC Machine Drives and Control of EV Using DC Machine



### PROF. RAMKRISHNA PASUMARTHY

Department of Electrical Engineering IIT Madras

**PRE-REQUISITES** : Network and Circuits, Basic Engineering Mathematics. we suggest the NPTEL course on Networks and Systems by Dr.V.G.K.Murti. Content in Lectures 1 -6 and 20-29 will be relevant for this course.

**INTENDED AUDIENCE :** Undergraduate students taking course on Control Engineering **INDUSTRIES APPLICABLE TO :** Any industry into Industrial Automation.

#### COURSE OUTLINE :

This course shall introduce the fundamentals of modeling and control of linear time invariant systems; primarily from the classical viewpoint of Laplace transforms and a brief emphasis on the state space formulation as well. The course will be useful for students from major streams of engineering to build foundations of time/frequency analysis of systems as well as the feedback control of such systems. The 11th module of the course will cover a detailed application of filter design in the field of navigation and human movement (gait). Students will be able to design their very own basic navigational system using inertial sensors and microcontrollers.

#### **ABOUT INSTRUCTOR :**

Prof. Ramkrishna Pasumarthy is an Associate Professor at the Dept. of Electrical Engineering, IIT Madras. He obtained his PhD in Systems and Control at the University of Twente, The Netherlands and held postdoc positions at the University of Melbourne and UCLA. He held visiting positions at Stanford University. His research interests are in the areas of network science with applications to power, traffic cloud and brain networks. also associated with the Robert Bosch Center for Data Sciences and Artificial Intelligence at IIT Madras. He also has interests in medical wearable devices and is a co founder of a start up iMov Motion Tech pvt. Itd. incubated at IITM Research Park

#### COURSE PLAN :

Week 1: Mathematical Modelling of Systems

- Week 2: Laplace Transforms, transfer functions, block diagram representation.
- Week 3: Block diagram reduction, Time response characteristics.
- Week 4: Introduction to stability, Routh Hurwitz stability criterion.
- Week 5: Root locus plots, stability margins.
- Week 6: Frequency response analysis: Nyquist stability criterion, Bode plots and stability margins in frequency domain.
- Week 7: Basics of control design, the proportional, derivative and integral actions.
- Week 8: Design using Root Locus
- Week 9: Design using Bode plots
- Week 10: Effects of zeros, minimum and non-minimum phase systems.
- Week 11: State space analysis
- Week 12: Design using State space



# MATLAB PROGRAMMING FOR NUMERICAL COMPUTATION

PROF. NIKET KAISARE Department of Chemical Engineering IIT Madras TYPE OF COURSE: Rerun | Elective | UG/PGCOURSE DURATION: 8 weeks (18 Jan' 21 - 12 Apr' 21)EXAM DATE: 21 Mar 2021

- PRE-REQUISITES : The students for this course are expected to know basics of linear algebra and calculus. These are covered in Introductory Math course(s) for Engineers (typically done in first year). This is intended to be practical (laboratory) course. Some prior background in programming will be useful, though not required. Likewise, students who have either completed or are currently doing "Numerical Methods" "Computational Techniques" will find it easier to follow this course.
- INTENDED AUDIENCE : This course is targeted towards scientists and engineers interested in using MATLAB programming for numerical computations. Examples taken in this course will be of generic interest to a wide range of students. This is a hands-on (like a laboratory) elective course. Intended audience include undergraduates, people with BE / ME / MS / MSc degrees; The course may be useful for PhD students also

### COURSE OUTLINE :

MATLAB is a popular language for numerical computation. This course introduces students to MATLAB programming, and demonstrate it's use for scientific computations. The basis of computational techniques are expounded through various coding examples and problems, and practical ways to use MATLAB will be discussed.

#### **ABOUT INSTRUCTOR :**

Dr. Niket Kaisare is an Associate Professor of Chemical Engineering in IIT-Madras. He works in the area of modeling, design and control for energy applications. He has over 7 years of research/teaching experience in academia, and three-year experience in Industrial R&D. He uses computational software, including MATLAB, FORTRAN, Aspen and FLUENT extensively in his research and teaching.

- Week 1: Introduction to MATLAB Programming
- Week 2: Approximations and Errors
- Week 3: Numerical Differentiation and Integration
- Week 4: Linear Equations
- Week 5: Nonlinear Equations
- Week 6: Regression and Interpolation
- Week 7: Ordinary Differential Equations (ODE) Part 1
- Week 8: Ordinary Differential Equations (ODE) Practical aspects



# KINEMATICS OF MECHANISMS AND MACHINES

PROF. ANIRVAN DASGUPTA Department of Mechanical Engineering IIT Kharagpur TYPE OF COURSE: Rerun | Elective | UG/PGCOURSE DURATION: 8 weeks (24 Jan' 22 - 18 Mar' 22)EXAM DATE: 27 Mar 2022

#### **PRE-REQUISITES :** Engineering Mechanics, Undergraduate Mathematics

INTENDED AUDIENCE : Mechanical, Electrical, Aerospace and Bio-Medical Engineering students INDUSTRIES APPLICABLE TO : Automobile and Aerospace industries, Automation and robotic device manufacturers, Bio-Medical device manufacturers

#### COURSE OUTLINE :

This course will deal with kinematic analysis of mechanisms and machines. It will include motion and force transmission analysis of linkage mechanisms, open and closed-chain planar robots, and geared transmission. The discussion will start with an introduction to the subject matter and nomenclature, and will cover direct and inverse kinematics, velocity and acceleration analysis, kinematic path generation for robots, singularities in kinematic chains, principle of virtual work and force analysis, and kinematic analysis of gear transmission. The course will demonstrate various concepts by working out problems relevant to real life applications of mechanisms. The course is expected to help students in their basic understanding and use of kinematic analysis.

#### ABOUT INSTRUCTOR :

Prof. 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, Dynamics of Machines, VibrationAnalysis, Wave Propagation in Continuous Media, and Rail Vehicle Dynamics.

- Week 1: Introduction to Mechanisms, Mobility Analysis
- Week 2: Mobility Analysis, Displacement Analysis
- Week 3: Displacement Analysis
- Week 4: Velocity Analysis
- Week 5: Velocity Analysis, (cont'd)
- Week 6: Velocity Analysis (cont'd), Acceleration Analysis
- Week 7: Force Analysis, Introduction to geared transmission
- Week 8: Analysis of gear trains



# POWER SYSTEM PROTECTION AND SWITCHGEAR

PROF. BHAVESHKUMAR R. BHALJA Department of Electrical Engineering IIT Roorkee

**PRE-REQUISITES** : Fundamentals of Power System

**INTENDED AUDIENCE :** Electrical Engineering, Electrical and Electronics Engineering **INDUSTRIES APPLICABLE TO :** 

- 1. ABB India Limited.
- 2. Semmens India Limited.
- 3. L&T Limited.
- 4. SEL Limited.

#### COURSE OUTLINE :

This course is to be prepared to serve as an introductory course for power system protection and switchgear for under graduate and post graduate students of various technical universities. It aims to give a comprehensive up-to-date presentation of the role of protection safety system, switchgears and its advances in modern power system. It begins with a state-of-the-art survey of theories and methods of protection and switchgear. In continuation, it provides a theoretical summary along with examples of real-life engineering applications to a variety of technical problems. In this point of view, the said course bridges the gap between the theoretical advances, experimental validations and practical engineering in real life

#### ABOUT INSTRUCTOR:

Prof. Bhaveshkumar R. Bhalja is working as a Professor, Department of Electrical Engineering, Indian Institute of Technology (IIT) Roorkee, Roorkee, India. He has a teaching experience of more than 20 years. He has published more than 150 papers in journals at international and national levels. He received Fulbright Nehru Academic and Professional Excellence Fellowships and worked as a visiting scholar at the Department of Electrical and Computer Engineering, Texas A & M University, College Station, Texas, US for a period of 9 months in 2018-19 in the area of "Fault Detection using Synchrophasor". He has been awarded "Young Engineers Award", "Certificate of Merit Award" and "Pandit Madan Mohan Malviya Memorial Prize" by Institution of Engineers, India in 2009, 2007 and 2016, respectively. He has been awarded "Hari-ohm Ashram Prerit Inter-University Smarak Trust Award" by Sardar Patel University, Vallabh Vidyanagar, Anand, India in 2009. One of his paper titled "Miscordination of Relay in Radial Distribution Network Containing Distributed Generation" also got Best Poster award at IEEE Conference on Recent Advances in Intelligent Computational Systems, Sep 22-24, 2011, Trivandrum, India. He has written books on Protection and Switchgear, Oxford University Press, New Delhi, India, 2nd Edition, 2018 and Transmission Line Protection Using Digital Technology, Springer Science Business Media Singapore Pte. Ltd; Singapore, January 2016. He has also delivered popular NPTEL course on "Power System Protection and Switchgear" in 2020. Currently, he is also holding a position of Associate Dean of Academic Affairs (Evaluation) of IIT Roorkee. He is involved in many research and development projects of DST, CSIR, CPRI and National High Speed Rail Corporation Limited. He is also associated with auditing and testing of 400 kV and 765 kV sub-stations of India. Further, he is having many consultancy projects related to the development of PMUs based set-up and FPGA controllers. His research interests include Digital Protection & Automation, Smart Grid Technologies and Applications, Distributed Generation, Micro-grid, Power Quality Improvement, Phasor Measurement Unit, Condition Monitoring of Electrical Apparatus and Application of Artificial Intelligence. He has guided more than 50 UG projects, 28 M. Tech. Dissertations 12 doctoral students. He is a Senior Member of IEEE and Fellow of IE and ISTE. He is working as an Associate Editor of IET Generation Transmission and Distribution and Canadian Journal of Electrical and Computer Engineering, IEEE Canada, Canada.

#### **COURSE PLAN :**

Week 1: Fundamentals of Protective Relaying

Week 2: Current based Relaying Scheme

Week 3: Current based Relaying Scheme and Protection of Transmission Lines using Distance Relays

Week 4: Protection of Transmission Lines using Distance Relays and Carrier Aided Schemes for Transmission Lines

Week 5: Carrier Aided Schemes for Transmission Lines and Auto-reclosing and Synchronizing

Week 6: Protection of Generators, Transformers, and Induction Motors

Week 7: Protection of Busbars, Protection against Transients and Surges along with System Response to Severe Upsets and Arc Interruption Theory in Circuit Breaker

Week 8: Arc Interruption Theory in Circuit Breaker, Types of Circuit Breakers and Testing, Commissioning and Maintenance of Relays



**PROF. SOUMYA KANTI GHOSH** Department of Computer Science and Engineering IIT Kharagpur

### **PRE-REQUISITES :** Basics of Computer Architecture and Organization, Networking

INTENDED AUDIENCE : CSE, ECE, EE

**INDUSTRIES APPLICABLE TO :** IT industries

#### COURSE OUTLINE :

Cloud computing is a scalable services consumption and delivery platform that provides on-demand computing service for shared pool of resources, namely servers, storage, networking, software, database, applications etc., over the Internet. It is a model for enabling ubiquitous, on-demand access to a shared pool of configurable computing resources, which can be rapidly provisioned and released with minimal management effort. This course will introduce various aspects of cloud computing, including fundamentals, management issues, security challenges and future research trends. This will help students (both UG and PG levels) and researchers to use and explore the cloud computing platforms.

#### **ABOUT INSTRUCTOR :**

Prof. Soumya K. Ghosh received the Ph.D. and M.Tech. degrees from Department of Computer Science and Engineering, Indian Institute of Technology (IIT), Kharagpur, India. Presently, he is a Professor with Department of Computer Science and Engineering, IIT Kharagpur. Before joining IIT Kharagpur, he worked for the Indian Space Research Organization in the area of satellite remote sensing and geographic information systems. He has more than 200 research papers in reputed journals and conference proceedings. His research interests include spatial data science, spatial web services and cloud computing.

- Week 1: Introduction to Cloud Computing
- Week 2: Cloud Computing Architecture
- Week 3: Service Management in Cloud Computing
- Week 4: Data Management in Cloud Computing
- Week 5: Resource Management in Cloud
- Week 6: Cloud Security
- Week 7: Open Source and Commercial Clouds, Cloud Simulator
- Week 8: Research trend in Cloud Computing, Fog Computing
- Week 9: VM Resource Allocation, Management and Monitoring
- Week 10: Cloud-Fog-Edge enabled Analytics
- Week 11: Serverless Computing and FaaS Model
- Week 12: Case Studies and Recent Advancements



**PROF. RAGHUNATHAN RENGASAMY** Department of Chemical Engineering IIT Madras

#### **PROF. SHANKAR NARASIMHAN** Department of Chemical Engineering IIT Madras

**PRE-REQUISITES :** 10 hrs of pre-course material will be provided, learners need to practice this to be ready to take the course.

INTENDED AUDIENCE : Any interested learner

INDUSTRIES APPLICABLE TO : HONEYWELL, ABB, FORD, GYAN DATA PVT. LTD.

### COURSE OUTLINE :

Learning Objectives :

Introduce R as a programming language Introduce the mathematical foundations required for data science Introduce the first level data science algorithms Introduce a data analytics problem solving framework Introduce a practical capstone case study Learning Outcomes:

Describe a flow process for data science problems (Remembering) Classify data science problems into standard typology (Comprehension) Develop R codes for data science solutions (Application) Correlate results to the solution approach followed (Analysis) Assess the solution approach (Evaluation) Construct use cases to validate approach and identify modifications required (Creating)

### **ABOUT INSTRUCTOR :**

Prof.Rengaswamy was a professor of Chemical Engineering and Co-Director of the Process Control and Optimization Consortium at Texas Tech University, Lubbock, USA. He was also a professor and associate professor at Clarkson University, USA and an assistant professor at IIT Bombay. His major research interests are in the areas of fault detection and diagnosis and development of data science algorithms for manufacturing industries.

Prof.Shankar Narasimhan is currently a professor in the department of Chemical Engineering at IIT Madras. His major research interests are in the areas of data mining, process design and optimization, fault detection and diagnosis and fault tolerant control. He has co-authored several important papers and a book titled Data Reconciliation and Gross Error Detection: An Intelligent Use of Process Data which has received critical appreciation in India and abroad.

### COURSE PLAN :

Week 1: Course philosophy and introduction to R

Week 2: Linear algebra for data science

1. Algebraic view - vectors, matrices, product of matrix & vector, rank, null space, solution of overdetermined set of equations and pseudo-inverse)

2. Geometric view - vectors, distance, projections, eigenvalue decomposition

**Week 3:** Statistics (descriptive statistics, notion of probability, distributions, mean, variance, covariance, covariance matrix, understanding univariate and multivariate normal distributions, introduction to hypothesis testing, confidence interval for estimates)

Week 4: Optimization

Week 5: 1. Optimization

- 2. Typology of data science problems and a solution framework
- Week 6: 1. Simple linear regression and verifying assumptions used in linear regression
- 2. Multivariate linear regression, model assessment, assessing importance of different variables, subset selection

Week 7: Classification using logistic regression

Week 8: Classification using kNN and k-means clustering





**PROF. PARTHA PRATIM DAS** Department of Computer Science and Engineering IIT Kharagpur TYPE OF COURSE: Rerun | Core | UG/PGCOURSE DURATION: 8 weeks (26 Jul' 21 - 17 Sep' 21)EXAM DATE: 26 Sep 2021

**PRE-REQUISITES** : Basic Knowledge of Programming, Data Structure, C Programming Attending a course on OOP/OOAD with this course will help

#### **INTENDED AUDIENCE :** BCA, MCA, B.Tech., M.Tech.

INDUSTRIES APPLICABLE TO : Programming in C++ is so fundamental that all companies dealing with systems as well as application development (including web, IoT, embedded systems) have a need for the same. These include -Microsoft, Samsung, Xerox, Yahoo, Google, IBM, TCS, Infosys, Amazon, Flipkart, etc.

