

SEMESTER- I

19N101 CALCULUS AND ITS APPLICATIONS

3 1 0 4

DIFFERENTIAL CALCULUS: Functions of two variables, limits and continuity, partial derivatives, chain rule, extreme values and saddle points, Lagrange multipliers, Taylor's formula for two variables. (9+3)

INTEGRAL CALCULUS: Double and iterated integrals over rectangles, double integrals over general regions, Fubini's theorem, area and volume by double integration, reversing the order of integration, Double integrals in polar form. (9+3)

FIRST ORDER ORDINARY DIFFERENTIAL EQUATIONS: Basic concepts, separable differential equations, exact differential equations, integrating factors, linear differential equations, modeling - mixing problems, Newton's law of cooling, Decay and growth problems. (9+3)

SECOND ORDER LINEAR DIFFERENTIAL EQUATIONS: Homogeneous linear equations of second order, homogeneous linear ODEs with constant coefficients, Euler-Cauchy equations, solution by variation of parameters, free oscillations mass spring systems, Electric circuits. (9+3)

VECTOR CALCULUS: Gradient and directional derivative of a scalar field, divergence and curl of a vector field. Integration in vector field – line integrals, path independence of line integrals, Green's theorem in the plane, divergence theorem of Gauss and Stokes's theorems. (9+3)

Total L: 45 +T: 15 = 60

TEXT BOOKS

1. Joel Hass, Christopher Heil, Maurice D.Weir, "Thomas' Calculus", Pearson Education, New Delhi, 2018.
2. Erwin Kreyszig, "Advanced Engineering Mathematics", Wiley India Pvt Ltd, New Delhi, 2015.

REFERENCES

1. Howard Anton, Irl Bivens, Stephen Davis, "Calculus", John Wiley & Sons, INC, USA, 2016.
2. Wylie C R and Barrett L C, "Advanced Engineering Mathematics", Tata McGraw-Hill, New Delhi, 2019.
3. Michael D.Greenberg, "Foundations of Applied Mathematics", Dover Publications, INC, New York, 2013.
4. Gilbert Strang, "Calculus", Wellesley Cambridge Press, USA, 2017.

19N102 ELECTRICAL AND ELECTRONICS SYSTEMS

3 0 0 3

DC CIRCUIT: Current-voltage – Power-energy, electrical circuit elements: resistors-inductor- capacitor, source of electrical energy - Ohm 's law-Kirchhoff's laws - series and parallel circuits - Maxwell's loop current method, Network theorems: superposition theorem- Thevenin'stheorem-Norton'stheorem-maximum power transfer theorem. (9)

AC CIRCUITS: Single phase AC circuits: Average and RMS values of sinusoidal wave form-RLC Circuit-Phasor representation-active, reactive apparent power –power factor, analysis of RLC Circuit, three phase circuit: star and delta connection-phase and line quantities-balance and unbalance systems (9)

ELECTROMAGNETISM AND MAGNETIC CIRCUITS: Electromagnetic induction: induced currents, Faraday's law, induction and energy, motional emf and Lenz's law. Magnetic field-magnetic circuit-inductance and mutual inductance-magnetic materials –ideal transformers and real transformers (8)

SEMICONDUCTOR DEVICES: Basic diode concepts-diode circuit: half wave rectifier-full wave rectifier-bridge rectifier-special purpose diodes-zener diode –transistor fundamentals –transistor biasing- bipolar junction transistors-basis amplifier concept-loading effect-power supplies and efficiency. (10)

OPERATIONAL AMPLIFIERS: Definition of terms – Inverting and non-inverting amplifiers, inverting summing amplifier, integrators and differentiators. (9)

Total L: 45

TEXT BOOKS:

1. John Hiley, Keith Brown, Ian McKenzie Smith, Edward Hughes "Electrical and Electronic Technology", Pearson education., New Delhi, 2016, Twelfth edition
2. Murugesh Kumar K "Basic Electrical Science and Technology", Vikas Publishing House., New Delhi, 2009

REFERENCES:

1. Leach D P, "Digital Principles & Applications", Tata McGraw Hill., 2014 , Eighth edition
2. Hambley A R, "Electrical Engineering Principles and Applications", PHI Learning Pvt. Ltd., New Delhi, 2011
3. Boylestad R. L., Nashelsky L "Electronic Devices and Circuit Theory", Pearson Education., Noida, 2014, Eleventh

edition

4. Theraja B. L., "Basic electronic Solid State", S. Chand & Company Ltd., New Delhi, 2010

19N103 CHEMISTRY OF ELECTRONIC MATERIALS

3 0 0 3

CONDUCTING PROPERTIES OF MATERIALS: Molecular orbital treatment of bonding in metals, insulators, semiconductors – direct band and indirect band, elemental, p-doped, n-doped, stoichiometric compound semiconductors and chalcogen semiconductors. Crystal defects and their influence on properties of materials – intrinsic defects - schottky and frenkel, non-stoichiometric compounds, extrinsic defects - oxide ion conductors - applications. Nanoscale materials – Quantum dots-band gap – size dependent optical properties. (9)

POLYMERIC MATERIALS: Classification, degree of polymerization, average molecular weights, polydispersity. Polymerization reactions – chain and condensation. Thermal properties -glass transition temperature(Tg) – factors affecting Tg - determination by DSC. Mechanical properties – significance in fabrication of electronics. Electrical insulating properties - dielectric breakdown - aging of polymer insulations - discharges in voids, electrical treeingThermal and photochemical degradations. Additives - plasticisers, stabilisers, functional additives. (9)

FLEXIBLE ELECTRONIC MATERIALS: Conjugated polymers – electronic energy bands - mechanism of charge transport– intrachain and interchain - solitons, polarons and bipolarons. Factors influencing charge transport – structural features - defects, molecular weight, crystalline/amorphous nature, doping- oxidative and reductive. Synthesis, properties and applications of polyaniline, polythiophene and polypyrrole. Molecular electronics - graphene, fullerenes, carbon nanotubes – structure, synthesis, properties and applications. (9)

OPTOELECTRONIC MATERIALS: Electroluminescence- exciton, OLED materials– emitters- charge transfer complexes, metal chelates, polycyclic aromatic oligomers, conjugated polymers –polyphenylenes, polyfluorenes. Liquid crystalline polymers- classification of liquid crystals, chemical constitution, stability and applications.Organic and dye sensitized photovoltaics – working principle, materials, advantages and disadvantages. Preparation of ultrathin polymer films - Langmuir-Blodgett Films –self assembled monolayers. (9)

MATERIALS FOR ELECTRONICS PROCESSING: Semiconductor wafer fabrication -Overview and challenges –high purity chemicals, air filters for clean rooms, electronic grade water- quality parameters, water treatment stages for ultrapure water production – membranes and ion-exchange resins, electrodialysis. Photoresists for wafer fabrication – microlithography, resist requirements, material chemistry-Electronic packaging materials-adhesives, connectors, eutectic alloys, phase change materials-phase diagrams, applications. (9)

Total L: 45

TEXT BOOKS:

1. Lesley E.Smart, Elaine A.Moore, "Solid State Chemistry - an Introduction", CRC Press, London, 2005, Fourth edition
2. Cowie J.M.G, Valeria Arrighi, "Polymers: Chemistry and Physics of modern materials", CRC Press, London, 2007, Third edition

REFERENCES:

1. Bansil D. Malhotra "Handbook of Polymers in Electronics", Rapra Technology Ltd., UK, 2002, First edition
2. Stergios Logothetidis "Handbook of Flexible Organic Electronics Materials - Manufacturing and Applications", WoodHead publishing, London, 2015, First edition
3. Peter Van Zant "Microchip Fabrication: A Practical Guide to Semiconductor Processing", Mc Graw Hill, 2014, Sixth edition
4. Shashi Chawla "A Textbook of Engineering Chemistry", Dhanpat Rai and Co., New Delhi, 2005, First edition

19N104 COMPUTATIONAL THINKING

3 0 0 3

INTRODUCTION:Computational Thinking – Logical Thinking – Algorithmic Thinking – Problem Decomposition – Flow charts – Algorithm Development – Top-down design approach– Performance Analysis – Abstract Models (9)

FUNDAMENTAL ALGORITHMS: Characteristics of Algorithms – Iterative Algorithms – Factoring Methods – Array Processing - Examples (10)

RECURSIVE ALGORITHMS: Recursion – Recursive Algorithms – Recurrence relations - Recursively finding GCD – Finding Saddle Point in a Matrix – Finding a Peak in an Array – Towers of Hanoi (9)

PATTERN SEARCHING: Text processing – Key word searching in Text – Pattern Search – Sublinear PatternSearch (7)

SORTING AND SEARCHING: Sorting methods – Insertion sort – Bubble sort – Selection sort – Partition sort – Merge sort – Linear search – Binary search – Comparison of performance of algorithms. (10)

Total L: 45

TEXT BOOKS:

1. Karl Beecher, "Computational Thinking: A Beginner's Guide to Problem Solving and programming", First Edition, BCS Learning & Development Limited, 2017.
2. R.G.Dromey, "How to Solve it by Computer", Pearson Education, Second Edition, 2014.

REFERENCES:

1. G Venkatesh and Madhavan Mukund, "Computational Thinking: A Primer for Programmers and Data Scientists", First Edition, Notion Press, 2021.
2. Peter J Denning, Matti Tedre, "Computational Thinking", The MIT Press, 2019.
3. Anany Levitin, "Introduction to the Design and Analysis of Algorithms", Third Edition, Pearson Education, 2017.
4. Peter William Mcowan, Paul Curzon, "Power of Computational Thinking, The: Games, Magic And Puzzles To Help You Become A Computational Thinker ", World Scientific Europe Ltd, 2017
5. Thomas Mailund, "Introduction to Computational Thinking: Problem Solving, Algorithms, Data Structures, and More", Apress, USA, 2021.

19G105 ENGLISH LANGUAGE PROFICIENCY**2 1 0 3**

LEARNING LANGUAGE THROUGH STANDARD LITERARY AND GENERAL TEXTS: Integrated tasks focusing on language skills; Training based on Text based vocabulary, tone, register and Syntax features. (12+0)

GRAMMAR IN CONTEXT: Word Order; Subject Verb Concord; Style features - Tenses, Conditionals, Prepositions, Active and Passive Voice, Modals, Cloze and Spotting Error exercises (10+0)

GUIDELINES FOR WRITTEN COMMUNICATION: Principles of clear writing, Paragraph writing, Essay writing, Emphasis Techniques, Summarizing and Paraphrasing, Analytical writing (8+0)

FOCUS ON SPOKEN ENGLISH: Task – based activities: Graded levels of difficulty and with focus on language functions - Level 1: Self – expression – Greetings in Conversation, Hobbies, Special interests, Daily routine - Level 2: General Awareness – Expression of Concepts, Opinions, Social Issues, Description of a process / picture/chart, news presentation / review - Level 3: Advanced Skills – Making Short Speeches and Participating in Role Plays(0+10)

LISTENING ACTIVITY: Task based activities using Language Laboratory. (0+5)

Total L: 30 +T: 15 = 45**TEXT BOOKS:**

1. Faculty Incharge, "Course Material on "English Language Proficiency", PSG College of Technology, Coimbatore, 2019

REFERENCES:

1. Jill Singleton, "Writers at Work: The Paragraph", Cambridge University Press, New York, 2012
2. Simon Haines, Mark Nettle and Martin Hewings, "Advanced Grammar In Use", Cambridge University Press, New Delhi, 2008
3. Anne Laws, "Writing Skills", Orient Black Swan, Hyderabad, 2011
4. Sinha DK, "Specimens of English Prose", Orient Black Swan, Hyderabad, 2012

19N110 BASIC SCIENCES LABORATORY**0 0 4 2****PHYSICS (ANY EIGHT EXPERIMENTS):**

1. Determination of Hysteresis loss of a ferromagnetic material
2. Determination of resistivity of metal and alloy using Carey Foster bridge
3. Determination of Temperature Coefficient of Resistance of metallic wire using post office box
4. Determination of capacitance using LCR bridge
5. Study of reverse bias characteristics of Germanium diode and determination of its band gap
6. Study of I-V characteristics of solar cell and determination of its efficiency
7. Thermistor: Measurement of temperature and band gap
8. Study of characteristics of Photo Diode
9. Operational Amp. (741) – Inverting and non inverting modes
10. Operational Amp. (741) – Integrator and differentiator (30)

CHEMISTRY (ANY EIGHT EXPERIMENTS):

1. Determination of hardness, TDS, pH and conductivity of a water sample.
2. Determination of molecular weight of polymers by Ostwald / Ubbelohde Viscometer.
3. Construction of phase diagram for eutectic system – for application in electronic cooling system.
4. Study of a galvanic cell.
5. Conductometric estimation of acid strength of a pickling bath.
6. Potentiometric estimation of ferrous ion in an effluent.
7. Anodizing of aluminium and determination of thickness of anodised film.
8. Preparation of chloride ion sensor by anodizing silver and calibration.
9. Electroplating of nickel & copper and determination of cathode efficiency.

