Indian Institute of Information Technology, Allahabad
Department of Information Technology
B.Tech. IT curriculum
(2022 Batch)

Total Credit : 164

Semester 1 Total Credit : 20					
Sl.No.	Course Name	Code	Type	Credit	L-T-P
1	Physics		Core	4	2–1–1
2	Linear Algebra		Core	4	3–1–0
3	Introduction to Programming		Core	4	2–1–1
4	Fundamentals of Electrical & Electronics Engg.		Core	4	2–1–1
5	Professional Communication		Core	2	1–0–1
6	Principles of Management		Core	2	1–1–0
					11–10–08
Total				20	29

Semester 2 Total Credit : 22					
Sl.No.	Course Name	Code	Type	Credit	L-T-P
1	Discrete Mathematical Structures		Core	4	3–1–0
2	Univariate and Multivariate Calculus		Core	4	3–1–0
3	Computer Organization and Architecture		Core	4	2–1–1
5	Data Structures		Core	4	2–1–1
6	Principles of Communication Engineering		Core	4	2–1–1
7	Principle of Economics		Core	2	2–0–0
					14–10–06
Total				22	30

Semester 3 Total Credit : 20					
Sl.No.	Course Name	Code	Type	Credit	L-T-P
1	Probability and Statistics		Hard	4	3–1–0
2	Theory of Computation		Hard	4	2–1–1
3	Object Oriented Methodologies		Hard	4	2–1–1
4	Operating System		Hard	4	2–1–1
5	Introduction to Finance		Hard	2	2–0–0
6	Introduction to Marketing		Hard	2	1–0–1
					12–08–08
Total				20	28

B.Tech. IT 2022 Batch

Semester 4					**Total Credit: 21**
Sl. No.	Course Name	Code	Type	Credit	Hours L-T-P-S
1	Design and Analysis of Algorithms		PCC	4	3-0-2-0
2	Principles of Programming Language		PCC	3	3-0-0-0
3	Computer Networks		PCC	4	3-0-2-0
4	Software Engineering		PCC	3	2-0-2-0
5	Database Management System		PCC	4	3-0-2-0
6	Multi-Disciplinary Minor-1		MDM	3	3-0-0-0
			Total	21	**17-00-08-00** **25**

Semester 5					Total Credit: 25
Sl. No.	Course Name	Code	Type	Credit	Hours
					L-T-P-S
1	Cyber Security	PC-IT-CSE301	PCC	4	3-0-2-0
2	Introduction to Machine Learning	PC-IT-IML302	PCC/VSEC	4	3-0-2-0
3	Image and Video Processing	PC-IT-IVP303	PCC/VSEC	4	3-0-2-0
4	Artificial Intelligence	PC-IT-AIN304	PCC	3	2-0-2-0
5	Project-I (Research Methodology)	PC-IT-PRO351	ELC	2	0-0-4-0
6	Computer Graphics and Visualization	PC-IT-CGV208	PCC	3	2-0-2-0
7	Design Thinking and Innovation	HM-MS-DTI306	HSMC	2	1-0-2-0
8	Multi-Disciplinary Minor-2		MDM	3	3-0-0-0
			Total	**25**	**17-0-16-0**
					33

Semester 6					Total Credit: 20
Sl. No.	Course Name	Code	Type	Credit	Hours
					L-T-P-S
1	Data Analytics	PC-IT-DAN305	PCC	3	2-0-2-0
2	Project-II	PC-IT-PRJ352	ELC	4	0-0-8-0
3	Biology for Engineers	BS-AS-BFE301	BSC	2	2-0-0-0
4	Elective-1	PE-IT-XXX401	PEC	3	3-0-0-0
5	Elective-2	PE-IT-XXX402	PEC	3	3-0-0-0
6	Indian/Foreign language Regional Language, Sanskrit, German, Japanese, French	HM-xx-XXX304	HSMC (AEC)	2	1-0-2-0
7	Multi-Disciplinary Minor-3		MDM	3	3-0-0-0
			Total	**20**	**14-0-12-0**
					26

Exit: After successful completion of 6 semesters, a student any get an exit option as per ordinance after completion of the summer semester internship (3 credits) and additional 3 credit courses in summer.

Summer Semester					Total Credit: 3
Sl. No.	Course Name	Code	Type	Credit	
1	Internship	PC-IT-ITP353	ELC	3	Credit will be added in VII Sem.

Note: Internship will be evaluated in the beginning of seventh semester. Its credit and grades will be reflected in the 7th Semester Grade Sheet.

Semester 7					Total Credit: 21
Sl. No.	Course Name	Code	Type	Credit	Hours
					L-T-P-S
1	Minor Project	PC-IT-PRJ451	ELC	4	0-0-8-0
2	Elective-3	PE-IT-XXX403	PEC	3	3-0-0-0
3	Elective-4	PE-IT-XXX404	PEC	3	3-0-0-0
4	Open Elective-1	OE-ZZ-XXX4SS	OEC	3	3-0-0-0
5	History of Indian Civilizations/Kautilya's Arthashastra/Vedic Mathematics/Vedic Corpus/Wisdom from the Ages/Panini's Grammar	HM-MS-XXX408	HSMC (IKS)	2	2-0-0-0
6	Internship(Summer Semester)	PC-IT-TO353	ELC	3	0-0-0-6
7	Multi-Disciplinary Minor-4		MDM	3	3-0-0-0
			Total	**21**	**14-0-8-6**
					28

Semester 8					**Total Credit: 15**
Sl. No.	Course Name	Code	Type	Credit	Hours L-T-P-S
1	Major Project	PC-IT-PRJ452	ELC	6	0-0-12-0 0-0-0-6
2	Elective-5	PE-IT-XXX402	PEC	3	3-0-0-0 0-0-0-3*
3	Open Elective-2	OE-ZZ-XXX4SS	OEC	3	3-0-0-0 0-0-0-3*
4	Multi-Disciplinary Minor-5		MDM	3	3-0-0-0
			Total	**15**	**9-0-12-0** **21**

*8th Semester courses may be allowed to join via MOOC/NPTEL etc.

Engineering

Name of the Course: Physics

2. **LTP structure of the course:** 2-1-1
3. **Objective of the course:** To let the first year B.Tech (IT) students exposed to basic laws of nature and to demonstrate their application on physical systems and electronic devices and circuits.
4. **Outcome of the course:** The students will learn how to handle dynamics of simple systems like point particle. Students will be exposed to laws of physics in the atomic or sub-atomic scale. Mathematical tools that the students will learn in this course will be highly beneficial for the students to explore many areas of engineering stream including: Quantum computation, Electronics, Semiconductor Devices and technology etc.
5. **Course Plan:**

Component	Unit	Topics for Coverage
Component 1	1	Classical Mechanics: Calculus of Variations; Lagranges Equations; Hamiltons principle, Hamiltons equations of motion, Applications.
	2	Heisenberg Uncertainty Principle, Wave Function, its Interpretation and Normalization; Superposition of Amplitudes, Dynamical Variables as Operators; Expectation Values, Schrodinger Equation and its Simple Applications like Particle in a Box, Quantum Well, Potential Barrier Problem, Electron in periodic potential and band structure of solid, k-space.
Component 2	3	Semiconductors: Introduction, Energy Bands in conductors, semiconductors, insulators, intrinsic and extrinsic semiconductor, and Carrier transport in semiconductor: diffusion current, drift current, mobility and resistivity. Generation and recombination of carriers in semiconductors. Thermal Noise, Shot Noise. Electrons and Holes in semiconductors: Silicon crystal structure, Donors and acceptors in the band model, electron effective mass, Density of states, Thermal equilibrium, and Fermi-Dirac distribution function for electrons and holes, Fermi energy. Equilibrium distribution of electrons & holes. The n-p product and the intrinsic carrier concentration at extremely high and low temperatures, Variation of Fermi energy with doping concentration and temperature
	4	Motion and Recombination of Electrons and Holes: Carrier drift: Electron and hole motilities, Mechanism of carrier scattering, Drift current and conductivity. Carrier diffusion: diffusion current, Total current density, relation between the energy diagram and potential, electric field, Einstein relationship between diffusion coefficient and mobility

6. **Text Book:**

Classical Mechanics:
Classical Mechanics; H. Goldstein, C. Poole, J. Safko.
Quantum Mechanics:
Introduction to Quantum Mechanics by D . J. Griffiths
Modern Physics by A. Beiser.
Solid State Physics
Physics of semiconductor devices, S M Sze, John Wiley & Sons, 2006.;
Goldstein : https://www.pearson.com/us/higher-education/program/Goldstein-Classical-Mechanics-3rd-Edition/PGM170105.html.
Griffiths: https://books.google.co.in/books?id=9sqIaRGx_EoC&pg=PP1&source=kp_read_button&redir_esc=y#v=onepage&q&f=false

7. **References:**

L.D. Landau and E.M. Lifshitz, Mechanics.
Theoretical Mechanics by M. Spiegel.
Feynman Lectures of Physics Vol-1 and Vol-3.
Quantum Physics for Atoms, Molecules, Solids, Nuclei and Particles by R Eisberg and R. Resnick.
Integrated Electronics: Analog and Digital Circuits and Systems by J. Millman and C.C. Halkias.

1. **Name of the Course: Linear Algebra**
2. **LTP structure of the course:** 3-1-0
3. **Objective of the course:** Solving systems of linear equations, Understanding vector spaces, linear transformations, eigenvalue, eigenvector, generalized notion of angle, distance, and length, diagonalization and orthogonalization.
4. **Outcome of the course:** To able to solve systems of linear equations, work within vector spaces, to manipulate matrices and to do matrix algebra.
5. **Course Plan:**

Component	Unit	Topics for Coverage
Component 1	Unit 1	System of linear equation, Gauss elimination method, Elementary matrices, Invertible matrices, Gauss-Jordon method for finding inverse of a matrix, Determinant, Cramers rule, Vector spaces, Linearly independence and independence, Basis, Dimension
	Unit 2	Linear transformation, Representation of linear maps by matrices, Rank-Nullity theorem, Rank of a matrix, Row and column spaces, Solution space of a system of homogeneous and non-homogeneous equations, Inner product space, Cauchy-Schwartz inequality, Orthogonal basis,
Component 2	Unit 3	Grahm-Schmidt orthogonalization process, Orthogonal projection, Eigen value, eigenvector, Cayley-Hamilton theorem, Diagonalizability and minimal polynomial, Spectral theorem,
	Unit 4	Positive, negative and semi definite matrices. Decomposition of the matrix in terms of projections, Strategy for choosing the basis for the four fundamental subspaces, Least square solutions and fittings, Singular values, Primary decomposition theorem, Jordan canonical form

6. **Text Book:** Gilbert Strang, Linear Algebra, Cambridge Press.
7. **References Books:**
   1. K. Hoffman and R. Kunze, Linear Algebra, Pearson.
   2. S. Kumaresan, Linear algebra - A Geometric approach, Prentice Hall of India.
   3. S. Lang, Introduction to Linear Algebra, Springer

1. **Name of the Course: Introduction to Programming**
2. **LTP structure of the course:** 2-1-1
3. **Objective of the course:** The purpose of this course is to provide the basic knowledge of C programming
4. **Outcome of the course:** The students will be able to program in C language with basic programming abilities
5. **Course Plan:**

Component	Unit	Topics for Coverage	Chapter No.(Optional)
Component 1	Unit 1	Introduction, pseudocode, data types, single precision floating point, representation, operators, bitwise operators, expressions and statements, operator precedence vs. order of evaluation, type casting, integral promotions, conversions (standard type and arithmetic), if-else condition, for loop, while loop, do-while loop, Jump statements.	
	Unit 2	1-d arrays, Strings, 2-d arrays, structure and union, pointers, functions, header files (math.h, time.h, custom headers), external functions.	
Component 2	Unit 3	Pointers, arrays vs. pointers, Pointers to pointers and pointers to functions, Pre-processor directives and macros, I/O handling.	
	Unit 4	Dynamic memory allocation, Linked lists, Command line arguments, Standard libraries	

6. **Text Book:**
   a. Programming in ANSI C, 7th Edition by E. Balagurusami, TMH
   b. Let Us C, 15th Edition by Yashwant Kanetkar, BPB Publication
7. **References:** a. The C Programming Language, 2nd Edition By Brian W. Kernighan, Dennis M. Ritchie, PHI

1. **Name of the Course: Fundamentals of Electrical and Electronics Engineering**
2. **LTP structure of the course:** 2:1:1
3. **Objective of the course:** This course is intended to be the text for a first course in electronics engineering. It is partitioned into four parts circuits, electronics, digital systems, and electro-mechanics. Although many topics are covered in each of these parts, the syllabus is more than just a survey of the basics of electrical engineering.
4. **Outcome of the course :**To provide an overall picture and working principles of electronics and electrical devices. The students will understand the working principles of network theorems, AC circuits, Transformers, Electrical Motors and simple semiconductor diode circuits.
5. **Course Plan:**

Component	Unit	Topics for Coverage
Component 1	Unit 1	**Network Theorems**: Network graphs and matrices, Transient and Steady-State Analysis, theorem.
	Unit 2	**DC and AC circuits**, Transformer, Transformers, Rotating coil devices
Component 2	Unit 3	**Semiconductor Diodes**: Semiconductors, Junction diode Zener diodes, Simple circuits
	Unit 4	**Introduction to Logic Circuits:** Boolean Algebra, Simple gates, Boolean Theorems.

6. **Text Book:**
   a. Fundamentals of Electrical Engineering, Leonard S Bobrow, 2nd Edition, Oxford Press.
   b. Fundamentals of Electrical Engineering and Electronics, B L Thereja, S Chand Press.
7. **References:**
   a. Network Analysis, M E van Valkenberg, 3rd Edition, PHI, 2000
   b. Linear Circuit Analysis: Time, Domain, Phasor and Laplace Transform Approaches, R A DeCarlo and P-M Lin, 2nd Edition, Oxford University Press, 2000

1. **Name of the Course: Professional Communication**
2. **LTP structure of the course:** 1-0-1
3. **Objective of the course:** The focus of the course is to engage and involve students with hands on situation and solve problems on regular basis.
4. **Outcome of the course:** The course is designed to enhance and polish communication skills of undergraduate students which will formally help them to be effective professionals by understanding importance of effective communication, presentation and designing of work.
5. **Course Plan:**

Component	Unit	Topics for Coverage
Component 1	Unit 1	Introduction to Types of communication , Speech and diction correction and counseling Formal communication I. Cover letter II. CV preparation III. Group discussion
	Unit 2	IV. Personal interview V. Report writing VI. Proposal development (Product development plan)
Component 2	Unit 3	I. Role play II. Moderation and intervention techniques
	Unit 4	III. SWOT Analysis IV. Interview types and techniques

6. Lab Exercises to be done in LAB Session.
7. **References:** Winning at Interviews by Edgar Thorpe

1. **Name of the Course: Principles of Management**
2. **LTP structure of the course:** 1-1-0
3. **Objective of the course:**
   This course is designed to be an overview of the major functions of management. It explores how organizations develop and maintain competitive advantage within a changing business environment. Upon completion, students should be able to work as contributing members of a team utilizing these functions of management.
4. **Outcome of the course:**
   Explain how organizations adapt to an uncertain environment and identify techniques managers use to influence and control the internal environment. Practice the process of management's four functions: planning, organizing, leading, and controlling.
5. **Course Plan:**

Component	Unit	Topics for Coverage
Component 1	Unit 1	Nature and Functions of Management - Importance and Process of Management - Development of Management Thoughts - Managerial Roles
	Unit 2	International Business and its Environment- globalization &WTO-. Dynamics of development Global business environment-. Internal and External analysis. Nature and Importance of Planning Management by Objectives Decision Making MIS Forecasting: Techniques of Forecasting.
Component 2	Unit 3	Need for Organization - Principles and Process of Organizing Span of Management Organization Structure Departmentalization Authority, Delegation and Decentralization
	Unit 4	Staffing and Directing Requirement of Effective Direction Supervisor and his Qualities Co-Ordination Control

6. **Text Book:** Mandatory for UG core courses
   - Koontz, Weihrich, Aryasri. Principles of Management, TATA McGraw Hill, New Delhi, 2004.

7. **References:**
   P.C.Tripathi, P.N. Reddy, Principles of Management, Tata McGraw-Hill Publishing Company Limited, New Delhi.
   Prasad LM, Principles and Practice of Management, Sultan Chand & Sons, New Delhi.
   Samuel C. Certo, S. TrevisCerto, Modern management 10 Ed, PHI Learning, New Delhi, 2008
   James A. Stoner, Edward Freeman, Daniel Gilbert, Management, PHI Learning, New Delhi, 2007
   Williams/ Kulshrestha, Principles of Management, Cengage Learning, New Delhi, 2011

Course Syllabus

1. **Name of the Course: Discrete Mathematical Structures**
2. **LTP structure of the course: 3-1-0**
3. **Objective of the course:** This is an introductory course on discrete mathematics and structures. Students will learn: some fundamental mathematical concepts and terminology.
4. **Outcome of the course:** On completion of this course, students will be able to explain and apply the basic methods of discrete (non-continuous) mathematics in Computer Science. They will be able to use these methods in subsequent courses in the design and analysis of algorithms, computability theory, software engineering, and computer systems.
5. **Course Plan:**

Component	Unit	Topics for Coverage
Compoent 1	Unit 1	• **Methods of Proof:** Proof by contradiction, Proof by induction. Usually in such proofs we prove statements of the kind: For all n, n 0, P(n) holds. Such a proof has two steps, proving the base of induction, and then proving the induction hypothesis, structural induction. This is applicable for entities or structures which are defined inductively, Proof by proving the contrapositive. **Logic & Proofs:** Introduction to Logic. Propositional Logic, Truth tables, Deduction, Resolution, Predicates and Quantifiers, Mathematical Proofs. Infinite sets, well-ordering. Countable and Uncountable sets, Cantors diagonalization. Mathematical Induction - weak and strong induction.
	Unit 2	• **Sets and Sequences: Data Models:** Finite Sets, Power Set, Cardinality of finite sets, Cartesian Product, Properties of Sets, Vector Implementations of Sets.
Component 2	Unit 3	• **Counting & Combinatorics:** Counting, Sum and product rule, Principle of Inclusion Exclusion. Pigeon Hole Principle, Counting by Bijections. Double Counting. Linear Recurrence relations - methods of solutions. Generating Functions. Permutations and counting.
	Unit 4	• **Relations & Graphs:** Relations, Equivalence Relations. Functions, Bijections. Binary relations and Graphs. Trees (Basics). Posets and Lattices, Hasse Diagrams. Boolean Algebra.

6. **Text Book:** Discrete Mathematics and its Applications, Kenneth H. Rosen, 7th Edition -Tata McGraw Hill Publishers, 2011.
7. **References:**
   - Mathematics for Computer Science, Eric Lehman; F Thomson Leighton; Albert R Meyer, 2010.
   - Logic in Computer Science, Huth and Ryan, Cambridge University Press, 2014.

1. **Name of the Course: Univariate and Multivariable Calculus**
2. **LTP structure of the course:** 3-1-0
3. **Objective of the course:** Develop a solid understanding of infinite sequences and series, understand the concept of limit, continuity and differentiability of functions of single and multivariable, understand partial derivatives, directional derivatives of several variable function, rectangular, cylindrical and spherical coordinates systems, Multiple integrals, vector fields.
4. **Outcome of the course:** To Compute limits and derivatives of functions, Apply the Fundamental Theorem of Calculus, Distinguish between the concepts of sequence and series, and determine limits of sequences and convergence and approximate sums of series, and define, differentiate, and integrate functions represented using power series expansions, including Taylor series, Compute limits and derivatives of functions of two and three variables, solve constraint problems using Lagrange multipliers, Evaluate double and triple integrals for area and volume.
5. **Course Plan:**

Component	Unit	Topics for Coverage
Component 1	Unit 1	The Real Number System, Convergence of a Sequence, Monotone Sequences, Cauchy Criterion, Bolzano-Weierstrass Theorem, Continuity and Limits, Existence of Maxima, Intermediate Value Property, Differentiabilty, Mean Value Theorem, Sufficient Conditions for Local Maximum, Point of Inflection
	Unit 2	Taylor's Theorem, Infinite Series, Convergence Tests, Leibniz's Theorem, Power Series, Taylor Series, Riemann Integration, Fundamental Theorems of Calculus, Riemann Sum, Improper Integrals, Area Between Two Curves, Polar Coordinates, Volume of Solids, Length of a plane curve, Areas of Surfaces of Revolution, Calculus of Vector Valued Functions
Component 2	Unit 3	Functions of Several Variables, Directional Derivatives, Gradient, MVT, Maxima, Minima, Second Derivative Test, Lagrange Multiplier Method,
	Unit 4	Multiple integrals, Line and Surface integrals, Green's Theorem , Stokes' Theorem, The Divergence Theorem

6. **Text Book:** G. B. Thomas, M. D. Weir. J. Hass, and F. Giordano, Thomas' Calculus, Pearson.
7. **References Books:**
   1. T. M. Apostol, Calculus, Vol. 1, Wiley.
   2. T. M. Apostol, Calculus, Vol. 2, Wiley.

1. **Name of the Course: Computer Organization and Architecture**
2. **LTP structure of the course:** 2-1-1
3. **Objective of the course:** A student should grasp the basic concepts of computer arch itecture and organization, and understand the key skills of constructing cost-effective computer systems. A student should learn how to quantitatively evaluate different designs and organizations, and provide quantitative arguments in evaluating different designs. A student should be able to articulate design issues in the development of processor or other components that satisfy design requirements and objectives. In addition, a student should experience use of design tools to model various alternatives in computer design
4. **Outcome of the course:**
   Understand the merits and pitfalls in computer performance measurements; Understand the design process of a computer and critical elements in each step; Understand memory hierarchy and its impact on computer cost/performance; Understand alternatives in cache design and their impacts on cost/performance Understand the impact of instruction set architecture on cost-performance of computer design; Understand contemporary microprocessor designs and identify various design techniques employed; Use a set of hardware simulators to model a complex processor at the behavioral level; Use tools for modeling various microprocessor design alternatives
5. **Course Plan:**

Component	Unit	Topics for Coverage
Component 1	Unit 1	Basic functional blocks of a computer: CPU, memory, input-output subsystems, control unit. Memory system design: semiconductor memory technologies, memory organization. Data representation: signed number representation, fixed and floating point representations, character representation. Computer arithmetic - integer addition and subtraction, ripple carry adder, carry look-ahead adder, etc. multiplication - shift-and-add, Booth multiplier, carry save multiplier, etc. Division - non-restoring and restoring techniques, floating point arithmetic.
	Unit 2	Instruction set architecture of a CPU - registers, instruction execution cycle, RTL interpretation of instructions, addressing modes, instruction set. Case study - instruction set of some common CPUs.
Component 2	Unit 3	Performance enhancement techniques : Memory interleaving, concept of hierarchical memory organization, cache memory, mapping functions, replacement algorithms, write policy. Peripheral devices and their characteristics: Input-output subsystems, I/O transfers - program controlled, interrupt driven and DMA, privileged and non-privileged instructions, software interrupts and exceptions.
	Unit 4	CPU control unit design: hardwired and micro-programmed design approaches, Case study - design of a simple CPU Performance enhancement techniques Pipelining: Basic concepts of pipelining, throughput and speedup, pipeline hazards

6. Text Book:

David A. Patterson and John L. Hennessy,, Computer Organization and Design: The Hardware/Software Interface Morgan Kaufmann ARM Edition, 2010.

7. References:

i. Carl Hamachar, Zvonco Vranesic and Safwat Zaky, Computer Organization, McGraw Hill
ii. William Stallings, Computer Organization and Architecture: Designing for Performance, Pearson Education
iii. John P. Hayes , Computer Architecture and Organization, McGraw Hill
iv. Morris Mano , Computer System Architecture, Pearson Education

Course Plan for the Lab Component:

a. Familiarization with assembly language programming – using /simulators such as SPIM and ARM based emulators

b. Synthesis/design of simple data paths and controllers, processor design – using Verilog Hardware description language and FPGA board to synthesize the designs.

1. **Name of the Course: Data Structures**
2. **LTP structure of the course:** 2-1-1
3. **Objective of the course:** To teach the linear and non-linear structures in which data can be stored and their pros and cons. To appreciate the need and working of different ways of storing data. To write algorithms that make use of different data structures.
4. **Outcome of the course:** The students will learn different structures by which data can be stored, retrieved and modified. This forms the foundations for the course on algorithms and a sound knowledge is used in almost every course and project work prescribed by the institute. The course emphasizes on lab work wherein the students learn not only to make different data structures, but also their application in different synthetic problems.
5. **Course Plan:**

Component	Unit	Topics for Coverage
Component 1	Unit 1	Stacks, Queues, Linked List
	Unit 2	Recursion, Searching and Sorting
Component 2	Unit 3	Trees, Priority Queue
	Unit 4	Hashing, Graphs

6. **Text Book:**
   1. T. H. Cormen, C.E. Leiserson, R.L. Rivest, C. Stein,Introduction to Algorithms 3rd ed., PHI, New Delhi, 2009.
   2.Y. Langsam, M. J. Augenstein, A. M. Tenenbaum, Data Structures Using C and C++, PHI, New Delhi, 2001.
7. **References:**

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1. **Name of the Course: Principles of Communication Engineering**
2. **LTP structure of the course:** 2-1-1
3. **Objective of the course:** To let the 2nd Semester B. Tech. (IT) students exposed to fundamental concepts of signals, systems and the communication engineering.
4. **Outcome of the course:** The students will learn the working principles of wired digital communication systems.
5. **Course Plan:**

Component	Unit	Topics for Coverage
Component 1	Unit 1	Study of Signals, the Systems and relevant tools like Fourier Transform, Correlation theory etc.
	Unit 2	Signal Digitization and baseband transmission of digital signals
Component 2	Unit 3	Bandpass transmission of digital signals
	Unit 4	Analysis of communication systems in presence of noise

6. **Text Book:**
   1. A. B. Carlson et. al.' Communication Systems, 4th/5th Ed., McGraw Hill 2008/20012
7. **References:**
   1. B. P. Lathi et. al., Modern Digital and Analog Communication Systems 4E, Oxford Publication.

1. **Name of the Course:** Principle of Economics
2. **LTP structure of the Course:** 2-0-0
3. **Objective of the Course:** This course introduces economic analysis of individual, business, and industry choices in the market economy. Topics include the price mechanism, supply and demand, optimizing economic behavior, costs and revenue, market structures, factor markets, income distribution, market failure, and government intervention. Upon completion, students should be able to identify and evaluate consumer and business alternatives in order to achieve economic objectives efficiently.
4. **Outcome of the Course:**
   a) Understand that economics is about the allocation of scarce resources, that scarcity for ceschoice, tradeoffs exist and that every choice has an opportunity cost.
   b) List the determinants of the demand and supply for a good in a competitive market and explain how that demand and supply together determine equilibrium price.
   c) Understand the role of prices in allocating scarce resources in market economies and explain the consequences of price controls.
   d) Define an externality and a public good and why explain the presence of externalities and public goods make markets inefficient. Analyse various government policies aimed at solving these inefficiencies.
5. **Course Plan:**

Component	Unit	Lecture
Component 1	Unit 1	Introduction to Economics; Production possibilities Supply and demand analysis; The price system and the mixed economy
	Unit 2	Elasticity; Consumer choice and the theory of demand The profit-maximizing competitive firm and market supply Long-run supply in competitive markets ; Production and cost
Component 2	Unit 3	Types of Markets:Monopoly; Perfect Markets Monopolistic competition and oligopoly Antitrust policy and regulation of markets
	Unit 4	Introduction to macro Economics; Macro-Economic Equilibrium GDP; Unemployment; Inflation

1. **Text Books**
   - Principles of Economics: Gregory Mankiw
   - Economics: Samuelson

1. **Name of the Course: Probability & Statistics**
2. **LTP structure of the course:** 3-1-0
3. **Objective of the course:** This course provides an elementary introduction to probability and statistics with applications. The topics covered in this course are basic concept of probability and statistics, random variables, probability distributions, Bayesian inference, joint probability distributions, random vectors, central limit theorem, confidence intervals.
4. **Outcome of the course:** The topics covered in this course would be very much useful for the B. Tech. to develop basic understanding of the subject. This course would also provide the students the background required to apply the basic concepts of probability and statistics in handling large data, analysing noise in a system and studying stochastic processes.
5. **Course Plan:**

Component	Unit	Topics for Coverage
Component 1	Unit 1	Probability: Axiomatic definition, Properties, Conditional probability, Bayes rule and independence of events, Random Variables, Distribution function.
	Unit 2	Linear transformation, Representation of linear maps by matrices, Rank-Nullity theorem, Rank of a matrix, Row and column spaces, Solution space of a system of homogeneous and non-homogeDiscrete and Continuous random variables, Expectation, Function of random variable, Moments, Moment generating function, Chebyshev's and Morkov's inequality. Bernoulli, Binomial, Geometric, Negative binomial, Hypergeometric, Poisson, Discrete uniform, Continuous uniform, Exponential, Gamma, Normal.
Component 2	Unit 3	Random vector: Joint distributions, Marginal and conditional distributions, Moments, Independence of random variables, Covariance, Correlation, Functions of random variables.
	Unit 4	Law of Large Numbers: Weak law of large numbers, Levy's Central limit theorem (independently and identically distributed with finite variance case), Normal and Poisson approximations to Binomial, Statistics: Introduction: Population, Sample, Parameters, Point Estimation: Method of moments, Maximum likelihood estimation, Unbiasedness, Consistency, Interval Estimation: Confidence interval.

6. **Text Book:**
   1. Sheldon M. Ross, An Introduction to Probability Models, 10th Edition, Academic Press, Elsevier.
   2. Sheldon M. Ross, An Introduction to Probability and Statistics for Engineers and Scientists, 3rd Edition, Academic Press, Elsevier.
7. **References Books:**
   1. Rohatgi, V. K. and Saleh, A. K. (2000), An Introduction to Probability and Statistics, 2nd Edition, Wiley-interscience.
   2. Bertsekas, D. P. and Tsitsiklis, J. N. (2008), Introduction to Probability, Athena Scientific, Massachusetts.
   3. Montgomery, D. C., Peck, E. A. and Vining, G. G. (2012), An Introduction to Linear Regression Analysis, 5th Edition, Wiley.

1. **Name of the Course: Theory of computation**
2. **LTP structure of the course:** 2-1-1
3. **Objective of the course:** This course is about the machine construction logic. It is core computer science paper and good for system level engineers.
4. **Outcome of the course:** Students will get exposure of machine creation mechanism, language construction etc.
5. **Course Plan:**

Component	Unit	Topics for Coverage
Component 1	Unit 1	*Regular languages*
	Unit 2	*Context free languages*
Component 2	Unit 3	*Pushdown automata (PDAs)*
	Unit 4	*Turing machines*

6. **Text Book:** Mandatory for UG core courses
   a) Introduction to Automata Theory, Languages, and Computation by John E. Hopcroft , Rajeev Motwani , Jeffrey D. Ullman
7. **References:**
   a) Introduction to the theory of Computation by Michael Sipser,
   b) An Introduction to Formal Languages and Automata by Peter Linz

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1. **Name of the Course: Object Oriented Methodologies**
2. **LTP structure of the course:** 2-1-1
3. **Objective of the course:**
   - To learn the concept of Object Orientation and its applicability in modelling real life scenarios.
   - To get acquainted with UML Diagrams using software tool STARUML.
   - To understand Object Oriented Analysis Processes, and Object oriented concepts like data abstraction, encapsulation, inheritance etc.
   - To solve the real world problems using top down approach, and understand various Java programming constructs.
4. **Outcome of the course:**
   - Understand Object Oriented Software Development Process; Gain exposure to Object Oriented Methodologies & UML Diagrams; To apply Object Orientation and related advances for software projects.
5. **Course Plan:**

Component	Unit	Topics for Coverage
Component 1	Unit 1	Characteristic differences between Procedural and Object Oriented approach for programming, Concepts of Class, Objects and Object Oriented Characteristics. Building upon basic programming skills in OO, specifically using basic Java programming constructs for object oriented problem solving (e.g., Classes: Abstraction, inheritance, interfaces, polymorphism), Methods in OO Programming: Method overloading and overriding.
	Unit 2	Design and analysis of larger, more complex programs using Object Oriented Modeling with UML. Why build models of software, Why should we build comprehensive designs before coding Static and Dynamic modeling diagrams and role of Use Case Diagrams.
Component 2	Unit 3	To appreciate the role of Object orientation in problem solving and to be able to design and implement a Java program to model a real world system, and subsequently analyze its behavior. Java implementation for GUI, Event handling and Applets for Web enabled applications. Developing Applications with GUI and Database connectivity.
	Unit 4	Overview of UML for Java Programmers: Class Diagrams Object Diagrams. Sequence Diagrams, Collaboration Diagrams, Static Diagrams: Working with Diagrams and role of Modeling, Making Effective use of UML, Communicating with Others, Back end documentation What to keep, and What to throw away, Iterative Refinement Behavior, Iterative Refinement Minimalism, When to draw diagrams, and when to stop.

6. **Text Book:**
   [1] H. Schildt, Java 2 : A Complete Reference 4th ed, McGraw-Hill, 2001
   [2] G. Booch, Object-Oriented Analysis and Design with Applications 2nd Edition, PHI, New Delhi, 1993

1. **Name of the Course :** Operating System
2. **L-T-P structure of the course:** 2-1-1
3. **Objective of the course:**
   i. To understand the services provided by and the design of an operating system.
   ii. To understand the structure and organization of the file system.
   iii. To understand what a process is and how processes are synchronized and scheduled.
   iv. To understand different approaches to memory management.
   v. Students should be able to use system calls for managing processes, memory and the file system. Students should understand the data structures and algorithms used to implement an OS.
4. **Outcome of the course:**
   I. Students should demonstrate the ability to design, implement and evaluate a computer based system, process, program to meet the desired needs
   ii. students should demonstrate the ability to apply design and development principles in the construction of software systems of varying complexity
   iii. Demonstrate knowledge of system calls, process and thread management, process and thread synchronization, compare and contrast semaphore and mutex, paging and segmented memory
   iv. Students should be able to demonstrate the knowledge of file systems and use the knowledge in designing of simple file systems.
5. **Course Plan:**

Component	Unit	Topics for Coverage
Component 1	Unit 1	OS Basics : Definition, Operating Systems as resource manager, Evolution of OS, Structural overview,Types of OS; System Calls, Types of System Call, Hardware requirements: protection, context switching, privileged mode; Processes, Process Concept, Process Scheduling,Threads : Overview, Multithreading Models, Threads and their Management;CPU Scheduling : Scheduling Criteria, Scheduling Algorithms, Multiple-Processor Scheduling
	Unit 2	Process Management : Operations on Processes, Interprocess Communication; Process Synchronization : The Critical-Section Problem, Peterson's Solution, Synchronization Hardware, Monitors, Semaphores, Classic Problems of Synchronization Deadlocks : System Model, Dynamic Resource Allocation, Deadlock Characterization, Methods for Handling Deadlocks, Deadlock Prevention, Deadlock Avoidance, Deadlock Detection, Recovery From Deadlock
Component 2	Unit 3	Memory Management: Main Memory Basics, Swapping, Contiguous Memory Allocation, Paging, Structure of the Page Table, Segmentation, Basics of Virtual Memory, Demand Paging, Page Replacement, Allocation of Frames, Thrashing Storage Management : Design of IO systems, File Management, Memory Management: paging, virtual memory management, Distributed and Multiprocessor Systems, Case Studies,
	Unit 4	Directory Structure, File-System Mounting, File Sharing, File-System Structure File-System Implementation, Directory Implementation, Allocation Methods, Mass-Storage Structure, Overview of Mass-Storage, Disk Scheduling, Disk Management Case Study – xv6 operating system

6. **Text Book:**

   Abraham Silberschatz Peter B. Galvin and Greg Gagne, Operating System Concepts, Wiley 8th Edition, 2008.

7. **References:**
   i. Garry. J. Nutt, Operating Systems: A Modern Perspective, Addison-Wesley
   ii. Andrew S. Tanenbaum and Herbert Bros, Modern Operating Systems (4th Edition), Pearson
   ii. Wiiliam Stallings , Operating Systems: Internals and Design Principles, Prentice Hall of India
   iv. D. M. Dhamdhere , Operating Systems: A Concept-Based Approach, Tata McGraw-Hill
   v. Russ Cox, Frans Kaashoek, Robert Morris , xv6: a simple, Unix-like teaching operating system

Course Plan for the Lab Component:

a. Introduction to operating systems concepts, process management, memory management, file systems, virtualization, and distributed operating systems. The laboratory exercises will include familiarization with UNIX system calls for process management and inter-process communication; Experiments on process scheduling and other operating system tasks through simulation/implementation.

b. The students would require to apply the operating system concepts by experimenting on either xv6 operating systems.

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1. **Name of the Course:** Introduction to Finance
2. **LTP structure of the Course:** 2-0-0
3. **Objective of the Course:** This course is a rigorous introduction to the study of the basic principles of finance and their application to the usual financial issues and decision-making of business enterprises. The main objective of this course is for the student to obtain at least a good working-knowledge of the topics stated in the tentative course outline below for use in future courses and for careers.
4. **Outcome of the Course:**
   - Identify the objective of the firm and the role of managerial finance.
   - Outline the implications of the separation of ownership and control.
   - Evaluate financial statements using ratio analysis.
   - Explain the general concept of valuing financial assets.
   - Explain the characteristics of debt and equity securities.
   - Identify why firms need to invest in working capital
   - Outline the alternative sources of long-terms fund
5. **Course Plan:**

Component	Unit	Lecture
Component 1	Unit 1	Introduction to financial management;Financial statements basics Ratio analysis
	Unit 2	Time value of money; Capital Budgeting; Relationship between risk and return.
Component 2	Unit 3	Long-term financing decisions; Working Capital Management; Dividend Decision
	Unit 4	Introduction to financial system; Capital Markets; Introduction to International finance and risk management

1. **Text Books**

   - Ross, Westerfield, Jordan, *Essentials of Corporate Finance*
   - James C. Van Horne and John M Wachowicz, *Fundamentals of financial management*
   - Jonathan Berk, *Financial Management*

Course Syllabus: Introduction to Marketing

1. **Name of the Course: Introduction to Marketing**
2. **LTP structure of the course:** 1-0-1
3. **Objective of the course:** To teach the basics of Marketing Management to students from Different streams.
4. **Outcome of the course:** Make the students excel in Practical world of Business Environment.
5. **Course Plan:**

Component	Unit	Topics for Coverage
Component 1	Unit 1	Introduction to Marketing, Marketing Environment.
	Unit 2	Market Segmentation, Market Targeting- Introduction, Procedure.
Component 2	Unit 3	Product Positioning, Consumer Behavior Marketing Mix Decisions, New Product Development. Branding & Packaging Decisions, Product Life cycles. Pricing Decisions, Management of Channels, Retail Distribution system in India.
	Unit 4	Promotion Mix, Marketing of Services, Rural Marketing, CRM, Electronic Marketing, International Marketing.

6. Text Book:

- Kotler Philip, Keller Kevin Lane, Koshy Abraham & JHA Mithileshwar- - Marketing Management: A south Asian Perspective (Pear sons Education 12th Edition).

7. References:

- Kotler Philip- Marketing Management, Analysis, Planning, Implementations & Control (Pear sons Education 12th Edition).
- Stanton William J- Fundamentals of Marketing (MC Graw Hill)
- Kotler, Philip and Armstrong Graw- Principles of Marketing (Pearson Education, 11th Edition)
- Kurtz & Boone Principles of Marketing (Thomas India Edition, 2007)

Indian Institute of Information Technology, Allahabad
Department of Information Technology
B.Tech. ECE curriculum
(2022 Batch)

Total Credit : 161

Semester 1 Total Credit : 20					
Sl.No.	Course Name	Code	Type	Credit	L-T-P
1	Physics		Core	4	2–1–1
2	Linear Algebra		Core	4	3–1–0
3	Introduction to Programming		Core	4	2–1–1
4	Fundamentals of Electrical & Electronics Engg.		Core	4	2–1–1
5	Professional Communication		Core	2	1–0–1
6	Principles of Management		Core	2	1–1–0
					11–10–08
Total				20	29

Semester 2 Total Credit : 22					
Sl.No.	Course Name	Code	Type	Credit	L-T-P
1	Univariate and Multivariate Calculus		Core	4	3–1–0
2	Digital System Design		Core	4	2–1–1
3	Data Structures		Core	4	2–1–1
4	Electronic Devices and Circuits		Core	4	2–1–1
5	Electromagnetic Field and Waves		Core	4	3–1–0
6	Electronic Workshop		Core	2	0–0–2
					12–10–10
Total				22	32

Semester 3 Total Credit : 22					
Sl.No.	Course Name	Code	Type	Credit	L-T-P
1	Analog Communication		Hard	4	2–1–1
2	Analog Electronics		Hard	4	2–1–1
3	Electrical Engineering		Hard	3	2-0-1
4	Electronics Measurement and Instrumentation		Hard	3	2–0–1
5	Micro Processor Interface and Programming		Hard	4	2–1–1
6	Probability and Statistics		Hard	4	3-1-0
					13–08–10
Total				22	31

B.Tech. ECE 2022 Batch

Semester 4				**Total Credit: 21**	
Sl. No.	Course Name	Code	Type	Credit	L-T-P
1	Discrete Time Signals and Systems		PCC	3	3-0-0-0
2	Control Systems		PCC	4	3-0-2-0
3	Digital IC Design		PCC	4	3-0-2-0
4	Integrated Circuit Technology		PCC	3	3-0-0-0
5	Antenna and Wave Propagation		PCC	4	3-0-2-0
6	Multi-Disciplinary Minor-1		MDM	3	3-0-0-0
				Total Credit 21	**18-0-06-0 24**

Exit: After successful completion of 4 semesters, a student may get an exit option as per ordinance. They need to do ***two courses*** before exit.

