Institute of Engineering and Technology

HAND BOOK

On

CURRICULUM STRUCTURE AND SYLLABUS

Bachelor of Technology

in

Computer and Communication Engineering

(Programme Code: 3110)

Batch: 2023-27

CONTENTS

JK Lakshmipat University, Jaipur Institute of Engineering and Technology

Curriculum Structure

Bachelor of Technology in Computer and Communication Engineering (Batch 2023-2027)

Sem.	Courses						Credits
I	Programming- I	Fundamentals of Electrical and Electronics Engineering	Electromagnetism and Quantum Mechanics / Environmental Studies	Calculus	Engineering Drawing	Fundamentals of Communications	
	4	4	3	4	3	2	**20**
II	Programming- II	Digital Circuit and Systems	Electromagnetism and Quantum Mechanics / Environmental Studies	Linear Algebra and Differential Equations	Design Thinking	Critical Thinking and Storytelling	
	4	4	3	4	3	2	**20**
III	Data Structure and Algorithms	Computer Organisation and Architecture	Signals and Systems	Probability and Statistics	Essentials of Management and Business	Perspectives on Contemporary Issues	
	4	4	4	4	3	2	**21**
IV	Analog Electronics	Machine Learning	Operating Systems	Random Variables and Stochastic Processes	Managing Business Functions	Communication and Identity	
	4	4	4	4	3	2	**21**
Summer	PS1(4)						**4**
V	Digital Signal Processing	Computer Networks	Digital Communication	DE-I	OE-I/ SEE1(2)+SEE2(2)	Understanding and Managing Conflicts	
	4	4	4	4	4	2	**22**
VI	Information theory and Coding	Minor Project	Wireless and Mobile Communication	DE-II	OE-II/ SEE3(2)+SEE4(2)	Critical Thinking for Decisions at Workplace	
	4	2	4	4	4	2	**20**
VII		Project	DE-III	OE-III	OE-IV		
		4	4	4	4		**16**
VIII	Practice School-II /Entrepreneurial Project/Research Project/Semester at a partner University PS1102/PR1105/PR1104						**16**
							160

List of Electives	
DE-I, II, III (Tentative)	**OE-I ,II,III,IV (Tentative)**
	Idea to business model
Microwave Engineering	Numerical and scientific computing
Cyber Security	Advanced statistics
Software Defined Radio	Fundamental of sustainable development
Sensor Networks	Integrating design, technology and business
Advanced Communication System	Introduction to IoT and Automation project
Satellite Communication	Computational game theory and applications
SEE-I, II, III, IV (Tentative)	Smart Materials
Virtual Reality Lab	Flexible Electronics
Geographical Information Systems Lab	Neuromorphic Engineering
Robotic Process Automation Lab	Digital Logic Verification
Google Cloud Lab	Mechanisms for Machines
Satellite Image Processing	Fundamentals of investing
	Operations research
	Behavioral assessments for employability
	Solid and e-waste management
	Disaster management

INDEX OF COURSE DESCRIPTIONS

B	EE1113	Microwave Engineering	3-0-2	40
C				
D				
	OE-I			
A	ED1102	Idea to business model	4-0-0	49
B	AS2202	Numerical and scientific computing	3-0-2	51
C	AS1202	Advanced statistics	3-1-0	53
D	ME1226	Introduction to Robotics	3-0-2	55
E	IL1211	Integrating design, technology and business	4	56
F	EE1222	Introduction to IoT and automation project	2-1-2	58
G	EE1223	Computational game theory and applications	3-1-0	59
	SEE-I/SEE-II			
A	CS1221	Virtual Reality Lab	0-0-4	61
B	CE1114	Geographical Information Systems Lab	0-0-4	63
	Semester VI			
32	EE1218	Information theory and Coding	3-1-0	65
33	PR1103	Minor Project	4	66
34	EE1123	Wireless and Mobile Communication	3-1-0	
35	CC1106	Critical Thinking for Decisions at Workplace	2-0-0	67
	DE-II			
A	EE1219	Cyber Security	3-0-2	68
B	EE1228	Software Defined Radio	3-1-0	69
C	EE1232	Sensor Network	3-0-2	
D	EE1124	Microprocessors and Microcontrollers	3-0-2	
	OE-II			
A	ME1228	Smart Materials	3-0-2	77
B	ME1227	Fundamental of sustainable development	3-1-0	79
C	ME1222	Motion Planning, Control, and Manipulation of Robots	3-0-2	81
D	ME1223	Project in Robotics	1-0-6	82
E	ME1224	Mechanics of Robots	3-0-2	83
F	EE1225	Flexible Electronics	3-1-0	84
G	EE1226	Neuromorphic Engineering	3-1-0	86
H	EE1227	Digital Logic Verification	3-0-2	88
I	IL1206	Mechanisms for Machines	3-0-2	89
	SEE-III/SEE-IV			
A	CS1125	Robotic Process Automation Lab	0-0-4	91
B	CS1223	Google Cloud Lab	0-0-4	93
C	EE1231	Satellite Image Processing	1-0-4	

	Semester VII			
36	PR1107	Project	-	94
	DE-III			
A	EE1211	Advanced Communication System	3-1-0	

B	EE1216	Industrial IoT	3-0-2	
C	EE1229	Satellite Communication	3-1-0	
D	CS1228	Computer Vision	3-0-2	
	OE-III/OE-IV			
A	IL1211	Integrating design, technology and business	4	
B	FA1127	Fundamentals of investing	4-0-0	
C	AS1201	Operations research	3-0-2	
D	BS1105	Behavioral assessments for employability	2-0-2	
E	AS1210	Solid and e-waste management	3-0-0	
F	CE1206	Disaster management	3-1-0	
	Semester VIII			
37	PS1102/ PR1105/ PR1104	Practice School-II/Entrepreneurial Project/Research Project/Semester at a partner University	-	

Course Title and Code: Programming I (Python) (CS1139)	
Hours per Week	**L-T-P: 3-0-2**
Credits	**4**
Students who can take	B. Tech. I semester
Prerequisite	None
Weightage	Theory 60%, Lab 40%

Course Objectives: The aim of the course is to build up a clear understanding of the fundamentals of computer programming. The course is taught using Python programming language. The course will discuss and cover the topics necessary for the students to write, execute and understand the programs on their own. The students will be able to demonstrate problem solving skills by developing and implementing algorithms to solve problems.

Learning Outcomes:

On successful completion of this course, the students should be able to:

1. Demonstrate problem solving skills in Python by designing and implementing basic computing techniques and algorithms.
2. Understand the basic programming syntax; tokens, operators, variables, data types and expressions. Identify different object-types.
3. Use Python control constructs and decision-making structures for writing programs.
4. Use lists, tuples, dictionaries, functions, strings for solving problems.
5. Use third-party Python packages and create our own packages or modules for reusability.
6. Understand data/file handling techniques, exception handling and basic OOP concepts in Python

Course Syllabus (Theory):

Basics of Computer Programming: Flowcharts, Algorithms, Writing pseudocode, computational thinking.

Fundamentals of Python: Beginnings with Python, Parts of a Program: Modules, Statements and Expressions, Whitespace, Comments, Special Python Elements: Tokens, Naming Objects, Variables, Objects and Types, Operators;

Control: The Selection Statement for Decisions: if,

Repetition: for Statement, In-Depth Control: Boolean Variables, Relational Operators, Boolean Operators, Precedence, while Statement, Nesting.

Functions: What Is a Function? Python Functions, Flow of Control with Functions, Scope, Arguments, Parameters, Default Values and Parameters, Functions as Objects;

Introduction to *Classes*: Object-Oriented Programming, Characteristics of OOP, Class and Instance, Object Methods, Fitting into the Python Class Model, Python and OOP, Python and Other OOP Languages, Classes, Inheritance.

Strings: The String Type, String Operations, Formatted Output for Strings;

Lists and Tuples: What Is a List? Iteration, Indexing and Slicing, Operators, Lists vs Strings, Split and Other Functions and Methods, Anagrams, Tuples from Lists.

Dictionaries and Sets: Dictionaries, Python Dictionaries, Dictionary Indexing and Assignment, Sets, Python Sets, Methods, Operators, and Functions for Python Sets, Set Methods;

Files and Exceptions: What Is a File? Accessing Files: Reading Text Files, Accessing Files: Writing Text Files, Reading and Writing Text Files in a Program, File Creation and Overwriting, Handling Errors: Error Names, the try-except Construct, try-except Flow of Control, Exception;

Reference Books:

1. David I. Schneider, 'An Introduction to Programming using Python' Pearson, 2016.
2. John V. Guttag, 'Introduction to Computation and Programming Using Python – with Applications to

Computational Modeling and Understanding Data', MIT Press, 3rd Edition, 2021.
3. William Punch, Richard Enbody, 'The Practice of Computing Using Python'. Pearson, 2016.
4. Allen B. Downey. Think Python. Green Tea Press, Massachusetts, USA.

Reference Online Course:

Programming for Everybody (Getting started with Python)
https://www.coursera.org/learn/python
https://www.coursera.org/specializations/python
Python 3: Programming Specialization
https://www.coursera.org/specializations/python-3-programming

Course Title and Code: Fundamentals of Electrical and Electronics Engineering (EE1118)	
Hours per Week	**L-T-P: 3-0-2**
Credits	**4**
Students who can take	B. Tech. I semester
Prerequisite	None
Weightage	Theory -70%, Practical and Projects – 30%
Course Objectives: This course aims to provide conceptual knowledge about electrical circuits and electronic devices and their real-life applications. It provides an overview of digital communication concepts and modulation techniques.	
Learning Outcomes: On successful completion of this course, the students should be able to: 1. Understand the behavior of active and passive components. 2. Develop applications using various type of diodes. 3. Use the small signal model to study the amplifiers. 4. Design switching circuits using MOSFETs. 5. Familiarize with modulation techniques used for digital communication.	

Course Syllabus (Theory)

Unit 1: Introduction to discrete components and abstractions on which design of electronic circuits are based. Sinusoidal steady state analysis of circuits containing resistors, capacitors, and inductors. Differential equations describing time and frequency behavior of circuits containing storge elements.
Unit 2: Circuit Analysis Techniques- KVL, KCL, Source Transformations, Network theorems.
Unit 3: Semiconductor, Diode, PN junctions, Diode equation and models.
Unit 4: BJT and MOSFET-construction and biasing, small signal model- BJT/MOSFET as a switch. Amplifiers- Transconductance Model, Magnitude and Phase response. MOSFET as invertor and switch. Operational amplifier and its applications.
Unit 5: Communication Systems: Various frequency bands used for communication, Block diagram of Digital communication, need of modulation, Digital modulation techniques (ASK, FSK, PSK).

Textbooks:

1. Engineering Circuit Analysis by WH Hayt, JE Kemmerly, SM Durbin, Tata Mc Graw Hill Education Private Limited.
2. Microelectronics Circuits by Adel S Sedra and Kenneth C Smith, Oxford Press.
3. Electronic Communication Systems by G.Kennedy, McGrawHill,4th Edition.

Course Title and Code: Electromagnetism and Quantum Mechanics (AS1108)	
Hours per Week	**L-T-P: 3-0-0**
Credits	**3**
Students who can take	B. Tech. I semester
Prerequisite	None
Weightage	Theory 100%

Course Objectives: The objective of the course is to: Formulate electromagnetic phenomena for static configurations and describe them using vector calculus; determine electric field in vacuum and matter and magnetic field in vacuum and determine the associated energy; describe unification of electric and magnetic field and Maxwell's equations; formulate propagation of electromagnetic waves and their reflection and transmission at change of medium.

Understand the dual nature of light and matter and the need of Quantum Mechanics; formulate quantum mechanics and apply it to simple systems to understand nature at atomic scale, formulate basic ideas of Quantum Mechanics with states and operations in Hilbert space

Learning Outcomes:

On successful completion of this course, the students should learn to

1. For a given charge (current) distribution, find the electric (magnetic) field in vacuum. Find electric fields in matter.
2. Use vector calculus for describing basic electromagnetic phenomena leading to Maxwell's equations.
3. Use polarised wave solution of electromagnetic wave equation and find reflection and transmission of electromagnetic wave incident upon a medium.
4. Determine the need for new Physics from dual nature of light and matter and write Schroedinger equation.
5. Use Schroedinger equations to solve bound state problems in some simple potentials.
6. Using results of simple harmonic oscillator, show that classical physics is a limiting case of quantum physics.
7. Solve the problem of scattering of a particle by a potential and determine transmission and reflection probabilities and apply quantum mechanical tunnelling in other fields.

Course Syllabus (Theory):

Recapitulation of Electrostatics, Vector Analysis and Electrostatics using vector calculus, electric potential, discrete and continuous charge distribution, electrostatic energy, conductors, Field of an electric dipole, Multipole expansion of charge distribution, Electric Fields in Matter, Polarisation and field of polarized object and inside dielectric, Linear dielectrics and properties.

Magnetostatics: force law, field due to steady current, divergence and curl of magnetic field, magnetic vector potential and field of a rotating spherical shell with surface charge, Force and torque due to magnetic fields, magnetization, magnetic moment and energy.

Electromagnetic Induction, Maxwell's equations, Energy of electromagnetic field and Poynting theorem. EM wave equation, formulation of wave propagation in one dimension, reflection, transmission, polarization. Electromagnetic Waves in vacuum and through linear media, Reflection and Transmission of EM waves, Snell's law, Total Internal Reflection.

Blackbody radiation, photoelectric effect and particle nature of light. Matter waves, Davisson- Germer experiment, Wave function and Schroedinger equation, Properties, interpretation and admissibility conditions on wave function, free particle equation and wave packet, uncertainty principle. Two slit interference experiment for electrons, measurement and interpretation.

Time Independent Schroedinger equation for bound state; infinite and finite square well, double potential well and many wells leading to formation of bands in solids (qualitative), one-dimensional harmonic oscillator --- solution using creation annihilation operators, discussion of eigenvalues and eigenfunctions taken from analytical solution (no derivation of eigenfunction or eigenvalues), correspondence principle.

Schroedinger equation for H-atom, discussion of energy eigenvalues and radial eigenfunctions (qualitative --- no derivation), Zeeman effect and space quantization of angular momentum, Angular momentum, commutation relations, raising and lowering operators and its eigenvalues, Spin angular momentum, Pauli spin matrices, Stern Gerlach experiment and spin.

Scattering from rectangular potential well and rectangular potential barrier, transmission and reflection, tunnelling, qualitative discussion of applications in nuclear physics and electronics.

Functions as vectors, Postulates of Quantum Mechanics and a brief introduction to vector space and bra and ket vector formalism, Introduction to quantum qubits and quantum gates, base states and superposed states.

The scope of the Electromagnetism part of the syllabus is from parts of chapters 1-9 of *Introduction to Electrodynamics by David Griffiths.* The scope of the major part of Quantum Mechanics in the syllabus is from parts of chapters 1-4 of *Introduction to Quantum Mechanics by David Griffiths.* Covering the topics marked with asterisk will be optional, and will depend on the pace of the class.

Reference Books:

1. Classical Electromagnetism by H.C.Verma
2. A Textbook of Quantum Mechanics by P.M.Mathews and K. Venkatesan

Course Title and Code: **Environment Studies ES1114**	
Hours per Week :	**L-T-P: 3-0-0**
Credits	**3**
Students who can take	BTech & BCA I Semester
Prerequisites	Basic science
Weightage	Theory -70% Practical -30%
Course Objectives: The primary goal of this course is to deepen participants' comprehension of the multidisciplinary aspects of the environment. It aims to explore diverse sources of natural energy, delve into the intricate workings of ecosystems, and foster an awareness of today's pressing environmental challenges. Through comprehensive study and analysis, this course seeks to broaden understanding and promote sustainable practices for a better future.	
Learning Outcomes: On successful completion of this course, the students should be able to: 1: Relate renewable energy with ecology and the environment. 2: Assess climate change and its threat to biodiversity and the ecosystem. 3: Identify various pollution sources and their impact on the Environment. 4: Understand and apply sustainable development principles and various environmental Protection acts.	

Course Syllabus (Theory):

UNIT-1 Introduction: Understanding the environment, Global crisis, Basic Concepts of the multidisciplinary nature of environmental studies, Need for public awareness.

UNIT-2: Natural Resources

Renewable and non-renewable resources, Natural resources and associated problems, Water resources, Mineral resources, Food resources, and Energy resources.

UNIT-3: Ecosystems

Concept of an ecosystem, Structure, and function of an ecosystem, types of ecosystems, Producers, consumers and decomposers, Food chains, food webs, and ecological pyramids. Introduction to Biodiversity, Value of Biodiversity, Hot Spot of Biodiversity, Threats to Biodiversity, Biodiversity Conservation.

UNIT-4: Environmental Pollution

Definition, Cause, effects, and control measures of Air pollution, Water pollution, Soil pollution, and Marine pollution, Solid waste Management: Causes, effects, and control measures of urban and industrial wastes.

UNIT-5: Social Issues and the Environment:

From Unsustainable to Sustainable development, urban problems related to energy, Water conservation, Greenhouse gases & Climate change, global warming, acid rain, and ozone layer depletion. Environment Protection Act, Air (Prevention and Control of Pollution) Act, Water (Prevention and Control of Pollution) Act, Wildlife Protection Act, Forest Conservation Act.

Reference:

1. Rajagopalan, R., "Environmental Studies: From Crisis to Cure", Oxford University Press, New Delhi, 2e, 2011
2. Ranjit Daniels & J. Krishnaswamy "Environmental Studies", Wiley India
3. Davis & Cornwell "Environmental Engineering", McGraw Hill
4. W. Cunningham – Principles of Environmental Science, TMH
5. P. Venugoplan Rao – Principles of Environmental Science and Engineering, PHI.

Video Lectures:

1. http://www.nptelvideos.in/2012/12/fundamentals-of-environmental-pollution.html

2. http://www.nptelvideos.in/2012/11/energy-resources-and-technology.html
3. https://nptel.ac.in/courses/122/102/122102006/
4. https://nptel.ac.in/courses/127106004/

Websites (related to the course)

1. http://www.cpcb.nic.in/
2. http://www.rpcb.rajasthan.gov.in
3. http://www.bis.org.in/
4. http://www.who.int/en/
5. http://www.moef.gov.in

Course Title and Code: Calculus (AS1109)	
Hours per Week	**L-T-P: 3-1-0**
Credits	**4**
Students who can take	B. Tech. I semester
Prerequisites	None
Weightage	Theory – 100%

Course Objectives: This course introduces the various forms of calculus useful in diverse engineering areas. The course builds upon the concepts learned in single-variable calculus and extends to the functions of several variables. Propositional calculus covers the basic concepts of mathematical logic useful for students in computer science courses.

Learning Outcomes:

On successful completion of this course, the students should be able to:

1. use the concepts of limits and convergence to analyze the sequences and series of real numbers.
2. define, analyze, and visualize functions of multiple variables.
3. apply higher-dimensional differential calculus methods to a range of physical problems including optimization.
4. use the concept of the gradient and its relationship to directional derivatives to analyze vector fields and scalar fields geometrically.
5. use propositional calculus to read, comprehend and construct mathematical logic and arguments.

Course Syllabus (Theory):

Differential Calculus

Infinite Series: Convergence of sequences and series of real numbers, absolute and conditional convergence, comparison, ratio and root tests for convergence, power series.

Function of several variables: Review of functions of one variable, curve sketching, limit, continuity, partial derivatives, differentiability, linearization, maxima-minima.

Integral Calculus

Arc length, Solids of Revolution: Surface Area and Volume, Double integrals, change of order of integration, Change of variables (Cartesian to Polar and vice versa), triple integrals.

Vector Calculus

Vector Differentiation: Vector functions and derivatives, arc length and unit tangent vector, curvature and unit normal vector, directional derivative and gradient vectors, tangent plane, divergence, and curl of a vector field.

Propositional Calculus

Proposition, Compound Proposition, Conjunction, Disjunction, Implication, Converse, Inverse & Contrapositive, Bi-conditional Statements, Mathematical Proof Methods

Textbooks:

1. George B. Thomas and Ross L. Finney, Calculus and Analytic Geometry, 9th Edition, Pearson Education Asia, 2006.
2. Kenneth H. Rosen, Discrete Mathematics and its Applications, 7th Edition, McGraw Hill, 2012.

Reference Books:

1. C. Ray Wylie and Louis Barrett, Advanced Engineering Mathematics, 6th edition, McGraw Hill, 2003.
2. Monty J. Strauss, Gerald L. Bradley, and Karl J. Smith. Calculus, 3rd edition, Pearson Education India, 2002.

Course Title and Code: Engineering Drawing (ME1103)	
Hours per Week	**L-T-P: 2-0-2**
Credits	**3**
Students who can take	B.Tech. I Semester
Prerequisites:	None
Weightage	Theory -60%, Practical and Assignments – 40%
Course Objectives: This course effectively conveys and develop the engineering drawing concepts. The objective is also to visualize and represent the 3D objects in 2D planes with proper dimensioning, by using the most generally used CAD application software, AutoCAD.	
Learning Outcomes: On successful completion of this course, the students should be able to: Read and interpret engineering drawings. Identify the three principal projection planes. Draw 2-dimensional orthographic projections. Create an isometric drawing using CAD Tool.	

Course Syllabus (Theory):

UNIT – I

Introduction to Engineering Drawing, Orthographic Projections:

Principles of Engineering Graphics and their significance, usage of Drawing instruments, lettering, Scales – Plain and Diagonal Scales. **(8 lectures)**

UNIT – II

Projection of points and lines

First angle projection, projection of points. Projection of straight lines (only First angle projections) inclined to both the principal planes. **(6 lectures)**

UNIT – III

Projection of plane surface and solid

Projection of simple solids like prisms, pyramids, cylinder, cone, and truncated solids when the axis is inclined to one of the principal planes and parallel to the other by rotating object method. **(10 lectures)**

UNIT – IV

Drawing using AutoCAD:

Introduction to AutoCAD, drawing commands, editing commands, annotate commands, layers. Drafting using AutoCAD**,** Layout, view arrangements, dimensioning, annotation, bill of materials. **(16 lectures).**

Text Books:

1. Bhatt, N. D. (2011). Engineering Drawing (5th ed.). Anand, India: Charotar Publishing Co.
2. "Engineering Graphics" by K.L. Narayana and P. Kannaiah, Scitech Publications (India), Pvt. Ltd., October 2008.
3. Engineering Drawing & Design: Cencil Jensen, Jay D. Helsel, Dennis R. Short, Seventh Edition, Tata Mcgraw Hill 2012.

Reference Online Course: https://nptel.ac.in/courses/112103019

Course Title and Code: Fundamentals of Communication (CC1101)	
Hours per Week	**L-T-P: 2-0-1**
Credits	**2**
Students who can take	B.Tech/BCA/BBA/BDes Semester I
Prerequisites	None
Weightage	Theory 40% Practical 60%

Course Objectives- This course provides an introduction to the importance of effective communication, the consequences of poor communication, and the different elements of verbal and non-verbal communication. Students learn about, and enhance, the components of communication: kinesics, paralanguage (voice) and language.

Course Outcomes:

On successful completion of this course, the students should be able to:

Identify cultural differences and their impact on communication.