10. Examination of different forms of corrosion using Ferroxy indicator and determination of corrosion rate by current measurement. (30)

Total P: 60

REFERENCES:

1. Department of Chemistry, "Chemistry Laboratory Manual", 2019
2. Department of Physics, "Physics Practicals", 2019
3. Wilson J. D., Hernandez C. A. "Physics Laboratory experiments", Hughton Mifflin Company, New York, 2005

19N111 ENGINEERING PRACTICES

0 0 2 1

MODULE 1:

1. Foundry- Tools, preparation of moulding sand, patterns, cores, foundry exercises.
2. Welding - Metal arc welding tools and equipment, exercises on arc welding and MIG welding processes.
3. Fitting - Tools, operations, exercises on —TII-Joint and —LII Joint, types of joints.
4. Carpentry- Tools, carpentry process, exercises on types of joints.
5. Plumbing-Exercises on external thread cutting and joining.
6. Sheet metal work and soldering - Tools, operations, exercise on rectangular tray using Galvanized Iron sheet. (15)

MODULE 2:

1. Study of passive and active components (resistors, capacitors, inductors, diodes and transistor).
2. Generation of Signals (DSO, Function generator).
3. Rectification of AC wave using bridge rectifier.
4. Construction of series and parallel circuits using resistors.
5. Assembling and disassembling of PC and troubleshooting.
6. Monitoring CPU Performance. (15)

Total P: 30

REFERENCES:

1. Department of Mechanical Engineering "Engineering Practices Laboratory Manual", PSG College of Technology, Coimbatore, 2019
2. Chapman W.A.J "Workshop Technology", Edward Arnold., 2001 Hambley A R "Electrical Engineering Principles and Applications", PHI Learning Pvt. Ltd., New Delhi, 2017
3. Wikibooks Contributors "How to assemble your Desktop PC", Platypus Global Media., 2011
4. Govindarajulu B "IBM PC and CLONES: Hardware, Troubleshooting and Maintenance", TATA McGraw-Hill Education., 2008
5. Jeff Heaton "Build a Computer from Scratch", Heaton Research Inc., 2006

19N112PROBLEM SOLVING AND PYTHON PROGRAMMING LABORATORY

0 0 4 2

Basics of Programming

1. Scratch Programming
2. Algorithm and Flowchart

Programming using Python

1. Input/Output Statements and data types
2. Applications using Decision Making statements
3. Applications using Looping Statements
4. Applications using Set
5. Applications using Lists
6. Applications using Tuples
7. Applications using Dictionary
8. Applications using Functions
9. Applications using Modules
10. Applications using Files

Debugging

Application Debugging

Total P: 60

REFERENCES:

1. Romano, Fabrizio, "Learn Python Programming: A Beginner's Guide to Learning the Fundamentals of Python Language to Write Efficient, High-Quality Code", 2nd Edition. India, Packt Publishing, 2018.
2. R. Nageswara Rao, "Core Python Programming", Second edition, Dreamtech press, 2019
3. Vijay Kumar Sharma, Vimal Kumar, Swati Sharma, Shashwat Pathak, "Python Programming: A Practical Approach", United States, CRC Press, 2021.
4. Meenu Kohli, "Basic Core Python Programming: A Complete Reference Book to Master Python with Practical Applications", First edition, BPB Publications, 2021.
5. Cogliati, Josh, "Non-Programmers Tutorial For Python 3", Platypus Global Media, 2019.

19IP15 INDUCTION PROGRAMME

0 0 0 0

As per AICTE guidelines

SEMESTER– II

19N201 TRANSFORMS AND ITS APPLICATIONS

3 1 0 4

LAPLACE TRANSFORMS: Laplace transform, inverse transform, linearity, s-shifting, transforms of derivatives and integrals, unit step function, t – shifting, Dirac ‘s delta function, periodic functions, differentiation and integration of transforms. (9 + 3)

APPLICATION OF LAPLACE TRANSFORMS: Convolution, solving differential equations with constant coefficients and variable coefficients, integral equations, systems of ODEs by using Laplace transform technique. (9 + 3)

Z TRANSFORMS: Z transform, inverse transform, shifting theorem, convolution theorem, initial and final value theorem, difference equation, application of Z transform to solve difference equations. (9 + 3)

FOURIER SERIES: Fourier series – even and odd functions, half range expansion, convergence of Fourier series, basic concepts of PDE ‘s, wave equation, solution by separating variables, solution of one-dimensional heat equation and steady state two-dimensional heat equation. (9 + 3)

FOURIER TRANSFORMS: Fourier integral, Fourier cosine and sine integrals, Fourier transform, Discrete Fourier transform, Fast Fourier transform – DIT algorithm. (9+3)

Total L: 45 +T: 15 = 60

TEXT BOOKS:

1. Erwin Kreyszig "Advanced Engineering Mathematics", John Wiley & Sons., New Delhi, 2015
2. Dean G. Duffy "Advanced Engineering Mathematics", CRC., USA, 2017

REFERENCES:

1. Peter V.O. Neil "Advanced Engineering Mathematics", Cengage., New Delhi, 2018
2. Wylie C. R. and Barrett L. C "Advanced Engineering Mathematics", Tata McGraw-Hill., New Delhi, 2019
3. Jain. R. K. and Iyenger. S. R. K. "Advanced Engineering Mathematics", Narosa Publishing House., New Delhi, 2018
4. Alexander D Poularikas, "Transforms and Applications Primer for Engineers with Examples and MATLAB", CRC press., USA, 2010

19N202 MATERIALS SCIENCE

3 0 0 3

QUANTUM MECHANICS: Wave particle duality, de Broglie waves- Heisenberg’s uncertainty principle. Wave function normalization. The wave equation. Schrodinger’s equation of motion: Time dependent form, steady-state form. Particle in a box. Quantum Tunneling and applications to Scanning Tunneling Microscope and Tunnel diode. (9)

ELECTRICAL PROPERTIES: Conducting materials-quantum free electron theory -Fermi Dirac Statistics-Band theory of solids-the density of states. Dielectrics-types of polarization-measurement of dielectric permittivity-Loss factor-Dielectric loss mechanisms. Magnetostriction. Electron ballistics- materials for thermionic emission electron guns-electron gun for electron beam machining-electric discharge plasma-EDM machining. (9)

MAGNETIC PROPERTIES: Types of magnetic materials-domain theory-hysteresis- hard and soft magnetic materials Applications-eddy current brakes, regenerative braking. Magnetic lenses. Superconductivity –Meissners effect-Josephson junction, SQUID magnetometer, applications of squid magnetometer- superconducting Magnets, and Magnetic levitation. (8)

PHYSICS OF SEMICONDUCTOR DEVICES: P type and N type semiconductors-the effective mass-P-N junction, rectifier equation -Hall effect-Quantum tunneling. Bipolar transistor. The field effect transistor- Integrated circuits— Hetero junction Quantum well, wire, dots- Optical properties of Semiconductors: LD, LED, Photo diode. Introduction to MEMS (10)

STORAGE DEVICES: Computer Data Storage, Types of Storage, Primary Storage- RAM, ROM, Cache. Secondary Storage –Hard disk, Tertiary Storage – Magnetic tape, Compact disc, Digital versatile disc, Blue-ray. Off-line Storage – USB Flash drive, memory card.Storage Device Features. (9)

Total L: 45

TEXTBOOKS:

1. William D Callister Jr, "Materials Science and Engineering-An Introduction", John Wiley and Sons Inc., New York, 2018, Tenth edition.
2. Shaffer J P, Saxena A, Antolovich S D, Sanders T H Jr, Warner S B, "The Science and Design of Engineering Materials", McGraw Hill Companies Inc., New York, 2000, Second edition.

REFERENCES:

1. Arthur Beiser, "Concepts of Modern Physics", Tata McGraw Hill., India, 2003, Sixth edition
2. Van Vlack, "Elements of Material Science And Engineering", Pearson Education, India, 2008, Sixth edition
3. Sze S.M, "Physics of Semiconductor Devices", John Wiley and Sons., USA, 2007, Third edition
4. Donald R Askeland, Wendelin J Wright, "Essentials of Materials Science and Engineering", Cengage Learning., 2013, Third edition
5. James F Shackelford S, "Introduction to Materials Science for Engineers", Macmillan Publishing Company, New York, 2015, Eighth edition.

19N203 INDUSTRIAL ELECTROCHEMISTRY**2 0 0 2**

ELECTROCHEMISTRY: Conductance of strong and weak electrolytes, mobility of ions - transport number, applications of conductance measurement. Electrode potential – standard and reference electrodes, Nernst equation, emf series – applications. Galvanic and concentration cells. Applications of emf measurements – glass electrode - pH measurement, potentiometric- redox titrations. (6)

CORROSION: Mechanisms - Galvanic and differential aeration corrosion. Corrosion rate – factors influencing corrosion - galvanic series. Corrosion control - corrosion inhibitors, cathodic protection - sacrificial anode, current impression, conversion coatings – anodizing – determination of thickness of anodized film. Nature inspired coatings- superhydrophobic coatings, self-healing coatings. Corrosion in electronic components – control by vapour phase inhibitors. (6)

METAL FINISHING IN ELECTRONIC INDUSTRY: Electroplating – plating parameters- polarization and overvoltage, current and energy efficiency. Electroplating of Cu, Ni, and Cr. Electroless deposition of Ni and Cu. Production of plated through hole PCBs, electroforming - fabrication of CD stampers, electrochemical etching of Cu from PCBs, Electrophoretic painting, Electrochemical etching of semiconductors. (6)

ELECTROCHEMICAL POWER SOURCES: Batteries- types, characteristics. Fabrication and working of leclanche cell, primary lithium cell, lead- acid battery, Ni-metal hydride and lithium-ion batteries. Supercapacitors. Fuel cells - Classification, working principle, components, applications of proton exchange membrane, direct methanol and solid oxide fuel cells. Hydrogen as a fuel-production and storage. (6)

SENSORS: Components of electrochemical sensors, electrochemical transducers-potentiometric, amperometric and conductometric methods – ion-selective electrodes – solid-state electrode, liquid ion-exchange membrane electrodes - Gassensors–CO₂, O₂ and NH₃ sensing- Sensors for healthcare – glucose and urea. (6)

Total L: 30**TEXTBOOKS:**

1. Derek Pletcher and Frank C. Walsh "Industrial Electrochemistry", Chapman and Hall, London, 1993, Second edition
2. John O'M. Bockris and Amulya K. N. Reddy "Modern Electrochemistry 2B", Kluwer Academic/Plenum Publishers, New York, 1998, Second edition

REFERENCES:

1. Dell R. M. and Rand D. A. J, "Understanding Batteries", Royal Society of Chemistry., UK, 2001, first edition
2. Brian Eggins, "Chemical Sensors and Biosensors", John Wiley & Sons, US, 2002, First edition
3. Zaki Ahmad, Digby Macdonald, "Principles of Corrosion Engineering and Corrosion Control", Butterworth-Heinemann, London, 2013, Second edition
4. Shashi Chawla, "A Textbook of Engineering Chemistry", Dhanpat Rai and Co, New Delhi, 2005, First edition

19N204 DISCRETE MATHEMATICS**3 0 0 3**

SETS, RELATIONS AND FUNCTIONS: Introduction to Sets - Set Operations – Computer representation of Sets - Sequences and Summations - Cardinality of Sets - Relations and Their Properties - Closures of Relations - Equivalence Relations - Partial Orderings – Functions: Injective, Surjective, Bijective, and Composition. (9)

MATHEMATICAL LOGIC AND PROOFS: Propositional Logic - Applications of Propositional Logic - Propositional Equivalences - Predicates and Quantifiers - Nested Quantifiers - Rules of Inference - Introduction to Proofs: Proof by contraposition, Proof by contradiction (9)

COUNTING AND COMBINATORICS: The Basics of Counting - The Pigeonhole Principle - Permutations and Combinations - Generalized Permutations and Combinations - Generating Permutations and Combinations (9)

RECURRENCE RELATIONS: Recursion – Recurrence relations: Linear First-order recurrence relations – Linear Second order recurrence relations – Divide and conquer recurrence relations (9)

ALGEBRAIC STRUCTURES: Algebraic Systems: properties – Groups, Semi groups, Monoids: Homomorphism of Semi groups and monoids – Sub semi groups and sub monoids – Rings: Structure and Properties. (9)

Total L: 45

TEXT BOOKS:

1. Discrete Mathematics and its Applications - Kenneth H. Rosen 7th Edition -Tata McGraw Hill Publishers, 2007
2. Tremblay J. P. and Manohar R., "Discrete Mathematical structures with application to Computer Science", Tata McGraw Hill, 2011.

REFERENCES:

1. Ralph. P. Grimaldi, "Discrete and Combinatorial Mathematics: An Applied Introduction", Pearson Education, Fifth Edition, New Delhi, 2014.
2. Seymour Lipschutz and Mark Lipson," Discrete Mathematics", Schaum 's Outlines, Tata McGraw Hill Pub. Co. Ltd., Third Edition, New Delhi, 2013.
3. Thomas Koshy," Discrete Mathematics with Applications", Elsevier Publications, Boston, 2004.