Sl. No.	Course Name	Code	Type	Credit	Hours L-T-P-S
1	Embedded System Design	PC-EC-ESD317	PCC	3	2–0–2-0
2	Mobile and Wireless Communication	PC-EC-MWC318	PCC	3	2-0-2-0

Semester 5					**Total Credit: 21**
Sl. No.	Course Name	Code	Type	Credit	Hours L-T-P-S
1	Embedded System Design	PC-EC-ESD317	PCC	3	2–0–2-0
2	Optical Communication	PC-EC-OPC319	PCC	3	2–0–2-0
3	Microwave Engineering	PC-EC-MWE315	PCC	3	2–0–2-0
4	Digital Communication	PC-EC-DCO316	PCC	3	3–0–0-0
5	Computer Networks		PCC	3	2–0–2-0
6	Multi-Disciplinary Minor-2	MD-xx-XXX303	MDM	3	3–0–0-0
7	Design Thinking and Innovation	HM-MS-DTI306	HSMC (AEC)	2	1-0-2-0
	SMT Workshop		VSEC	1	0-0-2-0
			Total	**21**	**17-0-12-0** **29**

Semester 6					**Total Credit: 20**
Sl. No.	Course Name	Code	Type	Credit	Hours L-T-P-S
1	Digital Signal Processing	PC-EC-DSP313	PCC	4	3–0–2-0
2	Mobile and Wireless Communication	PC-EC-MWC318	PCC	4	3–0–2-0
3	Program Elective-I	PE-EC-xxx301	PEC	3	2–0–2-0
4	Project	PP-EC-PRJ301	VSEC	4	0-0-8-0
5	Multi-Disciplinary Minor-3	MD-xx-XXX304	MDM	3	3–0–0-0
6	Indian/Foreign Language Regional Language, Sanskrit, German, Japanese, French	HM-xx-XXX304	HSMC (AEC)	2	1-0-2-0
			Total	**20**	**12-0-16-0** **28**

Exit: After successful completion of 6 semesters, a student any get an exit option as per ordinance. They need to do two courses before exit.

Sl. No.	Course Name	Code	Type	Credit	L-T-P-S
1	Skill based Elective – I		PCC	3	2-0-2-0
2	Skill based Elective - II		PCC	3	2-0-2-0

Summer Semester					**Total Credit: 3**
Sl. No.	Course Name	Code	Type	Credit	
1	Internship	PC-EC-ITP353	ELC	3	Credit will be added in VII Sem.

Note: Internship will be evaluated in the beginning of seventh semester. Its credit and grades will be reflected in the 7th Semester Grade Sheet.

Semester 7					**Total Credit: 21**
Sl. No.	Course Name	Code	Type	Credit	Hours L-T-P-S
1	Program Elective-II	PE-EC-xxx403	PEC	3	3–0–0-0
2	Program Elective-III	PE-EC-xxx404	PEC	3	3–0–0-0
3	Open Elective-I	OE-xx-xxx4xx	OEC	3	3-0-0-0
4	Multi-Disciplinary Minor-4	MD-xx-XXX405	MDM	3	3–0–0-0
5	*a) History of Indian Civilizations, b) Kautilya's Arthashastra, c) Vedic Mathematics, d) Vedic Corpus, e) Wisdom from the Ages, f) Panini's Grammar*	HM-MS-XXX08	HSMC (IKS)	2	2–0-0-0
6	Internship (Summer Semester)	PC-EC-ITP353	ELC	3	0-0-0-6
7	Mini Project		PEC	4	0-0-8-0
			Total	**21**	**14-0-8-6** **22+6**

Semester 8					**Total Credit: 14**
Sl. No.	Course Name	Code	Type	Credit	Hours L-T-P-S
1	Major Project	PP-EC-PRJ403	ELC	8	0–0-16-0
2	*Program Elective-IV	PE-EC-xxx405	PEC	3	0–0–0-3
3	*Multi-Disciplinary Minor-5	MD-xx-XXX405	MDM	3	3–0–0-0
			Total	**14**	**3-0-16-6** **25**

*8th Semester courses may be allowed to join via MOOC/NPTEL etc.

Honors:

- "Honors" is an additional credential, a student will earn if he/she opts for the extra 15 credits needed for this in his/her own discipline. The concerned department specifies the course requirements for earning the Honors.
- B.Tech.-ECE-Honor Course: Minimum 8 CGPI and No backlog.
- After 3rd Semester, students may choose extra credits for Honors.
- The 8th Semester project must be an academic project. At least one research publication in Tier I/II conferences or in SCI Journals communicated or one patent filed.

1. Name of the Course: Physics

2. LTP structure of the course: 2-1-1

3. Objective of the course: To let the first year B. Tech. (IT) students exposed to basic laws of nature and to demonstrate their application on physical systems and technical devices.

4. Outcome of the course: The students will learn how to handle dynamics of simple systems like point particle. They will also learn how to handle systems with constraints with the aid of powerful analytical treatment developed by Lagrange and Hamilton.

5. Course Plan:

Component	Unit	Topics for Coverage	Chapter No.(Optional)
Component 1	1	**Classical Mechanics:** Revisiting Newton's laws of motion; Calculus of Variations.	
	2	**Hamiltons Principle**; Hamilton's equations, Wave and Group Velocities,	
Component 2	3	**Heisenberg Uncertainty Principle**, Expectation Values.	
	4	**Schrodinger Equation and its Simple Applications** - Electron in periodic potential and band structure of solids	

6. Text Book:

Classical Mechanics:

1. Introduction to Mechanics; Kleppner and Kolenkow.
2. Classical Mechanics; H. Goldstein, C. Poole, J. Safko.

Quantum Mechanics:

1. Introduction to Quantum Mechanics by D . J. Griths Modern Quantum Mechanics by J. J. Sakurai
2. Modern Physics by A. Beiser.

7. References:

1. L.D. Landau and E.M. Lifshitz, Mechanics. Theoretical Mechanics by M. Spiegel.
2. Feynman Lectures of Physics Vol-1 and Vol-3.
3. Quantum Physics for Atoms, Molecules, Solids, Nuclei and Particles by R Eisberg and R. Resnick.

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1. Name of the Course: Linear Algebra

2. **LTP structure of the course:** 3-1-0

3. **Objective of the course:** Solving systems of linear equations, Understanding vector spaces, linear transformations, eigenvalue, eigenvector, generalized notion of angle, distance, and length, diagonalization and orthogonalization.

4.**Outcome of the course:** To able to solve systems of linear equations, work within vector spaces, to manipulate matrices and to do matrix algebra.

5. **Course Plan:**

Component	Unit	Topics for Coverage
Component 1	Unit 1	**System of linear equation**, Gauss elimination method. Linearly independence and Basis, Dimension
	Unit 2	**Linear transformation**, Representation of linear maps by matrices, Rank-Nullity theorem, Rank of a matrix, Cauchy-Schwartz inequality, Orthogonal basis,
Component 2	Unit 3	**Grahm-Schmidt orthogonalization process**, Orthogonal projection, Eigen value, and minimal polynomial, Spectral theorem,
	Unit 4	**Positive, negative and semi definite matrices**. Decomposition of the matrix in terms of projections, Primary decomposition theorem, Jordan canonical form

6. **Text Book:** Gilbert Strang, Linear Algebra, Cambridge Press.

7. **References Books:**

1. K. Hoffman and R. Kunze, Linear Algebra, Pearson.
2. S. Kumaresan, Linear algebra - A Geometric approach, Prentice Hall of India.
3. S. Lang, Introduction to Linear Algebra, Springer

1. Name of the Course: Introduction to Programming

2. LTP structure of the course: 2 1:1

3. Objective of the course: The purpose of this course is to provide the basic knowledge of C programming

4. Outcome of the course: The students will be able to program in C language with basic programming abilities

5. Course Plan: As per the below format only

Component	Unit	Topics for Coverage	Chapter No.(Optional)
Component 1	Unit 1	**Pseudocode, data types**-single precision floating point, bitwise operators,conversions, if-else condition, do-while loop.	
	Unit 2	**Functions** 1-d arrays, Strings, 2-d arrays, structure and union, pointers, header files.	
Component 2	Unit 3	**Pointers to pointers and pointers to functions**, Pre-processor directives and macros, I/O handling.	
	Unit 4	**Dynamic memory allocation**- Linked lists, Command line arguments, Standard libraries	

6. Text Book:

1. Programming in ANSI C, 7th Edition by E. Balagurusami, TMH
2. Let Us C, 15th Edition by YashwantKanetkar, BPB Publication

7. References:

1. The C Programming Language, 2nd Edition By Brian W. Kernighan, Dennis M. Ritchie, PHI

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1. Name of the Course: Fundamentals of Electrical and Electronics Engineering

2. LTP structure of the course: 2:1:1

3. Objective of the course: This course is intended to be the text for a first course in electronics engineering. It is partitioned into four parts circuits, electronics, digital systems, and electro-mechanics. Although many topics are covered in each of these parts, the syllabus is more than just a survey of the basics of electrical engineering.

4. Outcome of the course: To provide an overall picture and working principles of electronics and electrical devices. The students will understand the working principles of network theorems, AC circuits, Transformers, Electrical Motors and simple semiconductor diode circuits.

5. Course Plan: As per the below format only

Component	Unit	**Topics for Coverage**	Chapter No.(Optional)
Component 1	Unit 1	**Network Theorems**: Network graphs and matrices, Transient and Steady-State Analysis, theorem.	
	Unit 2	**DC and AC circuits**, Transformer, Transformers, Rotating coil devices	
Component 2	Unit 3	**Semiconductor Diodes**: Semiconductors, Junction diode Zener diodes, Simple circuits	
	Unit 4	**Introduction to Logic Circuits:** Boolean Algebra, Simple gates, Boolean Theorems.	

6. Text Book:

1. Fundamentals of Electrical Engineering, Leonard S Bobrow, 2nd Edition, Oxford Press.
2. Fundamentals of Electrical Engineering and Electronics, B L Thereja, S Chand Press.

7. References:

1. Network Analysis, M E van Valkenberg, 3rd Edition, PHI, 2000
2. Linear Circuit Analysis: Time, Domain, Phasor and Laplace Transform Approaches, R A DeCarlo and 3. 3. M Lin, 2nd Edition, Oxford University Press, 2000.

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1. Name of the Course: Professional Communication
2. LTP structure of the course: 1-0-1
3. Objective of the course: The focus of the course is to engage and involve students with hands on situation and solve problems on regular basis.
4. Outcome of the course: The course is designed to enhance and polish communication skills of undergraduate students which will formally help them to be effective professionals by understanding importance of effective communication, presentation and designing of work.
5. Course Plan: As per the below format only

Component	Unit	Topics for Coverage
Component 1	Unit 1 & Unit 2	**Introduction to Types of communication** Speech and diction correction and counseling Formal communication I. Cover letter II. CV preparation III. Group discussion IV. Personal interview V. Report writing VI. Proposal development (Product development plan)
Component 2	Unit 3	**Interview types and techniques** I. Role play II. Moderation and intervention techniques III. SWOT Analysis

6. Lab Exercises to be done in LAB Session.
7. References:
1. Winning at Interviews by Edgar Thorpe

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1. Name of the Course: Principles of Management
2. LTP structure of the course: 1-1-0
3. Objective of the course: This course is designed to be an overview of the major functions of management. It explores how organizations develop and maintain competitive advantage within a changing business environment. Upon completion, students should be able to work as contributing members of a team utilizing these functions of management.
4. **Outcome of the course:** Explain how organizations adapt to an uncertain environment and identify techniques managers use to influence and control the internal environment. Practice the process of management's four functions: planning, organizing, leading, and controlling.
5. Course Plan: As per the below format only

Component	Unit	Topics for Coverage
Component 1	Unit 1	**Nature and Functions of Management** - Importance and Process of Management - Development of Management Thoughts - Managerial Roles
	Unit 2	**International Business and its Environment**- Globalization &WTO-. Dynamics of development Global business environment-. Internal Tech. of Forecasting.
Component 2	Unit 3	**Need for Organization** - Principles and Process of Organizing – Authority, Delegation and Decentralization
	Unit 4	**Staffing and Directing** Requirement of Effective Direction

6. Text Book: Mandatory for UG core courses
1. Koontz, Weihrich, Aryasri. Principles of Management, TATA McGraw Hill, New Delhi, 2004.

7. References:
1. P. C. Tripathi, P. N. Reddy, Principles of Management, Tata McGraw-Hill Publishing Company Limited, New Delhi.
2. Prasad LM, Principles and Practice of Management, Sultan Chand & Sons, New Delhi.
3. Samuel C. Certo, S. TrevisCerto, Modern management 10 Ed, PHI Learning, New Delhi, 2008
4. James A. Stoner, Edward Freeman, Daniel Gilbert, Management, PHI Learning, New Delhi, 2007
5. Williams/ Kulshrestha, Principles of Management, Cengage Learning, New Delhi, 2011

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1. Name of the Course: Univariate and Multivariable Calculus

2. LTP structure of the course: 3-1-0

3. Objective of the course: Develop a solid understanding of infinite sequences and series, understand the concept of limit, continuity and differentiability of functions of single and multivariable, understand partial derivatives, directional derivatives of several variable function, rectangular, cylindrical and spherical coordinates systems, Multiple integrals, vector fields.

4. Outcome of the course: To Compute limits and derivatives of functions, Apply the Fundamental Theorem of Calculus, Distinguish between the concepts of sequence and series, and determine limits of sequences and convergence and approximate sums of series, and define, differentiate, and integrate functions represented using power series expansions, including Taylor series,

5. Course Plan:

Component	Unit	Topics for Coverage
Component 1	Unit 1	**The Real Number System**, Convergence of a Sequence, Sufficient Conditions for Local Maximum, Point of Inflection
	Unit 2	**Taylor's Theorem,** Infinite Series, Convergence Tests, Leibniz's Theorem, , Calculus of Vector Valued Functions
Component 2	Unit 3	**Functions of Several Variables**, Directional Derivatives, Gradient, MVT, Maxima, Minima, Second Derivative Test, Lagrange Multiplier Method,
	Unit 4	**Multiple integrals**, Line and Surface integrals, Green's Theorem , Stokes' Theorem, The Divergence Theorem

6. **Text Book:** G. B. Thomas, M. D. Weir. J. Hass, and F. Giordano, Thomas' Calculus, Pearson.

7. **References Books:**

1. T. M. Apostol, Calculus, Vol. 1, Wiley.
2. T. M. Apostol, Calculus, Vol. 2, Wiley.

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1. Name of the Course: Digital System Design

2. LTP structure of the course: 2:1:1

3. Objective of the course: This course is designed for the students seeking an extensive understanding of digital electronics and system design and problem solving techniques. It is partitioned into four parts.

4. Outcome of the course: After completion of this course, the student will be independent to drill any real world problems in this subject and appear in any challenging competitive exams.

5. Course Plan: As per the below format only

Component	Unit	Topics for Coverage	Chapter No. (Optional)
Component 1	Unit 1	**Pulse circuits:** Switching times &behavior of transistors – symmetrical/ asymmetrical triggering bi/monostable - astable.	
	Unit 2	**Combinational Logic Design:** Multiplexers and De-multiplexers, Binary Adders, Subtraction and Multiplication.	
Component 2	Unit 3	**Sequential Network:** Concepts of Sequential Networks, Analysis, Counters and Shift Registers, state machine**.**	
	Unit 4	**Memory Elements and Arrays** Registers, RAM and ROMs, programmable logic array, Memories. Data Converters	

6. Text Book:

1. M. Morris Mano, Digital Design, 2000.
2. M. Morris Mano, Digital Logic and Computer Design, 2004.
3. N. Balabanian, and B. Carlson, Digital Logic Design Principles, JohnWiley& Sons, 1998.
4. A.P.Malvino, and D.P.Leach, Digital Principles and Applications, 6th Ed., Tata McGraw Hill, 2008.
5. T.L.Floyd, Digital Fundamentals, 8th Ed., Pearson Education, 2000.

7. References Books:

1. J.F. Wakerly Digital design, Pearson Edu., 2000.

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1. **Name of the Course**: Data Structures
2**. LTP structure of the course**: 2-1-1
3. Objective of the course: To teach the linear and non-linear structures in which data can be stored and their pros and cons. To appreciate the need and working of different ways of storing data. To write algorithms that make use of different data structures.

4. Outcome of the course: The students will learn different structures by which data can be stored, retrieved and modified. This forms the foundations for the course on algorithms and a sound knowledge is used in almost every course and project work prescribed by the institute. The course emphasizes on lab work wherein the students learn not only to make different data structures, but also their application in different synthetic problems.
5. Course Plan: As per the below format only

Component	Unit	Topics for Coverage	Chapter No.(Optional)
Component 1	Unit 1	Stacks, Queues, Linked List	
	Unit 2	Recursion, Searching and Sorting	
Component 2	Unit 3	Trees, Priority Queue	
	Unit 4	Hashing, Graphs	

6. Text Books/Reference:-:
1. T. H. Cormen, C.E. Leiserson, R.L. Rivest, C. Stein,Introduction to Algorithms 3rd ed., PHI, New Delhi, 2009.
2.Y. Langsam, M. J. Augenstein, A. M. Tenenbaum, Data Structures Using C and C++, PHI, New Delhi, 2001.

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1. Name of the Course: Electronic Devices and Circuits

2. LTP structure of the course: 2:1:1
3. Objective of the course: This course is designed for the students seeking an extensive understanding of electronic devices and circuits and problem solving techniques. Being a freshman and a core course in electronics engineering, the lucidity is maintained throughout. It is partitioned into four parts semiconductor diodes, bipolar junction transistors, MOSFET and their small signal analysis.
4. Outcome of the course: After completion of this course, the student will be independent to drill any real world problems in this subject and appear in any challenging competitive exams.
5. Course Plan: As per the below format only

Component	Unit	Topics for Coverage	Chapter No.(Optional)
Component 1	Unit 1	**Semiconductor Diodes& Circuits:** Physical operation of p-n junction diodes, Light emitting diodes, photo diode, circuits	
	Unit 2	**Small Signal and Large Signal Analysis of BJTs:** Small & Large Signal Analysis of CE,CB,CC Multistage Amp.	
Component 2	Unit 3	**MOSFETs:** Energy band diagrams, Flat-band pinch-off voltage, JFET, Complementary MOS (CMOS), V-I Characteristics.	
	Unit 4	**Small Signal &Large Signal Analysis of FETs:** Small Signal & Large Signal Analysis of CS, CD, Multistage.	

6. Text Book:
1. Sedra, K. Carless Smith Microelectronics, , 7thEdition, Oxford University.
2. Integrated Electronics, J Milllman and C Halkias, TMH Press.

1. Name of the Course: Electromagnetic Field and Waves

2. LTP structure of the course: 3-1-0

3. Objective of the course: To let the Second Semester B. Tech. (ECE) students exposed to basic laws of Electromagnetism and to demonstrate their application on RF Communication.

4. Outcome of the course: The students will learn how to handle the RF Communication

5. Course Plan: As per the below format only

Component	Unit	Topics for Coverage	Chapter No.(Optional)
Component 1	Unit 1	**Introduction to Vector Analysis**, Electrostatics and Magnetostatics	
	Unit 2	**Time-Varying Fields** and Maxwell's Equations	
Component 2	Unit 3	**Uniform Plane Waves**	
	Unit 4	**Transmission Lines** and Smith Chart	

6. Text Book:

1. D.K. Cheng,Field and Wave Electromagnetic, 2nd Ed., Welsley Publishing Company, 1989.

7. References:

1. J. A. Edminister, Electromagnetics, Schaum's Outline Series, 1998.
2. W H Hayt and J A Buck, Engineering Electromagnetics, Oxford University Press, 2000

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1. Name of the Course: Electronic Workshop

2. LTP structure of the course: 0:0:2

3. Objective of the course: To let the students exposed to basic of **Electronic Workshop**

4. Outcome of the course: The students will learn PCB design and other aspects of electronic workshop

5. Course Plan: Will be announced in the lab.

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1. Name of the Course: Analog Communication
2. LTP structure of the course: 2:1:1
3. Objective of the course: To let the students exposed to basic of communication Engineering
4. Outcome of the course: The students will learn analog communication and design aspects of Communication
5. **Course Plan:**

Component	Unit	**Topics for Coverage**	Chapter No.(Optional)
Component 1	Unit 1	**Continuous Time Signals** and Systems	
	Unit 2	**Analog Baseband** and Bandpass Transmissions	
Component 2	Unit 3	**Analog to digital conversion**	
	Unit 4	**Noise and its implications** on the analog Communication systems	

6. Text Book/References:
A B Carlson, Communication, Pearson, 2000
B P Lathi and Z. Ding, Modern Analog and Digital Communication Systems, Oxford Press, 2002.

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1. Name of the Course: Analog Electronics
2. LTP structure of the course: 2-1-1
3. Objective of the course: The goal of this syllabus, as its name implies, is to allow the reader to become proficient in the analysis and design of circuits utilizing modern linear ICs.
4. Outcome of the course: After completion of this course, the student will be independent to drill any real world problems in this subject and appear in any challenging competitive exams.
5. Course Plan: As per the below format only

Component	Unit	**Topics for Coverage**	Chapter No.(Optional)
Component 1	Unit 1	**General feedback structure**, Types, Properties of negative feedback, Barkhausen criterion, Oscillators.	
	Unit 2	**Differential Amplifier,** passive and active current mirror circuits, Ideal Op-Amp, Characteristics and application	
Component 2	Unit 3	**Op-amp as Instrumentation amplifier**, Summing amplifier, Integrator, Differentiator, filters.	
	Unit 4	**555 Timer IC** and applications, PLL.	

6. Text Book:
1. J Millman and C Halkies, Integrated Electronics by, TMH Press, 1995.
2. J Millman and AGrabel, 2nd Edition, Microelectronics, 1998.
3. R Gregorian, Introduction to CMOS Op-Amp and Comparators",John Wiley & Sons. 1999
4. P R Gray, P T Hurst, S H Lewis and R G Meyer, "Analysis and Design of Analog Integrated Circuits", 4th Ed., John Wiley & Sons. 2001
5. R Gayakwad, "Op-amp and Linear Integrated Circuits", 4th Ed.,Pearson Education.2005
6. R F Coughline, and F F Driscoll, "Operational Amplifier and Linear Integrated Circuits", 6th Ed., Prentice-Hall of India.2002
7. W D Stanley, "Operational Amplifier with Linear Integrated Circuits", 3rd Ed., Merril.1993

7. References:
1. J M Fiore,Operational Amplifiers & Linear Integrated Circuits: Theory and Application Theory and Applications, Cambridge U Press, 2003

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1. Name of the Course: Electrical Engineering
2. LTP structure of the course: 2-0-1
3. Objective of the course: To expose them to basics of electrical engineering.
4. Outcome of the course: Students will be able to understand basic of electrical system. How they can and analyse, design and build any electrical system. They will be able to understand the basic function of basic electrical machines and equipment.
5. Course Plan: As per the below format only

Component	Unit	**Topics for Coverage**	Chapter No.(Optional)
Component 1	Unit 1	**Introduction to power systems**, Transformer analysis, Concept of AC and DC transmission	
	Unit 2	**3-phase systems:** Three phase voltages and currents, Delta connection, Three phase, Power measurement methods.	
Component 2	Unit 3	**Magnetic Circuits:** Electricity and Magnetism and force, flux density, field intensity, Electromechanical Energy Conversion	
	Unit 4	**Introduction to Electric Machines:** DC& AC Machines, DC Generators, DC Motors, Alternator, Power Amplifiers	

6. Text Book:
1. A. E. FitzgeraidCKingsley and AKusko, Electric Machinery,6th Ed., McGraw-Hill International Book Company.2008
2. G.K. Dubey, Fundamentals of Electrical Drives, Cambridge U Press, 2000
3. M. G.Say and E. O.Taylor, Direct Current Machines, 3rd Ed.,ELBS and Pitman.1986
4. I. J.Nagrath and D. P. Kothari, Electrical Machines, 3rd Ed., TataMcGraw-Hill Publishing Company Limited.2008.

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1. Name of the Course: Electronics Measurement and Instrumentation
2. LTP structure of the course: 2-0-1
3. Objective of the course: To introduce them to the basics of measuring instruments. To make them aware of working and practical application of instruments. They will be exposed to sensors.
4. Outcome of the course: They will be able to understand the working principle of various instruments. That will help to make better use of measuring instruments. They will be able to use different kind of sensor. How to select a suitable measuring instrument for the any measurement. They want to build sensor for measurement they will be able to select proper material according to the need or system.
5. Course Plan: As per the below format only

Component	Unit	**Topics for Coverage**	Chapter No.(Optional)
Component 1	Unit 1	**Theory Of Errors**:Accuracy& precision, Systematic & random errors Modeling of errors, Combination of errors.	
	Unit 2	**Electronic Instruments**: Voltmeters, Shielding & grounding, CTPT. **Oscilloscopes**: Construction, working, Types of Oscilloscope.	
Component 2	Unit 3	**Signal Generation and measurement techniques**: Sine wave generators, Harmonic distortion analyzer, Spectrum analyzer.	
	Unit 4	**Transducers** Classification, Selection Criteria, Characteristics, Construction, Application of following of different transducers.	

6. Text Book:
1. A.K. Sawhney, PuneetSawhney,A Course In Electrical And Electronic Measurements And Instrumentation, DhanpatRai Publications, 2012
2. H. S. Kalsi, Electronic Instrumentation,3 edition, McGraw Hill Education, 2017

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1. Name of the Course: Microprocessor Interface and Programming
2. LTP structure of the course: 2-1-1
3. Objective of the course: To demonstrate an understanding of the fundamental properties of Microprocessor Interface and Programming.
4. Outcome of the course: The student will learn the basics and working of Microprocessor, its Interface and Programming
5. Course Plan: As per the below format only

Component	Unit	**Topics for Coverage**	Chapter No.(Optional)
Component 1	Unit 1	**Introduction**: fixed and floating point arithmetic, Performance enhancement techniques,	
	Unit 2	**Memory organization**, Pipelining, 8086 Architecture, Instruction Sets Minimum and Maximum mode configurations, Interrupts	
Component 2	Unit 3	**Peripherals and Interfacing**: peripherals, Programmable communication interface. DMA	
	Unit 4	**Ad Microprocessors and Microcontrollers**: Basics of Ad processors, Multiprocessors	

6. Text Book:
J L Hennessy, D A. Patterson, Computer Organization
D.V. Hall, Microprocessors and Interfacing, 3rd Edition (English) 3rd Edition, 2000.

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1. **Name of the Course: Probability & Statistics**
2. **LTP structure of the course:** 3-1-0
3. **Objective of the course:** This course provides an elementary introduction to probability and statistics with applications. The topics covered in this course are basic concept of probability and statistics, random variables, probability distributions, Bayesian inference, joint probability distributions, random vectors, central limit theorem, confidence intervals.
4. **Outcome of the course:** The topics covered in this course would be very much useful for the B. Tech. to develop basic understanding of the subject. This course would also provide the students the background required to apply the basic concepts of probability and statistics in handling large data, analysing noise in a system and studying stochastic processes.
5. **Course Plan:**

Component	Unit	**Topics for Coverage**
Component 1	Unit 1	**Probability:** Axiomatic definition, Properties, Conditional probability, Bayes rule and independence of events, Random Variables, Distribution function.
	Unit 2	**Linear transformation,** Representation of linear maps by matrices, Rank-Nullity theorem, Rank of a matrix, , Exponential, Gamma, Normal.
Component 2	Unit 3	**Random vector:** Joint distributions, Marginal and conditional distributions, Moments, Independence of random variables, Functions of random variables.
	Unit 4	**Law of Large Numbers:** Weak law of large numbers, Interval Estimation: Confidence interval.

6. **Text Book:**
1. Sheldon M. Ross, An Introduction to Probability Models, 10th Edition, Academic Press, Elsevier.
2. Sheldon M. Ross, An Introduction to Probability and Statistics for Engineers and Scientists, 3rd Edition, Academic Press, Elsevier.
7. **References Books:**
1. Rohatgi, V. K. and Saleh, A. K. (2000), *An Introduction to Probability and Statistics*, 2nd Edition, Wiley-interscience.
2. Bertsekas, D. P. and Tsitsiklis, J. N. (2008), *Introduction to Probability*, Athena Scientific, Massachusetts.
3. Montgomery, D. C., Peck, E. A. and Vining, G. G. (2012), *An Introduction to Linear Regression Analysis*, 5th Edition, Wiley.

Indian Institute of Information Technology, Allahabad
Department of Information Technology
B.Tech. IT-BIN curriculum
(2022 Batch)

Total Credit : 164

Semester 1 Total Credit : 20					
Sl.No.	Course Name	Code	Type	Credit	L-T-P
1	Physics		Core	4	2–1–1
2	Linear Algebra		Core	4	3–1–0
3	Introduction to Programming		Core	4	2–1–1
4	Fundamentals of Electrical & Electronics Engg.		Core	4	2–1–1
5	Professional Communication		Core	2	1–0–1
6	Principles of Management		Core	2	1–1–0
					11–10–08
Total				20	29

Semester 2 Total Credit : 24					
Sl.No.	Course Name	Code	Type	Credit	L-T-P
1	Discrete Mathematical Structures		Core	4	3–1–0
2	Univariate and Multivariate Calculus		Core	4	3–1–0
3	Computer Organization and Architecture		Core	4	2–1–1
4	Business Process Modeling			2	1-1-0
5	Data Structures		Core	4	2–1–1
6	Principles of Communication Engineering		Core	4	2–1–1
7	Principle of Economics		Core	2	2–0–0
					15–11–06
Total				24	32

Semester 3 Total Credit : 22					
Sl.No.	Course Name	Code	Type	Credit	L-T-P
1	Probability and Statistics		Hard	4	3–1–0
2	Theory of Computation		Hard	4	2–1–1
3	Object Oriented Methodologies		Hard	4	2–1–1
4	Operating System		Hard	4	2–1–1
5	Introduction to Finance		Hard	2	2–0–0
6	Introduction to Marketing		Hard	2	1–0–1
7	Foreign Language & Intercultural Studies*			2	1-1-0
*can be floated in Semester 4 as will depending upon students enrolments					13–10–08
Total				22	31

Semester 4				Total Credit: 23	
Sl. No.	Course Name	Code	Type	Credit	
1	Design and Analysis of Algorithms		PCC	4	3-0-2-0
2	Principles of Programming Language		PCC	3	3-0-0-0
3	Computer Networks		PCC	4	3-0-2-0
4	Software Engineering		PCC	3	2-0-2-0
5	Database Management System		PCC	4	3-0-2-0
6	Foundations of FinTech		PCC	2	1-1-0-0
7	Multi-Disciplinary Minor-1		MDM	3	3-0-0-0
			Total Credit	**23**	**18-1-8-0**
					27

Semester 5				**Total Credit: 21**	
Sl.No.	**Course Name**	**Code**	**Type**	**Credit**	**Hours**
					L-T-P-S
1	Cyber Security	PC-IT-CSE301	PCC	4	3–0–2-0
2	Introduction to Machine Learning	PC-IT-IML302	PCC	4	3–0–2-0
3	Digital Marketing	PC-BI-DMK202	PCC	3	2-1-0-0
4	Artificial Intelligence	PC-IT-AIN304	PCC	3	3–0–0-0
5	Project – I (Research Methodology)	PC-IT-PRO351	PCC	2	0–0–4-0
6	Multi-Disciplinary Minor-2	MD-xx-XXX203	MDM	3	3–0–0-0
7	*Design Thinking and innovation*	HM-MS-DT306	HSMC (AEC)	2	1-0-2-0
					15–1–10-0
			Total	**21**	**26**

Semester 6					TotalCredit:18
Sl.No.	**Course Name**	**Code**	**Type**	**Credit**	**Hours**
					L-T-P
1	Data Analytics	PC-IT-IML302	PCC	3	2–0–2-0
2	Project – II	PC-IT-PRJ352	PCC	4	0–0-8-0
3	Biology for Engineers	BS-AS-BFE301	BSC	2	2-0-0-0
4	Process Mining & Analytics	PC-BI-PM303	PCC	3	2-0-1-0
5	BI-Elective-1	PE-BI-XXX301	PEC	3	3–0–0-0
	BI-Elective-Basket: • Details appended				
6	*Multi-Disciplinary Minor-3*	MD-xx-XXX204	MDM	3	3–0–0-0
					12–0–11-0
			Total	**18**	**23**

Exit: After successful completion of 6 semesters, a student may get an exit option as per ordinance after completion of the summer semester internship (3 credits) and additional 3 credit courses in summer.

Summer Semester TotalCredit:3					
Sl.No.	**Course Name**	**Code**	**Type**	**Credit**	
1	Internship	PC-IT-ITP353	ELC	3	Credit will be added in VII Sem.

Note: Internship will be evaluated in the beginning of seventh semester. Its credit and grades will be reflected in 7th semester Grade sheet.

Semester 7					**Total Credit:24**
Sl.No.	**Course Name**	**Code**	**Type**	**Credit**	**Hours**
					L-T-P-S
1	Minor Project	PCITPRJ451	PCC	4	0–0-8-0
2	**Big Data Analytics**	PEBIXXX403	PCC	3	2–0–2-0
3	Elective-3 BI-Elective II: **IT Project Management** + IT Electives	PEITXXX404	PCC	3	3–0-0-0
4	Open Elective-1	OEZZXXX4SS	OEC	3	3–0-0-0
5	a)History of Indian Civilizations, b)Kautiliya's Arthashastra, c)Vedic Mathematics, d) Vedic Corpus, e) Wisdom from the Ages, f) Panini's Grammar	HM-MS-XXX408	HSMC (IKS)	2	2–0-0-0
6	Internship (Summer Semester)	PC-IT-TO353	ELEC	3	0-0-0-6-0
7	*Multi-Disciplinary Minor-4*	MD-xx-XXX204	MDM	3	3–0–0-0
					13–0–10-06
				Total	**21**	**29**

Semester 8					**Total Credit:15**
Sl.No.	**Course Name**	**Code**	**Type**	**Credit**	**Hours**
					L-T-P-S
1	Major Project	PC-IT-PRJ452	ELC	6	0–0–12-0
2	*Elective-4	PE-IT-XXX402	PEC	3	3-0-0-0
3	*Open Elective-2	OE-ZZ-XXX4SS	OEC	3	3-0-0-0
4	**Multi-Disciplinary Minor-5*	MD-xx-XXX204	MDM	3	3–0–0-0
					9–0–12-0
				Total	**15**	**21**

8th Semester courses may be allowed to join via MOOC/ NPTEL.

The remaining course details for the 2022 batch are available in the course details for the 2023 batch.

Course Curriculum

B.Tech. IT

"Applicable with effect from 2023 admitted batch and onwards"

Semester 1					**Total Credit: 20**
Sl. No.	Course Name	Code	Type	Credit	Hours L-T-P-S
1	Engineering Physics	AS1001	BSC	4	3-0-2-0
2	Linear Algebra	AS1002	BSC	4	3-1-0-0
3	Problem Solving with Programming	IT1001	ESC/VSEC	5	3-0-4-0
4	Fundamentals of Electrical & Electronics Engineering	EC1001	ESC	4	3-0-2-0
5	Technical Communication Skills	MS1001	HSMC (AEC)	2	1-0-2-0
6	Constitution of India	MS1002	HSMC (VEC)	1	1-0-0-0
	Universal Human Values	MS1003			
	Professional Ethics	MS1004			
	Art of Living	MS1005			
			Total	**20**	**14-1-10-0** / **25**

Semester 2					**Total Credit: 20**
Sl. No.	Course Name	Code	Type	Credit	Hours L-T-P-S
1	Computer Organization and Architecture	IT1002	PCC	4	3-0-2-0
2	Data Structures and Algorithms	IT1003	PCC	4	3-0-2-0
3	Web Development	IT1004	VSEC	2	0-0-4-0
4	Discrete Mathematical Structures	IT1005	PCC	4	3-1-0-0
5	Principles of Data Communication	EC1006	ESC	3	3-0-0-0
6	Principles of Management	MS1006	HSMC (AEC)	2	1-0-2-0
7	Constitution of India	MS1002	HSMC (VEC)	1	1-0-0-0
	Environmental Studies	MS1007			
	Professional Ethics	MS1004			
	Physical Education (Sports)	MS1008			
			Total	**20**	**14-1-10-0** / **25**

Exit: After successful completion of one year (first two semesters), a student may get an exit option as per ordinance. They need to do Skill Based Courses of 6 credits additional, in summer, before exit. Department will provide a list of such courses.

Semester 3					**Total Credit: 24**
Sl. No.	Course Name	Code	Type	Credit	Hours L-T-P-S
1	Probability and Statistics	AS2001	BSC	3	2-1-0-0
2	Object Oriented Methodologies	IT2001	PCC	4	3-0-2-0
3	Theory of Computation	IT2002	PCC	3	2-1-0-0
4	Operating System	IT2003	PCC	4	3-0-2-0
5	Software Engineering	IT2004	PCC	3	2-0-2-0
6	Multi-Disciplinary Minor-1	MS2501-MS2599 AS2501-AS2599 CS2501- CS2599	MDM	3	3-0-0-0
7	Principles of Economics or Introduction to Finance	MS2001 MS2002	HSMC (AEC)	2	2-0-0-0
8	**Community Services** NCC NSS Yoga Unnat Bharat Abhiyaan Ek Bharat Shreshtha Bharat NGO Prayas Other courses	 MS1010 MS1011 MS1012 MS1013 MS1014 MS1015 MS1016 MS1017-MS1020	HSMC (CEA)	2	0-0-0-4
			Total	**24**	**16-2-10-4** **32**

Semester 4					**Total Credit: 21**
Sl. No.	Course Name	Code	Type	Credit	Hours L-T-P-S
1	Design and Analysis of Algorithms	IT2005	PCC	4	3-0-2-0
2	Principles of Programming Language	IT2006	PCC	3	3-0-0-0
3	Computer Networks	IT2007	PCC	4	3-0-2-0
4	Computer Graphics and Visualization	IT2008	PCC	3	2-0-2-0
5	Database Management System	IT2009	PCC	4	3-0-2-0
6	Multi-Disciplinary Minor-2	MS2501-MS2599 AS2501-AS2599 CS2501- CS2599	MDM	3	3-0-0-0
			Total	**21**	**17-0-08-0** **25**

Exit: After successful completion of 4 semesters, a student may get an exit option as per ordinance. They need to do ***Skill Based Courses of 6 credits***, additional, in summer, before exit. Department will provide a list of such courses.

Semester 5					**Total Credit: 22**
Sl. No.	Course Name	Code	Type	Credit	Hours L-T-P-S
1	Cyber Security	IT3001	PCC	4	3-0-2-0
2	Introduction to Machine Learning	IT3002	PCC/VSEC	4	3-0-2-0
3	Image and Video Processing	IT3003	PCC/VSEC	4	3-0-2-0
4	Artificial Intelligence	IT3004	PCC	3	2-0-2-0
5	Project-I (Research Methodology)	IT2501	ELC	2	0-0-4-0
6	Multi-Disciplinary Minor-3	MS2501-MS2599 AS2501-AS2599 CS2501- CS2599	MDM	3	3-0-0-0
7	Design Thinking and Innovation	IT3501	HSMC	2	1-0-2-0
			Total	**22**	**15-0-14-0** **29**

Semester 6					**Total Credit: 20**
Sl. No.	Course Name	Code	Type	Credit	Hours L-T-P-S
1	Data Analytics	IT3006	PCC	3	2-0-2-0
2	Project-II	IT3559	ELC	4	0-0-8-0
3	Biology for Engineers	AS1010	BSC	2	2-0-0-0
4	Elective-1 (X1 to X100)	IT5501-IT5599	PEC	3	3-0-0-0
5	Elective-2 (Y1 to Y100	IT5501-IT5599	PEC	3	3-0-0-0
6	Multi-Disciplinary Minor-4	MS2501-MS2599 AS2501-AS2599 CS2501- CS2599	MDM	3	3-0-0-0
7	**Indian language(I1-I10)**		HSMC (AEC)	2	1-0-2-0
	Sanskrit	MS1401			
	(I2-I10)	MS1402 – MS1410			
	Foreign language(F1-F10)				
	German	MS1500			
	Japanese	MS1501			
	French	MS1502			
	(F4-F10)	MS1503-MS1510			
	Regional Language(R1-R10)				
	(R1-R10)	MS1600- MS1610			
			Total	**20**	**14-0-12-0** **26**

Exit: After successful completion of 6 semesters, a student any get an exit option after completion of the summer semester internship (3 credits) and additional 3 credit courses in summer.

X1 to X99, Y1 to Y99, I1 to I10, F1 to F10 and R1 to R10 will be decided by concerned department.

Summer Semester					**Total Credit: 3**
Sl. No.	Course Name	Code	Type	Credit	
1	Internship	IT4600	ELC	3	Credit will be added in VII Sem.

Note: Internship will be evaluated in the beginning of seventh semester. Its credit and grades will be reflected in the 7th Semester Grade Sheet.

Semester 7					**Total Credit: 21**
Sl. No.	Course Name	Code	Type	Credit	Hours L-T-P-S
1	Minor Project	IT4501	ELC	4	0-0-8-0
2	Elective-3 (X1 to X100)	IT5501-IT5599	PEC	3	3-0-0-0
3	Elective-4 (Y1 to Y100	IT5501-IT5599	PEC	3	3-0-0-0
4	Open Elective-1		OEC	3	3-0-0-0
5	Multi-Disciplinary Minor-5	MS2501-MS2599 AS2501-AS2599 CS2501- CS2599	MDM	3	3-0-0-0
6	History of Indian Civilizations	MS1800	HSMC (IKS)	2	2-0-0-0
	Kautilya's Arthashastra	MS1801			
	Vedic Mathematics	MS1802			
	Vedic Corpus	MS1803			
	Wisdom from the Ages	MS1804			
	Panini's Grammar	MS1805			
	(X1 to X9)	MS1806 – MS1815			
7	Internship(Summer Semester)	IT4600	ELC	3	0-0-0-6
			Total	**21**	**14-0-8-6** **6+22**

Semester 8					**Total Credit: 12**
Sl. No.	Course Name	Code	Type	Credit	Hours L-T-P-S
1	Major Project	IT5601	ELC	6	0-0-12-0 0-0-0-6
2	Elective-5(X1 to X100	IT5501-IT5599	PEC	3	3-0-0-0 0-0-0-3*
3	Open Elective-2		OEC	3	3-0-0-0 0-0-0-3*
			Total	**12**	**6-0-12-0** **18**

*8th Semester courses may be allowed to join via MOOC/NPTEL etc. Major projects may be completed as Internship cum projects. MOOC/NPTEL courses start with level 4.