Deliver effective oral presentations following appropriate kinesics and paralinguistic features.

Compose grammatically correct sentences and paragraphs to write effective emails and essays.

Identify common language errors and take steps to avoid them.

Apply appropriate communication skills across settings, purposes, and audiences.

Module(s)	Topics to be covered
Basics of Communication	• Nature and Importance of Communication • Mehrabian's Communication Theory • Ethos, Pathos, Logos: The Three Pillars of Persuasive Communication • Consequences of Poor Communication • Influence of Culture on Communication
Public Speaking and Presentation Skills	• Formats of Public Speaking (oral narration, conversational skills) • Basics of Effective Presentations • 4 Ps of Presentations • The Power of Three
Writing Skills	• Structuring Better Paragraphs • Writing Strategy • Email and Formal Writing • Writing Essays
English	• English as a Foreign Language • World Englishes • English Pronunciation • Common errors in English

Reference Books:

- Raman, Meenakshi and Sangeeta Sharma, 2011. Technical Communication: Principles and Practice. Second Edition. New Delhi: Oxford University Press.
- Mohan, Krishna and Meenakshi Raman. 2010. Advanced Communicative English. New Delhi: Tata McGraw Hill.
- "The Quick And Easy Way To Effective Speaking" by Dale Carnegie

- “Effective Speaking Skills” by Terry O’ Brien

- “Communication Skills: A Practical Guide to Improving Your Social Intelligence, Presentation, Persuasion and Public Speaking” by Ian Tuhovsky

Recommended MooCs :

1. English for the Workplace (Offered By British Council)
   https://www.futurelearn.com/courses/workplace-english

2. Rhetoric: Art of Persuasive Writing and Public Speaking (Offered by Harvard University)
   https://online-learning.harvard.edu/catalog?keywords=Rhetoric&op=Search

Course Title and Code: Programming II (CS1139)	
Hours per Week	**L-T-P: 3-0-2**
Credits	**4**
Students who can take	B.Tech. II Semester, BCA III Semester
Prerequisite	None
Weightage	Theory 60% Lab 40%

Course Objectives: The purpose of this course is to introduce to students to the field of programming using C language. The students will be able to enhance their analysing and problem-solving skills using functional Programming language.

Learning Outcomes:

On successful completion of this course, the students should be able to:

1. Design solutions to simple mathematical and engineering problems by applying the basic programming principles of C language.
2. Problem-solving through structures, unions and files.
3. Apply code reusability with functions and pointers.
4. Develop an in-depth understanding of functional and logical concepts of C Programming.
5. Understand and analyze problems, develop and implement algorithms to solve it.

Course Syllabus (Theory)

UNIT I

Overview of C: History and importance of C, Basic structure of C program, executing a C program. Data Types and Operators, Variables, Sequences and Iteration Different types of Data types, Expressions, Precedence Rules, Operators- Operators: arithmetic operators, relational operators, logical operations, bitwise operators, miscellaneous operators, Local Variables, Global Variables.

UNIT II

Conditional Statements, Loops, Arrays and Strings, User Defined Data Types If-else statement, For loop, While Loop, Nested Iteration, Concept and use of arrays, declaration and usage of arrays, 2-dimensional arrays, different types of user defined data types, Character Arrays and Strings: Declaring and Initializing String Variables, Reading Strings from Terminal, Writing Strings to Screen, Arithmetic Operations on Characters, String-handling Functions.

Unit III

Functions in C, Passing Parameters (By value & Reference), using returned data, Passing arrays, structures, array of structures, pointer to structures etc., passing characters and strings, The void pointer.

UNIT IV

Pointers, Using pointers to represent arrays, Dynamic Memory allocation, structures, using typedef, Pointers: What is a Pointer? - How do you Define a Pointer? - Pointer Indexing – Pointer Arithmetic - Function data return with a Pointer - A pointer to a Function, Arrays of Structures & pointers Pointer Expressions, Pointer Increments and Scale Factor.

UNIT V

Files — Types of file processing: Sequential access, Random access — Sequential access file –Random access file –Command line arguments

Structure – Nested structures — Pointer and Structures — Array of structures — Example Program using structures and pointers — Self-referential structures — Dynamic memory allocation – Singly linked list – typedef.

TEXT BOOKS:

T1. Kernighan, B.W and Ritchie,D.M, “The C Programming language”, Second Edition, Pearson Education, 2015.
T2. Yashwant Kanetkar, Let us C, 17th Edition, BPB Publications, 2020.

REFERENCES:

R1. ReemaThareja, “Programming in C”, Oxford University Press, Second Edition, 2016.
R2. Griffiths, D., & Griffiths, D. (2012). Head First C: A Brain-Friendly Guide. " O'Reilly Media, Inc.".
R3. Paul Deitel and Harvey Deitel, “C How to Program with an Introduction to C++”, Eighth edition, Pearson Education, 2018.

Reference Online Material-

Introductory C Programming Specialization
https://www.coursera.org/specializations/c-programming
C for Everyone: Programming Fundamentals
https://www.coursera.org/learn/c-for-everyone

JAVATPOINT
C Programming Language
https://www.javatpoint.com/c-programming-language-tutorial
GeeksforGeeks
C Programming Language
https://www.geeksforgeeks.org/c-programming-language/

Course Title and Code: Digital Circuit and Systems (EE1120)	
Hours per Week	**L-T-P: 3-0-2**
Credits	**4**
Students who can take	B. Tech. II Semester
Prerequisite	None
Weightage	Theory -70%, Practical and Projects – 30%

Course Objectives: This course aims to impart fundamental knowledge about digital logic and circuits which lead to design of complex digital systems like microprocessors. This is the foundation course by which students get exposure to design of digital logic systems.

Learning Outcomes:

On successful completion of this course, the students should be able to:

1. To represent logical functions in canonical and standard form.
2. Evaluate and simplify Boolean functions and implement the minimized logic using logic gates/Programmable logic arrays.
3. To design and analyse combinational logic circuits using minimum gates.
4. Analyse the timing behaviour (circuits (clock skews, propagation delays, Setup and Hold Times). of sequential logic.
5. Develop Finite State Machine models for some real-life digital systems.

Course Syllabus (Theory):

Introduction to Digital electronic systems- examples of some real-life applications.

Number Systems, Axiomatic Definition of Boolean Algebra, Basic Theorems and Properties of Boolean Algebra, Boolean Functions, Canonical and Standard Forms.

Combinational systems. Logic gates and TRI-STATE logic. The Map Method - K-map, Product of Sums and Sum of Products Simplification, NAND and NOR Implementation of various logic circuits using CMOS.

Arithmetic blocks. Magnitude Comparator, Multiplexers, Demultiplexers, Encoder, Decoders, Parity Checkers, Implementation of Boolean functions using Multiplexers.

Sequential circuits. Explicit functional description. Latches and flip-flops. Registers and shift registers. Counters. Memories-introduction to SRAM & DRAM, Cache memory.

Introduction to Finite state machines (FSM)- Implement state machines for real life applications.

Textbooks:

1. Digital Systems, Principles and Applications by Ronald J. Tocci, Neal S Widmer, Gregory L. Moss, Pearson Publication.
2. Digital Logic and Computer Design Fundamental by Morris Mano, Pearson Publication, 5th Edition.

Course Title and Code: Critical Thinking and Storytelling (CC1102)	
Hours per Week	**L-T-P: 2-0-1**
Credits	**2**
Students who can take	B.Tech Semester- II
Prerequisites	None
Weightage	Theory 40% Practical 60%

Course Objectives: The modern world offers confounding opinions and choices that need to be navigated judiciously. This course explores frameworks and processes to critically examine narratives, reconstruct them, and craft well-reasoned stories that can be told using impactful communication.

Learning Outcomes:

On successful completion of this course, the students should be able to:

1 Formulate intelligent questions to investigate.

2 Evaluate information and argument for correctness, consistency, relevance, and validity.

3 Compose well-structured and well-reasoned arguments.

4 Articulate and evaluate the impact of narratives.

5 Distinguish between facts, assumptions, and opinion.

Course Syllabus (Theory)

UNIT I: Introduction to Critical Thinking- Definitions of Critical Thinking, its applications and the methods to think critically. Paul & Elder model will be used.

UNIT II: Importance of questioning- The key to critical thinking is the ability to formulate intelligent questions. Students will be able to create, improve and prioritize their questions. They will be able to use different types of question by using Bloom's taxonomy to understand the root of any situation, problem or subject.

UNIT III: Examine data critically- Students will be able to filter information, separate fact from opinion, identify cognitive biases and become aware of the ladder of inference. They will also be taught to conduct responsible research and basics of bibliography and citation.

UNIT IV: Construct and reconstruct argument- Students will be taught to construct arguments with sound reasoning. They will be able to support their claims and opinions with compelling data and facts, and present well-informed arguments. Evaluate argument using logical fallacies.

UNIT V: Building a compelling narrative- Stories that we create and narrate influence how we see ourselves and our association with others. The students will be able to observe, think, create and narrate their stories in an effective manner.

Reference:

Critical Thinking: An Introduction
Alec Fisher - Cambridge University Press - 2011

Critical Thinking: Its Definition and Assessment
Alec Fisher-Michael Scriven - Centre for Research in Critical Thinking - 1997

Art of Thinking Clearly

Rolf Dobelli - Harper Collins – 2014

Critical Thinking Skills: Developing Effective Analysis and Argument
Stella Cottrell - Palgrave Macmillan – 2017

Thinking, Fast and Slow
Daniel Kahneman - Farrar, Straus and Giroux – 2015

Chimamanda Ngozi Adichie: The danger of a single story | TED - YouTube. (n.d.). Retrieved 10 January 2023, from https://www.youtube.com/watch?v=D9Ihs241zeg&list=PLCttQajkONuymB2BTPLW5ndPn9nAt2QRC&index=10&t=13s&ab_channel=TED
Edward Said and Orientalism: A Simple Explanation—YouTube. (n.d.). Retrieved 10 January 2023, from https://www.youtube.com/watch?v=RfeAxw502Hs&list=PLCttQajkONuymB2BTPLW5ndPn9nAt2QRC&index=13&t=50s&ab_channel=UniversityQuickCourse
Edward Said—Framed: The Politics of Stereotypes in News—YouTube. (n.d.). Retrieved 10 January 2023, from https://www.youtube.com/watch?v=4QYrAqrpshw&list=PLCttQajkONuymB2BTPLW5ndPn9nAt2QRC&index=12&ab_channel=AlJazeeraEnglish
Noam Chomsky—Manufacturing Consent—YouTube. (n.d.). Retrieved 10 January 2023, from https://www.youtube.com/watch?v=tTBWfkE7BXU&list=PLCttQajkONuymB2BTPLW5ndPn9nAt2QRC&index=15&t=46s
Noam Chomsky—The 5 Filters of the Mass Media Machine—YouTube. (n.d.). Retrieved 10 January 2023, from https://www.youtube.com/watch?v=34LGPIXvU5M&list=PLCttQajkONuymB2BTPLW5ndPn9nAt2QRC&index=14&t=109s&ab_channel=AlJazeeraEnglish

Course Title and Code: Data Structures and Algorithms (CS1131)	
Hours per Week	**L-T-P: 3-0-2**
Credits	4
Students who can take	B.Tech. Semester III (CSE+CCE)
Prerequisites	Programming II
Weightage	Theory 70% Lab 30%

Course Objectives: In this course, students will explore the concepts of algorithms and data structures. This course aims to develop a good understanding of Data Structures concepts and its implementation to solve various computational problems using C and C++. Main topics are Complexity analysis (time & space), Recursion, Linear Data Structures (Arrays, Queue, Stack, Linked list), Searching, Sorting, Non-linear data structures (Trees, Graphs), Indexing and Hashing.

Learning Outcomes:

On the successful completion of this course, the students should be able to:

1. Have a good understanding of different data structures stacks, queues, lists, trees and graphs
2. Learn the implementation of above data structures in C and C++ by writing programs for performing the basic operations like insertion, deletion, searching, traversal, etc.
3. Develop skills to apply appropriate data structures in problem solving.
4. Analyse the algorithms in terms of asymptotic time and space complexity.
5. Implement and compare various searching and sorting algorithms.
6. Understand recursion and its implementation.

Course Syllabus (Theory)

Unit-1: Writing algorithms for simple problems, Understanding Analysis of time and space complexity, Big O notation, Evaluating complexity for simple problems.

Unit 2: Types of Data Structures: Linear & Non-Linear, Concepts of different linear structures: Arrays, Stacks, Queues, Linked list, Understanding Operations, Implementation and Applications of Stacks, Queues, Linked list. Evaluation of expression in infix, postfix & prefix forms using stack, Queues: Circular Queues: Operations and Applications, De-queue and Priority queue, Sparse matrix, Recursion.

Unit -3: Sorting and searching algorithms. Linear and binary search, insertion sort, selection sort, bubble sort, merge sort, quick sort. Complexity Analysis of different sorting and searching algorithms.

Unit-4: Non-linear Data Structures: Trees definition, characteristics, concept of child, sibling, parent child relationship etc., binary tree: its applications, insertion, deletion and traversal of binary trees, constructing binary tree from traversal results. Array-based implementation, Concept of Heap, Priority queue implementation using heap.

Binary Search Tree: Concept of BST, insertion into and deletion from BST, Height balanced tree: Introduction to AVL Tree, Application of trees for representation of sets.

Introduction to Multiway search trees.

Unit-5 Graphs: Directed and undirected graphs, representation of graphs using adjacency matrix and list, Depth first and breadth first traversal of graphs. Topological sorting. Hashing,

Text Books:

T1 Tenenbaum, A. M., Langsam, Y., & Augenstein, M. J. (1996). Data Structures using C and C++. Prentice-Hall.

T2. Seymour, L. (2020). Data Structures With C McGraw: Hill Book Company..

T4. “Fundamental of Data Structure” (Schaums Series) Tata-McGraw-Hill.

Reference Books:

R1. ReemaThareja, “Data structures using C”, Oxford University Press, Second Edition, 2014.
R2. Introduction to Algorithms, by Cormen, Leiserson, Rivest, and Stein.
R3. Alfred V. Aho, Jeffrey D. Ullman, John E. Hop croft, Data Structures and Algorithms. Pearson Education, 2012.

Reference Online Material

Data Structure and Algorithms NPTEL
https://nptel.ac.in/courses/106/102/106102064/
https://nptel.ac.in/courses/106/106/106106127/

Coursera
Data Structures and Algorithms Specialization
https://www.coursera.org/specializations/data-structures-algorithms
Data Structures and Performance
https://www.coursera.org/learn/data-structures-optimizing-performance
Ordered Data Structures
https://www.coursera.org/learn/cs-fundamentals-2

GeekforGeeks
https://www.geeksforgeeks.org/data-structures/

Course Title and Code: Computer Organization and Architecture (CS1134)	
Hours per Week	**L-T-P: 3-0-2**
Credits	**4**
Students who can take	B. Tech. III Semester
Prerequisite	Digital circuit and systems
Weightage	Theory -65%, Practical and Assignments – 35%

Course Objectives: To study the basic organization and architecture of digital computers (CPU, memory, I/O, software). Such knowledge leads to a better understanding and utilization of digital computers and can be used in the design and application of computer systems or as the foundation for more advanced computer-related studies.

Learning Outcomes:

On successful completion of this course, the students should be able to:

1. Draw the functional block diagram of the single bus architecture of a computer and describe the function of the instruction execution cycle, RTL interpretation of instructions, addressing modes, and instruction set.
2. Summarize and compare different computer systems.
3. Categorize different types of computers based on Instruction set Architecture.
4. Develop assembly language programs for multiplication, division, and I/O interface using 8086.
5. Given a CPU organization and instruction, design a memory module and analyze its operation by interfacing with the CPU.
6. Write a flowchart for Concurrent access to memory and cache coherency in Parallel Processors and describe the process.
7. Given a CPU organization, assess its performance, and apply design techniques to enhance performance using pipelining, parallelism, and RISC methodology.
8. Analyze the performance of pipeline and cache-based systems.

Course Syllabus (Theory):

Unit I: BASIC STRUCTURE OF COMPUTERS: Review of Digital Logic and Systems, Functional units, Von Neuman and Harvard Architecture Basic operational concepts, Bus structures, PCI, Multiple bus organization, Performance, and metrics,

Unit II: BASIC PROCESSING UNIT: Fundamental concepts, Execution of a complete instruction, The Arithmetic and Logic Unit (ALU), Number Systems, Fixed point representation, and Arithmetic, Floating Point Representation and Arithmetic, Hardwired control, Micro programmed control.

Unit III: INSTRUCTION SETS: Characteristics and functions, x86 Architecture, Instruction set architecture, Addressing modes and formats, RISC and CISC.

Unit IV: PIPELINING: Basic concepts, Data hazards, Instruction hazards, Influence on instruction sets, Data path, and control path, Performance considerations, Exception handling.

Unit V: MEMORY SYSTEM: Basic concepts, Memory Hierarchy, Semiconductor RAM, ROM, Speed, Size and cost, Cache memories, Improving cache performance, Virtual memory, Memory management requirements, Associative memories, and Secondary storage devices.

Unit VI: I/O ORGANIZATION: Accessing I/O devices, Programmed Input/Output, Interrupts, Direct Memory Access, I/O devices, and processors.

Unit VII: PARALLEL PROCESSING: The use of multiple processors, Symmetric Multiprocessors, Cache coherence, UMA, and NUMA.

Text Books:

- Mano, M. Morris. "Computer system architecture, 1993." Prentice Hall 3: 299.
- Patterson, David A., and John L. Hennessy. Computer Organization and Design MIPS Edition: The Hardware/Software Interface. Newnes, 2013.

Reference Books:

- Hayes, John P. Computer architecture and organization. McGraw-Hill, Inc., 2002.
- Heuring, Vincent P., Harry Frederick Jordan, and Miles Murdocca. Computer systems design and architecture. Addison-Wesley, 1997.
- Kai Hwang & Naresh Jotwani - Advanced Computer Architecture: Parallelism, Scalability, Programmability, Tata McGraw Hill, 2003

Course Title and Code: Signals and Systems (EE1120)	
Hours per Week	**L-T-P: 3-0-2**
Credits	**4**
Students who can take	B.Tech. Semester III
Prerequisite	None
Weightage	Theory -60%, Practical – 40%

Course Objective- This course objective is to introduce fundamentals of signal & systems, domain transformations and spectral energy density and their applications in modern communication systems. Analysis of static, linear, time invariant, causal and stable systems using various mathematical transformation.

Course Outcome:

On successful completion of this course, the students should be able to:

1. Introduction to fundamental signals (unit impulse, unit step, ramp, exponential) and their Fourier transforms.
2. Classify systems based on the impulse response behaviour of both continuous-time and discrete-time systems.
3. Usefulness of convolution for analysing the LTI systems and understanding the concepts of power spectral density through correlation.
4. Analyse and Characterize the DT systems through DTFT and z-Transform.

Syllabus (Theory):

UNIT-I: CLASSIFICATION OF SIGNALS AND SYSTEMS: Classification of Signals: Continuous time signals - Discrete time signals - Periodic and Aperiodic signals - Even and odd signals - Energy and power signals -Deterministic and random signals -Complex exponential and Sinusoidal signals. Unit step, Unit ramp, Unit impulse - Representation of signals in terms of unit impulse. Classification of Systems: Continuous time systems- Discrete time systems - Linear system - Time Invariant system - causal system - BIBO system - Systems with and without memory - LTI system

UNIT-II: ANALYSIS OF CONTINUOUS TIME SIGNALS: Fourier series: Representation of Continuous time Periodic signals – Trigonometric and exponential-symmetry conditions. Properties of continuous time Fourier series – Parseval's relation for power signals –Frequency spectrum. Fourier transform: Representation of Continuous time signals- Properties of Continuous time Fourier transform – Parseval's relation for energy signals – Frequency spectrum –Analysis of LTI system using Fourier methods.

UNIT-III: LTI CT SYSTEM MODELING: Solution of Differential equation with initial conditions – zero state response and zero input response impulse response - Frequency response - Convolution - Analysis and characterization of LTI system using Fourier Transform

UNIT-IV: ANALYSIS OF DT SIGNALS AND SYSTEMS: Representation of sequences - Discrete time Fourier transform (DTFT) - Discrete Fourier transform (DFT) and its properties - Solution of linear constant coefficient difference equation- with initial conditions-zero state response and zero input response, impulse response - Convolution sum - Frequency response. Continuous-time convolution, Convolution sum, Correlation between signals, Cross correlation, Autocorrelation, Energy spectral density, Power spectral density.

UNIT-V: Z-Transform and its properties, Region of convergence and its properties, inverse z transform, transfer function, causality and stability. Computational structure for implementing discrete time systems, Unilateral Z-Transforms.

Text Books:

1. Alan V Oppenheim,Alan S Wiisky and S.Hamid Nawab, “Signals and systems”, Pearson Education,2nd edition,2003
2. Simon Haykin and Barry van Veen “Signal and Systems”, John Wiley & Sons Inc,2007.

Reference Books:

1. John.G.Proakis and Manolakis “ Digital Signal Processing-Principles ,Algorithms and Applications”, Pearson Education ,4th Edition 2009.
2. B.P.Lathi, “ Linear Systems & Signals”, Oxford Press , Second Edition 2009.

Reference Online Course:

1. Principles of Signals and Systems, By Prof. Aditya K. Jagannatham

   https://onlinecourses.nptel.ac.in/noc23_ee04/preview
2. Signals and Systems. MIT OpenCourseWare.
   https://ocw.mit.edu/courses/res-6-007-signals-and-systems-spring-

Course Title and Code: Probability and Statistics (AS2170)	
Hours per Week	**L-T-P: 3-0-2**
Credits	**4**
Students who can take	B. Tech III Sem
Pre-requisite	None
Weightage	Theory – 70%, Lab – 30%

Course Objectives: This course introduces computational analysis of data based on fundamental concepts of statistics. The course will include utilizing Python in a hands-on way to solve various problems related to statistical data analysis.

Learning Outcomes:

On successful completion of this course, the students should be able to:

1. develop programs for analyzing and interpreting complex situations in various domains including sustainable development using statistical methods.
2. summarize and visualize different datasets.
3. analyze and interpret different datasets using discrete and continuous probability distributions and apply the same for problem-solving, e.g., Goodness of Fit.
4. formulate and validate hypotheses with reference to different datasets.
5. apply correlation, regression, and least square method, for modeling, analysis, interpretation, and forecasting.

Syllabus

Descriptive Statistics

Measures of central tendency, measures of dispersion, skewness and kurtosis, frequency distributions, graphical representation, measures of locations, and variability.

Probability Theory

Introduction to probability, conditional probability, Bayes' theorem, Discrete and continuous random variables, Probability mass and density functions, Probability distributions: Binomial, Poisson, Uniform, Normal, Exponential

Sampling Distributions

Sampling, Types of sampling, sampling errors, sampling distribution of means, variance, and proportions for the normal population, The Central Limit Theorem, Chi-Square, t, and F distributions, Point and interval estimation.

Test of Hypothesis

Null and alternative hypotheses, types of errors, p-values, Parametric test of hypothesis based on mean, variance, and proportion, goodness-of-fit tests, One-way analysis of variance (ANOVA), correlation, and regression analysis.