#### COURSE OUTLINE :

There has been a continual debate on which programming language/s to learn, to use. As the latest TIOBE Index for May 2019 indicates - Java (16%), C (14%), C++ (8%), C#(4%), and Python (8%) together control nearly half the programming community. Given this, it is still important to learn C and C++ because of the efficiency they offer. While we appreciate that Java is good for applications, for graphics; and we acknowledge that Python is appropriate for portable software, engineering problem solving, and graphics; it is worth bearing in mind that the JVM and Python interpreter are indeed written in C++, making C++ the father of all languages today.

#### ABOUT INSTRUCTOR :

Prof. Partha Pratim Das received his BTech, MTech and PhD degrees in 1984, 1985 and 1988 respectively from IIT Kharagpur. He served as a faculty in Department of Computer Science and Engineering, IIT Kharagpur from 1988 to 1998. In 1998, he joined Alumnus Software Ltd as a Business Development Manager. From 2001 to 2011, he worked for Interra Systems, Inc as a Senior Director and headed its Kolkata Center. In 2011, he joined back to Department of Computer Science and Engineering, IIT Kharagpur as Professor. Dr. Das has also served as a Visiting Professor with Institute of Radio Physics and Electronics, Calcutta University from 2003 to 2013.

- Week 1: Programming in C++ is Fun : Build and execute a C program in C++, Write equivalent programs in C++
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- Week 3: Overview of OOP in C++ : Classes and basic Object-Oriented features (encapsulation)
- Week 4: Overview of OOP in C++ : More OO features, overloading, namespace and using struct and union
- Week 5: Inheritance : Generalization / Specialization of Object Modeling in C++
- Week 6: Polymorphism : Static and Dynamic Binding
- Week 7: Type Casting & Exceptions : C++ cast operators; C++ Exceptions & standard exception classes
- Week 8: Templates & STL Function and Class templates and using STL like containers, algorithms



**PROF. ANUPAM BASU** Department of Computer Science and Engineering IIT Kharagpur

**INTENDED AUDIENCE :** BE/BTech in all disciplines BCA/MCA/M. Sc **INDUSTRIES APPLICABLE TO :** All IT Industries

COURSE OUTLINE : This course is aimed at enabling the students to

- · Formulate simple algorithms for arithmetic and logical problems
- Translate the algorithms to programs (in C language)
- Test and execute the programs and correct syntax and logical errors
- Implement conditional branching, iteration and recursion

• Decompose a problem into functions and synthesize a complete program using divide and conquer approach

· Use arrays, pointers and structures to formulate algorithms and programs

Apply programming to solve matrix addition and multiplication problems and searching and sorting problems

• Apply programming to solve simple numerical method problems, namely rot finding of function, differentiation of function and simple integration

#### **ABOUT INSTRUCTOR :**

Prof. Anupam Basu is Professor in the Dept. of Computer Science Engineering, IIT Kharagpur, and has been an active researcher in the areas of Cognitive and Intelligent Systems, Embedded Systems and Language Processing, Presently he is acting as the Chairman and Head of the Center for Educational Technology, IIT Kharagpur. He has developed several embedded system based tools empowering the physically challenged and has led several national projects in the area. He has taught at the University of California, Irvine at the Center for Embedded Systems. He is an Alexander von Humboldt Fellow and a Fellow of the Indian National Academy of Engineering. The awards won by him include the State Award for the Best Contributions in design for the disabled, by National Council for Promotion of Employment of Disabled Persons, India, the National Award for the Best Technology Innovation for the Physically Disabled (2007) and the Da-Vinci Award 2004 from the Engineering Society of Detroit.

#### **COURSE PLAN :**

Week 1: Introduction to Problem Solving through programs, Flowcharts/Pseudo codes, the compilation

process, Syntax and Semantic errors, Variables and Data Types

Week 2: Arithmetic expressions, Relational Operations, Logical expressions; Introduction to Conditional

#### Branching

- Week 3: Conditional Branching and Iterative Loops
- Week 4: Arranging things : Arrays
- Week 5: 2-D arrays, Character Arrays and Strings
- Week 6: Basic Algorithms including Numerical Algorithms
- Week 7: Functions and Parameter Passing by Value
- Week 8: Passing Arrays to Functions, Call by Reference

Week 9: Recursion

- Week 10: Structures and Pointers
- Week 11: Self-Referential Structures and Introduction to Lists
- Week 12: Advanced Topics



PROF. NINA SABNANI Department of Design Engineering IIT Bombay

**INTENDED AUDIENCE**: This course is for students who would like an introduction to the field of design and its relationship with other disciplines. It is also for those who would like to collaborate with designers for their future work. It is open to all. Mainly for Engineer, Design and Management students.

#### COURSE OUTLINE :

We are surrounded by designed objects, from highways that traverse thousands of kilometers to a pen drive that fits a lot in the smallest of spaces. Designers have used their skills to translate ideas and needs into all the objects that we see around us. Design can be interpreted in multiple ways and can mean different things in different contexts. This course aims to create an awareness and understanding of the discipline of design and its multidisciplinary nature. The relevance and value of design and how it impacts society, industry and the environment is established through lectures, case studies and project activities. This course is for those who are curious to understand what design is and why is it important.

#### **ABOUT INSTRUCTOR :**

Prof. Nina Sabnani is an artist and storyteller who uses film, illustration and writing to tell her stories. Graduating from the Faculty of Fine Arts, Vadodara she received a master's degree in film from Syracuse University, NY, as a Fulbright Fellow. Her doctoral research at IIT Bombay, focused on the Kaavad storytelling tradition of Rajasthan. Her work in film and illustrated books, seeks to bring together animation and ethnography. Her award-winning films have been made into illustrated books and translated in many Indian languages. Her passion to explore participatory design has led her to make Hum Chitra Banate Hain (We make Images) with Sher Singh Bhil from Madhya Pradesh won the prestigious National award from the President of India for 2016. Prof. Nina is currently involved in creating online courses.

#### COURSE PLAN :

#### Week 1:

- Module 1- An Introduction to Design,
- Module 2- Users and Context
- Week 2 :
  - Module 3-Design and Society,
- Module 4 Design and Sustainability
- Week 3 :
  - Module 5 Design and Industry,
  - Module 6 Design and collaboration
- Week 4 :
  - Module 7 Innovation by Design



# INTRODUCTION TO EMBEDDED SYSTEM DESIGN

**PROF. DHANANJAY V. GADRE** Department of Electrical, Electronics and Communications Engineering Netaji Subhas University of Technology,

TYPE OF COURSE COURSE DURATION EXAM DATE : Rerun I Core I UG/PG : 12 weeks (18 Jan' 21 - 9 Apr' 21) : 25 Apr 2021

PROF. BADRI SUBUDHI Department of Electrical, Electronics and Communications Engineering IIT Jammu

**PRE-REQUISITES :** Anyone with understanding of basic electronic components and circuits, digital electronics and C programming.

**INTENDED AUDIENCE :** Undergraduate students in engineering and science.

INDUSTRIES APPLICABLE TO : Supported by Texas Instruments.

**COURSE OUTLINE :** Embedded Systems surround us in the form of gadgets and devices that we use. There is no aspect of human lives, which is untouched by such devices at home or for health diagnostics, transportation, entertainment. Learning out Embedded Systems will give the skills to design and manufacture embedded system products of the future which will help participants towards better employability. This course teaches embedded system design using a building block approach, which allows one to visualize the requirement of an embedded system and then to design it efficiently.

#### **ABOUT INSTRUCTOR :**

Prof. Dhananjay V. Gadre (New Delhi, India) completed his M.Engr. (Computer Engineering) from the University of Idaho, USA after his M.Sc. (Electronic Science) from the University of Delhi. Professor Gadre teaches at the Netaji Subhas University of Technology (formerly Netaji Subhas Institute of Technology) in the Division of Electronics and Communication Engineering, currently as an Associate Professor.

Prof. Badri N Subudhi received M.Tech. in Electronics and System Communication from National Institute of Technology, Rourkela, India, in 2008-09. He worked for his PhD from Machine Intelligence Unit, Indian Statistical Institute, Kolkata, India in year 2014 (degree from Jadavpur University). Currently he is serving as an Assistant Professor at Indian Institute of Technology Jammu, India.

#### COURSE PLAN:

**Week 1:** Introduction to Embedded Systems and Computer Systems Terminology. Modular approach to Embedded System Design using Six-Box model: Input devices, output devices, embedded computer, communication block, host and storage elements and power supply.

**Week 2:** Microcontroller Based Embedded System Design. Salient Features of Modern Microcontrollers. Elements of Microcontroller Ecosystem and their significance.

**Week 3:** Design of Power Supply for Embedded Systems. Linear Regulator Topologies. Switching Power Supply Topologies. Power Supply Design Considerations for Embedded Systems.

**Week 4:** Introduction to MSP430 Microcontroller. MSP430 CPU Architecture. Programming Methods for MSP430. Introduction to Lunchbox Platform.

**Week 5:** Fundamentals of Physical Interfacing. Connecting Input Devices:Switches, Keyboard and Output devices: LEDs, Seven Segment Displays(SSD). Assignment: MCQ/MSQ

**Week 6:** Advanced Physical Interfacing: Driving load - high side, low side and H-bridge. Multiplexing displays including Charlieplexing. Shaft encoder.

**Week 7:** Programming the MSP430. Basics of version control system - Git. Installing and using Code Composer Studio(CCS). Introduction to Embedded C. Interfacing LEDs and Switches with MSP430 using Digital Input and Output.

**Week 8:** MSP430 Clock and Reset System. MSP430 Clock sources and distribution. Types of Reset sources. Handling Interrupts in MSP430. Writing efficient Interrupt Service Routine (ISR).

**Week 9:** Interfacing Seven Segment Displays and Liquid Crystal Displays with MSP430. Low Power Modes in MSP430. Introduction to MSP430 Timer Module and it's Modes of Operation.

**Week 10:** Generating Pulse Width Modulation (PWM) using Timer Capture Mode. ADC operation in MSP430. Interfacing analog inputs. Generating random numbers using LFSR and other methods. Adding DAC to MSP430. Custom Waveform generation using MSP430.

**Week 11:** Timer Capture Modes. Measuring frequency and time period of external signals and events. Serial Communication Protocols: UART, SPI, I2C. Interfacing Universal Serial Communication Interface (USCI) Module of the MSP430 for UART Communication. Advanced Coding Exercises based on Interrupt driven Programming. Building an Electronics Project.

**Week 12:** Circuit Prototyping techniques. Designing Single Purpose Computers using Finite State Machine with Datapath (FSMD) approach. MSP430 Based Project Design and Implementation. Recap of Course Coverage.



PROF. SUMAN CHAKRABORTY Department of Mechanical Engineering IIT Kharagpur PROF. ADITYA BANDYOPADHYAY Department of Cryogenic Engineering IIT Kharagpur

**INTENDED AUDIENCE :** B.Tech students of all disciplines and teachers of undergraduatethermodynamics

# **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 prob-lems 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 :**

Prof. 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, manofluidics, micro-nano scale transport.

Prof. 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

- 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



#### **PROF. SUBASHISA DUTTA**

Department of Civil Engineering IIT Guwahati

#### COURSE OUTLINE :

Fluid Mechanics is an inter-disciplinary course covering the basic principles and has applications in Civil Engineering, Mechanical Engineering and Chemical Engineering. The students will have new problem solving approaches like control volume concept and streamline patterns which are now a days required to solve the real-life complex problems. The visualization of the fluid-flow problems will be demonstrated to enhance student's interest on the subject.

#### ABOUT INSTRUCTOR :

Prof. Dutta has more than 15years experience of teaching in IIT Guwahati for both undergraduate and postgraduate students the Fluid Mechanics course in undergraduate level was instructed five times by Prof. Dutta. Besides this, he has developed an NPTEL web course on Fluid Mechanics for undergraduate students. As a part of research and consultancies work Prof Dutta has done mathematical modeling of different rivers like the Brahmaputra. In this course, some of the real life problems will be discussed.

#### **COURSE PLAN :**

Week-1: Introduction And Basic Concepts

- Week-2: Properties Of Fluids
- Week-3: Pressure And Fluid Statics
- Week-4: Fluid Kinematics

Week-5: Mass, Bernoulli, And Energy Equations

Week-6: Momentum Analysis Of Flow Systems

Week-7: Dimensional Analysis And Modeling

Week-8: Flow In Pipes

- Week-9: Differential Analysis Of Fluid Flow
- Week-10: Approximate Solution Of Navier Stokes Equation
- Week-11: Drag And Lift
- Week-12: Introduction To Open Channel Flow



**PROF. DILIP KUMAR BAIDYA** Department of Civil Engineering IIT Kharagpur

PRE-REQUISITES : Engineering Mechanics INTENDED AUDIENCE : Civil Engineering INDUSTRY SUPPORT : Most of the Civil Engineering companies

#### **COURSE OUTLINE :**

Broadly Geotechnical Engineering encompasses two distinct segments: Soil Mechanics and Foundation Engineering. Soil Mechanics deals with study of physical properties of soils, and the relevance of these properties as they affect soil strength, stability, and drainage. Foundation engineering deals with (i) selection of foundation type based on building site conditions and site constraints, (ii) determining size and reinforcement of the foundation and (iii) finally construction of foundation element. This course will focus on the first, soil mechanics. Soil Mechanics is the basis for all geotechnical applications.. One has to learn basic principle of geotechnical engineering through soil mechanics and it is a core course for civil engineering in every college/university across the globe. Every aspect of soil mechanics starting from origin of soil to stability of soil slopes will be covered with great detail under this course.

#### **ABOUT INSTRUCTOR :**

Prof. Dilip Kumar Baidya is presently a Professor in Civil Engineering at IIT Kharagpur, graduated in Civil Engineering in 1987 from Bengal Engineering College Sibpur and obtained ME and Ph D from IISc Bangalore in the year 1989 and 93, respectively. Have 25 years of experience in teaching and research and guided more than 25 M Tech dissertations and 7 Ph D theses on Geotechnical Engineering. Published more than 100 papers in National/international journals and conferences out of which 3 papers received best paper award. Visited different countries for presenting papers in the international conferences and served 2 years as Faculty members in the University of West Indies, Trinidad and Tobago.Besides teaching and research, provided consultancy services to various industrial problems. Held several administrative positions at IIT Kharagpur which includes responsible position like Vice Chairman/Chairman JEE for IIT Kharagpur zone, Prof In-charge Examination etc.Fellow of Indian Geotechnical Society and member of International Society for Soil Mechanics and Geotechnical Engineering, Elected member of Executive committee of IGS for 2017-18.