19N205COMPUTER ORGANIZATION AND ARCHITECTURE

3 1 0 4

DIGITAL CIRCUITS: Binary Arithmetic-Boolean Algebra - Basic Theorems and Properties of Boolean Algebra - Simplification of Boolean Functions- Digital Logic Gates - Karnaugh Map Method -Design of Combinational Circuits- Flip-Flops-Design of Sequential Circuits. (10+3)

COMPUTER ORGANIZATION & PROCESSOR DESIGN: Stored program organization (Von Neumann architecture) - Computer Registers -Stack organization - Instruction Formats - Addressing modes - RISC Vs CISC-Quantitative Principles of computer design. (9+3)

MEMORY AND I/O SYSTEMS: Memory Hierarchy - Associative Memory - Cache Memory - Mapping policies – Cache optimization; I/O Systems: Introduction-Interrupts-Modes of Transfer -DMA. (9+3)

PARALLELISM: Pipelining - Pipelining Hazards - Overcoming Hazards - Instruction Level Parallelism – Dependencies (9+3)

MULTIPROCESSOR SYSTEMS: Symmetric and Distributed shared memory architectures - Challenges – Cache Coherence - Snooping protocol (8+3)

Total L:45 + T:15 = 60

TEXT BOOKS:

1. M. Morris Mano, Michael D. Ciletti "Digital Design: With an Introduction to the Verilog HDL, VHDL and System Verilog", Pearson Education., USA, 2018, Sixth Edition
2. John L. Hennessey, David A. Patterson, "Computer Architecture: A Quantitative Approach", Elsevier India Pvt. Ltd, New Delhi, 2015.

REFERENCES:

1. Morris Mano, "Computer System Architecture", Prentice Hall of India, Prentice Hall of India, 2007.
2. Hennessey, John L., and Patterson, David A. "Computer Organization and Design MIPS Edition: The Hardware/Software Interface. Netherlands, Elsevier Science, 2020"
3. Thomas L. Floyd "Digital Fundamentals", Pearson Education., USA, 2015
4. Carl Hamacher, "Computer Organization", Tata McGraw Hill Publishing, New Delhi, 2002.
5. William Stallings, "Computer Organization and Architecture", Pearson Education / Prentice Hall of India, New Delhi, 2006.

19N210 C PROGRAMMING LABORATORY

0 0 4 2

1. Formatted I/O statements.
2. Decision Making statements: Simple If, If – else, Switch- case.
3. Looping Statements: For, While, Do – while.
4. Single dimensional arrays and multi-dimensional arrays.
5. Operations on Strings.
6. Pass by value and pass by address, Recursion using functions.
7. Structures and nested structures.
8. String handling operations using pointers.
9. Operations on arrays using pointers.
10. File operations using command line arguments

Total P: 60

REFERENCES:

1. Byron S. Gottfried, Jitendar Kumar Chhabra, "Programming with C", Tata McGraw Hill Publishing Company., New Delhi, 2018, Fourth edition

2. Herbert Schildt, "C – The Complete Reference", Tata McGraw Hill Publishing Company., New Delhi, 2010,Fourth edition
3. PradipDey and Manas Ghosh, "Programming in C", Oxford University Press., New Delhi, 2018
4. Yashavant P. Kanetkar, "Let Us C", BPB Publications., 2017,Sixteenth edition
5. H. M. Deitel, P. J. Deitel, "C How to Program", Pearson Education., New Delhi, 2013,Seventh edition

19N213ENGINEERING GRAPHICS

0 0 4 2

INTRODUCTION:

1. Lettering practice
2. Geometric constructions
3. Dimensioning practice as per BIS conventions (12)

THEORY OF PROJECTION:

1. Projection of points and lines
2. Projection of planes
3. Projection of solids (12)

SECTIONS OF SOLIDS:

1. Sections of regular solids as per BIS conventions
2. Types of sections - sectional views of engineering components
3. Constructing sectional views (12)

DEVELOPMENT OF SURFACES:

1. Development of lateral surfaces of regular solids
2. Projection of truncated solids and simple engineering sheetmetal components (12)

ORTHOGRAPHIC PROJECTION:

1. Projection of simple engineering components and missing view exercises
2. Modeling of simple engineering components using CAD software (12)

Total P: 60

TEXT BOOKS:

1. Venugopal K, Prabhu Raja V "Engineering Graphics", New Age International Publishers., New Delhi, 2018, Fifteenth Multi color edition.
2. P.I Varghese "Engineering Graphics", McGraw Hill Education India Pvt. Ltd., New Delhi, 2013.

REFERENCES:

1. K C John "Engineering Graphics for Degree", PHI Learning private limited., 2009.
2. Bureau of Indian Standards "Engineering Drawing Practices for Schools and Colleges SP 46-2003", BIS., New Delhi, 2004.

19A213 INTERNSHIP

0 0 0 2

THE HISTORY OF THE COMPUTER GENERATIONS: Generation of Computers- Computer Science Engineering as a Discipline: List of pioneers in computer science - Significant Event Timeline – Career paths.

DESIGN THINKING: Need - Persona - empathy map - scenario map - prioritization - needs and risk identification - Localisation - proposing solutions.

REPOSITORIES: Open source case study – Github - Bitbucket – Gitorious - Source Forge

CODINGTECHNIQUESANDDEBUGGING:Coding Standards and Code Reviews –Best practices. Tools and techniques – Open-source case study - Chrome DevTools - Sentry -GDB (GNU Debugger)

PACKAGE DEVELOPMENT: Problem Identification - Requirements Analysis - Design - Implementation - Testing - Documentation using standard digital tools.

GUIDELINES FOR SUCCESSFUL ENGINEERING CAREER: Relationship Building – Character Building and Personality Development - Laws for Engineers

TEXT BOOKS:

1. Stephen J Marshall "The Story of the Computer: A Technical and Business History", CreateSpace Independent Publishing Platform., 2017, First edition.
2. Roger S. Pressman "Software Engineering: A Practitioner's Approach", McGraw-Hill Education., 2014, Eighth edition.

SEMESTER– III

19N301 LINEAR ALGEBRA

3 1 0 4

LINEAR EQUATIONS: Introduction to systems of linear equations - Gauss elimination - linear systems and invertible matrices. (9+3)

VECTOR SPACES: General vector spaces- real vector spaces - Euclidean n-space - subspaces - basis and dimension - row space, column space and null space - rank and nullity. (9+3)

LINEAR TRANSFORMATIONS: General linear transformation - kernel and range - matrices of linear transformations - change of basis - geometry of linear operators on \mathbb{R}^2 . (9+3)

INNER PRODUCT SPACES: Inner products- angle and orthogonality in inner product spaces, orthonormal bases, Gram Schmidt process, QR decomposition, best approximation- least squares. (9+3)

EIGENVALUES AND EIGENVECTORS: Eigenvalues and eigenvectors, diagonalization- orthogonal diagonalization - spectral decomposition- singular value decomposition- principal component analysis - discrete dynamical systems. (9+3)

Total L: 45 +T: 15 = 60

TEXT BOOKS:

1. Howard Anton and Chris Rorres, "Elementary Linear Algebra", Wiley India, New Delhi, 2018.
2. Gilbert Strang, "Linear Algebra and its Applications", Cengage, New Delhi, 2012.

REFERENCES:

1. Gareth Williams, "Linear Algebra with Applications", Narosa Publishing House, New Delhi, 2012.
2. David C Lay, "Linear Algebra and its Applications", Pearson, New Delhi, 2016.
3. Friedberg, Insel and Spence, "Linear Algebra", Pearson Education, USA, 2015.
4. Kenneth Hoffman and Ray Kunze, "Linear Algebra", Prentice Hall, New Jersey, 2015.

19N302 PROBABILITY, STOCHASTIC PROCESSES AND STATISTICS

3 1 0 4

PROBABILITY AND DISCRETE RANDOM VARIABLES: Probability, axioms, Conditional Probability, Partitions and the Law of Total Probability, Baye's theorem, Independence, discrete random variables-definitions, probability mass function, families of discrete random variables - binomial, Poisson and geometric random variables, cumulative distribution functions, expectations. (9+3)

CONTINUOUS RANDOM VARIABLES: Continuous Sample Space, cumulative distribution functions, probability density function, families of continuous random variables - uniform, exponential, Erlang and Gaussian random variables, expectations. (9+3)

MULTIPLE RANDOM VARIABLES: Joint cumulative distribution function – joint probability mass function – marginal probability mass function - joint probability density function - marginal probability density function - independent random variables- expected values– Covariance, Correlation and Independence. (9+3)

STOCHASTIC PROCESSES: Definitions and Examples - Random Variables from Random Processes - Independent, Identically Distributed Random Sequences - The Poisson Process-Properties of the Poisson Process - Markov Process - Discrete-Time Markov Chains - Higher Transition Probabilities: Chapman–Kolmogorov Equations - Long-Run Behavior of Markov Chains (9+3)

STATISTICAL INFERENCE: Foundations for inference - Variability in estimates - Confidence intervals - Hypothesis testing - Central Limit Theorem - Inference for numerical data - t-distribution - ANOVA and the F Test - Inference for categorical data - Inference for a single proportion - Difference of two proportions - Testing for goodness of fit using chi-square - Testing for independence in two-way tables (9+3)

Total L: 45 +T: 15 = 60

TEXT BOOKS:

1. Roy D Yates and David J Goodman, "Probability and Stochastic Processes", Third Edition, Wiley India, New Delhi, 2021.
2. David M Diez, Christopher D Barr, Mine Cetinkaya-Rundel, "OpenIntro Statistics", 3rd Edition, Creative Commons license, 2017

REFERENCES:

1. Saeed Ghahramani, "Fundamentals of Probability with Stochastic Processes", CRC Press, Taylor & Francis Group, USA, 2018.
2. Douglas C Montgomery and George C Runger, "Applied Statistics and Probability for Engineers", Wiley India, New Delhi, 2018.
3. Ronald E. Walpole, Raymond H Myers, Sharon L Myers and Keying Ye, "Probability and Statistics for Engineers and Scientists", Pearson, New Delhi, 2016.
4. David Spiegelhalter, "The Art of Statistics: How to Learn from Data", Pelican Books, 2020.

5. Michael J. Evans, Jeffrey S. Rosenthal, "Probability and Statistics: The Science of Uncertainty", second Edition, WH Freeman, 2010.

19N303 DATA STRUCTURES

4 0 0 4

INTRODUCTION: Need for Data Structures - Types of Data Structures - Abstract Data Type - Program Development Life Cycle - Algorithms - Characteristics of Algorithms - Complexity Analysis - Best case and worst-case complexities - Asymptotic notations (8)

ARRAYS AND LISTS: Array Representation and Operations - Matrix representation using Multi-dimensional arrays - Linked List Representation - Operations on a Singly Linked List - Types of Linked List - Polynomial Addition - Sparse Matrices (12)

STACKS AND QUEUES: Stack ADT - Representation and Operations - Expression Handling - Role of Stack in implementing recursive algorithms - Queue ADT - Representation and Operations - Types of Queues - Circular Queue - Deque - Priority Queue (10)

BINARY TREES: Terminologies - Binary Tree - Traversal - Expression Trees - Threaded Binary Tree - Binary Heap - Priority Queue implementation using Binary Heap - Binary Search Tree - AVL Tree. (10)

MULTI WAY SEARCH TREES, HASHING AND GRAPHS: m-way search trees - B Tree - B+ Tree - Applications - Trie Structure - Hash Table - Hash Functions - Resolving Collisions - Rehashing. **GRAPHS:** Graph Terminologies - Types of Graphs - Representation - Breadth First Search - Depth First Search - Topological Sort (20)

Total L: 60

TEXT BOOKS:

1. Mark Allen Weiss, "Data Structures and Algorithm Analysis in C", 2nd Edition, Pearson Education, 2016.
2. Venkatesan R, Lovelyn Rose S, "Data Structures", 2nd Edition, Wiley India Pvt Ltd, 2019.

REFERENCES:

1. Thomas H. Cormen, Charles E. Leiserson, Ronald L. Rivest and Clifford Stein, "Introduction to Algorithms", 3rd Edition, MIT Press, England, 2009.
2. Jean Paul Tremblay, Sorenson, "An Introduction to Data Structures with Applications", McGraw Hill Publishing Company, New Delhi, 2017.
3. Ellis Horowitz, Sartaj Sahni, Sanguthevar Rajasekaran, "Fundamentals of Computer Algorithms", 2nd Edition, Universities Press, 2019.
4. Salaria R S, "Data Structures and Algorithms using C", 5th Edition, Khanna Book Publishing, New Delhi, 2017.
5. Amol M. Jagtap, Ajit S. Mali, "Data Structures Using C - A Practical Approach for Beginners", Chapman and Hall/CRC; 1st edition, 2021
6. Aaron M Tanenbaum, Moshe J Augenstein and Yedydyah Langsam, "Data structures using C and C++", Prentice Hall, 2016.