Text and Reference Books

1. Richard A. Johnson, Miller and Freund's Probability and Statistics for Engineers, PHI.
2. Douglas C. Montgomery and George C. Runger, Applied Statistics and Probability for Engineers, John Wiley & Sons, Inc., 3rd Edition (2004).
3. Meyer, P. L., Introductory Probability and Statistical Applications, Oxford & IBH (1970).
4. Baisnab, A. P. and Jas, Manoranjan, Elements of Probability and Statistics, Tata McGraw Hill, 13th Reprint (2006).
5. J. Ravichandran, Probability and Statistics for Engineers, Wiley India, New Delhi (2010).

Course Title and Code: Essentials of Management & Business (LS1108)	
Hours per Week	**L-T-P: 3-0-0**
Credits	**3**
Students who can take	B. Tech III Sem
Prerequisite	None
Weightage	Theory 60% Practical 40%

Course Objectives: This course explores the basic concepts, processes and practices of management in managing business organizations. It focuses on providing understanding of management and its application in all types of businesses. It also helps students to understand how organizations develop and maintain competitive advantage within a changing business environment. The course will involve more of interactive sessions and open discussions within the class. The students are expected to come prepared to the class and actively participate in classroom discussions

Learning Outcomes:

On successful completion of this course, the students should be able to

1. Appreciate multiple approaches to developing management as a field of study.
2. Comprehend the importance of managerial role in various functional areas for organizational performance
3. Identify the forces in business environment impacting organizations and its management practices.
4. Evaluate the relevance of management principles in alternative organizational context
5. Discuss current concerns in management theory and practices

Topics:

1. Managers and Management
2. Management Functions
3. Business Purpose: Vision, Mission, Goals and objectives
4. Understanding Business Organizations as Systems
5. Environment, Social and Corporate Governance
6. Economics and Business

Readings:

1. Bhat, A. and Kumar, A (2010). ***Management Principles, Processes and Practices***. New Delhi: Oxford University Press
2. Koontz, H. and Weihrich, H. (Latest Edition). ***Essentials of Management: An International Perspective, 8e.*** New Delhi: Tata McGraw Hill.
3. Tripathy, P.C. and Reddy, P. N. (2012). **Principles of Management.** McGraw Hill, New Delhi.
4. T. R. Jain (Latest Edition). Economics for Engineers. New Delhi: V K Publications.

MOOC

1. Fundamentals of Management by the University of California, Irvine (Coursera): https://www.coursera.org/learn/fundamentals-of-management?#about

Course Title and Code: Perspectives on Contemporary Issues (CC1103)	
Hours per Week	**L-T-P: 2-0-1**
Credits	**2**
Students who can take	BBA/ BDes/ B.Tech Sem III
Prerequisites	None
Weightage	Theory 60%, Practical 40%

Course Objectives-

In an era of globalization, there is an increasing need for the youth to be able to empathize with others, value diverse perspectives and cultures and understand how events around the world are intertwined. Global issues revolve around social, economic and environmental factors which ultimately add to the interconnectedness of countries. In this course, students will employ key critical thinking concepts to analyze contemporary issues from multiple perspectives. They will explore the impact at micro and macro levels.

Learning Outcomes :

On successful completion of this course, the students should be able to:

1 Identify different perspectives objectively.

2 Explain interconnectedness of the issues and their impact at micro and macro levels.

3 Recognize their own beliefs, biases, claims and assumptions.

4 Evaluate sources, argue and defend effectively.

Course Syllabus (Theory):

Research, analysis & evaluation of a topic from local, national and global perspectives.

- **Globalization**

With increasing development throughout the world, the focus of this theme will be on the impact of adopting policy of neoliberalism globally. Changes in India after implementation of new economic policy of 1991.

- **Poverty and Inequality**

What do you mean by wealth & equality? Is it enough to ascribe monetary values to human lives? Who has benefited from an increased access to resources, labour & capital due to globalisation? Which groups are historically marginalised & suffer from unequal access to opportunities

- **Social justice and human rights**

An understanding of the impact of inequality and discrimination, the importance of standing up for our own rights and our responsibility to respect the rights of others.

- **Climate Change and Sustainability**

Understanding the magnitude of the issue, its impact and future challenges. How we can meet our current needs without diminishing the quality of the environment or reducing the capacity of future generations to meet their own needs.

- **Technology**

Impact of unprecedented technological growth, challenges and opportunities. Is technocracy a boon or a bane?

References for reading:

1. Held, D. and McGrew, A., 2016. *The Global Transformations Reader*. 2nd ed. Cambridge: Polity Press.

2. Schmelzer, M., Vetter, A. and Vansintjan, A., 2022. *The Future is Degrowth*. London: Verso.

3. Harvey, D., 2020. A Brief History of Neoliberalism. In: F. Lechner and J. Boli, ed., *The Globalization Reader*, 6th ed. Wiley.

4. Kolbert, E. (2015). The Sixth Extinction: An unnatural History.

5. https://www.downtoearth.org.in/blog/governance/mass-poverty-is-back-in-india-76348

6. https://geographyandyou.com/indias-poverty-line-changing-perspectives/

Course Title and Code: Analog Electronics (EE1121)	
Hours per Week	**L-T-P: 3-0-2**
Credits	**4**
Students who can take	B.Tech. Semester IV
Prerequisite	Fundamentals of Electrical and Electronics
Weightage	Theory -60%, Practical – 40%

Course Objective- This course aim to provide students ability to design and analyze multistage amplifiers and their applications. It shall provide knowledge for design of oscillators and analog to digital convertors which are required as functional blocks in many analog and digital systems.

Course Outcome:

On successful completion of this course, the students should be able to:

1. Analyze the circuit parameters of amplifiers and develop circuits for specified performance.
2. Understand the advantages of negative feedback and recommend type of feedback amplifier for any application.
3. Design suitable oscillator circuits and simulate their response.
4. Use operational amplifier for various linear and nonlinear applications.
5. Recommend the type of ADC/DAC, multiplexers in hybrid circuits.

Syllabus (Theory):

1. BJT Amplifiers (operation and analysis): Amplifier with active load CE,CC,CB amplifiers Darlington pair; Cascade amplifiers, Current mirrors and differential amplifiers.
2. Feedback: Feedback topologies and analysis for discrete transistor amplifiers; stability of feedback circuits using Barkhausen criteria.
3. Waveform Generation: sinusoidal feedback oscillators; Relaxation oscillators, square-triangle oscillators
4. Design of operational amplifiers: Current sources and active loads, difference, intermediate and output stages including Miller capacitors for frequency computation; Operational amplifier parameters; Effects of real operational amplifier parameters on circuit performance.
5. Applications of operational amplifiers: Comparators, clippers and clampers; Linearization amplifiers; Precision rectifiers; Logarithmic amplifiers, multifunction circuits and true rms convertors. Amplifiers, summers, differentiators, integrators, active filters, Schmitt triggers and oscillators.
6. Analog and Digital interface circuits: A/D, D/A Converters, S/H circuits and multiplexers.

Textbooks:

1. Sedra, A. S., Smith, K. C., and Chandorkar, A. N., (2013), Microelectronic Circuits: International Version, 6th Edition, Oxford University Press
2. Op-amps and linear integrated circuits by Ramakant A Gayakward Prentice hall 4th edition
3. Electronics Devices & Circuit Theory, RL Boylestead & L Nashelsky, PHI

Reference Books:

1. Electronics Circuit Analysis and Design, Donald A. Neamen, Tata McGraw Hill
2. B. Razavi, Fundamentals of Microelectronics, 2nd edition. Wiley- India, 2014.

Course Title and Code: Machine Learning (CS1138)	
Hours per Week	**L-T-P: 3-0-2**
Credits	**4**
Students who can take	B.Tech. IV Sem
Prerequisites	Programming-I, Linear Algebra and Differential Equations, Probability and Statistics
Weightage	Theory 75%, Lab 25%

Course Objectives: This course introduces the fundamental concepts of machine learning and statistical pattern recognition. It will cover aspects of supervised and unsupervised learning. To be specific, linear regression, logistic regression, decision trees, random forests, SVM, clustering, PCA, KNN, etc will be taken up in detail. The course will also thoroughly cover gradient descent, its variants and regularization techniques. Towards the end, we will also introduce basics of neural networks and deep learning.

Learning Outcomes:

On successful completion of this course, the students should be able to:

1. Judge whether a problem should be solved using machine learning.
2. Apply various techniques that are well suited according to the problem.
3. Apply regularization techniques to solve the problem of high bias and high variance.
4. Design machine learning models that are suited to solve a particular problem.
5. Build programs that implement the theoretical concepts learned in this course.

Course Syllabus (Theory):

Unit I: Motivation, learning paradigms, Applications of ML. Representations (features) extracted from data. Linear transformations, matrix vector operations in the context of data and its representations. Problem formulation: classification and regression. Probability distributions in the context of data, Prior probabilities and Bayes Rule. Introduce paradigms of learning: supervised and unsupervised.

Unit II: PCA and Dimensionality Reduction, Nearest Neighbours and KNN, Linear Regression, Decision Tree Classifiers, Generalization and overfitting. Training, Dataset partitioning and preprocessing. Model evaluation metrics, ROC curve.

Unit III: Ensembling and Random Forest, Linear SVM, K-Means, Logistic Regression, Naive Bayes.

Unit IV: Role of Loss functions, optimization, gradient descent and perceptron learning, MLP, Backpropagation, neural network classification and regression, regularization, early stopping, Introduction to Deep Learning and CNNs.

Reference Books:

There is no particular book for the course. However, they serve as good references:

1. Tom Mitchell, *Machine Learning,* McGraw Hill, 1997.
2. Goodfellow et. al, Deep Learning, MIT Press, 2016.

Reference Online Course:

CS229: Machine Learning, Stanford University

Online available at: https://cs229.stanford.edu/

Coursera Specialization on Machine Learning

Online available at: https://www.coursera.org/specializations/machine-learning-introduction

Course Title and Code: Operating Systems (CS1108)	
Hours per Week	**L-T-P: 3-0-2**
Credits	**4**
Students who can take	B.Tech-CSE, Sem IV
Prerequisites	None
Weightage	Theory 70%, Lab 30%
Course Objectives: The main aim of this course is to describe the structure and functioning of operating system. At the end of the course, the students will be well aware of the concepts of process management, memory management, file management and I/O hardware.	
Learning Outcomes: On successful completion of this course, the students should be able to: 1 Use basic LINUX commands 2 Understand the structure of OS and its interface with hardware 3 Differentiate between different types of operating systems 4 Implement and assess the performance of different types of scheduling algorithms. 5 Have a good knowledge of process synchronization and Inter process communication, deadlock 6 Analyze and implement various disk-scheduling algorithms	

Course Syllabus (Theory):

Unit 1: Introduction to OS – Concept of operating system, Generations of Operating systems, Types of operating system, Services, System calls, Structure of an OS-Layered, Microkernels, Virtual Machines, Case study on Windows and LINUX operating system

Unit 2: Process Management - Concept of process, Process states, Process State transitions, Process Control Block (PCB), Context switching, **Process scheduling:** Foundation and Scheduling objectives, Types of Schedulers. **Scheduling criteria:** CPU utilization, Throughput, Turnaround Time, Waiting Time, Response Time. Scheduling algorithms: Pre-emptive and Non-preemptive, FCFS, SJF, Priority, R-R scheduling, Multilevel queue scheduling. **Inter process communication:** Critical section, Race condition, semaphores, monitors, message passing, **Classical IPC Problems:** Readers-Writer Problem, Dinning Philosopher Problem etc. Deadlock: Shared resources, resource allocation and scheduling, resource graph models, deadlock prevention, deadlock avoidance, deadlock detection, deadlock recovery algorithms.

Unit 3: Memory Management - Memory management schemes, Contiguous/Non-contiguous memory allocation, storage management, paging, page table structure, segmentation, segmentation with paging, virtual memory, demand paging, page fault, Page replacement algorithms.

Unit 4: File Management - File concept, types and structures, attributes of a file, operations performed on file, File organization and access method, file allocation methods, directory structure, file directories, directory implementation.

Unit 5: I/O Hardware - I/O devices, I/O hardware, device driver, Kernel I/O sub-system, Interrupt. **Disk scheduling:** Disk Structure, FCFS, SSTF, SCAN, LOOK, C-SCAN, C-LOOK.

Text Books:

1. Silberschatz, Peter B. Galvin and G. Gagne, Operating System Concepts, Wiley, 2012.
2. W. Stallings. Operating Systems: Internals and design Principles, Pearson Education, 2014.
3. M. G. Venkateshmurthy. Introduction to Unix & Shell Programming, Pearson Education, 2009.

Reference Books:

1. Andrew S. Tanenbaum and Herbert Bos. Modern Operating Systems, Pearson Education, 2014.
2. Thomas Anderson and Michael Dahlin. Operating Systems: Principles and Practice, Recursive Books, 2014.

3. Richard Blum, Christine Bresnahan. Linux Command Line and Shell Scripting Bible, Wiley, 2015.

Reference Online Course:

1. https://nptel.ac.in/courses/106106144
2. https://nptel.ac.in/courses/106105214

Course Title and Code: Random Variables and Stochastic Processes (AS1113)	
Hours per Week	L-T-P: 3-1-0
Credits	4
Pre-requisite	Probability and Statistics
Students who can take	B. Tech in CCE
Evaluation	Theory – 100%
Course Objective: To familiarize students with the fundamentals of probability theory, random variables, and random processes so that they can understand the systems involving random signals and analyze the response of random inputs to linear time invariant systems.	
Course Outcomes: On successful completion of this course, the students should be able to: 1. Construct the probability distribution of a random variable, based on a real-world situation, and use it to compute expectation and variance. 2. Analyze continuous and discrete-time random variables and processes. 3. Solve the problems involving multiple random variables. 4. To model various real-life processes as stochastic process and analyze them. 5. Evaluate response of a linear system to Random Process.	

Syllabus

Probability and Random Variables

Independence discrete random variables; probability mass functions (PMF); expectations, multiple discrete random variables: joint PMFs, expectations, conditioning, independence, continuous random variables: probability density functions, expectations, multiple continuous random variables, continuous Bayes rule, joint, marginal, and conditional distributions; convolution; covariance and correlation, iterated expectations, sum of a random number of random variables.

Stochastic Processes

Introduction, Classification of random processes, Expected values of stochastic processes, Bernoulli process, Poisson process, Markov process, Limit Theorems: Law of Large Numbers, Central Limit Theorem, Stationary processes, Random processes and Linear Systems, Transmission of random process through LTI, Power spectral density.

Text and Reference Books:

1. J. Susan Milton and Jesse C. Arnold, 'Introduction to Probability and Statistics', McGraw Hill Education.
2. Papoulis, 'Probability, Random Variables and Stochastic Processes', TMH.
3. VK Rohatgi and AK Saleh, 'An Introduction to Probability and Statistics', Wiley India.
4. Ross, 'Stochastic Processes', 2ed, Wiley.
5. H. Stark and J. Woods, 'Probability and Random Processes with Applications to Signal Processing', Third Edition, Pearson Education.
6. K. L. Chung, 'Introduction to Probability Theory with Stochastic Processes', Springer International Student Edition.
7. P. Kousalya, Probability, Statistics and Random Processes, Pearson.

Course Title and Code: Managing Business Functions (LS1109)	
Hours per Week	**L-T-P: 3-0-0**
Credits	**3**
Students who can take	B. Tech IV Sem
Prerequisite	None
Weightage	Theory 60% Practical 40%
Course Objectives: This course provides an overview of important functional verticals of any business organizations which work in integrated manner to ensure business performance The course will provide an in-depth understanding of how management principles gets reflected in its practices and processes. The students will gain holistic understanding about how businesses run and relevance of its each functional departments in contributing towards its goal achievement. The students would discuss and diagnose real case scenarios to gain clarity about business function, identify problems and recommend practical solutions.	
Learning Outcomes: On successful completion of this course, the students should be able to 1. Appreciate multiple functional verticals of business organizations. 2. Comprehend the connectedness of functional verticals in building successful business strategy. 3. Evaluate and analyse real business problems through an accurate synthesis of the information. 4. Identify the forces in business environment impacting organizations and its management practices. 5. Apply managerial knowledge, method and research techniques to identify and solve management problems	

Topics :

1. Introduction to core business functional areas and its integration
2. Excelling Through People: Overview of HRM, Job Design, Recruitment and Selection, Training and Development
3. Accounting and Financial Analysis: Understanding Accounting as the Language of Business, Key Financial Statement, Analysis of Financial statements, Ratio Analysis, Goals and Functions of Finance.
4. Operations Management: Introduction to Operations Management, Operations Strategy, Quality Management, Supply Chain Management.
5. Creating and delivering Customer value: Defining Marketing and the Marketing Process, Marketing Strategy and Developing an Integrated Marketing Mix, Understanding Consumer Markets and Consumer Buying Behavior.

Readings:

1. Dessler, G. (2018) – Fundamentals of Human Resource Management, 4e, India, Pearson Publications.
2. Rao VSP (Latest Edition)– Human Resource Management, Text and Cases,Excel Book, New Delhi
3. Kotler, P., Armstrong, G. and Agnihotri, P. (2022). Principles of Marketing. New Delhi: Pearson Education.
4. Ramaswamy, V. S., & Namakumari, S. (2018). Marketing Management: Global Perspective, Indian Context. New Delhi: SAGE Publications India Pvt. Ltd.
5. Ramachandran N & Kakani K.Ram.(2017). How to Read a Balance Sheet,2/e. New Dehi: Mc Graw Hill Publications.
6. Mott Graham. (2008). Accounting for Non-Accountants: A Manual for Managers and Students. Kogan Publication.
7. Goyal, V.K. & Goyal, Ruchi. (2016). Financial Accounting, 4/e, New Delhi: PHI Learning Pvt. Ltd.[ISBN.-978-81-203-4626-0]

8. Russell, R. S., & Taylor-Iii, B. W. (2008). Operations management along the supply chain. John Wiley & Sons.
9. Heizer, J., Render, B., & Munson, C. (2017). Operations management. Pearson Education Limited.

MOOC

- Operations Management: Analysis and Improvement Methods by University of Illinois (Coursera):
- https://www.coursera.org/programs/j-k-lakshmipat-university-on-coursera-kzogk?collectionId=&productId=schck0kuEealsQ4S5bCf-Q&productType=course&showMiniModal=true
- Marketing Management-I: University of Illinois at Urbana-Champaign: 24 hourshttps://www.my-mooc.com/en/mooc/marketing-management-i/
- Understanding Financial Statements: Company Performance by University of Illinois (Coursera): https://www.coursera.org/learn/income-statement?action=enroll#modules ·
- HR for Non HR Managers: https://onlinecourses.swayam2.ac.in/cec23_mg23/preview? (Swayam)

Course Title and Code: Communication and Identity (CC1104)	
Hours per Week	**L-T-P: 2-0-1**
Credits	**2**
Students who can take	B.Tech/BCA/BBA/B.Des Semester- IV
Prerequisite	None
Weightage	Theory 40%, Practical 60%

Course Objectives: This course enables students to explore their identities to mark their distinctive presence in professional spaces. It intends to help them gain an understanding of the basic purpose, benefits, and responsibilities of self-presence, and to begin the process of defining their values, strengths, and goals, which helps them enhancing their employability skills through exposing themselves through various activities.

Learning Outcomes:

On successful completion of this course, the students should be able to:

1. Analyze their personal identities by identifying their personal attributes, values, strengths and vision statement.
2. Articulate their personal statement and use it to craft an influential pitch.
3. Express themselves professionally on various social media platforms.
4. Write a well-structured professional business document.

Course Topics

Module(s)	Topics to be covered
Identifying Self	Discovering Identities: Words That Describe Me, Your Personal Identity, A Portrait of Yourself, Personal Identity Wheel, Self-Awareness from five aspects that influence our identity - Personal Attributes, Value and Principles, Emotional Awareness, Tendencies and Habit, Needs Assessment.
	Personal Branding: Meaning, Importance and how to create and use it; Identify, Build and Market your brand story.
Persuasive Communication	Personal Brand Statement, Resume, Cover Letter and The Elevator Pitch, Presence in Group Discussion and Personal Interviews
	Online Brand Communications- Creating an online presence for professional branding on social media platforms (LinkedIn, Facebook, Instagram, etc)
	Writing a well-structured and effective business documents (Agenda, Minutes of the meetings (MoM) Emails, Executive Summary)

Referred MOOCs –

Course Name- Introduction to Personal Branding

Course duration - approx. 7 hours

Offered by University of Virginia

https://www.coursera.org/learn/personal-branding

Course Name- Digital Footprint (If I Googled you, what would I find?)

Course duration - approx. 9 hours

Offered by The University of Edinburgh

https://www.coursera.org/learn/digital-footprint

Course Name- High Impact Business Writing

Course duration - approx. 7 hours

Offered by University of California, Irvine

https://www.coursera.org/learn/business-writing

Referred Books -

- Garner, B. A. (2012). HBR Guide to Better Business Writing. United States: Harvard Business Review Press.
- Westfall, C. (2012). The New Elevator Pitch. United States: Marie Street Press.
- Arruda, W., Dixson, K. (2010). Career Distinction: Stand Out by Building Your Brand. Germany: Wiley.
- Hedges, K. (2017). The Power of Presence: Unlock Your Potential to Influence and Engage Others. United States: AMACOM.
- Lacy, K., Deckers, E. (2012). Branding Yourself: How to Use Social Media to Invent Or Reinvent Yourself. United Kingdom: Pearson Education.

Course Title and Code: Practice School – I (PS-I), PS1101	
Total Duration	**45 Days**
Credits	**04**
Students who can take	B.Tech Semester-V
Prerequisite	None
Weightage	Practical 100%

Course Objectives:

The purpose of Practice School-I is to give an opportunity to re-understand their theoretical knowledge in the context of real life situations.

Learning Outcomes:

After course completion, the student will be able to:

1 Identify skills and capabilities that interconnect effectively with the needs of industry.

2 Demonstrate problem solving skills in the context of some real-life situation.

3 Reflect and evaluate on future employment opportunities.

Course Title and Code: Digital Signal Processing (EE1115)	
Hours per Week	**L-T-P: 3-0-2**
Credits	**4**
Students who can take	B.Tech. Semester V
Prerequisite	Signals and Systems
Weightage	Theory -60%, Practical – 40%
Course Objective- The course develops the fundamental concepts of signals & systems, the sampling concept, representation of signals in frequency & time domain and their analyses. Various operations on discrete time signals are done using z-transform, Fourier transform, DFT, and IIR and FIR digital filter designs are also emphasized.	
Course Outcome: On successful completion of this course, the students should be able to: EE1115.1. Analyze the various classifications & operations on signals. EE1115.2. Analyze the frequency & time domain representations of signals. EE1115.3. Implement fast Fourier transforms on signals. EE1115.4. Implement discrete time systems. EE1115.5. Analyze and solve problems using z transform. EE1115.6. Implement digital filter design techniques. EE1115.7. Implement IEEE standards for efficient signal processing.	