LIST OF ELECTIVES

Total Credit: 21					
Sl. No.	Course Name	Code	Type	Credit	Hours L-T-P-S
1	Image and Video Processing	IT5504	PEC	3	3
2	Deep Learning	IT5505	PEC	3	3
3	Probabilistic Machine Learning and Graphical Model	IT5506	PEC	3	3
4	Optimization	IT5507	PEC	3	3
5	Deep Learning	IT5508	PEC	3	3
6	Robot Motion Control	IT5509	PEC	3	3
7	Foundations of Robotics	IT5510	PEC	3	3
8	Advanced Graphics & Animation	IT5511	PEC	3	3
9	Virtual Reality	IT5512	PEC	3	3
10	Software Design & Architecture	IT5513	PEC	3	3
11	Software Requirements and Estimation	IT5514	PEC	3	3
12	Software Testing and Quality Management	IT5515	PEC	3	3
13	Data Visualization	IT5516	PEC	3	3
14	Big Data Analytics	IT5517	PEC	3	3
15	Parallel and Distributed Computing	IT5518	PEC	3	3
16	Principles of Wireless Communications	IT5519	PEC	3	3
17	Cloud and Edge Computing	IT5520	PEC	3	3
18	Embedded Systems and IoT	IT5521	PEC	3	3
19	Information Security Laws and Regulations	IT5522	PEC	3	3
20	Network Security	IT5523	PEC	3	3
21	Cyber Physical System Security	IT5524	PEC	3	3
22	Visual Recognition	IT5525	PEC	3	3
23	Computer vision	IT5526	PEC	3	3

24	Natural Language Processing	IT5527	PEC	3	3
25	Database Security	IT5528	PEC	3	3
26	Blockchain Technology	IT5529	PEC	3	3
27	Remote Sensing and GIS	IT5530	PEC	3	3
28	Social Network Analysis	IT5531	PEC	3	3
29	Generative AI and LLMs	IT5532	PEC	3	3
30	Large Language Model Conditioned Human-Robot Interactions	IT5533	PEC	3	3
31	Distributed Systems	IT5534	PEC	3	3
32	Optimization	IT5535	PEC	3	3
33	Probabilistic Graphical Models	IT5536	PEC	3	3
34	Cyber Security and Digital Forensics	IT5537	PEC	3	3
35	OMICS	AS5501	PEC	3	3
36	Data Analytics Fundamentals for Biology	AS5502	PEC	3	3
37	Scripting and Computer Environments	AS5503	PEC	3	3
38	Next-Generation Sequencing Tools and Algorithms	AS5504	PEC	3	3
39	Data Engineering for Molecular Structure Prediction	AS5505	PEC	3	3
40	Circuits and Instrumentation for Biomedical Engineering	AS5506	PEC	3	3
41	Biomechanics	AS5507	PEC	3	3
42	Biosignal Processing	AS5508	PEC	3	3
43	Mathematics and Statistics for Biology	AS5509	PEC	3	3
44	Molecular Biology	AS5510	PEC	3	3
45	Anatomy & Physiology	AS5511	PEC	3	3
46	Advanced Medical Instrumentation	AS5512	PEC	3	3
47	Biomedical Imaging	AS5513	PEC	3	3
48	Solid State Devices	EC5503	PEC	3	3

49	Testing and Verification	EC5505	PEC	3	3
50	Analog Integrated Circuit Design	EC5506	PEC	3	3
51	Advanced Digital Communication	EC5507	PEC	3	3
52	Statistical Signal Analysis	EC5508	PEC	3	3
53	Radiating Systems	EC5509	PEC	3	3
54	Introduction to Machine Learning	EC5510	PEC	3	3
55	Principles of Wireless Communications	EC5511	PEC	3	3
56	Recent Advances in Machine Learning	EC5512	PEC	3	3
57	Hardware Design Methodology	EC5513	PEC	3	3
58	Physics of Nanoscale Devices	EC5514	PEC	3	3
59	Radar & Satellite Communication	EC5515	PEC	3	3
60	Micro-electromechanical Systems	EC5516	PEC	3	3
61	Speech Processing	EC5517	PEC	3	3
62	Emerging Nanoscale Devices	EC5518	PEC	3	3
63	6G & THz Communication	EC5519	PEC	3	3
64	RF Integrated Circuit Design	EC5520	PEC	3	3

Multidisciplinary Minor

Entrepreneurship & Innovation				
Semester	**Course Code**	**Course Title**	**Credits**	**Hours**
				L-T-P-S
III	MS2501	Fundamentals of Entrepreneurship	3	2-0-2-0
IV	MS2502	Social Entrepreneurship	3	2-0-2-0
V	MS2503	Entrepreneurial Finance	3	2-1-0-0
VI	MS2504	Innovation Management	3	2-0-2-0
VII	MS2505	Managing Corporate Entrepreneurship	3	2-0-2-0
		Total	**15**	

Economics & Finance for Engineers				
Semester	**Course Code**	**Course Title**	**Credits**	**Hours**
				L-T-P-S
III	MS2506	Indian Economics	3	2-0-2-0
IV	MS2507	Money and Banking	3	2-0-2-0
V	MS2508	Economics of Business Environment	3	2-1-0-0
VI	MS2509	Start-up Economics	3	2-0-2-0
VII	MS2510	Digital Economics	3	2-0-2-0
		Total	15	

Science of Happiness				
Semester	**Course Code**	**Course Title**	**Credits**	**Hours**
				L-T-P-S
III	CS2501	Introduction to Science of Happiness	3	2-0-2-0
IV	CS2502	Understanding Domains of Happiness	3	2-0-2-0
V	CS2503	Happiness Indices	3	2-1-0-0
VI	CS2504	Assessment of happiness	3	2-0-2-0
VII	CS2505	Independent Study of Science of Happiness	3	2-0-2-0
		Total	**15**	

Biological Data Analytics				
Semester	**Course Code**	**Course Title**	**Credits**	**Hours**
				L-T-P-S
III	AS2501	Proteomics and Genomics	3	2-0-2-0
IV	AS2502	Next Generation Sequencing	3	2-0-2-0
V	AS2503	Cheminformatics for Engineers	3	2-1-0-0
VI	AS2504	Systems Biology and Modeling	3	2-0-2-0
VII	AS2505	Molecular Structure Prediction	3	2-0-2-0
		Total	**15**	

Medical Diagnostics and Therapeutic Technology				
Semester	**Course Code**	**Course Title**	**Credits**	**Hours**
				L-T-P-S
III	AS2506	Basics of Human Anatomy & Physiology	3	2-0-2-0
IV	AS2507	Biomedical Instrumentation	3	2-0-2-0
V	AS2508	Bio-MEMs and Nanotechnology	3	2-1-0-0
VI	AS2509	Medical Imaging	3	2-0-2-0
VII	AS2510	Tissue engineering and Gene therapy	3	2-0-2-0
		Total	15	

Mathematical Analysis				
Semester	**Course Code**	**Course Title**	**Credits**	**Hours**
				L-T-P-S
III	AS2511	Real Analysis	3	3-0-0-0
IV	AS2512	Introduction to Topology	3	3-0-0-0
V	AS2513	Differential Geometry of Curves and Surfaces	3	3-0-0-0
VI	AS2514	Measure Theory	3	3-0-0-0
VII	AS2515	Functional Analysis	3	3-0-0-0
		Total	15	

Frontiers in Physics				
Semester	**Course Code**	**Course Title**	**Credits**	**Hours**
				L-T-P-S
III	AS2516	Light Matter Interaction	3	2-1-0-0
IV	AS2517	Physics of Space and Time	3	2-1-0-0
V	AS2518	Magnetic Materials and Applications	3	2-1-0-0
VI	AS2519	Quantum Materials & Devices	3	2-1-0-0
VII	AS2520	Green Energy Physics	3	2-1-0-0
		Total	15	

Engineering Physics (AS1001)

Objective: Students will be able Demonstrate ability to collect, process, and analyze scientific data, display critical thinking skills in applying physics knowledge in the experimental process.

Course outcome

At the end of this course, Students will be able to

- To analyze dynamics of system of particles for applications in Physics and Engg.
- Identify, formulate and solve engineering problems requiring principles of physics
- Gain knowledge about modern physics and quantum mechanics
- Apply quantum physics to understand solid state materials
- Design & conduct experiments, analyze & interpret data

Classical Mechanics

Symmetry and conservation laws, Fermat's principle, Principle of least action, Euler Lagrange equations and its applications, Degrees of freedom, Constraints and constraint forces, Generalized momentum, Concept of phase space, Hamiltonian.

Quantum Mechanics

De Broglie's hypothesis, wave function and wave packets, phase and group velocities. Schrödinger Equation. Probabilities and Normalization, Eigenvalues and eigen functions. Infinite potential well and energy quantization. Finite square well, potential steps and barriers - notion of tunneling, band structure of solid.

Solid State Physics

Energy Bands, Carrier transport in semiconductor, mobility and resistivity, electron effective mass, Density of states, Fermi-Dirac distribution function, intrinsic carrier concentration, Mechanism of carrier scattering, Einstein relationship.

Text Books

- Classical Mechanics; H. Goldstein, C. Poole, J. Safko; Pearson Education, Third Edition (2002)
- Modern Physics by A. Beiser; McGraw-Hill Higher Education, Sixth Edition (2003)
- Introduction to Quantum Mechanics by D. J. Griffiths; Pearson Education, Second Edition (2005)
- Introduction to Solid State Physics by C. Kittel; Wiley Students Edition, (2005)
- Physics of semiconductor devices, S M Sze, John Wiley & Sons, 2006

Reference Books

- Theoretical Mechanics by M. Spiegel; McGraw Hill Education, 2017
- Feynman Lectures of Physics Vol-1 and Vol-3; The Millenium Edition, Pearson (2012)
- Quantum Physics for Atoms, Molecules, Solids, Nuclei and Particles by R. Eisberg and R. Resnick; 2nd Edition, New Delhi Wiley (2012)

Linear Algebra (AS1002)

Objective: Students will be able to solve linear equations & develop understanding of vector spaces, linear transformations, Eigen value, diagonalization and orthogonalization, least square solutions and singular value decomposition etc

Course Outcome

Students will be able to

- Understand the concept of matrices, their properties & solve linear equations
- Understand basic concepts of vector spaces, subspace, linear dependence etc
- Calculate the rank-nullity of a matrix / linear map, eigenvalues, and eigenvectors.
- Apply the Gram-Schmidt process, Find the SVD, Jordan Canonical form .
- Apply concepts of linear algebra to various applications.

Matrices and Vector Spaces

System of linear equation, Gauss elimination method, Elementary matrices, Invertible matrices, Gauss-Jordan method, Determinant, Cramer's rule, Vector spaces, Linearly independence and independence, Basis, Dimension.

Linear transformation & Diagonalizability

Linear transformation, Representation of linear maps by matrices, Rank-Nullity theorem, Rank of a matrix, Row and column spaces, Solution space of a system of homogeneous and non-homogeneous equations, Eigenvalue, eigenvector, Cayley-Hamilton theorem, Diagonalizability, minimal polynomial

Inner product space

Inner product space, Cauchy-Schwarz inequality, Orthogonal basis, Gram-Schmidt orthogonalization process, Orthogonal projection, Spectral theorem.

SVD & Jordan Canonical Form

Positive, negative, and semi-definite matrices. Decomposition of the matrix in terms of projections, Strategy for choosing the basis for the four fundamental subspaces, Least square solutions and fittings, Singular values, Primary decomposition theorem, and Jordan canonical form.

Text/Reference Books

- K. Hoffman and R. Kunze, Linear Algebra, 2nd Edition, Pearson (2015).
- Gilbert Strang, Introduction to Linear Algebra, 4th Edition, Cambridge Press (2009).
- S. Kumaresan, Linear algebra - A Geometric approach, Prentice Hall of India (2000).
- S. Lang, Introduction to Linear Algebra, 2nd Edition, Springer (2012).

Problem Solving with Programming (IT1001)

Objective: Students will be able to understand programming language (in this case C language), develop a problem-solving approach from programmer's perspective.

Course Outcome

Students will be able to:

- break down complex real-world problems into smaller, manageable subproblems and develop logical approaches for solving them through programming.
- learn to debug code, identify and fix logical errors, and write test cases.
- develop a systematic approach to problem-solving, logical reasoning, and iterative refinement.

Introduction to Computers & Demo

Computer hardware, Computer Networks, IP Address, Proxy, Gateway, Operating Systems, Disk/Directory/Files system, Application Software. Professional Ethics.

Programming Basics: Structure of a simple C program, Constants and Variables, Basic Data Types, Precedence and Associativity, implicit and explicit type conversion, Selection Statements, Loop Structures

Functions and Arrays: User-defined functions, function definition, Storage class and Scope, Macros, Nested, and Recursive Functions, One Dimensional arrays, Passing Arguments, Two and higher Dimensional Arrays, Strings, String Library Functions

Pointer and Structure: Addresses and Pointers, Structures, Dynamic Memory Allocation, Linked List, Stack, Queue. Data Files.

Text Books

- "Engineering Problem Solving with C", Delores M. Etter, Fourth Edition, 2012, Pearson.
- "C: How to Program", Paul Deitel and Harvey Deitel, Ninth Edition, 2022, Pearson.

Reference Books

- "Computer Systems: A Programmer's Perspective", Randal E Bryant and David R O'Hallaron, Third Edition, 2015, Pearson.
- "Problem Solving and Program Design in C", Jeri R. Hanly and Elliot B. Koffman, Eighth Edition, 2015, Pearson.
- "Programming in C", Brian Kernighan and Dennis Ritchie, Second Edition, 2015, Pearson.

Fundamentals of Electrical and Electronics Engineering (EC1001)

Objective: Students will be able to understand the fundamental concepts of electrical and electronics engineering.

Course Outcome
Students will be able to:

- Understand working principles of basic electrical and electronic devices and circuits.
- Design basic electronic circuits

Introduction
Basic physical laws, circuit elements, KVL, KCL, Network Theorems

Transients
R-L, R-C, R-L-C, Sinusoidal Steady State, Real/Reactive Power, Three Phase,

Transformers/AC/DC machines
Working Principles of Transformers/AC/DC machines

Semiconductors
Semiconductors, Band Diagram, n-type and p-type semiconductor, junction diode, diode biasing, Zener diode, DC Power supply

Transistors
Introduction to Bipolar Junction Transistor, MOS Capacitor, Introduction to Operational Amplifier, Schmitt Trigger, Multivibrator, Oscillators

Text Book

- Microelectronic Circuits SEDRA/SMITH 7th Edition Oxford University Press
- Fundamentals of Electrical Engineering, Leonard S Bobrow, 2nd Edition, Oxford Press.
- Fundamentals of Electrical Engineering and Electronics, B L Thereja, S Chand Press.

References

- Network Analysis, M E Van Valkenberg, 3rd Edition, PHI, 2000
- Linear Circuit Analysis: Time, Domain, Phasor and Laplace Transform Approaches, R A DeCarlo and M Lin, 2nd Edition, Oxford University Press, 2000

Technical Communication Skills (MS1001)

Objective: Students will be able to enhance and polish communication skills which will formally help them to be effective professionals by understanding importance of effective communication, presentation and designing of work.

Course Outcome
Students will be able to:

- Speak and participate in GD
- Write technical letters, CV, product development plans etc

Introduction
Introduction to types of communication, Lab sessions and mock presentation pertaining to Communication Styles, Content Management and Delivery Making Effective Public presentations, Speech and diction correction and counseling

Formal communication
Written communication, Problems and solutions Lab sessions will have exposure to: Cover letter, CV preparation Group discussion and Personal Interview Report writing and Proposal development plan, Interview: types and techniques SWOT Analysis.

Reference Books

- Winning at Interviews by Edgar Thorpe Books on Technical Writing

Constitution of India (MS1002)

Objective: Students will be able to understand the Fundamental features of the Indian Constitution, Union Government, Rights and Duties, Statutory Institutions.

Course Outcome
Students will be able to:

- Understand Indian Constitution, its composition and functions, Union and state Government
- Understand Rights and Duties, Statutory Institutions etc

Introduction
Evolution of the Indian Constitution, Acts, Fundamental features of the Indian Constitution, Union, State and Local Government.

Rights and Duties
Fundamental Rights and Duties, Directive Principles, Relation between Federal and Provincial units: Union-State relations, Administrative, legislative& Financial, Inter-State Council, NITI Ayog, Finance Commission of India, Union List, State List, Concurrent List, Statutory Institutions: Elections-Election Commission of India, National Human Rights Commission, National Commission for Women

Reference

- D.D. Basu, Introduction to the Constitution of India, Lexis Nexis, New Delhi
- Subhash Kashyap, Our Parliament, National Book Trust, New Delhi
- Peu Ghosh, Indian Government &Politics, Prentice Hall of India, New Delhi

Universal Human Values (MS1003)

Objective: Students will be able to understand the human values.

Course Outcome
Students will be able to:

- Understand the importance of human values, family, society, nature etc.
- Develop commitment and courage to act.

Introduction
Development of a holistic perspective based on self-exploration about themselves (human being), family, society and nature/existence, Understanding (or developing clarity) of the harmony in the human being, family, society and nature/existence

Self Reflection
Right understanding Strengthening of self-reflection, Development of commitment and courage to act, Method to fulfill the human aspirations: understanding and living in harmony at various levels.

Reference

Professional Ethics (MS1004)

Objective: Students will be able to understand the awareness on Engineering Ethics and Human Values.

Course Outcome
Students will be able to:

- Understand social responsibility of an engineer etc.
- To appreciate ethical dilemma while discharging duties in professional life.

Values
Human Values Morals, Integrity, Work Ethics, Honesty, Courage, Empathy etc. Kohlberg's theory, Gilligan's theory, Models of Professional Roles.

Ethics
Codes of ethics, Challenger case study, Safety and Risk, The Three Mile Island And Chernobyl Case Studies, global issues, moral leadership

Reference

- Mike Martin and Roland Schinzinger, “Ethics in Engineering”, McGraw-Hill, New York 1996.
- Govindarajan M, Natarajan S, Senthil Kumar V. S, “Engineering Ethics”, Prentice Hall of India, New Delhi, 2004.
- Charles D. Fleddermann, “Engineering Ethics”, Pearson Education / Prentice Hall, New Jersey, 2004 (Indian Reprint now available).
- Charles E Harris, Michael S. Protchard and Michael J Rabins, “Engineering Ethics – Concepts and Cases”, Wadsworth Thompson Leatning, United States, 2000 (Indian Reprint now available)
- John R Boatright, “Ethics and the Conduct of Business”, Pearson Education, New Delhi, 2003.

Youth Empowerment and Skills (MS 1005)

Objective: To equip students with practical tools and techniques that will make them more creative, efficient, confident, clear-minded, stress-free, joyful and energetic

Course Outcome
Students will be able to:

- learn challenges and will learn group processes, talks, presentations and hands-on learning methodology that helps students to enhance their lives.
- Participate in Group discussions and role-plays to inculcate life-skills and human values
- Yoga Asanas and Pranayama to increase concentration & build confidence
- Breathing techniques (like the world-renowned and well-researched Sudarshan KriyaTM)
- Talks and Presentations to bring out attitudinal and behavioral changes towards achieving student excellence.

Personality Development
Personality Development Self-awareness, Emotional Intelligence / Coping with Emotions, Mind Management, Coping with Stress, Health and Nutrition, Social Adaptability and Effectiveness Effective Communication Skills, Interpersonal Relationship Skills, Lifestyle and Environment

Ethics
Ethics, Morality and Integrity, Time Management and Goal Setting, Professional Skills, Active Learning and Effective Learning Strategies, Decision Making

Reference

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Computer Organization and Architecture (IT1002)

Objective: To make student learn the basic concepts of computer architecture and organization, and understand the key skills of constructing cost-effective computer systems**.**

Course Outcome

- To understand the basic operations of computing hardware interface and system-level programming, compilers, assemblers, instruction sets etc.
- Understand merits/demerits for performance, design process of a computer, memory hierarchy, cache design, microprocessor designs etc.

Introduction

Basic organization of computer and block level description of the functional units; Review of Digital Systems, Memory system design, FSM, Fixed and Floating-point data.

Computer Arithmetic and Design of ALU

Integer Data computation, Floating point arithmetic, Design of 8/16/32 bit ALU

CPU Architecture

Register Organization, Instruction formats, Instruction interpretation and Sequencing, RTL, addressing modes, instruction set. Case study - instruction sets of MIPS processor and ARM.

Assembly language programming

ARM instruction set, Introduction to Memory and Memory parameters. Classifications of memories, Allocation policies, Memory hierarchy and interleaving

Cache memory

Concept, architecture, mapping techniques. Virtual Memory, Page replacement policies. Data Path and Control Unit design, Memory, bus structure, hardwired and microprogrammed design approaches, Case study - design of a simple CPU

I/O Organization and Peripherals

I/O subsystems, DMA, privileged and non-privileged instructions, software interrupts & exceptions. Assessing and Enhancing Performance of Computer Systems; Pipelining, hazards, Flynn's classifications, Architectures - Multi-core systems, GPU

Text Book

- David A. Patterson and John L. Hennessy, Computer Organization and Design: The Hardware/Software Interface Morgan Kaufmann ARM Edition, 2010.

Reference Book

- C. Hamachar, Z.Vranesic and Safwat Zaky, Computer Organization, McGraw Hill
- William Stallings, Computer Organization and Architecture: Designing for Performance, Pearson Education
- John P. Hayes, Computer Architecture and Organization, McGraw Hill
- Morris Mano, Computer System Architecture, Pearson Education

Data Structures and Algorithms (IT1003)

Objective: To make student learn the linear and non-linear structures in which data can be stored and their pros and cons & to write algorithms using different data structures.

Course Outcome

- Understanding of data structures, linked-lists, trees, binary search trees, AVL trees, stacks, queues, priority queues, and hash-tables and graphs, ADT
- To apply & implement learned algorithm design techniques and data structures to solve problems.

Introduction, Arrays and Linked Lists
Basic Terminology, Elementary Data Organization, Asymptotic notations Efficiency of an Algorithm, Time and Space Complexity and trade-off**,** Single and Multidimensional Arrays, Sparse Matrices, Single, Double and Circularly Linked List, Header node based Linked List, Operations on a Linked List. Insertion, Deletion, Traversal, Polynomial Representation and Addition, Generalized Linked List

Abstract Data Types (ADT), Searching and Sorting, **Priority Queues**
Stacks: Primitive Stack operations (Push & Pop) Implementation and Application of stack, Queue Implementation and Applications, Doubly Ended Queue, Sequential search, Binary Search, Comparison Sorting Techniques, Efficient Sorting Techniques, linear sorting techniques, Queue Definition & Implementation.

Hashing, Trees & Graphs- Hash table, hash function, collison & resolution strategies, Linear and Quadratic Probing, Trees, Binary Tree Representation, Expression Tree, Binary Tree Traversals, Binary Search Trees, Sequential & linked Representations of Graphs, Adjacency Matrix, Adjacency List, Graph Traversals, Connected Components, Minimum Cost Spanning Trees, Prims & Kruskal algorithm, Dijkstra algorithm

Text Books

- E. Horowitz, S. Sahni, S. Anderson-Freed “Fundamentals of Data Structures in C”, Second Edition, 2008, Universities Press.
- R. Kruse et al. , *Data Structures and Program Design in C,* Pearson Education
- S. Lipschutz , *Data Structures, Schaum's Outlines Series,* Tata McGraw-Hill.
- Mark Allen Weiss, “Data Structures and Algorithm Analysis in C (DSAC)”, Second Edition, 2002, Pearson Education India.

Reference Books

- “Algorithms Design”, Jon Kleinberg and Eva Tardos, First Edition, 2013, Pearson.
- “The C Programming Language”, Brian W. Kernighan and Dennis M. Ritchie, Second Edition, 2015, Pearson Education India.
- “Introduction to Algorithms”, Thomas H Cormen, Charles E Leiserson, Ronald L Rivest, Clifford Stein, Third Edition, 2009, MIT Press.

Web Development (IT1004)

Objective: To make students aware about the latest technologies in Web development and to give hands-on exposure on web development technologies.

Course Outcome

Students will be able to:

1. learn about the latest technologies in web development and get hands-on exposure on web development technologies.
2. to use the web application frameworks in web development and to deploy the modern web development tools and techniques.

Introduction to Web Development

Overview of web technologies, Web development tools and environments, HTML (Hypertext Markup Language), Working with text, links, images, and tables, Semantic HTML and accessibility, HTML forms and input validation, multi-page websites.

CSS (Cascading Style Sheets) & JavaScript

CSS and its role in web design, CSS selectors, properties, and values, Layout and positioning of HTML elements, Responsive design and media queries, JavaScript syntax, variables, and data types, Control structures, DOM manipulation and event handling, JavaScript frameworks/libraries, Backend Development, server-side programming & language, Handling HTTP requests/responses, Working with databases

Web Application Frameworks, Security and Deployment

Web application framework, frontend frameworks, State management and data binding, web vulnerabilities, Best practices for secure web development, User authentication and authorization, Optimization, Techniques for improving website performance, Web Deployment and Hosting, Setting up a web server, Deploying web applications.

Text Books

- Jon Duckett “HTML and CSS: Design and Build Websites”, First Edition, 2011, John Wiley & Sons
- Jon Duckett “JavaScript and jQuery”, First Edition, 2014, Wiley.

Reference Books

- “The Web Developer Bootcamp", by Colt Steele
- “Modern JavaScript from The Beginning 2.0 - 2023 Revamp
- The Complete Web Developer Course 3.0
- Web Design for Everybody: Basics of Web Development & Coding by University of Michigan

Discrete Mathematical Structures (IT1005)

Objective: To make student learn the fundamental mathematical concepts and terminology for discrete mathematics and structures.

Course Outcome

Students will be able to

- Understand logic and proof techniques
- Apply the above techniques in counting and solving recurrence relations
- Analyze real-world models using graph theory
- Extend their usefulness in succeeding courses in algorithm design and analysis, computing theory, software engineering, and computer systems

Methods of Proof, Logic & Proofs

Proof by contradiction, Proof by induction-weak and strong induction, Structural induction, Proof by proving the contrapositive, Proof by cases, and Proof by counter-example. Logic. Propositional Logic, Truth tables, Deduction, Resolution, Predicates and Quantifiers, Mathematical Proofs. Infinite sets, well-ordering. Countable and Uncountable sets, Cantor's diagonalization.

Sets and Sequences

Finite Sets, Power Set, Cardinality of finite sets, Cartesian Product, Properties of Sets, Vector Implementations of Sets.

Counting & Combinatorics

Counting, Sum and product rule, Principle of Inclusion Exclusion. Pigeon Hole Principle, Counting by Bijections. Double Counting. Linear Recurrence relations - methods of solutions. Generating Functions. Permutations and counting.

Relations, Graphs & Algebraic Structures

Relations, Equivalence Relations. Functions, Bijections. Binary relations, Posets and Lattices, Hasse Diagrams, Boolean Algebra, and Graphs and Trees. Structured sets with respect to binary operations. Groups, Semigroups, Monoids. Rings, and Fields.

Text Books

- Discrete Mathematics and its Applications, Kenneth H. Rosen, 7th Edition -Tata McGraw Hill Publishers, 2011.
- Mathematics for Computer Science, Eric Lehman; F Thomson Leighton; Albert R Meyer, 2010.

Reference Books

- Logic in Computer Science, Huth and Ryan, Cambridge University Press, 2014.

Principles of Data Communication (EC1006)

Objectives: To make student learn the fundamental concepts of signals and systems, communication technologies and information theory.

Course Outcomes

Students will be able to

- Understand fundamental concepts of signals and systems, various transforms, communication technologies and information theory.
- Understand the importance of coding, error detection and correction.

Signals and Transformations

Fourier Transform, LTI Systems, Convolution and LTI System Properties, Sampling theorem, Quantization, Pulse Code Modulation.

Information and Entropy

Entropy, Joint Entropy and Conditional Entropy, Relative Entropy and Mutual Information, Relationship Between Entropy and Mutual Information, Chain Rules for Entropy, Relative Entropy, and Mutual Information, Channel Capacity

Coding, Error Control Coding & Transmission Media

Source Coding- Prefix codes, Huffman Coding, Lempel Ziv Source coding, Parity Check Codes, Cyclic Redundancy Checks, Wired- Magnetic Media, Twisted Pairs, Coaxial Cable, Optical Fiber.

Wireless, Digital Modulation & Multiplexing

Electromagnetic Spectrum, Radio Transmission, Microwave Transmission, Infrared Transmission, Light Transmission, Modulation and Demodulation of Digital modulation schemes-ASK, FSK, PSK, DPSK, QPSK. Constellation diagram, M-ary Digital carrier Modulation, Frequency Division Multiplexing, Wavelength Division Multiplexing, Time Division Multiplexing, Code Division Multiplexing, Orthogonal Frequency Division Multiplexing, Space Division Multiplexing

Text Book

- V. Oppenheim, A. S. Willsky and S. H. Nawab, “Signals and Systems”, 2nd Edition
- William Sinnema and Tom McGavern, “Digital, Analogue and Data Communication”, Prentice Hall.
- Proakis, John, and Masoud Salehi. Communication Systems Engineering. 2nd ed. Upper Saddle River, NJ: Prentice Hall, 2001. ISBN: 9780130617934

Reference Book

- B. P. Lathi et. al., Modern Digital and Analog Communication Systems, Fourth Edition, Oxford Publication.
- Haykin, Simon. Communication Systems. 5th ed. New York, NY: Wiley, 2009.

Principles of Management (MS1006)

Objective: This course is designed to be an overview of the major functions of management. It explores how organizations develop and maintain competitive advantage within a changing business environment. Upon completion, students should be able to work as contributing members of a team utilizing these functions of management.

Course Outcome

Students will be able to

- Understand how organizations adapt to an uncertain environment and identify techniques managers use to influence and control the internal environment.
- Practice the process of management's four functions: planning, organizing, leading, and controlling.

Nature and Functions of Management

Importance and Process of Management, Development of Management Thoughts, Managerial Roles.

International Business and its Environment

Globalization & WTO, Dynamics of development Global business environment, Internal Tech. of Forecasting.

Need for Organization

Principles and Process of Organizing, Authority, Delegation and Decentralization

Staffing and Directing

Requirement of Effective Direction

Text Book

- Koontz, Weihrich, Aryasri. Principles of Management, TATA McGraw Hill, New Delhi, 2004.

References

- P. C. Tripathi, P. N. Reddy, Principles of Management, Tata McGraw-Hill Publishing Company Limited, New Delhi.
- Prasad LM, Principles and Practice of Management, Sultan Chand & Sons, New Delhi.
- Samuel C. Certo, S. TrevisCerto, Modern management 10 Ed, PHI Learning, New Delhi, 2008
- James A. Stoner, Edward Freeman, Daniel Gilbert, Management, PHI Learning, New Delhi, 2007
- Williams/ Kulshrestha, Principles of Management, Cengage Learning, New Delhi, 2011

Environmental Studies (MS1007)

Objective: To make student learn the importance of environmental studies, different resources, ecosystem etc.

Course Outcome

Students will be able to

- Understand the Multidisciplinary nature of environmental studies.
- Structure and function of an ecosystem
- Environmental Pollution etc.

Nature of Environmental studies, Ecosystems

Definition, Scope and importance, Need for public awareness. Different resources, Concept of an ecosystem, Structure and its function, Food chains, Different eco systems, Biodiversity, Threats, In-situ and Ex-situ conservation of biodiversity.

Environmental Pollution & Field Work

Causes, effects and control measures of different pollution, Nuclear hazards, Pollution case studies, Disaster management, Water conservation, rain water harvesting, watershed management, Case studies on Environmental ethics, Climate change, global warming, Case studies. - Wasteland reclamation, Environment Protection Act, Water Act, Wildlife Protection Act, Visit to a local polluted site and Study of ecosystems.

References:

- Agarwal, K.C.2001 Environmental Biology, Nidi Publ. Ltd. Bikaner.
- BharuchaErach, The Biodiversity of India, Mapin Publishing Pvt.Ltd. , Ahmedabad — 380 013, India, Email: mapin@icenet.net (R)
- Brunner R.C., 1989, Hazardous Waste Incineration, McGraw Hill Inc.480p
- Clark R.S., Marine Pollution, Clanderson Press Oxford (TB)
- Cunningham, W.P.Cooper, T.H.Gorhani, E &Hepworth, M.T.2001. Environmental Encyclopedia, Jaico Publ. House. Mumbai, 1196p
- Dc A.K., Environmental Chemistry, Wiley Eastern Ltd.
- Down to Earth, Centre for Science and Environment(R)
- Gleick, 11.P. 1993. Water in crisis, Pacific Institute for Studies in Dev., Environment & Security. Stockholm Env. Institute. Oxford Univ. Press. 473

Physical Education (Sports) (MS1008)

Objective: To aware the students on the importance of physical education for a healthy life and train them on various sports, games, yoga, etc. for physical fitness.

Course Outcome
Students will be able to

- Understand the knowledge of various ways for maintaining both physical and mental wellness

Know your body
First Aid for basic medical conditions, CPR for emergency, Diabetic and Obesity condition of Indian and world, Importance of physical education.

Yoga and Meditation
Yoga for wellness and concentration, Meditation for wellness

Athletics and Aquatics
Rules, benefits and mastering of various track and field events such as Sprint, Marathon, Hurdles, Long Jump, High Jump, Javelin throw, Shot Put, Discus throw, etc.
Rules, benefits and mastering of various styles of swimming, butterfly, freestyle, backstroke, and breaststroke, Sports for physical fitness like Cricket, basketball, football, volleyball, etc.

References:

- Dr. V K Sharma, “Health and Physical Education”. New Sarasvati House Publishers.
- “Yoga: A Healthy Way of Living”. By National Council of Educational Research and Training.
- Mark Young. “The Complete Beginners Guide to Swimming”.
- Dr. Ashwini Bhardwaj. “A Complete Guide to Family Safety and First Aid”. GoodWill’s Publishers.

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Probability and Statistics (AS2001)

Objective: This course provides an elementary introduction to probability and statistics with applications. The topics covered in this course are basic concept of probability and statistics, random variables, probability distributions, Bayesian inference, joint probability distributions, random vectors, central limit theorem, confidence intervals.

Course Outcome

Students will be able to:

- Understand the basic concepts of probability and random variables.
- Apply the standard discrete and continuous probability distributions to real problems and use the inequalities.
- Extend the concept of random variables to higher dimensions and approximate probabilities by central limit theorem.
- Analyze the data by using statistical techniques of point and interval estimation and testing of hypotheses.

Probability: Axiomatic definition, Properties, Conditional probability, Bayes rule and independence of events, Random Variables, Distribution function

Probability Distributions: Discrete and Continuous random variables, Expectation, Function of random variable, Moments, Moment generating function, Chebyshev's and Morkov's inequality. Bernoulli, Binomial, Geometric, Negative binomial, Hypergeometric, Poisson, Discrete uniform, Continuous uniform, Exponential, Gamma, Normal.

Random vector: Joint distributions, Marginal and conditional distributions, Moments, Independence of random variables, Covariance, Correlation, Levy's Central limit theorem (independently and identically distributed with finite variance case), Normal approximation to Binomial and Poisson

Statistics: Introduction: Population, Sample, Parameters, Point Estimation: Method of moments, Maximum likelihood estimation, Unbiasedness, Consistency, Interval Estimation: Confidence interval, Tests of Hypotheses, Linear Regression.

Text/Reference Books

- Sheldon M. Ross, An Introduction to Probability Models, 10th Edition, Academic Press, Elsevier.
- Sheldon M. Ross, An Introduction to Probability and Statistics for Engineers and Scientists, 3rd Edition, Academic Press, Elsevier.
- Rohatgi, V. K. and Saleh, A. K. (2000), An Introduction to Probability and Statistics, 2nd Edition, Wiley-interscience.
- Bertsekas, D. P. and Tsitsiklis, J. N. (2008), Introduction to Probability, Athena Scientific, Massachusetts.

Object Oriented Methodologies (IT2001)

Objective: To learn the concept of Object Orientation and its applicability in modeling real life scenarios and to get acquainted with UML Diagrams and Object Oriented Analysis Processes, and concepts like data abstraction, encapsulation, inheritance etc.

Course Outcomes

Students will be able to

1. Understand and apply the object-oriented approach in software development.
2. Optimize the codes by applying the concepts of modularity, reusability etc.
3. Design Java programs to model real-world systems and analyze their behavior using object-oriented principles and create models for software design using Unified Modeling Language (UML).
4. Apply Design principles for a flexible, maintainable software design

Introduction

Characteristic differences between Procedural and Object Oriented approach for programming, Concepts of Class, Objects, and Object Oriented Characteristics. Building upon basic programming skills in OO, specifically using basic Java programming constructs for object-oriented problem solving (e.g., Classes: Abstraction, inheritance, interfaces, polymorphism), Methods in OO Programming: Method overloading and overriding.

Models

Design and analysis of larger, more complex programs using Object Oriented Modeling with UML. Need for models, Static and Dynamic modeling diagrams, and role of Use Case Diagrams. Role of Object orientation in problem solving, Java program to model a real world system, and subsequently analyze its behavior. Java implementation for GUI, Event handling and Applets for Web enabled applications. Developing Applications with GUI and Database connectivity.

UML

Overview of UML, Class Diagrams Object Diagrams. Sequence Diagrams, Collaboration Diagrams, Static Diagrams: Working with Diagrams and role of Modeling, Making Effective use of UML, Communicating with Others, Back end documentation What to keep, and What to throw away, Iterative Refinement Behavior, Iterative Refinement Minimalism, Object Oriented design Principles & Intro to Design Patterns.

Text Books:

- H. Schildt, Java 2: A Complete Reference 4th ed, McGraw-Hill, 2001
- G. Booch, Object-Oriented Analysis and Design with Applications 2nd Edition, PHI, New Delhi, 1993

Theory of Computation (IT2002)

Objective: This course is about the machine construction logic.

Course Outcomes
Students will be able to:

- understand automata as an abstract model of computation and its significance
- relate the concepts of automata, grammar and languages and their applications
- understand the (Chomsky) hierarchy and argue about model limitations
- identify the characteristics for which no computational solution exists.

Regular languages
Notion of a formal language, DFAs and notion for their acceptance, informal and formal definitions. Class of regular languages, Closure of the class under complementation, union and intersection. Strategy for designing DFAs, Pumping lemma for regular languages, NFAs. Notion of trees, Construction of equivalent DFAs of NFAs. NFAs with epsilon transitions, Closure properties for languages, States minimization of DFAs,

Context free languages
Notion of grammars and languages generated by grammars. Equivalence of regular grammars and finite automata. Context free grammars and their parse trees. Context free languages. Ambiguity, Elimination of useless symbols, epsilon productions, unit productions from CFGs. Chomsky normal form, Pumping lemma, Closure properties of CFLs, Decision problems for CFLs.

Pushdown automata (PDAs)
Deterministic and nondeterministic. Instantaneous descriptions of PDAs. Language acceptance by final states and by empty stack. Equivalence of PDAs and CFGs,

Turing machines
Recursively enumerable languages, Turing machines (TMs)-their instantaneous descriptions. Language acceptance by TMs, Types of TMs, Church-Turing hypothesis and its foundational implications, Codes for TMs. Recursively enumerable (r.e.) and recursive languages. Existence of non-r.e. languages. Notion of undecidable problems. Universal language and universal TM. Separation of recursive and r.e. classes.

Textbooks:

- J. E. Hopcroft , R. Motwani , J. D. Ullman “Introduction to Automata Theory, Languages, and Computation”, , Pearson Publications, Third edition.
- “An Introduction to Formal Languages and Automata”, Peter Linz, Narosa Publications, Fourth edition.

References:

- Michael Sipser, “Introduction to the theory of Computation”, Cengage Learning, Third edition.
- N.Chandrasekaran, “Theory of Computer Science Automata, Languages and Computation”, K.L.P. Mishra, PHI, Third Edition.

Operating Systems (IT2003)

Objective: To make student learn the design and services provided by an operating system particularly xv6 operating system.

Course Outcome
Students will be able to:

- Understand operating systems
- Memory management, input-output and storage management
- concept of distributed systems, OS Systems security etc.

Introduction, System Calls & Process and Thread Management
OS Basics, Definition, Operating Systems as resource manager, Evolution of OS, Structural overview, Types of System Call, Hardware requirements, Process Model, Process States, Operation on Process, System calls for process operations, Overview of Threads, Multithreading Models, Threads and their Management; POSIX Threads, Implementing Threads in User space and Kernel space

CPU Scheduling, Interprocess Comm., Process Synchronization & Deadlocks
Scheduling Criteria & Algorithms, Multiple-Processor Scheduling, Concept of shared memory, message passing, pipes, The Critical-Section Problem, Peterson's Solution, Synchronization, Semaphores, Problems of Synchronization, Dynamic Resource Allocation, Deadlock Characterization, Prevention, Avoidance, Detection, Recovery

Memory Management, Input Output and Storage Management, File Management
Main Memory Basics, Swapping, Contiguous Memory Allocation, Paging, Structure Segmentation, Virtual Memory, Demand Paging, Page Replacement, Allocation of Frames, Thrashing, Principles of I/O hardware, I/O Software Layers, Mass-Storage Structure, Disk Scheduling & Management, File Concept, Protection, Mounting, Sharing, Structure, Implementation, Directory Implementation, Allocation Methods

Advanced Topics
Multiprocessor Hardware and OS, scheduling and synchronization, multicomputer hardware, distributed shared memory, remote procedure call, concept of distributed systems; OS Systems security, controlling access to resources, exploiting software

Text Book

- R H. Arpaci-Dusseau and A C. Arpaci-Dusseau “Operating Systems: Three Easy Pieces”, Arpaci-Dusseau Books, November, 2023 (Version 1.10)

Reference Book

- P. B. Galvin and G Gagne “Operating System Concepts”, Abraham Silberschatz, 8th Edition, 2008, Wiley.
- A S. Tanenbaum and H Bros “Modern Operating Systems” 4th Edition, 2015,
- W Stallings “Operating Systems: Internals and Design Principles”, Prentice Hall

Software Engineering (IT2004)

Objective: To apply software engineering theory, principles, tools and processes, as well as the theory and principles of computer science and mathematics, to the development and maintenance of complex, scalable software systems

Course Outcome

Students will be able to:

- Understand and apply software lifecycle development models to effectively manage the software development process and
- utilize software design principles and modeling to develop scalable and maintainable software systems.
- Develop and implement project plans, apply metrics for measurement, estimate costs etc in software project development to ensure quality.