19N304 SOFTWARE ENGINEERING

3 0 0 3

PRELIMINARIES: Definition of Software – Software characteristics – Types of Software – Evolution of Software – Software Development Lifecycle – Waterfall Model – Incremental Model – Prototyping – Spiral Model – Unified Process – Agile Development Approach – Software Myths (8)

REQUIREMENTS ENGINEERING: Requirements elicitation – Functional and Non-functional Requirements – Prioritization – Use cases – Use case diagram — Data flow diagrams – UML – Object Model – Class diagram – State diagram – Sequence diagram – Activity diagram – CRC cards – Software Requirements Specification document (SRS) (12)

SOFTWARE DESIGN: Architectural Design: Views and Viewpoints – Styles and Patterns – Layered Architecture. Detailed Design: Functional Decomposition – Object Oriented Design – User Interface Design – Good Design Attributes – Design Specifications – Coding Standards (8)

SOFTWARE TESTING: Testing fundamentals: Black Box and White Box Testing – Test Cases – Equivalence Partitioning – Boundary Value Analysis – Basis Path Testing – Cyclomatic Complexity. Testing Strategies: Unit Testing – Integration Testing – System Testing – Acceptance Testing. Special Testing: Regression Testing – Smoke Testing – Stress Testing - User Interface Testing – Test Automation – Test Documenting and Reporting – Testing Object Oriented System (8)

SOFTWARE ENGINEERING MANAGEMENT: Software Quality: Views of Quality – Quality Attributes – Cost of Quality – Quality Control vs. Quality Assurance – Formal Technical Reviews – Guidelines for Reviews – Quality Metrics. Software Configuration Management: Software Baselines – Version Control – Change Control – Software Configuration Audit. Software Maintenance: Maintenance Phase – Activities – Reengineering – Metrics (9)

Total L: 45

TEXT BOOKS:

1. Roger S Pressman and Bruce Maxim, "Software Engineering - A Practitioner's Approach", McGraw Hill International Edition, Singapore, 2020.
2. Pankaj Jalote, "A Concise Introduction to Software Engineering", Springer, New Delhi, 2011

REFERENCES:

1. Ian Sommerville, "Software Engineering", Pearson Addison Wesley, Boston, 2017
2. Shari Lawrence Pfeeger, "Software Engineering: Theory and Practices", Pearson Education, New Delhi, 2009
3. Orlando Karam, Frank Tsui, "Essentials of Software Engineering", SBS Publishers and Distributors (P) Ltd, 2007 New Delhi.

19N305 PRINCIPLES OF PROGRAMMING LANGUAGES**3 1 0 4**

INTRODUCTION (PROGRAMMING LANGUAGE DEFINITION AND DESCRIPTION): Reason for studying concepts of Programming Languages – Programming Domains – Language Evaluation Criteria – Influences on Language Design – Language Categories – Language Design Trade-offs – Implementation methods – Programming Environment - Language Description: Syntactic Structure: Expression Notations - Abstract Syntax Trees - Lexical Syntax - Semantic Structure: Synthesized Attributes - Attribute Grammars - Variants of Grammars - Natural Semantics - Denotational Semantics. (9+3)

IMPERATIVE AND OBJECT-ORIENTED LANGUAGES: Names, their scope, life and binding. Control-flow, control abstraction; in subprogram and exception handling. Primitive and constructed data types, data abstraction, inheritance, type checking and polymorphism. (9+3)

FUNCTIONAL LANGUAGES: Elements of Functional Programming - Types: Values and Operations - Function Declarations - Approaches to Expression Evaluation - Lexical Scope. Type Checking - Functional Programming in a typed calculus- Functional Programming with Lists: The Structure of Lists, List Manipulation -Storage Allocation for Lists. Case study. (9+3)

LOGIC PROGRAMMING LANGUAGES: Computing with relation, first-order logic, SLD-resolution, unification, sequencing of control, negation, implementation, case study. (9+3)

CONCURRENT PROGRAMMING: Communication and synchronization, shared memory and message passing, safety and liveness properties, multithreaded program. (9+3)

Total L: 45 +T: 15 = 60**TEXTBOOKS:**

1. Sebesta R W, "Concepts of Programming Languages", Eleventh Edition, Pearson, USA, 2019.
2. Sethi R, "Programming Languages: Concepts and Constructs", Second Edition, PearsonIndia, 2007.

REFERENCES:

1. Friedman D P, Wand M, "Essentials of Programming Languages", 3rd Edition, The MIT Press, 2008.
2. Harper R, "Practical Foundations for Programming Languages", 2nd Edition, Cambridge University Press, 2016.
3. Scott M L, "Programming Language Pragmatics", Morgan Kaufmann, 4th Edition, 2015.
4. Turbak F A, Gifford D K, Sheldon M A, "Design Concepts in Programming Languages", The MIT Press, Massachusetts, 2008.
5. Benjamin C. Pierce, Types and Programming Languages, MIT Press, 2002

19O306 ECONOMICS FOR ENGINEERS**3 0 0 3**

INTRODUCTION: Definition - Nature and Scope - Central Problems of an Economy - Positive and Normative Economics– Micro Economics and Macro Economics, Significance of Economics, Economic Assumptions. (9)

THEORY OF CONSUMER BEHAVIOR: Utility - Indifference Curve Analysis - Properties, Consumer 's Budget Line - Demand Analysis: Demand Function and Law of Demand, Elasticity of Demand. Demand forecasting using Econometric Techniques. Supply- Factors Affecting Supply, Market Equilibrium Price, Consumer Surplus. (9)

PRODUCTION, COST AND REVENUE: Production Function, Total Product, Average Product and Marginal Product, Returns to Scale. Costs, Nature of Costs, Short-run and Long-run Cost Curves, Revenue concepts. (9)

MARKET STRUCTURE: Types of Markets - Perfect Competition - Characteristics - Imperfect Competition: Monopoly Monopolistic Competition – Oligopoly and Duopoly - Price Discrimination and Product Differentiation under Different Markets -Price and Output Determination in Shortrun and Long run and profit maximization. (9)

PERFORMANCE OF AN ECONOMY (MACROECONOMICS): Demand and Supply of Money – Quantity Theory of Money, Banking - Functions of Commercial Banks and Central Bank - Inflation - Causes - Control Measures - National

Income - Concepts - Methods of Calculating National Income - Problems in Calculating National Income (9)

Total L: 45

TEXT BOOKS:

1. Varian H.R. , "Intermediate Microeconomics", East– West Press, New Delhi, 2014.
2. Dewett.K.K, Navalur. M.H. , "Modern Economic Theory", S. Chand, New Delhi, 2015.

REFERENCES:

1. William A, McEachern, Simrit Kaur, "Micro ECON", Cengage Learning, Noida, 2013.
2. William A, McEachern, Indira A, "Macro ECON", Cengage Learning, Noida, 2014.
3. Deepashree, "Principles of Economics", Ane Books Pvt Ltd, New Delhi, 2010.
4. Dwivedi, "Essentials of Business Economics", Vikas Publishing House Pvt Ltd, New Delhi, 2010.

19N310 DATA STRUCTURES LABORATORY

0 0 4 2

1. Solving Problems using arrays
2. Searching and Sorting algorithms
3. Implementation of Linked List
4. Applications of Linked List
5. Implementation Stack and queue
6. Applications of Stack
7. Operations on Binary Search Trees
8. Applications of Binary Search Tree, AVL tree
9. Graphs - Depth First Search and Breadth First Search
10. Hashing and Collision Resolution

Total P:60

REFERENCES:

1. Ellis Horowitz, Sartaj Sahni and Sanguthevar Rajasekaran, "Fundamentals of Computer Algorithms", Second Edition, Universities Press, 2011.
2. Jean Paul Tremblay and Sorenson, "An Introduction to Data Structures with Applications", McGraw Hill Publishing Company, New Delhi, 2012.
3. Thomas H Cormen, Charles E Leiserson, Ronald L Rivest and Clifford Stein, "Introduction to Algorithms", MIT Press, England, 2009.
4. Salaria R S, "Data Structures and Algorithms using C", 5th Edition, Khanna Book Publishing, New Delhi, 2017.
5. Amol M. Jagtap, Ajit S. Mali, "Data Structures Using C - A Practical Approach for Beginners", Chapman and Hall/CRC; 1st edition , 2021

19N311 OBJECT ORIENTED PROGRAMMING LABORATORY USING JAVA

0 0 4 2

1. Study of JDK,JRE,JVM, IDE and REPL
2. Classes and Methods
3. Inheritance
4. Interfaces and packages
5. Exception Handling
6. I/O and Files
7. Collection classes
8. Generics and Lambda Expressions
9. Applets and Event handling
10. GUI with Swing

Total P: 60

REFERENCES:

1. Schildt H, "Java: The Complete Reference", Eleventh Edition, McGraw-Hill Education, 2018.
2. Deitel P and Deitel H, "Java: How to Program", Eleventh Edition, Prentice Hall, 2018.
3. Hortsman CS and Cornell G, "Core Java: Volume 1 - Fundamentals", Eleventh Edition, Prentice Hall, 2018.
4. James Gosling, Bill Joy, Guy Steele, Gilad Bracha, Alex Buckley and Daniel Smith, "The Java Language Specification – Java SE", Thirteenth Edition, Oracle America Inc., USA, 2019.
5. Daniel Liang L, "Introduction to Java Programming", Tenth Edition, Pearson Education, New Delhi, 2015.
6. Matt Weisfeld, "The Object Oriented Thought Process", Fifth Edition, Addison-Wesley Professional, US, 2019.

19K312 ENVIRONMENTAL SCIENCE

2 0 0 0

INTRODUCTION TO ENVIRONMENT: Environment - Definition, scope and importance. Types and composition of atmosphere - particles, ions and radicals. Ozone layer- significance, formation and depletion. Ecosystems- Structure and functions, components, energy flow, food chains, food web, Biodiversity-levels, values and threats - India as a mega-diversity nation - hotspots of biodiversity - endangered and endemic species of India - conservation of biodiversity. (6)

ENERGY RESOURCES: Introduction - National and International status- exploitation - sustainable strategies- Fossil fuels classification, composition, physico-chemical characteristics and energy content of coal, petroleum and natural gas; solar energy - introduction, harnessing strategies. Wind energy - availability, wind power plants, wind energy conversion systems, site characteristics, and types of wind turbines. Supporting renewable energy resources - tidal – geothermal - hydroelectric. (6)

ENVIRONMENTAL POLLUTION: Definition - Sources, causes, impacts and control measures of (a) Air pollution (b) Water pollution (c) Soil pollution (d) Marine pollution (e) Noise pollution (f) Thermal pollution (g) Nuclear hazards (h) RF hazards - Role of an individual in prevention of pollution. **DISASTER MANAGEMENT:** Floods, earthquake, cyclone and landslides -Case studies, consequences and rescue measures (6)

WASTE MANAGEMENT: Wastewater - Characteristics of domestic and industrial wastewater - COD and BOD - Various stages of treatment - primary, secondary, tertiary treatment- Biological and advanced oxidation processes. Solid waste management - Characteristics of municipal solid waste(MSW), biomedical, automobile and e-wastes and their management – landfills, incineration, pyrolysis, gasification and composting. (6)

SOCIAL ISSUES AND THEENVIRONMENT:Environmentally Sustainable work practices- Rain water harvesting - Role of non-governmental organizations. Human ethics and rights- impact on environment and human health - role of information technology on environment and human kind. Green IT policies, Process of EIA - ISO14000. Legislation Environment protection act - Air (Prevention and Control of Pollution) act - Water (Prevention and controlofPollution) act-Wildlifeprotectionact-Forestconservationact. (6)

Total L: 30

TEXT BOOKS:

1. Gilbert M.Masters, "Introduction to Environmental Engineering and Science", Pearson Education, New Delhi, 2004.
2. De A K, "Environmental Chemistry", New Age International P Ltd, New Delhi, 2006.

REFERENCES:

1. Benny Joseph, "Environmental Science and Engineering", Tata McGraw-Hill, New Delhi, 2006.
2. KoteswaraRao MVR, "Energy Resources: Conventional & Non-Conventional", BSP Publications, New Delhi, 2006.
3. Deswal S and Deswal A, "A Basic Course in Environmental Studies", Dhanpat Rai and Co, New Delhi, 2004.