**COURSE PLAN :** 

Week 1: Origin of soil and its Classification

Week 2: Three-phase diagram & Weight volume relationship

Week 3: Soil Compaction, seepage and permeability

Week 4: Effective stress concept and applications

Week 5: Bouusinesq's theory and vertical stress distribution

Week 6: Shear Strength I

Week 7: Shear strength II

Week 8: Compressibility of soils

Week 9: Consolidation and time rate of settlement

Week 10: Earth pressure theory I

Week 11: Earth pressure theory II

Week 12: Introduction to Stability of slopes



# DATA ANALYTICS WITH PYTHON

**PROF. A RAMESH** Department of Management Studies **IIT Roorkee** 

TYPE OF COURSE EXAM DATE

: Rerun | Elective | UG/PG **COURSE DURATION** : 12 weeks (24 Jan' 22 - 15 Apr' 22) : 23 Apr 2022

### INTENDED AUDIENCE : Management, Industrial Engineering and Computer Science Engineering Students

**INDUSTRIES APPLICABLE TO :** Any analytics company

#### **COURSE OUTLINE :**

This course includes examples of analytics in a wide variety of industries, and we hope that students will learn how one can use analytics in their career and life. One of the most important aspects of this course is that hands-on experience creating analytics models will be shared.

#### **ABOUT INSTRUCTOR :**

Prof. Ramesh Anbanandam graduated in Production Engineering from Madras University, Chennai. He did his post-graduation from National Institute of Technology, Trichy. He later earned his Ph.D. in Supply Chain Management from Indian Institute of Technology Delhi. His professional interest includes Humanitarian Supply Chain Management, Operations Management, Operations Research, Healthcare Waste Management, Sustainable Multi-model and Freight Transportation, Transportation Asset Management and Advanced Data Analytics using Python and R-programming. He has published various research articles in reputed journals. He was also awarded Emerald Literati Award for Excellence under "Highly Commended Research Paper in the Year 2011 and 2016" in the field of Supply Chain Management.

- Week 1: Introduction to data analytics and Python fundamentals
- Week 2: Introduction to probability
- Week 3: Sampling and sampling distributions
- Week 4: Hypothesis testing
- Week 5: Two sample testing and introduction to ANOVA
- Week 6: Two way ANOVA and linear regression
- Week 7: Linear regression and multiple regression
- Week 8: Concepts of MLE and Logistic regression
- Week 9: ROC and Regression Analysis Model Building
- Week 10: c<sup>2</sup>Test and introduction to cluster analysis
- Week 11: Clustering analysis
- Week 12: Classification and Regression Trees (CART)



# DEVELOPMENT AND APPLICATIONS OF SPECIAL CONCRETES

**PROF. SUDHIR MISRA** Department of Civil Engineering IIT Kanpur TYPE OF COURSE : Rerun | Elective | PGCOURSE DURATION: 8 Weeks (24 Jan' 22 - 18 Mar' 22)EXAM DATE: 27 Mar 2022

**PRE-REQUISITES** : The course will assume basic understanding of concrete materials and construction processes, including expected performance, quality control, etc.

INTENDED AUDIENCE : A) PG Students of Civil Engineering B) Practising Professionals in the area of Concrete Construction INDUSTRIES APPLICABLE TO : It Is My Earnest Hope That All Industries Related To Planning, Design And Construction Of Projects Using Concrete Will Find The Material Relevant And Thought Provoking.

#### COURSE OUTLINE :

Concrete is no longer simply a mixture of water, cement, sand and coarse aggregate-the advent of chemical admixtures and better understanding of the hydration of cement, and other issues relating to properties of concrete, has made it possible to use several other ingredients and have led to the development of several special concretes and construction methods and use concrete in diverse environments. Building on the fundamental principles of normal concrete, this course explains how some commonly used special concretes have been developed and how they are used in different conditions. The course seeks to present a unified view of concrete materials, construction methods and construction environment and examine the matter on parameters such as quality control methods

#### ABOUT INSTRUCTOR :

Prof. Sudhir Misra is Professor at the Department of Civil Engineering, Indian Institute of Technology Kanpur and has a keen interest in concrete materials, construction and engineering. He has worked with consulting and construction companies also during his 35 years of professional experience, and also led the effort to initiate a graduate programme in Infrastructure Engineering and Management at IIT Kanpur. He has been a member of committees of the BIS and also worked with professional organizations in Japan and India. His research interests include durability and non-destructive testing of concrete and development and utilization of special concretes. A lecture module of Concrete Engineering and Technology by him is also available online under the NPTEL scheme of the Government of India.

COURSE PLAN :

Week 1: Normal concrete

Week 2: Normal concrete (Cont'd)

- Week 3: Special concretes (1)-Concreting in cold and hot weather
- Week 4: Special concretes (2)-Self-compacting and fiber reinforced concretes
- Week 5: Special concretes (3)-Basic understanding of high strength concrete, mass concrete and shotcrete
- Week 6: Special concretes (4)-Handling preplaced aggregate concrete and light weight aggregate concrete
- Week 7: Special concretes (5)-Special topics I: Underwater anti-washout concrete; micro-concrete
- Week 8: Special concretes (6)-Special topics II: Expansive concrete, roller compacted concrete, concrete using recycled aggregate



# **INSPECTION AND QUALITY CONTROL IN** MANUFACTURING

**PROF. KAUSHIK PAL** Department of Mechanical Engineering **IIT Roorkee** 

TYPE OF COURSE EXAM DATE

: Rerun | Elective | UG/PG COURSE DURATION : 4 weeks (21Feb' 22 - 18 Mar' 22) : 23 Apr 2022

INTENDED AUDIENCE : UG & PG students of Mechanical Engg., Automobile Engg., Welding Engg., Metallurgy, Chemical Engg, Aerospace Engg, Material Science, Manufacturing and Production Engg. etc. R&D personals in industries.

**INDUSTRIES APPLICABLE TO**: Manufacturing based industries: TATA Motors, ISRO, DRDO, Railways,

BHEL, IOCL, Bharat Forge, Larsen and Toubro, Mahindra & Mahindra; etc

#### **COURSE OUTLINE :**

In manufacturing, quality control is a process that ensures customers receive products free from defects and meet their requirements. Inspection and measurement is needed during production for quality control because of the inherent variability introduced by the machines, tools, raw materials, and human operators which causes variations in the different quality characteristics (length, diameter, thickness, tensile strength, surface finish etc.) of the product. Inspection and testing is very important in maintaining a certain quality level in the product during production. It helps to control the quality of products by fixing the sources of defects immediately after they are detected. Several non-destructive inspection methods also help to perform in-service inspection to avoid any catastrophic failure and predict the remaining life of the product.

#### **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.

- Week 1: Introduction, Fundamental Concept of Quality, Role of Inspection and Measurement for Quality Control in Manufacturing, Need of Inspection, Inspection types and Principles, Design for Inspection, Destructive Inspection, Testing of Composite Materials
- Week 2: Non-destructive Inspection-I: Visual Inspection, Dye Penetrant Inspection, Magnetic Particle Inspection, Eddy Current Inspection, Ultrasonic Testing
- Week 3: Non-destructive Inspection-II: Acoustic Emission Inspection, Radiography, Leak Testing, Thermographic Non-destructive Testing, Advanced Non-destructive Techniques, NDT Standards, Safety in NDT
- Week 4: Engineering Metrology: Linear Measurement, Angular Measurement, Measurement of Surface Finish, Screw Thread Metrology, Gear Measurement, Miscellaneous Measurements



# **INTRODUCTION TO FLUID MECHANICS**

**PROF. SUMAN CHAKRABORTY** Department of Mechanical Engineering **IIT Kharagpur** 

TYPE OF COURSE EXAM DATE

: Rerun | Core | UG COURSE DURATION : 12 weeks (24 Jan' 22 - 15 Apr' 22) : 24 Apr 2022

**PRE-REQUISITES :** Basic knowledge of Mathematics

### **INTENDED AUDIENCE : Interested students**

INDUSTRIES APPLICABLE TO : Oil Companies (IOCL, SHELL, BPCL and others), Automobile and Aviation companies (GE, AIRBUS, TATA Motors and others)

### **COURSE OUTLINE :**

This is an introductory course in Fluid Mechanics. The subject Fluid Mechanics has a wide scope and is of prime importance in several fields of engineering and science. Present course emphasizes the fundamental underlying fluid mechanical principles and application of those principles to solve real life problems. Special attention is given towards deriving all the governing equations starting from the fundamental principle. 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 fundamental understanding of the basic principles of Fluid Mechanics and will be able to apply the basic principles to analyze fluid mechanical systems.

### **ABOUT INSTRUCTOR :**

Prof. 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, with particular focus on biomedical applications. He has been awarded the Santi Swaroop Bhatnagar Prize in the year 2013, which is the highest Scientific Award from the Government of India.

- Week 1: Introduction and Basic Principles
- Week 2: Properties of Fluids
- Week 3: Properties of Fluids and Fluid Statics
- Week 4: Fluid Statics
- Week 5: Fluid Kinematics (Part I)
- Week 6: Fluid Kinematics (Part II)
- Week 7: Dynamics of Inviscid Flows (Part I)
- Week 8: Dynamics of Inviscid Flows (Part II)
- Week 9: Integral Forms of Control Volume Conservation Equations (Part I)
- Week 10: Integral Forms of Control Volume Conservation Equations (Part II)
- Week 11: Integral Forms of Control Volume Conservation Equations (Part III); Dynamics of Viscous Flows (Part I)
- Week 12: Dynamics of Viscous Flows (Part II)



# KINEMATICS OF MECHANISMS AND MACHINES

PROF. ANIRVAN DASGUPTA Department of Mechanical Engineering IIT Kharagpur TYPE OF COURSE: Rerun | Elective | UG/PGCOURSE DURATION: 8 weeks (24 Jan' 22 - 18 Mar' 22)EXAM DATE: 27 Mar 2022

#### **PRE-REQUISITES :** Engineering Mechanics, Undergraduate Mathematics

INTENDED AUDIENCE : Mechanical, Electrical, Aerospace and Bio-Medical Engineering students INDUSTRIES APPLICABLE TO : Automobile and Aerospace industries, Automation and robotic device manufacturers, Bio-Medical device manufacturers

#### COURSE OUTLINE :

This course will deal with kinematic analysis of mechanisms and machines. It will include motion and force transmission analysis of linkage mechanisms, open and closed-chain planar robots, and geared transmission. The discussion will start with an introduction to the subject matter and nomenclature, and will cover direct and inverse kinematics, velocity and acceleration analysis, kinematic path generation for robots, singularities in kinematic chains, principle of virtual work and force analysis, and kinematic analysis of gear transmission. The course will demonstrate various concepts by working out problems relevant to real life applications of mechanisms. The course is expected to help students in their basic understanding and use of kinematic analysis.

#### ABOUT INSTRUCTOR :

Prof. 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, Dynamics of Machines, VibrationAnalysis, Wave Propagation in Continuous Media, and Rail Vehicle Dynamics.

- Week 1: Introduction to Mechanisms, Mobility Analysis
- Week 2: Mobility Analysis, Displacement Analysis
- Week 3: Displacement Analysis
- Week 4: Velocity Analysis
- Week 5: Velocity Analysis, (cont'd)
- Week 6: Velocity Analysis (cont'd), Acceleration Analysis
- Week 7: Force Analysis, Introduction to geared transmission
- Week 8: Analysis of gear trains

# NPTEL SYLLABUS

NATIONAL PROGRAMME ON TECHNOLOGY ENCHANCED LEARNING

Introduction to Materials Science and Engineering Metallurgy and Material Science

Instructor Name: Prof. Rajesh Prasad Institute: IIT Delhi Department: Mechanical Engineering

**About Instructor:** Professor Rajesh Prasad began teaching Materials Science as a graduate student at University of Cambridge where he was supervisor and demonstrator for undergraduate course IA Crystalline Materials. He now has about three decades of experience of teaching materials science courses at both undergraduate and graduate levels at the Indian Institutes of Technology, at Varanasi, Kanpur and Delhi. He has been awarded a Teaching Excellence Award in 2012 by the Indian Institute of Technology Delhi. In 2013, he received the Distinguished Alumnus Award of the Department of Metallurgical Engineering, IIT-BHU, Varanasi.

**Pre Requisites:** : Science at school level equivalent to 10+2 of Central Board of Secondary Education (CBSE), India **Core/Elective:** : Core\_Elective

UG/PG: : UG

**Industry Support** : Any industry concerned with materials, in particular automobile and manufacturing industry. Condensed versions of this course have been offered at Maruti Udyog Limited, Gurgaon, and Terminal Ballistic Research Lab of CSIR, Chandigarh, India.

**Course Intro:** : This course is designed as a first introduction to microstructure and mechanical properties of engineering materials for undergraduate engineering students. The focus will be on clear presentation of basic fundamentals of structure and defects of crystalline materials. This will then be used to understand the transformations, heat treatments and mechanical behavior of structural materials. The course will also include several classroom and laboratory demonstrations.

SL.NO	Week	Module Name
1	1	Crystal Geometry Part I
2	2	Crystal Geometry Part II
3	3	Structure of Solids Part I
4	4	Structure of Solids Part II
5	5	Structure of Solids Part III
6	6	Defects in Crystalline Solids Part I
7	7	Defects in Crystalline Solids Part II
8	8	Phase Diagrams
9	9	Diffusion
10	10	Phase Transformation Part I and Part II
11	11	Plastic Deformation Part I and Part II
12	12	Fracture and Fatigue



**PROF. ANUPAM BASU** Department of Computer Science and Engineering IIT Kharagpur

**INTENDED AUDIENCE :** BE/BTech in all disciplines BCA/MCA/M. Sc **INDUSTRIES APPLICABLE TO :** All IT Industries

COURSE OUTLINE : This course is aimed at enabling the students to

- · Formulate simple algorithms for arithmetic and logical problems
- Translate the algorithms to programs (in C language)
- Test and execute the programs and correct syntax and logical errors
- Implement conditional branching, iteration and recursion

• Decompose a problem into functions and synthesize a complete program using divide and conquer approach

· Use arrays, pointers and structures to formulate algorithms and programs

Apply programming to solve matrix addition and multiplication problems and searching and sorting problems

• Apply programming to solve simple numerical method problems, namely rot finding of function, differentiation of function and simple integration

#### **ABOUT INSTRUCTOR :**

Prof. Anupam Basu is Professor in the Dept. of Computer Science Engineering, IIT Kharagpur, and has been an active researcher in the areas of Cognitive and Intelligent Systems, Embedded Systems and Language Processing, Presently he is acting as the Chairman and Head of the Center for Educational Technology, IIT Kharagpur. He has developed several embedded system based tools empowering the physically challenged and has led several national projects in the area. He has taught at the University of California, Irvine at the Center for Embedded Systems. He is an Alexander von Humboldt Fellow and a Fellow of the Indian National Academy of Engineering. The awards won by him include the State Award for the Best Contributions in design for the disabled, by National Council for Promotion of Employment of Disabled Persons, India, the National Award for the Best Technology Innovation for the Physically Disabled (2007) and the Da-Vinci Award 2004 from the Engineering Society of Detroit.

#### **COURSE PLAN :**

Week 1: Introduction to Problem Solving through programs, Flowcharts/Pseudo codes, the compilation

process, Syntax and Semantic errors, Variables and Data Types

Week 2: Arithmetic expressions, Relational Operations, Logical expressions; Introduction to Conditional

#### Branching

- Week 3: Conditional Branching and Iterative Loops
- Week 4: Arranging things : Arrays
- Week 5: 2-D arrays, Character Arrays and Strings
- Week 6: Basic Algorithms including Numerical Algorithms
- Week 7: Functions and Parameter Passing by Value
- Week 8: Passing Arrays to Functions, Call by Reference

Week 9: Recursion

- Week 10: Structures and Pointers
- Week 11: Self-Referential Structures and Introduction to Lists
- Week 12: Advanced Topics



## PROF. DEBASIS SAMANTA Department of Computer Science and Engineering

IIT Kharagpur

**PRE-REQUISITES** : This course requires that the students are familiar with programming language such as C/C++ and data structures, algorithms.