Introduction to Software Engineering

Software characteristics, Software components, Software applications, Software Engineering Principles, Software metrics and measurement, monitoring and control. Software development life-cycle, various model and recent developments in models.

Requirements

Elicitation Techniques, Requirements analysis, Modeling and Architecture, Functional versus object-oriented approach of design, design specification, Cohesiveness and Coupling. Overview of SA/SD Methodology, structured analysis, UML diagrams. Data flow diagrams (DFDs), extending DFD to structure chart.

Software project Planning

Project scheduling. Software Metrics: Size Metrics, Cost estimation using models like COCOMO. Risk management, Software Reliability and Quality Assurance: Reliability issues, Reliability metrics, reliability models, Software quality, ISO 9000 certification for software industry, SEI capability maturity model, Client server software development.

Verification and validation

Code inspection, test plan, test case specification. Level of testing, Various testing Top down and bottom-up integration, Alpha and Beta, System and debugging, functional structural testing, Software testing strategies, Software reliability and quality, Software maintenance and reuse, Structured Vs unstructured maintenance, Maintenance Models, Configuration Management, Reverse Engineering, Software Re-engineering.

Text Books

- Sommerville “Software Engineering”, Tenth ed, 2016, Pearson Education .
- R S. Pressman & B R. Maxim “Software Engineering: A practitioner’s approach”, Eighth Edition, 2014, Mcgraw-Hill.

Reference Book

- W. S. Jawadekar “Software Engineering: Principles and Practice”, 2004, Tata McGraw-Hill Education.

Principle of Economics (MS2001)

Objective: This course introduces economic analysis of individual, business, and industry choices in the market economy. Topics include the price mechanism, supply and demand, optimizing economic behavior, costs and revenue, market structures, factor markets, income distribution, market failure, and government intervention. Upon completion, students should be able to identify and evaluate consumer and business alternatives in order to achieve economic objectives efficiently.

Course Outcome

Students will be able to:

- Understand that economics is about the allocation of scarce resources, that scarcity for ceschoice, tradeoffs exist and that every choice has an opportunity cost.
- List the determinants of the demand and supply for a good in a competitive market and explain how that demand and supply together determine equilibrium price.
- Understand the role of prices in allocating scarce resources in market economies and explain the consequences of price controls.
- Define an externality and a public good and why explain the presence of externalities and public goods make markets inefficient. Analyse various government policies aimed at solving these inefficiencies.

Introduction to Economics

Production Possibilities, Supply and demand, analysis; The price system and the mixed economy

Elasticity; Consumer choice and the theory of demand

The profit-maximizing competitive firm and market supply; Long-run supply in competitive markets, Production and cost

Types of Market:

Monopoly; Perfect Markets; Monopolistic competition and oligopoly; Antitrust policy and regulation of markets

Introduction to macro Economics

Macro-Economic Equilibrium GDP; Unemployment; Inflation

Text Books

- Principles of Economics: Gregory Mankiw
- Economics: Samuelson

Introduction to Finance (MS2002)

Objective of the Course: This course is a rigorous introduction to the study of the basic principles of finance and their application to the usual financial issues and decision-making of business enterprises. The main objective of this course is for the student to obtain at least a good working-knowledge of the topics stated in the tentative course outline below for use in future courses and for careers.

Course Outcome
Students will be able to:

- Identify the objective of the firm and the role of managerial finance.
- Outline the implications of the separation of ownership and control.
- Evaluate financial statements using ratio analysis.
- Explain the general concept of valuing financial assets.
- Explain the characteristics of debt and equity securities.
- Identify why firms need to invest in working capital Outline the alternative sources of long-terms fund.

Introduction to financial Management
Financial statement basics, Ratio Analysis

Time value of Money
Capital Budgeting, Relationship between risk and return

Long term financial decisions
Working Capital Management, Dividend Decision

Introduction to Financial Systems
Capital Markets, Introduction to International finance and risk Management

Text Books ·

- Ross, Westerfield, Jordan, Essentials of Corporate Finance
- James C. Van Horne and John M Wachowicz, Fundamentals of financial management.
- Jonathan Berk, Financial Management

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Design and Analysis of Algorithms (IT2005)

Objective: To analyze the asymptotic performance of algorithms, Write rigorous correctness proofs for algorithms and to demonstrate a familiarity with major algorithms and data structures.

Course Outcome

Students will be able to:

- Demonstrate the ability to fully understand the analysis of various known algorithms.
- Identify problems where algorithm design paradigms can possibly be applied.
- Explain graph algorithms and their analysis and to understand the notions of computational intractability and learn how to cope with hardness
- Synthesize efficient algorithms in common engineering design situations.

Introduction

Basic concepts, Growth of Functions – Asymptotic Notations, Tradeoff between Time and Space Complexities, Searching and Sorting - Sorting in Linear Time

Divide and Conquer & Randomized Algorithms

Definition, Designing, Analysis, Proof of Correctness, Recurrence Relations, Master's Theorem, Definition, Designing, Analysis, Proof of Correctness

Dynamic Programming & Greedy Algorithms

Definition, Designing, Analysis, Proof of Correctness, Longest common subsequence, Optimal Binary Search Trees, Matrix Chain Multiplication, Definition, Designing, Analysis, Proof of Correctness, Interval scheduling, Huffman tree, Knapsack problems

Graph Algorithms & Complexity classes

Traversal, Topological sort, Minimum Spanning Tree, Single Source Shortest Path, All Pairs Shortest Path, Maximum Flow, P, NP, NP-Complete, NP-Hard

Approximation Algorithms

Definition, Designing, Analysis, Proof of Correctness, Vertex cover problem, Travelling Salesman problem, Subset Sum Problem,

Text Books

- T H Cormen, C E Leiserson, R L Rivest, and C Stein E, Introduction to Algorithms, MIT Press, 4th edition, 2022.

Reference Books

- J Kleinberg, and E Tardos, Algorithm Design, Pearson, 1st edition, 2013

Principles of Programming Languages (IT2006)

Objective: This course describes the fundamental concepts of programming languages by discussing the design issues of the various language constructs, examining the design choices for these constructs in some of the most common languages, and critically comparing design alternatives.

Course Outcomes
Students will be able to:

- Understand the design choices of various constructs of programming languages and their implementation details.
- Understand the significance of implementation, and make better use of languages that are already known.
- Develop the ability to quickly learn new languages
- Assess various programming languages and choose an appropriate language for the task at hand.

Introduction, Syntax and Semantics
Rationale for studying programming languages, criteria used for evaluating programming languages and language constructs, context free grammar, BNF, attribute grammars, semantics: operational, denotational, and axiomatic semantics, various phases of compilers

Design Issues for statements and subprograms
Design issues for expressions and assignment statements, control statements, subprograms and their implementation

Introduction to Concurrency and Logic Programming languages
Motivation for concurrency, semaphores, Monitors. Introduction to predicate calculus, logic programming using Prolog, Inferencing process in Prolog, Applications and Limitations of Prolog.

Introduction to Functional Programming
Functional programming with Lisp and Scheme, brief introduction to ML, Haskell, and F#, Comparison of functional and imperative languages.

Textbooks:

- R W. Sebesta "Concepts of Programming Languages", , Tenth Edition, Pearson

References:

- Allen B Tucker and Robert E. Noonan, "Programming Languages: Principles and Paradigms", , second edition, Mc Graw Hill
- Carlo Ghezzi and Mehdi Jazayeri "Programming Language Concepts", , Third edition, Wiley

Computer Networks (IT2007)

Objective: To grasp the fundamental concepts of computer networking, including the OSI model, TCP/IP protocol suite, network topologies, and addressing schemes and to learn about various networking protocols and technologies.

Course outcomes
Students will be able to:

- Explain the fundamental concepts of computer networking, including the OSI model, TCP/IP protocol suite, network topologies, and addressing schemes.
- Apply various networking protocols and technologies, such as Ethernet, TCP, IP, UDP, HTTP, DNS, DHCP, etc.
- Use network management principles & to Assess network problems systematically and implement effective solutions.
- Use emerging networking technologies such as SDN, NFV, and IoT

Introduction to Computer Networks
Evolution of computer networks, networks topologies. Layering and protocols.

Physical Layer & Data link layer: Different types of transmission media, errors in transmission: attenuation, noise. Repeaters. Encoding (NRZ, NRZI, Manchester, etc. Error detection, Sliding Window, Stop and Wait protocols, Framing, HDLC, PPP, Channel Access Protocols, Token Ring, Wireless LAN, Virtual circuit switching.

Network Layer & Transport Layer: Internet addressing, Internet Protocol (IPv4, IPv6), ARP, ICMP, DHCP, Internet QoS, routing algorithms (RIP, OSPF, BGP), Software Defined Networking, UDP, TCP, Connection establishment and termination, Sliding window revisited, Buffer Management and Congestion Control at the Transport Layer, Timers, Retransmission.

Session, Presentation, and Application Layers: DNS, SMTP, IMAP, HTTP, etc.

Text Books:

- S. Tanenbaum, Computer Networks, 4th Ed, Pearson India, 2003.
- L. L. Peterson and B. S. Davie, Computer Networks: A Systems Approach, 4th Ed, Elsevier India, 2007.

Reference Books:

- J. F. Kurose and K. W. Ross, Computer Networking: A Top Down Approach, 3rd Ed, Pearson India, 2005.
- D. E. Comer, Internetworking with TCP/IP Vol. 1, 5th Ed, Prentice Hall of India, 2006.
- B. Forouzan, Data Communications and Networking, 5th Ed, Tata Mcgraw Hill, 2013.

Computer Graphics and Visualization (IT2008)

Objective: To prepare students in computer graphics, visualization, and related areas and to develop a complete graphics implementation in which the students implement every aspect of the graphics pipeline. This involves a substantial software project in C/C++ , Python, OpenGL, and WebGL libraries.

Course outcomes
Students will be able to:

- Understand computer graphics, visualization, and related areas
- Develop a complete graphics implementation and
- Prepare software project in C/C++ , Python, OpenGL, and WebGL libraries

Introduction
Basics, applications and scope, Graphics standards, Interaction (sample- and event-driven) and GUI features. Display Systems, Graphics pipeline, Line-Drawing Algorithms, Frame Buffer, Circle-Generating Algorithms, Ellipse-Generating Algorithms. Fill Algorithm, Line Attributes, Line Type, Line Width, Digital signal processing, Sampling, aliasing and Antialiasing, Super-sampling Straight Line Segments, Pixel-Weighting Masks, Area Sampling Straight Line, Segments, Filtering Techniques, Pixel Phasing, Compensating for Line intensity Differences, Antialiasing, Clipping algorithms.

Transformations
Affine Rotation, Translation, Scale, Reflection and Shear; Viewing, Solid Modelling: Wire-frame, Octrees, Sweep, Boundary representations. Regularized Boolean set operations, Constructive Solid Geometry (CSG); Hierarchical Scene and Object graphs, Scene Description. Hidden Surface Removal: Back face detection, Z-buffer method, Painter's algorithm, scan-line algorithm, BSP-trees, Area subdivision method, Ray tracing.

Hidden Surface Removal
Back face detection, Z-buffer method, Painter's algorithm, scan-line algorithm, BSP-trees, Area sub-division method, Ray tracing. Shading & Illumination Reflection Models, Ambient Light, Diffuse Reflection, Specular Reflection and the Phong Model. Combined Diffuse and Specular Reflections, Colour Considerations, Transparency, Shadows, Texture mapping, Polygon-Rendering Methods, Interpolation and Approximation Splines, Continuity, Natural Cubic Splines, Hermite Interpolation, Cardinal Splines, Kochanek-Bartels Splines, Bezier Curves and Surfaces, Bezier, Curves, Matrix Representation, Conversion. Fractals, Generation and Classification, Self-Similar Fractals, Affine Fractal-Construction Methods. Applications. Introduction to GPUs.

Text Books

- Donald Hearn & M. Pauline Baker, Computer Graphics.

Reference Books

- Foley, van Dam, Feiner & Hughes, Computer Graphics Principles & Practice

Database Management System (IT2009)

Objective of the course: The main objective of this course is to provide students with the background to design, implement, and use database management systems.

Course Outcomes
Students will be able to:

- Apply knowledge of database techniques to develop relational models and identify and define the information needs and requirements appropriate to its' business context and solution.
- Use current relational database techniques, skills, and tools necessary for developing information systems.
- Develop the ability to explore recent advances like NoSQL and Linked data principles etc. along with applications towards data warehousing & data mining.

Database Systems
Introduction of Data Base systems, User Categories and Architecture, Data Abstraction and Independence. Data Modeling, Mapping Cardinalities, Generalization, Specialization and Aggregation, Case Study ER Diagrams.

Basic of SQL, **SQL & PL/SQL**
Overview of Query Language, SQL, Queries, Relational Model, Concepts of Keys, Weak Entity, Surrogate Keys, CODD Rules, Anomalies in Relational Model, Mapping from ER Model to Relational Model, Data Manipulation Language and DDL Operations, Set Operations, Aggregate Functions, Nested Subqueries, Modification of the Database, PL/SQL, Data Types, Program structure, Embedding SQL statements, Using conditional statements and loops, Functions and Procedures, Cursor, Triggers.

Relational Algebra & Transactions and Concurrency Control
Basic & Extended Operators, Joins, nested query in DBMS, Tuple Relational Calculus, Relational Database, Functional Dependencies, Attribute Closure, Canonical Cover, Decomposition, ACID Properties, Transaction Atomicity, Durability, Isolation, Serializability, Schedule, Isolation Levels. Lock-Based Protocols, Deadlock Handling, Multiple Granularity, Timestamp based Protocols, Index Locking, Recovery.

Query Processing
Overview, Measuring Query Cost, Selection Operation, Sorting, Join Operation, Query Optimization, Transformation of Relational Expressions, etc. Storage and File structure

Text Books

- Silberschatz, Korth and Sudarshan, Database System Concepts, McGraw-Hill.

Reference Books

- R Ramakrishnan, and J Gehrke, Database Management Systems McGraw-Hill.
- R E, Shamkant B. Navathe, Addison-Wesley, Fundamentals of Database Systems (6th ed.)

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Cyber Security (IT 3001)

Objective: The course is outlined with the objective to inculcate necessary skill, education and abilities among the students in the sphere of cyber security

Course Outcome:
Student will be able to:

- Model attack vectors & defense control in confidentiality, integrity and availability.
- Implement Symmetric & Asymmetric cryptographic algorithms & Test the security of the web application, Vulnerability Assessment and Penetration Testing.
- Design and Secure the Network Infrastructure by implementing IDS, Firewalls and Analysis of Malware to find out Indicator of Compromise.

Introduction and basic terminology
Cyber Security and CIA Triad, basic cyber threats to CIA, cyber-attack surfaces, recent cyber-security incidents and their high-level analysis

Basic Cryptography & Authentication, Authorization and Privilege
Role in confidentiality for data at rest, motion, process. Symmetric and Asymmetric Cryptography, Hashing and Digital Signature and some example, understanding digital signature, Digital Certificate and PKI., role of PRNG, strong Authentication, distinction between authorization and authorization, access control, Mandatory and Discretionary Access control, role based authorization, privilege and privilege escalation.

Application Security
Method of Reconnaissance, Port Scanning and Enumaration. Stages of Vulenaribility Assessment. Owasp Model. Basic application vulnerabilities, Basic mitigations of buffer overflow, Web Client Security, DOM, Java Script Vulnerability, Cookies and Cookie attributes Secure, http only, session and session ID, hijacking, http vs. https and SSL/TLS and version issus, XSS, CSRF, SQL Injection, Command Injection concepts, Vulnerabilities in DNS, Routing and IP protocols & suggested remedies.

Perimeter protection & Network Security
Host Intrusion Detection techniques, Network Intrusion Detection, Snort, Firewall vs. Intrusion Detection tool, Firewall rules and customization techniques. Various malware classes and their characteristics, static & dynamic analysis, Signature vs. behavioral detection., WEP, evil twin attack, unauthorized access point based attacks.

Text Book

- J. Anderson "Security Engineering"Ross, Security Engineering, 3rd Ed. Wiley,
- William Stallings "Cryptography and Network Security" 7th Ed. Pearson,

References

- D Stuttard and M Pinto "The Web Application Hacker's Handbook: Finding and Exploiting Security Flaws" , 2nd Edition, ISBN: 978-1118026472.
- Peter Kim, The Hacker Playbook: Practical Guide To Penetration Testing (vol. 1 and 2) by. Third Edition, ISBN: 978-1980901754

Introduction to Machine Learning (IT3002)

Objective: This course gives an introduction to machine learning. It is about unified understanding of the models and algorithms used in machine learning.

Course Outcomes
Students will be able to:

- Understand Core Concepts of Machine Learning, comprehend the fundamentals of supervised, unsupervised, and reinforcement learning and their applications.
- Develop Predictive Models and implementation of different algorithms.
- Optimize Learning Models and apply optimization techniques.
- Analyze and Evaluate Models and to perform model evaluation
- Explore Dimensionality Reduction and Latent Models and to gain foundational knowledge of deep neural networks and reinforcement learning.

Course Logistics and Introduction to Machine Learning
Supervised learning, Decision Trees for Classification and Regression, Random Forest, Bagging, Boosting, Linear Regression, Learning via Probabilistic Modeling

Probabilistic Models for Supervised Learning
Discriminative and Generative Approaches, Basics of Convexity, Gradient Descent, Stochastic GD Hyperplane based Classifiers (Perceptron and SVM) SVM (Contd), Multiclass and One-Class SVM Making Linear Models Nonlinear via Kernel Methods
Intro to Unsupervised Learning
K-means Clustering and Extensions, Parameter Estimation in Latent Variable Models Expectation Maximization-GMM Model Selection, Evaluation Metrics, Learning from Imbalanced Data Linear and Non-Linear Dimensionality Reduction Bias/Variance Trade-off, Some Practical Issues, Semi-supervised and Active Learning

Introduction to Artificial Neural Networks
Introduction to Deep Neural Networks, Learning to Recommend via Matrix Factorization/Completion, Reinforcement Learning

Text Book:

- Duda, Peter Hart, David Stork, “Pattern Classification”, Wiley; Second edition
- Tom Mitchell, “Machine Learning”.
- Hal Daumé III, “A Course in Machine Learning (CIML)”, 2017 .

Reference Book:

- Christopher Bishop, “Pattern recognition and machine learning”, Springer, 2007.
- Kevin Murphy, “Machine learning: a probabilistic perspective”, MIT Press, 2012.
- E. Alpaydin, “Machine Learning”,(https://www.cmpe.boun.edu.tr/~ethem/i2ml3e/)
- Kevin Murphy, “Machine Learning: A Probabilistic Perspective (MLAPP)”, MIT Press, 2012

Image and Video Processing (IT3003)

Objective: To provide the visualization of relationships between spatial and frequency, understanding of signal processing techniques, provide an idea of multimedia data (image, video) and exposure to various image and video compression standards.

Course Outcomes
Students will be able to:

- Understand digital image formation and visualization and analyze.
- Evaluate the techniques for image enhancement and image restoration.
- Categorize various image and video compression standards and to apply the image and video processing algorithms to solve various real-time problems.
- Develop new state-of-the-art image and video processing methods.

Digital Image Fundamentals
Simple image model, digital image formation, sampling, quantization, resolutions and representation, relationship among pixels, types of digital images.

Color Image Processing & Image Enhancement
Color Representation, Chromaticity Diagram and Color Spaces, types of digital imaging and application areas, Point Processing: Contrast Stretching, Power-law and Gamma Transformation. Histogram Processing: Histogram Equalization and Matching

Filtering and Restoration
Degradation function and Noise Models, Spatial Domain Filtering, Smoothing Linear and Nonlinear Filters, Adaptive Filtering, Sharpening Linear and Nonlinear Filters, Unsharp Masking, High-boost Filtering. Frequency Domain Filtering, Homomorphic Filtering, Periodic Noise Reduction & Inverse Filtering & Wiener Filtering.

Edges, Lines, Boundary Detection & Morphological Operations and Application
First & second Order Edge Operators, Multi-scale Edge Detection, Canny Edge Detection, Hough Transform, Boundary, Skelton, Convex-Hull, Thinning, Pruning etc.

Segmentation & Feature Extraction & Compression: Model-based and probabilistic methods and Image Classification Optimal and Multilevel Thresholding, Gray Image Segmentation, Watershed Algorithm. Lossy and Lossless compression techniques, JPEG, JPEG2000 and Variants, Introduction to video processing, Compression standards and formats (MPEG & H.XXX), Video Streaming.

Text Books

- Willam K. Pratt, Digital Image Processing John Willey & Sons, 4th Ed. 2007
- Gonzalez, Rafael C., and R. E. Woods, Digital Image Processing Pearson Education, 4th edition, 2018

Reference Books:

- The Essential Guide to Video Processing by Alan C. Bovik, Academic Press, 2nd edition, 2009

Artificial Intelligence (IT3004)

Objective: To introduce the basic principles of Artificial Intelligence, problem solving, and knowledge representation

Course Outcomes

Students will be able to:

- Grasp the historical, ethical implications & basic principles of artificial intelligence
- Apply search algorithms, optimization methods, & game strategies to design intelligent problem-solving systems & decision-making and planning.
- Use probabilistic reasoning, Bayesian networks, and decision theory to address uncertainty in dynamic environments and
- Apply decision trees, ensemble methods, and reinforcement learning to learn from observations.

Introduction

Definition, History, The Turing Test, Machine Learning and Robotics, Expert Systems, Current status of AI, Weak AI, Strong AI, Ethics and Risks of Developing AI, Intelligent Agents, Agent programs, Different agents, Components, Agent Architectures

Problems Solving by Searching

Searching for Solutions, Uninformed Search Strategies, Iterative deepening, Bidirectional search, Search Strategies and Optimization, Genetic algorithms, CSP, Intelligent backtracking, minimax algorithm, Alpha-Beta Pruning, Real-Time Decisions

Knowledge Engineering

Knowledge-Based Agents, Propositional and first order logic, Knowledge Engineering, Inference, Unification and Lifting, Forward & Backward Chaining, Ontological Engineering, Planning, Planning Graphs, Logic; Acting in the Real World- Time, Schedules, and Resources, Hierarchical Task Network Planning, Conditional Planning

Uncertainty

Uncertainty, Axioms, Inference Using Full Joint Distributions; Probabilistic Reasoning, Bayesian Networks, Hidden Markov Models, Kalman Filters, Utility Theory, Decision Networks, Expert Systems, Making Complex Decisions, Inductive Learning, Learning Decision Trees, Ensemble, Statistical Learning Methods, Reinforcement Learning

Text Books

- P Norvig and S J. Russell, Artificial Intelligence: A Modern Approach, 4th ed. Pearson Education, 2022
- Deepak Khemani, First Course in Artificial Intelligence, 6th Ed., McGraw Hills,

Reference Books:

- K Knight, E Rich, S B. Nair, Artificial Intelligence, 3rd Ed., McGraw Hills, 2017
- J P Mueller, L Massaron, Artificial Intelligence For Dummies, 2nd Ed., O'Reilly,2021

Design Thinking and Innovation (IT 3501)

Objective: The objective of this course is to learn the innovation cycle of Design Thinking process for developing innovative products.

Course Outcome

Student will able to

- Compare and classify the various learning styles and memory techniques and Apply them in their engineering education
- Analyze emotional experience and Inspect emotional expressions to better understand users while designing innovative products
- Develop new ways of creative thinking and Learn the innovation cycle of the Design Thinking process for developing innovative products
- Propose real-time innovative engineering product designs and Choose appropriate frameworks, strategies, and techniques during prototype development and to perceive individual differences and its impact on everyday decisions and further Create a better customer experience

An Insight to Learning, Remembering Memory & Emotions

Kolb's Learning Styles, Assessing and Interpreting, Understanding the Memory process, Problems in retention, Memory enhancement techniques, Understanding Emotions:

Basics of Design Thinking & Being Ingenious & Fixing Problem

Definition, Need, Objective, Concepts & Brainstorming, Stages of Design Thinking Process, Bottlenecks of Processes-Process Centric approach, Creative thinking process, Problem Solving, Testing Creative Problem Solving

Process of Product Design, Prototyping & Testing and Celebrating the Difference

Process of Engineering Product Design, Design Thinking Approach, Stages of Product Design, User Interface Design, Mobile App Design, Prototype creation, Rapid Prototype Development process, Testing, Test Group Marketing, Group Discussion

Design Thinking & Customer Centricity & Feedback, Re-Design & Re-Create

Practical Examples of Customer Challenges, Use of Design Thinking to Enhance Customer Experience, Feedback loop, rapid prototyping & testing, final product, Creative Solution".

Text Book

Reference Book

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Data Analytics (IT3006)

Objective: The objective of this course is to make student learn about mining issues and methods/algorithms.

Course outcomes:
Students will be able to:

- Get exposure of data analysis steps
- Perform data preprocessing task
- Apply logic to implement different category of Algorithms

Introduction
Fundamentals of data mining, Data Mining Functionalities, Classification of Data Mining systems, Major issues in Data Mining, Preprocessing the Data (Data Cleaning, Integration, Transformation & Reduction)

Mining Association Rules
Association Rule Mining, Mining Single-Dimensional Boolean Association Rules from Transactional Databases, APRIORI, Variations of APRIORI (Sampling, Hash Based, Partitioning, Transaction Reduction), Frequent Pattern Growth, Mining Multilevel Association Rules from Transaction Databases, Mining Multidimensional Association Rules, Concept of LIFT, Clustering of Association rules.

Classification and Prediction
Classification by Decision Tree Induction, Bayesian Classification, Classification & Prediction continues, Classification by Back propagation, Classification Based on concepts from association Rule Mining, SVM, Regression Analysis, Classifier Accuracy.

Clustering
Data types in cluster analysis, Categories of clustering methods, partitioning methods- K-Means, PAM, CLARA, CLARANS, KNN. Hierarchical Clustering- Agglomerative and Divisive Clustering, BIRCH and Chameleon, Density Based methods-DBSCAN, CURE, OPTICS, Grid Based Methods- COBWEB

Text Book

- J. Han, M. Kamber, Jian Pei “Data Mining: Concepts and Techniques” 3rd Edition, 2011

References

- Hadzic F., Tan H. & Dillon T. S. “Mining data with Complex Structures,” Springer, 2011
- Yates, R. B. and Neto, B. R., “Modern Information Retrieval” Pearson Education, 2005

Biology for Engineers (AS1010)

Objective: The objective is to provide the fundamental knowledge of Modern Biology and its application.

Course Outcome

Students will be able to:

- Get basic understanding of the Advanced Biology
- Get exposure to different areas of Biology including Cell Biology, Microbiology, Molecular Biology, Biochemistry and Immunology.
- Learn the principles of different advanced laboratory techniques used in biological research works and interdisciplinary research.

Introduction

Introduction to living organisms, Different cell organelles and cellular processes. Prokaryotes and Eukaryotes cells.

Structures and functions

Structures and functions of bimolecules, DNA, RNA, Carbohydrates, Proteins and Lipids.

Immunity, Electrical signal & Biomaterials

Antigen, Antibody, Antigen-Antibody interactions, Electrical signal of cells, HH model. Concept of Stem cells, Differentiation, Characterization**,** Biomaterials for tissue engineering, 3D bio-printing, DNA origami and Biocomputing.

Text book

- Bruce Alberts, Alexander Johnson, Julian Lewis, David Morgan, Martin Raff, Keith Roberts, and Peter Walter, Molecular Biology of the Cell.

References

- Prescott, Harley, and Klein's Microbiology by Joanne M. Willey, Linda Sherwood, and Christopher J. Woolverton.
- Biochemistry by Jeremy M. Berg, John L. Tymoczko, and Lubert Stryer.
- Immunology by Thomas J. Kindt, Richard A. Goldsby, Barbara A. Osborne, Janis Kuby.

French Language (MS 1502)

Objective: To equip students with the necessary skills to understand, speak, read, and write French effectively, allowing them to communicate in everyday situations, including basic grammar, vocabulary, pronunciation, and cultural understanding, often aiming to reach a specific proficiency level.

Course outcome
At the end of this course, Students will

- be familiar with the pronunciation of French letters and greetings
- would be able to count numbers
- would be able to form basic questions and answer them and would be able to read the city map, converse of time and appointments etc

Introduction
Personal Information, Introducing yourself (name, age, nationality), Family members Basic greetings and farewells

Basic Communication
Asking and answering simple questions, Expressing likes and dislikes, Making requests.

Numbers and Time
Counting, Telling time, Days of the week and months

Everyday Life
Describing daily routines, Talking about hobbies and interests, Weather descriptions

Places and Directions
Asking for and giving directions, Identifying basic places in a town

Shopping and Dining
Making simple purchases, Ordering food and drinks

Basic Grammar
Subject-verb agreement, Present tense verb conjugation, Basic sentence structure, Articles (le, la, les, un, une)

German Language (MS 1500)

Objective: The student will learn the basics of standard German language, and will get to know about the norms of language of German.

Course outcome
At the end of this course, Students will

- Be familiar with the pronunciation of German letters and greetings
- would be able to count numbers
- would be able to form basic questions and answer them and would be able to read the city map, converse of time and appointments etc

Introduction
Alphabets, Numbers, Greetings

Phrases
Basic introductory phrases

Calenders
Days of the week, Months

Introduction of self and introduction of others
Map, Time, Vocabulary- things around, Nations and nationalities, stationery, professions, hobbies

Grammar
present tense, past tense, plurals, pronouns, verb conjugations, (regular, and three or four important irregular verbs), prepositions, and so on

Japanese Language (MS 1501)

Objective: The student will learn the basics of standard Japanease language, and will get to know about the norms of language of Japan.

Course outcome

At the end of this course, Students will

- Be familiar with the pronunciation of Japan letters and greetings
- would be able to count numbers
- would be able to form basic questions and answer them and would be able to read the city map, converse of time and appointments etc

Introduction

Introduction to Japanese Syllables (phonetic alphabet), greetings & Self introduction, Identifying things, point objects and listen to their names, Listen to things and places etc. Creating shopping lists

Time Delay

Introduction to Time, day of the week, simple inquiries on telephone, Means of transport, Basic conversations of everyday life.

Frame questions in Japanese

Vocabulary of giving and receiving objects. Stating impressions/things surrounding us, Expressing likes and dislikes, good/bad, possessions. Talking about the country, town and the environment.

Quantity

Number of people, time, period etc., Stating thoughts and impressions. Conveying movement (e.g. go / come)

Sanskrit Language (MS 1401)

Objective: The student will learn the basics of standard Sanskrit language, and will get to know its importance with respect to national unity, integrity, morality and spirituality.

Course outcome

At the end of this course, Students will be

- familiar with the pronunciation of Sanskrit language
- understand ancient scientific concepts, principles, and methodologies without the limitations of translations or interpretations

Introduction to Sanskrit Phonetics

Devanagiri Lipi: Swar and Vyanjan. (Writing rules,Definition,classification,Pronunciation system),Sanskrit Sentence formationand spoken Sanskrit rules.Translation:From Sanskrit to English or English to Sanskrit. Sanskrit Subhashita.

Sanskrit grammar

Sandhi (introduction, classification, Swar-Sandhi),Kāraka&Vibhakti (Definition, Types, Example). Sabdārūpa&Dhāturūpa.

Introductory Vedic & Classical Literature

Four Vedas, Āraṇyakas, Upaniṣads, Vedāṅgas, Purāṇas.Rāmāyaṇa(by Vālmīki) and **Mahābhārata** (by Vyāsa), Bhagavad Gita etc.

Introductory Vedic Mathematics and Sciences in Sanskrit:

Illustrations from book- Vedic Mathematics written by Bharati Krishna Teertha ji, (published by MLBD) –Calculation pi, square root finding, Philosophical meanings of zero and one. Surya Siddhanta. (Kalganana), Katapayadi Sankhya,NāradāŚilpa Śāstra(Architecture and Vastu Shastra), Aṣṭāṅga Hridayam.

Modern Age Possibilities: Sanskrit for ICT : Paper by Subhash Kak and Saroja Bhate Panini's Grammar and Computer Science.

Text Books:

- Sanskrit Sahitya ka Samikshatmak Itihas by Dr. Kapil Dev Dwivedi.

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B.TECH- IT(Bin)

Applicable with effect from 2023 admitted batch and onwards

Semester 1					Total Credit: 20
Sl. No.	Course Name	Code	Type	Credit	Hours L-T-P-S
1	Engineering Physics	AS1001	BSC	4	3-0-2-0
2	Linear Algebra	AS1002	BSC	4	3-1-0-0
3	Problem Solving with Programming	IT1001	ESC/VSEC	5	3-0-4-0
4	Fundamentals of Electrical & Electronics Engineering	EC1001	ESC	4	3-0-2-0
5	Technical Communication Skills	MS1001	HSMC (AEC)	2	1-0-2-0
6	Constitution of India	MS1002	HSMC (VEC)	1	1-0-0-0
	Universal Human Values	MS1003			
	Professional Ethics	MS1004			
	Art of Living	MS1005			
			Total	**20**	**14-1-10-0** / **25**

Semester 2					Total Credit: 20
Sl. No.	Course Name	Code	Type	Credit	Hours L-T-P-S
1	Computer Organization and Architecture	IT1002	PCC	4	3-0-2-0
2	Data Structures and Algorithms	IT1003	PCC	4	3-0-2-0
3	Web Development	IT1004	VSEC	2	0-0-4-0
4	Discrete Mathematical Structures	IT1005	PCC	4	3-1-0-0
5	Essentials of Business Informatics	IT 1600	PCC	3	3-0-0-0
6	Principles of Management	MS1006	HSMC (AEC)	2	1-0-2-0
7	Constitution of India	MS1002	HSMC (VEC)	1	1-0-0-0
	Environmental Studies	MS1007			
	Professional Ethics	MS1004			
	Physical Education (Sports)	MS1008			
			Total	**20**	**14-1-10-0** / **25**

Exit: After successful completion of one year (first two semesters), a student may get an exit option as per ordinance. They need to do Skill Based Courses of 6 credits additional, in summer, before exit. Department will provide a list of such courses.

Semester 3					Total Credit: 24
Sl. No.	Course Name	Code	Type	Credit	Hours L-T-P-S
1	Probability and Statistics	AS2001	BSC	3	2-1-0-0
2	Object Oriented Methodologies	IT2001	PCC	4	3-0-2-0
3	Foundation of FinTech	IT2600	PCC	3	2-1-0-0
4	Operating System	IT2003	PCC	4	3-0-2-0
5	Software Engineering	IT2004	PCC	3	2-0-2-0
6	Multi-Disciplinary Minor-1	MS2501-MS2599 AS2501-AS2599 CS2501- CS2599	MDM	3	3-0-0-0
7	Introduction to Finance	MS2002	HSMC (AEC)	2	2-0-0-0
8	**Community Services** NCC NSS Yoga Unnat Bharat Abhiyaan Ek Bharat Shreshtha Bharat NGO Prayas Other courses	 MS1010 MS1011 MS1012 MS1013 MS1014 MS1015 MS1016 MS1017-MS1020	HSMC (CEA)	2	0-0-0-4
			Total	**24**	**16-2-10-4** **32**

Semester 4					Total Credit: 21
Sl. No.	Course Name	Code	Type	Credit	Hours L-T-P-S
1	Design and Analysis of Algorithms	IT2005	PCC	4	3-0-2-0
2	Operation Research	MS2601	PCC	3	3-0-0-0
3	Computer Networks	IT2007	PCC	4	3-0-2-0
4	Digital Marketing	MS2602	PCC	3	2-0-2-0
5	Database Management System	IT2009	PCC	4	3-0-2-0
6	Multi-Disciplinary Minor-2	MS2501-MS2599 AS2501-AS2599 CS2501- CS2599	MDM	3	3-0-0-0
			Total	**21**	**17-0-08-0** **25**

Exit: After successful completion of 4 semesters, a student may get an exit option as per ordinance. They need to do ***Skill Based Courses of 6 credits***, additional, in summer, before exit. Department will provide a list of such courses.

Semester 5					Total Credit: 22
Sl. No.	Course Name	Code	Type	Credit	Hours L-T-P-S
1	Cyber Security	IT3001	PCC	4	3-0-2-0
2	Introduction to Machine Learning	IT3002	PCC/VSEC	4	3-0-2-0
3	Business Process Management	MS3601	PCC/VSEC	4	3-0-2-0
4	Artificial Intelligence	IT3004	PCC	3	2-0-2-0
5	Project-I (Research Methodology)	IT2501	ELC	2	0-0-4-0
6	Multi-Disciplinary Minor-3	MS2501-MS2599 AS2501-AS2599 CS2501- CS2599	MDM	3	3-0-0-0
7	Design Thinking and Innovation	IT3501	HSMC	2	1-0-2-0
			Total	**22**	**15-0-14-0** **29**

Semester 6					Total Credit: 20
Sl. No.	Course Name	Code	Type	Credit	Hours L-T-P-S
1	Data Analytics	IT3006	PCC	3	2-0-2-0
2	Project-II	IT3559	ELC	4	0-0-8-0
3	Biology for Engineers	AS1010	BSC	2	2-0-0-0
4	Process Mining & Analytics	IT3007	PEC	3	3-0-0-0
5	Elective-1 (X1 to X9,Y1 to Y9)	IT5501-IT5599	PEC	3	3-0-0-0
6	Multi-Disciplinary Minor-4	MS2501-MS2599 AS2501-AS2599 CS2501- CS2599	MDM	3	3-0-0-0
7	**Indian language(I1-I10)**		HSMC (AEC)	2	1-0-2-0
	Sanskrit	MS1401			
	(I2-I10)	MS1402 – MS1410			
	Foreign language(F1-F10)				
	German	MS1500			
	Japanese	MS1501			
	French	MS1502			
	(F4-F10)	MS1503-MS1510			
	Regional Language(R1-R10)				
	(R1-R10)	MS1600- MS1610			
			Total	**20**	**14-0-12-0** **26**

Exit: After successful completion of 6 semesters, a student any get an exit option after completion of the summer semester internship (3 credits) and additional 3 credit courses in summer.

X1 to X9, Y1 to Y9, I1 to I10, F1 to F10 and R1 to R10 will be decided by concerned department.

Summer Semester					Total Credit: 3
Sl. No.	Course Name	Code	Type	Credit	
1	Internship	IT4600	ELC	3	Credit will be added in VII Sem.

Note: Internship will be evaluated in the beginning of seventh semester. Its credit and grades will be reflected in the 7th Semester Grade Sheet.

Semester 7					Total Credit: 21
Sl. No.	Course Name	Code	Type	Credit	Hours L-T-P-S
1	Minor Project	IT4501	ELC	4	0-0-8-0
2	Big Data Analytics	IT4050	PCC	3	3-0-0-0
3	Elective-3(X1 to X9) (Y1 to Y9)	IT5501-IT5599	PEC	3	3-0-0-0
4	Open Elective-1		OEC	3	3-0-0-0
5	Multi-Disciplinary Minor-5	MS2501-MS2599 AS2501-AS2599 CS2501- CS2599	MDM	3	3-0-0-0
6	History of Indian Civilizations Kautilya's Arthashastra Vedic Mathematics Vedic Corpus Wisdom from the Ages Panini's Grammar (X1 to X9)	MS1800 MS1801 MS1802 MS1803 MS1804 MS1805 MS1806 – MS1815	HSMC (IKS)	2	2-0-0-0
7	Internship(Summer Semester)	IT4600	ELC	3	0-0-0-6
			Total	**21**	**14-0-8-6** **6+22**

Semester 8					Total Credit: 12
Sl. No.	Course Name	Code	Type	Credit	Hours L-T-P-S
1	Major Project	IT5601	ELC	6	0-0-12-0 0-0-0-6
2	Elective-4(X1 to X99)	IT5501-IT5599	PEC	3	3-0-0-0 0-0-0-3*
3	Open Elective-2		OEC	3	3-0-0-0 0-0-0-3*
			Total	**12**	**6-0-12-0** **18**

*8th Semester courses may be allowed to join via MOOC/NPTEL etc. Major projects may be completed as Internship cum projects. MOOC/NPTEL courses start with level 4.

Semester 7					**Total Credit:24**
Sl.No.	**Course Name**	**Code**	**Type**	**Credit**	**Hours**
					L-T-P-S
1	Minor Project	PCITPRJ451	PCC	4	0–0-8-0
2	**Big Data Analytics**	PEBIXXX403	PCC	3	2–0–2-0
3	Elective-3 BI-Elective II: **IT Project Management** + IT Electives	PEITXXX404	PCC	3	3–0-0-0
4	Open Elective-1	OEZZXXX4SS	OEC	3	3–0-0-0
5	a)History of Indian Civilizations, b)Kautiliya's Arthashastra, c)Vedic Mathematics, d) Vedic Corpus, e) Wisdom from the Ages, f) Panini's Grammar	HM-MS-XXX408	HSMC (IKS)	2	2–0-0-0
6	Internship (Summer Semester)	PC-IT-TO353	ELEC	3	0-0-0-6-0
7	*Multi-Disciplinary Minor-4*	MD-xx-XXX204	MDM	3	3–0–0-0
					13–0–10-06
				Total	**21**	**29**

Semester 8					**Total Credit:15**
Sl.No.	**Course Name**	**Code**	**Type**	**Credit**	**Hours**
					L-T-P-S
1	Major Project	PC-IT-PRJ452	ELC	6	0–0–12-0
2	*Elective-4	PE-IT-XXX402	PEC	3	3-0-0-0
3	*Open Elective-2	OE-ZZ-XXX4SS	OEC	3	3-0-0-0
4	**Multi-Disciplinary Minor-5*	MD-xx-XXX204	MDM	3	3–0–0-0
					9–0–12-0
				Total	**15**	**21**

8th Semester courses may be allowed to join via MOOC/ NPTEL.