Syllabus (Theory):

Unit 1 Introduction: Review of concepts of Signal and System and z-Transforms, Frequency domain Characteristics of LTI Systems

Unit 2 Discrete Fourier Transform (DFT) and Fast Fourier Transform (FFT): Discrete Fourier Transform and its Properties, FFT Algorithms: Direct Computation of the DFT, Radix-2 FFT Algorithms, Divide and Conquer Approach, Decimation in Time and Decimation in Frequency FFT Algorithms.

Unit 3 Digital Filter Structure: Describing Equation of digital filter, Structures for FIR Systems: Direct Form Structure, Cascade Form Structure, Structure for IIR Systems: Direct Form Structures, Cascade Form Structure, Parallel Form Structure and Lattice Structure.

Unit 4 Design of Digital Filters: Causality and its Implications, Difference between analog filters and digital filters, FIR filter design using windows, Design of IIR filters from analog filters using: Approximation of Derivatives, Impulse Invariance and Bilinear Transformation, Frequency transformations.

Unit 5 Analysis of Finite Word length Effects: Introduction, The quantization process and errors, Analysis of coefficient quantization effects in FIR filters, A/D noise analysis, Analysis of arithmetic round off errors, Limit cycles in IIR filters

Text Books:

1. Digital Signal Processing Principles, Algorithms and Applications, J. G. Proakis and D. G. Manolakis, 4th

Edition, Pearson, 2014.
2. Digital Signal Processing, Tarun Kumar Rawat, Oxford University Press, 2014.

Reference Books:

1. Digital Signal Processing: a Computer-Based Approach, Sanjit K. Mitra, TMH, 2007.
2. Digital Signal Processing, S. Salivahan, A. Vallavraj and C. Gnanapriya, TMH, 2017.
3. Digital Signal Processing, Manson H. Hayes, Schaum's Outlines, TMH, 2011.
4. Digital Signal Processing: A Modern Introduction, Ashok K Ambardar, Cengage Learning, 2007
5. Digital Signal Processing: Fundamentals and Applications, Li Tan, Jean Jiang, Academic Press, Elsevier, 2018.

Online Courses

1. *Digital Signal Processing and its Applications*
   https://onlinecourses.nptel.ac.in/noc21_ee20/preview

Course Title and Code: Computer Networks (CS1111)	
Hours per Week	**L-T-P: 3-0-2**
Credits	**4**
Students who can take	B.Tech V Sem
Prerequisites	None
Weightage	Theory 55% Practical 45%
Course Objectives: This course aims to provide an understanding of the fundamental concepts of computer networking, layers of protocols and network technologies. The course includes computer network organization and implementation, obtaining a theoretical understanding of data communication and computer networks, and gaining practical experience in installation, monitoring, and troubleshooting of current LAN systems.	
Learning Outcomes: On successful completion of this course, the students will be able to: 1 Categorize the various type of Networks on the basis of geographical distance, topology and implementation. 2 Implement socket programming to develop networking programs in C. 3 Apply the concepts of IP addressing, subnet masking and routing algorithms to design efficient computer networks 4 Build and deploy applications that use transport protocols like UDP, TCP 5 Analyze distributed systems and classification of agreement protocol.	

Course Syllabus (Theory)

Unit 1: Introduction, history and development of computer networks, network topologies. Layering and protocols.

Unit 2: Physical Layer: Different types of transmission media, errors in transmission: attenuation, noise. Repeaters. Encoding (NRZ, NRZI, Manchester, 4B/5B, etc.).

Unit 3: MAC Layer: Aloha, CSMA, CSMA/CD, CSMA/CA protocols. Examples: Ethernet, including Gigabit Ethernet and WiFi (802.11).

Unit 4: Data Link Layer: Error detection (Parity, CRC), Sliding Window, Stop and Wait protocols.

Network layer: Internet Protocol, IPv6, ARP, DHCP, ICMP, Routing algorithms: Distance vector, Link state, Metrics, Inter-domain routing. Subnetting, Classless addressing, Network Address Translation.

Unit 5: Transport layer: UDP, TCP. Connection establishment and termination, sliding window revisited, flow and congestion control, timers, retransmission, TCP extensions, etc,

Application Layer: File Transfer, DNS, DHCP, etc.

References

1. LL Peterson, BS Davie, Computer Networks: A Systems Approach, 5th Ed., Morgan-Kauffman, 2011.

2. Andrew Tanenbaum. 2010. *Computer Networks* (5th ed.). Prentice Hall Professional Technical Reference.

3. Behrouz A. Forouzan. 2007. *Data Communications and Networking* (4 ed.). McGraw-Hill, Inc., New York, NY, USA.

4. James F. Kurose and Keith Ross. 2002. *Computer Networking: A Top-Down Approach Featuring the Internet* (2nd ed.). Addison-Wesley Longman Publishing Co., Inc., Boston, MA, USA

Course Title and Code: Digital Communication (EE1122)	
Hours per Week	**L-T-P: 3-0-2**
Credits	**4**
Students who can take	B.Tech. Semester V
Prerequisite:	Signals and Systems
Weightage:	Theory -60%, Practical – 40%

Course Objective- This Course aims to develop interest about the principle and techniques required for analog and digital communication. This also motivate students to anticipate, appraise and pursue future trends in digital communications research and technologies.

Course Outcome:

On successful completion of this course, the students should be able to:

1. Apply the knowledge of signals and system to analyze the communication system.
2. Differentiate between different types of pulse modulation and demodulation techniques.
3. Implement signal multiplexing for varied applications.
4. Use the sampling theorem to determine optimum sampling frequency for a signal.
5. Implement and analyze various digital modulation and demodulation techniques.
6. Improve receiver's performance by applying various algorithms.

Syllabus (Theory):

Review of signals and systems, Frequency domain representation of signals, Principles of Amplitude Modulation Systems - DSB, SSB and VSB modulation. Angle Modulation, Representation of FM and PM signals. Introduction to Gaussian and white noise characteristics.

Introduction – Waveform Coding – PCM – DPCM – DM – Geometric representation of signal waveforms – Binary pulse modulation – Optimum receiver for binary modulated signals in additive white Gaussian noise – M-ary binary and orthogonal pulse modulation – Probability of error for binary and M-ary pulse modulation.

Digital Transmission through band limited channels – Signal design for band limited channels – Probability of error for detection of digital PAM – System design in the presence of channel distortion.

Digital Modulation schemes - Phase Shift Keying, Frequency Shift Keying, Quadrature Amplitude Modulation, Continuous Phase Modulation and Minimum Shift Keying. Maximum likelihood sequence detection (Viterbi receiver), Equalization Techniques

Text Books:

1. Communication Systems-B.P. Lathi, BS Publication, 2006.
2. Haykin S., "Communications Systems", John Wiley and Sons, 2001.
3. Proakis J. G. and Salehi M., "Communication Systems Engineering", Pearson Education, 2002.
4. Taub H. and Schilling D.L., "Principles of Communication Systems", Tata McGraw Hill,2001.

Reference Books:

1. Barry J. R., Lee E. A. and Messerschmitt D. G., ``Digital Communication'', Kluwer Academic Publishers, 2004.
2. Proakis J.G., ``Digital Communications'', 4th Edition, McGraw Hill, 2000.

Online Resources:

1. Principles of Communication Systems – Part I by Prof. Aditya K. Jagannathan, IIT Kanpur. https://www.youtube.com/watch?v=XoVLa6Dqd5I
2. Principles of Communication Systems – Part II by Prof. Aditya K. Jagannathan , IIT Kanpur. https://www.youtube.com/watch?v=OyWdYkx0PmI&list=PL7EYujdHIJbZ9ZRMTBmYz7i61FppXLT0p&index=1

Course Title and Code: Understanding and Managing Conflict (CC1105)	
Hours per Week	**L-T-P: 2-0-0**
Credits	**2**
Students who can take	B.Tech. V Sem
Prerequisite	None
Weightage	Theory 60%, Practical -40%
Course Objectives: In today's increasingly complex and fragmented world, it is important to be able to resolve conflicts and build healthy relationships. Interpersonal and group dynamics is a course designed to prepare students to identify conflicts, manage emotions, analyze the situation and characters, and practice different frameworks to deal with conflicts	
Learning Outcomes: On successful completion of this course, the students should be able to: 1. Define a group and explain the stages of group development. 2. Describe conflicts and explain the types and causes of conflict. 3. Use inquiry and advocacy to engage with groups. 4. Give and receive feedback effectively. 5. Identify sources of conflict and manage them using different conflict handling styles.	

Course Syllabus (Theory):

UNIT I: Group Development and Personality Enhancement: Introduction to the stages of group development. Introduction to the personality, perception and learning as a source of difference in individuals and groups.

UNIT II: Conflict and Conflict Management Strategies: Names and types of conflicts, Intra and Interpersonal conflict, and conflict resolution strategies.

UNIT III: Emotional Intelligence: Development of emotional intelligence. Significance of empathy and feedback in intra and inter-personal development.

UNIT IV: Inquiry and Advocacy: Concept of Silence (Masking, Avoiding, Withdrawing) and Violence (Controlling, Labelling, Attacking).

Reference Online Course:

1. Fisher, R., & Ury, W. (2011). *Getting to Yes: Negotiating Agreement without Giving In*. Toronto, ON: Penguin Random House.
2. Harper, G. (2004). *The Joy of Conflict Resolution: Transforming Victims, Villains and Heroes in the Workplace and at Home*. Gabriola Island, BC: New Society Publishers.
3. Miles, E. W. (2013). Developing Strategies for Asking Questions in Negotiation. *Negotiation Journal*, 29(4): 383–412. doi: 10.1111/nejo.12034.
4. Morrison, E. W., & Rothman, N. B. (2009). Silence and the Dynamics of power. In J. Greenberg and M. S. Edwards (eds.), *Voice and silence in organizations*, pp. 111-133. Bingley, UK: Emerald Group Publishing

Course Title and Code: Digital Image Processing and Introduction to Quantum Computing (EE1224)	
Hours per Week	**L-T-P: 3-0-2**
Credits	**4**
Students who can take	B. Tech. CSE/CCE -V Semester
Prerequisites	Calculus, Linear Algebra and Differential Equations
Weightage	Theory -60%, Practical and Projects – 40%
Course Objectives: The course introduces with the basic principles, techniques, algorithms of image processing and how to use them to solve problems of commercial and scientific interests. Students will be involved in real world project on crop monitoring using quantum computation.	
Learning Outcomes: On successful completion of this course, the students should be able to: 1. Ascertain and describe the basics of image processing concepts through mathematical interpretation. 2. Acquire the knowledge of various image transforms and image enhancement techniques involved. 3. Demonstrate image restoration process and its respective filters required. 4. Stride convolution filter with different step size, observe the effect of padding and pooling in the image matrix. 5. Represent images into various quantum image formats (Qubit Lattice, Flexible Representation of Quantum Images (FRQI), Realket) and perform geometric/ color transformations.	

Course Syllabus (Theory):

Unit I: Introduction to Image Processing: Background and Applications, Elements of Visual Perception, Brightness Adaption and Discrimination, Statistical Background, Image representation formats.

Unit II: Image Transforms- Two-dimensional Fourier Transform- Properties – Properties of 2D DFT, Hadamard Transform, Walsh and Discrete Sine/ Cosine Transforms, Walsh Transform, Discrete Cosine Transform, Wavelet Transforms, Wavelet Functions. Transform operations using filters.

Unit III: Convolution, Filters-Mean Filters, Order Static Filters, Strided convolution, Padding Images, Pooling.

Unit IV: Image Processing using Quantum Computing: qubit, logic gates, Quantum circuits, Quantum Fourier Transform, Quantum Image Representation through quantum states, Transformations using quantum circuits.

Textbooks:

1. Digital Image Processing -S Sridhar, Oxford University Pres, Second Edition.
2. Quantum Computation and Quantum Information: M. Nielsen & I. Chuang, Cambridge University Press, 2010 edition.

Online Courses:

Digital Image Processing by Dr Prabir Kumar Biswas, NPTEL, Swayam.

Course Title and Code: Microwave Engineering (EE1113)	
Hours per Week	**L-T-P: 3-0-2**
Credits	**4**
Students who can take	B.Tech. Semester V
Prerequisite	Nil
Weightage	Theory -60%, Quiz/Assignments– 40%

Course Objective-

This course aims to provide knowledge of microwave transmission lines, waveguides, generators and amplifiers and connectors. It will help students to understand the applications of microwave devices and know the precautions while using these high frequency gadgets

Course Outcome:

On successful completion of this course, the students should be able to:

1. Analyze various parameters of transmission lines and measure reflection coefficient, standing wave ratio and cutoff frequency.
2. Use Smith chart for finding solutions of transmission line and impedance matching problems.
3. Analyze operation modes and parameters of various waveguides.
4. Design & Simulate various microwave components such as waveguides, E plane TEE, H plane TEE, Magic TEE and power dividers.
5. Design & Simulate a microwave/RF communication system using ITU standard frequency for a given application using appropriate components.
6. Plan preventive mechanism for safety against microwave hazards in view of prescribed standards & practices

Syllabus (Theory):

Transmission structures and Resonators: RF and microwave spectrum, historical background, application of RF and microwave. Transmission Line equation, Characteristic impedance, losses in transmission line, reflection coefficient, standing wave ratio, Smith Chart, Impedance matching, Rectangular Waveguides – TE/TM mode analysis, Characteristic Equation and Cut-off Frequencies, Circular Waveguides- Nature of Fields, Characteristic Equation, Dominant and Degenerate Modes. Cavity Resonators– Introduction, Transmission cavity, Rectangular and Cylindrical Cavities, Dominant Modes and Resonant Frequencies, Q factor and Coupling Coefficients.

Microwave network theory and passive devices: Scattering matrix -Concept of N port scattering matrix Representation-Properties of S matrix- S matrix formulation of two-port junction. Power divider, Microwave junctions -Tee junctions -Magic Tee - Rat race - Corners - bends and twists - Directional couplers -two-hole directional couplers- Ferrites - important microwave properties and applications– Termination - Gyrator-Isolator-Circulator - Attenuator

Microwave Generators: Transit-time effect, Limitations of conventional tubes, Two-cavity and multi-cavity Klystrons, Reflex Klystron, TWT, Magnetrons.

Microwave semiconductor devices: operation -Principles of tunnel diodes Transferred Electron Devices -Gunn diode- Avalanche Transit time devices- IMPATT and TRAPATT devices, MASER.

Applications of microwave: Radar systems, Satellite Communication System, Industrial Applications

Text Books:

1. Microwave Engineering by David M. Pozar, WILEY India
2. Microwave Devices and Circuits by S.Y. Liao, Pearson

Reference Books:

1. Foundations for Microwave Engineering by Robert E. Collin, Wiley India.
2. Electronic Communication Systems by Kennedy, Davis and Prasanna, TMH.

Course Title and Code: IDEA TO BUSINESS MODEL (ED1102)	
Hours per Week	**L-T-P: 4-0-0**
Credits	**4**
Students who can take	B.Tech /BCA V Semester Elective
Pre-requisite	None
Weightage	Exam, Presentations, Assignments, Activities and Quiz 80%; Project 20%

Course Objectives:

To encourage students to nurture their entrepreneurial traits and think creatively to develop innovative ideas/products for commercial exploitation.

Course Outcomes:

Upon successful completion of the course, the students will be able to:

1. Identify problem worth solving through design thinking.
2. Identify customer segment and niche for specific markets.
3. Craft Value Preposition Canvas.
4. Analyse competition
5. Create business model using Lean Canvas Template
6. Design and validate solution demo and MVP.
7. Analyse cost, revenue, key channels and pricing model for the venture.
8. Craft positioning statement of a new venture.
9. Classify the different sources of funding

TOPICS

1. Overview of Entrepreneur and Entrepreneurship
2. Self-Discovery & Entrepreneurial Thinking
3. Opportunity Discovery
4. Identify Customer
5. Value Preposition Canvas
6. Competition Analysis
7. Business Model
8. Minimum Viable Product
9. Money (Revenue, Costs, Pricing and Financing)
10. Marketing and Sales
11. Funding your Venture
12. Support (Institutional and Government policies)
13. Project

TEXT BOOK AND ADDITIONAL READING MATERIALS

NextGen (It is a leading digital learning platform provided by Wadhwani Foundation)

Additional Reading Material

1. Robert D Hisrich, Michael P Peters, Dean A Shepherd (2017). Entrepreneurship/10e..New Delhi; Tata McGraw-Hill.
2. Poornima M Charantimath (2012). Entrepreneurship Development Small Business Enterprises. New Delhi: Pearson.
3. Rajeev Roy (2011). Entrepreneurship. New Delhi: Oxford 4. Arya Kumar (2015). Entrepreneurship: Creating and Leading an Entrepreneurial Organisation. New Delhi: Pearson.

4. Vasant Desai (2016). Dynamics of Entrepreneurial Development and Management. Himalaya Publishing House.
Note: Latest edition of the readings will be used

Course Title and Code: Numerical and Scientific Computing (AS2202)	
Hours per Week	**L-T-P: 3-0-2**
Credits	**4**
Pre-requisite	None
Students who can take	B. Tech and BCA Semester-V Elective
Weightage	Theory – 70%, Lab – 30%

Course Objectives:
This course aims to introduce advanced numerical methods to model engineering systems and to solve them using various computational techniques. Laboratory sessions involve the application of numerical analysis to various physical problems.

Learning Outcomes: After course completion, the student will be able to:

1. demonstrate an understanding of common numerical methods and used them to obtain approximate solutions to otherwise intractable mathematical problems.
2. develop numerical techniques for different mathematical operations and tasks, such as interpolation, differentiation, integration, the solution of linear and nonlinear equations, and the solution of differential equations.
3. analyze and evaluate the accuracy of common numerical methods.
4. write efficient, well-documented programming code and present numerical results in an informative way.

Course Syllabus (Theory)

Modeling, Computers, and Error Analysis: Mathematical Modeling and solution using Programming and Software, Computer Arithmetic and Errors: Approximations and Round-Off Errors, Truncation Errors, and the Taylor Series.
Transcendental and polynomial equations: Solution of non-linear Equations: Bracketing Methods, Open Methods, Roots of polynomials.
Linear Algebraic Equations: LU Decomposition and Matrix Inversion, Iterative methods for solving system of linear equations, finding eigenvalues and eigenvectors.
Interpolation and approximation: Interpolation for equally and unequally spaced points, Lagrangian Polynomial.
Numerical Differentiation and Integration: Numerical Differentiation and Integration, Newton-Cotes Integration Formulae.
Ordinary Differential Equations: Difference equation, Single step methods, Stiffness and Multistep Methods, Predictor-corrector method.
Partial Differential Equations: Finite Difference: Elliptic and Parabolic Equations.

Textbooks:

1. M.K. Jain, S. R. K. Iyengar, R. K. Jain, Numerical Methods for Scientific and Engineering Computation, New Age International Publishers, New Delhi.
2. JV Lambers, ACS Mooney, VA Montiforte, Explorations in Numerical Analysis: Python Edition, WSPC (January 18, 2021).

Reference Books:

1. Q Kong, T Siauw, A Bayen, Python Programming, and Numerical Methods: A Guide for Engineers and Scientists, Academic Press; 1st edition (December 16, 2020)
2. K. E. Atkinson, Introduction to Numerical Analysis, John Wiley and Sons.
3. Steven C Chapra, Raymond P Canale, Numerical Methods for Engineers, 6/e, Mc Graw Hill

4. Srimanta Pal, Numerical Methods: Principles, Analyses, and Algorithms, Oxford University Press, New Delhi.
5. Cheney and Kincaid, Numerical Methods and Applications, Cengage Publications, New Delhi.
6. Cleve B. Moler, Numerical Computing with MATLAB, Prentice Hall of India, New Delhi.

Course Title and Code: Advanced Statistics (AS1202)	
Hours per Week	**L-T-P: 3-1-0**
Credits	**4**
Pre-requisite	None
Students who can take	B.Tech Sem V (Open Elective)
Weightage	Theory – 100%

Course Objectives- To familiarize students with concepts of multiple random variables and their properties to use them to analyze real-life problems. This course also focuses on developing an understanding of regression models, data analysis, model building, interpretation of results and statistical computation.

Learning Outcomes:

On successful completion of this course, the students should be able to:

1. identify, formulate, and derive various properties of probability distributions and density functions of one and more random variables.
2. choose appropriate descriptive properties to summarise a variety of data sets.
3. apply the concepts of the central limit theorem and algebra of random variables to analyze linear systems.
4. analyze a system of multiple random variables using the appropriate regression model.
5. model experiments as processes and analyze them using ANOVA.

Course Syllabus (Theory)

Random Variables

Random variables, Distribution and density functions of random variables, Discrete and continuous random variables, Gaussian, Exponential, Rayleigh, Cauchy, Uniform, discrete Uniform and conditional distributions, general properties of distributions.

Multiple Random Variables

Joint and marginal distributions for discrete and continuous random variables. Joint moments, Conditional distributions, correlation coefficient, statistical independence. Multiple random variables, expected value, Variance, standard deviation, moments of multiple random variables.

Operations On Multiple Random Variables

Central limit theorem, Chebyshev's Inequality, covariance, variance of a linear combination of random variables, and distribution of sums of independent random variables.

Regression Analysis

Introduction to the regression model, Types of regression models, Least square estimators, Estimation of the regression coefficients and error variance, Inferences for the regression coefficients, Predicting future observations, Inverse prediction, and regulation. Multiple linear regression models.

Design of Experiments

Analysis of variance, one-way ANOVA, two-way ANOVA, and nonparametric tests.

Recommended MOOC :

1. **https://www.coursera.org/learn/linear-models**
2. https://www.coursera.org/projects/linear-regression-numpy-python

Reference Books:

1. J. Susan Milton and Jesse C. Arnold, 'Introduction to Probability and Statistics', McGraw Hill Education.

2. Papoulis, ‘Probability, Random Variables And Stochastic Processes’, TMH.
3. VK Rohatgi and AK Saleh, ‘An Introduction to Probability and Statistics’, Wiley India.
4. Sheldon M. Ross, ‘Stochastic Processes’, 2ed, Wiley.
5. Shumway & Stoffer (2011) Time Series Analysis and its applications, with examples in R , 3rd edition, Springer.
6. K. L. Chung, ‘Introduction to Probability Theory with Stochastic Processes’, Springer International Student Edition.
7. Applied Linear Statistical Models by Kutner, Nachtsteim, Neter and Li (5th edition).

Course Title and Code: Introduction to Robotics (ME1226)	
Hours per Week	**L-T-P: 3-0-2**
Credits	**4**
Students who can take	B. Tech. V Semester
Prerequisite:	Calculus and Mechanics
Weightage:	Theory - 60%, Practical and Projects - 40%
Course Objectives: This is a first level course where students will be introduced to the fundamentals of robots required to get started in the field of robotics.	
Learning Outcomes: On successful completion of this course, the students should be able to: 1. Understand basic robotic terminologies. 2. Implement various sensors and actuators to plan robotic motion and control. 3. Design and develop basic robotic system.	

Course Syllabus (Theory):

Unit I Introduction: Basic concepts, elements of robotic systems, i.e., robot anatomy, DOF, misunderstood devices, classification of robotic systems, Resolution, accuracy, repeatability, dexterity, and compliance of robots, Principles & strategies of automation, and Applications of robots.