**INTENDED AUDIENCE :** The undergraduate students from the engineering disciplines namely CSE, IT, EE, ECE, etc. might be interested for this course.

**INDUSTRIES APPLICABLE TO :** All IT companies.

#### COURSE OUTLINE :

With the growth of Information and Communication Technology, there is a need to develop large and complex software. Further, those software should be platform independent, Internet enabled, easy to modify, secure, and robust. To meet this requirement object-oriented paradigm has been developed and based on this paradigm the Java programming language emerges as the best programming environment. Now, Java programming language is being used for mobile programming, Internet programming, and many other applications compatible to distributed systems. This course aims to cover the essential topics of Java programming so that the participants can improve their skills to cope with the current demand of IT industries and solve many problems in their own field of studies.

#### **ABOUT INSTRUCTOR :**

Prof. Debasis Samanta holds a Ph.D. in Computer Science and Engineering from Indian Institute of Technology Kharagpur. His research interests and work experience spans the areas of Computational Intelligence, Data Analytics, Human Computer Interaction, Brain Computing and Biometric Systems. Prof. Samanta currently works as a faculty member at the Department of Computer Science Engineering at IIT Kharagpur.

#### COURSE PLAN :

Week 1: Overview of Object-Oriented Programming and Java

Week 2: Java Programming Elements

Week 3: Input-Output Handling in Java

Week 4: Encapsulation

Week 5: Inheritance

Week 6: Exception Handling

- Week 7: Multithreaded Programming
- Week 8: Java Applets and Servlets
- Week 9: Java Swing and Abstract Windowing Toolkit (AWT)
- Week 10: Networking with Java
- Week 11: Java Object Database Connectivity (ODBC)
- Week 12: Interface and Packages for Software Development



# WATER SUPPLY ENGINEERING

PROF. MANOJ KUMAR TIWARI School of Water Resources IIT Kharagpur TYPE OF COURSE: Rerun | Elective | UG/PGCOURSE DURATION: 12 weeks (24 Jan' 22 - 15 Apr' 22)EXAM DATE: 24 Apr 2022

# INTENDED AUDIENCE : UG students of Civil Engineering / Environmental Engineering PG students doing specializations in Environmental Engineering / Water Engineering / Urban Planning / Architecture / Infrastructure (Core/Elective)

INDUSTRIES APPLICABLE TO : Municipal Corporations and Jal Boards of various cities, Public Health Engineering Departments, Companies working in water management sector, such as TCE, L&T, JUSCO, CH2MHill, Veolia Water, Phonix, WABAG, Vulture Innovations, Wipro Infra etc.

### COURSE OUTLINE :

Water supply schemes are a basic necessity of every town/city. With growing concerns over managing urban water demands along with resource sustainability, concept of efficient and smart urban water supply systems is progressively getting more pertinent. Incorporating sustainable design and operation principles based on innovative water technologies such as cost-effective treatment solutions, automated supervisory controls, leakage detection and control etc. into water supply systems improves water supply from sustainable perspectives. This course aims to discuss the technical aspects of modern systems for drinking water treatment and distribution in an integrated way. The course will cover topics from traditional aspects of demand calculations and source selections to the up-to-date treatment methods, network design tools etc. The course will also provide insight to smart water supply systems and sustainable water pricing models will also be covered.

#### ABOUT INSTRUCTOR :

Prof. Manoj Kumar Tiwari [Ph.D. (IIT Kanpur)] is a Civil Engg. graduate with specialization in Environmental Engg. and holds expertise in water and wastewater treatment, water distribution systems, water pricing, and contaminant fate and transport. He is a recipient of prestigious Fulbright Fellowship. Prof.Tiwari has co-authored several papers in apex international journals, and has presented his research in various top ranked conferences across the globe. He has over 8 years of teaching experience with both : UG as well as PG level course. He has designed several new courses at IIT Kharagpur for Master's programme in Water Engineering and Management. He has delivered several invited lectures at various organizations, and has also conducted short-term course under Technical Education Quality Improvement Programme (TEQIP) with participants ranging from Faculties and Ph.D. students to field professionals working in government organizations as well as private companies.

#### COURSE PLAN :

Week 1: Introduction: General outline of water supply; Water availability and uses

- Week 2: Water Demand
- Week 3: Water Intake
- Week 4: Treatment Philosophy
- Week 5: Water Quality and Treatment
- Week 6: Conventional Water Treatment
- Week 7: Water Treatment: Disinfection and Advanced Treatment
- Week 8: Water Distribution Networks
- Week 9: Water Losses and Control
- Week 10: Advanced Water Distribution Design Approaches
- Week 11: Automation in Water Supply
- Week 12: Water Economics and Pricing



PROF. MANAS DAS Department of Mechanical Engineering IITGuwahati

**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)



# **COMPUTATIONAL FLUID DYNAMICS**

PROF. SREENIVAS JAYANTI Department of Chemical Engineering IIT Madras TYPE OF COURSE: Rerun | Elective | UG/PGCOURSE DURATION: 12 weeks (24 Jan' 22 - 15 Apr' 22)EXAM DATE: 24 Apr 2022

**PRE-REQUISITES** : At least one course in fluid mechanics. In addition, at least one course in numerical techniques and one course in computer programming would be essential

**INTENDED AUDIENCE** : UG/ PG students in chem/mech/civil/aerospace engg departments **INDUSTRIES APPLICABLE TO** : Automobile, Process, Power generation industries

#### COURSE OUTLINE :

The course deals with the numerical solution of equations governing fluid flow and would be of interest to engineers and scientists—both aspiring and professional—with chemical/ mechanical/ civil/ aerospace engineering applications. In all these fields, one needs to deal extensively with fluid flow related phenomena and one needs to resolve flow-related features of the processes and equipment. Although the equations governing fluid flow have been formulated more than 150 years ago, it is only in recent years that these are being solved in the practical applications in which the flow occurs. The course deals with the basic techniques that enable the numerical solution of these equations.

#### **ABOUT INSTRUCTOR :**

Prof. Sreenivas Jayanti studied mechanical engineering at IIT-BHU, Varanasi, India; nuclear engineering at Ohio State University, Columbus, Ohio, USA; fluid mechanics at INPG, Grenoble, France, and obtained his PhD from the department of chemical engineering at Imperial College, London, UK in 1990. After a post-doctoral fellowship at Imperial College, he joined IIT Madras as a visiting faculty in 1994. He is currently a professor in the department of chemical engineering at IIT Madras. His main research interests include computational fluid dynamics, combustion and fuel cells.

- Week 1: Introduction : calculation of flow in a rectangular duct
- Week 2: Calculation of fully developed flow in a triangular duct
- Week 3: Derivation of equations governing fluid flow
- Week 4: Equations for incompressible flow and boundary conditions
- Week 5: Basic concepts of CFD: Finite difference approximations
- Week 6: Basic concepts of CFD: Consistency, stability and convergence
- Week 7: Solution of Navier Stokes for compressible flows
- Week 8: Solution of Navier Stokes equations for incompressible flows
- Week 9: Solution of linear algebraic equations: basic methods
- Week 10: Solution of linear algebraic equations: advanced methods
- Week 11: Basics of finite volume method including grid generation
- Week 12: Turbulent flows and turbulence modelling



# DESIGN OF REINFORCED CONCRETE STRUCTURES

**PROF. NIRJHAR DHANG** Department of Civil Engineering IIT Kharagpur

**INTENDED AUDIENCE**: Students of Civil Engineering and Architecture **INDUSTRIES APPLICABLETO**: This course will be recognized by design consultancy firms and construction industries.

## **COURSE OUTLINE :**

Design of reinforced concrete structures is an introductory design course in civil engineering. In this course, basic elements governed by bending, shear, axial forces or combination of them are identified and are considered as building blocks of the whole structure. Different methods of design will be briefly described before introducing the limit states of collapse and serviceability. The design will be done as per IS 456:2000

# **ABOUT INSTRUCTOR :**

Prof. Nirjhar Dhang (born 1962) is currently Professor of the Department of Civil Engineering, Indian Institute of Technology, Kharagpur, where he teaches Bridge Engineering, Structural Health Monitoring & Control, Design of Reinforced Concrete Structures. He works in the field of structural engineering particularly in the area of concrete, structural health monitoring & control and railway bridges applicable for high speed rail. He has done many consultancy and research project work.

- Week 01 : Introduction, Different methods of design of reinforced concrete structures
- Week 02 : Working stress method
- Week 03 : Limit state of collapse flexure
- Week 04 : Design of singly reinforced beam
- Week 05 : Design of doubly reinforced beam
- Week 06 : Limit state of collapse shear
- Week 07 : Design for shear
- Week 08 : Design of slab
- Week 09 : Design of compression members
- Week 10 : Design of footing
- Week 11 : Design of staircase
- Week 12 : Limit state of serviceability


**PROF. DAMODAR MAITY** Department of Civil Engineering IIT Kharagpur

# INTENDED AUDIENCE : Civil Engineering

INDUSTRIES APPLICABLE TO : TATA Steel, SAIL, HSCL, EPIL, Jinadal Steel & Power, NBCC, RITES Limited, STUP Consultancy, MN Dastur Co. Ltd., TRF Ltd., Thyssenkrupp, WBHDC Ltd, PWD, CPWD etc.

# **COURSE OUTLINE :**

The course deals with design of steel structures using "Limit State Design Method". The design methodology is based on the latest Indian Standard Code of Practice for general construction (IS 800:2007). The subject covers all the necessary components such as material specifications, connections and elementary design of structural members for designing industrial steel structures. The course provides material specifications and design considerations. It provides relevant material properties of different types of steel. It deals with two types of connections namely welded and bolted connections. The advantages and limitations of these two methods of connections are also spelt out. Eccentric connections due to different plane of loading for both bolt and weld are discussed. The course also comprises of analysis and design procedure of steel members under axial tension. Design of compression members, built-up compression members along with the batten and lacing systems are explained in in this course. It deals with the design procedures of flexural members having laterally supported and laterally unsupported beams. It comprises of design of various types of column bases which transfers different kind of loads from super structures to underneath soil. Design of gantry girder with reference to industrial applications is also demonstrated.

#### **ABOUT INSTRUCTOR :**

Prof. Damodar Maity did his graduation and post-graduation from Jadavpur University, Kolkata and Ph. D. from IIT Kharagpur. He has worked in Research Engineers Pvt. Ltd. as System Analyst for two years on the development of Software STAAD.Pro which includes steel design. He has served as faculty member in IIT Guwahati for seven years. He is currently Professor in the Department of Civil Engineering, IIT Kharagpur. His research works concentrated mainly in computational mechanics which includes structural health monitoring, earthquake analysis of dams, vibration control of highrise buildings etc. He has published more than 70 technical papers in various journals of National and International repute. Many of his papers have become top downloaded articles. Prof. Maity organized several training courses for teachers of Engineering Colleges as well as engineers of Government organizations like PWD, CPWD, NF Railway, NEC etc. He is member of Technical Advisory Committee of National Disaster Management Authority, Government of India. Prof. Maity is author of a text book titled, Computer Analysis of Frame Structures, published by IK International Pvt. Ltd. He has developed a video course in Design of Steel Structures in working stress method and a web course in Finite Element Analysis under NPTEL.

- Week 01 : Introduction: Material Overview
- Week 02 : Introduction: Design Overview
- Week 03 : Bolted Connections
- Week 04 : Welded Connections
- Week 05 : Eccentric Connections
- Week 06 : Failure and Strength Calculations of Tension Members
- Week 07 : Design of Tension Members
- Week 08 : Design of Compression Members
- Week 09 : Design of Lacing and Batten Systems
- Week 10: Design of laterally supported Beams
- Week 11 : Design of laterally unsupported Beams
- Week 12 : Design of Column Base



# FUNDAMENTALS OF ADDITIVE MANUFACTURING TECHNOLOGIES

#### PROF. SAJAN KAPIL

Department of Mechanical Engineering IIT Guwahati

**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. Therefore, the academic people, as well as the industrial practitioner both, will be benefitted from this course. The special emphasis is given to link computer interface with the digital manufacturing process and their demonstration using commercially available software. The modules cover almost all the direction of additive manufacturing technologies, and it is blended with fundamental development to the recent technologies. The audience will be able to develop a fundamental understanding of different perspectives and recent development in this field through the lectures, skill development through demonstration, 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. 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. At IIT Bombay, he had developed an Additive Manufacturing process called "Hybrid Layered Manufacturing". He had simplified the manufacturing process of complex geometries by generating both 3 and 5-axis metal deposition toolpaths. He has published his research work in 13 international journals, 7 Indian patents, and more than 20 conferences. He has developed a new elective course entitled as 'Additive Manufacturing Technologies' at IIT Guwahati. He is involved in teaching the subjects like 'Additive Manufacturing Technologies', 'Kinematics of Machinery', 'Engineering Drawing', and 'Manufacturing Laboratory', at IIT Guwahati.

- 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



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

**INTENDED AUDIENCE** : Any interested learners

# **COURSE OUTLINE :**

It is proposed to include fundamental of following aspects of manufacturing technology

A) 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

B) 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

C) 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

D) 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

E) 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.

F) 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 14 years at IIT Roorkee in subjects related with manufacturing at UG level and welding engineering related subjects at PG level. He has published more than 120 research papers in SCI/SCIE indexed journals and undertaken 20 sponsored research and 50 industrial consultancy projects. He has authored two books entitled Production and Properties of Cast Al-Si Alloys with New Age International, New Delhi (2013) and Surface Engineering with Springer, New Delhi (2018).

Week 1 :	Understanding Manufacturing		
	Fundamental approaches of manufacturing		
	Manufacturing process specific advantages and limitation		
	Materials and manufacturing processes		
	Classification of manufacturing processes		
Week 2 :	Selection of manufacturing processes		
	Application of manufacturing processes		
	Effect of manufacturing processes on properties of metals		
	Break-even point analysis in manufacturing processes		
	Metal Casting: Introduction & Suitability		
Week 3 :	Metal Casting: Steps of casting processes		
	Metal Casting: Terminology		
	Metal Casting: Pattern allowances I		
	Metal Casting: Pattern allowances II		
	Metal Casting: Sand Moulding I		

Week 4 :	Metal Casting: Sand Moulding II
	Metal Casting: Core & Core Prints
	Metal Casting: Gating System
	Metal Casting: Yield
	Metal Casting: Riser Design
Week 5 :	Metal Casting: Cleaning of casting
	Metal Casting: Casting defects & their prevention
	Metal Casting: Shell molding
	Metal Casting: Investment and permanent mould casting
	Metal working processes: Hot and cold working
Week 6 :	Metal working processes: Rolling
	Metal working processes: Forging
	Metal working processes: Extrusion
	Metal working processes: Wire Drawing
<b>.</b>	Metal working processes: Press
Week 7 :	Metal working processing: Sheet metal operations (Shearing)
	Metal working processing: Sheet metal operations II
	Metal working processing: Sheet metal operations III
	Metal working processing: Dies and die set
	Material removal processes: Machining
Week 8 :	Material removal processes: Mechanism of the metal cutting
	Material removal processes: Chip Formation
	Material removal processes: Types of chips and power consumption
	Material removal processes: Heat generation
Weeko	Material removal processes: Tool failure and tool life
week 9:	Material removal processes: Tool materials
	Material removal processes. Cutting huids
	Material removal processes: Grinding I
	Material removal processes: Grinding II
Wook 10 ·	Material removal processes: Grinding in Material removal processes: Grinding operations
Week IV.	loining of metals: Fundamentals I
	Joining of metals: Fundamentals II
	Joining of metals: Welding processes I
	Joining of metals: Brazing, soldering and weldability
Week 11 :	Joining of metals: Weldability and welding defects
	Heat treatment: Fundamentals
	Heat treatment: Fundamentals II
	Heat treatment: Fundamentals III
	Heat treatment: Normalizing and hardening
Week 12 :	Heat treatment: Tempering
	Improving surface properties: Introduction
	Improving surface properties: Surface modification processes I
	Improving surface properties: Changing chemical composition
	Improving surface properties: Coating



# PROF. ASHISH GARG

Department of Materials Science and Engineering IIT Kanpur

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



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

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 :**

Prof. 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**: Recapitulation of Thermodynamics, Introduction to Refrigeration, Air Refrigeration Cycle, Aircraft Refrigeration Cycles.