Engineering Physics (AS1001)

Objective: Students will be able Demonstrate ability to collect, process, and analyze scientific data, display critical thinking skills in applying physics knowledge in the experimental process.

Course outcome

At the end of this course, Students will be able to

- To analyze dynamics of system of particles for applications in Physics and Engg.
- Identify, formulate and solve engineering problems requiring principles of physics
- Gain knowledge about modern physics and quantum mechanics
- Apply quantum physics to understand solid state materials
- Design & conduct experiments, analyze & interpret data

Classical Mechanics

Symmetry and conservation laws, Fermat's principle, Principle of least action, Euler Lagrange equations and its applications, Degrees of freedom, Constraints and constraint forces, Generalized momentum, Concept of phase space, Hamiltonian.

Quantum Mechanics

De Broglie's hypothesis, wave function and wave packets, phase and group velocities. Schrödinger Equation. Probabilities and Normalization, Eigenvalues and eigen functions. Infinite potential well and energy quantization. Finite square well, potential steps and barriers - notion of tunneling, band structure of solid.

Solid State Physics

Energy Bands, Carrier transport in semiconductor, mobility and resistivity, electron effective mass, Density of states, Fermi-Dirac distribution function, intrinsic carrier concentration, Mechanism of carrier scattering, Einstein relationship.

Text Books

- Classical Mechanics; H. Goldstein, C. Poole, J. Safko; Pearson Education, Third Edition (2002)
- Modern Physics by A. Beiser; McGraw-Hill Higher Education, Sixth Edition (2003)
- Introduction to Quantum Mechanics by D. J. Griffiths; Pearson Education, Second Edition (2005)
- Introduction to Solid State Physics by C. Kittel; Wiley Students Edition, (2005)
- Physics of semiconductor devices, S M Sze, John Wiley & Sons, 2006

Reference Books

- Theoretical Mechanics by M. Spiegel; McGraw Hill Education, 2017
- Feynman Lectures of Physics Vol-1 and Vol-3; The Millenium Edition, Pearson (2012)
- Quantum Physics for Atoms, Molecules, Solids, Nuclei and Particles by R. Eisberg and R. Resnick; 2nd Edition, New Delhi Wiley (2012)

Linear Algebra (AS1002)

Objective: Students will be able to solve linear equations & develop understanding of vector spaces, linear transformations, Eigen value, diagonalization and orthogonalization, least square solutions and singular value decomposition etc

Course Outcome

Students will be able to

- Understand the concept of matrices, their properties & solve linear equations
- Understand basic concepts of vector spaces, subspace, linear dependence etc
- Calculate the rank-nullity of a matrix / linear map, eigenvalues, and eigenvectors.
- Apply the Gram-Schmidt process, Find the SVD, Jordan Canonical form .
- Apply concepts of linear algebra to various applications.

Matrices and Vector Spaces

System of linear equation, Gauss elimination method, Elementary matrices, Invertible matrices, Gauss-Jordan method, Determinant, Cramer's rule, Vector spaces, Linearly independence and independence, Basis, Dimension.

Linear transformation & Diagonalizability

Linear transformation, Representation of linear maps by matrices, Rank-Nullity theorem, Rank of a matrix, Row and column spaces, Solution space of a system of homogeneous and non-homogeneous equations, Eigenvalue, eigenvector, Cayley-Hamilton theorem, Diagonalizability, minimal polynomial

Inner product space

Inner product space, Cauchy-Schwarz inequality, Orthogonal basis, Gram-Schmidt orthogonalization process, Orthogonal projection, Spectral theorem.

SVD & Jordan Canonical Form

Positive, negative, and semi-definite matrices. Decomposition of the matrix in terms of projections, Strategy for choosing the basis for the four fundamental subspaces, Least square solutions and fittings, Singular values, Primary decomposition theorem, and Jordan canonical form.

Text/Reference Books

- K. Hoffman and R. Kunze, Linear Algebra, 2nd Edition, Pearson (2015).
- Gilbert Strang, Introduction to Linear Algebra, 4th Edition, Cambridge Press (2009).
- S. Kumaresan, Linear algebra - A Geometric approach, Prentice Hall of India (2000).
- S. Lang, Introduction to Linear Algebra, 2nd Edition, Springer (2012).

Problem Solving with Programming (IT1001)

Objective: Students will be able to understand programming language (in this case C language), develop a problem-solving approach from programmer's perspective.

Course Outcome

Students will be able to:

- break down complex real-world problems into smaller, manageable subproblems and develop logical approaches for solving them through programming.
- learn to debug code, identify and fix logical errors, and write test cases.
- develop a systematic approach to problem-solving, logical reasoning, and iterative refinement.

Introduction to Computers & Demo

Computer hardware, Computer Networks, IP Address, Proxy, Gateway, Operating Systems, Disk/Directory/Files system, Application Software. Professional Ethics.

Programming Basics: Structure of a simple C program, Constants and Variables, Basic Data Types, Precedence and Associativity, implicit and explicit type conversion, Selection Statements, Loop Structures

Functions and Arrays: User-defined functions, function definition, Storage class and Scope, Macros, Nested, and Recursive Functions, One Dimensional arrays, Passing Arguments, Two and higher Dimensional Arrays, Strings, String Library Functions

Pointer and Structure: Addresses and Pointers, Structures, Dynamic Memory Allocation, Linked List, Stack, Queue. Data Files.

Text Books

- "Engineering Problem Solving with C", Delores M. Etter, Fourth Edition, 2012, Pearson.
- "C: How to Program", Paul Deitel and Harvey Deitel, Ninth Edition, 2022, Pearson.

Reference Books

- "Computer Systems: A Programmer's Perspective", Randal E Bryant and David R O'Hallaron, Third Edition, 2015, Pearson.
- "Problem Solving and Program Design in C", Jeri R. Hanly and Elliot B. Koffman, Eighth Edition, 2015, Pearson.
- "Programming in C", Brian Kernighan and Dennis Ritchie, Second Edition, 2015, Pearson.

Fundamentals of Electrical and Electronics Engineering (EC1001)

Objective: Students will be able to understand the fundamental concepts of electrical and electronics engineering.

Course Outcome
Students will be able to:

- Understand working principles of basic electrical and electronic devices and circuits.
- Design basic electronic circuits

Introduction
Basic physical laws, circuit elements, KVL, KCL, Network Theorems

Transients
R-L, R-C, R-L-C, Sinusoidal Steady State, Real/Reactive Power, Three Phase,

Transformers/AC/DC machines
Working Principles of Transformers/AC/DC machines

Semiconductors
Semiconductors, Band Diagram, n-type and p-type semiconductor, junction diode, diode biasing, Zener diode, DC Power supply

Transistors
Introduction to Bipolar Junction Transistor, MOS Capacitor, Introduction to Operational Amplifier, Schmitt Trigger, Multivibrator, Oscillators

Text Book

- Microelectronic Circuits SEDRA/SMITH 7th Edition Oxford University Press
- Fundamentals of Electrical Engineering, Leonard S Bobrow, 2nd Edition, Oxford Press.
- Fundamentals of Electrical Engineering and Electronics, B L Thereja, S Chand Press.

References

- Network Analysis, M E Van Valkenberg, 3rd Edition, PHI, 2000
- Linear Circuit Analysis: Time, Domain, Phasor and Laplace Transform Approaches, R A DeCarlo and M Lin, 2nd Edition, Oxford University Press, 2000

Technical Communication Skills (MS1001)

Objective: Students will be able to enhance and polish communication skills which will formally help them to be effective professionals by understanding importance of effective communication, presentation and designing of work.

Course Outcome
Students will be able to:

- Speak and participate in GD
- Write technical letters, CV, product development plans etc

Introduction
Introduction to types of communication, Lab sessions and mock presentation pertaining to Communication Styles, Content Management and Delivery Making Effective Public presentations, Speech and diction correction and counseling

Formal communication
Written communication, Problems and solutions Lab sessions will have exposure to: Cover letter, CV preparation Group discussion and Personal Interview Report writing and Proposal development plan, Interview: types and techniques SWOT Analysis.

Reference Books

- Winning at Interviews by Edgar Thorpe Books on Technical Writing

Constitution of India (MS1002)

Objective: Students will be able to understand the Fundamental features of the Indian Constitution, Union Government, Rights and Duties, Statutory Institutions.

Course Outcome
Students will be able to:

- Understand Indian Constitution, its composition and functions, Union and state Government
- Understand Rights and Duties, Statutory Institutions etc

Introduction
Evolution of the Indian Constitution, Acts, Fundamental features of the Indian Constitution, Union, State and Local Government.

Rights and Duties
Fundamental Rights and Duties, Directive Principles, Relation between Federal and Provincial units: Union-State relations, Administrative, legislative& Financial, Inter-State Council, NITI Ayog, Finance Commission of India, Union List, State List, Concurrent List, Statutory Institutions: Elections-Election Commission of India, National Human Rights Commission, National Commission for Women

Reference

- D.D. Basu, Introduction to the Constitution of India, Lexis Nexis, New Delhi
- Subhash Kashyap, Our Parliament, National Book Trust, New Delhi
- Peu Ghosh, Indian Government &Politics, Prentice Hall of India, New Delhi

Universal Human Values (MS1003)

Objective: Students will be able to understand the human values.

Course Outcome
Students will be able to:

- Understand the importance of human values, family, society, nature etc.
- Develop commitment and courage to act.

Introduction
Development of a holistic perspective based on self-exploration about themselves (human being), family, society and nature/existence, Understanding (or developing clarity) of the harmony in the human being, family, society and nature/existence

Self Reflection
Right understanding Strengthening of self-reflection, Development of commitment and courage to act, Method to fulfill the human aspirations: understanding and living in harmony at various levels.

Reference

Professional Ethics (MS1004)

Objective: Students will be able to understand the awareness on Engineering Ethics and Human Values.

Course Outcome
Students will be able to:

- Understand social responsibility of an engineer etc.
- To appreciate ethical dilemma while discharging duties in professional life.

Values
Human Values Morals, Integrity, Work Ethics, Honesty, Courage, Empathy etc. Kohlberg's theory, Gilligan's theory, Models of Professional Roles.

Ethics
Codes of ethics, Challenger case study, Safety and Risk, The Three Mile Island And Chernobyl Case Studies, global issues, moral leadership

Reference

- Mike Martin and Roland Schinzinger, “Ethics in Engineering”, McGraw-Hill, New York 1996.
- Govindarajan M, Natarajan S, Senthil Kumar V. S, “Engineering Ethics”, Prentice Hall of India, New Delhi, 2004.
- Charles D. Fleddermann, “Engineering Ethics”, Pearson Education / Prentice Hall, New Jersey, 2004 (Indian Reprint now available).
- Charles E Harris, Michael S. Protchard and Michael J Rabins, “Engineering Ethics – Concepts and Cases”, Wadsworth Thompson Leatning, United States, 2000 (Indian Reprint now available)
- John R Boatright, “Ethics and the Conduct of Business”, Pearson Education, New Delhi, 2003.

Youth Empowerment and Skills (MS 1005)

Objective: To equip students with practical tools and techniques that will make them more creative, efficient, confident, clear-minded, stress-free, joyful and energetic

Course Outcome
Students will be able to:

- learn challenges and will learn group processes, talks, presentations and hands-on learning methodology that helps students to enhance their lives.
- Participate in Group discussions and role-plays to inculcate life-skills and human values
- Yoga Asanas and Pranayama to increase concentration & build confidence
- Breathing techniques (like the world-renowned and well-researched Sudarshan KriyaTM)
- Talks and Presentations to bring out attitudinal and behavioral changes towards achieving student excellence.

Personality Development
Personality Development Self-awareness, Emotional Intelligence / Coping with Emotions, Mind Management, Coping with Stress, Health and Nutrition, Social Adaptability and Effectiveness Effective Communication Skills, Interpersonal Relationship Skills, Lifestyle and Environment

Ethics
Ethics, Morality and Integrity, Time Management and Goal Setting, Professional Skills, Active Learning and Effective Learning Strategies, Decision Making

Reference

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Computer Organization and Architecture (IT1002)

Objective: To make student learn the basic concepts of computer architecture and organization, and understand the key skills of constructing cost-effective computer systems**.**

Course Outcome

- To understand the basic operations of computing hardware interface and system-level programming, compilers, assemblers, instruction sets etc.
- Understand merits/demerits for performance, design process of a computer, memory hierarchy, cache design, microprocessor designs etc.

Introduction

Basic organization of computer and block level description of the functional units; Review of Digital Systems, Memory system design, FSM, Fixed and Floating-point data.

Computer Arithmetic and Design of ALU

Integer Data computation, Floating point arithmetic, Design of 8/16/32 bit ALU

CPU Architecture

Register Organization, Instruction formats, Instruction interpretation and Sequencing, RTL, addressing modes, instruction set. Case study - instruction sets of MIPS processor and ARM.

Assembly language programming

ARM instruction set, Introduction to Memory and Memory parameters. Classifications of memories, Allocation policies, Memory hierarchy and interleaving

Cache memory

Concept, architecture, mapping techniques. Virtual Memory, Page replacement policies. Data Path and Control Unit design, Memory, bus structure, hardwired and microprogrammed design approaches, Case study - design of a simple CPU

I/O Organization and Peripherals

I/O subsystems, DMA, privileged and non-privileged instructions, software interrupts & exceptions. Assessing and Enhancing Performance of Computer Systems; Pipelining, hazards, Flynn's classifications, Architectures - Multi-core systems, GPU

Text Book

- David A. Patterson and John L. Hennessy, Computer Organization and Design: The Hardware/Software Interface Morgan Kaufmann ARM Edition, 2010.

Reference Book

- C. Hamachar, Z.Vranesic and Safwat Zaky, Computer Organization, McGraw Hill
- William Stallings, Computer Organization and Architecture: Designing for Performance, Pearson Education
- John P. Hayes, Computer Architecture and Organization, McGraw Hill
- Morris Mano, Computer System Architecture, Pearson Education

Data Structures and Algorithms (IT1003)

Objective: To make student learn the linear and non-linear structures in which data can be stored and their pros and cons & to write algorithms using different data structures.

Course Outcome

- Understanding of data structures, linked-lists, trees, binary search trees, AVL trees, stacks, queues, priority queues, and hash-tables and graphs, ADT
- To apply & implement learned algorithm design techniques and data structures to solve problems.

Introduction, Arrays and Linked Lists
Basic Terminology, Elementary Data Organization, Asymptotic notations Efficiency of an Algorithm, Time and Space Complexity and trade-off**,** Single and Multidimensional Arrays, Sparse Matrices, Single, Double and Circularly Linked List, Header node based Linked List, Operations on a Linked List. Insertion, Deletion, Traversal, Polynomial Representation and Addition, Generalized Linked List

Abstract Data Types (ADT), Searching and Sorting, **Priority Queues**
Stacks: Primitive Stack operations (Push & Pop) Implementation and Application of stack, Queue Implementation and Applications, Doubly Ended Queue, Sequential search, Binary Search, Comparison Sorting Techniques, Efficient Sorting Techniques, linear sorting techniques, Queue Definition & Implementation.

Hashing, Trees & Graphs- Hash table, hash function, collison & resolution strategies, Linear and Quadratic Probing, Trees, Binary Tree Representation, Expression Tree, Binary Tree Traversals, Binary Search Trees, Sequential & linked Representations of Graphs, Adjacency Matrix, Adjacency List, Graph Traversals, Connected Components, Minimum Cost Spanning Trees, Prims & Kruskal algorithm, Dijkstra algorithm

Text Books

- E. Horowitz, S. Sahni, S. Anderson-Freed “Fundamentals of Data Structures in C”, Second Edition, 2008, Universities Press.
- R. Kruse et al. , *Data Structures and Program Design in C,* Pearson Education
- S. Lipschutz , *Data Structures, Schaum's Outlines Series,* Tata McGraw-Hill.
- Mark Allen Weiss, “Data Structures and Algorithm Analysis in C (DSAC)”, Second Edition, 2002, Pearson Education India.

Reference Books

- “Algorithms Design”, Jon Kleinberg and Eva Tardos, First Edition, 2013, Pearson.
- “The C Programming Language”, Brian W. Kernighan and Dennis M. Ritchie, Second Edition, 2015, Pearson Education India.
- “Introduction to Algorithms”, Thomas H Cormen, Charles E Leiserson, Ronald L Rivest, Clifford Stein, Third Edition, 2009, MIT Press.

Web Development (IT1004)

Objective: To make students aware about the latest technologies in Web development and to give hands-on exposure on web development technologies.

Course Outcome
Students will be able to:

3. learn about the latest technologies in web development and get hands-on exposure on web development technologies.
4. to use the web application frameworks in web development and to deploy the modern web development tools and techniques.

Introduction to Web Development
Overview of web technologies, Web development tools and environments, HTML (Hypertext Markup Language), Working with text, links, images, and tables, Semantic HTML and accessibility, HTML forms and input validation, multi-page websites.

CSS (Cascading Style Sheets) & JavaScript
CSS and its role in web design, CSS selectors, properties, and values, Layout and positioning of HTML elements, Responsive design and media queries, JavaScript syntax, variables, and data types, Control structures, DOM manipulation and event handling, JavaScript frameworks/libraries, Backend Development, server-side programming & language, Handling HTTP requests/responses, Working with databases

Web Application Frameworks, Security and Deployment
Web application framework, frontend frameworks, State management and data binding, web vulnerabilities, Best practices for secure web development, User authentication and authorization, Optimization, Techniques for improving website performance, Web Deployment and Hosting, Setting up a web server, Deploying web applications.

Text Books

- Jon Duckett “HTML and CSS: Design and Build Websites”, First Edition, 2011, John Wiley & Sons
- Jon Duckett “JavaScript and jQuery”, First Edition, 2014, Wiley.

Reference Books

- “The Web Developer Bootcamp", by Colt Steele
- “Modern JavaScript from The Beginning 2.0 - 2023 Revamp
- The Complete Web Developer Course 3.0
- Web Design for Everybody: Basics of Web Development & Coding by University of Michigan

Discrete Mathematical Structures (IT1005)

Objective: To make student learn the fundamental mathematical concepts and terminology for discrete mathematics and structures.

Course Outcome

Students will be able to

- Understand logic and proof techniques
- Apply the above techniques in counting and solving recurrence relations
- Analyze real-world models using graph theory
- Extend their usefulness in succeeding courses in algorithm design and analysis, computing theory, software engineering, and computer systems

Methods of Proof, Logic & Proofs

Proof by contradiction, Proof by induction-weak and strong induction, Structural induction, Proof by proving the contrapositive, Proof by cases, and Proof by counter-example. Logic. Propositional Logic, Truth tables, Deduction, Resolution, Predicates and Quantifiers, Mathematical Proofs. Infinite sets, well-ordering. Countable and Uncountable sets, Cantor's diagonalization.

Sets and Sequences

Finite Sets, Power Set, Cardinality of finite sets, Cartesian Product, Properties of Sets, Vector Implementations of Sets.

Counting & Combinatorics

Counting, Sum and product rule, Principle of Inclusion Exclusion. Pigeon Hole Principle, Counting by Bijections. Double Counting. Linear Recurrence relations - methods of solutions. Generating Functions. Permutations and counting.

Relations, Graphs & Algebraic Structures

Relations, Equivalence Relations. Functions, Bijections. Binary relations, Posets and Lattices, Hasse Diagrams, Boolean Algebra, and Graphs and Trees. Structured sets with respect to binary operations. Groups, Semigroups, Monoids. Rings, and Fields.

Text Books

- Discrete Mathematics and its Applications, Kenneth H. Rosen, 7th Edition -Tata McGraw Hill Publishers, 2011.
- Mathematics for Computer Science, Eric Lehman; F Thomson Leighton; Albert R Meyer, 2010.

Reference Books

- Logic in Computer Science, Huth and Ryan, Cambridge University Press, 2014.

Essentials of Business Information (IT1600)

Objective: In this course, students will acquire the introductory and key aspects of business informatics. The theoretical foundations, methodologies and tools will also be introduced in this introductory course

Course Outcomes
The students will be able to:

- Have a good understanding of the basic concepts of Process Mining.
- Understand the role of Data Science in Today's Life.
- Have a good understanding of the data needed to start a process mining project.

Information Technology and the Modern Enterprise
Technical Foundation of Business Informatics: IT influence on Businesses, IT influence on Finance, Marketing, HR, Operations etc. Overview and Introductory concepts: Fin Tech, Digital Marketing, Digital Transformation with BPM, Case Studies.

Information Systems
Characteristics & Components, Types of IS: MIS, ERP, Managing Digital Firms: Global E-business and Collaboration. IT Infrastructure and Emerging Technologies: Evolution of Web, Client-Server to Distributed Computing, Cloud Computing, Emergence of Mobile Digital platform: Mobile Apps, Data driven systems, Transactional data, Operational data and data for Machine Learning: Characteristics and Use Cases.

Data Science Vs Process Science
Introduction to BPM (Business Process Management), Characteristics of Business Process, Types of Business Processes, Bottlenecks of Business Processes, Business Process Mining Introductory concepts.

E-Commerce& AI driven Business
History and evolution Key business models: B2B, B2C, C2C, D2C, E-commerce infrastructure and technology stack Supply Chain & Logistics. Recent trends in AI for Businesses.

References Books:

- Basics of Business Informatics by Peter Weber, Roland Gabriel • Thomas Lux • Katharina Menke Springer-Vieweg, Berlin, 2021
- Information Systems: A manager's Guide to Harnessing Technology (Version 9.0) by John Gallaugher-Flat World.
- MIS-Managing the Digital Firm (13th Edition) by Kenneth C Laudon. Jane P. Laudon.(Pearson)

Principles of Management (MS1006)

Objective: This course is designed to be an overview of the major functions of management. It explores how organizations develop and maintain competitive advantage within a changing business environment. Upon completion, students should be able to work as contributing members of a team utilizing these functions of management.

Course Outcome

Students will be able to

- Understand how organizations adapt to an uncertain environment and identify techniques managers use to influence and control the internal environment.
- Practice the process of management's four functions: planning, organizing, leading, and controlling.

Nature and Functions of Management

Importance and Process of Management, Development of Management Thoughts, Managerial Roles.

International Business and its Environment

Globalization & WTO, Dynamics of development Global business environment, Internal Tech. of Forecasting.

Need for Organization

Principles and Process of Organizing, Authority, Delegation and Decentralization

Staffing and Directing

Requirement of Effective Direction

Text Book

- Koontz, Weihrich, Aryasri. Principles of Management, TATA McGraw Hill, New Delhi, 2004.

References

- P. C. Tripathi, P. N. Reddy, Principles of Management, Tata McGraw-Hill Publishing Company Limited, New Delhi.
- Prasad LM, Principles and Practice of Management, Sultan Chand & Sons, New Delhi.
- Samuel C. Certo, S. TrevisCerto, Modern management 10 Ed, PHI Learning, New Delhi, 2008
- James A. Stoner, Edward Freeman, Daniel Gilbert, Management, PHI Learning, New Delhi, 2007
- Williams/ Kulshrestha, Principles of Management, Cengage Learning, New Delhi, 2011

Environmental Studies (MS1007)

Objective: To make student learn the importance of environmental studies, different resources, ecosystem etc.

Course Outcome

Students will be able to

- Understand the Multidisciplinary nature of environmental studies.
- Structure and function of an ecosystem
- Environmental Pollution etc.

Nature of Environmental studies, Ecosystems

Definition, Scope and importance, Need for public awareness. Different resources, Concept of an ecosystem, Structure and its function, Food chains, Different eco systems, Biodiversity, Threats, In-situ and Ex-situ conservation of biodiversity.

Environmental Pollution & Field Work

Causes, effects and control measures of different pollution, Nuclear hazards, Pollution case studies, Disaster management, Water conservation, rain water harvesting, watershed management, Case studies on Environmental ethics, Climate change, global warming, Case studies. - Wasteland reclamation, Environment Protection Act, Water Act, Wildlife Protection Act, Visit to a local polluted site and Study of ecosystems.

References:

- Agarwal, K.C.2001 Environmental Biology, Nidi Publ. Ltd. Bikaner.
- BharuchaErach, The Biodiversity of India, Mapin Publishing Pvt.Ltd. , Ahmedabad — 380 013, India, Email: mapin@icenet.net (R)
- Brunner R.C., 1989, Hazardous Waste Incineration, McGraw Hill Inc.480p
- Clark R.S., Marine Pollution, Clanderson Press Oxford (TB)
- Cunningham, W.P.Cooper, T.H.Gorhani, E &Hepworth, M.T.2001. Environmental Encyclopedia, Jaico Publ. House. Mumbai, 1196p
- Dc A.K., Environmental Chemistry, Wiley Eastern Ltd.
- Down to Earth, Centre for Science and Environment(R)
- Gleick, 11.P. 1993. Water in crisis, Pacific Institute for Studies in Dev., Environment & Security. Stockholm Env. Institute. Oxford Univ. Press. 473

Physical Education (Sports) (MS1008)

Objective: To aware the students on the importance of physical education for a healthy life and train them on various sports, games, yoga, etc. for physical fitness.

Course Outcome

Students will be able to

- Understand the knowledge of various ways for maintaining both physical and mental wellness

Know your body

First Aid for basic medical conditions, CPR for emergency, Diabetic and Obesity condition of Indian and world, Importance of physical education.

Yoga and Meditation

Yoga for wellness and concentration, Meditation for wellness

Athletics and Aquatics

Rules, benefits and mastering of various track and field events such as Sprint, Marathon, Hurdles, Long Jump, High Jump, Javelin throw, Shot Put, Discus throw, etc.

Rules, benefits and mastering of various styles of swimming, butterfly, freestyle, backstroke, and breaststroke, Sports for physical fitness like Cricket, basketball, football, volleyball, etc.

References:

- Dr. V K Sharma, “Health and Physical Education”. New Sarasvati House Publishers.
- “Yoga: A Healthy Way of Living”. By National Council of Educational Research and Training.
- Mark Young. “The Complete Beginners Guide to Swimming”.
- Dr. Ashwini Bhardwaj. “A Complete Guide to Family Safety and First Aid”. GoodWill’s Publishers.

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Probability and Statistics (AS2001)

Objective: This course provides an elementary introduction to probability and statistics with applications. The topics covered in this course are basic concept of probability and statistics, random variables, probability distributions, Bayesian inference, joint probability distributions, random vectors, central limit theorem, confidence intervals.

Course Outcome

Students will be able to:

- Understand the basic concepts of probability and random variables.
- Apply the standard discrete and continuous probability distributions to real problems and use the inequalities.
- Extend the concept of random variables to higher dimensions and approximate probabilities by central limit theorem.
- Analyze the data by using statistical techniques of point and interval estimation and testing of hypotheses.

Probability: Axiomatic definition, Properties, Conditional probability, Bayes rule and independence of events, Random Variables, Distribution function

Probability Distributions: Discrete and Continuous random variables, Expectation, Function of random variable, Moments, Moment generating function, Chebyshev's and Morkov's inequality. Bernoulli, Binomial, Geometric, Negative binomial, Hypergeometric, Poisson, Discrete uniform, Continuous uniform, Exponential, Gamma, Normal.

Random vector: Joint distributions, Marginal and conditional distributions, Moments, Independence of random variables, Covariance, Correlation, Levy's Central limit theorem (independently and identically distributed with finite variance case), Normal approximation to Binomial and Poisson

Statistics: Introduction: Population, Sample, Parameters, Point Estimation: Method of moments, Maximum likelihood estimation, Unbiasedness, Consistency, Interval Estimation: Confidence interval, Tests of Hypotheses, Linear Regression.

Text/Reference Books

- Sheldon M. Ross, An Introduction to Probability Models, 10th Edition, Academic Press, Elsevier.
- Sheldon M. Ross, An Introduction to Probability and Statistics for Engineers and Scientists, 3rd Edition, Academic Press, Elsevier.
- Rohatgi, V. K. and Saleh, A. K. (2000), An Introduction to Probability and Statistics, 2nd Edition, Wiley-interscience.
- Bertsekas, D. P. and Tsitsiklis, J. N. (2008), Introduction to Probability, Athena Scientific, Massachusetts.

Object Oriented Methodologies (IT2001)

Objective: To learn the concept of Object Orientation and its applicability in modeling real life scenarios and to get acquainted with UML Diagrams and Object Oriented Analysis Processes, and concepts like data abstraction, encapsulation, inheritance etc.

Course Outcomes

Students will be able to

5. Understand and apply the object-oriented approach in software development.
6. Optimize the codes by applying the concepts of modularity, reusability etc.
7. Design Java programs to model real-world systems and analyze their behavior using object-oriented principles and create models for software design using Unified Modeling Language (UML).
8. Apply Design principles for a flexible, maintainable software design

Introduction

Characteristic differences between Procedural and Object Oriented approach for programming, Concepts of Class, Objects, and Object Oriented Characteristics. Building upon basic programming skills in OO, specifically using basic Java programming constructs for object-oriented problem solving (e.g., Classes: Abstraction, inheritance, interfaces, polymorphism), Methods in OO Programming: Method overloading and overriding.

Models

Design and analysis of larger, more complex programs using Object Oriented Modeling with UML. Need for models, Static and Dynamic modeling diagrams, and role of Use Case Diagrams. Role of Object orientation in problem solving, Java program to model a real world system, and subsequently analyze its behavior. Java implementation for GUI, Event handling and Applets for Web enabled applications. Developing Applications with GUI and Database connectivity.

UML

Overview of UML, Class Diagrams Object Diagrams. Sequence Diagrams, Collaboration Diagrams, Static Diagrams: Working with Diagrams and role of Modeling, Making Effective use of UML, Communicating with Others, Back end documentation What to keep, and What to throw away, Iterative Refinement Behavior, Iterative Refinement Minimalism, Object Oriented design Principles & Intro to Design Patterns.

Text Books:

- H. Schildt, Java 2: A Complete Reference 4th ed, McGraw-Hill, 2001
- G. Booch, Object-Oriented Analysis and Design with Applications 2nd Edition, PHI, New Delhi, 1993

Foundation of Fin Tech (IT2600)

Objective: To provide an understanding of the historical development and transformation of FinTech, and to examine the principles and applications of crypto-currencies, blockchain technology, and alternative finance models.

Course Outcomes

Students will be able to

- Understanding history, opportunities, and challenges of FinTech.
- Exploring innovative products and business models.
- Navigating legal and regulatory issues and AI role and data protection in digital finance and applying data analytics for finance.

Introduction & History of Data Regulation:

FinTech Transformation, FinTech Evolution 1.0, FinTech Evolution 2.0, FinTech: Opportunities and challenges, Rise of new TechFins, Innovative products in mobile-based, person to person, credit cards, pos based ecosystem.

Cryptocurrencies and Blockchain: Alternative Finance; Developing Countries and DFS: The Story of Mobile Money; Developing Countries and DFS: Regulation of Mobile Money; Legal and Regulatory Implications of Cryptocurrencies; ICO (Initial coin offering)

Digital Finance: A Brief History of Financial Innovation; Digitization of Financial Services; Crowdfunding; FinTech & Funds, Case study of FinTech startups; FinTech ecosystem, players, processes, modes and various charges; FinTech Regulations; Challenges of Data Regulation; Innovation in consumer and retail payments led by govt & private sector; new payments banks

AI is Transforming the Future of FinTech: Governance; New Challenges of AI and Machine Learning in finTech; AI in Smart Regulation and Fraud Detection; Redesigning Better Financial Infrastructure-case studies; Data in Financial Services Application of Data Analytics in Finance; Methods of Data Protection: GDPR Compliance and Personal Privacy; Digital Identity; Case studies on data-driven finance- Alibaba, Aadhar, Paytm, BHIM etc.

Text Books:

- The Fintech Book: The Financial Technology Handbook for Investors, Entrepreneurs and Visionaries by Susanne Chishti
- Digital Bank: Strategies to launch or become a digital bank (Kindle Edition by Chris Skinner
- Fintech in a Flash: Financial Technology Made Easy by Agustin Rubini
- The Business Blockchain: Promise, Practice, and Application of the Next Internet Technology by William Mougayar

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Operating Systems (IT2003)

Objective: To make student learn the design and services provided by an operating system particularly xv6 operating system.

Course Outcome
Students will be able to:

- Understand operating systems
- Memory management, input-output and storage management
- concept of distributed systems, OS Systems security etc.

Introduction, System Calls & Process and Thread Management
OS Basics, Definition, Operating Systems as resource manager, Evolution of OS, Structural overview, Types of System Call, Hardware requirements, Process Model, Process States, Operation on Process, System calls for process operations, Overview of Threads, Multithreading Models, Threads and their Management; POSIX Threads, Implementing Threads in User space and Kernel space

CPU Scheduling, Interprocess Comm., Process Synchronization & Deadlocks
Scheduling Criteria & Algorithms, Multiple-Processor Scheduling, Concept of shared memory, message passing, pipes, The Critical-Section Problem, Peterson's Solution, Synchronization, Semaphores, Problems of Synchronization, Dynamic Resource Allocation, Deadlock Characterization, Prevention, Avoidance, Detection, Recovery

Memory Management, Input Output and Storage Management, File Management
Main Memory Basics, Swapping, Contiguous Memory Allocation, Paging, Structure Segmentation, Virtual Memory, Demand Paging, Page Replacement, Allocation of Frames, Thrashing, Principles of I/O hardware, I/O Software Layers, Mass-Storage Structure, Disk Scheduling & Management, File Concept, Protection, Mounting, Sharing, Structure, Implementation, Directory Implementation, Allocation Methods

Advanced Topics
Multiprocessor Hardware and OS, scheduling and synchronization, multicomputer hardware, distributed shared memory, remote procedure call, concept of distributed systems; OS Systems security, controlling access to resources, exploiting software

Text Book

- R H. Arpaci-Dusseau and A C. Arpaci-Dusseau “Operating Systems: Three Easy Pieces”, Arpaci-Dusseau Books, November, 2023 (Version 1.10)

Reference Book

- P. B. Galvin and G Gagne “Operating System Concepts”, Abraham Silberschatz, 8th Edition, 2008, Wiley.
- A S. Tanenbaum and H Bros “Modern Operating Systems” 4th Edition, 2015,
- W Stallings “Operating Systems: Internals and Design Principles”, Prentice Hall

Software Engineering (IT2004)

Objective: To apply software engineering theory, principles, tools and processes, as well as the theory and principles of computer science and mathematics, to the development and maintenance of complex, scalable software systems

Course Outcome

Students will be able to:

- Understand and apply software lifecycle development models to effectively manage the software development process and
- utilize software design principles and modeling to develop scalable and maintainable software systems.
- Develop and implement project plans, apply metrics for measurement, estimate costs etc in software project development to ensure quality.

Introduction to Software Engineering

Software characteristics, Software components, Software applications, Software Engineering Principles, Software metrics and measurement, monitoring and control. Software development life-cycle, various model and recent developments in models.

Requirements

Elicitation Techniques, Requirements analysis, Modeling and Architecture, Functional versus object-oriented approach of design, design specification, Cohesiveness and Coupling. Overview of SA/SD Methodology, structured analysis, UML diagrams. Data flow diagrams (DFDs), extending DFD to structure chart.

Software project Planning

Project scheduling. Software Metrics: Size Metrics, Cost estimation using models like COCOMO. Risk management, Software Reliability and Quality Assurance: Reliability issues, Reliability metrics, reliability models, Software quality, ISO 9000 certification for software industry, SEI capability maturity model, Client server software development.

Verification and validation

Code inspection, test plan, test case specification. Level of testing, Various testing Top down and bottom-up integration, Alpha and Beta, System and debugging, functional structural testing, Software testing strategies, Software reliability and quality, Software maintenance and reuse, Structured Vs unstructured maintenance, Maintenance Models, Configuration Management, Reverse Engineering, Software Re-engineering.

Text Books

- Sommerville “Software Engineering”, Tenth ed, 2016, Pearson Education .
- R S. Pressman & B R. Maxim “Software Engineering: A practitioner’s approach”, Eighth Edition, 2014, Mcgraw-Hill.

Reference Book

- W. S. Jawadekar “Software Engineering: Principles and Practice”, 2004, Tata McGraw-Hill Education.

Introduction to Finance (MS2002)

Objective of the Course: This course is a rigorous introduction to the study of the basic principles of finance and their application to the usual financial issues and decision-making of business enterprises. The main objective of this course is for the student to obtain at least a good working-knowledge of the topics stated in the tentative course outline below for use in future courses and for careers.

Course Outcome
Students will be able to:

- Identify the objective of the firm and the role of managerial finance.
- Outline the implications of the separation of ownership and control.
- Evaluate financial statements using ratio analysis.
- Explain the general concept of valuing financial assets.
- Explain the characteristics of debt and equity securities.
- Identify why firms need to invest in working capital Outline the alternative sources of long-terms fund.

Introduction to financial Management
Financial statement basics, Ratio Analysis

Time value of Money
Capital Budgeting, Relationship between risk and return

Long term financial decisions
Working Capital Management, Dividend Decision

Introduction to Financial Systems
Capital Markets, Introduction to International finance and risk Management

Text Books ·

- Ross, Westerfield, Jordan, Essentials of Corporate Finance
- James C. Van Horne and John M Wachowicz, Fundamentals of financial management.
- Jonathan Berk, Financial Management

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Design and Analysis of Algorithms (IT2005)

Objective: To analyze the asymptotic performance of algorithms, Write rigorous correctness proofs for algorithms and to demonstrate a familiarity with major algorithms and data structures.

Course Outcome

Students will be able to:

- Demonstrate the ability to fully understand the analysis of various known algorithms.
- Identify problems where algorithm design paradigms can possibly be applied.
- Explain graph algorithms and their analysis and to understand the notions of computational intractability and learn how to cope with hardness
- Synthesize efficient algorithms in common engineering design situations.

Introduction

Basic concepts, Growth of Functions – Asymptotic Notations, Tradeoff between Time and Space Complexities, Searching and Sorting - Sorting in Linear Time

Divide and Conquer & Randomized Algorithms

Definition, Designing, Analysis, Proof of Correctness, Recurrence Relations, Master's Theorem, Definition, Designing, Analysis, Proof of Correctness

Dynamic Programming & Greedy Algorithms

Definition, Designing, Analysis, Proof of Correctness, Longest common subsequence, Optimal Binary Search Trees, Matrix Chain Multiplication, Definition, Designing, Analysis, Proof of Correctness, Interval scheduling, Huffman tree, Knapsack problems

Graph Algorithms & Complexity classes

Traversal, Topological sort, Minimum Spanning Tree, Single Source Shortest Path, All Pairs Shortest Path, Maximum Flow, P, NP, NP-Complete, NP-Hard

Approximation Algorithms

Definition, Designing, Analysis, Proof of Correctness, Vertex cover problem, Travelling Salesman problem, Subset Sum Problem,

Text Books

- T H Cormen, C E Leiserson, R L Rivest, and C Stein E, Introduction to Algorithms, MIT Press, 4th edition, 2022.

Reference Books

- J Kleinberg, and E Tardos, Algorithm Design, Pearson, 1st edition, 2013

Operation Research (MS2601)

Objective: To grasp the fundamental concepts and techniques of operations research and to develop skills in formulating and solving linear and nonlinear optimization problems.

Course Outcomes

Students will be able to:

- Explore methods for decision-making under uncertainty and risk
- Apply operations research techniques to real-world business and IT problems to improve efficiency and decision-making
- Develop proficiency in solving LP problems using graphical, algebraic, simplex methods.

Linear Programming

Terminology and formulations, Graphical and Algebraic solutions to LP, Simplex methods and its variants: Algebraic form, Tabular form, Types of LPs, Matrix method, Duality: Writing the dual of an LP, Primal-Dual relationships.

Dual

Basic understanding, significance, interpretation, Dual Simplex algorithm

Problem

Transportation Problem, Assignment Problem, Solving LPs using Solver, Sensitivity analysis, Game theory: Two Person Zero-Sum Game, Theorems of Game Theory, Solution of Mixed Strategy Games, Linear Programming method for solving games,

Text Books:

- "Operations Research: Principles and Applications" by G.Srinivasan, PHI Learning Private Limited.
- "Operations Research: An Introduction" by Hamdy A. Taha, Pearson.
- "Operations Research: Principles and Practice" by Ravindran, Phillips and Solberg, Wiley India
- "Operations Research: Concepts and Cases" by Hillier and Liberman, McGraw-Hill

Computer Networks (IT2007)

Objective: To grasp the fundamental concepts of computer networking, including the OSI model, TCP/IP protocol suite, network topologies, and addressing schemes and to learn about various networking protocols and technologies.

Course outcomes
Students will be able to:

- Explain the fundamental concepts of computer networking, including the OSI model, TCP/IP protocol suite, network topologies, and addressing schemes.
- Apply various networking protocols and technologies, such as Ethernet, TCP, IP, UDP, HTTP, DNS, DHCP, etc.
- Use network management principles & to Assess network problems systematically and implement effective solutions.
- Use emerging networking technologies such as SDN, NFV, and IoT

Introduction to Computer Networks
Evolution of computer networks, networks topologies. Layering and protocols.

Physical Layer & Data link layer: Different types of transmission media, errors in transmission: attenuation, noise. Repeaters. Encoding (NRZ, NRZI, Manchester, etc. Error detection, Sliding Window, Stop and Wait protocols, Framing, HDLC, PPP, Channel Access Protocols, Token Ring, Wireless LAN, Virtual circuit switching.

Network Layer & Transport Layer: Internet addressing, Internet Protocol (IPv4, IPv6), ARP, ICMP, DHCP, Internet QoS, routing algorithms (RIP, OSPF, BGP), Software Defined Networking, UDP, TCP, Connection establishment and termination, Sliding window revisited, Buffer Management and Congestion Control at the Transport Layer, Timers, Retransmission.