Unit II Drives and Control for Robotics: Type of drives and transmission systems, Actuators and their selection. Types of controllers, and Introduction to closed loop control. Robot motion, planning and control.

Unit III Grippers and Sensors for Robotics: Types of grippers and design of robotic gripper. Sensor's classification, selection and applications, Need of sensors and vision system in the working and control of a robot.

Unit IV Related Topics in Robotics: Socio-economic aspect of robotization. Economical aspects for robot design, Safety for robot and standards, Basic robot programming, Need and application of AI, New trends in robotics.

Textbooks:

1.Kevin M. Lynch and Frank C. Park, Modern Robotics Mechanics, Planning, and Control Cambridge University Press (2017).

2.S K Saha, Introduction to Robotics, McGraw Hill Education (India) Private Limited (2014).

3.DK Pratihar, Fundamentals of Robotics, Narosa Publishing House, (2019).

4.S. B. Niku, Introduction to Robotics - Analysis, Control, Applications, 3rd edition, John Wiley & Sons Ltd., (2020).

Online Courses for Reference:

1.Introduction to Robotics by Dr. Krishna Vasudevan, Dr. Balaraman Ravindran, Dr. T Asokan, IIT Madras https://nptel.ac.in/courses/107106090.

2.Introduction to Robotics by Prof. Harry Asada and Prof. John Leonard, MIT Opencoursware, https://ocw.mit.edu/courses/2-12-introduction-to-robotics-fall-20050.

3.Robotics by Dr. D K Pratihar, IIT Kharagpur https://onlinecourses.nptel.ac.in/noc20_me56/preview.

4.Sensors and Actuators by Prof. Hardik Jeetendra Pandya, IISc Bangalore https://nptel.ac.in/courses/108108147.

Course Title and Code: Integrating Design, Technology and Business (IL1211)	
Hours per Week	**9 sessions (3 hours each)**
Credits	**4**
Students who can take	B. Tech. V Semester
Prerequisite	The course is open to Vth semester students of B.Tech/BBA/B.Des programmes being offered by the University. The course will be restricted to 36 students, with 12 from each discipline (Design, Engineering and Management). As the course will require group working for stretched periods beyond classroom hours, it is highly desirable that participating students stay in hostels during the entire course journey. Students under academic warning/probation are advised to refrain from applying for this course.
Weightage	Design Conceptualization/Process 30%; New Technology Application 30%; Business Model (BMC) 40%

Course Objectives: Organizations in present times are operating in a highly competitive and an uncertain environment. Innumerable stories exist about products, services and business models that once ruled the market but have now ceased to exist. Many new industry structures, business models, products and services have emerged in the recent past. AirBNB, Uber/Ola, PayTM, Zomato/Swiggy etc. are just a few examples that have transformed the industry structures.

Design-led and technology-driven products are becoming the order of the day. Even the startup/entrepreneurial eco-system in the country is increasingly becoming conducive to these developments. All these (and many more) changes need a corporate workforce that has a strong interdisciplinary perspective.

Today's designers, technocrats and business managers cannot afford to operate in silos and must effectively collaborate. The present course has been designed and is being offered to meet this very need.

It aims to develop future-ready professionals with skills and capabilities that will enable them to collaborate with cross-functional teams and inter-disciplinary forces while they identify business problems/opportunities from the real-world and design and develop technology-driven marketable solutions to solve the identified problems/tap the business opportunities.

The present course would be offered as a project-based learning opportunity to the students of B.Tech, BBA, and B.Des students at the University. The focus of the course would be to identify a real-world business problem/opportunity, develop proposed solution to solve/tap it using contemporary technologies and prepare a business plan to commercialize it. Groups of students from all the three disciplines shall be working together at every stage of the course and producing their proposed plan.

To make it a little specific, the context for the current cohort will be Healthcare Sector while the target technologies will broadly be AI/ML, IoT (Internet of Things), Blockchain and AR/VR. The course will involve classroom interactions with experts in the technology, design, and management domain. There will also be expert sessions from the healthcare sector for facilitating the identification of challenges and opportunities in the same.

Through these interactions and collaborative working, students will learn about the development of modern technology applications using design principles and prepare a business plan that is ready for commercialization. The course will also provide an opportunity for the students to learn how to meaningfully engage themselves in an intelligent discussion with members across diverse functions.

Detailed Session Plan

The course will be delivered over nine weeks during Aug-Oct'23. There will be one session of three hours every week. During these sessions, the students will be exposed to the concepts relating to recent technology applications, business models, and strategic design management.

The sessions will involve lectures by domain experts, invited talks by experts, classroom/lab exercises besides having a mix of several other pedagogical tools. Besides these sessions, students will be required to work with their respective group members on the key takeaway tasks/assignments and achieve the weekly milestones as indicated in the session schedule. An indicative schedule is presented herewith which may be fine-tuned depending upon the progress of the groups and availability of experts.

Week/Session	Focus Area/Broad Topics	Milestones/ Remarks
W1/S1	**Technology** Introducing the Context and Technology Domain	
W2/S2	**Design Thinking & Process** Preliminary Investigation for identifying opportunities using Design principles	
W3	**Field Work** Identification of real-world problems worth solving	
W4/S3	**Design & Technology** Discussion & Evaluation of alternative applications	
W5	**Field Work** Narrowing down the solution space	
W6/S4	**Business** Use Business Model Canvas to identify business issues	
W7-W8	Sessions in Workshop mode on business plan and prototype development	
W9	Final Submissions and Presentation	

Course Title and Code: Introduction to IoT and Automation Projects (EE1222)	
Hours per Week	**L-T-P: 2-1-2**
Credits	**4**
Students who can take	B.Tech. Semester V
Prerequisite	Computer Organization and Architecture, Programming -I
Weightage	Theory -40%, Practical– 60%

Course Objectives-

The course aims to introduce Internet of Things (IoT) technologies for developing different applications. It focusses to develop skills for designing, implementing and testing solutions for automation using IoT.

Learning Outcomes:

On successful completion of this course, the students should be able to:

1. Recommend sensor and networking technologies for an IoT application.
2. Explore various protocols and data conversion process using various IoT devices.
3. Use cloud servers for data streaming and analysis.
4. Design and implement a complete project in IoT/Automation using microcontroller/SOC interfaced with sensors or any other automation hardware/tools,
5. Deploy techniques to conserve bandwidth/energy/other resources and achieve cost economy for project.

Course Syllabus (Theory):

UNIT I Definition and Characteristics of Internet of Things (IoT) - - Physical Design of IoT - Logical Design of IoT - IoT Functional Blocks, network configuration, emerging technologies for IoT: RFID, Wireless Sensor Networks.

UNIT II: Physical parameters, Measurement principles, Calibration, Amplification, Mechanical and Electrical Actuators, Closed loop systems for automation.

UNIT III – Communication modules – Bluetooth – Zigbee – WiFi – GPS - IoT Protocols (IPv6, 6LoWPAN, RPL, CoAP) – MQTT - Wired Communication (Serial, I2C and SPI) - Power Sources.

UNIT IV: IoT Endpoints: ARM architecture, Raspberry pi, ESP8266 firmware, Interfacing sensors to edge endpoints. Uploading data to cloud for visualization and analysis.

Textbooks:

1. Arshdeep Bahga and Vijay Madisetti Internet of Things: A Hands-on Approach, Universities Press.
2. Rajkamal, Internet of Things, Architecture and Design Principles, Mc. Graw Hill Education (India) Pvt Ltd.

Reference Book:

T.A. Kern, C. Hatzfeld and A. Abbasimoshaei, Engineering Haptic Devices, Third Edition, Springer.

MOOC courses

1. The Raspberry Pi Platform and Python Programming for the Raspberry Pi
https://www.coursera.org/learn/raspberry-pi-platform?specialization=iot
2. AWS Cloud Technical Essentials

https://www.coursera.org/learn/aws-cloud-technical-essentials.

Course Title and Course Code: **Computational Game Theory and Applications (EE1223)**	
Hours per Week	**L T P: 3 1 0**
Credits	**4**
Students who can take	**BTech Semester-V**
Prerequisite	Calculus, Probability and Statistics, Mathematical Modeling, Knowledge of computer programming
Weightage	Theory - 60%, Project, Quiz, Viva, and Assignments – 40%

Course Objectives:

The course focuses on areas of game theory that are relevant for engineering applications. The emphasis is both on theoretical principles and on the application of the theory to problem formulation and problem solving. The course covers a wide range of topics, from different models of non-cooperative games and related equilibrium concepts to cooperative games.

Learning Outcomes:

On successful completion of this course, the students will be able to:

1. Explain the key concepts of preferences, utility, and decision-making under certainty and uncertainty.
2. Apply the key models and solution concepts of non-cooperative game theory, including both strategic form and extensive form games.
3. Evaluate the importance of competitive and cooperative factors in a variety of decision problems.
4. Analyse the key models and solution concepts of cooperative game theory, including TU and NTU games.
5. Analyze games with imperfect and incomplete information.

Course Syllabus :

Unit-1: Introduction

Introduction to game theory, routing games and mechanism design; Strategies, costs, and payoffs; Prisoner's dilemma, Nash Equilibrium, Strategic games; Best response; Dominant strategies; Pure strategy v/s Mixed strategy.

Unit-2: Preferences, Utility, and Goals

Preference relations and their interpretation, utility as a numeric model of preference, Decision-making under uncertainty: preferences over lotteries; Von Neumann and Morgenstern utility functions; expected utility and expected utility maximisation, Paradoxes of expected utility maximization; framing effects and prospect theory.

Unit-3: Bayesian Games

Definition of a Bayesian Game and Bayesian Nash Equilibrium, Games with incomplete information, Bayesian-Nash equilibrium, Perfect Bayesian equilibrium, Refinements of PBE, Applications to spence job-market signaling game, oligopoly games with asymmetric information etc.

Unit-4: Cooperative and Non-Cooperative Games

Noncooperative Game Theory: Strategic form games, existence of Nash equilibrium, computation of Nash equilibrium, matrix games, minimax theorem, extensive form games.

Cooperative Game Theory: Correlated equilibrium, two person bargaining problem, coalitional games, core, shapley value and its implications, Transferable utility (TU) and nontransferable utility (NTU) games.

Unit-5: Engineering Applications

Game theory based control approach for smart grid operation, power control schemes, reactive power management, demand side management, electric vehicle charging, storage management, electricity pricing etc.

MOOC Course Link:

https://www.coursera.org/learn/game-theory-1?action=enroll&courseSlug=game-theory-1&showOnboardingModal=check

https://online.stanford.edu/courses/soe-ycs0002-game-theory

Reference Books:

1. Dutta, Prajit K., “Strategies and Games : Theory and Practice” MIT Press.
2. Vladimir Mazalov, “Mathematical Game Theory and Applications” John Wiley & Sons, Ltd.
3. Ken Binmore, “Playing for Real: A Text on Game Theory” Oxford University Press.
4. Erich Prisner, “Game Theory Through Examples” The Mathematical Association of America.
5. Steven Tadelis, “Game Theory: An Introduction” Princeton University Press.

Course Title and Code: Virtual Reality Lab (CS1221)	
Hours per Week	**L-T-P: 0-0-4**
Credits	**2**
Students who can take	B.Tech. CSE Semester V
Prerequisite	None
Weightage	Practical 100%

Course Objectives: This course presents an introduction to virtual reality technologies, with an emphasis on designing and developing interactive virtual reality experiences. The course will cover 3-D modelling, interaction techniques, and specific application areas. Students will be able to work on real-life projects using VR technology.

Learning Outcomes:

On successful completion of this course, the students should be able to:

1. Understand how the design of VR technology relates to human perception and cognition.
2. Apply the acquired knowledge for the analysis and design of VR systems.
3. Apply and use several types of Hardware and software in Virtual Reality systems.
4. Gain first-hand experience with using virtual environment technology, including 3D rendering software, tracking hardware, and input/output functions for capturing user data.
5. Develop and deploy VR (Virtual Reality) applications using Blender and Unity/ Unreal tools.

Course Syllabus (Theory):

Hands-on Modeling using Blender

- Overview
- Start Modeling
- Installing Blender
- Blender: Essential Training
- Blender: Essential Concepts Summary
- Optimization and Rendering
- Create interactive 3D models
-

Introduction to Virtual Environment Technology

- VR and its relation to humans
- The relation of VR to research, training, design, and manufacturing.
- An overview of VR applications.
- VR design: perceptual and cognitive factors.

Introduction to Unity/Unreal Engine:

- Interface overview and navigation
- Creating a new project, importing standard assets, adding a player character
- Tracking, Latency, Field of View in Real life,
- Fidelity, depth, isolation, smell, range of motion (DoF)
- Sensory Influence: Kinetics, Spatial Audio, Haptics, Other senses?
- Megascans plugin for Unity/Unreal

Note - Tools recommended: - Blender, Unity/Unreal

FINAL PROJECT: Building one VR Application.

Reference Books:

1. Erin Pangilinan, Steve Lukas, and Vasanth Mohan, “Creating Augmented & Virtual Realities”, 1stedition, O’REILLY, 2019.
2. Grigore C. Burdea, Philippe Coiffet , Virtual Reality Technology, Wiley 2016
3. Alan B. Craig, Understanding Augmented Reality, Concepts and Applications, Morgan Kaufmann, 2013
4. Fei GAO. Design and Development of Virtual Reality Application System, Tsinghua Press, March 2012.
5. Guangran LIU. Virtual Reality Technology, Tsinghua Press, Jan. 2011.

Recommended MooC:

Introduction to Virtual Reality– Coursera

https://www.coursera.org/learn/introduction-virtual-reality#syllabus

Introduction to Augmented Reality and ARCore– Coursera

https://www.coursera.org/learn/ar

Course Title and Code: Geographical Information Systems Lab (GIS) (CE1114)	
Hours per Week	**L-T-P: 0-0-4**
Credits	**2**
Students who can take	B.Tech V sem
Prerequisite	None
Weightage	Practical 100%

Course Objectives: This course presents an introduction to virtual reality technologies, with an emphasis on designing and developing interactive virtual reality experiences. The course will cover 3-D modelling, interaction techniques, and specific application areas. Students will be able to work on real-life projects using VR technology.

Learning Outcomes:

On successful completion of this course, the students should be able to:

1 Assess the various sources for remote sensing data and analyze the various type of images.

2 Analyze the data acquisition and data output through GIS, with the help of open-source tool of QGIS and Python.

3 Automate GIS processes with Python-based plugin development for QGIS.

4 Incorporate GIS in resource management and climate change applications

Course Syllabus

- Remote sensing satellites and their data products, Sensors and orbital characteristics, Satellite Image - Characteristics and formats, Introduction to Image rectification, Image Enhancement, Land use and land cover classification system.
- Basic concepts of geographic data, GIS and its components, Data acquisition, Raster and Vector formats, Topology and Data models, Spatial modeling, Data output
- Applications of GIS: Climate change, Natural resources management, Forest management, Water Resources management, Drought Management, Location-based services.

Syllabus (Practical with QGIS and Python)

QGIS experiments

1. Creating and Exploring a Basic Map
2. Classifying and Creating Vector Data
3. Laying Out of the Maps
4. Classifying and Creating Raster Data
5. Terrain Analysis
6. Raster to Vector Conversion
7. Hydrologic Analysis

Python-based experiments

1. Working with Shapely package and geometric objects
2. Vector data analysis with Geopandas
3. Geocoding in Geopandas
4. Analyzing raster data and automatically detecting features
5. Working with Maps
6. Plugin development and integration with QGIS

Links to Some Sample Github implementations (for plugin development)

https://github.com/ConservationInternational/trends.earth
https://github.com/ghtmtt/DataPlotly

Talks on Python integration with QGIS
https://vimeo.com/106874213
https://www.youtube.com/watch?v=z_QEi212DEQ

Text /Reference Books:
1. Erik Westra - “Python Geospatial Development”, Packt Publishing.
2. Joel Lawhead - “QGIS Python Programming Cookbook”, Packt Publishing.
3. Bhatta B., “Remote sensing and GIS”, Oxford University Press, 2011.
4. Satish G., “Advanced Surveying: Total Station, GIS and Remote Sensing”, Pearson, 2011.
5. QGIS 3 and PyQGIS online documentation files.

https://autogis-site.readthedocs.io/en/latest/
https://nptel.ac.in/courses/105/108/105108077/

Course Title and Code: Information Theory and Coding (EE1218)	
Hours per Week	**L-T-P: 3-1-0**
Credits	**4**
Students who can take	B.Tech. Semester VI
Prerequisite	Signals and Systems
Weightage	Theory -60%, Practical/Assignment/Quiz – 40%
Course Objective- At the end of this course, the students should be able to appreciate the concept of information, entropy and entropy rates, get familiarized with asymptotic equipartition property theorem. The student should also be able to understand various data compression schemes and evaluate the capacity for discrete memoryless channels. The student should also be able to understand the encoding and decoding of different linear block and convolution codes.	
Course Outcome: On successful completion of this course, the students should be able to: 1. Describe the concepts of information, entropy and entropy rates. 2. Get familiarized with asymptotic equipartition property theorem and its applications in data 3. compression. 4. Understand various data compression schemes. 5. Evaluate the capacity for discrete memoryless channels and get an understanding of channel coding theorem and source–channel separation theorem. 6. Understand coding and decoding of linear block codes and convolutional codes	

Syllabus (Theory):

INTRODUCTION TO THE CONCEPT OF INFORMATION:

Shannon measure of information, Self-information and entropy, Joint and conditional entropy, Mutual information, Markov processes and Entropy rates. Channel capacity. Capacity evaluation of various binary channels, capacity evaluation of symmetric channels (Strongly and Weakly symmetric discrete memoryless channels), Channel coding theorem and the promise of the existence of block codes, Source–channel separation theorem.

ASYMPTOTIC EQUIPARTITION PROPERTY AND DATA COMPRESSION:

Asymptotic equipartition property (AEP) theorem, Consequences of the AEP: Data Compression, High-probability sets and the typical set, Examples of source codes, Kraft Inequality, Optimal Codes, Bounds on the optimal code length, Kraft inequality for uniquely decodable codes, Huffman codes, Shannon–Fano–Elias coding

LINEAR BLOCK CODES:

Linear codes and vector spaces, Generator matrix and parity check matrix, Weights and distance for linear block codes, Hamming codes, Syndrome decoding, Weight distribution polynomial, Bounds on minimum distance of linear block codes (Singleton and Hamming Bound), Cyclic codes, Encoding of cyclic codes, Decoding of cyclic codes using *Meggitt* Decoder

CONVOLUTIONAL CODES:

Structure of convolutional codes (trellis representation), Encoding of convolutional codes, Transfer function of convolutional codes, Decoding of convolutional codes using Viterbi algorithm.

Text Books:

1. Elements of Information Theory, by Thomas Cover and Joy Thomas, 2nd edition, Wiley –Interscience.
2. A Course in Error Correcting Codes, by Jorn Justesen and Tom Hoholdt, 1st edition, Hindustan Book Agency

Reference Books:

1. Digital Communications, by John Proakis & Masoud Salehi, 5th edition, McGraw-Hill.

Course Title and Code: Minor Project (PR1103)	
Credits	**4**
Students who can take	B.Tech Sem VI
Prerequisites	None
Weightage	Report and Project 100%

Course Objectives- This course offers an opportunity to apply and extend knowledge learned throughout the program to solve real world issues. The minor projects undertaken span a diverse range of topics, including design, simulation, and experimental studies. The course emphasizes, facilitating student learning in technical, project implementation and presentation spheres.

Course Outcome:

On successful completion of this course, the students should be able to:

1. Identify and formulate industrial and societal problems.
2. Design engineering solutions for complex problems.
3. Develop/fabricate, and implement solutions for identified problem.
4. Demonstrate the knowledge, skills and attitudes of a professional engineer.

Course Title and Code: Wireless and Mobile Communication (EE1123)	
Hours per Week	**L-T-P: 3-1-0**
Credits	**4**
Students who can take	B.Tech. Semester VI
Prerequisite	Digital Communication
Weightage	Theory -60%, Practical/Quiz/Assignment– 40%

Course Objective- By the end of this course, students should be able to have a broad overview of wireless communication technology, identify and explain path loss, shadowing and fading phenomena in wireless communication systems, evaluate capacity of wireless communication channel, can compare various diversity achieving schemes, and understand the contemporary technologies used in wireless communications like Orthogonal Frequency-Division Multiplexing (OFDM) and Spread spectrum techniques.

Course Outcome:

On successful completion of this course, the students should be able to:

1. Understand the concepts of Cellular communications.
2. Understand the concept of shadowing and fading in wireless communications and model wireless communication systems for different fading characteristics, i.e., Flat, Frequency Selective, Fast, and Slow fading characteristics.
3. Derive the capacity of a flat-faded wireless channel under the assumptions of channel side information at the receiver/transmitter.
4. Appreciate various schemes of achieving diversity and get an introduction to space time block coding- Alamouti Scheme.
5. Understand contemporary and widely used wireless communication techniques like Orthogonal Frequency-Division Multiplexing (OFDM) and MIMO.

Syllabus (Theory):

INTRODUCTION TO WIRELESS COMMUNICATIONS: History of Wireless Communications. Introduction to Cellular Communication.

WIRELESS CHANNEL MODELS:

Free Space path-loss models, empirical path-loss models such as Okumura, Hata, Cost-231, Indoor attenuation factor models, statistical multipath channel models- Time varying channel impulse response, narrow band fading models (auto-correlation, cross correlation, PSD, Level crossing rate average fade duration) wide band fading models (Power Delay Profile, Coherence Bandwidth, Doppler Power Spectrum, Coherence Bandwidth, Coherence Time)

CAPACITY OF WIRELESS CHANNELS:

Capacity in additive white Gaussian noise, Capacity of Flat Fading Channels: Channel and System Model, Channel Side Information at Receiver, Channel Side Information at Transmitter and Receiver, Capacity with Receiver Diversity, Capacity Comparisons.

DIVERSITY:

Realization of Independent Fading Paths, Receiver Diversity: Selection Combining, Threshold Combining, Maximal-Ratio Combining, Equal-Gain Combining, Transmitter Diversity, Channel Known at Transmitter, Channel Unknown at Transmitter –Alamouti Scheme. Introduction to MIMO and OFDM

GSM system for mobile Telecommunication, General Packet Radio Service, Long Term Evolution (LTE), Mobile Satellite Communication, Introduction to Mobile Adhoc Networks, Li-Fi Communication, Ultra-Wideband Communication, Introduction to 4G and concept of 5G.