SEMESTER –IV

19N401 FOUNDATIONS OF OPTIMIZATION TECHNIQUES

3 0 0 3

INTRODUCTION: Components of Optimization Problem – Terminology - Classes of Mathematical Programs - Linear Programming Models - Real-world problems – Linear Programming Formulations - Changing Form - Linearization of Piecewise Linear Functions. (9)

ITERATIVE ALGORITHMS: Iterative Search and Constructive Algorithms - Improving Directions and Optimality - Computational Complexity and Correctness - Convexity - Convex Sets - Convex and Concave Functions. (9)

GEOMETRY AND ALGEBRA OF LP & DUALITY THEORY: Geometry and Algebra of LPs - Extreme Points and Basic Feasible Solutions - Optimality of Extreme Points - Linear Programs in Canonical Form - Optimality Conditions - Duality Theory - Dual of a Linear Program - Duality Theorems - Complementary Slackness - Lagrangian Duality - Farkas' Lemma and Optimality (9)

SIMPLEX METHOD & APPLICATIONS OF DUALITY: Simplex Method From a Known Feasible Solution - Degeneracy and Correctness - Finding an Initial Feasible Solution - Computational Strategies and Speed - Dual Simplex Method - Network Simplex Method - Primal-Dual Interior Point Method (9)

CONVEX PROGRAMMING: KKT Optimality Conditions - Lagrangian Duality - Convex Optimization Models - Separable Programs - Unconstrained Optimization - Quadratic Programming - Primal-dual Interior Point Method (9)

Total L: 45

TEXT BOOKS:

1. Michael H. Veatch, "Linear and Convex Optimization", John Wiley and Sons, Inc, 2021.

2. Richard W. Cottle, Mukund N. Thapa, "Linear and Nonlinear Optimization", Springer Science+Business Media, LLC 2017.

REFERENCES:

1. Hamdy A Taha, "Operations Research – An Introduction", Pearson Education Limited, 2017.
2. Stephen Boyd, Lieven Vandenberghe, "Convex Optimization", Cambridge University Press, 2004.
3. David G. Luenberger, Yinyu Ye, "Linear and Nonlinear Programming", Springer Nature Switzerland, 2021.
4. Edwin K P Chong, Stanislaw H Zak, "Introduction to Optimization", Wiley India, 2017.
5. Charu C. Aggarwal, "Linear Algebra and Optimization for Machine Learning", Springer Nature Switzerland, 2020

19N402 DESIGN AND ANALYSIS OF ALGORITHMS

3 0 0 3

DIVIDE AND CONQUER: Introduction to Algorithm Design techniques - Divide and Conquer Methodology - Solving recurrence relations - Masters Theorem - Finding Maximum and Minimum Element - Quick sort - Merge sort - Convex Hull. (9)

GREEDY METHOD: Greedy Strategy - Knapsack Problem - Minimum Spanning Trees - Single Source Shortest Path Method - Huffman Trees (9)

DYNAMIC PROGRAMMING: Principle of Optimality - Knapsack Problem - All Pairs Shortest Path - Optimal Binary Search Tree - Multistage Graphs (9)

BACKTRACKING: State Space Tree - Knapsack Problem - The Eight Queens Problem - Sum of subsets - Graph Coloring (9)

BRANCH AND BOUND: Bounding Functions - 0/1 Knapsack Problem - Traveling Sales Person Problem - Assignment Problem (9)

Total L: 45

TEXT BOOKS:

1. Anany Levitin, "Introduction to the Design and Analysis of Algorithms", 3rd Edition, Prentice Hall of India, New Delhi, 2017.
2. Ellis Horowitz, Sartaj Sahni, Sanguthevar Rajasekaran, "Fundamentals of Computer Algorithms", Galgotia Publications, New Delhi, 2010.

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1. Thomas H Cormen, Charles E Leiserson, Ronald L Rivest, Clifford Stein, "Introduction to Algorithms", 3rd Edition, MIT Press, England, 2009.
2. Donald E. Knuth, —The Art of Computer ProgrammingII, Volumes 1& 3 Pearson Education, 2 009.
3. Jeffrey J McConnell, "Analysis of Algorithms", Jones and Bartlett Publishers, 2008.
4. Parag Himanshu Dave, Himanshu Bhalchandra Dave, "Design and Analysis of Algorithms", Pearson Education, 2008.

19N403 OPERATING SYSTEMS

3 1 0 4

INTRODUCTION: Functions - History - Operating System Concepts - System Calls - Services - User Operating System Interface - Design and Implementation - Introduction to Virtual Machines. (6+3)

PROCESS MANAGEMENT: Process Model - Creation – Termination - Hierarchies - States - Implementation - Scheduling Criteria - Scheduling Algorithms - Multithreading Models - Thread Libraries - Threading Issues - Thread and Multiprocessor Scheduling Algorithms - Interprocess Communication. (10+3)

PROCESS SYNCHRONIZATION AND DEADLOCKS: Race Conditions - Critical Section - Mutual Exclusion - Peterson's Solution – **Synchronization:** Hardware - Semaphores - Mutex - Monitor - Message Passing, Dining Philosophers Problem - Readers Writers Problem. **Deadlocks:** Conditions - Detection - Recovery - Prevention - Avoidance. (9+3)

MEMORY MANAGEMENT:Main Memory: Swapping - Contiguous Memory Allocation - Paging - Structure of Page Table - Segmentation - Examples. **Virtual Memory:** Demand Paging - Copy on Write - Page Replacement - Allocation of Frames - Thrashing - Memory Mapped Files - Allocating Kernel Memory - Memory Management Utilities (10+3)

STORAGE MANAGEMENT: Files: Naming - Structure - Types - Access - Attributes - Operations - Implementation. Directories: Operations - Path Names - Hierarchical Directory System - Implementation - Allocation Methods - Free Space Management - NFS - Efficiency and Performance - Recovery. Mass Storage: Disk Structure - Disk Scheduling Algorithms - Swap Space Management - Streams. (10+3)

Total L: 45 +T: 15 = 60

TEXT BOOKS:

1. Silberschatz A, Galvin P, Gagne G, "Operating Systems Concepts", John Wiley and Sons, Singapore, 2018.
2. William Stallings, "Operating Systems: Internals and Design Principles", Pearson Education, New Delhi, 2018.

REFERENCES:

1. Andrew S. Tanenbaum, "Modern Operating System", Fourth Edition, PHI Learning, New Delhi, 2018.
2. Dhamdhare, "Operating Systems: A Concept Based approach", Third Edition, Tata McGraw Hill, New Delhi, 2015.
3. Harvey M Deitel, Paul J Deitel, David R Choffnes, "Operating Systems", Third Edition, Pearson Education, New Delhi, 2013.
4. Remzi Arpacı-Dusseu , Andrea Arpacı-Dusseu, "Operating Systems: Three Easy Pieces", First edition, Arpacı-Dusseu Books, 2015
5. Achyut S Godbole, Atul Kahate, "Operating Systems", McGraw Hill Education, 2016.

19N404 DATABASE SYSTEMS

3 0 0 3

INTRODUCTION TO DATABASE: Purpose of Database System - Database Characteristics - Advantages of DBMS Approach - Schemas and Instances - Three Schema Architecture and Data Independence - The Database System Environment - Relational Algebra. (9)

LOGICAL DATABASE DESIGN: Relational DBMS - Codd's Rule - Entity-Relationship model - Traps - Extended ER - Keys - Integrity Constraints - SQL Fundamentals: DDL - DML - DCL - TCL - Views. (9)

NORMALIZATION: Need - Types of Anomalies - Armstrong axioms - Functional Dependencies - 1NF, 2NF, 3NF, BCNF, 4NF and 5NF, Denormalization. (9)

QUERY PROCESSING AND OPTIMIZATION: Indexing- Types of Single Level Ordered Indexes - Multilevel Indexes - Dynamic Multilevel Indexes. Algorithms for Query Processing- Heuristics of Query Optimization- Cost Based Query Optimization. (9)

TRANSACTION PROCESSING, CONCURRENCY CONTROL AND CURRENT TRENDS: Transaction Concepts - ACID Properties - Transaction States - Concurrency Control Problems - Serializability - Recoverability - Pessimistic and Optimistic Concurrency Control Schemes - Deadlocks: prevention, detection - Parallel Database - Multimedia Database - Mobile Database - Web Database - Multidimensional Database - OLTP Vs OLAP - NoSQL Database. (9)

Total L: 45

TEXT BOOKS:

1. Abraham Silberchatz, Henry F Korth and Sudarshan S, "Database System Concepts", Seventh Edition, Tata McGraw-Hill, New Delhi, 2021.
2. Ramez Elmasri and Shamkant B Navathe, "Fundamentals of Database Systems", Seventh Edition, Addison Wesley, USA, 2016.

REFERENCES:

1. Raghu Ramakrishnan and Johannes Gehrke, "Database Management Systems", Fourth edition, Tata McGraw-Hill, New Delhi, 2015.
2. A. Hoffer Jeffrey, V. Ramesh, Topi Heikki, "Modern Database Management", Pearson, Twelfth Edition, 2017
3. Gupta G K, "Database Management System", Tata McGraw-Hill, New Delhi, 2011.
4. Thomas Connolly, Carolyn Begg, Database Systems: A Practical Approach to Design, Implementation and Management, Sixth Edition, 2012.
5. Pramod J. Sadalage and Marin Fowler, NoSQL Distilled: A brief guide to merging world of Polyglot persistence, Addison Wesley, 2012.

19N405 MACHINE LEARNING – I

3 0 0 3

INTRODUCTION TO MACHINE LEARNING AND CONCEPT LEARNING: Machine Learning applications - Concept Learning Task - FIND-S - Version Spaces and Candidate Elimination - Inductive Bias. (9)

SUPERVISED LEARNING AND BAYESIAN DECISION THEORY: Learning a Class from Examples - Vapnik-Chervonenkis Dimension - Probably Approximately Correct Learning - Noise - Learning Multiple Classes - Regression - Model Selection and Generalization - Dimensions of a Supervised Machine Learning Algorithm - Classification - Losses and Risks - Discriminant Functions. (9)

PARAMETRIC METHODS AND MULTIVARIATE METHODS: Maximum Likelihood Estimation - Evaluating an Estimator - The Bayes' Estimator - Parametric Classification - Regression - Bias/Variance Dilemma - Model Selection Procedures - Multivariate Data - Parameter Estimation - Parameter Estimation - Multivariate Normal Distribution - Multivariate Classification - Discrete Features - Multivariate Regression. (9)

LINEAR DISCRIMINATION AND ASSESSING CLASSIFIER PERFORMANCE: Generalizing the Linear Model - Geometry of the Linear Discriminant - Pairwise Separation - Parametric Discrimination Revisited - Gradient Descent - Logistic Discrimination - Learning to Rank - Factors, Response, and Strategy of Experimentation - Response Surface Design - Randomization, Replication, and Blocking - Guidelines for Machine Learning Experiments - Cross-Validation

and Resampling Methods - Measuring Classifier Performance - Interval Estimation - Hypothesis Testing - Assessing a Classification Algorithm's Performance - Comparing Two Classification Algorithms - Comparing Multiple Algorithms - Comparison over Multiple Datasets - Multivariate Tests. (9)

DIMENSIONALITY REDUCTION AND CLUSTERING: Subset Selection - Feature Embedding - Factor Analysis - MDS - LDA - Canonical Correlation Analysis - Isomap - Locally Linear Embedding - Laplacian Eigenmaps - Mixture Densities - k Means Clustering - Expectation Maximization Algorithm - Mixtures of Latent Variable Models - Supervised Learning after Clustering - Spectral Clustering - Hierarchical Clustering - Cluster number Selection. (9)

Total L:45

TEXT BOOKS:

- 1.Ethem Alpaydin, "Introduction to Machine Learning", Fourth Edition, PHI Learning, 2020.
- 2.Tom Mitchell, "Machine Learning", McGraw Hill, 2017.

REFERENCES:

- 1.Christopher M Bishop, "Pattern Recognition and Machine Learning", Springer, 2011.
- 2.Yaser S. Abu-Mostafa, "Learning from Data", AML, 2017.
3. Richard O. Duda, Peter E. Hard, David G. Stork, "Pattern Recognition", Second Edition, Wiley, 2020
- 4.Marc Peter Deisenroth, A. Aldo Faisal, Cheng Soon Ong, "Mathematics for Machine Learning", Cambridge University Press, 2020.

19N410 DATABASE SYSTEMS LABORATORY

0 0 4 2

- 1.SQL Practice: DDL, DML, DCL,TCL commands.
2. Database design using E-R model, Normalization– case study.
- 3.Implement Views and stored procedures.
- 4.Implement functions, Cursors, Triggers and Embedded SQL
5. Study of performance monitoring and tuning Tools
6. Study of NoSQL databases
7. Mini project- Application development

Total P: 60

REFERENCES:

1. Abraham Silberchatz, Henry F Korth and Sudarshan S, "Database System Concepts", 7th Edition, Tata McGraw-Hill, New Delhi, 2021.
2. Ramez Elmasri and Shamkant B Navathe, "Fundamentals of Database Systems", 7th Edition, Addison Wesley, USA, 2016.
- 3.Ivan Bayross, "SQL, PL/SQL the Programming Language of Oracle", 4th Edition,BPB Publications New Delhi, 2020.
- 4.Rosenzweig, "Oracle PL/SQL by Example 5/e, For Dummies",5th Edition, Pearson Education India, 2015.
- 5.Raghu Ramakrishnan and Johannes Gehrke, "Database Management Systems", 4th edition, Tata McGraw-Hill, New Delhi, 2015.

19N411 MACHINE LEARNING LABORATORY

0 0 4 2

Implement the following topics

- 1) FIND-S algorithm
- 2) Linear regression
- 3) Naive Bayes classifier
- 4) Association rule mining
- 5) Polynomial regression
- 6) Multivariate classification
- 7) Logistic Discrimination
- 8) Principal Component analysis
- 9) Expectation Maximization Algorithm
- 10) Assess and compare the performances of classification algorithms

Total P: 60

REFERENCES:

1. Ethem Alpaydin , "Introduction to Machine Learning", 4thEdition, PHI Learning, 2020.
2. Willi Richert, Luis Pedro Coelho, Building Machine Learning Systems with Python, Packt Publishing, 2018.
3. Aurelien Geron, Hands-On Machine Learning with Scikit-Learn, Keras and Tensor Flow: Concepts, Tools and Techniques to Build Intelligent Systems, O'Reilly, 2019.
4. Tom Mitchell, "Machine Learning", McGraw Hill, 2017
5. Richard O. Duda, Peter E. Hard, David G. Stork, "Pattern Recognition", 2nd Edition, Wiley, 2020

19O412 INDIAN CONSTITUTION

2 0 0 0

INTRODUCTION: Evolution of Indian Constitution; Significance of Constitution; Composition; Preamble and its Philosophy. (4)

RIGHTS, DUTIES AND DIRECTIVE PRINCIPLES: Fundamental Rights- Writs and Duties, Directive Principles of State Policy. (6)

COMPOSITION OF PARLIAMENT AND FEDERALISM: Union Government, President and Vice President, Houses of the Parliament and their functions; Composition of State Legislature; Powers, Functions and Position of Governor, Function of Chief Ministers, Council of Ministers; The Indian Federal System, Administrative Relationship between Union and States. (8)

BILLS AND CONSTITUTION AMENDMENT PROCEDURE: Types of Bills, Stages of passing of Bill into an Act, Veto Power, Constitution Amendment Procedure, Various Amendments made and their significance for India. (6)

JUDICIARY: Supreme Court and High Court; Functions and powers, Judicial Review. (6)

Total L: 30

TEXT BOOKS:

1. Subash C. Kashyap, "Our Constitution", 5th Edition, NBT, India, New Delhi, 2015.
2. Basu D D, "Introduction to the Constitution of India", 20th Edition, Prentice Hall of India, New Delhi, 2011.