Week-2: Aircraft Refrigeration Cycles, Vapour Compression Cycle, P-h Charts, Actual Vapour Compression Cycle

**Week-3 :** Actual Vapour Compression Cycle, Compound Compression with Inter-cooling, Multiple Evaporator and Cascade System, Problem Solving

Week-4: Refrigerants, Vpour Absorption Systems.

Week-5: Introduction to Air-conditioning, Properties of Moist Air, Psychrometric Chart, Psychrometric Processes.

Week-6: Psychrometric Processes, Infiltration Design Conditions, Cooling Load.

Week-7: Cooling Load, Air Distribution System, Problem Solving, Air-Conditioning Systems

Week-8 : Human Physiology, Thermal Comfort, Indoor Environmental Health, Problem Solving



**PROF. DILIP KUMAR BAIDYA** Department of Civil Engineering IIT Kharagpur

PRE-REQUISITES : Engineering Mechanics INTENDED AUDIENCE : Civil Engineering INDUSTRY SUPPORT : Most of the Civil Engineering companies

#### **COURSE OUTLINE :**

Broadly Geotechnical Engineering encompasses two distinct segments: Soil Mechanics and Foundation Engineering. Soil Mechanics deals with study of physical properties of soils, and the relevance of these properties as they affect soil strength, stability, and drainage. Foundation engineering deals with (i) selection of foundation type based on building site conditions and site constraints, (ii) determining size and reinforcement of the foundation and (iii) finally construction of foundation element. This course will focus on the first, soil mechanics. Soil Mechanics is the basis for all geotechnical applications.. One has to learn basic principle of geotechnical engineering through soil mechanics and it is a core course for civil engineering in every college/university across the globe. Every aspect of soil mechanics starting from origin of soil to stability of soil slopes will be covered with great detail under this course.

#### **ABOUT INSTRUCTOR :**

Prof. Dilip Kumar Baidya is presently a Professor in Civil Engineering at IIT Kharagpur, graduated in Civil Engineering in 1987 from Bengal Engineering College Sibpur and obtained ME and Ph D from IISc Bangalore in the year 1989 and 93, respectively. Have 25 years of experience in teaching and research and guided more than 25 M Tech dissertations and 7 Ph D theses on Geotechnical Engineering. Published more than 100 papers in National/international journals and conferences out of which 3 papers received best paper award. Visited different countries for presenting papers in the international conferences and served 2 years as Faculty members in the University of West Indies, Trinidad and Tobago.Besides teaching and research, provided consultancy services to various industrial problems. Held several administrative positions at IIT Kharagpur which includes responsible position like Vice Chairman/Chairman JEE for IIT Kharagpur zone, Prof In-charge Examination etc.Fellow of Indian Geotechnical Society and member of International Society for Soil Mechanics and Geotechnical Engineering, Elected member of Executive committee of IGS for 2017-18.

**COURSE PLAN :** 

Week 1: Origin of soil and its Classification

Week 2: Three-phase diagram & Weight volume relationship

Week 3: Soil Compaction, seepage and permeability

Week 4: Effective stress concept and applications

Week 5: Bouusinesq's theory and vertical stress distribution

Week 6: Shear Strength I

Week 7: Shear strength II

Week 8: Compressibility of soils

Week 9: Consolidation and time rate of settlement

Week 10: Earth pressure theory I

Week 11: Earth pressure theory II

Week 12: Introduction to Stability of slopes



### **PROF. KAUSHIK PAL**

Department of Mechanical and Industrial Engineering IIT Roorkee

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 APPLICABLETO : 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.

- **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.

# **CORROSION - PART I**



**PROF. KALLOL MONDAL** Department of Metallurgy and Material Science IIT Kanpur TYPE OF COURSE: Rerun | Core | UGCOURSE DURATION: 8 weeks (24 Jan' 22 - 18 Mar' 22)EXAM DATE: 27 Mar' 2022

**PRE-REQUISITES** : Chemical Thermodynamics, Phase transformation and Electrochemistry **INTENDED AUDIENCE** : Bachelor and Master students / Industry people, PhD student

INDUSTRIES APPLICABLE TO : Oil companies, Chemical companies and Power sector

#### COURSE OUTLINE :

The course will begin with emphasis on the importance of studying Corrosion of materials. Fundamentals of corrosion will be addressed from the angle of thermodynamics and kinetics of electrochemical phenomena. Different forms of corrosion related to materials and mixed potential theory will be discussed. Finally, electrochemical ways of protection of metals and alloys will be explained.

#### ABOUT INSTRUCTOR :

Prof. 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.

- Week 1: Introduction:Definitions, Different forms of Environmental degradation, Cost of Corrosion, Electrochemical Nature, Aims
- Week 2: Thermodynamics of Corrosion: Process at Interface, Free Energy and Electrochemical Potential, EMF Series
- Week 3: Thermodynamics of Corrosion: Nernst Relationship, Important Reactions, Cell Potential, Reference Electrodes
- Week 4: Thermodynamics of Corrosion: Pourbaix diagram and its important in metal corrosion, Calculation of Pourbaix diagram for Al, Cu, Ni and Fe. Kinetics of Corrosion: Current Density and Corrosion Rate, Corrosion Rate Expressions, Exchange Current Density
- Week 5: Kinetics of Corrosion: Polarization, Activation, Concentration and Resistance polarization
- Week 6: Mixed potential theory for understanding common corrosion of metals and alloys: Fundamental, Applications to Active metals
- Week 7: Mixed potential theory for understanding common corrosion of metals and alloys: Passivation, Application of mixed potential theory in passivating metals
- Week 8: Corrosion protection: Electrochemical ways: Sacrificial anode, Impressed current cathodic protection, Anodic protection



# PROGRAMMING, DATA STRUCTURES AND ALGORITHMS USING PYTHON

#### **PROF. MADHAVAN MUKUND**

Department of Computer Science and Engineering Chennai Mathematical Institute

**INTENDED AUDIENCE**: Students in any branch of mathematics/science/engineering, 1st year

**PRE-REQUISITES** : School level mathematics.

**INDUSTRIES APPLICABLE TO** : This course should be of value to any company requiring programming skills.

#### **COURSE OUTLINE :**

This course is an introduction to programming and problem solving in Python. It does not assume any prior knowledge of programming. Using some motivating examples, the course quickly builds up basic concepts such as conditionals, loops, functions, lists, strings and tuples. It goes on to cover searching and sorting algorithms, dynamic programming and backtracking, as well as topics such as exception handling and using files. As far as data structures are concerned, the course covers Python dictionaries as well as classes and objects for defining user defined datatypes such as linked lists and binary search trees.

#### **ABOUT INSTRUCTOR :**

Prof. Madhavan Mukund studied at IIT Bombay (BTech) and Aarhus University (PhD). He has been a faculty member at Chennai Mathematical Institute since 1992, where he is presently Professor and Director. His main research area is formal verification. He has active research collaborations within and outside India and serves on international conference programme committees and editorial boards of journals.

He has served as President of both the Indian Association for Research in Computing Science (IARCS) (2011-2017) and the ACM India Council (2016-2018). He has been the National Coordinator of the Indian Computing Olympiad since 2002. He served as the Executive Director of the International Olympiad in Informatics from 2011-2014.

In addition to the NPTEL MOOC programme, he has been involved in organizing IARCS Instructional Courses for college teachers. He is a member of ACM India's Education Committee. He has contributed lectures on algorithms to the Massively Empowered Classroom (MEC) project of Microsoft Research and the QEEE programme of MHRD

#### **COURSE PLAN:**

Week 1:

Informal introduction to programmin, algorithms and data structures viaged Downloading and installing Python gcd in Python: variables, operations, control flow - assignments, condition-als, loops, functions Week 2: Python: types, expressions, strings, lists, tuples Python memory model: names, mutable and immutable values List operations: slices etc **Binary search** Inductive function denitions: numerical and structural induction Elementary inductive sorting: selection and insertion sort In-place sorting Week 3: Basic algorithmic analysis: input size, asymptotic complexity, O() notation Arrays vs lists Merge sort Quicksort Stable sorting Week 4: Dictionaries More on Python functions: optional arguments, default values Passing functions as arguments Higher order functions on lists: map, lter, list comprehension Week 5: Exception handling Basic input/output Handling files String processing Week 6: Backtracking: N Queens, recording all solutions Scope in Python: local, global, nonlocal names Nested functions Data structures: stack, queue Heaps Week 7: Abstract datatypes Classes and objects in Python "Linked" lists: find, insert, delete Binary search trees: find, insert, delete Height-balanced binary search trees Week 8: Effcient evaluation of recursive definitions: memoization Dynamic programming: examples Other programming languages: C and manual memory management Other programming paradigms: functional programming



# THEORY AND PRACTICE OF NON DESTRUCTIVE TESTING

PROF. RANJIT BAURI Department of Metallurgical and Materials Engineering IIT Madras TYPE OF COURSE: Rerun | Elective | UG/PGCOURSE DURATION: 8 weeks (24 Jan' 22 - 18 Mar' 22)EXAM DATE: 27 Mar 2022

PRE-REQUISITES : BE/Diploma in Engineering Mech/Material Engg)

(Mech/Manufac/Production/Civil/Aerospace/App.

**INTENDED AUDIENCE :** Students, Researchers, Practicing Engineers **INDUSTRIES APPLICABLE TO :** Manufacturing and Automotive Industries

#### COURSE OUTLINE :

Nondestructive Testing (NDT) plays an extremely important role in quality control, flaw detection and structural health monitoring covering a wide range of industries. There are varieties of NDT techniques in use. This course will first cover the fundamental science behind the commonly used NDT methods to build the basic understanding on the underlying principles. It will then go on to cover the process details of each of these NDT methods.

#### ABOUT INSTRUCTOR :

Prof. Ranjit Bauri is an Professor in the Dept. of Metallurgical and Materials Engineering, IIT Madras. He has more than a decade of experience in teaching NDT theory and practical courses. He is a life member of Indian Society for Non Destructive Testing (ISNT). He is also a seasoned researcher with more than a decade of research experience. His research areas include Composite materials, Al alloys, Friction stir welding and processing, Powder Metallurgy and Microscopy.

- **Week 1:** Introduction to NDT, Visual Optical methods, Dye penetrant testing, Basic principle, Types of dye and methods of application, Developer application and Inspection.
- **Week 2:** Magnetic particle testing, Basic theory of magnetism, Magnetization methods, Field indicators, Particle application, Inspection.
- **Week 3:** Eddy current testing, Basic principle; Faraday's law, Inductance, Lenz's law,Self and Mutual Inductance, Impedance plane, Inspection system and probes,System calibration.
- Week 4: Ultrasonic testing: Basics of ultrasonic waves, Pulse and beam shapes, Ultrasonic transducers.
- Week 5: Test method, Distance and Area calibration, Weld inspection by UT.
- **Week 6:** Acoustic emission testing: Basic principle, Sources of acoustic emission, Source parameters, Kaiser-Felicity theory, Equipment and Data display, Source location schemes.
- Week 7: Radiography: X-rays and their properties, X-ray generation, X-ray absorption and atomic scattering.
- **Week 8:** Image formation, Image quality, Digital Radiography, Image interpretation, Radiation Shielding. Comparison and selection of NDT methods, Concluding remarks.



**PROF. JAYANTA DAS** Department of Metallurgical and Material Science IIT Kharagpur

INTENDED AUDIENCE: Metallurgical & Materials Engineering; Materials Science; PhysicsPRE-REQUISITES: Physical Metallurgy, Mechanical Metallurgy, Phase transformation, Solidification Processing

# **COURSE OUTLINE :**

Introduction and classification of structural and functional materials; High T emperature 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 :**

Prof. 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.

- 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



# FUNDAMENTAL OF WELDING SCIENCE AND **TECHNOLOGY**

**PROF. PANKAJ BISWAS** Department of Mechanical Engineering IIT Guwahati

TYPE OF COURSE EXAM DATE

: Rerun | Core | UG/PG COURSE DURATION : 8 weeks (24 Jan' 22 - 18 Mar' 22) : 27 Mar 2022

#### **COURSE OUTLINE :**

In this course, Prof. Pankaj Biswas will try to cover the fundamental overview of the traditional/ industrial welding technology especially those welding processes which are widely used in manufacturing industries. 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. Welding is a joining process which is an unavoidable technology in most of the manufacturing sector. It is such a topic in which you will get the taste of most of the science and engineering subjects. Knowledge of almost all science subjects like physics, chemistry, mathematics and engineering subjects like solid mechanics, thermal science, fluid mechanics etc. are highly essential to understand the area welding technology. It is observed that in manufacturing industry over 30 % expenditure is spent on welding. Welding has significant application in various manufacturing sectors like aerospace, automobile, ship building, railway etc. It plays very important and crucial role in service life of the structure. That's why basic fundamental knowledge of welding is highly essential. The brief overview of the course content can be stated like; this course will cover the classification of welding process, classification of welding joints, industrial relevance of welding, welding symbols, characteristics of traditional welding power sources. It will give the fundamental knowledge of principle and physics involve in various welding processes. It will also cover the importance and applications of different traditional welding techniques. This course will highlight safety precautions to be followed in welding. This course will also cover welding defects & inspection and with their remedies to improve the weld quality.

#### **ABOUT INSTRUCTOR:**

Prof. 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 16 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 modeling of welding processes using soft computing techniques. I guided 01 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 77 journal articles, 73 conference proceedings, 23 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: Introduction and classification of welding

- Week 2: Nomenclature and symbol of welding joints
- Week 3: Power source of welding
- Week 4: Physics and principle of arc welding
- Week 5: Different type of welding methods and their details
- Week 6: Different type of welding methods their details
- Week 7: Different type of welding methods their details
- Week 8: Welding defects and inspection



**PROF. GOUR GOPAL ROY** Department of Metallurgical Engineering and Materials Sciences IIT Kharagpur

**PRE-REQUISITES :** Interested Learners

INTENDED AUDIENCE : Metallurgy, Mechanical, Chemical

INDUSTRIES APPLICABLE TO : HEC, Ranchi; Tata Steel, Jamshedpur; SAIL Steel plants; RINL steel Plant, JSW

#### COURSE OUTLINE :

The emphasis on extractive metallurgy including ironmaking and steelmaking has been diluted significantly to accommodate newer courses on structure, properties and processing of different kinds of advanced materials. This is in contrary to the fact that India is going to be the second largest producer of crude steel in the world. Besides, after globalization of market, we stand in cut-through competition for day to day innovation in steel processing. Based on changing scenario a conceptual, fundamental and more quantitative course is desirable. Keeping in view of the above consideration, the course has been designed.