Text Books:

Wireless communication, Principles &Practice, by T.S Rappaport. Pearson Mobile Cellular Telecommunications; William, by C Y Lee. McGraw Hill

Reference Books:

Wireless Digital Communications: Modulation and Spread Spectrum Applications , by Dr. Kamilo Feher. PHI

Course Title and Code: Critical Thinking for Decisions at Workplace (CC1106)	
Hours per Week	**L-T-P: 2-0-0**
Credits	**2**
Students who can take	BTech Semester VI
Prerequisite	None
Weightage	Theory 40% Practical 60%
Course Objectives- In today's world, the idea of right and wrong is being challenged by businesses, use of technology, economic conditions, and norms of societies. The relevance of a well-reasoned decision is crucial. This course intends to make students take better decisions keeping in mind purpose, context, and ethics.	
Learning Outcomes: The students will be able to: 1 Apply strategies of Critical Thinking to examine organisational problems through positive inquiry 2 Describe and examine suitable problem-solving and ethical decision-making processes 3 Choose the simplest and logical decision among multiple alternatives 4 Evaluate solutions and count on possible risks based on purpose, context and ethics	

Course Syllabus:

Topics
• Importance of decision making at workplace • Robust decision making by David G Ullman • Taxonomy of decision making by Rowe and Boulgarides • Factors impacting decision-making • Concept of enquiry circle • Theories of ethics (Teleological, Deontological, Virtue Ethics, Conduct Ethics, Rights based, Utilitarianism, Hedonism, Egoism) • Concept of moral development by Kohlberg • Role of ethics and values in decision Making • Role of Stakeholders in decision making. • Root cause analysis

Suggested Readings

1. Jonah Lehrer, 2009: **How we Decide.** Houghton Mifflin Harcourt, Boston, New York
2. Chip Heath and Dan Heath, 2013. **Decisive: How to Make Better Choices in Life and Work.** Crown Business, ISBN 0307956393
3. John S. Hammond, Howard Raiffa, Ralph L. Keeney, 2002. **Smart Choices: A Practical Guide to Making Better Decisions.** Crown Business, ISBN 0767908864
4. Ramesh K. Arora, **Ethics, Integrity and Values in Public Service.** New Age International Publishers, New Delhi.
5. Bradley H. Dowden, 1993. **Logical Reasoning.** Wadsworth Publishing Company, Belmont, California, ISBN 0534176887

I

Course Title and Code: Cyber Security (EE1219)	
Hours per Week	**L-T-P: 3-0-2**
Credits	**4**
Students who can take	B. Tech. VI Semester
Prerequisite	Nil
Weightage	Theory -70%, Practical and Projects – 30%
Course Objectives: This course introduces the NIST Cybersecurity framework and sensitizes the students on security risks, malware and social engineering attacks. It builds skills for ensuring good cyber hygiene, monitoring and reporting cyber-attacks for an online computer.	
urse Outcomes: On successful completion of this course, the students should be able to: EE1219.1. Recommend the implementation tier for the NIST framework for a specific organization. EE1219.2 Detect malicious attempts in a network using network sniffers EE 1219.3 Carry out stages of forensic investigation by taking memory backups, data recovery, analyzing registry, traffic logs etc. EE1219.5 Perform ethical hacking on virtual boxes and understand how hackers work. EE1219.6 Use automation tools for threat intelligence perception.	

Syllabus:

Unit 1: Introduction to NIST framework, Organization functions, CyberSeek, Types of Cyber Attacks, Vulnerabilities, Risks and Exploits, Overview of zero trust.

Unit 2 Network and Application Security- What is network security, Revision on Principals of Cryptography, Message Integrity, Digital Signatures, End point Authentication, Securing Email, Securing TCP connection, Securing Wireless LAN.

Intrusion Detection systems (IDS), Intrusion Prevention systems (IPS), Security Information and Event Management (SIEM) log analysis- using Splunk, Snort, Demilitarized zones (DMZ), Honeypots in network. Monitoring cyberattacks using SIEM for DOS, SQLi, XXS, XXE, LFi, Command Injection, identifying False Positive and False Negatives in SIEM logs.

Unit 3- Forensic - Introduction, Benefits and Challenges of Digital Forensic, Methodology, setting up Forensic workstation, NIST catalog for searching forensic tools and techniques, Computer, Registry, Mobile forensic tools, difference between Digital and Electronic Forensic, Hands-on using tools-Autopsy, Scalpel and Binwalk for data carving, extracting Botnet from memory, RAM triage., Network Miner and Wireshark for traffic analysis, Registry acquisition using FTK Imager, Shellbag explorer ,Registry viewer. Anti-forensic methods.

Unit 4 Ethical Hacking -White hat hackers, Big bounty programs, familiarization with Common Vulnerabilities and Exploits (CVE), Nmap to locate attack vectors, Metasploit framework, Burp Suite for automated scanning.

Text Books:

1. Computer Networking -A top down approach – Kurose , Ross. Pearson.
2. Cryptography and Network security- William Stallings, Pearson

Online resource: ”Ethical Hacking Essentials” EC Council, Coursera.

Course Title and Code: Software Defined Radio (EE1228)	
Hours per Week	**L-T-P: 3-1-0**
Credits	**4**
Students who can take	B.Tech. Semester VI
Prerequisite	Basic knowledge of Signal processing and Digital Communication
Weightage	Theory -60%, Quiz/Assignments– 40%

Course Objective-

This course will cover the necessary components of SDR with an understanding of the limitations of traditional radio design and the application of SDR to overcome them.

Course Outcome:

On successful completion of this course, the students should be able to:

1. Understand requirements, benefits and different models for Software Defined Radio.
2. Understand in detail about Software Defined Radio Architecture for performance optimization.
3. Acquire complete knowledge regarding functioning of different blocks associated with Software Defined Radio.
4. Design circuits at different multirate signaling technique for frequency conversion and sampling issues.

Syllabus (Theory):

Unit 1 Introduction: The requirement for software defined radio, the benefits of multi-standard terminals, operational requirements, business models for software defined radio, new base station and network architectures, smart antenna systems

Unit 2 Basic Architecture of a Software Defined Radio: Software defined radio architectures; Ideal Software defined radio architectures, required hardware specifications, Digital aspects of a Software Defined radio, Current technology limitations.

Unit 3 Flexible RF receiver architectures: Receiver architecture options, implementation of a digital receiver: frequency up conversion using under sampling, achieving processing gain using oversampling, Noise figure, Receiver sensitivity, ADC spurious signals.

Unit 4 Multi-Band and General Coverage Systems: Multiband Flexible receiver design, The problem of the Diplexer, Achieving Image rejection, Dynamic range enhancement, feedback and feed forward techniques

Unit 5 Flexible transmitters and Power amplifiers: Analog quadrature up conversion, quadrature up conversion with interpolation, Interpolated band pass up conversion, PLL based transmitters, Active All-pass filter, Use of high pass and low pass filters, Polyphase filtering.

Text Books:

1. P Kenington, “RF and Baseband Techniques for Software Defined Radio”, Artec House,2005

Reference Books:

1. Jouko Vanakka, “Digital Synthesizers and Transmitter for Software Radio”, Springer,2005

Course Title and Code: Sensor Networks (EE1232)	
Hours per Week	**L-T-P: 3-0-2**
Credits	**4**
Students who can take	B. Tech. VI Semester
Prerequisite	Signals and Systems, Random Variables and Stochastic Processes
Weightage	Theory -70%, Practical and Projects – 30%
Course Objectives: This course introduces the architecture and protocols for wireless sensor networks and help students to develop temporal and functional models to evaluate network performance.	
urse Outcome: **On successful completion of this course, the students will be able to** EExxxx.1 - Understand the architecture for wireless sensor networks and protocols used. EExxx.2 Develop models for performance evaluation for wireless networks and evaluate various performance parameters. EExxxx.3 Use statistical tools (UPAAL) to develop state diagrams for nodes and hubs functions.	

Syllabus:

Introduction: Overview of Wireless and adhoc networks, Mobile sensor network, Underwater sensor network, IEEE 802.15.4.and IEEE 802.15.6.

MAC layer issues: Types of MAC protocols for WBAN, Contention-based and scheduling based protocols. Congestion and Flow control, Routing in Wireless sensors

Queueing models for communication-M/M/1 M/G/1, G/M/, M/M/m, Queues, Queues with Finite buffer, FSM models for nodes and hubs.

1. **Textbooks:**
   Ibrahiem M. M. El Emary, S. Ramakrishnan, Wireless Sensor Networks: From Theory to Applications, CRC Press, 2013, ISBN 9781466518100.
2. Art of computer systems Performance analysis by Dr Raj Jain, Wiley Professional Computing.

Online resources: NPTEL course Introduction to Wireless and Adhoc networks by Dr Sudip Misra, IIT Kharagpur

Course Title and Code: Microprocessors and Microcontroller (EE1124)	
Hours per Week	**L-T-P: 3-0-2**
Credits	**4**
Students who can take	**B.Tech. V Sem**
Prerequisites	**Basic Programming**
Weightage	**Theory 60% Lab 40%**

Course Objective:

This course aims to impart knowledge on CISC and RISC architectures and to understand the difference between microprocessor and microcontroller. It enables students to choose and program the processor/controller for application.

Learning Outcomes:

On successful completion of this course, the students will be able to

EE1124.1 Understand RISC architecture and instruction set for assembly level programming.
EE1124.2 Write C program that will compile efficiently in terms of code footprint and speed.
EE1124.3 Develop application using interrupts and handle them using Interrupt service routines.
EE1124.4 Develop real world applications using microprocessors and microcontrollers.

Course Syllabus (Theory):

Introduction to 8086 — Microprocessor architecture — Addressing modes — Instruction set and assembler directives — Assembly language programming — Modular Programming — Linking and Relocation — Stacks — Procedures — Macros — Interrupts and interrupt service routines — Byte and String Manipulation. Characteristics and functions, x86 Architecture, Instruction set architecture, Addressing modes and formats.

ARM architecture and Assembly language Programming- General purpose registers, Memory map, Load and Store Instructions, ARM data format and Pseudo Instructions and Directives. ARM addressing modes, Arithmetic, Logic, Rotate Shift, Branch, Call and Looping Instructions, Signed number arithmetic, Floating point Arithmetic, Viewing registers and Memory with ARM Keil IDE. ARM pipeline and CPU evolution.

Simple C Programs using Function Calls, Pointers, Structures, Integer and Floating-Point Arithmetic, Assembly Code using Instruction Scheduling, Register Allocation, Conditional Execution and Loops. Exception Handling, Interrupts, Interrupt handling schemes, Firmware and boot loader.

Text Books:

1. M. A. Mazidi, Microcontroller and Embedded Systems, Pearson Education, 2008
2. Steve Furber, “ARM System –On –Chip architecture,” Addision Wesley, 2000. 4. Daniel Tabak, “Advanced Microprocessors,” Mc Graw Hill. Inc., 1995
3. Microprocessor 8086: Architecture, Programming and Interfacing by SUNIL MATHUR, Prentice Hall India Learning Private Limited

Course Title and Code: Smart Material (ME1228)	
Hours per Week	**L-T-P: 3-0-2**
Credits	**4**
Students who can take	B.Tech. VI Sem
Prerequisites	None
Weightage	Theory 60% Practical 40%

Course Objectives: The objective is to introduce students to the basic concepts of smart materials and composites that are required for their design and fabrication as per the industrial applications.

Learning Outcomes:

On successful completion of this course, the students will be able to:

1. identify various smart materials and its importance in engineering application
2. understand various processing techniques of smart materials
3. identify types of composites for various engineering applications
4. design various application based metal matrix composites

Course Syllabus (Theory):

Unit-1: Introduction to Smart Material

Introduction to smart materials. Classification of smart materials, Components of a smart System, Applications of smart material.

Piezoelectric Materials, Shape Memory Alloys, Shape Memory Polymers, Self-Healing Materials

Unit-2: Processing of Smart Materials

Metals and metallization techniques, Ceramics and their processing, Polymers and their synthesis, UV radiation curing of polymers. Smart material-based MEMS.

Unit-3: Introduction to composite

Define Composites, Reinforcements and matrices, Types of reinforcements, Types of matrices, Types of composites, Properties of composites in comparison with standard materials. Applications of metal, ceramic and polymer matrix composites.

Stiffness and Strength of composite: volume and weight fraction. Unidirectional continuous fiber, discontinuous fibers, Short fiber systems, woven reinforcements **Mechanical Testing:** Determination of stiffness and strengths of unidirectional composites in tension, compression, and fatigue.

Unit 4: Metal Matrix Composites

Characteristics of MMC, various types of metal matrix composites, alloy vs. MMC, Reinforcements, particles, fibers. Effect of reinforcement volume fraction rule of mixtures. Applications of MMC in aerospace, automotive industries

Processing of MMC: powder metallurgy process, diffusion bonding, stir casting, squeeze casting, a spray process, Liquid infiltration, measurement of interface properties.

Laminates: Lamina Constitutive Equations, basic assumptions of laminated anisotropic plates. Laminate Constitutive Equations, Balanced Laminates, Symmetric Laminates, Angle Ply Laminates, Cross Ply Laminates. Laminate Structural Moduli. Evaluation of Lamina properties from Laminate Tests.

Text Books:

1. Smart Material Systems and MEMS: Design and Development Methodologies, V. K. Varadan, K. J. Vinoy, S. Gopalakrishnan, John Wiley and Sons, England, 2006.
2. Smart Structures and Materials, Brain Culshaw, Artech House, London, 1996.

3. Smart Materials and Structures, Mukesh V. Gandhi, Brian S. Thompson, , Springer, May1992
4. Autar K. Kaw, Mechanics of Composite materials, CRC Taylor & Francis, 2nd Ed, 2005.
5. Composite Material Science and Engineering, Krishan K. Chawla, Springer, 3e, 2012.

Reference Online Course:

1.Introduction to Composites https://swayam.gov.in/nd1_noc20_me95/preview
2.Smart Materials and Intelligent System Design
https://archive.nptel.ac.in/courses/112/104/112104251/#

Course Title and Code: Fundamental of Sustainable Development (ME1227)	
Hours per Week	**L-T-P: 3-1-0**
Credits	**4**
Students who can take	B.Tech VI Sem
Prerequisites	Basic knowledge of physics and chemistry (Basic Science), Basic knowledge of the Environment
Weightage	Theory 55% Practical 45%

Course Objectives:

The goal of this course is to develop an understanding of the fundamental critical concepts on Sustainable Development (S.D.), such as intra- and inter-generational equity, economic, social and environmental sustainability; strong and weak sustainability; natural capitalism;
steady state and green economy;

Learning Outcomes:

After course completion, the student will be able to:

1. Explain the concept of Sustainable Development and its Role in Building of Environment
2. Identify the critical empirical issues on sustainable development, such as renewable energy transitions, urban agriculture, and green architecture and Analyze the effect of releasing toxicsubstances.
3. Distinguish between "green economy" and "sustainability" and various efforts at multiple governance levels: individual to the government.
4. Make their lives more sustainable and join social movements to achieve more sustainable development.
5. Apply appropriate theoretical knowledge of public policy and international relations to sustainable development.

Course Syllabus (Theory)

Concept of Sustainable Development:

Definition of sustainability; History and the emergence of the concept of sustainable development; Our Common Future; Objectives of Sustainable Development; Millennium Development Goals; Environment and Development linkages; Globalization and Environment; Population, Poverty and Pollution; Global, Regional and Local environmental issues; Resource Degradation; Greenhouse gases and climate Change; Desertification; Industrialization; Social insecurity.

Sustainability and The Triple Bottom Line:

Components of sustainability; Complexity of growth and equity; Social, economic and environmental dimensions of sustainable development; Environment, Biodiversity, Natural Resources; Ecosystem integrity; Clean air and water; Carrying capacity; Equity, Quality of Life, Prevention, Precaution, Preservation and Public participation;Structural and functional linking of developmental dimensions; Sustainability in the national and regional context.

Sustainable Development and International Response:

Role of developed countries in the development of developing countries; International summits; Stockholm to Johanesburg; Rio Principles; Agenda 21, Conventions, Agreements;

Tokyo Declaration; Doubling Statement; Transboundary issues; Integrated approach for resource protection and management.

Sustainable Development of Socio-Economic Systems:

Demographic dynamics of sustainability; Policies for socio-economic development; Strategies for implementing eco-development programmes; Sustainable development through trade; Economic growth; Action plan for implementing sustainable development; Urbanization and Sustainable Cities; Sustainable Energy and Agriculture; Sustainable Livelihoods, and Ecotourism.

Framework for Achieving Sustainability

Sustainability indicators; Hurdles to Sustainability; Operational guidelines; Interconnected prerequisites for sustainable development; Empowerment of Women, Children, Youth, Indigenous People, Non-Governmental Organizations, Local Authorities, Business and Industry; Science and Technology for sustainable development; Performance indicators of sustainability and Assessment mechanism; Constraints and barriers for sustainable development.

Main References

1. Austin, James and Tomas Kohn. 1990. Strategic Management in Developing Countries.The Free Press.
2. Berger. 1994. "The Environment and the Economy." In Smelser and Swedberg (eds.)he Handbook of Economic Sociology. Russel Sage Foundation. D'Arcy, David. Transcript of broadcast, Dec. 5, 2002, "In Houston, a Treasure of Exiled AfghanArt," National Public Radio.
3. Elkington, John. Cannibals with Forks: The Triple Bottom Line for 21st Century Business Oxford: Capstone Publishing, October 1997.
6. Guillen, Mauro and Sandra L. Suarez. 2002. "The Institutional Context of Multinational Activity." In Organization Theory and the Multinational Corporation. 2nd edition. New York: St. Martin's Press

Online Courses:

1. Driving business towards Sustainable Development Goals (https://www.coursera.org/learn/sdgbusiness)
2. The Sustainable Development Goals – A global, transdisciplinary vision for the future(https://www.coursera.org/learn/global-sustainable-development)
3. Sustainable Cities and Communities Specialization (https://www.coursera.org/specializations/sustainable-cities)
4. Leading Sustainable Community Transformation Specialization (https://www.coursera.org/specializations/sustainabletransformmation) tion

Course Title and Code: Motion Planning, Control, and Manipulation of Robots ME1222	
Hours per Week	**L-T-P: 3-0-2**
Credits	**4**
Students who can take	B. Tech. VI Semester
Prerequisite:	ME1226 Introduction to Robotics
Weightage:	Theory - 60%, Practical and Projects - 40%
Course Objectives: The course aims to equip the students with basic fundamentals of robotic motion planning and control, and develop control functionality in robots.	
Learning Outcomes: On successful completion of this course, the students shuld be able to: 1 Understand key concepts of robot motion generation. 2 Plan a motion for a robot for different situations including the presence of obstacles. 3 Develop real-time feedback control system and manipulation of the planned motion.	

Course Syllabi (Theory):

Unit I Introduction: Introduction to robot motion planning, Basics of serial robotic arms and mobile robots, Transformations.

Unit II Motion Planning: Motion planning on a discretized C-space grid, C-space obstacles, C-space for mobile robots, C- Space for serial robotic arms, randomized sampling-based planners, Motion planning for multi robotic systems.

Unit III Robot Control: First- and second-order linear error dynamics, stability of a feedback control system, Motion control of robots using joint velocities and/or torques, force control, and hybrid motion-force control.

Unit IV Robot Manipulation: Kinematic constraint, graphical methods for representing kinematic constraints and forces/ torques in the plane, force closure grasping, and examples of manipulation.

Textbooks:

1. K M Lynch and F C Park, Modern Robotics: Mechanics, Planning, and Control, Cambridge University Press (2017).
2. S K Saha, Introduction to Robotics, McGraw Hill Education (India) Private Limited (2014).

Online Courses for Reference:

1. Modern Robotics: Mechanics, Planning, and Control Specialization, 6 course series, Coursera https://www.coursera.org/specializations/modernrobotics.
2. Robot Motion Planning by Prof. Ashish Dutta, IIT Kanpur https://archive.nptel.ac.in/courses/112/104/112104308/.

Course Title and Code: Project in Robotics (ME1223)	
Hours per Week	**L-T-P: 1-0-6**
Credits	**4**
Students who can take	B. Tech. VII Semester
Prerequisite:	ME1226 Introduction to Robotics
Weightage:	Practical and Projects - 100%
Course Objectives: To develop basic robotic system(s) for real-life practical problem and preparing the students to be job ready in the domain of robotics and automation.	
Course Outcomes: On successful completion of this course, the students should be able to: 1 Critically analyze and use/choose suitable hardware components for the project. 2 Develop working model of the robot and control it using software/ remote. 3 Communicate project work among peers and develop soft skills needed in the industry.	

Course Syllabus:

The course is project based. Basic guidelines of conducting the course are provided hereunder:

1. Students will work in team (number of team members in each team will be decided based on the students registered in the course.
2. Each team is expected to come with the novel project idea, discuss and get it approved from the instructor(s), and work on it throughout the course.
3. The projects could be of the following types:
    a. Literature search (LS) type and systematic analysis.
    b. Algorithm development (AD) type and/or implementation.
    c. Design/synthesis (DS) of the final
4. One lecture per week will be taken to explain how to do literature survey, identify and analyze important results, find the software/ hardware (primarily open source) needed to successfully develop the project.
5. Student needs to submit high-quality technical report, a small video (preferably less than 60 seconds), and deliver a presentation of his/her work.

Reference Books:

1. Kevin M. Lynch and Frank C. Park, Modern Robotics Mechanics, Planning, and Control Cambridge University Press (2017).
2. S K Saha, Introduction to Robotics, McGraw Hill Education (India) Private Limited (2014).
3. M. Spong, M. Vidyasagar, S. Hutchinson, Robot Modeling and Control, Wiley & Sons, (2005).
4. J. J. Craig, Introduction to Robotics: Mechanics and Control, 3rd edition, Addison-Wesley (2003).

Online Courses for Reference:

1. Modern Robotics: Mechanics, Planning, and Control Specialization, 6 course series, Coursera https://www.coursera.org/specializations/modernrobotics.
2. DD National Robocon, IIT Delhi http://www.ddrobocon.in/.
3. Robo-One Workshop, MIT Opencoursware, http://courses.csail.mit.edu/iap/6.095/.

Course Title and Code: Mechanics of Robots (ME1224)	
Hours per Week	**L-T-P: 3-0-2**
Credits	**4**
Students who can take	B. Tech. VI Semester
Prerequisite:	None
Weightage:	Theory - 60%, Practical and Projects - 40%

Course Objectives: This course is aimed to provide the basic knowledge of kinematics and dynamics of the robotic system(s) essential to devise motion planning and control functionality in robots.

Learning Outcomes:
On successful completion of this course, the students should be able to:

1 Understand basic mathematical concepts to comprehend kinematics and dynamics.

2 Apply concepts of kinematics to develop robotic structure/ framework.

3 Design and develop static/dynamic stable robust robotic system.

Course Syllabi (Theory):

Unit I Mathematical Preliminaries: Spatial Descriptions: positions, orientations, and frame, mappings: changing description from frame to frame, Operators: translations, rotations and transformations, transformation arithmetic, compound Transformations, inverting a transform, transform equations, Euler Angles, Fixed Angles, Euler Parameters.

Unit II Robot Kinematics: Manipulator Kinematics, Link Description, Link to reference frame connections, Denavit-Hartenberg approach, Position representations, Homogeneous transformation matrix, Forward kinematics. Inverse kinematics, Geometric and analytical approach.

Unit III Velocities & Statics: Cross product operator for kinematics, Jacobians - Direct differentiation, Basic Jacobian, Jacobian in a frame, Kinematic singularity, Kinematics redundancy, Force balance equation, Velocity/force duality, Kinematics redundancy, Mechanical design of robot linkages,

Unit IV Robot Dynamics: Introduction to dynamics, Velocity kinematics, Acceleration of rigid body, mass distribution, Newton's equation, Euler's equation, Iterative Newton - Euler's dynamic formulation, Closed dynamic, Lagrangian formulation of manipulator dynamics, Dynamic simulation.