REFERENCES:

1. Brijji Kishore Sharma, " Introductionto the Constitution of India", 8th Edition, Prentice Hall of India, New Delhi, 2017.
3. Hoshiar Singh, "Indian Administration", 1st Edition, Pearson Education, New Delhi, 2011.
4. Jain M C, "The Constitution of India", 5th Edition, State Mutual Book & Periodical Service, Limited, New Delhi, 1988.
5. Shukla V N, " Constitutionof India", 13th Edition, Eastern Book Company Limited, New Delhi, 2017.

19Q413 SOFT SKILLS DEVELOPMENT

0 0 2 1

SOFT SKILLS DEVELOPMENT:

1. Body Language and Professionalism
2. Interpersonal skills
3. Goal setting
4. Impression Management
5. Team Building
6. Time Management
7. Stress Management
8. Convincing Skills
9. Motivation
10. Change Management
11. Communication Confidence
12. Group discussion basics
13. Personal Interview basics
14. Resume writing

Total P: 30

REFERENCES:

1. Jeff Butterfield, "Soft Skills for Everyone", 6th Edition, Cengage Learning, Delhi, 2015.
2. Rao M S, "Soft Skills - Enhancing Employability", LK International Publishing House, New Delhi, 2011.

SEMESTER- V

19N501 ARTIFICIAL INTELLIGENCE CONCEPTS

3 1 0 4

INTRODUCTION: Artificial Intelligence - The state of art - Intelligent Agents - Rationality - Nature of Environments – Structure of Agents - Examples. (9+3)

PROBLEM SOLVING AGENTS: Searching for solutions: Uninformed search - BFS, DFS, Uniform cost search, Iterative deepening search - Informed Search - Greedy Best First search, A* search, AO* search - Adversarial search – Games - Optimal decisions in Games, alpha - beta pruning (9+3)

KNOWLEDGE AND REASONING: Representations and mappings – Approaches to knowledge representation – Property inheritance algorithm - First Order Predicate logic- Instance and ISA relationships – Computable functions and predicates - Unification-Resolution – Question Answering. (9+3)

ACTING UNDER UNCERTAINTY: Quantifying uncertainty – Efficient representation of conditional distributions – Probability and Bayes Theorem - Bayesian Networks - Exact and approximate inferences - Making simple decisions –

Utility theory - Decision networks – Value of information – Decisions with multiple agents (9+3)

PLANNING: Classical Planning- Algorithms for Planning as state space search - Planning Graphs – Classic planning as Boolean Satisfiability - Analysis of planning approaches –Time, schedules and resources – Hierarchical planning (9+3)

Total L: 45 +T: 15 = 60

TEXT BOOKS:

1. Stuart J Russell and Peter Norvig, "Artificial Intelligence – A Modern Approach", 3rd Edition, Prentice Hall of India, Pearson Education, New Delhi, 2021.
2. Elaine Rich, Kevin Knight and Shivashankar B Nair, "Artificial Intelligence", 3rd Edition, Tata McGraw Hill Publishing Company, New Delhi, 2019.

REFERENCES:

1. George F Luger, "Artificial Intelligence: Structures and Strategies for Complex Problem Solving", 6th Edition, Pearson Education, New Delhi, 2021.
2. Deepak Khemani, "A First Course in Artificial Intelligence", McGraw Hill Education, New Delhi, 2017.
3. John Paul Mueller, "Artificial Intelligence For Dummies", Wiley, 2018
4. Lavika Goel, "Artificial Intelligence: Concepts and Applications", Wiley,2021
5. Pradeepta Mishra, "Practical Explainable AI Using Python: Artificial Intelligence Model Explanations Using Python-based Libraries, Extensions, and Frameworks", Apress,2021

19N502 DEEP LEARNING

3 0 0 3

INTRODUCTIONDeep Feed forward Networks – Regularization for Deep Learning – Optimization for Training Deep Models (9)

CONVOLUTIONAL NETWORKS: Convolution operation – Motivation – Pooling – Convolution variants – Down sampling, stride and padding –Local, convolution, tiled and full connections– CNN training – Structured outputs – Data types – Efficient convolution algorithms – Random or unsupervised features – Neuro scientific basis of CNN(9)

SEQUENCE MODELING: Recurrent networks – Unfolding computational graphs – RNN design patterns - Backpropagation through time – Bidirectional RNN – Encoder Decoder Sequence-to-Sequence Architectures – Deep recurrent networks – Recursive neural networks - Challenge of long-term dependencies – Strategies for multiple time scales – LSTM and GRU – Optimization for long-term dependencies – Explicit memory – Attention and the Transformer (9)

AUTOENCODERS, REPRESENTATION LEARNING Autoencoders (AE) – AE variants - Undercomplete AE - Regularized AE – Overcomplete AE - Sparse AE – Denoising AE – Learning Manifolds with Autoencoders - Contractive AE – Variational AE - Representation Learning – Greedy pre-training – Transfer learning and domain adaptation – Semi-Supervised Disentangling of Casual Factors – Distributed Representation – Exponential Gains from Depth – Providing Clues to Discover Underlying Causes. (9)

DEEP GENERATIVE MODELS: Restricted Boltzmann Machine –Deep Belief Networks – Deep Boltzman Machines – Boltzmann Machines for Real – Valued Data – Convolutional Boltzmann Machines- Boltzmann Machines for Structured or Sequential Outputs – Back Propagation through Random Operations – Directed Generative Nets – Drawing Samples from Autoencoders - Generative Stochastic Networks - Evaluating Generative Models (9)

Total L: 45

TEXT BOOKS:

1. Ian Goodfellow, Yoshua Bengio, Aaron Courville, "Deep Learning", The MIT Press, 2017.
2. Magnus Ekman, Learning Deep Learning, Addison-Wesley Professional, 2021

REFERENCES:

1. Charu C. Aggarwal, "Neural Networks and Deep Learning", Springer 2018.
2. Adam Gibson, Josh Patterson "Deep Learning: A Practitioner's Approach ", O'Reilly, 2017.
3. Umberto Michelucci "Applied Deep Learning. A Case-based Approach to Understanding Deep Neural Networks" Apress, 2018.
4. Nicholas Locascio and Nikhil Buduma "Fundamentals of Deep Learning: Designing Next-Generation Machine Intelligence Algorithms", O'Reilly, 2017
5. Giancarlo Zaccane, Md. Rezaul Karim, Ahmed Menshawy "Deep Learning with TensorFlow: Explore neural networks with Python", Packt Publisher, 2017.

19N503 MACHINE LEARNING – II

3 1 0 4

Non-Parametric Methods and Decision Trees: Nonparametric Density Estimation - Generalization to Multivariate Data - Nonparametric Classification - Condensed Nearest Neighbor - Distance-Based Classification - Outlier Detection - Nonparametric Regression: Smoothing Models - Univariate Trees - Pruning - Rule Extraction from Trees - Learning Rules from Data - Multivariate Trees (9+3)

Kernel Machines and Local Methods : Optimal Separating Hyperplane - The Nonseparable Case: Soft Margin Hyperplane - v-SVM - Kernel Trick - Vectorial Kernels - Defining Kernels - Multiple Kernel Learning - Multiclass Kernel Machines -Kernel Machines for Regression - Kernel Machines for Ranking - One-Class Kernel Machines - Large Margin Nearest Neighbor Classifier - Kernel Dimensionality Reduction - Competitive Learning - Radial Basis Functions - Incorporating Rule-Based Knowledge - Normalized Basis Functions- Competitive Basis Functions - Learning Vector Quantization - The Mixture of Experts (9+3)

Graphical Models and HMM: Canonical Cases for Conditional Independence - Generative Models - d-Separation - Belief Propagation - Undirected Graphs: Markov Random Fields - Learning the Structure of a Graphical Model - Influence Diagrams - Discrete Markov Processes - Hidden Markov Models - Three Basic Problems of HMMs - Evaluation Problem- Finding the State Sequence - Learning Model Parameters - Continuous Observations - The HMM as a Graphical Model - Model Selection in HMMs (9+3)

REINFORCEMENT LEARNING PROBLEM: Reinforcement Learning and its Elements - Limitations and Scope - An n-Armed Bandit Problem - Action-Value Methods - Incremental Implementation- Tracking a Nonstationary Problem - Optimistic Initial Values - Upper-Confidence-Bound Action Selection - Gradient Bandits - Associative Search - The Agent-Environment Interface-Goals and Rewards - Returns - Unified Notation for Episodic and Continuing Tasks - The Markov Property- Markov Decision Processes - Value Functions - Optimal Value Functions - Optimality and Approximation. (9+3)

SOLVING FINITE MARKOV DECISION PROBLEMS: Dynamic Programming Policy Evaluation - Policy Improvement- Policy Iteration -Value Iteration - Asynchronous Dynamic Programming- Generalized Policy Iteration - Efficiency of Dynamic Programming - Monte Carlo Monte Carlo Prediction, Estimation, Control , Control without Exploring Starts - Off-policy Prediction via Importance Sampling - Incremental Implementation -Off-Policy Monte Carlo Control - Importance Sampling on Truncated Returns- Temporal Difference Learning - TD Prediction -Advantages of TD Prediction Methods -Optimality of TD(0)- Sarsa - Q-Learning- Games, Afterstates, and Other Special Cases(9+3)

Total L:45 + T:15 = 60

TEXTBOOKS:

- 1.Ethem Alpaydin, "Introduction to Machine Learning", 4thEdition, PHI Learning, 2020.
2. Richard S. Sutton and Andrew G. Barto, "Reinforcement Learning: An Introduction", The MIT Press, 2014.

REFERENCES:

- 1.Christopher M Bishop, "Pattern Recognition and Machine Learning Learning", Springer, 2011.
- 2.Yaser S. Abu-Mostafa, "Learning from Data", AML, 2017.
3. Richard O. Duda, Peter E. Hard, David G. Stork, "Pattern Recognition", 2nd Edition, Wiley, 2020
- 4.Marc Peter Deisenroth, A. Aldo Faisal, Cheng Soon Ong, "Mathematics for Machine Learning", Cambridge University Press, 2020.

19N504 COMPUTER NETWORKS

3 1 0 4

INTRODUCTION AND MEDIUM: Building a Network - Network Edge and Core - Layering and Protocols - TCP/IP Protocol suite - OSI Reference Model - Network Topologies - Internet Architecture-Physical Layer: Signal Characteristics – Transmission media – Signal Encoding Techniques – Performance Metrics. (10+3)

LINK LAYER SERVICES: Link Layer Services - Framing - Flow Control - Error Control - Media Access Control - Ethernet -Wireless LAN – Introduction about Bluetooth, Zigbee. (8+3)

SWITCHING AND ROUTING:Switching: Circuit Switching - Packet Switching - IPV4 - Global Address - Datagram Forwarding - Subnetting - CIDR - ARP- ICMP - Routing Algorithms: Distance Vector Routing and Link State Routing - IPV6 Addressing – IPV6 Protocol. (9+3)

CONNECTION-ORIENTED AND CONNECTIONLESS SERVICES: Overview of Transport Layer - UDP - TCP – Reliable Byte Stream - Connection Management - Flow Control - Congestion Control - SCTP. (9+3)

APPLICATION LAYER SERVICES: Needs/Principles of Application Layer Protocols – Role of proxy, Web and HTTP - FTP - Electronic Mail (SMTP - POP3 - IMAP - MIME) - DHCP - DNS - DASH - QUIC. (9+3)

Total L: 45 +T:15 = 60

TEXTBOOKS:

1. Larry L Peterson and Bruce S Davie," Computer Networks: A systems approach", Morgan Kaufmann Publishers, USA, 6th Edition 2021.
- 2 James F Kurose, Keith W Ross," Computer Networking - A Top-Down Approach Featuring the Internet", Pearson Education, New Delhi, Sixth Edition, 2012.

REFERENCES:

- 1.Behrouz A. Forouzan , " Data Communications and Networking with TCP/IP Protocol Suite", 6th Edition, McGraw Hill, 2021.
- 2.Andrew S Tanenbaum and David J Wetherall, "Computer Networks", Prentice Hall of India/ Pearson Education, New Delhi,6th Edition, 2021
- 3.Prakash C Gupta," Data Communication and Computer Networks", Prentice Hall of India, New Delhi, 2014.