Session, Presentation, and Application Layers: DNS, SMTP, IMAP, HTTP, etc.

Text Books:

- S. Tanenbaum, Computer Networks, 4th Ed, Pearson India, 2003.
- L. L. Peterson and B. S. Davie, Computer Networks: A Systems Approach, 4th Ed, Elsevier India, 2007.

Reference Books:

- J. F. Kurose and K. W. Ross, Computer Networking: A Top Down Approach, 3rd Ed, Pearson India, 2005.
- D. E. Comer, Internetworking with TCP/IP Vol. 1, 5th Ed, Prentice Hall of India, 2006.
- B. Forouzan, Data Communications and Networking, 5th Ed, Tata Mcgraw Hill, 2013.

Digital Marketing (MS2602)

Objective: To introduce the fundamental concepts of digital marketing and the evolving media landscape and to examine the impact and advantages of digital media over traditional media in today's marketing plans.

Course Outcomes
Students will be able to:

- Design and execute effective digital marketing strategies, incorporating audience targeting content creation and social media marketing.
- Analyse digital marketing performance using web analytics tools to optimize campaigns and improve ROI.
- Leverage SEO, SEM, and social media to build brand presence and engage target audiences across digital platforms.
- Plan and manage digital advertising campaigns on different platforms Understand business and revenue models in the digital space,

Fundamental
Fundamental Marketing Concepts, 7D of digital marketing, RACE concept, Digital audience, Digital device, digital marketing goal and strategy.

Models
Business model, revenue model, online marketplace, digital branding and marketing mix, types of digital media.

Design
Website design, CMS platform, and types, social media marketing, content marketing-mail marketing, Google keyword planner, Google trend.
Analytics
Google analytics, web analytics, Facebook and LinkedIn analytics, blog site designing, and tracking.
Google ad words, campaign planning, cases.
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References Book:

- "Digital Marketing: Strategy, Implementation and Practice" by Dave Chaffey and Fiona Ellis-Chadwick
- "E-Marketing" by Judy Strauss, Raymond Frost, and Alexa Fox
- "Digital Marketing Excellence: Planning, Optimizing and Integrating Online Marketing" by Dave Chaffey and PR Smith
- "Understanding Digital Marketing: Marketing Strategies for Engaging the Digital Generation" by Damian Ryan

Database Management System (IT2009)

Objective: The main objective of this course is to provide students with the background to design, implement, and use database management systems.

Course Outcomes
Students will be able to:

- Apply knowledge of database techniques to develop relational models and identify and define the information needs and requirements appropriate to its' business context and solution.
- Use current relational database techniques, skills, and tools necessary for developing information systems.
- Develop the ability to explore recent advances like NoSQL and Linked data principles etc. along with applications towards data warehousing & data mining.

Database Systems
Introduction of Data Base systems, User Categories and Architecture, Data Abstraction and Independence. Data Modeling, Mapping Cardinalities, Generalization, Specialization and Aggregation, Case Study ER Diagrams.

Basic of SQL, **SQL & PL/SQL**
Overview of Query Language, SQL, Queries, Relational Model, Concepts of Keys, Weak Entity, Surrogate Keys, CODD Rules, Anomalies in Relational Model, Mapping from ER Model to Relational Model, Data Manipulation Language and DDL Operations, Set Operations, Aggregate Functions, Nested Subqueries, Modification of the Database, PL/SQL, Data Types, Program structure, Embedding SQL statements, Using conditional statements and loops, Functions and Procedures, Cursor, Triggers.

Relational Algebra & Transactions and Concurrency Control
Basic & Extended Operators, Joins, nested query in DBMS, Tuple Relational Calculus, Relational Database, Functional Dependencies, Attribute Closure, Canonical Cover, Decomposition, ACID Properties, Transaction Atomicity, Durability, Isolation, Serializability, Schedule, Isolation Levels. Lock-Based Protocols, Deadlock Handling, Multiple Granularity, Timestamp based Protocols, Index Locking, Recovery.

Query Processing
Overview, Measuring Query Cost, Selection Operation, Sorting, Join Operation, Query Optimization, Transformation of Relational Expressions, etc. Storage and File structure

Text Books

- Silberschatz, Korth and Sudarshan, Database System Concepts, McGraw-Hill.

Reference Books

- R Ramakrishnan, and J Gehrke, Database Management Systems McGraw-Hill.
- R E, Shamkant B. Navathe, Addison-Wesley, Fundamentals of Database Systems (6th ed.)

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Cyber Security (IT 3001)

Objective: The course is outlined with the objective to inculcate necessary skill, education and abilities among the students in the sphere of cyber security

Course Outcome:
Student will be able to:

- Model attack vectors & defense control in confidentiality, integrity and availability.
- Implement Symmetric & Asymmetric cryptographic algorithms & Test the security of the web application, Vulnerability Assessment and Penetration Testing.
- Design and Secure the Network Infrastructure by implementing IDS, Firewalls and Analysis of Malware to find out Indicator of Compromise.

Introduction and basic terminology
Cyber Security and CIA Triad, basic cyber threats to CIA, cyber-attack surfaces, recent cyber-security incidents and their high-level analysis

Basic Cryptography & Authentication, Authorization and Privilege
Role in confidentiality for data at rest, motion, process. Symmetric and Asymmetric Cryptography, Hashing and Digital Signature and some example, understanding digital signature, Digital Certificate and PKI., role of PRNG, strong Authentication, distinction between authorization and authorization, access control, Mandatory and Discretionary Access control, role based authorization, privilege and privilege escalation.

Application Security
Method of Reconnaissance, Port Scanning and Enumaration. Stages of Vulenaribility Assessment. Owasp Model. Basic application vulnerabilities, Basic mitigations of buffer overflow, Web Client Security, DOM, Java Script Vulnerability, Cookies and Cookie attributes Secure, http only, session and session ID, hijacking, http vs. https and SSL/TLS and version issus, XSS, CSRF, SQL Injection, Command Injection concepts, Vulnerabilities in DNS, Routing and IP protocols & suggested remedies.

Perimeter protection & Network Security
Host Intrusion Detection techniques, Network Intrusion Detection, Snort, Firewall vs. Intrusion Detection tool, Firewall rules and customization techniques. Various malware classes and their characteristics, static & dynamic analysis, Signature vs. behavioral detection., WEP, evil twin attack, unauthorized access point based attacks.

Text Book

- J. Anderson "Security Engineering"Ross, Security Engineering, 3rd Ed. Wiley,
- William Stallings "Cryptography and Network Security" 7th Ed. Pearson,

References

- D Stuttard and M Pinto "The Web Application Hacker's Handbook: Finding and Exploiting Security Flaws" , 2nd Edition, ISBN: 978-1118026472.
- Peter Kim, The Hacker Playbook: Practical Guide To Penetration Testing (vol. 1 and 2) by. Third Edition, ISBN: 978-1980901754

Introduction to Machine Learning (IT3002)

Objective: This course gives an introduction to machine learning. It is about unified understanding of the models and algorithms used in machine learning.

Course Outcomes
Students will be able to:

- Understand Core Concepts of Machine Learning, comprehend the fundamentals of supervised, unsupervised, and reinforcement learning and their applications.
- Develop Predictive Models and implementation of different algorithms.
- Optimize Learning Models and apply optimization techniques.
- Analyze and Evaluate Models and to perform model evaluation
- Explore Dimensionality Reduction and Latent Models and to gain foundational knowledge of deep neural networks and reinforcement learning.

Course Logistics and Introduction to Machine Learning
Supervised learning, Decision Trees for Classification and Regression, Random Forest, Bagging, Boosting, Linear Regression, Learning via Probabilistic Modeling

Probabilistic Models for Supervised Learning
Discriminative and Generative Approaches, Basics of Convexity, Gradient Descent, Stochastic GD Hyperplane based Classifiers (Perceptron and SVM) SVM (Contd), Multiclass and One-Class SVM Making Linear Models Nonlinear via Kernel Methods
Intro to Unsupervised Learning
K-means Clustering and Extensions, Parameter Estimation in Latent Variable Models Expectation Maximization-GMM Model Selection, Evaluation Metrics, Learning from Imbalanced Data Linear and Non-Linear Dimensionality Reduction Bias/Variance Trade-off, Some Practical Issues, Semi-supervised and Active Learning

Introduction to Artificial Neural Networks
Introduction to Deep Neural Networks, Learning to Recommend via Matrix Factorization/Completion, Reinforcement Learning

Text Book:

- Duda, Peter Hart, David Stork, “Pattern Classification”, Wiley; Second edition
- Tom Mitchell, “Machine Learning”.
- Hal Daumé III, “A Course in Machine Learning (CIML)”, 2017 .

Reference Book:

- Christopher Bishop, “Pattern recognition and machine learning”, Springer, 2007.
- Kevin Murphy, “Machine learning: a probabilistic perspective”, MIT Press, 2012.
- E. Alpaydin, “Machine Learning”,(https://www.cmpe.boun.edu.tr/~ethem/i2ml3e/)
- Kevin Murphy, “Machine Learning: A Probabilistic Perspective (MLAPP)”, MIT Press, 2012

Business Process Management (MS3601)

Objective: To introduce Business Process Modeling Notation and to analyze existing business processes to identify inefficiencies and improvement opportunities.

Course Outcomes

Students will be able to:

- Understand BPM concepts, methodologies, and lifecycle stages and learning of process identification, selection, modeling, and improvement techniques.
- Mastering process analysis and improvement strategies like Lean and Six Sigma.
- Understanding of process design and redesign strategies, Integrating IT with BPM, including WFMS and BPA tools.

Introduction

Introduction to Business Process, BPM Lifecycle, Importance of BPM in modern organizations, Process Identification, Process Selection. Introduction, concepts, properties, methodology, architecture and applications of business processes. The Different phases of Business Process Management Lifecycle.

Process Modeling

Introduction to BPMN: Will be discussed with process modelling and Business Process Modelling and Notations (BPMN). Elements of BPMN: events, activities, gateways, and flows, Branching and Merging, Creating BPMN diagrams

Process Analysis & Improvement Techniques

Techniques for analyzing business processes, Identifying inefficiencies and bottlenecks, Root cause analysis and improvement, process design and improvement: Lean, Six Sigma, Strategies for process redesign and reengineering, BPM and Architecture, Implementation Refine a BPMN model with workflow-specific activities. Real-life examples for business process modelling and innovation with group presentations.

IT and BPM

Workflow Management Systems, Implementation & Business Process Automation (BPA), Tools and technologies for BPA, Benefits and challenges of BPA

Text Books

- Business Process Change, Paul Harmon
- Business Analysis, Debra Paul; Donald Yeates & James Cadle

Reference Book

- Fundamentals of Business Process Management, Marlon Dumas, La Rosa, Marcello, Jan Mendling, Hajo A. Reijers
- Business Process Management: Concepts, Methods, Technology, Mathias Weske

Artificial Intelligence (IT3004)

Objective: To introduce the basic principles of Artificial Intelligence, problem solving, and knowledge representation

Course Outcomes

Students will be able to:

- Grasp the historical, ethical implications & basic principles of artificial intelligence
- Apply search algorithms, optimization methods, & game strategies to design intelligent problem-solving systems & decision-making and planning.
- Use probabilistic reasoning, Bayesian networks, and decision theory to address uncertainty in dynamic environments and
- Apply decision trees, ensemble methods, and reinforcement learning to learn from observations.

Introduction

Definition, History, The Turing Test, Machine Learning and Robotics, Expert Systems, Current status of AI, Weak AI, Strong AI, Ethics and Risks of Developing AI, Intelligent Agents, Agent programs, Different agents, Components, Agent Architectures

Problems Solving by Searching

Searching for Solutions, Uninformed Search Strategies, Iterative deepening, Bidirectional search, Search Strategies and Optimization, Genetic algorithms, CSP, Intelligent backtracking, minimax algorithm, Alpha-Beta Pruning, Real-Time Decisions

Knowledge Engineering

Knowledge-Based Agents, Propositional and first order logic, Knowledge Engineering, Inference, Unification and Lifting, Forward & Backward Chaining, Ontological Engineering, Planning, Planning Graphs, Logic; Acting in the Real World- Time, Schedules, and Resources, Hierarchical Task Network Planning, Conditional Planning

Uncertainty

Uncertainty, Axioms, Inference Using Full Joint Distributions; Probabilistic Reasoning, Bayesian Networks, Hidden Markov Models, Kalman Filters, Utility Theory, Decision Networks, Expert Systems, Making Complex Decisions, Inductive Learning, Learning Decision Trees, Ensemble, Statistical Learning Methods, Reinforcement Learning

Text Books

- P Norvig and S J. Russell, Artificial Intelligence: A Modern Approach, 4th ed. Pearson Education, 2022
- Deepak Khemani, First Course in Artificial Intelligence, 6th Ed., McGraw Hills,

Reference Books:

- K Knight, E Rich, S B. Nair, Artificial Intelligence, 3rd Ed., McGraw Hills, 2017
- J P Mueller, L Massaron, Artificial Intelligence For Dummies, 2nd Ed., O'Reilly,2021

Design Thinking and Innovation (IT 3501)

Objective: The objective of this course is to learn the innovation cycle of Design Thinking process for developing innovative products.

Course Outcome

Student will able to

- Compare and classify the various learning styles and memory techniques and Apply them in their engineering education
- Analyze emotional experience and Inspect emotional expressions to better understand users while designing innovative products
- Develop new ways of creative thinking and Learn the innovation cycle of the Design Thinking process for developing innovative products
- Propose real-time innovative engineering product designs and Choose appropriate frameworks, strategies, and techniques during prototype development and to perceive individual differences and its impact on everyday decisions and further Create a better customer experience

An Insight to Learning, Remembering Memory & Emotions

Kolb's Learning Styles, Assessing and Interpreting, Understanding the Memory process, Problems in retention, Memory enhancement techniques, Understanding Emotions:

Basics of Design Thinking & Being Ingenious & Fixing Problem

Definition, Need, Objective, Concepts & Brainstorming, Stages of Design Thinking Process, Bottlenecks of Processes-Process Centric approach, Creative thinking process, Problem Solving, Testing Creative Problem Solving

Process of Product Design, Prototyping & Testing and Celebrating the Difference

Process of Engineering Product Design, Design Thinking Approach, Stages of Product Design, User Interface Design, Mobile App Design, Prototype creation, Rapid Prototype Development process, Testing, Test Group Marketing, Group Discussion

Design Thinking & Customer Centricity & Feedback, Re-Design & Re-Create

Practical Examples of Customer Challenges, Use of Design Thinking to Enhance Customer Experience, Feedback loop, rapid prototyping & testing, final product, Creative Solution".

Text Book

Reference Book

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Data Analytics (IT3006)

Objective: The objective of this course is to make student learn about mining issues and methods/algorithms.

Course outcomes:
Students will be able to:

- Get exposure of data analysis steps
- Perform data preprocessing task
- Apply logic to implement different category of Algorithms

Introduction
Fundamentals of data mining, Data Mining Functionalities, Classification of Data Mining systems, Major issues in Data Mining, Preprocessing the Data (Data Cleaning, Integration, Transformation & Reduction)

Mining Association Rules
Association Rule Mining, Mining Single-Dimensional Boolean Association Rules from Transactional Databases, APRIORI, Variations of APRIORI (Sampling, Hash Based, Partitioning, Transaction Reduction), Frequent Pattern Growth, Mining Multilevel Association Rules from Transaction Databases, Mining Multidimensional Association Rules, Concept of LIFT, Clustering of Association rules.

Classification and Prediction
Classification by Decision Tree Induction, Bayesian Classification, Classification & Prediction continues, Classification by Back propagation, Classification Based on concepts from association Rule Mining, SVM, Regression Analysis, Classifier Accuracy.

Clustering
Data types in cluster analysis, Categories of clustering methods, partitioning methods- K-Means, PAM, CLARA, CLARANS, KNN. Hierarchical Clustering- Agglomerative and Divisive Clustering, BIRCH and Chameleon, Density Based methods-DBSCAN, CURE, OPTICS, Grid Based Methods- COBWEB

Text Book

- J. Han, M. Kamber, Jian Pei “Data Mining: Concepts and Techniques” 3rd Edition, 2011

References

- Hadzic F., Tan H. & Dillon T. S. “Mining data with Complex Structures,” Springer, 2011
- Yates, R. B. and Neto, B. R., “Modern Information Retrieval” Pearson Education, 2005

Biology for Engineers (AS1010)

Objective: The objective is to provide the fundamental knowledge of Modern Biology and its application.

Course Outcome

Students will be able to:

- Get basic understanding of the Advanced Biology
- Get exposure to different areas of Biology including Cell Biology, Microbiology, Molecular Biology, Biochemistry and Immunology.
- Learn the principles of different advanced laboratory techniques used in biological research works and interdisciplinary research.

Introduction

Introduction to living organisms, Different cell organelles and cellular processes. Prokaryotes and Eukaryotes cells.

Structures and functions

Structures and functions of bimolecules, DNA, RNA, Carbohydrates, Proteins and Lipids.

Immunity, Electrical signal & Biomaterials

Antigen, Antibody, Antigen-Antibody interactions, Electrical signal of cells, HH model. Concept of Stem cells, Differentiation, Characterization**,** Biomaterials for tissue engineering, 3D bio-printing, DNA origami and Biocomputing.

Text book

- Bruce Alberts, Alexander Johnson, Julian Lewis, David Morgan, Martin Raff, Keith Roberts, and Peter Walter, Molecular Biology of the Cell.

References

- Prescott, Harley, and Klein's Microbiology by Joanne M. Willey, Linda Sherwood, and Christopher J. Woolverton.
- Biochemistry by Jeremy M. Berg, John L. Tymoczko, and Lubert Stryer.
- Immunology by Thomas J. Kindt, Richard A. Goldsby, Barbara A. Osborne, Janis Kuby.

Process Mining & Analytics (IT 3007)

Objective: The objective is to provide the key aspects of business process analytics and a solid foundation for studies in the Process mining field.

Course Outcome
Students will be able to:

- Have a good understanding of the basic concepts of Process Mining.
- Understand the role of Data Science in Today's Life.
- Have a good understanding of the data needed to start a process mining project.

Process Analytics
Analytics as a combination of Process Modeling and Process Mining, Characteristics and challenges of standard business processes, Process modeling notations: BPMN, Petri Nets, and modeling tools, Types of business processes: Order-to-Cash (O2C), Procure-to-Pay (P2P), Hire-to-Retire (H2R), Quote-to-Order (Q2O), Sample event logs for different processes and their significance, Benefits of process mining and actionable insights from event data analysis.

Business Process types and Organizational structures
Introduction to Event Log Data & Traces and their attributes, Using various Process Mining Tools for Event Data processing, Process mining tools for event data processing (PM4Py, ProM, Celonis, Disco), Petri net analysis in process mining.

Basic process discovery, process discovery algorithms
Process discovery algorithms: Alpha Miner, Heuristic Miner, Inductive Miner, and Genetic Miner, Software tools for process discovery, Quality dimensions, Conformance checking and Process enhancement, Process model matching and similarity. Concept of conformance checking in process mining, Importance of aligning event logs with process models, conformance analysis, Methods, Token-based replay, Alignment-based conformance checking, Fitness, precision, generalization, and simplicity metrics.

OCPM (Object Centric Process Mining)
Multi-Entity Event Logs, Object-Centric Event Data Model, Object-Centric Petri Nets (OCPN), Discovery of OCPM, Quality metrics for OCPM, AI applications in process mining using a Large language model, Explainable AI in Process mining

Text book

- Basics of Business Informatics by Peter Weber, Roland Gabriel • Thomas Lux • Katharina Menke Springer-Vieweg, Berlin, 2021
- Information Systems: A manager's Guide to Harnessing Technology (Version 9.0) by John Gallaugher -FlatWorld

References

- MIS-Managing the Digital Firm (13th Edition) by Kenneth C Laudon. Jane P. Laudon.(Pearson)

French Language (MS 1502)

Objective: To equip students with the necessary skills to understand, speak, read, and write French effectively, allowing them to communicate in everyday situations, including basic grammar, vocabulary, pronunciation, and cultural understanding, often aiming to reach a specific proficiency level.

Course outcome
At the end of this course, Students will

- be familiar with the pronunciation of French letters and greetings
- would be able to count numbers
- would be able to form basic questions and answer them and would be able to read the city map, converse of time and appointments etc

Introduction
Personal Information, Introducing yourself (name, age, nationality), Family members Basic greetings and farewells

Basic Communication
Asking and answering simple questions, Expressing likes and dislikes, Making requests.

Numbers and Time
Counting, Telling time, Days of the week and months

Everyday Life
Describing daily routines, Talking about hobbies and interests, Weather descriptions

Places and Directions
Asking for and giving directions, Identifying basic places in a town

Shopping and Dining
Making simple purchases, Ordering food and drinks

Basic Grammar
Subject-verb agreement, Present tense verb conjugation, Basic sentence structure, Articles (le, la, les, un, une)

German Language (MS 1500)

Objective: The student will learn the basics of standard German language, and will get to know about the norms of language of German.

Course outcome
At the end of this course, Students will

- Be familiar with the pronunciation of German letters and greetings
- would be able to count numbers
- would be able to form basic questions and answer them and would be able to read the city map, converse of time and appointments etc

Introduction
Alphabets, Numbers, Greetings

Phrases
Basic introductory phrases

Calenders
Days of the week, Months

Introduction of self and introduction of others
Map, Time, Vocabulary- things around, Nations and nationalities, stationery, professions, hobbies

Grammar
present tense, past tense, plurals, pronouns, verb conjugations, (regular, and three or four important irregular verbs), prepositions, and so on

Japanese Language (MS 1501)

Objective: The student will learn the basics of standard Japanease language, and will get to know about the norms of language of Japan.

Course outcome

At the end of this course, Students will

- Be familiar with the pronunciation of Japan letters and greetings
- would be able to count numbers
- would be able to form basic questions and answer them and would be able to read the city map, converse of time and appointments etc

Introduction

Introduction to Japanese Syllables (phonetic alphabet), greetings & Self introduction, Identifying things, point objects and listen to their names, Listen to things and places etc. Creating shopping lists

Time Delay

Introduction to Time, day of the week, simple inquiries on telephone, Means of transport, Basic conversations of everyday life.

Frame questions in Japanese

Vocabulary of giving and receiving objects. Stating impressions/things surrounding us, Expressing likes and dislikes, good/bad, possessions. Talking about the country, town and the environment.

Quantity

Number of people, time, period etc., Stating thoughts and impressions. Conveying movement (e.g. go / come)

Sanskrit Language (MS 1401)

Objective: The student will learn the basics of standard Sanskrit language, and will get to know its importance with respect to national unity, integrity, morality and spirituality.

Course outcome

At the end of this course, Students will be

- familiar with the pronunciation of Sanskrit language
- understand ancient scientific concepts, principles, and methodologies without the limitations of translations or interpretations

Introduction to Sanskrit Phonetics

Devanagiri Lipi: Swar and Vyanjan. (Writing rules,Definition,classification,Pronunciation system),Sanskrit Sentence formationand spoken Sanskrit rules.Translation:From Sanskrit to English or English to Sanskrit. Sanskrit Subhashita.

Sanskrit grammar

Sandhi (introduction, classification, Swar-Sandhi),Kāraka&Vibhakti (Definition, Types, Example). Sabdārūpa&Dhāturūpa.

Introductory Vedic & Classical Literature

Four Vedas, Āraṇyakas, Upaniṣads, Vedāṅgas, Purāṇas.Rāmāyaṇa(by Vālmīki) and **Mahābhārata** (by Vyāsa), Bhagavad Gita etc.

Introductory Vedic Mathematics and Sciences in Sanskrit:

Illustrations from book- Vedic Mathematics written by Bharati Krishna Teertha ji, (published by MLBD) –Calculation pi, square root finding, Philosophical meanings of zero and one. Surya Siddhanta. (Kalganana), Katapayadi Sankhya,NāradāŚilpa Śāstra(Architecture and Vastu Shastra), Aṣṭāṅga Hridayam.

Modern Age Possibilities: Sanskrit for ICT : Paper by Subhash Kak and Saroja Bhate Panini's Grammar and Computer Science.

Text Books:

- Sanskrit Sahitya ka Samikshatmak Itihas by Dr. Kapil Dev Dwivedi.

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ELECTIVES

(Some of the elective's syllabus are as follows)

Visual Recognition (IT5525)

Objective: To introduce the basic principles of visual recognition, CNN, Generative and Large-Language Models.

Course Outcomes

Students will be able to:

- Apply the concepts to solve some real problems in recognition.
- Use computational visual recognition for problems ranging from extracting features, classifying images, to detecting and outlining objects and activities in an image or video.
- Use ML and deep learning concepts to solve the visual recognition problems and to invent new methods in visual recognition for various applications.

Introduction

Visual Recognition Introduction, Overview and Historical Context, Image Features, Feature Detection, Properties of Features, Feature Representation, Regional Descriptors-SIFT and Local Descriptors-LBP. Data-driven Approaches, Neural Networks.

Convolutional Neural Networks: CNN Architectures for Image Recognition, Residual Concept, Object Detection, Semantic Segmentation, and Dense Prediction.

Generative and Large-Language Models: Adversarial Attack and Defense, Image Generation, Variational Auto-encoders, Generative Adversarial Networks, Recurrent Neural Network, Image Captioning, Visual Question Answering, Attention Mechanism, Self-Attention, Transformer Models.

Recent Research Trends: Biometrics: Video Recognition, Video Analytics: Scene Understanding, Action Recognition, Crowd Behavior Analysis, Surveillance Systems; Super-resolution, Image-to-Image Translation, etc.

Text Books

- “Computer Vision: Algorithms and Applications”, Richard Szeliski, Second Edition, 2022, Springer.
- “Deep Learning”, Ian Goodfellow, Aaron Courville, and Yoshua Bengio, First Edition, 2016, The MIT Press.

Reference Books

- “Computer Vision: A Modern Approach”, Forsyth and Ponce, Second Edition, 2015, Pearson Education India.

Deep Learning (IT5505)

Objective: To introduce the basic principles of different deep architectures, mathematics involved in deep learning solutions and to develop deep learning solutions.

Course Outcomes

Students will be able to:

- Acquire knowledge of different deep architectures for different data modalities.
- Be exposed to the background mathematics involved in deep learning solutions, and categorize deep architecture to use for solving problem in deep learning.
- Set up the hyperparameters and train the deep learning models and validate the trained models.
- Develop deep learning solutions for real-world problems.

Neural Networks

Machine learning challenges motivating deep learning. Basic concepts of perceptron. Overfitting and underfitting, bias and variance, Fundamentals back propagation algorithm, Gradient based optimization. Deep Neural Network.

Convolutional Neural Networks

Convolutional Neural Networks (CNN), Training Aspects of Neural Networks, Activation Functions, Gradient Descent Optimizers, Weight Initialization, Regularization, Dropout, Batch Normalization, Data Augmentation, Transfer Learning, etc.

CNN Architectures

State-of-the-art CNN Architectures and Applications. Self-supervised Learning, Deep Network Visualization, Generative Adversarial Networks (GAN) and variants

Recurrent Neural Networks

Recurrent Neural Networks (RNN), RNN Variants, Attention Model, Deep Reinforcement Learning, and Trends in Deep Learning.

Text Books

- “Deep Learning”, Ian Goodfellow, Aaron Courville, and Yoshua Bengio, First Edition, 2016, The MIT Press.

Reference Books

- “Neural Networks and Deep Learning: A Textbook:, Charu C. Aggarwal, First Edition, 2018, Springer
- “Deep Learning with Python”, François Chollet, First Edition, 2017, Manning Publications.
- “Neural Networks and Deep Learning”, Michael Nielsen, First Edition, 2015, Determination Press.
- “Learning Deep Architectures for AI”, Yoshua Bengio, First Edition, 2009, Now Publishers.

Computer Vision (IT5526)

Objective: To introduce the basic principles of computer vision, image enhancement, filtering, and segmentation.

Course Outcomes

Students will be able to:

- Understand the fundamental concepts and principles of computer vision and apply image processing techniques for tasks such as image enhancement, filtering, and segmentation and Implement feature extraction methods.
- Utilize machine learning algorithms for classification in computer vision.
- Develop new state-of-the-art computer vision methods.

Introduction

Human Vision & Computer Vision, Eye & Brain, Low, Intermediate & High level Vision, Visual Perception, Processing, Illusions, Structuralism, Gestaltism, Ecological Optics, Marr's 2.5 D Sketch, Color Perception & Processing, neuromorphic computing.

Viewing through Camera

Multiview Geometry Camera, Image and World Reference Frames, Camera Calibration. Perspective, and Epipolar Geometry, Binocular Stereopsis, Homography, Rectification, DLT, RANSAC, Depth Map and 3D reconstruction, Depth Estimation stitching.

Shape, Surface and Shading, Filtering, Feature Detection and Matching

Brain Inspired High level vision computing, Simulation of Visual Attention and Visual Memory Processes. Shape from X and Motion Analysis Light at Surfaces, Phong Model, Reflectance Map, Albedo estimation, Photometric Stereo, Use of Surface Smoothness Constraint, Shape from Texture, color, motion and edges. Image Filtering, Feature level Processing, Hough transform, Harris corner detector, Image pyramid, Scale Invariant Feature Transform, Surfaces Extraction; Principal Component Analysis and Eigenfaces

Image Segmentation & Motion Models, Convolutional Neural Networks

Expectation-Maximization algorithm, active contour model, Background Subtraction and Modeling, Optical Flow, KLT, Spatio-Temporal Analysis, Dynamic Stereo, Motion parameter estimation; Motion Models and Analysis; Rigid and Non–Rigid Body Motion, Basics, Projects on applying computer vision algorithms to the real-world problem.

Text Books

- Computer Vision: A Modern Approach, D. A. Forsyth, J. Ponce, Pearson Education, 2nd edition, 2012.
- Computer Vision: Algorithms and Applications, Richard Szeliski, Springer, 2nd edition, 2022.

Reference Books

- Handbook of Computer Vision and Applications, Vol.1, Vol.2, Vol.3, by Bernd Jahne, Horst Haubecker, and Peter Geibler (Eds.), Academic Press, London, 1999.

Parallel and Distributed Computing (IT5518)

Objective: To introduce the basic principles of various parallel and distributed computing platforms

Course Outcome

Students will be able to:

- Understand the basics of various parallel and distributed computing platforms.
- Identify the models and frameworks best suited to various workloads.
- Apply parallel and distributed computing techniques to solve real world problems
- Develop critical analytical skills to evaluate and analyze the performance of parallel and distributed programs.

Introduction to PDC

Latency vs Bandwidth, Applications and Challenges, Types of architecture, Flynn's taxonomy, Basic concepts: cores, nodes, threads, processes, speedup, efficiency, overhead, strong and weak scaling (Amdahl's law, Gustafson's law), Cache, Principle of Locality, Programming Models

Parallel Computing

Shared memory, data & task parallelism, Synchronization, Concurrent Data Structures, Shared Memory Programming with available APIs: PThreads, OpenMP, TBB

GPU Programming

GPU Architecture, Programming Models: CUDA/OpenCL, Basic Concepts: Threads, Blocks, Grids, GPU memory hierarchy, Thread Scheduling, Warps and Control divergence, Memory Coalescing, Programming with CUDA, Using: CuBLAS, CuFFT.

Distributed Computing

Distributed Memory, Message Passing Interface, Asynchronous/Synchronous computation/communication, concurrency control, fault tolerance, Distributed Programming with Open MPI

Textbooks:

- "Introduction to Parallel Computing", Ananth Grama, Anshul Gupta, George Karypis, Vipin Kumar, Addison-Wesley, Second Edition.
- "Programming Massively Parallel Processors: A Hands-on Approach", Wen-Mei W Hwu, David B Kirk, Morgann Kaufmann, Third edition.

References:

- "The Art of Multiprocessor Programming", Maurice Herlihy and Nir Shavit, Morgan Kaufmann Publishers.
- "Principles of Parallel Programming", Calvin Lin and Larry Snyder, Addison-Wesley.
- "Introduction to Parallel Programming", Peter S. Pacheo, Morgan Kaufmann Publishers.

Natural Language Processing (IT5527)

Objective: To introduce the fundamental concepts of NLP and deep learning

Course Outcomes

Students will be able to:

- Understand the fundamental concepts of NLP and deep learning.
- Implement basic NLP preprocessing tasks and deep learning models.
- Analyze the performance and effectiveness of various NLP models.
- Evaluate ethical considerations and potential biases in NLP applications and design and develop custom NLP solutions using advanced DL techniques.

Overview of NLP, Data Cleaning and Preparation

Basic Linguistic Concepts; Linguistic structures; Core NLP Tasks; NLP Tools and Libraries; Ethical Considerations; OpenAI, Hugging Face, ChatGPT, Text Normalization and Standardization, Tokenization, Stemming and Lemmatization, Regular Expressions, Text Vectorization; Data Preparation: One-Hot Encoding, BoW, Term Frequency-Inverse Document Frequency, Word Embeddings, Word2Vec, GloVe, FastText

Deep Learning for NLP

Word Embeddings: Word2Vec, GloVe, FastText, Contextual embeddings: ELMo, BERT; CNN- Applying CNNs to text data, RNN, LSTM, GRUs; text classification and sentiment analysis; Encoder-decoder architecture, machine translation and text summarization; Introduction to attention, Self-attention; Transformers, BERT, GPT; Pre-trained models and fine-tuning; Evaluation Metrics: Accuracy, precision, recall, F1-score, BLEU, METEOR, ROUGE, CIDEr

NLP Applications: Text classification using ML/DL; Image Caption Generation; Pre-trained CNN models to extract image features; combining CNNs and RNNs; Attention mechanisms to improve caption quality; transformers for image captioning; text Generation techniques.

Text Books

- “Deep Learning for Natural Language Processing”, Stephan Raaijmakers, First edition, 2022, Manning Publications.
- “Natural Language Processing with Python”, Steven Bird, Ewan Klein, and Edward Loper; First Edition, 2011, O'Reilly Publications
- “Natural Language Processing in Action”, Hobson Lane, Hannes Hapke, and Cole Howard, First Edition, 2019, Manning Publications

Reference Books:

- “Transformers for Natural Language Processing” Denis Rothman, First Edition, 2021, Packt Publishing
- “Applied Natural Language Processing with Python” Taweh Beysolow II, First edition, 2018, Apress
- “Natural Language Processing with Transformers”, Revised Edition, Lewis Tunstall, Leandro von Werra, Thomas Wolf, 2022, O'Reilly

Database Security (IT5528)

Objective: To introduce the security issues in the local and remote database

Course Outcomes

Students will be able to:

- Understand the security issues in the local and remote database and Learn different security techniques to secure the database against various attacks.
- Understand the overhead of the security techniques and the need for an efficient security mechanism.
- Learn the method to create the data ownership proof.
- Understand the applicability of the database security in real life applications.

Introduction to Database

Relational Database & Management System, ACID Properties, Normalization, RAID, Relational Algebra, Query tree, Data Abstraction - Physical Level, Logical Level & View Level, Multi-level Database, Distributed Database

Security issues in Database

Possible Attacks, Polyinstantiation - Integrity Lock - Sensitivity Lock – Security Models – Access Control (Grant & Revoke Privileges) - Statistical Database, Differential Privacy. Distributed Database Security. Outsourced Database and security requirements – Query Authentication Dimension – Condensed RSA, Merkle Tree, B-$^{+}$ Tree with Integrity and Embedded Merkle B-Tree –

Partitioning & Mapping

Keyword Search on Encrypted Data - Text file. Geospatial Database Security – Geospatial data models – Geospatial Authorization, Access Control Models: Geo-RBAC, Geo- LBAC. Privacy-Preserving Data Mining – Introduction - Randomization method: Privacy Quantification, Attacks on Randomization, Multiplicative Perturbations, Data Swapping - *K*-Anonymity framework, L-Diversity, t-closeness, Distributed Privacy-Preserving Data Mining.

Database Watermarking

Basic Watermarking Process - Discrete Data, Multimedia, and Relational Data – Attacks on Watermarking - Single Bit Watermarking, Multi bit Watermarking.

Reference Books

- Michael Gertz and Sushil Jajodia (Editors), Handbook of Database Security: Applications and Trends, ISBN-10: 0387485325. Springer, 2007
- Osama S. Faragallah, El-Sayed M. El-Rabaie, Fathi E. Abd El-Samie, Ahmed I. Sallam, and Hala S. El-Sayed, Multilevel Security for Relational Databases by; ISBN 978-1-4822-0539-8. CRC Press, 2014.
- Bhavani Thuraisingham, Database and Applications Security: Integrating Information Security and Data Management, CRC Press, Taylor & Francis Group, 2005.

Blockchain Technology (IT 5529)

Objective: To introduce the need and working of block chain technology, its variants and implementation.

Course Outcomes

Students will be able to:

- Understand the need and working of blockchain technology and its variants.
- Understand the basic components of the implementation of the blockchain technology and the implementation in cryptocurrency and various attacks.
- Learn to implement blockchain technology in various non cryptocurrency applications and to develop a blockchain based real time application.

Basics

Distributed Database, Two General Problem, Byzantine General problem and Fault Tolerance, Hadoop Distributed File System, Distributed Hash Table, ASIC resistance, Turing Complete. Cryptography: Hash function, Digital Signature - ECDSA, Memory Hard Algorithm, Zero Knowledge Proof.

Blockchain

Introduction, Advantage over conventional distributed database, Blockchain Network, Mining Mechanism, Distributed Consensus, Merkle Patricia Tree, Gas Limit, Transactions and Fee, Anonymity, Reward, Chain Policy, Life of Blockchain application, Soft & Hard Fork, Private and Public blockchain. Sybil Attack, Distributed Consensus: Nakamoto consensus, Proof of Work, Proof of Stake, Proof of Burn, Difficulty Level.

Cryptocurrency

Distributed Ledger, Bitcoin protocols - Mining strategy and rewards, Ethereum - Construction, DAO, Smart Contract, GHOST, Vulnerability, Attacks, Sidechain, Namecoin, Cryptocurrency Regulation: Stakeholders, Roots of Bitcoin, Legal Aspects - Cryptocurrency Exchange, Black Market and Global Economy, Attacks - Layer 2 Blockchain Attacks, Stateless Blockchain, Hyperledger Fabric and IOTA, Anonymous Blockchain -Monero, Blockchain Applications: Internet of Things, Medical Record Management System, Domain Name Service and Web 3.0.

Text Book

- Arvind Narayanan, Joseph Bonneau, Edward Felten, Andrew Miller and Steven Goldfeder, Bitcoin and Cryptocurrency Technologies: A Comprehensive Introduction, Princeton University Press (July 19, 2016).
- Venkatesan Subramanian, Sandeep Kumar Shukla and Mohan Dawan, Blockchain and Cryptocurrency [Book Draft]

References:

- Wattenhofer, The Science of the Blockchain,2016
- Antonopoulos, Mastering Bitcoin: Unlocking Digital Cryptocurrencies, 1st Edition, 2015
- Satoshi Nakamoto, Bitcoin: A Peer-to-Peer Electronic Cash System

Remote Sensing and GIS (IT5530)

Objective: To introduce the concept of Remote Sensing and GIS principles

Course Outcomes
Students will be able to:

- Understand Remote Sensing and GIS principles.
- Work on Remote Sensing and GIS Data for various applications.

Remote Sensing Principles
Scope of remote sensing, Remote sensing imagery, Energy sources and radiation principles, Electromagnetic radiation and its interaction with the surfaces and atmosphere, Land observation satellites, Active and Passive Remote sensing

Image Acquisition
Fundamentals of image acquisition, Digital photographic sensor systems, The role and importance of digital data, Ground truth, Image interpretation, Various Earth observation missions, Microwave, LiDAR, Thermal sensor systems, The role of image resolution in projects integrating remote sensing and GIS

Image Analysis
Image preprocessing (i.e. radiometric, geometric corrections, and feature extraction), Pattern recognition, Shape analysis, Textural analysis, Digital image classification, Accuracy assessment, Hyperspectral remote sensing

Geographic Information System and Remote Sensing Applications
Information system, Components of GIS, Geospatial data architecture, Geographic co-ordinate systems, Map projections, GIS categories, GIS data types, Data Representation, Data sources, GIS software, Land use/land cover analysis, Geologic, geomorphic, soil and hydrologic phenomena at a variety of scales

Text Book

- Thomas M. Lillesand, Ralph W. Kiefer, Jonathan W. Chipman, Remote Sensing and Image Interpretation, 7th Ed. John Wiley & Sons, 2015
- Kang tsung Chang, Introduction to Geographical Information System, 9th Ed. Tata McGraw Hill, 2020.

References:

- George Joseph, C. Jeganathan, Fundamentals of Remote Sensing, 3rd Ed. Universities Press, Hyderabad 2018
- A.M. Chandra and S.K. Ghosh. Remote Sensing and Geographical Information system, 2nd Ed. Alpha Science International Ltd. 2015

Big Data Analytics (IT5517)

Objective: To introduce the concept of big data analytics and its application

Course Outcomes
Students will be able to:

- Perform a detailed study of big data analytics.
- Apply big data analytics in practical problems.