#### ABOUT INSTRUCTOR :

Prof. Gour Gopal Roy is presently professor in the Department of Metallurgical & amp; Materials Engineering at IIT Kharagpur and also joint faculty member of Steel Technology Center and Center of Excellence on Advanced Manufacturing Technology, IIT Kharagpur. Since the inception of his professional career at IIT Kharagpur in 1997, he is teaching the course Ironmaking and Steelmaking either as separate subject courses or in combined form.

- Week 1: Introduction: Various routes of modern steel making (BF-BOF, DRI-EAF, SR). Blast furnace Ironmaking: Shape of the furnace, Various reactions and zones in the blast Furnace Thermodynamics of Iron making, Direct & indirect reduction Blast Furnace as an efficient counter current gas solid reactor and maximum carbon efficiency.
- Week 2: Overall heat and Material Balance in Blast Furnace. Rist Diagram based on oxygen balance Rist Diagram based on heat & Material balance
- Week 3: Blast Furnace as a two stage reactor. Predictive model for coke rate in blast furnace.
- Week 4: Aerodynamics in Blast Furnace (pressure drop, fluidization, channeling, Flooding).
- Week 5: Burden preparation (sintering, pelletization, coke making). Testing of raw materials
- Week 6: Burden distribution in Blast Furnace. Auxiliary injection, fuel efficiency and productivity in Blast furnace.
- Week 7: Thermodynamics of steelmaking. Introduction to LD steel making (process, emulsion, decarburization, catch carbon technique, impurity & slag evolution)
- Week 8: Hybrid steel making. Modern EAF/IF steel making. Secondary Steel making: Thermodynamics & kinetics of deoxidation
- Week 9: Secondary steel making: Vacuum treatment of steel and processes, gas stirring.
- Week 10: Secondary Steel making: Ladle desulphurization, inclusion modification by calcium treatment. Inclusion control by optimizing upstream operating parameters.
- Week 11: Heat transfer and segregation during casting. Ingot casting, continuous casting, defects in steel.
- Week 12: Alternative routes of iron & steel making (Rotary kiln, Corex, Midrex)



**PROF. SHRIKRISHNA N. JOSHI** Department of Mechanical Engineering IIT Guwahati

**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. His research interests include mechatronics and manufacturing automation, CAD/CAM, advanced and precision manufacturing processes with a focus on applications of laser in manufacturing, thin-wall machining and single point diamond turning. Four PhD students have been graduated under his supervision and right now, about 7 students are working on cutting-edge research problems. He has published about 60 research papers and tweleve book chapters in refereed international journals and conferences. He has edited two books on "Laser-based manufacturing" and a book on Advances in Computational Methods in Manufacturing with Springer Nature. He has carried out sponsored and consultancy research work of about INR ten millions. The consultancy work was aimed at "Mechanization of Food Grain Handling Operations at FCI Godowns". Dr. Joshi has also developed a web course on Mechatronics and Manufacturing Automation under the scheme of NPTEL of MHRD, Govt. of India. The course was very well appreciated among the engineering industry, academia and research community. He has conducted this course at IIT Guwahati four times for B.Tech final year, M.Tech. and Ph.D students.

#### 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.



# PROF. MURUGAIYAN AMIRTHALINGAM

Department of Metallurgical and Materials Engineering IIT Madras

INTENDED AUDIENCE :	Final year bachelors and masters students in Metallurgy, Mechanical, Automobile and		
	Production Engineering. Industrial personnel working in automotive and steel making		
PRE-REQUISITES	industries.		
	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 APPLICABI	<b>ETO</b> : 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

- 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.



# **PROF. VINAYAK N. KULKARNI**

Department of Mechanical Engineering IIT Guwahati

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

INTENDED AUDIENCE : Undergraduate students of Aerospace and Mechanical engg. (5th semester onwards) and postgraduate students specializing in the thermofluids/Fluid Mechanics/Automobiles; industry personnel associated with aerospace engineering; faculty members associated with Mechanical /Aerospace engg.

#### **COURSE OUTLINE :**

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

#### **ABOUT INSTRUCTOR :**

Prof. Vinayak N. Kulkarni is an Associate Professor in the Department of Mechanical Engineering ofIndian Institute of Technology Guwahati since January 2015. He completed his undergraduate studies inMechanical Engineering in the Shivaji University, Maharashtra, India. His post graduation and PhD isfrom Aerospace Engineering Department of Indian Institute of Science Bangalore. His teachinginterests 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.

- 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
- Week 5: Real cycles
- Week 6: Real cycles
- 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



**PROF. SUBASHISA DUTTA** Department of Civil Engineering IIT Guwahati

#### **INTENDED AUDIENCE :** Undergraduate Students in Different Engineering Colleges

#### COURSE OUTLINE :

In the last few decades, water demand in the globe has increased in many folds.Rivers,one of the major source of water demand for domestic,agricultural and industrial uses, are often not utilised properly for long term sustainability.Therefore, it is a challenging task for engineers for understanding water, sediment and energy transport processes in rivers in both spatial and temporal scales.This course will address how to understand and model hydro-fluvial processes and designing of advanced river intervention structures.

#### **ABOUT INSTRUCTOR :**

Prof. Subashisa Dutta, having more than 15 years experience of teaching in IIT Guwahati for both undergraduate and postgraduate students. The Fluid Mechanics course in undergraduate level was instructed five times by the Subject Matter Expert. Besides this, he developed a NPTEL web course on Fluid Mechanics for undergraduate students. In the research and consultancies work of mathematical modelling of different rivers like Brahmaputra, he has been exposed to real life challenging works. In this course, some of the real life problems in Indian rivers will be discussed.

#### **COURSE PLAN :**

#### Week 1: PHYSICAL PROPERTIES AND EQUATIONS

- o Dimensions and units
- o Properties of water and sediment
- o River flow kinematics
- o Conservation of mass
- o Equations of motion
- o Hydraulic and energy grade lines

#### Week 2:STEADY FLOW IN RIVERS

- o Steady river flow
- o Steady-nonuniform river flow
- o Sediment transport in rivers

#### Week 3: UNSTEADY FLOW IN RIVERS

- o River continuity equation
- o River momentum equations
- o River flood waves
- o Loop-rating curves
- o River flood routing
- o River flow and sediment-duration curves

#### Week 4: RIVER EQUILIBRIUM

- o Particle stability
- o Channel stability
- o Regime relationships
- o Equilibrium in river bends
- o Downsteam hydraulic geometry
- o Bars in alluvial rivers
- o River meandering
- o Lateral river migration

#### Week 5: RIVER DYNAMICS

- o River dynamics
- o Riverbed degradation
- o Riverbed aggradation
- o River confluences and branches
- o River databases

#### Week 6: RIVER STABILIZATION AND RIVER TRAINING WORK

- o Riverbank stability
- o Riverbank riprap revetment
- o Riverbank protection
- o River flow-control structures
- o River training along braided rivers.

#### Week 7: RIVER ENGINEERING

- o River flood control
- o River closure
- o Canal headworks
- o Bridge scour
- o Navigation waterways

#### Week 8: RIVER MODELLING

- o Rigid-bed model
- o Mobile-bed river models
- o Finite-difference approximations
- o One-dimensional river models
- o Multidimensional river models



PROF. NINA SABNANI Department of Design Engineering IIT Bombay

**INTENDED AUDIENCE**: This course is for students who would like an introduction to the field of design and its relationship with other disciplines. It is also for those who would like to collaborate with designers for their future work. It is open to all. Mainly for Engineer, Design and Management students.

#### COURSE OUTLINE :

We are surrounded by designed objects, from highways that traverse thousands of kilometers to a pen drive that fits a lot in the smallest of spaces. Designers have used their skills to translate ideas and needs into all the objects that we see around us. Design can be interpreted in multiple ways and can mean different things in different contexts. This course aims to create an awareness and understanding of the discipline of design and its multidisciplinary nature. The relevance and value of design and how it impacts society, industry and the environment is established through lectures, case studies and project activities. This course is for those who are curious to understand what design is and why is it important.

#### **ABOUT INSTRUCTOR :**

Prof. Nina Sabnani is an artist and storyteller who uses film, illustration and writing to tell her stories. Graduating from the Faculty of Fine Arts, Vadodara she received a master's degree in film from Syracuse University, NY, as a Fulbright Fellow. Her doctoral research at IIT Bombay, focused on the Kaavad storytelling tradition of Rajasthan. Her work in film and illustrated books, seeks to bring together animation and ethnography. Her award-winning films have been made into illustrated books and translated in many Indian languages. Her passion to explore participatory design has led her to make Hum Chitra Banate Hain (We make Images) with Sher Singh Bhil from Madhya Pradesh won the prestigious National award from the President of India for 2016. Prof. Nina is currently involved in creating online courses.

#### COURSE PLAN :

#### Week 1:

- Module 1- An Introduction to Design,
- Module 2- Users and Context
- Week 2 :
  - Module 3-Design and Society,
- Module 4 Design and Sustainability
- Week 3 :
  - Module 5 Design and Industry,
  - Module 6 Design and collaboration
- Week 4 :
  - Module 7 Innovation by Design



PROF. SOUNAK KUMAR CHOUDHURY Department of Mechanical Engineering IIT Kanpur

### INTENDED AUDIENCE : UG students; practicing engineers

**INDUSTRIES SUPPORT :** Machine Tool industries; Automobile manufacturing industries; Foundry industries.

#### COURSE OUTLINE :

This course is intended to introduce the characteristic features of casting and welding processes.Process characteristics, analysis, and design criteria of various casting and welding processes will be discussed in detail with examples and video clips from industries. Typical numerical examples will be discussed to help the students understand the theory in a better way. The course is designed for undergraduate engineering students as a part of the core course on Manufacturing Technology as well as for practicing engineers.

#### **ABOUT INSTRUCTOR :**

Prof. Sounak Kumar Choudhuryhave 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:** Casting: Introduction; Classification of casting processes; Advantages and drawbacks; Historical background; Foundry practice on video; Casting of BMW car wheels on video; Patterns; Shrinkage and Mechanical allowances; Moulds; Gating system; Properties of moulding sand; Gating design; Vertical gating: aspiration effect; Optimum riser design;

**Week 2:** Solidification of pure metal and alloy; Solidification time: Chvorinov's rule; Categories of metal casting processes; Steps in sand casting; Mould properties and characteristics; Shell moulding; Investment casting: Process characteristics, Process to show through video, Advantages and disadvantages; Multiple mould casting, Steps in permanent mould casting; Die casting: Hot and Cold Chamber die casting; Centrifugal casting; Continuous casting; Cost analysis of casting; Casting defects; Product design considerations in casting;

**Week 3:** Joining Processes: Preamble, classification of joining processes; Welding: advantages and limitations; Joints in welding; Fusion welding processes; Heat density; Comparison among welding processes; Features of a Fusion Welded Joint; Typical Fusion Welded Joints; Heat Affected Zone; Solidification of Weld; Solid-State (Phase) Welding: Forge welding, butt welding, friction welding, explosion welding, resistance welding;

**Week 4:** Ultrasonic welding: process characteristics and applications; Electron beam welding; Laser beam welding; Plasma arc welding; Arc welding: characteristics; Consumable and non-consumable electrodes; Power source; Shielded metal arc welding: Principles and applications; Gas metal arc welding; Gas Tungsten Arc Welding; Tungsten-Inert Gas Welding (TIG); Submerged Arc Welding; Gas Welding: Principles, types of flames; Brazing and Soldering: Process capabilities; Welding defects;



## PROF. RAGHUNATHAN RENGASAMY

Department of Chemical Engineering IIT Madras

### **PRE-REQUISITES** : Knowledge of basic data science algorithms

#### **INTENDED AUDIENCE :** Final Year Undergraduates

#### **COURSE OUTLINE :**

The course aims at equipping participants to be able to use python programming for solving data science problems

#### **ABOUT INSTRUCTOR :**

Prof. Rengaswamy was a professor of Chemical Engineering before joining at IIT Madras as a professor and Co-Director of the Process Control and Optimization Consortium at Texas Tech University, Lubbock, USA. He was also a professor and associate professor at Clarkson University, USA and an assistant professor at IIT Bombay. His major research interests are in the areas of fault detection and diagnosis and development of data science algorithms for manufacturing industries.

### COURSE PLAN :

#### Week 1:

#### **BASICS OF PYTHON SPYDER (TOOL)**

- Introduction Spyder
- Setting working Directory
- Creating and saving a script file
- File execution, clearing console, removing variables from environment, clearing environment
- Commenting script files
- Variable creation
- Arithmetic and logical operators
- Data types and associated operations

## Week 2:

#### Sequence data types and associated operations

- Strings
- Lists
- <u>Arrays</u>
- Tuples
- Dictionary
- SetsRange

# NumPy

ndArray

### Week 3:

Pandas dataframe and dataframe related operations on Toyota Corolla dataset

- 1. Reading files
- 2. Exploratory data analysis
- 3. Data preparation and preprocessing
- Data visualization on Toyoto Corolla dataset using matplotlib and seaborn libraries
  - 1. Scatter plot
  - 2. Line plot
  - 3. Bar plot
  - 4. Histogram
  - 5. Box plot
  - 6. Pair plot
- Control structures using Toyota Corolla dataset
- 1. if-else family
- 2. for loop
- 3. for loop with if break
- 4. while loop
- 5. Functions

### Week 4: CASE STUDY

Regression

- 1. Predicting price of pre-owned cars
- Classification 1. Classifying personal income



# HARDWARE MODELING USING VERILOG

**PROF. INDRANIL SENGUPTA** Department of Computer Science and Engineering IIT Kharagpur

**INTENDED AUDIENCE:** Computer Science and Engineering ; Electronics and Communication Engineering ; Electrical Engineering

**PRE-REQUISITES :** Basic concepts in digital circuit design ; Familiarity with a programming language like C or C++

INDUSTRY SUPPORT : Intel, Cadence, Mentor Graphics, Synopsys, Xilinx.

## COURSE OUTLINE:

The course will introduce the participants to the Verilog hardware description language. It will help them to learn various digital circuit modeling issues using Verilog, writing test benches, and some case studies.

## **ABOUT INSTRUCTOR:**

Prof.Indranil Sengupta has obtained his B.Tech., M.Tech. and Ph.D. degrees in Computer Science and Engineering from the University of Calcutta. He joined the Indian Institute of Technology, Kharagpur, as a faculty member in 1988, in the Department of Computer Science and Engineering, where he is presently a full Professor. He had been the former Heads of the Department of Computer Science and Engineering and also the School of Information Technology of the Institute. He has over 28 years of teaching and research experience. He has guided 22 PhD students, and has more than 200 publications to his credit in international journals and conferences. His research interests include cryptography and network security, VLSI design and testing, and mobile computing.

He is a Senior Member of IEEE. He had been the General Chairs of Asian Test Symposium (ATS-2005), International Conference on Cryptology in India (INDOCRYPT-2008), International Symposium on VLSI Design and Test (VDAT-2012), International Symposium on Electronic System Design (ISED-2012), and the upcoming Conference on reversible Computation (RC-2017). He had delivered invited and tutorial talks in several conferences in the areas of VLSI design and testing, and network security.