Textbooks:

1. S K Saha, Introduction to Robotics, McGraw Hill Education (India) Private Limited (2014).
2. DK Pratihar, Fundamentals of Robotics, Narosa Publishing House, (2019).
3. Asitava Ghoshal, Robotics: Fundamental concepts and analysis, Oxford University Press (2006).
4. M. Spong, M. Vidyasagar, S. Hutchinson, Robot Modeling and Control, Wiley & Sons, (2005).
5. J. J. Craig, Introduction to Robotics: Mechanics and Control, 3rd edition, Addison-Wesley (2003).

Online Courses for Reference:

1. Robotics by Dr. D K Pratihar, IIT Kharagpur https://onlinecourses.nptel.ac.in/noc20_me56/preview.

Course Title and Code: Flexible Electronics (EE1225)	
Hours per Week	**L-T-P: 3 1 0**
Credits	**4**
Students who can take	B.Tech VI Sem
Prerequisite:	None
Weightage:	Theory 70%, Assignment and Quiz 30%

Course Objectives:

Gain a fundamental understanding of the field of organic and printed electronic materials, fabrication techniques and devices and their potential impact.

1. Learn the fundamentals of flexible and printable electronics and deepen your understanding of them.

2. Develop a grasp of the link between soft matter electronics printing techniques, device performance, and intended applications.

3. Understand the fundamental concepts of device integration on flexible platforms, as well as the benefits and drawbacks of emerging technology that will be employed in future devices.

4. Acquire a basic knowledge of Future Trends in Flexible/Printable Electronics Technology, as well as the commercialization paths for new materials, methods, and tools for printed and flexible electronic systems.

Learning Outcomes:

On successful completion of this course, the students should be able to:

1. **Understand the trends and technologies of flexible electronics and its road map.**
2. **Identify the materials used in the design and manufacturing of flexible electronic devices.**
3. **Recognize and introduce the various thin-film deposition techniques used in fabrication of Flexible and Printable electronics devices.**
4. To provide an understanding of the structure and features of TFT devices.
5. **Develop an ability to design a system, component, or process to meet desired needs using novel materials and devices.**

Course Syllabus:

1 Motivation for study of organic and printed flexible electronics

2 Materials properties/synthesis of printable semiconductors:
Nanowire and nanoparticle synthesis, transition metal oxides, amorphous thin films, polymeric semiconductors, structure and property relationships, paper-based electronics, textile substrates, barrier materials.

3 Thin-film Deposition and Processing Methods for Flexible: Devices CVD, PECVD, PVD, etching, photolithography, low-temperature process integration

4 Introduction: display and lighting technology, solar cells and sensors

5 Organic and Printable Flexible Electronics (Flexible displays technologies, Flat panel lighting technologies, Flexible solar cells and Flexible electronics for RF applications)

6 Thin Film Transistors: Thin Film Thin Film Transistors device structure and performance. Fundamental issues for low-temperature processing, Low temperature thin-film transistor

Devices, Device structures and materials processing, Low-temperature a-Si:H and a-IGZO thin-film transistor device performance, I-V characteristics, device stability.

7 Organic sensors (bio & chemical): Organic material synthesis and Deposition techniques, challenges and road block in fabrication and development of flexible and organic electronics devices.

Reference Books:

Text / Reference book:

1. Wong, William S., Salleo, Alberto, Flexible Electronics: Materials and Application, https://doi.org/10.1007/978-0-387-74363-9.
2. Guozhen Shen and Zhiyong Fan, Editors, Flexible Electronics: From Materials to Devices, MRS Bulletin 41, 818–819 (2016). https://doi.org/10.1557/mrs.2016.227

Related Online Courses for Reference:

1. NPTEL course: Fundamentals Of Electronic Materials And Devices By Prof. Parasuraman Swaminathan | IIT Madras

Course Title and Code: Neuromorphic Engineering (EE1226)	
Hours per Week	**L-T-P: 3 1 0**
Credits	**4**
Students who can take	B.Tech VI sem
Prerequisite:	None
Weightage:	Theory 70%, Assignment and Quiz 30%

Course Objectives:

This course aims to provide an insight of neuromorphic electronic devices, circuits and system design.

1. Learn Ultra-low power computing electronics concepts mimicking computing by biological neurons.
2. Develop a grasp of different Design and simulation techniques of CMOS and nano electronic circuits modelling biological brain.
3. Understand Commercial neuromorphic systems and processors for machine learning applications.
4. Acquire a basic knowledge of Future Trends in neuromorphic engineering Technology, as well as the commercialization paths for new materials, methods, and tools for neuromorphic electronic systems design.

Learning Outcomes:

On successful completion of this course, the students should be able to:

1. Build power-saving hardware devices to analyse real-world noisy data utilizing brain-like mechanisms.
2. Identify and learn basic concepts and current trends in neuromorphic device, circuit, and system design.
3. Design, Develop and Document Analog and Digital neuromorphic systems.
4. Apply neuromorphic systems to develop new VLSI circuits and make report on the same.
5. The students will learn how electronics circuits mimic biological neurons, and will explore their novel variations in these circuits.

Course Syllabus:

1 Introduction to classic neuromorphic circuits. Signalling and operation of Biological neurons, neuron models, signal encoding and statistics; Synapses and plasticity rules, biological neural circuits.

2 MOSFETs for Neuromorphic electronics : FETs - device physics and sub-threshold circuits.

3 Analog and digital electronic neuron design.

4 Programmable Neuromorphic Circuits and Synapses: (Spiking Neural Network, Non-volatile memristive semiconductor devices; Electronic synapse design; Interconnection Networks; Interconnection schemes for large non-spiking and spiking neural networks).

5 Analog and Digital Neuromorphic Circuit and System Design: Analysis of design, architecture and performance characteristics of demonstrated chips employing Analog neuromorphic and Digital neuromorphic VLSI, Electronic synapses and other neuromorphic systems.

Reference Books:

1.Shih-Chii Liu, Jörg Kramer, Giacomo Indiveri, Tobias Delbrück, Rodney Douglas, Analog VLSI: circuits and principles, MIT press, 2002, ISBN 0262122553

2.Carver Mead, Analog VLSI and neural systems, Addison-Wesley, 1989, ISBN0201059924

3.Eric Kandel, James Schwartz, Thomas Jessell, Steven Siegelbaum, A.J. Hudspeth, Principles of neural science, McGraw Hill 2012, ISBN 0071390111

4.Dale Purves, Neuroscience, Sinauer, 2008, ISBN 0878936971

Online Courses for Reference:

1. EE 698P: Memory Technology and Neuromorphic Computing by Prof Shubham Sahay, IIT Kanpur available online at https://www.youtube.com/playlist?list=PLP-rjhz_nIi7vrSb2YyZaLvEMiLC7l26N

Course Title and Code: Digital Logic Verification (EE1227)	
Hours per Week	**L-T-P: 3 0 2**
Credits	**4**
Students who can take	B. Tech. VI Semester
Prerequisite:	Digital Circuit and Systems
Weightage:	Theory 70%, Project 30%

Course Objectives: This course aims to provide knowledge on functional and formal verification models and methodologies used for digital logic. It helps to create test benches using system Verilog and use CAD tools for fault detection.

Learning Outcomes:

On successful completion of this course, the students should be able to:

1 Use the partitioning, scheduling, and allocation algorithms to implement high level synthesis to meet space, time, and storage constraints for given behavioral description.

2 Generate input patterns using fault models and perform structural testing of the synthesized RTL.

3 Use YACC tools to generate Control and Data Graphs and perform HLS transformation for VHDL description.

4 Develop Binary Decision Diagrams and deploy equivalence checking and model checking for Sequential Digital Logic Circuits.

Course Syllabus:

1. Introduction to Digital VLSI Design Flow, High level design representation, Scheduling algorithms, Allocation and Binding algorithms.
2. Logic Optimization & Synthesis-Transformations for High Level Synthesis (HLS), Computational Tree Logic, Temporal Logic, Combinational Circuit Test Pattern Generation, Fault Models-Stuck-at-fault, Transistor faults, Bridging faults, Delay faults.
3. Binary Decision Diagram, Implementation using Multiplexer, Fault Tree analysis, Ordered BCD for Sequential Circuits.
4. Verification Techniques-Design Flow, Functional RTL verification, Formal Verification, Models for design verification-Structural network model, State diagrams.

Reference Books:

1. Principles of Functional Verification- Andrew S Meyer, ISBN 13: 978-0750676175.
2. Writing testbenches using System Verilog-Jack Bergeron, ISBN 13: 978-0387292212.

Online Courses for Reference:

1. NPTEL course: Design Verification and Test of Digital VLSI by Dr Santosh Biswas, Dr Jatindra Kumar Deka.

Course Title and Code: Mechanisms for Machines (IL1206)	
Hours per Week	**L-T-P: 3-0-2**
Credits	**4**
Students who can take	B. Tech Semester-VI(DE)
Prerequisites	None
Weightage	Theory 40% Practical 60%

Course Objectives:

This course aims to build concepts and skills in the design of various mechanisms for machines. The interdisciplinary course includes understanding of sensors for various physical parameters of moving parts/machines. It will aid the domain of Automation courses like Robotics, Machine Vision, Internet of Things, and Industrial Instrumentation and Safety.

Learning Outcomes:

After course completion, the student will be able to:

1. Identify various types of links and pairs for motions in machines
2. Select and use suitable mechanisms to converting one type of motion into Another
3. Select suitable sensors to measure physical parameters.
4. Develop suitable automated mechanism for machine.

Course Syllabus (Theory)

UNIT – I

Introduction to Links and Pairs:

Classification of mechanisms- Basic kinematic concepts and definitions- Degree of freedom, mobility- Grashof's law. Types of links, pairs and joints. **(10 lectures)**

UNIT - II

Transducer and Actuators:

Physical parameters, Measurement principles, Calibration, Amplification, Mechanical and Electrical Actuators, Closed loop systems for automation. (**10 lectures)**

UNIT – III

Mechanisms for Motion Conversion:

Introduction to four bar chain mechanisms and their inversions for various applications, Introduction to single slider crank chain mechanisms and their inversions for various applications, Introduction to double slider crank chain mechanism and their inversions for various applications. Mechanisms for balancing of ships and aero-planes. **(10 lectures)**

UNIT – IV

Mechanisms for Motion Transmission:

Power transmission through chain, rope and belt drive. Mechanisms for precise and compact power transmission through gears, cam and follower, and lead screws.

Text /Reference Books:

1. Rattan S.S, “Theory of Machines” Tata McGraw-Hill Publishing Company Ltd., New Delhi, and 2nd edition -2005.
2. Sadhu Singh, “Theory of Machines,” Pearson Education (Singapore) Pvt. Ltd., Indian Branch, New Delhi, 2ND Edi. 2006.
3. Curtis D Johnson,”Process Control Instrumentation Technology”, PHI, 1986
4. Shigley. J. V. and Uickers, J.J., “Theory of Machines & Mechanisms” OXFORD University press.2004.
5. Theory of Machines, by Thomas Bevan, CBS Publishers and Distributors.
6. Doeblin E.O, “Measurement Systems: Application and Design”, Fourth Edition, McGraw Hill, Newyork, 1992

Course Title and Code: Robotic Process Automation Lab (CS1125)	
Hours per Week	**L-T-P: 0-0-4**
Credits	**2**
Students who can take	BTech (CSE, ECE, CE, ME) Sem VI + BCA Sem IV
Prerequisite	Any Programming Language
Weightage	Quiz 20% Practical 80%
Course Objectives- The course aim is to develop an understanding of Intelligent Automation through Robotic Process Automation for automating business processes using software robots with cost-efficient digital delivery.	
Learning Outcomes: On successful completion of this course, the students should be able to: 1. Use and understand the various functionalities and features of UiPath Studio and Orchestrator. 2. Design, implement, and use RPA activities. 3. Develop basic robots using UiPath Community Edition. 4. Explore various data extraction techniques. 5. Identify processes which can be automated. 6. Develop business BOTs using Automation Anywhere (360). 7. Apply best practices in RPA projects.	

Course Syllabus (Theory):

Unit I: Programming Basic & Recap: Programming concept basic; **Introduction to RPA:** scopes and techniques of automation, RPA components and various RPA platforms, Introduction to UiPath as RPA platform, Applications and Benefits of RPA, Introduction to UiPath Studio, UiPath robot, types of robots, and UiPath Orchestrator. Brief on Studio interface and components.

Unit II: **RPA Projects:** Types of Projects in RPA: Sequence, Flowcharts, and State machines; Variables, Arguments, Data Types and Control flow: flow chart activities and sequences activities. **Data Manipulation:** Text and Data Manipulation**,** Data tables, clipboard management, file operation, importing from and exporting to CSV/Excel file and data table.

Unit III: **Control of Controls:** Attach window activity, Find and wait for the control, Introduction to Recorder, OCR, types of OCR and Screen Scrapping Using OCR. **Selectors:** Selectors, Defining and Assessing Selectors, Customization, Debugging, Dynamic Selectors, Partial Selectors, RPA Challenge.

Unit IV: **Application with Plugins and Extensions:** Mail plugins, PDF plugins, Web integration, excel and word plugins. Extensions- Java, chrome and firefox. **UiPath Advanced Automation concepts and techniques:** Image, Text and introduction of Citrix Automation; **Excel Data Tables & PDF:** Data Tables in RPA, Excel and Data Table basics, Data Manipulation in excel, Extracting Data from PDF, Extracting a single piece of data, Anchors. **Email Automation:** Incoming Email automation, Sending Email automation.

Unit V: **Automation Anywhere (AA):** Overview and Installation of Automation Anywhere Community Edition; Configuration of profile and device credentials; AA Architecture, Flow, List, and Dual Views of projects, Variables and Triggers; and Capstone Projects.

Text Material & Resources:

Text Books:

T1 Tripathi, Alok Mani. Learning Robotic Process Automation: Create Software robots and automate business processes with the leading RPA tool–UiPath. Packt Publishing Ltd, 2018.

T2 Murdoch, Richard. "Robotic Process Automation: Guide to Building Software Robots, Automate Repetitive Tasks & Become an RPA Consultant." Middletown, DE. Omakustanne (2018).

T3 Mahey, H. Robotic Process Automation with Automation Anywhere: Techniques to fuel business productivity and intelligent automation using RPA. Packt Publishing Ltd (2020).

Reference Books:

R1. Abhinav Sabharwal, “Introduction To RPA”, Independently Published Kindle Edition on Amazon Asia-Pacific Holdings Private Limited, 201 8

R2. Gerardus Blokdyk, “RPA Robotic Process Automation”, 5 Star cook, Second Edition, 2018

R3. Kelly Wibbenmeyer, “The Simple Implementation Guide to Robotic Process Automation (RPA): How to Best Implement RPA in an Organization” Paperback, iUniverse, 2018

R4. Willcocks, Leslie P., Mary Lacity, and Andrew Craig. "The IT function and robotic process automation." (2015).

R5. Mullakara, Nandan, and Arun Kumar Asokan. Robotic process automation projects: build real-world RPA solutions using UiPath and automation anywhere. Packt Publishing Ltd, 2020.

Course Title and Code: Google Cloud Lab (CS1223)	
Hours per Week	**L-T-P: 0-0-4**
Credits	**2**
Students who can take	B.Tech. VI Sem
Prerequisite	None
Weightage	Practical 100%

Course Objectives: This course aims to provide hands-on training on Google cloud. The students will learn the Infrastructure and services provided by Google cloud based on well-known practices.

Learning Outcomes:

On successful completion of this course, the students should be able to:

1. Create and deploy resilient, elastic, cost-effective cloud applications on Google Cloud.
2. Examine the trade-offs between deploying applications in Google Cloud and over the local Infrastructure.
3. Deploy applications over commercial cloud computing infrastructures, i.e., Google Cloud.
4. Evaluate the performance, scalability, and availability of the underlying cloud
5. technologies and software.

Course Contents:

Getting Started with Compute Engine, Getting Started with Cloud Marketplace, Getting Started with Cloud Storage and Cloud SQL, Getting Started with GKE, Getting Started with App Engine, Getting Started with Deployment Manager and Cloud Monitoring

Getting Started with BigQuery, Working with the Cloud Console and Cloud Shell, Infrastructure Preview, VPC Networking. Implement Private Google Access and Cloud NAT

Creating virtual machines, Working with Virtual Machines, Cloud IAM, Cloud Storage, Implementing Cloud SQL, Examining Billing Data with BigQuery, Resource Monitoring, Error Reporting, and Debugging

Virtual Private Networks (VPN), Configuring an HTTP Load Balancer with Autoscaling, Configuring an Internal Load Balancer, Automating the Infrastructure of networks using Terraform, Building a DevOps Pipeline, Deploying Apps to Google Cloud, Monitoring Applications in Google Cloud

Text Books:

1. Google Cloud Associate Examination Workbook, Google Cloud 2022
2. Thomas Erl, Ricardo Puttini, Zaigham Mahmood. Cloud Computing: Concepts, Technology & Architecture. Pearson, 2013.
3. Michael J. Kavis. Architecting the Cloud: Design Decisions for Cloud Computing Service Models. Wiley, 2014.

Course Title and Code: Satellite Image Processing (EE1231)	
Hours per Week	**L-T-P: 1-0-4**
Credits	**4**
Students who can take	B. Tech. VI Semester
Prerequisite	Digital Image Processing and Introduction to Quantum Computing
Weightage	Theory -70%, Practical and Projects – 30%
Course Objectives: This course aims to educate the students on opensource resources for satellite imagery and use of deep learning techniques for developing real time applications using these images.	
urse Outcome: **On successful completion of this course, the students will be able to** 1. Download satellite images and preprocess them for suitable applications. 2. Use statistical analytics to detect changes in region of interest. 3. Use deep learning models for object detection and segmentation. 4. Use mapping tools of EOS platform and write SQL queries for identifying physical infrastructures.	

Syllabus:

Earth Observation Platform-Search imagery using EOS Land Viewer form open sources, EOS storage, sorting imagery, creating catalogs and folders, sharing data with users. Imagery processing -radiometric calibration, geometric correction, orthorectification, pan sharpening. Analytics using NVDI, NDWI, NBR, Crop health monitoring using statistical parameters.
Image classification using deep learning-CNN, YOLO, Image segmentation, Spectral Indices, Temperature Map, Land classification, field contours, Change detection. Mapping and spatial data analysis with EOS vision, writing SQL queries for identifying roads and other infrastructure on image maps.
Developing Applications: Forest Fire detection, Landslide detection using CNN, Flood detection, tracking aircrafts and ships.

Text Book:

1. *Mathematical Models for Remote Sensing Image Processing: Models and Methods for the Analysis of 2D Satellite and Aerial Images (Signals and Communication Technology)*
   by Gabriele Moser and Josiane Zerubia

Online Resources: Remote Sensing and Satellite Image Processing with the EOS Platform(https://www.geo.university/courses/take/the-eos-platform).

Course Title and Code: Project (PR1107)	
Credits	**4**
Students who can take	B.Tech Sem VII
Prerequisites	None
Weightage	Report and Project 100%

Course Objectives- This course offers an opportunity to apply and extend knowledge learned throughout the program to solve real world issues. The projects undertaken span a diverse range of topics, including design, simulation, and experimental studies. The course emphasizes, facilitating student learning in technical, project implementation and presentation spheres.

Learning Outcomes:

On successful completion of this course, the students should be able to:

1. Identify and formulate industrial and societal problems.
2. Design engineering solutions for complex problems.
3. Develop/fabricate, and implement solutions for identified problem.
4. Demonstrate the knowledge, skills and attitudes of a professional engineer.

Course Title and Code: Advanced Communication Systems (EE1211)	
Hours per Week	**L-T-P: 3-1-0**
Credits	**4**
Students who can take	B.Tech. Semester VII
Prerequisite	Nil
Weightage	Theory -60%, Quiz/Assignments– 40%

Course Objective-

This course is focused on application of advanced communication techniques in Wireless communication, fiber optic communication and antenna design. The course also emphasizes issues of electromagnetic interference and compatibility.

Course Outcome:

On successful completion of this course, the students should be able to:

1. Characterize fibre optic system components and classify optical fibres
2. Design optical link for specific bit error rate
3. Analyse EMI/EMC standards and procedures
4. Characterize Antenna Radiation Hazards and implement AISG (The Antenna Interface Standards Group) standards.
5. Design and analyse Planar Antenna Arrays, Microstrip Antennas and Broadband and Compact antennas.

Syllabus (Theory):

Module 1: Optical Fiber Communication

UNIT-I: Evolution of Light wave systems, System components, Optical fibers - Step Index & Graded index - Mode theory, Dispersion in fibers, Dispersion shifted and dispersion flattened fibers - Fiber Losses - Non-linear effects, OPTICAL TRANSMITTERS/SOURCES: - LED structures - Spectral Distribution - Semiconductor lasers - Structures – Threshold conditions - SLM and STM operation - Transmitter design

UNIT-II: OPTICAL DETECTORS AND AMPLIFIERS: Basic Concepts - PIN and APD diodes structures, Photo detector Noise, Receiver design, Coherent detection Semiconductor optical amplifiers; Raman - and Brillouin amplifiers - Erbium-doped fiber amplifiers, pumping requirements, cascaded in-line amplifiers, COHERENT LIGHTWAVE SYSTEMS: Homodyne and heterodyne detectors - Modulation formats - Demodulation schemes - BER in synchronous receivers - Sensitivity degradation – Post - and pre compensation techniques - Optical solitons - Soliton based communication system

Module 2: EMI/EMC and Antenna Design

Unit I: EMI/EMC standards and procedures, Antenna design parameters, IEEE 149-1977 test procedure, Antenna Fundamentals, Antenna Radiation Hazards, Introduction to AISG (The Antenna Interface Standards Group)

Unit II: Loop Antennas, Slot Antennas, Planar Arrays, Microstrip Antennas, MSA Parametric Analysis, Broadband & Compact MSA, Tunable MSA, MSA Arrays, PIFA, Design of low power Antenna having controlled EM radiation

Text Books:

1. G. Keiser, "Optical Fiber Communication Systems", McGraw Hill, New York 2000
2. John M. Senior, “Optical Fiber Communication”, Pearson education, 3rd Edition, 2010
3. Constantine A. Balanis “Antenna Theory: Analysis and Design”, Wiley Student Edition, 2006

Reference Books:

1. Optical Fiber Communications– – John M. Senior, Pearson Education. 3/e, 2007
2. John D Kraus,” Antennas for all Applications”, 3rd Edition, McGraw Hill, 2005

Other Web Resources:

1. Optical fibre communication: https://nptel.ac.in/courses/117/101/117101054/
2. Antenna design: https://nptel.ac.in/courses/108/101/108101092/

Course Title and Code: Industrial IoT (EE1216)	
Hours per Week	**L-T-P: 3-0-2**
Credits	**4**
Students who can take	B. Tech. VII Semester
Prerequisite	Introduction to IoT and Automation Projects
Weightage	Theory -70%, Practical and Projects – 30%

Course Objectives: This course aims at creating the fundamentals skills required to design, implement, and maintain industrial IoT systems.

urse Outcome:

On successful completion of this course, the students will be able to

EE1216.1 - Explain the key components that make up an Industrial IoT system.