Introduction to Big Data and its importance
3 Vs and more, Big data analytics, Big data applications. Hadoop & Hadoop EcoSystem, Moving Data in and out of Hadoop, Inputs and outputs of MapReduce, Hadoop Architecture, HDFS, Common Hadoop Shell commands, NameNode, Secondary NameNode, and DataNode

Maps
Hadoop Map Reduce paradigm, Map and Reduce tasks, Job, Task trackers , Algorithms using MapReduce, Examples of Map Reduce (Word count problem, Matrix-Vector vector multiplication), YARN & Zookeeper, Hadoop Cluster Setup & Hadoop Configuration, and HDFS Administration: Monitoring & Maintenance

Hive Architecture, Comparison with Traditional Database, HiveQL - Querying Data - Sorting And Aggregating, Map Reduce Scripts, Joins & Subqueries, HBase Concepts; Advanced Usage, Schema Design & Indexing - PIG, Zookeeper

Spark
RDD in Spark, Data Frames & Spark SQL, Spark Streaming, MongoDB, NoSQL

Text Book

- Chris Eaton, Dirk Deroos et al. , “Understanding Big data ”, McGraw Hill, 2012
- Boris Lublinsky, Kevin t. Smith, Alexey Yakubovich, “Professional Hadoop Solutions," Wiley, ISBN: 9788126551071, 2015

References:

- Tom White, “HADOOP: The Definitive Guide”, O'Reilly 2012
- Aven Jeffrey, Data Analytics with Spark Using Python | Big Data | First Edition | Pearson Paperback, November 2018

Social Network Analysis (IT5531)

Objective: To introduce the concept of social network analysis and its significance

Course Outcomes

Students will be able to:

- Understand the concept of social network analysis and its significance.
- Identify different types of networks, their characteristics, and fundamental concepts in analysing the large-scale data that are derived from social networks
- Implement mining algorithms for social networks and perform hands-on lab exercises to implement network analysis techniques
- Apply network analysis methods to solve practical problems in various domains, including social media, healthcare, e-commerce, and scientific research.
- Collaborate with peers and communicate findings effectively through lab reports and presentations.Introduction, representation, visualisation, centrality and power, strength of the weak ties, diffusion, homophily. Gephi and other tools

Introduction

Introduction to Social Network Analysis, Graph Models and Node Metrics

Social-Network Graph Representation

Social-Network Graph Representation-Analysis and Properties, Community Structure, Link Analysis and Prediction, Information Diffusion in Social Networks

Dynamic Social Networks

Dynamic Social Networks, Applications, Case studies and Research Trends

References:

- Networks, Crowds and Markets by David Easley and Jon Kleinberg, Cambridge University Press, 2010
- Network Science, Albert-Lazzlo Barabasi
- Social and Economic Networks by Matthew O. Jackson, Princeton University Press, 2010.
- Social Network Analysis, Tanmoy Chakraborty, Wiley, 2021
- Social Network Analysis: Methods and Applications, Stanley Wasserman, Katherine Faus
- https://networkx.org/documentation/stable/reference/

Generative AI and LLMs (IT5532)

Objective: To introduce the concept of Generative AI and LLMs

Course Outcomes
Students will be able to:

- Understand the concept of Generative AI, Deep Learning Fundamentals
- Understand the concept of Natural Language Processing, Language Models, Basics of GANs and Learn advanced topics in Large Language Models

Introduction to Generative AI
Overview of Generative Models, Definition, types, Applications. Probability and Statistics Foundations, Probability distributions MLE and Bayesian inference, Introduction to Neural Networks, Basics of feedforward and recurrent neural networks

Deep Learning Fundamentals & Natural Language Processing
Backpropagation & gradient descent functions, Training, Overfitting, regularization, and dropout Hyperparameter tuning, NLP, Tokenization, stemming, and lemmatization Part-of-speech tagging, Word Embeddings Word2Vec, GloVe, and embeddings

Introduction to Language Models & Sequence-to-Sequence Models
N-grams to neural language models, Challenges, RNNs for Sequences Understanding sequential data Challenges of vanishing and exploding gradients, Seq2Seq Models Encoder-decoder architecture Attention mechanisms, Applications of Seq2Seq Models Machine Translation, summarization etc

Generative Adversarial Networks, Transformers & Advanced Topics in LLM
GANs, Generative vs. discriminative models GAN architecture and training process, Applications of GANs, Transformer Architecture, BERT and Pre-trained Models Bidirectional Encoder Representations from Transformers Fine-tuning for various tasks, Llama -2 model Architecture and Training Overview of GPT, Challenges and issues of Training LLM, Applications

Ethical Considerations in AI & Future Trends and Research Directions
Bias and Fairness Addressing biases in AI models Ensuring fairness in language models 9.2 Social Implications and Responsible AI Impact of AI on society Ethical considerations in AI research and development, Current Research Trends - State-of-the-art models and techniques - Open challenges and future directions 10.2 Student Projects and Presentations - Hands-on projects using popular frameworks (e.g., TensorFlow, PyTorch) - Final project presentations and discussions

Text Book:
References:

Large Language Model Conditioned Human-Robot Interactions (IT5533)

Objective: To introduce the concept of Large Language Model Conditioned Human-Robot Interactions

Course Outcomes
Students will be able to:

- Gain insights into the integration of advanced language models into robotic systems, allowing for more sophisticated and context-aware interactions

Introduction to Large Language Models and Robotics
Overview of large language models (e.g., Llama2,GPT-3, BERT) Introduction to human-robot interactions Challenges and opportunities in integrating LM with robots

Natural Language Processing for Human-Robot Interactions
Fundamentals of natural language processing (NLP) Syntax and semantics in robot communication Sentiment analysis and emotion recognition

Machine Learning for Language Understanding
Supervised and unsupervised learning approaches Training language models for specific tasks Transfer learning and fine-tuning techniques

Implementing Large Language Models in Robotics
Integrating language models into robot systems Design principles for large language model-conditioned robots Hands-on programming exercises and projects

Ethical Considerations and Social Implications
Ethical frameworks in AI and robotics Bias and fairness in language models Impact of large language model-conditioned robots on society

Text Book:

- "Natural Language Processing in Action" by Lane, Howard
- Hapke "Hands-On Machine Learning with Scikit-Learn, Keras, and TensorFlow" by Aurélien Géron

References:

Distributed Systems (IT5534)

Objective: To design and develop distributed programs and analyze different algorithms and techniques for the design and development of distributed systems

Course Outcomes
Students will be able to:

- Design and develop distributed programs using sockets and RPC/RMI.
- Analyze different algorithms and techniques for the design and development of distributed systems
- Identify the advantages/disadvantages and challenges in designing distributed algorithms for different primitives like mutual exclusion, deadlock detection, agreement, etc.
- Differentiate between different types of faults and fault handling techniques in order to implement fault tolerant systems.

Introduction
Defining Distributed Systems, Goals and Challenges, Representation, Models of Distributed Systems, Architecture Models of computation, Client-Server architecture - Application layering; Peer to Peer Systems;

Middleware & Distributed Computing Model
Message passing systems, synchronous and asynchronous systems; Remote procedure calls, Remote Method Invocation, Clock and Causal Ordering: Managing physical clocks in distributed systems; Logical clocks: Lamport's and vector clocks;
Global state recording and Snapshot Algorithms; Clock synchronization,

OS concepts
Distributed mutual exclusion - permission based algorithms, token based algorithms. OS concepts, Handling deadlocks; Event driven systems for asynchronous Distributed Systems; Distributed Leader election Algorithms; Distributed Termination Detection Algorithms; Distributed Consensus and agreement

Resource management
Distributed file systems; DFS examples: Hadoop; Load distribution; Cloud computing, SOA; Fault tolerance and recovery; Distributed & Routing Algorithms, Graph traversals;

Text Book:

- A.D. Kshemkalyani, M. Singhal, Distributed Computing: Principles, Algorithms, and Systems.
- George Coulouris Jean Dollimore, and Tim Kindberg, Distributed Systems: Concepts and Design.

References:

- Nancy Lynch; Distributed Algorithms/ Sukumar Ghosh, Distributed Systems.
- Andrew S. Tanenbaum and Martan Van Steen, Distributed Systems, Principles and Paradigms.

Optimization (IT5535)

Objective: To recognize and formulate convex optimization problems.

Course Outcomes

Students will be able to:

- Recognize and formulate convex optimization problems as they arise in practice
- Know a range of algorithms for solving linear, quadratic and semi definite programming problems, and evaluate their performance
- Understand the theoretical foundations and be able to use it to characterize optimal solutions to optimization problems in Machine Learning

Convex Analysis

Convex Sets, Convex Functions, Calculus of convex functions

Optimality of Convex Programs

1st order nec. and suff. conditions, KKT conditions, Duality: Lagrange and Conic duality

Standard Convex Programs and Applications

Linear and Quadratic Programs, Conic Programs: QCQPs, SOCPs, SDPs.

Optimization Techniques

Smooth Problems: Gradient descent, Stochastic gradient descent, Newton's methods, Interior Point method. Nonsmooth Problems: Subgradient descent, Online convex optimization, Non-convex optimization: Adom and other variants.

Text Book:

- S.Boyd and L.Vandenberghe. Convex Optimization. Cambridge University Press, 2004

References

- R.T.Rockafellar. Convex Analysis. Princeton University Press, 1996.
- A.Nemirovski. Lectures On Modern Convex Optimization (2005). Available at
- www2.isye.gatech.edu/~nemirovs/Lect_ModConvOpt.pdf
- Y.Nesterov. Introductory Lectures on Convex Optimization: A Basic Course. Kluwer Academic Publishers, 2004

Probabilistic Graphical Models (IT 5536)

Objective: To understand about probabilistic machine learning and describe and analyze properties of graphical models, and formulate suitable models.

Course Outcomes

Students will be able to:

- Understand about probabilistic machine learning and get exposure to current cutting edge research.
- To develop an in-depth understanding of probabilistic graphical models.
- To describe and analyze properties of graphical models, and formulate suitable models for concrete estimation and learning tasks.
- To understand inference algorithms, judge their suitability and apply them to graphical models in relevant applications.

Probabilistic supervised learning

Probabilistic Unsupervised learning

Graphical Model representation

Bayesian and Markov networks, and dynamic Bayesian networks. Probabilistic inference algorithms, both exact and approximate; Sampling; and learning methods for both the parameters and the structure of graphical models. Encoder-Decoder, Variational Autoencoder, Generative Adversarial Network (GAN)

Text Book

- Kevin Murphy, “Machine learning: a probabilistic perspective”, MIT Press, 2012.

References:

- Daphne Koller and Nir Friedman, Probabilistic Graphical Models: Principles and Techniques
- Michael I. Jordan, An Introduction to Probabilistic Graphical Models, in preparation.

Cyber Security and Digital Forensics (IT 5537)

Objective: To understand Cyber Crime Classification and its mapping with IT Act

Course Outcomes
Students will be able to:

- Understand Cyber Crime Classification and its mapping with IT Act.
- Understand the importance of digital investigation lifecycle and attack classification.
- Understanding how to handle digital evidence and its classification in different scenarios like system forensics, network forensics and other domains.
- Understand the analysis of E- evidence and correlation with class of cyber crime.

Introduction to Cyber Crime and E-Evidence
Cyber Crime Classification based on behavioral features, Relevant section of IT Act implicating the E-Evidence. Digital Forensics Life Cycle.

System Forensics & Handling E-Evidence
Registries and file systems e.g NTFS. Data acquisition, verification, errors in handling data, Registry analysis.

Network Forensics
Network Forensics, analysis of the network traffic, flow and protocol analysis, network based attacks, specialized tools, OSINT Framework, analysis of TCPDUMP file and experimentation for data acquisition.

Incident handling and Report writing
Admissibility of E-evidence, Verification of the integrity of evidence, Types of Evidence, Test of Admissibility of Evidence

Text Books

- John R. Vacca, “Computer Forensics: Computer Crime Scene Investigation”, Cengage Learning, 2nd Edition, 2005
- Marjie T Britz, “Computer Forensics and Cyber Crime: An Introduction”, Pearson Education, 2nd Edition, 2008.

References:

- MariE-Helen Maras, “Computer Forensics: Cybercriminals, Laws, and Evidence”, Jones & Bartlett Learning; 2nd Edition, 2014.
- Chad Steel, “Windows Forensics”, Wiley, 1st Edition, 2006.
- Majid Yar, “Cybercrime and Society”, SAGE Publications Ltd, Hardcover, 2nd Edition, 2013.
- Robert M Slade, “Software Forensics: Collecting Evidence from the Scene of a Digital Crime”, Tata McGraw Hill, Paperback, 1st Edition, 2004.

B.TECH- ECE

Applicable with effect from 2023 admitted batch and onwards

Semester 1					Total Credit: 20
Sl. No.	Course Name	Code	Type	Credit	Hours L-T-P-S
1	Engineering Physics	AS1001	BSC	4	3-0-2-0
2	Linear Algebra	AS1002	BSC	4	3-1-0-0
3	Problem Solving with Programming	IT1001	ESC/VSEC	5	3-0-4-0
4	Fundamentals of Electrical & Electronics Engineering	EC1001	ESC	4	3-0-2-0
5	Technical Communication Skills	MS1001	HSMC (AEC)	2	1-0-2-0
6	Constitution of India	MS1002	HSMC (VEC)	1	1-0-0-0
	Universal Human Values	MS1003			
	Professional Ethics	MS1004			
	Art of Living	MS1005			
			Total	**20**	**14-1-10-0** **25**

Semester 2					Total Credit: 20
Sl. No.	Course Name	Code	Type	Credit	Hours L-T-P-S
1	Electronic Workshop	EC1002	VSEC	1	0-0-2-0
2	Digital Logic Design with HDL	EC1008	PCC	3	2-0-2-0
3	Electronic Devices and Circuits	EC1004	ESC	3	2-0-2-0
4	Electronics Measurements and Instrumentations	EC1005	PCC	3	2-0-2-0
5	Data Structures and Algorithms	IT1003	ESC	4	3-0-2-0
6	Network Synthesis & Analog Filters	EC1007	PCC	3	2-1-0-0
7	Principles of Management	MS1006	HSMC(AEC)	2	1-0-2-0
8	Constitution of India	MS1002	HSMC(VEC)	1	1-0-0-0
	Environmental Studies	MS1007			
	Professional Ethics	MS1004			
	Physical Education(Sports)	MS1008			
			Total	**20**	**13-1-12-0** **26**

Exit: After successful completion of one year (first two semesters), a student may get an exit option as per ordinance. They need to do Skill Based Courses of 6 credits additional, in summer, before exit. Department will provide a list of such courses.

Semester 3					Total Credit: 23
Sl. No.	Course Name	Code	Type	Credit	Hours L-T-P-S
1	Electromagnetic Field and Waves	EC2001	PCC	3	3–0–0-0
2	Signal and Systems	EC2002	PCC	4	3–1–0-0
3	Analog Electronics & Linear ICs	EC2003	PCC	4	3–0–2-0
4	Microprocessor Interface and Programming	EC2004	PCC	3	2–0–2-0
5	Biology for Engineers	AS1010	BSC	2	2-0-0-0
6	Multi-Disciplinary Minor-1	MS2501-MS2599 AS2501-AS2599 CS2501-CS2599	MDM	3	3–0–0-0
7	Principles of Economics	MS2001	HSMC (AEC)	2	2–0–0-0
	Introduction to Finance	MS2002			
8	**Community Services**		HSMC (CEA)	2	0-0-0-4
	NCC	MS1010			
	NSS	MS1011			
	Yoga	MS1012			
	Unnat Bharat Abhiyaan	MS1013			
	Ek Bharat Shreshtha Bharat	MS1014			
	NGO	MS1015			
	Prayas	MS1016			
	Other Courses	MS1017-MS1020			
			Total	**23**	**18-01-04-04** **28**

Semester 4					Total Credit: 22
Sl. No.	Course Name	Code	Type	Credit	Hours L-T-P-S
1	Control Systems	EC2005	PCC	4	3–0–2-0
2	Analog Communication	EC2006	PCC	3	2–0-2-0
3	CMOS VLSI Design	EC2007	PCC	3	2–0–2-0
4	Probability and Statistics	AS2001	BSC	3	2–1–0-0
5	Antenna and Wave Propagation	EC2009	PCC	3	2-0-2-0
6	Integrated Circuit Technologies	EC2010	PCC	3	3-0-0-0
7	Multi-Disciplinary Minor-2	MS2501-MS2599 AS2501-AS2599 CS2501- CS2599	MDM	3	3–0–0-0
			Total	**22**	**17-1-08-0** **26**

Exit: After successful completion of 4 semesters, a student may get an exit option as per ordinance. They need to do ***Skill Based Courses of 6 credits***, additional, in summer, before exit. Department will provide a list of such courses.

"Applicable with effect from 2023 admitted batch and onwards"

Semester 5					Total Credit: 22
Sl. No.	Course Name	Code	Type	Credit	Hours L-T-P-S
1	Digital Signal Processing	EC3001	PCC	4	3–0–2-0
2	Embedded System Design	EC3002	PCC	3	2–0–2-0
3	Microwave Engineering	EC3003	PCC	3	2–0–2-0
4	Digital Communication	EC3004	PCC	4	3–0–2-0
5	Program Elective-I A) Electrical Machines B) Advanced Computer Architectures C) AI & ML Techniques D) Solid State Devices E) Any Other	EC5501-EC5599	PEC	3	3–0–0-0
6	Multi-Disciplinary Minor-3	MS2501-MS2599 AS2501-AS2599 CS2501- CS2599	MDM	3	3–0–0-0
7	Design Thinking and Innovation	EC3501	HSMC (AEC)	2	1-0-2-0
			Total	**22**	**17-0-10-0=27** **27**

Semester 6					**Total Credit: 18**
Sl. No.	Course Name	Code	Type	Credit	Hours L-T-P-S
1	Data Communication & Networking	EC3005	PCC	3	2-0-2-0
2	Mobile and Wireless Communication	EC3006	PCC	3	2–0–2-0
3	Program Elective-II A) Power Electronics B) Testing & Verification C) Optical Communication D) Detection & Estimation Theory E) Physics of Nanoscale Devices F) Any Other	EC5501-EC5599	PEC	3	3–0–0-0
4	Project	EC3559	VSEC	4	0-0-8-0
5	Multi-Disciplinary Minor-4	MS2501-MS2599 AS2501-AS2599 CS2501- CS2599	MDM	3	3–0–0-0
6	**Indian language(I1-I10)** Sanskrit **(I2-I10)** **Foreign language(F1-F10)** German Japanese French **(F4-F10)** **Regional Language(R1-R10)** **(R1-R10)**	 MS1401 MS1402 – MS1410 MS1500 MS1501 MS1502 MS1503-MS1510 MS1600- MS1610	HSMC (AEC)	2	1-0-2-0
			Total	**18**	**11-0-14-0** **24**

Exit: After successful completion of 6 semesters, a student any get an exit option after completion of the summer semester internship (3 credits) and additional 3 credit courses in summer.

I1 to I10, F1 to F10 and R1 to R10 will be decided by concerned department.

Summer Semester					**Total Credit: 3**
Sl. No.	Course Name	Code	Type	Credit	
1	Internship	EC4600	ELC	3	Credit will be added in VII Sem.

Note: Internship will be evaluated in the beginning of seventh semester. Its credit and grades will be reflected in the 7th Semester Grade Sheet.

Semester 7					**Total Credit: 21**
Sl. No.	Course Name	Code	Type	Credit	Hours L-T-P-S
1	Program Elective-III A) Electrical Vehicles B) FPGA Architectures C) Image Processing & Image Vision D) Multiple Input-Multiple Output (MIMO) E) Low Power System Design F) Any Other	EC5501-EC5599	PEC	3	3–0–0-0
2	Program Elective-IV A) Radar & Satellite Communication B) MEMS C) Speech Processing D) Emerging Nanoscale Devices E) 6G & THz Communication F) Any Other	EC5501-EC5599	PEC	3	3–0–0-0
3	Open Elective-I		OEC	3	3-0-0-0
4	Multi-Disciplinary Minor-5	MS2501-MS2599 AS2501-AS2599 CS2501- CS2599	MDM	3	3–0–0-0
5	History of Indian Civilizations Kautilya's Arthashastra Vedic Mathematics Vedic Corpus Wisdom from the Ages Panini's Grammar X1 – X9	MS1800 MS1801 MS1802 MS1803 MS1804 MS1805 MS1806 – MS1815	HSMC (IKS)	2	2–0–0-0
6	Internship (Summer Semester)	EC4600	ELC	3	0-0-0-6
7	Project	EC4501	ELC	4	0-0-8-0
			Total	**21**	**14-0-8-6** **28**

Semester 8					**Total Credit: 14**
Sl. No.	Course Name	Code	Type	Credit	Hours L-T-P-S
1	Major Project	EC5601	ELC	8	0–0-16-0
2	Program Elective-V(X1-X199) A) IOT B) System on Chip C) Any Other	EC5501-EC5599	PEC	3	0–0–0-3
3	Open Elective-II		OEC	3	0–0–0-3
			Total	**14**	**0-0-16-6** **22**

*8th Semester courses may be allowed to join via MOOC/NPTEL etc.

"Applicable with effect from 2023 admitted batch and onwards"

Engineering Physics (AS1001)

Objective: Students will be able Demonstrate ability to collect, process, and analyze scientific data, display critical thinking skills in applying physics knowledge in the experimental process.

Course outcome

At the end of this course, Students will be able to

- To analyze dynamics of system of particles for applications in Physics and Engg.
- Identify, formulate and solve engineering problems requiring principles of physics
- Gain knowledge about modern physics and quantum mechanics
- Apply quantum physics to understand solid state materials
- Design & conduct experiments, analyze & interpret data

Classical Mechanics

Symmetry and conservation laws, Fermat's principle, Principle of least action, Euler Lagrange equations and its applications, Degrees of freedom, Constraints and constraint forces, Generalized momentum, Concept of phase space, Hamiltonian.

Quantum Mechanics

De Broglie's hypothesis, wave function and wave packets, phase and group velocities. Schrödinger Equation. Probabilities and Normalization, Eigenvalues and eigen functions. Infinite potential well and energy quantization. Finite square well, potential steps and barriers - notion of tunneling, band structure of solid.

Solid State Physics

Energy Bands, Carrier transport in semiconductor, mobility and resistivity, electron effective mass, Density of states, Fermi-Dirac distribution function, intrinsic carrier concentration, Mechanism of carrier scattering, Einstein relationship.

Text Books

- Classical Mechanics; H. Goldstein, C. Poole, J. Safko; Pearson Education, Third Edition (2002)
- Modern Physics by A. Beiser; McGraw-Hill Higher Education, Sixth Edition (2003)
- Introduction to Quantum Mechanics by D. J. Griffiths; Pearson Education, Second Edition (2005)
- Introduction to Solid State Physics by C. Kittel; Wiley Students Edition, (2005)
- Physics of semiconductor devices, S M Sze, John Wiley & Sons, 2006

Reference Books

- Theoretical Mechanics by M. Spiegel; McGraw Hill Education, 2017
- Feynman Lectures of Physics Vol-1 and Vol-3; The Millenium Edition, Pearson (2012)
- Quantum Physics for Atoms, Molecules, Solids, Nuclei and Particles by R. Eisberg and R. Resnick; 2nd Edition, New Delhi Wiley (2012)

Linear Algebra (AS1002)

Objective: Students will be able to solve linear equations & develop understanding of vector spaces, linear transformations, Eigen value, diagonalization and orthogonalization, least square solutions and singular value decomposition etc

Course Outcome

Students will be able to

- Understand the concept of matrices, their properties & solve linear equations
- Understand basic concepts of vector spaces, subspace, linear dependence etc
- Calculate the rank-nullity of a matrix / linear map, eigenvalues, and eigenvectors.
- Apply the Gram-Schmidt process, Find the SVD, Jordan Canonical form .
- Apply concepts of linear algebra to various applications.

Matrices and Vector Spaces

System of linear equation, Gauss elimination method, Elementary matrices, Invertible matrices, Gauss-Jordan method, Determinant, Cramer's rule, Vector spaces, Linearly independence and independence, Basis, Dimension.

Linear transformation & Diagonalizability

Linear transformation, Representation of linear maps by matrices, Rank-Nullity theorem, Rank of a matrix, Row and column spaces, Solution space of a system of homogeneous and non-homogeneous equations, Eigenvalue, eigenvector, Cayley-Hamilton theorem, Diagonalizability, minimal polynomial

Inner product space

Inner product space, Cauchy-Schwarz inequality, Orthogonal basis, Gram-Schmidt orthogonalization process, Orthogonal projection, Spectral theorem.

SVD & Jordan Canonical Form

Positive, negative, and semi-definite matrices. Decomposition of the matrix in terms of projections, Strategy for choosing the basis for the four fundamental subspaces, Least square solutions and fittings, Singular values, Primary decomposition theorem, and Jordan canonical form.

Text/Reference Books

- K. Hoffman and R. Kunze, Linear Algebra, 2nd Edition, Pearson (2015).
- Gilbert Strang, Introduction to Linear Algebra, 4th Edition, Cambridge Press (2009).
- S. Kumaresan, Linear algebra - A Geometric approach, Prentice Hall of India (2000).
- S. Lang, Introduction to Linear Algebra, 2nd Edition, Springer (2012).

Problem Solving with Programming (IT1001)

Objective: Students will be able to understand programming language (in this case C language), develop a problem solving approach from programmer's perspective.

Course Outcome

Students will be able to:

- break down complex real-world problems into smaller, manageable subproblems and develop logical approaches for solving them through programming.
- learn to debug code, identify and fix logical errors, and write test cases.
- develop a systematic approach to problem-solving, logical reasoning, and iterative refinement.

Introduction to Computers & Demo

Computer hardware, Computer Networks, IP Address, Proxy, Gateway, Operating Systems, Disk/Directory/Files system, Application Software. Professional Ethics.

Programming Basics: Structure of a simple C program, Constants and Variables, Basic Data Types, Precedence and Associativity, implicit and explicit type conversion, Selection Statements, Loop Structures

Functions and Arrays: User-defined functions, function definition, Storage class and Scope, Macros, Nested, and Recursive Functions, One Dimensional arrays, Passing Arguments, Two and higher Dimensional Arrays, Strings, String Library Functions

Pointer and Structure: Addresses and Pointers, Structures, Dynamic Memory Allocation, Linked List, Stack, Queue. Data Files.

Text Books

- "Engineering Problem Solving with C", Delores M. Etter, Fourth Edition, 2012, Pearson.
- "C: How to Program", Paul Deitel and Harvey Deitel, Ninth Edition, 2022, Pearson.

Reference Books

- "Computer Systems: A Programmer's Perspective", Randal E Bryant and David R O'Hallaron, Third Edition, 2015, Pearson.
- "Problem Solving and Program Design in C", Jeri R. Hanly and Elliot B. Koffman, Eighth Edition, 2015, Pearson.
- "Programming in C", Brian Kernighan and Dennis Ritchie, Second Edition, 2015, Pearson.

Fundamentals of Electrical and Electronics Engineering (EC1001)

Objective: Students will be able to understand the fundamental concepts of electrical and electronics engineering.

Course Outcome
Students will be able to:

- Understand working principles of basic electrical and electronic devices and circuits.
- Design basic electronic circuits

Introduction
Basic physical laws, circuit elements, KVL, KCL, Network Theorems

Transients
R-L, R-C, R-L-C, Sinusoidal Steady State, Real/Reactive Power, Three Phase,

Transformers/AC/DC machines
Working Principles of Transformers/AC/DC machines

Semiconductors
Semiconductors, Band Diagram, n-type and p-type semiconductor, junction diode, diode biasing, Zener diode, DC Power supply

Transistors
Introduction to Bipolar Junction Transistor, MOS Capacitor, Introduction to Operational Amplifier, Schmitt Trigger, Multivibrator, Oscillators

Text Book

- Microelectronic Circuits SEDRA/SMITH 7th Edition Oxford University Press
- Fundamentals of Electrical Engineering, Leonard S Bobrow, 2nd Edition, Oxford Press.
- Fundamentals of Electrical Engineering and Electronics, B L Thereja, S Chand Press.

References

- Network Analysis, M E Van Valkenberg, 3rd Edition, PHI, 2000
- Linear Circuit Analysis: Time, Domain, Phasor and Laplace Transform Approaches, R A DeCarlo and M Lin, 2nd Edition, Oxford University Press, 2000

Technical Communication Skills (MS1001)

Objective: Students will be able to enhance and polish communication skills which will formally help them to be effective professionals by understanding importance of effective communication, presentation and designing of work.

Course Outcome
Students will be able to:

- Speak and participate in GD
- Write technical letters, CV, product development plans etc

Introduction
Introduction to types of communication, Lab sessions and mock presentation pertaining to Communication Styles, Content Management and Delivery Making Effective Public presentations, Speech and diction correction and counseling

Formal communication
Written communication, Problems and solutions Lab sessions will have exposure to: Cover letter, CV preparation Group discussion and Personal Interview Report writing and Proposal development plan, Interview: types and techniques SWOT Analysis.

Reference Books

- Winning at Interviews by Edgar Thorpe Books on Technical Writing

Constitution of India (MS1002)

Objective: Students will be able to understand the Fundamental features of the Indian Constitution, Union Government, Rights and Duties, Statutory Institutions.

Course Outcome
Students will be able to:

- Understand Indian Constitution, its composition and functions, Union and state Government
- Understand Rights and Duties, Statutory Institutions etc

Introduction
Evolution of the Indian Constitution, Acts, Fundamental features of the Indian Constitution, Union, State and Local Government.

Rights and Duties
Fundamental Rights and Duties, Directive Principles, Relation between Federal and Provincial units: Union-State relations, Administrative, legislative& Financial, Inter-State Council, NITI Ayog, Finance Commission of India, Union List, State List, Concurrent List, Statutory Institutions: Elections-Election Commission of India, National Human Rights Commission, National Commission for Women

Reference

- D.D. Basu, Introduction to the Constitution of India, Lexis Nexis, New Delhi
- Subhash Kashyap, Our Parliament, National Book Trust, New Delhi
- Peu Ghosh, Indian Government &Politics, Prentice Hall of India, New Delhi

Universal Human Values (MS1003)

Objective: Students will be able to understand the human values.

Course Outcome
Students will be able to:

- Understand the importance of human values, family, society, nature etc.
- Develop commitment and courage to act.

Introduction
Development of a holistic perspective based on self-exploration about themselves (human being), family, society and nature/existence, Understanding (or developing clarity) of the harmony in the human being, family, society and nature/existence

Self Reflection
Right understanding Strengthening of self-reflection, Development of commitment and courage to act, Method to fulfill the human aspirations: understanding and living in harmony at various levels.

Reference

Professional Ethics (MS1004)

Objective: Students will be able to understand the awareness on Engineering Ethics and Human Values.

Course Outcome
Students will be able to:

- Understand social responsibility of an engineer etc.
- To appreciate ethical dilemma while discharging duties in professional life.

Values
Human Values Morals, Integrity, Work Ethics, Honesty, Courage, Empathy etc. Kohlberg's theory, Gilligan's theory, Models of Professional Roles.

Ethics
Codes of ethics, Challenger case study, Safety and Risk, The Three Mile Island And Chernobyl Case Studies, global issues, moral leadership

Reference

- Mike Martin and Roland Schinzinger, “Ethics in Engineering”, McGraw-Hill, New York 1996.
- Govindarajan M, Natarajan S, Senthil Kumar V. S, “Engineering Ethics”, Prentice Hall of India, New Delhi, 2004.
- Charles D. Fleddermann, “Engineering Ethics”, Pearson Education / Prentice Hall, New Jersey, 2004 (Indian Reprint now available).
- Charles E Harris, Michael S. Protchard and Michael J Rabins, “Engineering Ethics – Concepts and Cases”, Wadsworth Thompson Leatning, United States, 2000 (Indian Reprint now available)
- John R Boatright, “Ethics and the Conduct of Business”, Pearson Education, New Delhi, 2003.

Youth Empowerment and Skills (MS 1005)

Objective: To equip students with practical tools and techniques that will make them more creative, efficient, confident, clear-minded, stress-free, joyful and energetic

Course Outcome
Students will be able to:

- learn challenges and will learn group processes, talks, presentations and hands-on learning methodology that helps students to enhance their lives.
- Participate in Group discussions and role-plays to inculcate life-skills and human values
- Yoga Asanas and Pranayama to increase concentration & build confidence
- Breathing techniques (like the world-renowned and well-researched Sudarshan KriyaTM)
- Talks and Presentations to bring out attitudinal and behavioral changes towards achieving student excellence.

Personality Development
Personality Development Self-awareness, Emotional Intelligence / Coping with Emotions, Mind Management, Coping with Stress, Health and Nutrition, Social Adaptability and Effectiveness Effective Communication Skills, Interpersonal Relationship Skills, Lifestyle and Environment

Ethics
Ethics, Morality and Integrity, Time Management and Goal Setting, Professional Skills, Active Learning and Effective Learning Strategies, Decision Making

Reference

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Electronic Workshop (EC1002)

Objective: The objective of this course is to familiarize the students with the PCB design and SMT**.**

Course Outcome
Students will be able to:

- Fabricate design on PCB and
- learn SMT Fabrication and other aspects of SMT and PCB

Introduction
Introduction to System/PCB, Design the PCB

Fabrication on PCB
Full wave Rectifier & Flasher Circuit

Clipper and Clamper
Design and fabrication on PCB/SMT

Text Book

Reference Book

Digital Logic Design with HDL (EC1008)

Objective: The objective of this course is to familiarize the students with the design of digital systems using Verilog HDL**.**

Course Outcome

Students will be able to:

- Design digital circuits, strong skill set of Verilog HDL,
- Write Test bench and implementing any digital system on FPGA.

Introduction

Number System, r-1s complement, Sign and Magnitude Numbers, r's Complement Numbers, Gray Code, Boolean Algebra & logic minimization, k-map, Logic Family (BJT and CMOS based), Data-flow description using Verilog

Combinational Logic Design

arithmetic circuit design, Design using MSI components, Multiplexers and De-multiplexers, Encoder, Decoder Binary Adders, Subtraction and Multiplication. Structural design and implementation using Verilog HDL

Sequential Network

Concepts of Sequential Networks, State Diagram, Latches and Flip, Flops, Counters and Shift Registers, state machine, Finite state machine; HDL Implementation of Digital circuits, Behavioral description of sequential circuits using HDL

Memory Elements and Arrays Registers

RAM and ROMs, programmable logic array, Memories. Field Programmable Gate Array (FPGA), LUT, Slices, Semi-custom and Ful custom design, Implementation of the digital system on FPGA

Text Book

- M. Morris Mano, Michael D. Ciletti, "Digital Design with an Introduction to the Verilog HDL", 5th Edition, Pearson Education Inc

Reference Book

- Samir Palnitkar, "Verilog HDL: A Guide to Digital Design and Synthesis", Second Edition, Prentice Hall, Computer Arithmetic Algorithms, 2nd Edition by Israel Koren

Electronic Devices and Circuits (EC1004)

Objective: This course is designed for the students seeking an extensive understanding of electronic devices and circuits and problem solving techniques. Being a freshman and a core course in electronics engineering, the lucidity is maintained throughout.

Course Outcome
Students will be able to:

- Design electronic circuits, amplifiers and
- Independently to drill any real world problems related to EDC.

Semiconductors
Semiconductor Diodes& Circuits: Physical operation of p-n junction diodes, Light emitting diodes, photo diode, circuits

Small Signal and Large Signal Analysis
Small & Large Signal Analysis of BJTs and FETs.

Energy band diagrams
Flat-band pinch-off voltage, JFET, Complementary MOS (CMOS), V-I Characteristics.

Text Book

- S. Sedra, K. Carless Smith Microelectronics, , 7thEdition, Oxford University. Integrated Electronics, JMilllman and C Halkias, TMH Press.

Reference Book

Electronics Measurements and Instrumentations (EC1005)

Objective: To introduce students to the basics of measuring instruments. To make them aware of working and practical application of instruments and sensors.

Course Outcome
Students will be able to:

- Understand the working principle of various instruments that will help to make better use of measuring instruments.
- Will be able to use different kind of sensors and
- How to select a suitable measuring instrument for the any measurement

Static Characteristics and Errors
Measurements, classification of instruments, Static characteristics of measurement instruments, Types of errors, Loading effect.

Electronic Instruments for Measuring Basic Parameters
DC Voltmeters, AC Voltmeters, Ammeters, Shielding & grounding, CTPT. Oscilloscopes: Basic construction, working, Kinds of Oscilloscopes.

Signal Generation and measurement techniques
Sine wave generators, Harmonic distortion analyzer, Spectrum analyzer.

Transducers
Transducers Classification, Selection Criteria, Characteristics, Construction, Application of following of different transducers..

Text Books

- A.K. Sawhney, Puneet Sawhney,A Course In Electrical And Electronic Measurements And Instrumentation, DhanpatRai Publications, 2012 H. S. Kalsi, Electronic Instrumentation, 3 edition, McGraw Hill Education, 2017

Reference Books

Data Structures and Algorithms (IT1003)

Objective: To make student learn the linear and non-linear structures in which data can be stored and their pros and cons & to write algorithms using different data structures.

Course Outcome
Students will be able to:

- Understand data structures, linked-lists, trees, binary search trees, AVL trees, stacks, queues, priority queues, and hash-tables and graphs, ADT
- To apply & implement learned algorithm design techniques and data structures to solve problems.

Introduction, Arrays and Linked Lists
Basic Terminology, Elementary Data Organization, Asymptotic notations Efficiency of an Algorithm, Time and Space Complexity and trade-off**,** Single and Multidimensional Arrays, Sparse Matrices, Single, Double and Circularly Linked List, Header node based Linked List, Operations on a Linked List. Insertion, Deletion, Traversal, Polynomial Representation and Addition, Generalized Linked List

Abstract Data Types (ADT), Searching and Sorting, **Priority Queues**
Stacks: Primitive Stack operations (Push & Pop) Implementation and Application of stack, Queue Implementation and Applications, Doubly Ended Queue, Sequential search, Binary Search, Comparison Sorting Techniques, Efficient Sorting Techniques, linear sorting techniques, Queue Definition & Implementation.

Hashing, Trees & Graphs- Hash table, hash function, collison & resolution strategies, Linear and Quadratic Probing, Trees, Binary Tree Representation, Expression Tree, Binary Tree Traversals, Binary Search Trees, Sequential & linked Representations of Graphs, Adjacency Matrix, Adjacency List, Graph Traversals, Connected Components, Minimum Cost Spanning Trees, Prims & Kruskal algorithm, Dijkstra algorithm

Text Books

- E. Horowitz, S. Sahni, S. Anderson-Freed “Fundamentals of Data Structures in C”, Second Edition, 2008, Universities Press.
- R. Kruse et al. , *Data Structures and Program Design in C,* Pearson Education
- S. Lipschutz , *Data Structures, Schaum's Outlines Series,* Tata McGraw-Hill.
- Mark Allen Weiss, “Data Structures and Algorithm Analysis in C (DSAC)”, Second Edition, 2002, Pearson Education India.

Reference Books

- “Algorithms Design”, Jon Kleinberg and Eva Tardos, First Edition, 2013, Pearson.
- “The C Programming Language”, Brian W. Kernighan and Dennis M. Ritchie, Second Edition, 2015, Pearson Education India.
- “Introduction to Algorithms”, Thomas H Cormen, Charles E Leiserson, Ronald L Rivest, Clifford Stein, Third Edition, 2009, MIT Press.

Network Synthesis and Analog Filters (EC1007)

Objective: To elaborate on the principles and applications of electrical network theorems for solving complex circuits and to analyze the steady-state & transient behavior of electrical networks using mathematical techniques.To introduce the fundamentals of filter design and their implementation in signal processing systems

Course Outcome
Students will be able to:

- Apply electrical network theorems and mathematical techniques to analyze and solve complex circuits.
- Perform transient and steady-state analysis of RL, RC, and RLC circuits, including sinusoidal and frequency-domain responses.Design and implement passive and active filters for various signal processing applications.
- Analyze and synthesize two-port networks and evaluate their performance using standard parameter representations.

Basic elements of a network
Basic RL and RC circuits, RLC circuits. Network Theorems: Superposition, Reciprocity, Thevenin's, Norton's, Maximum Power Transfer.

R-L, R-C, R-L-C circuits
Initial conditions for networks, Differential equations, Transients in R-L, R-C, R-L-C circuits, Sinusoidal Steady-State Analysis, Laplace Transform Circuit Analysis in S-domain, Frequency Response of a Network, Design of Passive Circuits from Network Functions.

Two-Port Networks
Open Circuit Impedance Parameter (z Parameter), Admittance Parameter (y Parameter), Transmission Parameters, Hybrid Parameters (h Parameters), Two-Port Parameter Conversion, Interconnection of Two-Port Networks.

Filters
Passive Filters, Low Pass, High Pass, Band Pass, Band Reject Filters, OPAMP-Based Active Filters.

Text Books:

- M. E. Van Valkenburg, Network Analysis, Prentice Hall, 1955.
- Fundamentals of Electrical Engineering, Leonard S Bobrow, 2nd Edition, Oxford Press.
- Fundamentals of Electrical Engineering and Electronics, B L Thereja, S Chand Press.
- W.H. Hayt and J.E. Kemmerly: Engineering Circuit Analysis; 8th edition. McGraw-Hill, 2013.

Principles of Management (MS1006)

Objective: This course is designed to be an overview of the major functions of management. It explores how organizations develop and maintain competitive advantage within a changing business environment. Upon completion, students should be able to work as contributing members of a team utilizing these functions of management.

Course Outcome

Students will be able to

- Understand how organizations adapt to an uncertain environment and identify techniques managers use to influence and control the internal environment.
- Practice the process of management's four functions: planning, organizing, leading, and controlling.

Nature and Functions of Management

Importance and Process of Management, Development of Management Thoughts, Managerial Roles.

International Business and its Environment

Globalization & WTO, Dynamics of development Global business environment, Internal Tech. of Forecasting.

Need for Organization

Principles and Process of Organizing, Authority, Delegation and Decentralization

Staffing and Directing

Requirement of Effective Direction

Text Book

- Koontz, Weihrich, Aryasri. Principles of Management, TATA McGraw Hill, New Delhi, 2004.

References

- P. C. Tripathi, P. N. Reddy, Principles of Management, Tata McGraw-Hill Publishing Company Limited, New Delhi.
- Prasad LM, Principles and Practice of Management, Sultan Chand & Sons, New Delhi.
- Samuel C. Certo, S. TrevisCerto, Modern management 10 Ed, PHI Learning, New Delhi, 2008
- James A. Stoner, Edward Freeman, Daniel Gilbert, Management, PHI Learning, New Delhi, 2007
- Williams/ Kulshrestha, Principles of Management, Cengage Learning, New Delhi, 2011

Environmental Studies (MS1007)

Objective: To make student learn the importance of environmental studies, different resources, ecosystem etc.