- Week 1: Introduction to digital circuit design flow (3 hours)
- Week 2: Verilog variables, operators and language constructs (2 hours)
- Week 3: Modeling combinational circuits using Verilog (2 hours)
- Week 4: Modeling sequential circuits using Verilog (3 hours)
- Week 5: Verilog test benches and design simulation (2 hours)
- Week 6: Behavioral versus structural design modeling (2 hours)
- Week 7: Miscellaneous modeling issues: pipelining, memory, etc. (2 hours)
- Week 8: Processor design using Verilog (4 hours)



# THEORY AND PRACTICE OF NON DESTRUCTIVE TESTING

PROF. RANJIT BAURI Department of Metallurgical and Materials Engineering IIT Madras TYPE OF COURSE: Rerun | Elective | UG/PGCOURSE DURATION: 8 weeks (24 Jan' 22 - 18 Mar' 22)EXAM DATE: 27 Mar 2022

PRE-REQUISITES : BE/Diploma in Engineering Mech/Material Engg)

(Mech/Manufac/Production/Civil/Aerospace/App.

**INTENDED AUDIENCE :** Students, Researchers, Practicing Engineers **INDUSTRIES APPLICABLE TO :** Manufacturing and Automotive Industries

#### COURSE OUTLINE :

Nondestructive Testing (NDT) plays an extremely important role in quality control, flaw detection and structural health monitoring covering a wide range of industries. There are varieties of NDT techniques in use. This course will first cover the fundamental science behind the commonly used NDT methods to build the basic understanding on the underlying principles. It will then go on to cover the process details of each of these NDT methods.

#### ABOUT INSTRUCTOR :

Prof. Ranjit Bauri is an Professor in the Dept. of Metallurgical and Materials Engineering, IIT Madras. He has more than a decade of experience in teaching NDT theory and practical courses. He is a life member of Indian Society for Non Destructive Testing (ISNT). He is also a seasoned researcher with more than a decade of research experience. His research areas include Composite materials, Al alloys, Friction stir welding and processing, Powder Metallurgy and Microscopy.

- **Week 1:** Introduction to NDT, Visual Optical methods, Dye penetrant testing, Basic principle, Types of dye and methods of application, Developer application and Inspection.
- **Week 2:** Magnetic particle testing, Basic theory of magnetism, Magnetization methods, Field indicators, Particle application, Inspection.
- **Week 3:** Eddy current testing, Basic principle; Faraday's law, Inductance, Lenz's law,Self and Mutual Inductance, Impedance plane, Inspection system and probes,System calibration.
- Week 4: Ultrasonic testing: Basics of ultrasonic waves, Pulse and beam shapes, Ultrasonic transducers.
- Week 5: Test method, Distance and Area calibration, Weld inspection by UT.
- **Week 6:** Acoustic emission testing: Basic principle, Sources of acoustic emission, Source parameters, Kaiser-Felicity theory, Equipment and Data display, Source location schemes.
- Week 7: Radiography: X-rays and their properties, X-ray generation, X-ray absorption and atomic scattering.
- **Week 8:** Image formation, Image quality, Digital Radiography, Image interpretation, Radiation Shielding. Comparison and selection of NDT methods, Concluding remarks.





PROF. PABITRA MITRA Department of Computer Science and Engineering IIT Kharagpur TYPE OF COURSE: Rerun | Elective | UGCOURSE DURATION: 8 weeks (21 Feb' 22 - 15 Apr' 22)EXAM DATE: 23 Apr 2022

**INTENDED AUDIENCE** : Any engineering discipline and mathematics, physics. **INDUSTRIES APPLICABLE TO** : TCS, Infosys, CTS, Accenture

#### COURSE OUTLINE :

Data mining is study of algorithms for finding patterns in large data sets. It is an integral part of modern industry, where data from its operations and customers are mined for gaining business insight. It is also important in modern scientific endeavors. Data mining is an interdisciplinary topic involving, databases, machine learning and algorithms. The course will cover the fundamentals of data mining. It will explain the basic algorithms like data preprocessing, association rules, classification, clustering, sequence mining and visualization. It will also explain implementations in open source software. Finally, case studies on industrial problems will be demonstrated.

#### **ABOUT INSTRUCTOR :**

Prof.Pabitra Mitra is an Associate Professor of Computer Science and Engineering at Indian Institute of Technology Kharagpur. He did his BTech in Electrical Engineering from IIT Kharagpur and PhD from ISI Calcutta. He was a Scientist at Centre for Artificial Intelligence and Robotics, Bangalore and an Assistant Professor at IIT Kanpur. He received the INAE Young engineer Award, IBM Faculty Award and Yahoo Faculty Award. He has authored a book on Data mining and about 50 papers in international journals.

#### COURSE PLAN :

Week 1: Introduction, Data Preprocessing

- Week 2: Association Rule Mining, Classification Basics
- Week 3: Decision Tree, Bayes Classifier, K nearest neighbor
- Week 4: Support Vector Machine, Kernel Machine
- Week 5: Clustering, Outlier detection
- Week 6: Sequence mining
- Week 7: Evaluation, Visualization
- Week 8: Case studies



# MATERIALS SCIENCE AND ENGINEERING

**PROF. VIVEK PANCHOLI** Department of Metallurgy and Material Science IIT Roorkee TYPE OF COURSE: Rerun | Elective | UGCOURSE DURATION: 8 weeks (24 Jan' 22 - 18 Mar' 22)EXAM DATE: 27 Mar 2022

**INTENDED AUDIENCE :** B.E., B.Tech. students of Mechanical, Production Engineering, practicing engineers in manufacturing industry

**INDUSTRIES APPLICABLE TO**: Automobile companies, Auto ancillary companies, Manufacturing companies.

#### COURSE OUTLINE :

The course is primarily designed for Mechanical and Production Engineering students. Therefore, focus of the course is on structural materials. The course covers three important parts of materials which students and practicing engineers should know. The course is hoping to address both theoretical and practical aspects of Materials Engineering. To serve this purpose, the course is divided into three broad categories.

a) Crystallography and crystal defects – It covers crystal systems, crystal structures, indexing of planes and directions, vacancies, dislocations, grain boundaries and microstructures.

b) Phase diagram and heat treatment – It covers, Gibbs phase rule, one component systems, binary phase diagrams, lever rule, invariant reactions, iron-carbon phase diagram and heat treatment.
c) Mechanical properties – Elastic and plastic deformation, engineering and true strain and stress,

ultimate tensile strength, ductility, toughness, cold/hot working and strengthening mechanisms.

#### 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 10 years teaching experience at IIT Roorkee. He taught UG core courses like Structural Metallurgy, Phase transformation and Heat treatment, Welding and Casting and, Mechanical Behavior of Materials. He also taught M.Tech. core course on Materials Characterization.. He has published more than 35 research papers in SCI/SCIE indexed journals and completed 05 sponsored research projects. Under his guidance four PhD research scholars completed their thesis and five are working.

#### COURSE PLAN :

Week 1: Lattice, Crystal structures, Miller indices for planes and directions.

Week 2: Microscopes, microstructures and quantitative metallography.

- Week 3: Defects, diffusion and phase diagram.
- Week 4: Equilibrium phase diagram, lever rule, phase transformation.
- Week 5: Iron-carbon phase diagram, TTT and CCT curves, heat treatments.
- Week 6: Introduction to mechanical properties, cold and hot working.
- Week 7: Strengthening mechanism Fracture, and Fatigue.
- Week 8: Creep, ceramics and plastic, NDT techniques, alloy designation.



# **CMOS DIGITAL VLSI DESIGN**

PROF. SUDEB DASGUPTA Department of Electronics & **Communication Engineering** 

IIT Roorkee

PRE-REQUISITES: A basic course of Semiconductor Devices and Digital Electronics. A course on Computer Organization will be guite helpful.

**INTENDED AUDIENCE**: Final year Undergraduates and/or First year Master Student (Microelectronics) **INDUSTRIES APPLICABLE TO**: Cadence, Synopsys, ST Microelectronics, NXP Semiconductors, SCL, Chandigarh

#### **COURSE OUTLINE :**

This course brings circuit and system level views on design on the same platform. The course starts with basic device understanding and then deals with complex digital circuits keeping in mind the current trend in technology. The course follows a design perspective, starts from basic specifications and ends with system level blocks. Eight Assignments are provided which will add/help in understanding the course in a better manner both at conceptual as well as hands-on level.

#### **ABOUT INSTRUCTOR :**

Prof. S. Dasgupta, is presently working as an Associate Professor, in Microelectronics and VLSI Group of the Department of Electronics and Communication Engineering at Indian Institute of Technology, Roorkee. He received his PhD degree in Electronics Engineering from Institute of Technology-Banaras Hindu University (currently IIT-BHU), Varanasi in 2000. During his PhD work, he carried out research in the area of effects of ionizing radiation on MOSFET. Subsequently, he was member of faculty of Department of Electronics Engg., at Indian School of Mines, Dhanbad (currently IIT-Dhanbad). In 2006, he joined as an Assistant Professor in the Department of Electronics and Communication Engineering at Indian Institute of Technology, Roorkee. He is currently the Chairman, Faculty Search Committee of the Department. He has authored/co-authored more than 200 research papers in peer reviewed international journals and conferences.

#### **COURSE PLAN :**

- Week 1: L1: MOS Transistor Basic-I: L2: MOS Transistor Basic-I: L3: MOS Transistor Basic-II: L4: MOS Parasitic & SPICE Model; L5: CMOS Inverter Basics-I
- Week 2: L1: CMOS Inverter Basics-II; L2: CMOS Inverter Basics-III; L3: Power Analysis-I; L4: Power Analysis-II; L5: SPICE Simulation-I
- Week 3: L1: SPICE Simulation-II; L2: Combinational Logic Design-I; L3: Combinational Logic Design-II; L4: Combinational Logic Design-III; L5: Combinational Logic Design-IV
- Week 4: L1: Combinational Logic Design-V; L2: Combinational Logic Design-VI; L3: Combinational Logic Design-VII; L4: Combinational Logic Design-VIII; L5: Combinational Logic Design-IX
- Week 5: L1: Combinational Logic Design-X; L2: Logical Efforts-I; L3: Logical Efforts-II; L4: Logical Efforts-III; L5: Sequential Logic Design-I
- Week 6: L1: Sequential Logic Design-II; L2: Sequential Logic Design-III; L3: Sequential Logic Design-IV; L4: Sequential Logic Design-V; L5: Sequential Logic Design-VI
- Week 7: L1: Sequential Logic Design-VII; L2: Sequential Logic Design-VIII; L3: Clock Strategies for Sequential Design-I; L4: Clock Strategies for Sequential Design-II; L5: Clock Strategies for Sequential Design-III
- Week 8: L1: Clock Strategies for Sequential Design-IV; L2: Sequential Logic Design-IX; L3: Clock Strategies for Sequential Design-V; L4: Concept of Memory & its Designing-I; L5: Concept of Memory & its Designing-II

TYPE OF COURSE EXAM DATE

: Rerun | Elective | UG/PG **COURSE DURATION** : 8 weeks (24 Jan' 22 - 18 Mar' 22) : 27 Mar 2022



# INTRODUCTION TO MACHINE LEARNING (TAMIL)

## **PROF. ARUN RAJKUMAR**

Department of Computer Science IIT Madras

INTENDED AUDIENCE: Native Tamil speaking audience (Teachers/ Undergraduate Students)

**PREREQUISITES:** A basic course in linear algebra/probability/programming/algorithms would be a big plus. These are not strong pre-requisites.

**INDUSTRY SUPPORT:** All Data centric companies including those that have core business in search/e-commerce/social-media

### COURSE OUTLINE:

A short course introducing the main ideas and algorithms of Machine Learning. The goal of the course is to cover the topics at a high level so that it would act as a first course for a full fledged Machine Learning course. The course will be delivered in spoken Tamil while the technical terms discussed/exams/assignments will be in English.

### ABOUT INSTRUCTOR:

Prof.Arun Rajkumar is currently an assistant professor in the department of CSE at IIT Madras. His PhD thesis was in the area of Machine Learning and his broad research interests are in the areas of Machine Learning, sequential decision making.

# COURSE PLAN:

Week 1: Basics of Linear Algebra, Probability, Optimization

Week 2: Introduction to Supervised Learning - Regression; Topics - Linear Regression; Ridge Regression; LASSO

Week 3: Supervised Learning - Classification; Topics: K-NN, Decision Tree.

Week 4: Supervised Learning - Classification; Topics: Naive Bayes.

Week 5: Supervised Learning - Logistic Regression , Perceptron.

Week 6: Supervised Learning - Support Vector Machines

- Week 7: Supervised Learning Ensemble Methods
- Week 8: Unsupervised Learning K-means Clustering, PCA



# PROF. DEBASIS SAMANTA Department of Computer Science and Engineering

IIT Kharagpur

**PRE-REQUISITES** : This course requires that the students are familiar with programming language such as C/C++ and data structures, algorithms.

**INTENDED AUDIENCE :** The undergraduate students from the engineering disciplines namely CSE, IT, EE, ECE, etc. might be interested for this course.

**INDUSTRIES APPLICABLE TO :** All IT companies.

#### COURSE OUTLINE :

With the growth of Information and Communication Technology, there is a need to develop large and complex software. Further, those software should be platform independent, Internet enabled, easy to modify, secure, and robust. To meet this requirement object-oriented paradigm has been developed and based on this paradigm the Java programming language emerges as the best programming environment. Now, Java programming language is being used for mobile programming, Internet programming, and many other applications compatible to distributed systems. This course aims to cover the essential topics of Java programming so that the participants can improve their skills to cope with the current demand of IT industries and solve many problems in their own field of studies.

#### **ABOUT INSTRUCTOR :**

Prof. Debasis Samanta holds a Ph.D. in Computer Science and Engineering from Indian Institute of Technology Kharagpur. His research interests and work experience spans the areas of Computational Intelligence, Data Analytics, Human Computer Interaction, Brain Computing and Biometric Systems. Prof. Samanta currently works as a faculty member at the Department of Computer Science Engineering at IIT Kharagpur.

#### COURSE PLAN :

Week 1: Overview of Object-Oriented Programming and Java

Week 2: Java Programming Elements

Week 3: Input-Output Handling in Java

Week 4: Encapsulation

Week 5: Inheritance

Week 6: Exception Handling

- Week 7: Multithreaded Programming
- Week 8: Java Applets and Servlets
- Week 9: Java Swing and Abstract Windowing Toolkit (AWT)
- Week 10: Networking with Java
- Week 11: Java Object Database Connectivity (ODBC)
- Week 12: Interface and Packages for Software Development



# **ETHICAL HACKING**

# **PROF. INDRANIL SENGUPTA**

Dept. of Computer Science and Engineering IIT Kharagpur

**INTENDED AUDIENCE :** Computer Science and Engineering / Information Technology / Electronics and Communication Engineering / Electrical Engineering

**PREREQUISITES** : Basic concepts in programming and networking

INDUSTRIES APPLICABLE TO : TCS, Wipro, CTS, Google, Microsoft, Qualcomm

#### **COURSE OUTLINE**

Ethical hacking is a subject that has become very important in present-day context, and can help individuals and organizations to adopt safe practices and usage of their IT infrastructure. Starting from the basic topics like networking, network security and cryptography, the course will cover various attacks and vulnerabilities and ways to secure them. There will be hands-on demonstrations that will be helpful to the participants. The participants are encouraged to try and replicate the demonstration experiments that will be discussed as part of the course.

#### ABOUT INSTRUCTOR

Prof. Indranil Sengupta has obtained his B.Tech., M.Tech. and Ph.D. degrees in Computer Science and Engineering from the University of Calcutta. He joined the Indian Institute of Technology, Kharagpur, as a faculty member in 1988, in the Department of Computer Science and Engineering, where he is presently a full Professor. He had been the former Heads of the Department of Computer Science and Engineering and also the School of Information Technology of the Institute. He has over 28 years of teaching and research experience. He has guided 22 PhD students, and has more than 200 publications to his credit in international journals and conferences. His research interests include cryptography and network security, VLSI design and testing, and mobile computing.