4. Prakash C Gupta, "Data Communication and Computer Networks", 2nd Edition, Prentice Hall of India, New Delhi, 2013
5. Ajit Pal, "Data Communication And Computer Networks", 1st Edition, PHI Learning, 2013

19N510 DEEP LEARNING LABORATORY

0 0 4 2

1. Deep learning Packages Basics: Tensorflow, Keras
Implement the following from scratch
2. Train Simple Perceptron with Gradient Descent for regression
3. Train MLP with Backpropagation for classification
4. CNN with maxpooling for MNIST Dataset
5. Bahdanau and Lounq Attention
6. Transformer
- Implement the following using existing packages.
7. Face Recognition using SSD
8. Time Series Prediction using LSTM
9. Image generation using GAN
10. Generating fake videos using autoencoders
11. Recommender systems using RBM

Total P: 60

REFERENCES:

1. Ian Goodfellow, Yoshua Bengio and Aaron Courville, "Deep Learning", MIT Press, 2017.
2. Josh Patterson, Adam Gibson "Deep Learning: A Practitioner's Approach", O'Reilly Media, 2017
3. Giancarlo Zaccone, Md. Rezaul Karim, Ahmed Menshawy, Deep Learning with TensorFlow: Explore neural networks with Python, Packt Publisher, 2017.
4. Antonio Gulli, Sujit Pal, Deep Learning with Keras, Packt Publishers, 2017.
5. Francois Chollet, Deep Learning with Python", Manning Publications, 2017.

19N511 APPLICATION DEVELOPMENT LABORATORY

0 0 4 2

Problem Formulation and Design:

1. Problem Identification
2. Requirements Analysis and Design

Implementation:

1. Development of required packages
2. Implementation of the application using coding standards and the packages developed.

Testing and Documentation:

1. Application Testing
2. Documentation of the development process

NOTE: The students can develop Web based Application or Mobile Application of their choice. The Language for development can be chosen based on their application requirement.

Total P: 60

REFERENCES:

1. Love, Chris. Progressive Web Application Development by Example: Develop Fast, Reliable, and Engaging User Experiences for the Web. United Kingdom, Packt Publishing, 2018.
2. Robbins, Jennifer. Learning Web Design: A Beginner's Guide to HTML, CSS, JavaScript, and Web Graphics. United States, O'Reilly Media, 2018.
3. User Interface Design: Bridging the Gap from User Requirements to Design. United States, CRC Press, 2018.
4. Carlson Ph D, John R, and Carlson, John. Cross-Platform Mobile Application Development: A Beginner's Guide Using the Corona SDK. N.P., Amazon Digital Services LLC - KDP Print US, 2019.
5. Mobile Apps Engineering: Design, Development, Security, and Testing. United Kingdom, CRC Press, 2018.

19Q513 BUSINESS AND MANAGERIAL COMMUNICATIONS

0 0 2 1

BUSINESS AND MANAGERIAL COMMUNICATIONS:

1. Advanced Group discussion
2. Advanced Resume writing
3. Mock Group discussion
4. Advanced Personal Interview
5. Mock Personal Interview
6. Cracking special Interviews
7. Essential Grammar for Placements
8. Vocabulary for Placements

9. Email writing
10. Paragraph writing
11. Essay writing

Total P: 30

REFERENCES:

1. Priyadarshi Patnaik, "Group Discussion and Interview Skills", Cambridge, New Delhi, 2011.
2. Hari Mohan Prasad, Rajnish Mohan, "How to Prepare for Group Discussion and Interview", 2nd Edition, Tata McGraw-Hill, New Delhi, 2009.

SEMESTER– VI

19N601 DATA PRIVACY AND SECURITY

3 0 0 3

INTRODUCTION: Security goals –threats and attacks. – Services and mechanisms – A model for Network Security
crypto Systems: Introduction – symmetric key cryptography-substitution cipher – transposition cipher -stream ciphers and block ciphers – Data Encryption Standard - Advanced Encryption Standard (AES) (10)

PUBLIC KEY CRYPTOSYSTEM: Basic Concepts of Number Theory - Principles of Public key cryptosystem – RSA cryptosystem - attacks on RSA – Diffie – Hellman key agreement–Elliptic Curve cryptosystem. (8)

MESSAGE INTEGRITY, AUTHENTICATION: Message digest – Cryptographic hash function - Message authentication code – Message authentication Requirements- Message Authentication Functions - Digital signatures-Digital Signature standard. **DATA BASE SECURITY:** Security Requirements – database administration security – SQL injection and exploitation and defense methods - database roles and permissions – Object level security - Sensitive data (9)

DATA PRIVACY: Foundations of privacy: Privacy and Contextual Integrity, Privacy regulations, Goals of Privacy engineering, taxonomy of privacy, Attacks on private data - **DATA PRIVACY MODELS AND DISCLOSURE RISK MEASURES:** Formal model of Data privacy, K-anonymity: Definition of k-anonymity, Practical Implications, Mechanism design, Evaluating the risk of disclosure- Limitations of K-anonymity. Disclosure Risk Measures: Attribute disclosure, identity disclosure, Synthetic datasets and network trace analysis (8)

MASKING METHODS & DIFFERENTIAL PRIVACY: Perturbative methods - non-Perturbative methods - Synthetic Data Generators. **DIFFERENTIAL PRIVACY:** Definition of Differential Privacy (DP), Privacy and databases, Noiseless differential privacy- Promise of DP, Formalizing DP, Lower bounds, Mechanism Design, Machine learning and Differential Privacy- Differential privacy for large data- Differentially private social network analysis – Web privacy: online tracking and advertisement Applications of Differential privacy (10)

Total L:45

TEXT BOOKS:

1. William Stallings, " Cryptography and Network Security: Principles and Practice", 8th Edition, Prentice Hall of India, Pearson Education, New Delhi , 2020.
2. Vicenc Torra, " Data Privacy: Foundations, New Developments and Big Data Challenge", Springer, 2017.

REFERENCES:

1. Behrouz A. Forouzan and Debdeep Mukhopadhyay, "Cryptography and Network Security", Tata McGraw Hill, 2011.
2. Atul Kahate, " Cryptography and Network Security", Tata McGraw Hill, 2013.
3. Tianqing Zhu, Gang Li, Wanlei Zhou, Philip S. Yu, "Differential Privacy and Applications", Springer, 2017
4. Benjamin C.M. Fung, Ke Wang, Ada Wai-Chee Fu and Philip S. Yu, "Introduction to Privacy-Preserving Data Publishing: Concepts and Techniques", Chapman & Hall/CRC, 2010.
5. Charu C. Aggarwal, "Privacy-Preserving Data Mining: Models and Algorithms", Springer, 2008.

19N602 PARALLEL AND DISTRIBUTED COMPUTING

3 1 0 4

INTRODUCTION TO PARALLEL COMPUTING: Flynn's Taxonomy-Types of Parallel Computers-Characteristics of Parallel Systems-Parallel Computing Models: Shared Memory Models-Interconnection Network Models-Dataflow Model-Parallel Algorithms: Classes of Problems Solvable through Parallelization-Types of Parallelization-Assigning Computational Tasks to Processors. (9+3)

PARALLEL COMPUTING ARCHITECTURE: Introduction-Shared Memory Architecture: Shared Memory Paradigm- Cache Coherency- Memory Consistency- Message-Passing Architecture: Message-Passing Paradigm- Routing- Switching- Stream Processing Architecture: Dataflow Paradigm- Parallel Accelerators- Stream Processors (9+3)

PARALLEL PROGRAMMING WITH OpenMP and MPI: OpenMP: Overview of Features- Additional Feature Details: OpenMP Directives- Synchronization- Runtime Library Routines- MPI: Introduction to MPI- Basic Point-to-point Communication Routines- Basic MPI Collective Communication Routines- Environment Management Routines- Point-to-point Communication Routines- Collective Communication Routines (9+3)

DISTRIBUTED COMPUTING: Definition, motivation, communication protocols – RPC-RMI, Coordination – clocks-mutual exclusion – leader election, Replication management – Consistency protocols. (9+3)

GPU COMPUTING: CPU vs GPU, Architecture of CUDA capable GPU – GPU computing – Data parallelism – CUDA program structure – Vector addition – CUDA thread Organisation – Matrix-matrix multiplication – Blocks – OpenCL data parallel model, device architecture (9+3)

Total L:45 + T:15 =60

TEXT BOOKS:

1. Vivek Kale, Parallel Computing Architectures and APIs: IoT, big data stream processing”, CRC Press, 2020.
2. Andrew S.Tanenbaum and Maarten van Steen, “Distributed Systems, Principles and Paradigm” Prentice Hall,2016

REFERENCES:

1. Ananth Grama, Anshul Gupta, George Karypis and Vipin Kumar,“Introduction to Parallel ComputingII”, Second Edition, Pearson Education, 2009
2. David Kirk, Wen Mei W Hwu, “Programming Massively Parallel Processors”, Third Edition: A Hands-on Approach”, Morgan Kaufmann Publishers Inc, 3rd edition, 2016
3. Roman Trobec Boštjan Slivnik , Patricio Bulić, Boru”t Robič , “Introduction to Parallel Computing”, Springer,2018
4. Shane Cook,“CUDA Programming: A Developer’s Guide to Parallel Computing with GPU’s (Applications of GPU Computing),MK Publishers,2013
5. Wan Fokkink, “ Distributed Algorithms: An Intuitive Approach”, PHI Learning Pvt. Ltd,2nd Edition, 2018

19N603 BIG DATA AND MODERN DATABASE SYSTEMS

3 0 0 3

BIG DATA OVERVIEW: Big data- Needs and challenges - Architecture of big data systems, NoSQL data models, CAP theorem, Components of Hadoop Ecosystem, Map-Reduce programming – Columnar Database - HBase, big data software lifecycle. (9)

DOCUMENT DATABASE: Introduction to MongoDB - Installation of MongoDB – Create Database, collection and documents – CRUD Operations - Query and Criteria. (9)

GRAPH DATABASE: - Overview of Neo4j - Neo4j Architecture - - Exploring Neo4j using Cypher Query Language: Create Nodes and Relationships - Importing Data with Neo4j. (9)

MINING DATA STREAMS: Concepts - Stream Data Model and SPARK Architecture – RDD – Transformations - parallel programming - Data Frames and Spark SQL. (9)

DATABASE INTEGRATION: Importance – Types and Complexity - ETL – data lakes- Schema Extraction Approaches– Data Integration Framework - Semantic Integration - RDF Schema –Traditional Ontology Languages: OWL (9)

Total L: 45

TEXT BOOKS:

- 1.G. Sudha Sadasivam,R. Thirumahal, "Big Data Analytics",Oxford University Press,2020.
2. April Reeve, “Managing Data in Motion”, Elsevier 2013.

REFERENCES:

- 1.EMC Educational Series, "Data Science and Big Data Analytics", Wiley, New Delhi, 2015.
- 2.David Stevenson, "Big Data Demystified", Pearson Education, 2018.
- 3.Mohammed Guller, Big Data Analytics with Spark, Apress,2015
- 4.Jeffrey A. Hoffer, Ramesh Venkataraman, Heikki Topi, "Modern Database Management", 12th Edition, Pearson, New Delhi, 2016.
- 5.Ian Robinson, Jim Webber, Emil Eifrem, “Graph Databases: New Opportunities for Connected Data”, Second Edition, O’Reilly, January 2016.

19N604 NATURAL LANGUAGE PROCESSING

3 0 0 3

WORDS: Introduction - Mathematical Foundations – Linguistic Essentials - Regular Expressions, Text Normalization, Edit Distance - Finite State Transducers - Language Modeling with N-grams - Naive Bayes Classification and Sentiment - Neural Nets and Neural Language Models - Hidden Markov Models - Part-of-Speech Tagging. (10)

SYNTAX: Formal Grammars of English - Syntactic Parsing – Ambiguity – Cocke Kasami Younger (CKY) algorithm – PCFG – Inside and Outside probabilities – Dependency Grammar – Transition based parsing – MST based Dependency parsing. (8)

SEMANTICS: Vector Semantics - Semantics with Dense Vectors - Word Senses: WSD and WordNet - Lexicons for Sentiment and Affect Extraction - Representation of Sentence Meaning - Computational Semantics - Information Extraction – Named Entity Recognition - Semantic Role Labeling and Argument Structure - Coreference Resolution and Entity Linking. (9)

PRAGMATICS AND APPLICATIONS: Discourse Coherence – Neural Sequence modeling: RNN, LSTM – Text Summarization - Topic Modelling - Question Answering. (9)

NATURAL LANGUAGE GENERATION: Architecture of NLG Systems- Generation Tasks and Representations- Application of NLG. Machine Translation: Language similarities and differences – The transfer metaphor – Direct translation – Statistical translation - Translation involving Indian Languages. (9)

Total L:45

TEXTBOOKS:

1. Daniel Jurafsky and James H. Martin, "Speech and Language Processing", Prentice-Hall, Inc., 2017
2. Christopher D. Manning, Hinrich Schütze, "Foundations of Statistical Natural Language Processing", The MIT Press, 2018.