Course Outcome

Students will be able to

- Understand the Multidisciplinary nature of environmental studies.
- Structure and function of an ecosystem
- Environmental Pollution etc.

Nature of Environmental studies, Ecosystems

Definition, Scope and importance, Need for public awareness. Different resources, Concept of an ecosystem, Structure and its function, Food chains, Different eco systems, Biodiversity, Threats, In-situ and Ex-situ conservation of biodiversity.

Environmental Pollution & Field Work

Causes, effects and control measures of different pollution, Nuclear hazards, Pollution case studies, Disaster management, Water conservation, rain water harvesting, watershed management, Case studies on Environmental ethics, Climate change, global warming, Case studies. - Wasteland reclamation, Environment Protection Act, Water Act, Wildlife Protection Act, Visit to a local polluted site and Study of ecosystems.

References:

- Agarwal, K.C.2001 Environmental Biology, Nidi Publ. Ltd. Bikaner.
- BharuchaErach, The Biodiversity of India, Mapin Publishing Pvt.Ltd. , Ahmedabad — 380 013, India, Email: mapin@icenet.net (R)
- Brunner R.C., 1989, Hazardous Waste Incineration, McGraw Hill Inc.480p
- Clark R.S., Marine Pollution, Clanderson Press Oxford (TB)
- Cunningham, W.P.Cooper, T.H.Gorhani, E &Hepworth, M.T.2001. Environmental Encyclopedia, Jaico Publ. House. Mumbai, 1196p
- Dc A.K., Environmental Chemistry, Wiley Eastern Ltd.
- Down to Earth, Centre for Science and Environment(R)
- Gleick, 11.P. 1993. Water in crisis, Pacific Institute for Studies in Dev., Environment & Security. Stockholm Env. Institute. Oxford Univ. Press. 473

Physical Education (Sports) (MS1008)

Objective: To aware the students on the importance of physical education for a healthy life and train them on various sports, games, yoga, etc. for physical fitness.

Course Outcome
Students will be able to

- Understand the knowledge of various ways for maintaining both physical and mental wellness

Know your body
First Aid for basic medical conditions, CPR for emergency, Diabetic and Obesity condition of Indian and world, Importance of physical education.

Yoga and Meditation
Yoga for wellness and concentration, Meditation for wellness

Athletics and Aquatics
Rules, benefits and mastering of various track and field events such as Sprint, Marathon, Hurdles, Long Jump, High Jump, Javelin throw, Shot Put, Discus throw, etc.
Rules, benefits and mastering of various styles of swimming, butterfly, freestyle, backstroke, and breaststroke, Sports for physical fitness like Cricket, basketball, football, volleyball, etc.

References:

- Dr. V K Sharma, “Health and Physical Education”. New Sarasvati House Publishers.
- “Yoga: A Healthy Way of Living”. By National Council of Educational Research and Training.
- Mark Young. “The Complete Beginners Guide to Swimming”.
- Dr. Ashwini Bhardwaj. “A Complete Guide to Family Safety and First Aid”. GoodWill’s Publishers.

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Electromagnetic Field and Waves (EC2001)

Objective: To let the Second Semester B. Tech. (ECE) students exposed to basic laws of Electromagnetism and to demonstrate their application on RF Communication.

Course Outcome

Students will be able to:

- Understand the different types of coordinate systems Divergence and Stokes's Theorems.
- Learn boundary conditions, Maxwell's equations and its applications.
- Visualize wave propagation in different medium.
- Apply Smith chart to solve problems of Transmission lines

Vector Calculus

Cartesian, Cylindrical and Spherical Coordinates systems, Line, Surface, and Volume Integrals, Gradient, Divergence, Curl and Laplacian, Divergence and Stokes's Theorems

Electromagnetic Fields

Review of Static Electric and Magnetic Field, Boundary Conditions of Electric and Magnetic fields, Electrostatic Boundary Value Problems: Poisson and Laplacian equations and its solution, Time varying fields, Maxwell's equations for time varying fields

Wave Propagation

Wave equation and its solution, Propagation of wave in lossless, lossy and conducting medium, Power and Poynting Theorem, Wave Polarization: Linear, circular and Elliptical. Reflection of a Plane Wave at Normal Incidence, Reflection of a Plane Wave at Oblique Incidence

Transmission line

Transmission Line Parameters, Transmission Line Equations, Input Impedance, Standing Wave Ratio, Smith Chart: Basic Operation of Smith Chart, Impedance matching: Single Stub, Double Stub, Quarter wave matching Techniques

Text Books

- N. O. Sadiku, Elements of Electromagnetics, 5th Edition. Oxford University Press, 2010.
- W H Hayt and J A Buck, Engineering Electromagnetics, Oxford University Press, 2000

Reference Books

- K. Shevgaonkar, Electromagnetic Waves, 1st Edition. McGraw-Hill, 2006.
- F. Harrington, Time-Harmonic Electromagnetic Fields, 2nd Edition. Wiley-IEEE, 2001.
- K. Cheng, Field and Wave Electromagnetics, 2nd Edition. Pearson, 2014.

Signals and Systems (EC2002)

Objective: To demonstrate an understanding of the fundamental properties of signal and systems.

Course Outcome

Students will be able to:

- Analyze the different types of signals and systems.
- Determine the linearity, causality, time-invariance and stability properties of continuous and discrete time systems.
- Represent continuous and discrete systems in time and frequency domain using different transforms.
- Recognize the characteristics of linear time invariant systems.

Classification of Signals and Systems

Step, Ramp, Pulse, Impulse, Real and complex exponentials and Sinusoids. Classification of signals: Continuous time (CT) and Discrete Time (DT) signals, Periodic & Aperiodic signals, Deterministic & Random signals, Energy & Power signals Classification of systems CT systems and DT systems: Linear & Nonlinear, Time-variant & Time-invariant, Causal & Non-causal, Stable & Unstable

Continuous Time Signals & Linear Time Invariant Continuous Time Systems

Fourier series for periodic signals Fourier Transform and properties, Laplace Transforms and properties. Impulse response, convolution integrals, Differential Equation, Fourier and Laplace transforms in Analysis of CT systems, Systems connected in series / parallel.

Analysis of Discrete Time Signals

Sampling and Quantization, Discrete Fourier Transform and Properties, Discrete Fourier transform (DTFT) and Properties of DTFT, Z Transform and Properties of Z- Transform.

Linear Time Invariant-Discrete Time Systems

Impulse response, Difference Equations-Convolution sum- DFT & Z Transform Analysis of Recursive & Non-Recursive systems-DT systems connected in series and parallel

Text Books

- “Signals and Systems”, Simon Haykins and Barry Van Veen, 2nd Edition, 2008, Wiley India. ISBN 9971-51-239-4.
- “Signals and Systems” Alan V Oppenheim, Alan S, Willsky and A Hamid Nawab, Pearson Education Asia / PHI, 2nd edition, 1997. Indian Reprint 2002

Reference Books

- “Fundamentals of Signals & Systems”, Michael Roberts, 2nd edition, Tata McGraw-Hill, 2010, ISBN 978-0-07-070221-9.
- “Linear Systems and Signals”, B. P. Lathi, Oxford University Press, 2005.
- “Digital signal processing: principles algorithms and applications” Proakis, John G. : Pearson Education India, 2001

Analog Electronics and Linear ICs (EC2003)

Objective: To demonstrate an understanding of the analog electronics and linear integrated circuits

Course Outcome
Students will be able to:

- Understanding the types of amplifiers for analog electronics applications.
- Know the concept of various positive and negative feedback in electronic circuits.
- Solve circuits for designing ICs for applications in semiconductor industries.
- Become proficient in the analysis and design of circuits utilizing modern transistors.
- Understand the designing concept of power amplifiers in terms of the conversion efficiency and power delivered to the load.

Operational Amplifier
Type of Amplifiers, Op-Amp, non-idealities of Op-Amp, equivalent circuit, 741-IC, Op-amp used in negative feedback: inverting, non-inverting amplifier, integrator, differentiator, Instrumentation amplifier, Op-Amp as computational block

Feedback Systems
Properties of feedback system, Barkhausen criterion, Op-Amp with positive feedback, Oscillators, wave shaping circuits, filters, 555 timers, Schmitt Triger, PLL

MOSFET amplifiers
CSA, CGA, CDA, Cascode, Cascade, pole and zeros calculation, 3-dB bandwidth, current mirror.

Power amplifiers
Power amplifier circuits, Class A output stage, class B output stage and class AB output stages, class C amplifiers, push pull amplifiers with and without transformers. Complementary symmetry & quasi complimentary symmetry amplifiers.

Text Books

- Adel S. Sedra, Kenneth C. Smith, Microelectronics Circuits Theory and application, 6th edition, Oxford press.
- Behzad Razavi, "Design of Analog CMOS Integrated Circuits", 2nd edition, McGraw Hill, 2017
- R Gayakwad, “Op-amp and Linear Integrated Circuits”, 4th Ed.,Pearson Education.2005

Reference Books

- J Millman and C Halkias, Integrated Electronics by, TMH Press, 1995.
- W D Stanley, “Operational Amplifier with Linear Integrated Circuits”, 3rd Ed.,

Microprocessor Interface and Programming (EC2004)

Objectives: Students will be able to learn about the architecture of microprocessors, fundamentals of assembly language programming, interfacing with peripheral devices and enabling them to create products and solutions for real time problem.

Course Outcome

At the end of this course, students will demonstrate the ability to:

- Explain 8086 architecture and its instruction set
- Develop assembly language programs for the 8086 microprocessor
- Design memory organization
- Interface peripheral chips with respect to PPI, timer, DMA controller etc
- Describe the interrupt response of 8086 family processors and understanding of multi-processor system.

Introduction to Microprocessors

Introduction of Microprocessors and Micro-controllers, Concept of Pipelining, CISC and RISC, Von Neumann vs Harvard architecture, Different microprocessor family, features and evolution

8086 processors and Interrupts

8086 Architecture, Instruction Set, Minimum and Maximum mode configurations, Interrupts, Programmable Interrupt Controller 8259, Architecture, Commands, Interfacing

Peripherals and Interfacing

8255 Programmable Peripheral Interface, Architecture, Commands, Modes, Interfacing
8254 Programmable Interval Timer, Architecture, Modes, Concept of DMA

Memory Design, Multiprocessors and Advanced Microprocessors

Memory Design, Multiprocessor systems, Problems in Multiprocessor systems, Bus Contention, Features and Architecture of Pentium 80586, Microcontrollers

Text Books

- D.V. Hall, Microprocessors and Interfacing, 3rd Edition, McGraw Hill, 2017.
- K M Burchandi, A K Ray, Advanced Microprocessor And Peripherals 3rd Edition McGraw Hill, 2017.

Reference Books

- J. E. Uffenback, 8086/8088 Family rd Edition (English) 3rd Edition, Prentice Hall 2013.
- Y. Gandole, A Text Book Of Advanced Microprocessors and Microcontroller: Intel 80286,80386,80486, 80586 Microprocessor and 8051 Microcontroller, Lambert Academic Publisher, 2012.

Biology for Engineers (AS1010)

Objective: The objective is to provide the fundamental knowledge of Modern Biology and its application.

Course Outcome

Students will be able to:

- Get basic understanding of the Advanced Biology
- Get exposure to different areas of Biology including Cell Biology, Microbiology, Molecular Biology, Biochemistry and Immunology.
- Learn the principles of different advanced laboratory techniques used in biological research works and interdisciplinary research.

Introduction

Introduction to living organisms, Different cell organelles and cellular processes. Prokaryotes and Eukaryotes cells.

Structures and functions

Structures and functions of bimolecules, DNA, RNA, Carbohydrates, Proteins and Lipids.

Immunity, Electrical signal & Biomaterials

Antigen, Antibody, Antigen-Antibody interactions, Electrical signal of cells, HH model. Concept of Stem cells, Differentiation, Characterization**,** Biomaterials for tissue engineering, 3D bio-printing, DNA origami and Biocomputing.

Text book

- Bruce Alberts, Alexander Johnson, Julian Lewis, David Morgan, Martin Raff, Keith Roberts, and Peter Walter, Molecular Biology of the Cell.

References

- Prescott, Harley, and Klein's Microbiology by Joanne M. Willey, Linda Sherwood, and Christopher J. Woolverton.
- Biochemistry by Jeremy M. Berg, John L. Tymoczko, and Lubert Stryer.
- Immunology by Thomas J. Kindt, Richard A. Goldsby, Barbara A. Osborne, Janis Kuby.

Principle of Economics (MS2001)

Objective: This course introduces economic analysis of individual, business, and industry choices in the market economy. Topics include the price mechanism, supply and demand, optimizing economic behavior, costs and revenue, market structures, factor markets, income distribution, market failure, and government intervention. Upon completion, students should be able to identify and evaluate consumer and business alternatives in order to achieve economic objectives efficiently.

Course Outcome

Students will be able to:

- Understand that economics is about the allocation of scarce resources, that scarcity for ceschoice, tradeoffs exist and that every choice has an opportunity cost.
- List the determinants of the demand and supply for a good in a competitive market and explain how that demand and supply together determine equilibrium price.
- Understand the role of prices in allocating scarce resources in market economies and explain the consequences of price controls.
- Define an externality and a public good and why explain the presence of externalities and public goods make markets inefficient. Analyse various government policies aimed at solving these inefficiencies.

Introduction to Economics

Production Possibilities, Supply and demand, analysis; The price system and the mixed economy

Elasticity; Consumer choice and the theory of demand

The profit-maximizing competitive firm and market supply; Long-run supply in competitive markets, Production and cost

Types of Market:

Monopoly; Perfect Markets; Monopolistic competition and oligopoly; Antitrust policy and regulation of markets

Introduction to macro Economics

Macro-Economic Equilibrium GDP; Unemployment; Inflation

Text Books

- Principles of Economics: Gregory Mankiw
- Economics: Samuelson

Introduction to Finance (MS2002)

Objective of the Course: This course is a rigorous introduction to the study of the basic principles of finance and their application to the usual financial issues and decision-making of business enterprises. The main objective of this course is for the student to obtain at least a good working-knowledge of the topics stated in the tentative course outline below for use in future courses and for careers.

Course Outcome
Students will be able to:

- Identify the objective of the firm and the role of managerial finance.
- Outline the implications of the separation of ownership and control.
- Evaluate financial statements using ratio analysis.
- Explain the general concept of valuing financial assets.
- Explain the characteristics of debt and equity securities.
- Identify why firms need to invest in working capital Outline the alternative sources of long-terms fund.

Introduction to financial Management
Financial statement basics, Ratio Analysis

Time value of Money
Capital Budgeting, Relationship between risk and return

Long term financial decisions
Working Capital Management, Dividend Decision

Introduction to Financial Systems
Capital Markets, Introduction to International finance and risk Management

Text Books ·

- Ross, Westerfield, Jordan, Essentials of Corporate Finance
- James C. Van Horne and John M Wachowicz, Fundamentals of financial management.
- Jonathan Berk, Financial Management

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Control Systems (EC2005)

Objectives: To introduce them to the basic of control systems. How a basic control system is formed? How they can analyze and build a control system.

Course Outcome

At the end of this course, students will be able to:

- analyze a control system if given to them. They will
- be able to find the equivalent mathematical model for it and if the system is
- not stable they will be able to, by the use techniques learned in this course,
- stabilize the system.

Introduction to Control System

Basic Concepts of Control Systems, Feedback characteristics of Control Systems.

Time response Analysis

Standard Test Signals. Time response of different order of systems. concept of stability.

Frequency Response Analysis

Frequency domain specifications, Gain and Phase Margin.

Stability in frequency domain

Root locus concepts, Effect of adding open loop poles and zeros, Nichol's chart, controllers.

Text Books

- N S. Nise, Control Systems Engineering, International Student Version, 6th Edition, Wiley, April 2011.
- R H. Bishop, Richard C. Dorf, Modern Control Systems, 12th edition, Pearson
- Higher Education, 2010.
- I.J. Nagrath and M Gopal, Control Systems Engineering, 6th edition, New Age International Pvt Ltd, 2017

Reference Books

Analog Communication (EC2006)

Objectives: To make the student learn the fundamentals of communication systems and to let the students be exposed to technological progress in communication systems.

Course Outcome

At the end of this course, students will be able to:

- analyze and design various transmission techniques.
- to tackle the challenges in designing a transceiver for a communication system..

Introduction

Basic elements of a communication systems.

Analog Baseband and Bandpass Transmissions:

Baseband versus passband communication,
Modulation and need of modulation, Analog modulation and demodulation- AM, DSB-SC, VSB, SSB, Comparison of different modulation techniques, Phased locked loop and applications, Pulse modulation: PAM, PPM, PWM..

Angle Modulation and demodulation

Non-linear modulation and concept of instantaneous
frequency, Relationship between PM and FM, Power and bandwidth of angle modulated signals, Narrowband and wideband FM, NBFM generation-direct and indirect method, Demodulation of FM signals and effect of non-linear distortion, Deemphasis and Preemphasis Filtering, Superheterodyne analog AM/FM receivers.

Noise in analog modulation systems

White Gaussian noise, Bandpass noise, PSD of noise, Noise analysis-DSB-SC, AM, SSB, FM.

Text Books

- A B Carlson, Communication, Pearson, 2000
- B P Lathi and Z. Ding, Modern Analog and Digital Communication Systems, Oxford Press, 2002

Reference Books

CMOS VLSI Design (EC2007)

Objectives: To make the student learn the fundamentals of design styles used in CMOS ICs, covering both full-custom and semi-custom design approaches.

Course Outcome

At the end of this course, students will be able to:

- Understand the fundamentals of MOSFET, CMOS Technology, and Scaling.
- Understand the fundamentals of the CMOS static and dynamic logic implementation and physical design
- Apply logic optimization techniques to improve the PPA of any CMOS ICs.
- Perform physical design and static timing analysis (STA).
- Make the skillsets aligned with India's semiconductor mission and VLSI industry.

Introduction to CMOS

MOSFETs, threshold voltage, Inverters: ratioed, ratioless, CMOS Inverter. DC transfer characteristics, Dynamic characteristics, Static and dynamic power consumption, standby power consumption, activity factor MOS leakage, delay computation using average current method, exact analysis, RC-delay model, interconnects, MOS capacitances.

Compact models and physical design

MOS SPICE Models, level-1, level-2, level-3, BSIM models, Verilog-A models, SPICE model parameter extraction, Short channel effects, Technology Scaling considering long-channel and short-channel transistors, CMOS Fabrication steps, Layout, stick diagram, Euler Path, junction sharing, calculation of parasitic. LVS, DRC, corner and PVT analysis, yield, PPA.

Combinational Logic Optimization

Pass transistors, CPL, Transmission gates, DCVSL logic, input reordering, progressive sizing, method of logical effort, critical path optimization using logical effort and RC-delay model.

Sequential Logic Implementation

Master-slave D-FF implementation using pass transistor and/or transmission gate, setup time, hold time, Static timing analysis, Min and Max delay constraints, hold time violation, clock skew, STA, dynamic logics: charge-precharge based, Dominos, charge-sharing.

Text Books

- J. M. Rabaey et al. & Digital Integrated Circuits A design perspective 2 nd edition, PHI.
- Weste, Harris, CMOS VLSI Design: A Circuits and Systems Perspective 4th edition, Pearson.
- Sung-Mo Kang, Yusuf Leblebici, CMOS Digital Integrated Circuits Analysis
- and Design Tata McGraw-Hill.

Reference Book

Probability and Statistics (AS2001)

Objective: This course provides an elementary introduction to probability and statistics with applications. The topics covered in this course are basic concept of probability and statistics, random variables, probability distributions, Bayesian inference, joint probability distributions, random vectors, central limit theorem, confidence intervals.

Course Outcome

Students will be able to:

- Understand the basic concepts of probability and random variables.
- Apply the standard discrete and continuous probability distributions to real problems and use the inequalities.
- Extend the concept of random variables to higher dimensions and approximate probabilities by central limit theorem.
- Analyze the data by using statistical techniques of point and interval estimation and testing of hypotheses.

Probability: Axiomatic definition, Properties, Conditional probability, Bayes rule and independence of events, Random Variables, Distribution function

Probability Distributions: Discrete and Continuous random variables, Expectation, Function of random variable, Moments, Moment generating function, Chebyshev's and Morkov's inequality. Bernoulli, Binomial, Geometric, Negative binomial, Hypergeometric, Poisson, Discrete uniform, Continuous uniform, Exponential, Gamma, Normal.

Random vector: Joint distributions, Marginal and conditional distributions, Moments, Independence of random variables, Covariance, Correlation, Levy's Central limit theorem (independently and identically distributed with finite variance case), Normal approximation to Binomial and Poisson

Statistics: Introduction: Population, Sample, Parameters, Point Estimation: Method of moments, Maximum likelihood estimation, Unbiasedness, Consistency, Interval Estimation: Confidence interval, Tests of Hypotheses, Linear Regression.

Text/Reference Books

1. Sheldon M. Ross, An Introduction to Probability Models, 10th Edition, Academic Press, Elsevier.
2. Sheldon M. Ross, An Introduction to Probability and Statistics for Engineers and Scientists, 3rd Edition, Academic Press, Elsevier.
3. Rohatgi, V. K. and Saleh, A. K. (2000), An Introduction to Probability and Statistics, 2nd Edition, Wiley-interscience.
4. Bertsekas, D. P. and Tsitsiklis, J. N. (2008), Introduction to Probability, Athena Scientific, Massachusetts.
5. Montgomery, D. C., Peck, E. A. and Vining, G. G. (2012), An Introduction to Linear Regression Analysis, 5th Edition, Wiley

Antenna and Wave Propagation (EC2009)

Objectives: To provide a comprehensive introduction to the fundamentals of antenna, its types, design and measurement parameters.

Course Outcome

At the end of this course, students will be able to:

- Learn the basics of radiation principle and foundational concepts through mathematical analysis.
- Gain insight about fundamental parameters and terminology used in Antenna Engineering.
- Analyze and design various types of antennas to achieve a specified performance.
- To understand various modes of EM wave propagation.
- To acquire hands-on experience with antenna measurements and testing

Radiation Integrals and Auxiliary Potential Functions

Vector Potential for an Electric and Magnetic Current Sources, Electric and Magnetic Fields for Electric and Magnetic Current Sources, Solution of the Inhomogeneous Vector Potential Wave Equation, Far-Field Radiation, Duality Theorem, Reciprocity and Reaction Theorems.

Fundamental Parameters of Antennas

Principle of Radiation, Radiation Pattern, Field Regions, Radiation Power Density, Radiation Intensity, Beamwidth, Directivity, Antenna Efficiency, Gain, Bandwidth, Polarization, Input Impedance, Antenna Radiation Efficiency, Maximum Directivity and Maximum Effective Area, Friis Transmission Equation and Radar Range Equation.

Antenna Arrays

Uniform linear arrays of isotropic elements, array factor and directivity. Broadside & Endfire array, Principle of pattern multiplication. Binomial array.

Working Principle of Antennas & Wave Propagation

Linear Wire Antennas, Monopole, folded dipole, Yagi-Uda, Log
periodic, Parabolic reflector, Horn, V-antenna, Rhombic antenna, Microstrip antenna, Resonant and non-resonant antenna. Atmosphere, Ground wave propagation, Sky-wave propagation, space wave, propagation, Troposcatter and Duct propagation

Text Books

- C A Balanis, Antenna Theory and Design.3rd Ed., John Wiley & Sons. 2005.
- R. Harish, and M. Sachidananda. Antennas and wave propagation. Oxford University Press, USA, 2007.
- Reference Books
- R. S. Elliot, Antenna Theory and Design. Revised edition, Wiley-IEEE Press. 2003.
- R. E. Collin, Antennas and Radio Wave Propagation. McGraw-Hill. 1985.
- R. K. Shevgaonkar, Electromagnetic waves. Tata McGraw-Hill Education, 2005.

Integrated Circuit Technology (EC2010)

Objectives: The subject provides an in-depth knowledge of how a semiconductor device is prepared right from the substrate preparation to device fabrication..

Course Outcome

At the end of this course, students will be able to:

- Achieve in-depth knowledge of how a semiconductor device is prepared right from the substrate preparation to the final device realization.
- Understand the latest device fabrication technologies and basic principles underlying state-of-the-art processes involved

Semiconductor materials and manufacturing

Historical perspective, Modern CMOS Technology, Crystal growth, and wafer preparation: crystal structures, wafer fabrication, crystal defects, gettering

Lithography

Light Sources, Masks, Wafer Exposure System, Photoresists, Modern Photolithography Techniques, DUV, EUV, Resolution enhancement methods, Other lithography Techniques

Thermal Oxidation and Interfaces

Oxidation kinetics and its dependencies, substrate doping effects, impurity redistribution during oxidation, oxide charges, High-K Dielectrics

Doping in Semiconductors & Etching Technologies

Diffusion from Macroscopic and microscopic viewpoint, Analytical solutions of Diffusion equation, evaluation of diffused layers, Ion Implantation and implant range, Ion stopping and ion channelling, Transient Enhanced Diffusion (TED), Wet and dry etching, Plasma chemistry, plasma etching mechanisms, high density plasma, atomic layer etching, planarization methods CMP

Deposition Technologies and Interconnects

CVD, hetroepitaxy, PVD, sputtering systems, LPCVD, MOCVD, PECVD, ALD, MBE, Metal deposition, multilayer interconncets and their issues, Electromigration silicidation, salicide process

Text Books

- J. D. Plummer and P.B. Griffin, “Integrated Circuit Fabrication Processes: Science and Technology”, by Cambridge University Press, 2024

Reference

- S. M. Sze, VLSI Technology, McGraw Hill Education.
- G. S. May and S M Sze, Fundamentals of Semiconductor Fabrication, John Wiley & Sons,
- S. K. Gandhi, VLSI Fabrication Principles: Silicon and Gallium Arsenide, John Wiley & Sons,

Digital Signal Processing (EC3001)

Objective: To learn about the basics and advanced topics in the field of Digital Signal Processing.

Course outcomes

Students will be able to:

- Students will learn to utilize the advanced approaches of processing the signals and various aspects of discrete system design.

Introduction

Review of the fundamental concepts of digital signal processing, Sampling and Quantization, Convolution and correlation, DTFT, DFT and FFT

FIR & IIR

Filter concepts, Structures for realization of FIR and IIR Systems and their analysis, Recursive and Non-recursive structures, Windowing methods, comparison of design methods.

Multirate DSP

Design of FIR filters, Analysis of finite word length effects, Multirate digital signal processing, optimum linear filters and Power spectrum estimation.

Statistical Signal Processing

Introduction to Statistical Signal Processing, applications of autoregressive (AR), Moving average (MA), and ARMA processes, Applications of DSP etc.

Text Books:

- John G Proakis, Digital Signal Processing, 4th Edition PHI, 2012
- V. Oppenheim and R. W. Schafer, Discrete-Time Signal Processing, 2nd Edition,
- Pearson Education, 2003.
- J. G. Proakis and D. G. Manolakis, Digital Signal Processing: Principles, Algorithms
- and Applications, 4th Edition, Prantice Hall, 1996.
- S. Haykin and B.V. Been, Signals and Systems, 2nd Edition, John Wiley & Sons. 2003.
- B.P. Lathi, Linear Systems and Signals, 2nd Edition, Oxford University Press, 2005.

Reference Books:

Embedded System Design (EC3002)

Objective: Understanding of Hardware and Software Components of a typical Embedded System, the challenges in " System Level Design" and develop system design skills and to Develop programming skills and practical expertise in designing, debugging and developing small scale and medium scale Embedded systems

Course outcomes

Students will be able to:

- Understand the hardware and software components of embedded systems.
- Develop system design skills and address challenges in system-level design.
- Gain practical expertise in designing, debugging, and developing embedded systems.
- Ability to design embedded electronic hardware and firmware.
- Comprehend microcontroller architecture and interfacing techniques

Introduction

Design process of embedded systems, hardware/software interface, design issues in embedded systems, and system-on-chip technologies.

Implementation

Hardware implementation methodologies, interaction for general microcontrollers, and communication protocols like USB, I2C.

Embedded Processor

Performance, efficiency of ARM architecture, data processing, and parallelism.

Interfacing

Memory interfacing, I/O interfacing, real-time OS, scheduling, and testing.

Text Books

- Wolf, Wayne. Computers as Components – Principles of Embedded Computing System Design. Second Edition, Morgan-Kaufmann, 2008.
- Vahid, F., & Givargis, T. Embedded System Design – A Unified Hardware/Software Introduction. John Wiley, 2002.

Reference Books

- James K. Peckol. Embedded System Design – A Contemporary Design Tool. Wiley Student Edition, 2010.
- Steve Furber. ARM System-on-Chip Architecture. Second Edition, Pearson, 2007.
- Lyla B Das. Embedded Systems: An Integrated Approach. Pearson Education.
- Santanu Chattopadhyay. Embedded System Design. PHI.
- Muhammad Ali Mazidi. 8051 Microcontroller & Embedded Systems: Using Assembly and C. Pearson Education.
- ARMv7 Reference Manual.

Microwave Engineering (EC3003)

Objective of the course: To provide a comprehensive introduction to various devices and passive components used at microwave frequencies.

Course Outcomes
Students will be able to:

- Understand the different types of matching techniques using Smith Chart.
- Analyze and implement metamaterial transmission lines.
- Design RF filters using planar technologies.
- Design microwave amplifiers.

Impedance Matching
Smith Chart, Single and double stub matching, Quarter-wave Transformer, Theory of Small Reflection, Binomial and Chebyshev multi-section matching, Tapered line

Metamaterial Transmission lines
Negative Refractive Index (NRI) Media, Negative-Refractive-Index Transmission-Line (NRI-TL) Metamaterial Medium: Propagation Characteristics of the T and Unit Cell, Effective Medium Propagation Characteristics, Multi-Stage NRI-TL Metamaterial Phase-Shifting Lines

Microwave Filters
Filter design by the insertion loss method, Maximally Flat Low-Pass Filter Prototype, Equal-Ripple Low-Pass Filter Prototype, Filter transformations: Impedance and Frequency Scaling, Band-pass and Band-stop Transformations, Richards' Transformation, Kuroda's Identities, stepped-impedance low-pass filters

Microwave Active Circuit Design
Nonlinear distortion: Gain Compression, Harmonic and Intermodulation Distortion, Third-Order Intercept Point, Dynamic range, Diode Circuits, Amplifier Design: Two port power gain, stability circles, Single stage transistor amplifier design

Text Books

- D.M. Pozar, Microwave Engineering. 4th Ed., John Wiley & Sons. 2012.
- R.E. Collin, Foundations for Microwave Engineering. 2nd Ed., John Wiley & Sons. 2000.

Reference Books

- D.M. Pozar, Microwave and RF design of Wireless System, John Wiley & Sons. 2001.
- Marc A. Antoniades, Microwave Devices and Antennas Based on Negative-Refractive-Index Transmission-Line Metamaterials, PhD Thesis, Department of Electrical and Computer Engineering University of Toronto, 2009.

Digital Communication (EC3004)

Objective: To learn about the fundamental concepts of digital communications.

Course Outcome:
Student will be able to:

- Understand the fundamental principles underlying the analysis and design of digital communication systems.
- Gain knowledge of digital communication methods for transmitting information from a source to one or more destinations in digital form.
- Evaluate the performance of digital communication system in the presence of noise.
- Apply the knowledge of information theory and describe the error control codes like block code, cyclic code.

Digital communication systems and signal representation
Analog versus digital communication, Elements of a digital communication system, Review of probability and random process, Signal spaces: Waveforms and vector spaces, Gram Schmidt orthogonalization, bandpass and low pass representation of a random process, Line Coding, Spectral properties of line codes.

Digital modulation and demodulation techniques
Baseband pulse shaping, Digital modulations and demodulation schemes: Binary ASK, PSK, FSK, QPSK, 8-PSK, DPSK, QAM, Calculation of probability of error.

Optimum signal detection
Design of optimum receivers over AWGN channel, Noise in digital communications, Equalizers.

Introduction to Information Theory
Entropy, Mutual information, Data compression, Source coding, Channel coding, Error correction codes.

Text Book

- B P Lathi and Z. Ding, Modern Analog and Digital Communication Systems, Oxford Press, 2002.
- John G Proakis and M. Salehi, Digital communications, McGraw-hill, 2008.

References

- S. Haykin, Digital communications, Wiley, New York, 1988

Design Thinking and Innovation (EC3501)

Objective: The objective of this course is to learn the innovation cycle of Design Thinking process for developing innovative products.

Course Outcome

Student will able to

- Compare and classify the various learning styles and memory techniques and Apply them in their engineering education
- Analyze emotional experience and Inspect emotional expressions to better understand users while designing innovative products
- Develop new ways of creative thinking and Learn the innovation cycle of the Design Thinking process for developing innovative products
- Propose real-time innovative engineering product designs and Choose appropriate frameworks, strategies, and techniques during prototype development and to perceive individual differences and its impact on everyday decisions and further Create a better customer experience

An Insight to Learning, Remembering Memory & Emotions

Kolb's Learning Styles, Assessing and Interpreting, Understanding the Memory process, Problems in retention, Memory enhancement techniques, Understanding Emotions:

Basics of Design Thinking & Being Ingenious & Fixing Problem

Definition, Need, Objective, Concepts & Brainstorming, Stages of Design Thinking Process, Bottlenecks of Processes-Process Centric approach, Creative thinking process, Problem Solving, Testing Creative Problem Solving

Process of Product Design, Prototyping & Testing and Celebrating the Difference

Process of Engineering Product Design, Design Thinking Approach, Stages of Product Design, User Interface Design, Mobile App Design, Prototype creation, Rapid Prototype Development process, Testing, Test Group Marketing, Group Discussion

Design Thinking & Customer Centricity & Feedback, Re-Design & Re-Create

Practical Examples of Customer Challenges, Use of Design Thinking to Enhance Customer Experience, Feedback loop, rapid prototyping & testing, final product, Creative Solution".

Text Book

Reference Book

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Data Communication and Networking (EC3005)

Objective: The objective of this course is to describe communication protocols and layered network architectures

Course outcomes:
Students will be able to:

- Explain convention computer system interfacing standards and peer-to-peer data link and communication protocols
- Design basis network systems and Analyze data communication technology
- Analyze data communication technology.

Data Communications
Components – Direction of Data flow – Networks – Components and Categories – Types of Connections – Topologies –Protocols and Standards – ISO / OSI model, Example Networks such as ATM, Frame Relay, ISDN Physical layer: Transmission modes, Multiplexing, Transmission Media, Switching, Circuit Switched Networks, Datagram Networks, Virtual Circuit Networks.

Data link layer: Introduction, Framing, and Error – Detection and Correction – Parity – LRC – CRC Hamming code, Flow and Error Control, Noiseless Channels, Noisy Channels, HDLC, Point to Point Protocols. Medium Access sub-layer: ALOHA, CSMA/CD, LAN – Ethernet IEEE 802.3, IEEE 802.5 – IEEE 802.11, Random access, Controlled access, Channelization.

Network and Transport Layer: Logical Addressing, Internetworking, Tunneling, Address mapping, ICMP, IGMP, Forwarding, Uni-Cast Routing Protocols, Multicast Routing Protocols, Process Process Delivery, UDP and TCP protocols, Data Traffic, Congestion, Congestion Control, QoS, Integrated Services, Differentiated Services, quality of service in Switched Networks.

Application Layer: Domain name space, DNS in internet, electronic mail, SMTP, FTP, WWW, HTTP, SNMP.

Text/Reference Books:

- D. Bertsekas and R. Gallager, Data Networks, 2nd Edn., Prentice Hall, 1992.
- L. Peterson and B. Davies, Computer Networks: A Systems Approach, 4th Edition, Elsevier, 2007.
- L Garcia and I. Widjaja, Communication Networks, 2nd Edn., McGraw Hill,2009
- Kumar, D. Manjunath and J. Kuri, Communication Networking: An Analytical Approach, Elsevier, 2004.
- Behrouz A. Forouzan, Data Communications and Networking, Fourth Edition TMH,2006.
- Andrew S Tanenbaum, Computer Networks, 4th Edition. Pearson Education, PHI.

Mobile and Wireless Communication (EC3006)

Objective: The objective of this course is to develop an understanding of advanced multiple access and diversity reception techniques.

Course outcomes:
Students will be able to:

- Synthesis and analysis of wireless and mobile communication systems over a stochastic fading channel
- Evaluate the performance of wireless communication systems, taking into account the impact of physical channel characteristics on end-to-end transmission.
- Identify the recent technologies in the domain of wireless communication

Cellular concepts: Fundamentals of cellular networks, Frequency reuse, Handoff, Co-channel interference, Adjacent interference, System capacity, Trunking and grade of service.

Mobile radio propagation: Free space propagation model, Log distance path loss model, Shadowing, Various outdoor and indoor propagation models, Types of fading, Doppler shifts, Characteristics of fading channel: level crossing and average fade duration, Diversity Techniques.

Multiple access techniques: Frequency division multiple access (FDMA), Time division multiple access (TDMA), Spread spectrum multiple access: CDMA and frequency hopping, Orthogonal frequency division multiplexing (OFDM).

Recent wireless technologies: Cooperative Communication: Relaying and other similar Networks, LTE Networks, NOMA and others recent trends in 5G and beyond.

Text Book

- T. S. Rappaport, Wireless Communication, 2nd Edition, Principles and Practice, Pearson Education India, 2009.
- Tse and P. Viswanath, Fundamentals of Wireless Communication, Cambridge University Press, 2005

References

- B. Carlson, P. B. Crilly and J.C. Rutledge, Communication Systems: An Introduction to Signals and Noise in Electrical Communication, 4th Edition, McGraw Hill, 2002.
- L. Song and J. Shen, Evolved Cellular Networks Planning and Optimization for UMTS and LTE, 1st Edition, CRC Press, 2010.

French Language (MS 1502)

Objective: To equip students with the necessary skills to understand, speak, read, and write French effectively, allowing them to communicate in everyday situations, including basic grammar, vocabulary, pronunciation, and cultural understanding, often aiming to reach a specific proficiency level

Course outcome

At the end of this course, Students will

- be familiar with the pronunciation of French letters and greetings
- would be able to count numbers
- would be able to form basic questions and answer them and would be able to read the city map, converse of time and appointments etc

Introduction

Personal Information, Introducing yourself (name, age, nationality), Family members Basic greetings and farewells

Basic Communication

Asking and answering simple questions, Expressing likes and dislikes, Making requests.

Numbers and Time

Counting, Telling time, Days of the week and months

Everyday Life

Describing daily routines, Talking about hobbies and interests, Weather descriptions

Places and Directions

Asking for and giving directions, Identifying basic places in a town

Shopping and Dining

Making simple purchases, Ordering food and drinks

Basic Grammar

Subject-verb agreement, Present tense verb conjugation, Basic sentence structure, Articles (le, la, les, un, une)

German Language (MS 1500)

Objective: The student will learn the basics of standard German language, and will get to know about the norms of language of German.

Course outcome

At the end of this course, Students will

- Be familiar with the pronunciation of German letters and greetings
- would be able to count numbers
- would be able to form basic questions and answer them and would be able to read the city map, converse of time and appointments etc

Introduction

Alphabets, Numbers, Greetings

Phrases

Basic introductory phrases

Calenders

Days of the week, Months

Introduction of self and introduction of others

Map, Time, Vocabulary- things around, Nations and nationalities, stationery, professions, hobbies

Grammar

present tense, past tense, plurals, pronouns, verb conjugations, (regular, and three or four important irregular verbs), prepositions, and so on

Japanese Language (MS 1501)

Objective: The student will learn the basics of standard Japanease language, and will get to know about the norms of language of Japan.

Course outcome

At the end of this course, Students will

- Be familiar with the pronunciation of Japan letters and greetings
- would be able to count numbers
- would be able to form basic questions and answer them and would be able to read the city map, converse of time and appointments etc

Introduction

Introduction to Japanese Syllables (phonetic alphabet), greetings & Self introduction, Identifying things, point objects and listen to their names, Listen to things and places etc. Creating shopping lists

Time Delay

Introduction to Time, day of the week, simple inquiries on telephone, Means of transport, Basic conversations of everyday life.

Frame questions in Japanese

Vocabulary of giving and receiving objects. Stating impressions/things surrounding us, Expressing likes and dislikes, good/bad, possessions. Talking about the country, town and the environment.

Quantity

Number of people, time, period etc., Stating thoughts and impressions. Conveying movement (e.g. go / come)

Sanskrit Language (MS 1401)

Objective: The student will learn the basics of standard Sanskrit language, and will get to know its importance with respect to national unity, integrity, morality and spirituality.

Course outcome

At the end of this course, Students will be

- familiar with the pronunciation of Sanskrit language
- understand ancient scientific concepts, principles, and methodologies without the limitations of translations or interpretations

Introduction to Sanskrit Phonetics

Devanagiri Lipi: Swar and Vyanjan. (Writing rules,Definition,classification,Pronunciation system),Sanskrit Sentence formationand spoken Sanskrit rules.Translation:From Sanskrit to English or English to Sanskrit. Sanskrit Subhashita.

Sanskrit grammar

Sandhi (introduction, classification, Swar-Sandhi),Kāraka&Vibhakti (Definition, Types, Example). Sabdārūpa&Dhāturūpa.

Introductory Vedic & Classical Literature

Four Vedas, Āraṇyakas, Upaniṣads, Vedāṅgas, Purāṇas.Rāmāyaṇa(by Vālmīki) and **Mahābhārata** (by Vyāsa), Bhagavad Gita etc.

Introductory Vedic Mathematics and Sciences in Sanskrit:

Illustrations from book- Vedic Mathematics written by Bharati Krishna Teertha ji, (published by MLBD) –Calculation pi, square root finding, Philosophical meanings of zero and one. Surya Siddhanta. (Kalganana), Katapayadi Sankhya,NāradāŚilpa Śāstra(Architecture and Vastu Shastra), Aṣṭāṅga Hridayam.

Modern Age Possibilities: Sanskrit for ICT : Paper by Subhash Kak and Saroja Bhate Panini's Grammar and Computer Science.

Text Books:

- Sanskrit Sahitya ka Samikshatmak Itihas by Dr. Kapil Dev Dwivedi.

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