EE1216.2 - Discuss protocols and standards employed at each layer of the IIoT stack.

EE1216.3 - Design, deploy and test a basic Industrial IoT system, including data analysis functionalities. EE1216.4 - Apply best practices to meet desired requirements for IIoT applications

EE1216.5 Choose technology for constrained nodes and network while maintaining real time data collection.

Syllabus:

Unit 1 IIoT Fundamentals 93 Industrial communication: principles, protocols and technologies. IIoT definition, architectures and use cases. Convergence of IT and OT. Design methodology.

Unit 2 Interfacing sensors and actuators. Interfacing proximity sensor, vibration sensor, color sensors. Controlling AC motor .

Unit 3 Programming with Node Red- Injecting nodes, debugging, managing palettes, designing dashboard.

Unit 4 Cloud services Basic concepts. Applications: predictive maintenance, quality monitoring, personalized dashboards. Practical work: Design and test a basic IIoT system involving prototyping, programming, and data analysis.

Text Book: Bahga and Madisetti (2014). “Internet of Things: a hands-on approach”. CreateSpace Independent Publishing Platform, 1st edition. ISBN: 978-0996025515. Hanes, Salgueiro, Grossetete, Barton and Henry (2017).

Reference Book:

“IoT Fundamentals: Networking Technologies, Protocols and Use Cases for the Internet of Things”. Cisco Press Reference book: Gilchrist (2016). “Industry 4.0: The Industrial Internet of Things”.

Course Title and Code: Satellite Communication (EE1229)	
Hours per Week	**L-T-P: 3-1-0**
Credits	**4**
Students who can take	B.Tech. Semester VI CCE
Prerequisite	Digital Communication
Weightage	Theory -60%, Quiz/Assignments– 40%

Course Objective-

The aim of the course is to build a conceptual knowledge of communication through satellites. This course also helps students in understanding of navigation of satellites along with analyse of different challenges of satellite based systems.

Course Outcome:

On successful completion of this course, the students should be able to:

1. Understand the concept of orbits, launch vehicles and satellites.
2. Comprehend the design of satellite sub systems.
3. Have an in-depth knowledge of navigation satellite services.
4. Understand the impact of diverse parameters on satellite link design.
5. Appreciate the applications of satellite systems.

Syllabus (Theory):

Unit 1 Elements of Orbital Mechanics: Overview of satellite communication - Orbital mechanics - Equations of the orbit - Kepler's laws of planetary motion - Orbital elements - Look angle determination - Orbital perturbation and determination.

Unit 2 Orbital Launchers: Launches and launch vehicles- Launch vehicle selection factors - Satellite positioning into geostationary orbit - Orbital effects in communication systems performance - Doppler shift - Range variations - Solar eclipse and sun transit outage.

Unit 3 Elements of Communication Satellite: Satellite subsystems - Attitude and orbit control electronics - Telemetry and tracking – Power subsystems - Communication subsystems - Satellite antennas - Reliability and redundancy Frequency modulation techniques.

Unit 4 Satellite Link Design: Basic transmission theory – System noise temperature and G/T Ratio- Noise figure and noise temperature- Calculation of system noise temperature – G/T ratio for earth stations - Link budgets - Uplink and downlink budget calculations - Error control for digital satellite links - Prediction of rain attenuation and propagation impairment counter measures.

Unit 5 VSAT Systems: Overview of VSAT systems - Network architectures – One way implementation – Split IP implementation – Two-way implementation – Access control protocols – Delay considerations - VSAT earth station engineering - System design procedure and calculation of link margins for VSAT network.

Unit 6 Direct Broadcast Satellite Television systems and GPS : DBS TV system design - Direct broadcast satellite television transmitters and receivers - DBS TV link budget - Radio and satellite navigation –GPS position location principles – GPS navigation messages and signal levels - GPS receivers design – Role of satellites in future networks

Text Books:

1. T. Pratt, C.W. Boastian and Jeremy Allnutt Satellite Communication, 2013, 2nd edition, John Wiley and Sons, Bangalore, India.

2. Madhavendra Richharia, Mobile Satellite Communications: Principles and Trends, 2014, 2nd edition, John Wiley and Sons, United Kingdom.

Reference Books:

1. D.Roddy, Satellite Communications, 2011, 4th edition (sixth reprint), Tata McGraw Hill, New York.
2. W.L. Pritchard and H.G Suyderhoud, Satellite Communication Systems Engineering, 2011, 2nd edition, Pearson Education, India.
3. Teresa M. Braun, Satellite Communications Payload and System, 2012, 1st edition, John Wiley and Sons, USA

Course Title and Code: Computer Vision (CS1228)	
Hours per Week	**L-T-P: 3-0-2**
Credits	**4**
Students who can take	B.Tech. VII Sem and BCA 5th Sem
Prerequisites	Programming I, Linear Algebra and Differential Equations, Probability and Statistics, Machine Learning, Deep Learning
Evaluation	Theory 55%, Lab 45%

Course Objective: This course introduces the fundamental concepts of image and video-based features and how to use them for training ML/DL models for recognition tasks. It will cover object detection, segmentation, convolutional network model construction and training pipeline for image/video-based recognition applications. The course will also discuss the end-to-end development of state-of-the-art machine learning and deep learning models used in computer vision. This course will provide a hands-on state-of-the-art experience with tools and libraries used for building a vision pipeline.

Course Outcomes:

On successful completion of this course, the students should be able to:

1. Understand the fundamentals of Image Processing, Computer Vision and its applications.
2. Learn about the major vision tasks (detection, recognition, segmentation and tracking) along with their evaluation methodology.
3. Learn about state-of-the-art deep learning models for solving the major vision tasks applied for images and videos.
4. Learn the tools and techniques for implementing the core functionality of a computer vision system.
5. Identify the domain-specific requirements and build custom image/video processing learning based models and pipeline.

Course Syllabus (Theory):

UNIT-I: *Introduction to Image Processing and Computer Vision*: Image Formation, Digital Camera, Image data representation, Color Spaces, Filtering, Histogram Equalization, Fourier Transforms, Pyramids, Wavelets, Edge Detection, Image Features.

UNIT-II: *Convolutional Neural Networks (CNN) - Features and Applications:* CNN architectures for Classification, and Detection tasks (AlexNet, VGG, ResNet, FasterRCNN, MaskRCNN, YOLO). Video action classification features and models (Two-stream, 3DCNNs).

UNIT-III: *Spatial Features and working with video data:* Low level image features - SIFT, HOG, LBP. Face/Pedestrian/Object Detection, Video data representation, RGBD, background modeling / subtraction, MBH, BoVW based model training. Semantic Segmentation.

UNIT-IV: *Motion understanding:* Optical Flow, Shot Boundary Detection, detection and tracking in videos, Trajectory extraction (iDTs), trajectory clustering, FlowNet, SLAM.

UNIT-V: *Benchmark Datasets and Video Action Recognition:* Large-scale datasets, ActivityNet, Kinetics, AVA, TRECVid. Transformer Models, ViT, PixelCNN, Self-supervised learning on videos. Generative models. Applications of Action Recognition. Eigen Faces.

Reference Books:

1. Richard Szeliski – 'Computer Vision'.

2. Computer Vision: A Modern Approach, David A. Forsyth and Jean Ponce, Pearson 2nd Edition.
3. Deep Learning – Ian Goodfellow.
4. CVPR/ICCV/ECCV/BMVC conference and journal papers.
5. PyTorch and OpenCV tutorials.

Reference Online Course:

Computer Vision - CAP5415 UC CRCV
https://www.youtube.com/playlist?list=PLd3hlSJsX_IkXSinyREhlMjFvpNfpazfN

Computer Vision and Image Processing – IIT Guwahati NPTEL
https://www.youtube.com/playlist?list=PLwdnzlV3ogoVsma5GmBSsgJM6gHv1QoAo

Computer Vision (Univ of Washington)
https://courses.cs.washington.edu/courses/cse455/22sp/

Computer Vision (Univ of Washington - Shapiro)
https://courses.cs.washington.edu/courses/cse576/22sp/

NYU Deep Learning 2021: Alfredo and Yann LeCun
https://www.youtube.com/playlist?list=PLLHTzKZzVU9e6xUfG10TkTWApKSZCzuBI

Course Title and Code: Fundamentals of Investing (FA1127)	
Hours per Week	**L-T-P: 4-0-0**
Credits	**4**
Students who can take	B. Tech Semester-VII Elective
Pre-requisite	None
Weightage	Theory 70% Practical 30%

Course Objective:

The income that a person receives may be used for purchasing goods and services that he currently requires or it may be saved for purchasing goods and services that he may require in the future. In other words, income can be what is spent for current consumption. savings are generated when a person or organization abstain from present consumption for a future use. The person saving a part of his income tries to find a short term or long term investment avenues for his savings until they are required to finance his future expenditure, this result in investment.

The course is primarily designed for novice investors who want to better understand the concept of investing and investment decision making. This course will cover different investment vehicles, Time value of money and power of compounding, balancing risk and return, project valuation and the capital budgeting process, financial services and institutions.

Course Outcomes:

After course completion, the student will be able to:

1. Comprehend the fundamentals of investment and different investment vehicles.
2. Evaluate and Explore the effects of investments on personal finances
3. Apply the concept of Time value of money to your personal finance and retirement planning.
4. Analyze viability of different projects for investment decision making.
5. Comprehend the role of financial markets and intermediaries and financial services.

Course Syllabus (Theory):

Module-I Investment Environment

The investment decision process, Types of Investments – Commodities, Real Estate and Financial Assets (Equity, Mutual funds, Debt), Introducing investment tools- Deposits, Bonds, saving schemes such as PF, PPF, NPS, SSY, NSC, Post office saving schemes, Insurance- Term, Endowment plans, Gold, SGBs etc.

Module-II Time Value of Money and balancing Risk and Return

Fundamental Valuation Concept- Time value of Money: Concept and Rationale, Compounding and Discounting of cash flows. FV & PV of Annuity, Risk & Return Trade.

Module-III Project Valuation and capital budgeting process

Capital Budgeting: Capital budgeting process, Non-Discounting cash flow techniques, Discounting cash flow techniques, Accept Reject Rules.

Module IV: Introducing Financial Markets and Institutions: The Indian securities market, the market participants (Stock exchanges, Stock brokers, Clearing House, Depositories, Depository Participants, FIIs, Domestic institutional investors, Individual investors), Online and offline trading in securities, security market indices, sources of financial information.

Course Title and Code: Operations Research (AS1201)	
Hours per Week	**L-T-P: 3-0-2**
Credits	**4**
Students who can take	B. Tech Semester-VII Open **Elective**
Pre-requisite	**None**
Evaluation	Theory – 70%, Lab – 30%

Course Objective:

This Course aims to develop various concepts and tools to help students understand operations research and mathematical modeling methods. To introduce the students to the advanced methods for large-scale decision analysis, supply chain management, and reliability problems.

Course Outcomes: After course completion, the student will be able to:

1 Determining the characteristics of different types of decision-making environments and the appropriate decision-making approaches and tools to be used in each type.

2 Formulate and translate a real-world problem, given in words, into a mathematical formulation.

3 Use these tools to analyze strategic, tactical, and operational supply chain decisions including facility location, vehicle routing, and inventory management.

4 Improve decision-making by identity minimize trouble spots by identifying the critical factors.

5 Find reliability and operation analysis which includes system reliability analysis, failure investigation and corrective action.

6 Know how to work in a team, specifically to solve larger problems, communicate technical knowledge, partition a problem into smaller tasks, and complete tasks on time.

Course Syllabus (Theory)

Decision Analysis

Introduction to OR, Introduction to Decision Analysis, A Prototype Example, Decision Making without Experimentation, Decision Making with Experimentation, Decision Trees.

Markov Chain

Introduction to Markov Chain, Stochastic Processes, Chapman-Kolmogorov Equations, Classification of States of Markov Chain.

Supply Chain Analysis and Inventory Management

Introduction, Introduction to Supply Chain Management and Supply Chain Strategy, Supply Chain Performance Metrics and Drivers Objectives of Inventory Control, Types of Inventories.

Network Optimization Models

The Terminology of Networks, Shortest-Path Problem, Minimum Spanning Tree Problem, and Project Management with CPM/PERT.

Reliability Theory

Introduction, System Reliability, Failure Rates, Bath-tub, Reliability of Systems, Practical Utility of Reliability Evaluation.

Text and References Books:

1. Hillier F.S. and Lieberman G.J., Introduction to Operations Research: Concepts and Cases, Tata McGraw Hill, 8th Ed., 2010 Ed. TMH.
2. Kasana H.S. and Kumar K.D., Introductory Operations Research: Theory and Applications, Springer.
3. Srinivasan, G., Operations Research: Principles And Applications. PHI Learning Pvt. Ltd, 2007.
4. Taha. H. A, Operations Research: An Introduction, Pearson Education, 7th ed., 2017.
5. Ackoff, R.L. and Sasini, M. W., Fundamentals of Operations Research, Wiley & Sons, New York.
6. Waddington, C. H., O. R. in World War 2: Operational Research Against the U-boat, London, Elek Science, 1973.

Recommended MOOC:

https://www.coursera.org/specializations/supply-chain-management#courses

Course Title and Code: Behavioral Assessments for Employability (BS1105)	
Hours per Week	**L-T-P: 2-0-2**
Credits	**4**
Students who can take	B. Tech Semester-VII Elective
Pre-requisite	None
Weightage	Presentations 20% Assignments 40% Reports 30% Participation 10%

Course Objectives: This course aims to enhance student's self-awareness, and to expand their capacity of self -management and development. Human Behavior is manifestation of certain innate and learned competencies. These competencies encompass intelligence, knowledge, skills, attitudes and actions. Right behaviors are precondition for excellence in other competencies. Further technical knowledge and skill can be taught vis-a- vis behavioral competencies are consciously developed through self-awareness. It immerses them to understand the key behavior and attitude assessed by the employer in job market and makes them undergo various psychological test. By the end of the course students will be able to develop their psychological assessment profile and identify their strength. This would enable their personal growth and help them project right behavior and attitude while seeking employment

Course Outcomes:

On successful completion of this course, the students should be able to:

1. Create awareness about different types of psychological tests in vogue.
2. Provide a theoretical background for supplementing the understanding of psychological assessment.
3. Learn to interpret test profiles and explore patterns in interpretation from several tests.
4. Explore and identify their core personal strengths and values.
5. Identify and expand their capacity of development

Topics :

- Theory and Issues in Psychological Testing
- Intelligence Testing - Theoretical Background
- Aptitude Testing - The D.A.T.
- Personality Assessment - Theoretical Background
- Self-Report Inventories
- Assertiveness Test
- Stress Assessment
- Ego states & life positions
- Growth mindset
- Ethics assessment
- Typological Tests
- Projective Techniques
- Integration of Profiles

Course Title and Code: Solid and E-Waste Management (AS1210)	
Hours per Week	**L-T-P: 3-0-0**
Credits	**3**
Students who can take	Open Elective
Pre-requisite	None
Weightage	Theory 55% Practical 45%

Course Objective: This course provides an in-depth understanding of solid and hazardous waste characteristics and management. This course will also discuss the overall scenario of E-Waste management. This imparts life skills about E-waste management in routine daily life to minimize the different wastes and apply effective management throughout society.

Course Outcomes:

After course completion, the student will be able to:

1. Analyze key sources, typical quantities generated, composition, and properties of solid and hazardous wastes.
2. Compare effective methods of solid & hazardous waste handling and segregation of wastes at source.
3. Test the most common techniques for preventing, minimizing, recycling, disposing, and treatment of solid and e-waste and their application in on-site remediation.
4. Recognize the important regulations which are applied for the effective management of solid and E-wastes.
5. Use engineering methods to identify, formulate, and solve waste problems.

Course Syllabus (Theory):

INTRODUCTION: Types and Sources of solid wastes and E-waste- Indian and global scenario of the - Need for solid and E-waste management – Indian and global scenario of e-Waste, Growth of Electrical and Electronics industry in India, E-waste generation in India, Composition of E-waste, Possible hazardous substances present in E-waste, Environmental and Health implications.

WASTE LEGISLATION: Legislations on management and handling of solid waste. The regulatory regime for e-waste in India, the hazardous waste (Management and Handling) rules 2003, E-waste management rules 2015, Regulatory compliance including roles and responsibilities of different stakeholders – producer, manufacturer, consumer, etc., Proposed reduction in the use of hazardous substances (RoHS), Extended producer responsibility (EPR).

WASTE PROCESSING & TECHNOLOGY: Composition - Hazardous Characteristics –Source reduction of wastes – Recycling and reuse. Handling and segregation of wastes at source – storage and collection of solid & E-wastes – Analysis of Collection systems - Need for transfer and transport – Transfer stations - labeling and handling of hazardous wastes. Processing technologies – thermal conversion technologies - energy recovery – incineration. Life cycle assessment of a product (LCA) method, Emerging recycling, and recovery technologies

DISPOSAL: Guidelines for environmentally sound management of e-waste, environmentally sound treatment technology for e-waste, Disposal in landfills - site selection - design and operation of sanitary landfills- secure landfills, leachate, and landfill gas management. Case studies, and unique initiatives from around the world. Case study -Optimal planning for computer waste.

Text Book:

1. George Tchobanoglous, Hilary Theisen and Samuel A, Vigil, Integrated Solid Waste Management, McGraw- Hill, New York, 1993

2. Johri R., “E-waste: implications, regulations, and management in India and current global best practices”, TERI Press, New Delhi

REFERENCE BOOKS:

Refer to all courses related books, other than textbooks here.

1. CPHEEO, Manual on Municipal Solid waste management, Central Public Health and Environmental Engineering Organization, Government of India, New Delhi, 2000.
2. George Tchobanoglous; Frank Kreith Handbook of Solid Waste Management, Second Edition ISBN: 9780071356237 Publication Date & Copyright: 2002.The McGraw-Hill Companies, Inc
3. Thomas H. Christensen; Solid Waste Technology & Management, 1 & 2; First published:23 November 2010 Print ISBN:9781405175173 |
4. NPTL course IIT Kharagpur. (https://nptel.ac.in/courses/105105169)

Course Title and Code: **Disaster Management (CE 1206)**	
Hours per Week	**L-T-P: 3-1-0**
Credits	**4**
Students who can take	B. Tech Sem VII (OE)
Prerequisite	None
Weightage	Theory 50% Practical 50%

Course Objective: This course aims to develop understanding of various natural and manmade disasters. Natural disasters include earthquake, Tsunami, Flood, forest fires and Land Slides. Manmade disasters include fire, Industrial Pollution, embankment failure, structural failure and due to electric supply. Topics includes the causes for these disasters and remedial measures which can minimize the losses to the life and property. The course also includes the identification and description of electric supply resilience and restoration.

Course Outcomes

On completion of the course, the student should be able to:

1. Asses the types of disasters, causes and their impacts.
2. Assess vulnerability and various methods of risk reduction measures and mitigation.
3. Draw the hazard and vulnerability profile of a given region.
4. Analyze the impact of Storms and Severe Weather on electric utility.
5. Plan and execute framework to black start and restoration procedure with considering security criteria and power system reliability.

Course Syllabus (Theory)

Unit-1 Introduction to Disasters, Various types of disaster, Natural: Flood, Earthquake, cyclone, Land slide, Manmade: Fire, Industrial Pollution, embankment failure, structural failure, Loss of resources.

Unit-2

Risk and Vulnerability:

Risk: Its concept and analysis, Risk reduction, Vulnerability: Its concept and analysis, strategic development for vulnerability reduction

Unit 3

Disaster Management in Electrical Systems:

Causes of Extended Outages, System Impact of the Loss of Major Components, Methods to Reduce Energy System Vulnerability, Development of an On-Site and Off-site Disaster management Plan, Accident prevention techniques and Reporting procedures, Investigation reports, Impacts of Blackouts.

Unit – 4

Management- Objectives, Processes, Events, analysis, base-line data, forecasting and Warnings. Disaster preparedness plan concept and nature, Emergency operation center and IT aids- physical environment, Applications. Public-private agency co-ordination- federal, state and local disaster response organization and network, Citizen and community role in disaster response and recovery.

Text /Reference Books:

1. M. Pandey, “Disaster Management” Wiley India Pvt. Ltd.
2. Tushar Bhattacharya, “Disaster Science and Management” McGraw Hill Education (India) Pvt. Ltd.
3. Crisis and disaster management plan for power sector by central electricity authority of India

4. N. Malla, S. Poudel, N. R. Karki and N. Gyawali, "Resilience of electrical power delivery system in response to natural disasters," 2017 7th International Conference on Power Systems (ICPS), Pune, 2017, pp. 806-811.doi: 10.1109/ICPES.2017.8387400
5. Sahni, Pardeepet. al. (Eds.),” Disaster Mitigation Experiences and Reflections”, Prentice Hall of India, New Delhi.

Course Title and Code: Practice School – II (PS-2), PS1102	
Total Duration	**4-4.5 months**
Credits	**16**
Students who can take	B.Tech Semester-VIII
Prerequisites	None
Weightage	Practical 100%

Course Objective:

The aim of this course is to expose students to the real-world industrial environment to acquire knowledge of various professional skills, working of industry, and interaction with the people. Practice school-II is essential to inculcate confidence and encourage to take-up professions/entrepreneurship to serve the society in general

Course Outcomes:

On successful completion of Practice school-II, the students be able to:

1. Apply skills and engineering knowledge to identify various Industrial problems.
2. Analyze and solve engineering related problems in industry using methods, tools and techniques learnt at the university.
3. Demonstrate ethic and professionalism in engineering practice.
4. Communicate effectively with the technical community and produce effective reports and presentations

Course Title and Course Code: Entrepreneurial Project (PR1105)	
Duration	**16 weeks**
Credits	**16**
Students who can take	B. Tech Semester-VIII
Prerequisites	None
Weightage	Practical 100%

Course Objectives:

The aim of this course is to expose students to the entrepreneurship in computer science. The students are expected to identify new business opportunities in the technology sector, innovate and create a solution and finally implement Business strategy.

Course Outcomes:

On successful completion of Entrepreneurial Project, the students will be able to:

1. Apply skills and knowledge to identify new entrepreneurial opportunities
2. Analyze the market and competitors around the identified opportunity
3. Innovate, Design and Create the specific product or solution
4. Develop a business model for the entire solution

Course Title and Course Code: Research Project (PR1104)	
Duration	**16 weeks**
Credits	**16**
Students who can take	B. Tech Semester-VIII
Prerequisites	None
Weightage	Practical 100%

Course Objectives:

The aim of this course is to expose students to the research conducted in computer science. The students are expected to identify, formulate and solve a research problem.

Course Outcomes:

On successful completion of Research Project, the students will be able to:

1. Apply skills and knowledge to identify research problems.
2. Analyze the related work around the identified research problem.
3. Design efficient solutions to solve the identified problem.
4. Evaluate, test and compare the methodology used to solve the problem.