He is a Senior Member of IEEE. He had been the General Chairs of Asian Test Symposium (ATS-2005), International Conference on Cryptology in India (INDOCRYPT-2008), International Symposium on VLSI Design and Test (VDAT-2012), International Symposium on Electronic System Design (ISED-2012), and the upcoming Conference on reversible Computation (RC-2017). He had delivered invited and tutorial talks in several conferences in the areas of VLSI design and testing, and network security.

#### **COURSE PLAN**

Week 1: Introduction to ethical hacking. Fundamentals of computer networking. TCP/IP protocol stack.

Week 2: IP addressing and routing. TCP and UDP. IP subnets.

Week 3: Routing protocols. IP version 6.

**Week 4:** Installation of attacker and victim system. Information gathering using advanced google search, archive.org, netcraft, whois, host, dig, dnsenum and NMAP tool.

**Week 5:** Vulnerability scanning using NMAP and Nessus. Creating a secure hacking environment. System Hacking: password cracking, privilege escalation, application execution. Malware and Virus. ARP spoofing and MAC attack.

Week 6: Introduction to cryptography, private-key encryption, public-key encryption.

Week 7: Cryptographic hash functions, digital signature and certificate, applications.

Week 8: Steganography, biometric authentication, network-based attacks, DNS and Email security.

**Week 9:** Packet sniffing using wireshark and burpsuite, password attack using burp suite. Social engineering attacks and Denial of service attacks.

Week 10: Elements of hardware security: side-channel attacks, physical inclinable functions, hardware trojans.

Week 11: Different types of attacks using Metasploit framework: password cracking, privilege escalation, remote code execution,

etc.Attack on web servers: password attack, SQL injection, cross site scripting.

Week 12: Case studies: various attacks scenarios and their remedies.



# MANUFACTURING PROCESS TECHNOLOGY I & II

**IIT Kanpur** 

**PROF. SHANTANU BHATTACHARYA** Department of Mechanical Engineering



TYPE OF COURSE	: Rerun   Core   UG/PG	COURSE DURATION	: 12 weeks (28 Jan'19 - 19 Apr'19)	
PRE - REQUISITES	: None	EXAM DATE	<b>:</b> 28 Apr 2019	
INDUSTRY SUPPORT	: SMIL (Gurgaon), HAL (Kanpur and Lucknow), Cyeint (Hyderabad), Small and medium scale production industries.			

**INTENDED AUDIENCE** : Students of BE/ME/MS/BSc/MSc stream

# **COURSE OUTLINE :**

This is an introductory level course in Manufacturing Process Technology and is mostly meant for Undergraduate engineers. At the heart of any manufacturing system is a set of processes which change the size, shape and form of raw materials into the desirable thus giving an industrial nation the power of growing. This course is an introductory course for engineering professionals who would like to take up careers in manufacturing particularly at the process level and also for professionals who are already in manufacturing careers and would like to see the technological changes that the manufacturing processes have witnessed in the last about 5 decades.

# **ABOUT INSTRUCTOR :**

Prof. Shantanu Bhattacharya is currently a 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 2 : Manufacturing properties of materials.

Week 3 to 4 : Casting Processes, Gating Design and Casting Defects.

Week 5 to 6 : Machining Processes e.g. turning, drilling, grinding etc. Tool life.

Week 7 to 8 : Advanced Machining Processes e.g. AJM, ECM, EDM, LBM, USM etc.

Week 9 to 10: Metal Forming Processes such as rolling, forging, extrusion etc.

Week 11 to 12: Micro-fabrication processes, Additive manufacturing.



# WELDING METALLURGY

PROF. PRADEEP K. JHA Department of Metallurgy and Material Science IIT Roorkee TYPE OF COURSE: Rerun | Core | PG/UGCOURSE DURATION: 12 weeks (24 Jan' 22 - 15 Apr' 22)EXAM DATE: 24 Apr 2022

**PRE-REQUISITES** : Introduction to courses such as Welding processes, Materials science etc. **INDUSTRIES APPLICABLE TO** : Manufacturing Industries like SAIL, BHEL etc.

#### COURSE OUTLINE :

The course focuses on understanding the metallurgy and solidification of weldments The course will make the students aware with the metallurgical aspects of welding. For getting a sound weld, the students are required to be aware of the science behind the welding phenomena, especially in the domain of weld metal solidification, heat transfer, heat treatment processes, strengthening mechanisms etc. The course will be useful for engineering graduates as well as professionals working in the area of welding.

#### **ABOUT INSTRUCTOR :**

Prof. Pradeep K. Jha is presently working as Associate Professor in the Department of Mechanical & amp; 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, especially casting and welding processes.

- Week 1: Introduction to welding metallurgy, phase diagrams
- Week 2: Phase transformation, TTT and CCT diagrams
- Week 3: Metal strengthening approaches
- Week 4: Heat treatment processes for weldments
- Week 5: Analysis of heat flow and temperature distribution in welding
- Week 6: Concept of solidification in welding, constitutional supercooling
- Week 7: Introduction to heat affected zones, Properties of HAZ
- Week 8: Residual stresses in welding, Preheat and postweld heat treatment
- Week 9: Types of welding distortion and its control
- Week 10: Cracks in welds
- Week 11: Weldability issues in materials
- Week 12: Welding defects, Design considerations in welding



# ADVANCED COMPUTER ARCHITECTURE

**PROF. SMRUTI R. SARANGI** Department of CSE IIT Delhi

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

: New | Elective | UG/PG

### **PRE-REQUISITES** : Computer Architecture (2nd year level)

**INTENDED AUDIENCE**: UG and PG students (Computer Science and Electrical Engineering) **INDUSTRIES APPLICABLE TO :** Intel. AMD. IBM. Qualcomm. Texas Instruments

#### **COURSE OUTLINE :**

This course is on Advanced Computer Architecture. It will introduce students to advanced aspects of processor design and will specifically focus on out-of-order pipelines, GPUs, and compiler techniques for enhancing ILP. The course will subsequently move on to cache design and main memory technologies such as DDR-4. A substantial portion of the course will be devoted to the theory of on-chip networks and memory models. The last part of the course will cover aspects of low-power design, hardware security, and reliability.

#### **ABOUT INSTRUCTOR :**

Dr. Smruti R. Sarangi is an Associate Professor in the Computer Science and Engineering department at IIT Delhi. He has a Ph.D in computer science from the University of Illinois at Urbana Champaign, USA, and a B.Tech from IIT Kharagpur. Prior to his appointment as a faculty member in IIT Delhi in 2011, he spent 5 years working for IBM Research Labs, and Synopsys Research. He has published 60 papers in prestigious international conferences and journals, and holds 5 US patents. He is a member of the IEEE and ACM.

#### **COURSE PLAN:**

Week 1: In-order pipelines overview

- Week 2: Out-of-order pipelines, Branch prediction
- Week 3: Advanced branch prediction techniques
- Week 4: Issue, select, and commit
- Week 5: Aggressive speculation
- Week 6: Compiler techniques for enhancing ILP
- Week 7: Caches: Design, modeling, and optimizations
- Week 8: On-chip networks
- Week 9: Theory of memory models
- Week 10: Coherence Protocols
- Week 11: Low power design
- Week 12: Reliability and Hardware Security



# WELDING PROCESSES

**PROF. MURUGAIYAN AMIRTHALINGAM** Department of Metallurgy and Material Science IIT Madras TYPE OF COURSE: Rerun | Elective | UG/PGCOURSE DURATION: 12 weeks (24 Jan' 22 - 15 Apr' 22)EXAM DATE: 23 Apr 2022

PRE-REQUISITES : Graduates of Metallurgical/Mechanical/Automobile/Production Engineering

INTENDED AUDIENCE : Masters students in Metallurgical, Mechanical, Automobile and Production Engineering. Practicing welding engineers, welders, R&D personnel in academia and national laboratories, quality management personnel from welding and manufacturing industries and research scholars who are working in welding and joining.

**INDUSTRIES APPLICABLE TO**: Construction, Fabrication, Automobile and Power generation industries and research labs

#### COURSE OUTLINE :

The modern material assemblies require the combined use of alloys for a given commercial application. Welding technologies are of critical importance for the construction of virtually all components of the assemblies. This course aims to elaborate the physical principles of arc, plasma, laser, resistance spot, electron beam and solid state welding processes. This includes, physics of electric arc-plasma, engineering the arc-plasma for welding, metal transfer and mass flow in the weld pool, laser/electron beam - material interactions, pressure and force balance in keyhole mode power beam welding, fundamentals of heat generation by Joule heating and process principles and overview on types of resistance and solid state welding processes.

#### **ABOUT INSTRUCTOR :**

Prof. Murugaiyan Amirthalingam is currently working as an Assistant Professor in IIT-Madras. His research and teaching interests include welding metallurgy, welding processes development, steel product development and additive manufacturing.

- Week 1: Introduction to the course
- Week 2: Physics of welding arc Part I
- Week 3: Physics of welding arc Part II
- Week 4: Introduction to arc welding processes Part I
- Week 5: Electrical power sources for welding
- Week 6: Introduction to arc welding processes Part II
- Week 7: Fundamentals of resistance welding Part I
- Week 8: Fundamentals of resistance welding Part II
- Week 9: Introduction to power beam welding processes Plasma, laser and electron beam welding processes
- Week 10: Principles of power beam welding processes
- Week 11: Introduction to pressure welding processes
- Week 12: Principles and operational considerations of pressure welding processes



# **INTRODUCTION TO MINERAL PROCESSING**

PROF. ARUN KUMAR MAJUMDER Department of Mining Engineering IIT Kharagpur TYPE OF COURSE: Rerun | Elective | UG/PGCOURSE DURATION: 12 Weeks (24 Jan' 22 - 15 Apr' 22)EXAM DATE: 23 Apr 2022

INTENDED AUDIENCE: Mining, Chemical & Metallurgical Engineering, Geology. PRE-REQUISITES : +2 Science

INDUSTRIES APPLICABLE TO : Tentatively all mining companies like: NMDC, CIL, SAIL, IREL, UCIL,

HZL, HCL, GMDC, APMDC, MPSMC, RSMML, HINDALCO etc. and equipment manufacturing companies like Weir Minerals, Tega Industries, METSO, FL-Smidth, AllMinerals etc.

#### COURSE OUTLINE :

Mineral processing is the first process that most ores undergo after mining in order to provide a more concentrated material for the procedures of extractive metallurgy. Although the primary operations are comminution and concentration, but there are other important operations in a modern mineral processing plant, including sizing, sampling and bulk material handling. This course is intended to provide a detailed understanding of the afore-mentioned operations.

#### ABOUT INSTRUCTOR :

Arun Kumar Majumder is an Associate Professor in the Department of Mining Engineering of IIT Kharagpur. He is a PhD in Mineral Processing from the University of Queensland, Australia. Prior to joining the Department of Mining Engineering at IIT, Kharagpur in 2010, he had served AMPRI (CSIR), Bhopal since 1990 at various levels.

He has carried out extensive and in-depth modeling work on complex coal and mineral processing unit operations. These models are developed based on sound fundamental concepts and they have strong industrial relevance too. The most significant aspect of his work is the identification of many problems at their roots first and then providing solutions elegantly.

He has set up a new mineral engineering laboratory at IIT, Kharagpur with financial supports from industries. He is in the editorial boards of three international journals, has authored one book, has more than hundred publications and is currently the reviewer of many international journals of repute. He has filed one international and one Indian patent as of now.

In recognition of his contributions in the areas of coal and mineral processing, various professional bodies have honored him with 12 awards so far.

#### COURSE PLAN :

- Week 1: Importance of Mineral Processing
- Week 2: Particle Characterization
- Week 3: Comminution 1
- Week 4: Comminution 2
- Week 5: Industrial Screening
- Week 6: Movement of Solids in Fluids
- Week 7: Hydrocyclone
- Week 8: Gravity Concentration

Week 9: Flotation

- Week 10: Bulk Material Storage and Handling
- Week 11: Slurry Transportation
- Week 12: Iron Ore Washing



# SCANNING ELECTRON/ION/PROBE MICROSCOPY IN MATERIALS CHARACTERIZATION

**PROF. DEBABRATA PRADHAN** Department of Materials Science Centre IIT Kharagpur

EXAM DAT

TYPE OF COURSE: Rerun | Core | PGCOURSE DURATION: 8 Weeks (21 Feb' 22 - 15 Apr' 22)EXAM DATE: 23 Apr 2022

PRE-REQUISITES : M.Sc./BE

**INTENDED AUDIENCE :** B.Tech./M.Tech./Ph.D. students and researchers from academics and industries.

**INDUSTRIES APPLICABLE TO** : Any industries related to materials

#### COURSE OUTLINE :

This course Scanning Electron / Ion / Probe Microscopy in Materials Characterization will provides indepth understanding on three different microscopy techniques to students as well as engineers, technicians, and researchers (material and biological scientists). These three scanning microscopy techniques are widely used to obtain the surface morphology of solid materials (primarily) at nanometer range. The topics will cover not only basic principles of these techniques and different parameters that affect the image quality but also preparation of different types of samples and the interpretation of results/data. The advancements to these microscopic techniques will be briefed with examples.

#### **ABOUT INSTRUCTOR :**

Prof. Debabrata Pradhan has been serving as Assistant and Associate Professor at Materials Science Centre, IIT Kharagpur since 2010. He received his PhD degree from IIT Bombay, and did postdoctoral research at Tamkang University, Taiwan, for 2 years and University of Waterloo, Canada, for 4 years. He also served Electron Microscopy facility at SAIF, IIT Bombay, for a year after completion of PhD work. He has received Adani Award for Excellence in Teaching Physical Chemistry to the B. Tech. students at IIT-Bombay (2001-2002), MRSI Medal 2019 by MRS, India, in recognition of significant contributions to the field of Materials Science and Engineering, and Faculty Excellence Award 2019 by IIT Kharagpur for outstanding contributions towards Teaching, Research, and Institutional Development. He has published more than 130 research papers, 1 book, 2 book chapters, and 2 patents. His current h-index is 40 with citations >5500.

#### COURSE PLAN :

Week 1: Introduction to microscopy in general. Resolution, Light versus electron versus ion as source. Lens aberrations, Main components of scanning electron microscope (SEM), Electron beam-specimen interaction

**Week 2:** Generation and detection of signals, Imaging modes, Major parameters that affect the SEM image quality, Additional capabilities of SEM, Specimen preparation.

**Week 3 :** Introduction to helium ion microscope (HIM), Electrons versus ions, Ion source and operation of ion microscope, Ion-solid interaction, Signal generation, Image formation, and contrast mechanisms.

**Week 4 :** Imaging techniques, Scanning transmission ion microscopy, Microanalysis with HIM, ToF-SIMS on HIM, Modification of materials using ion microscope.

Week 5: Introduction to scanning probe microscopy (SPM), Important parts of scanning tunneling microscope (STM), STM Tip fabrication, Working principles, Different modes of operation, Image processing and analysis, Artifacts.

**Week 6:** Work function measurement, Scanning tunneling spectroscopy, and Imaging the surface states. Atomic force microscopy (AFM), fabrication of cantilevers, calculation of spring constant.

**Week 7:** Different forces and their interaction with the sample, Modes of AFM operation and their principle, Noises in AFM, Advanced imaging modes, Work function and surface potential measurements, other force microscopy.

**Week 8:** Mechanical, chemical, and electric properties measurement using probe microscope, Manipulation of atoms and molecules using AFM and STM, Industrial applications.