REFERENCES:

1. Yoav Goldberg, "Neural Network Methods for Natural Language Processing", Synthesis Lectures on Human Language Technologies, April 2017.
2. Steven Bird, Ewan Klein, and Edward Loper, "Natural Language Processing with Python - Analyzing Text with the Natural Language Toolkit", O'Reilly. 2019
3. Li Deng and Yang Liu, "Deep Learning in Natural Language Processing", Springer, Germany. 2018.
4. Dipanjan Sarkar, "Text Analytics with Python - A Practitioner's Guide to Natural Language Processing, Apress, 2019
5. Jalaj Thanaki, "Python Natural Language Processing - Advanced machine learning and deep learning techniques for natural language processing, Packt Publisher, 2017.

19N610 BIG DATA LABORATORY

0 0 4 2

1. Map Reduce Program 1
2. Map Reduce Program 2
3. CRUD Operations in MongoDB
4. Mongo DB – case study.
5. CRUD Operations in Neo4j
6. Neo4j – Case study
7. Spark streaming using R - Case Studies
8. Local and global schema generation through XML.

Total P: 60

REFERENCES:

1. Tom White "Hadoop: The Definitive Guide" Third Edit on, O'reilly Media, 2012. • Seema Acharya, Subhasini Chellappan, "Big Data Analytics" Wiley 2015.
2. Tom Plunkett, Mark Hornick, "Using R to Unlock the Value of Big Data: Big Data Analytics with Oracle R Enterprise and Oracle R Connector for Hadoop", McGraw-Hill/Osborne Media (2013), Oracle press
3. Ian Robinson, Jim Webber, Emil Eifrem, "Graph Databases: New Opportunities for Connected Data", Second Edition, O'Reilly, January 2016
4. Guy Harrison, "Next Generation database: NoSQL and big data", Apress, 2015
5. Shannon Bradshaw, Eoin Brazil, Kristina Chodorow, "MongoDB: The Definitive Guide: Powerful and Scalable Data Storage", O'Reilly, 3rd Edition, December 2019.

19Q613 QUANTITATIVE AND REASONING SKILLS

0 0 2 1

QUANTITATIVE AND REASONING SKILLS:

1. Number System, Time and Work
2. Percentages, Simple and Compound Interests
3. Time, Speed and Distance
4. Permutation, Combination and Probability
5. Ratio and Proportion
6. Profit, Loss and Partnership
7. Logarithms, Progressions, Geometry and Quadratic Equations
8. Coding and Decoding
9. Series, Analogy and Odd Man Out
10. Visual Reasoning
11. Data Arrangements

12. Blood Relations
13. Clocks, Calendars and Direction Sense
14. Cubes, Logical Connectives and Syllogisms
15. Venn Diagrams, Interpretations and solving

Total P: 30

REFERENCES:

1. Aggarwal R S, "Quantitative Aptitude for Competitive Examinations", 3rd Edition, S Chand Publishing, New Delhi, 2017.
2. ETHNUS, "Aptimithra", 1st Edition, McGraw-Hill Education Pvt Ltd, 2013.
3. FACE, "Aptipedia Aptitude Encyclopedia", 1st Edition, Wiley Publications, Delhi, 2016.

19N620 INNOVATION PRACTICES

0 0 4 2

INNOVATIVE PRACTICES:

This course involves preparing students to think innovatively and present possible solutions to identified industry/academic problem or issue

Total P: 60

SEMESTER– VII

19N701 EMBEDDED SYSTEMS

3 0 0 3

INTRODUCTION: Fundamental Components of Embedded Systems - Architecture of Embedded Systems - Embedded Design Life Cycle - Development Environment - Validation - Host and Target Testing - Debugging tool(9)

MEMORY AND INTERRUPTS: Types of Memory - Memory Access Procedure - Memory Management techniques - Memory Testing - Common Memory problems - Interrupts - Interrupt Service Routines (9)

COMMUNICATION INTERFACES AND PROTOCOLS: Interfacing Buses - Serial Interfaces - RS232/UART - UART Programming - RS422/RS485 - I2C Interface - SPI Interface - I2C/SPI Programming - USB (9)

REAL TIME OPERATING SYSTEMS: Real-Time Concepts - Task Management - Task Scheduling - Classification of Scheduling Algorithms - Clock Driven Scheduling - Event Driven Scheduling - Resource Sharing - Priority Inheritance Protocol - Priority Ceiling Protocol - Commercial RTOS (9)

CASE STUDY: Requirement Engineering -Requirements for a Smart Card reader system - Development of Automatic Vending Machine - Protocol converter - Development of a navigation system - Simultaneous Localization and Mapping (SLAM) for autonomous vehicles (9)

Total L: 45

TEXT BOOKS:

1. Arnold S Berger, "Embedded Systems Design - An Introduction to Processes, Tools and Techniques", Elsevier, New Delhi, 2011
2. Prasad K V K K, "Embedded/Real-Time Systems: Concepts, Design and Programming - The Ultimate Reference", Himal Impressions, New Delhi, 2003

REFERENCES:

1. RajKamal, "Embedded Systems - Architecture, Programming and Design", 3rd Edition, Tata McGraw Hill, 2017
2. Rajib Mall, "Real-Time Systems: Theory and Practice", First Edition, Pearson, 2009
3. Sriram V Iyer and Pankaj Gupta, "Embedded Real-time Systems Programming", Tata McGraw-Hill Publishing Company Limited, New Delhi, 2006.

19N710 EMBEDDED SYSTEMS LABORATORY

0 0 4 2

1. Introduction to Development Tools and Environment
2. Programming - Basics of Embedded C
3. Interfacing Keyboard and LCD Display
4. UART Serial Port Programming
5. Communication Interface using I2C and SPI
6. RTOS Programming Environment
7. RTOS - Creating Multiple Tasks
8. RTOS - Inter-Task Communication
9. RTOS - Task Synchronization
10. Automatic Vending Machine

Total P: 60

REFERENCES:

1. Michael J Pont, "Embedded C", Addison-Wesley Longman Publishing Co., Inc. Boston, MA, USA, 2002.
2. Michael Barr and Anthony Massa, "Programming Embedded Systems with C and GNU Development Tools", Second Edition, O'Reilly Media, 2006.
3. Jean J Labrosse, "MicroC OS II: The Real Time Kernel", Second Edition, CRC Press, 2002.

19N720 PROJECT WORK I

0 0 4 2

The project I involves the following:

- Identification of Real-World Problem
- System Requirement Analysis and Specification
- Developing a Model and Solution for the Identified Problem
- Consolidated Report Preparation and Presentation

Total P:60

SEMESTER- VIII

19N820 PROJECT WORK II

0 0 8 4

The Project work II involves

- Preparing a project - brief proposal including
- Problem Identification
- A statement of system / process specifications proposed to be developed
- List of possible solutions including alternatives and constraints
- Cost benefit analysis
- Time Line of activities
- Presentation highlighting the
- Design based on functional requirements
- Implementation
- Testing and Validation
- Results and future work
- Consolidated report based on standards

Total P: 120

LANGUAGE ELECTIVES

19G001 COMMUNICATION SKILLS FOR ENGINEERS

0 0 4 2

COMMUNICATION CONCEPTS:

Process of Communication
Inter and Intrapersonal Communication
Inter and Intrapersonal Communication Activities

(9)

FOCUS ON SOFT SKILLS:

Etiquette –Work Place etiquette – Telephone etiquette
Body Language
Persuasive Communication
Public Speaking
Critical Reasoning and Conflict Management based on Case Studies
Group Communication
Meetings
Interview Techniques

(14)

TECHNICAL WRITING:

Technical Writing Principles
Style and Mechanics
Technical Definitions – Physical, Functional and Process Descriptions
Technical Report Writing
Preparing Instructions and Manuals

Interpretation of Technical Data (15)

BUSINESS CORRESPONDENCE:

Writing Emails
Preparing Resumes
Memos
Technical and Business Proposals (7)

TECHNICAL COMMUNICATION:

Seminars
Process Description and Group Discussions
Use of Visual Aids (15)

Total P: 60

TEXT BOOKS:

1. Faculty Incharge "Course Material on "Communication Skills for Engineers"", PSG College of Technology., Coimbatore, 2019.

REFERENCES:

1. Jeff Butterfield "Soft Skills for Everyone", Cengage Learning., New Delhi, 2013
2. Jean Naterop B and Rod Revell "Telephoning in English", Cambridge University Press., Cambridge, 2011
3. David A Mc Murrey and Joanne Buckley "Handbook for Technical Writing", Cengage Learning., New Delhi, 2011
4. Simon Sweeney "English for Business Communication", Cambridge University Press., New Delhi, 2012

19G002 GERMAN- LEVEL A1.1

0 0 4 2

GUTEN TAG!:

1. To greet, learn numbers till 20, practice telephone numbers & e mail address, learn alphabet, speak about countries & languages
2. Vocabulary: related to the topic
3. Grammar: W – Questions, Verbs & Personal pronouns I. (10)

FREUNDE, KOLLEGEN UND ICH:

1. To speak about hobbies, jobs, learn numbers from 20; build dialogues and frame simple questions & answers
2. Vocabulary: related to the topic
3. Grammar: Articles, Verbs & Personal pronouns II, sein & haben verbs, ja/nein Frage, singular/plural (10)

IN DER STADT:

1. To know places, buildings, question, know transport systems, understand international words; build dialogues and write short sentences
2. Vocabulary: related to the topic
4. Grammar: Definite & indefinite articles, Negotiation, Imperative with Sien verbs (12)
5.

GUTEN APPETIT! :

1. To speak about food, shop, converse; Vocabulary: related to the topic; build dialogues and write short sentences
2. Grammar: Sentence position, Accusative, Accusative with verbs, personal pronouns & prepositions, Past tense of haben & sein verbs (13)

TAG FÜR TAG/ZEIT MIT FREUNDEN:

1. To learn time related expressions, speak about family, about birthdays, understand & write invitations, converse in the restaurant; ask excuse, fix appointments onphone
2. Vocabulary: related to the topic
3. Grammar: Time related prepositions, Possessive articles, Modalverbs (15)

Total P: 60

TEXT BOOKS:

1. Dengler Stefanie "Netzwerk A1.1", Klett-Langenscheidt Gmbh., München, 2013
2. Sandra Evans, Angela Pude "Menschen A1", Hueber Verlag., Germany, 2012

REFERENCES:

1. Stefanie Dengler "Netzwerk A1", Klett-Langenscheidt Gmbh., München, 2013
2. Hermann Funk, Christina Kuhn "Studio d A1", Goyal Publishers & Distributors Pvt. Ltd., New Delhi, 2009
3. Rosa-Maria Dallapiazza "Tangram Aktuell 1 (Deutsch als Fremdsprache)", Max Hueber Verlag., Munchen, 2004
4. Christiane Lemcke und Lutz Rohmann "Grammatik Intensivtrainer A 1", Goyal Publishers & Distributors Pvt. Ltd., New Delhi, 2012

19G003 FRENCH LANGUAGE LEVEL 1

0 0 4 2

PARTS OF SPEECH:

1. inviter et répondre à une invitation, Pronoms sujets
2. L'article définis, l'article indéfinis
3. Conjugation : présent, adjectifs possessifs
4. interrogation, décrire les personnes
5. La vie de quatre parisiens de professions différentes

(12)

ELEMENTS OF GRAMMAR:

1. Exprimer l'ordre et l'obligation demander et commander
2. l'adjectif possessifs, l'article partitif, l'article démonstratif, négation ne
3. pas, l'article contracté
4. verbe pronominaux
5. prepositions

(12)

SENTENCE STRUCTURE:

1. Raconter et reporter-donner son avis
2. Futur simple, pronom complètement d'objet direct, passé composé
3. plusieurs région de France, imparfait, pronom y/en, imparfait

(12)

TENSES AND NUMBERS:

1. Demander l'autorisation-passé récent, futur proche
2. La vie administrative et régionale, Pluriel des noms, moyens de transport

(12)

DISCOURSE:

1. le discours rapporté, décrire un lieu, exprimer ses préférences
2. décrire la carrière, discuter d'un système éducation de France
3. parler de la technologie de l'information

(12)

Total P: 60**TEXT BOOKS:**

1. Christine Andant étal "À propos (livre de l'élève", LANGER., NEW DELHI,2012
2. Myrna Bell Rochester "Easy French Step By Step", MCGrawhill Companies.,USA, 2008

REFERENCES:

1. Michael D. Oates "Entre Amis: An Interactive Approach", Houghton Mifflin., 2005 , 5th
2. Bette Hirsch, Chantal Thompson "Moments Literaries : An Anthology for intermediate French". ,
3. Simone Renaud, Dominique van Hooff "En bonne forme", ..

19G004 BASIC JAPANESE**0 0 4 2****JAPANESE PEOPLE AND CULTURE:**

1. Basic greetings and responses
2. Basic script—Method of writing hiragana and katakana —Combination sounds and simple words 3. Self introductions:—Hajimemashite! -Demonstratives —Korell,—Sorell,—Arell—Demonstrative —Konoll,—Sonoll,—Anoll 4. Possessive noun particle —noll —Japanese apartments: Greeting your neighbor

(12)

PARTICLE "NI (AT)" FOR TIME:

1. kara (from) ~ made(until) — Particle —to (and)ll
2. Time periods: Days of the week, months, time of day —Verbs (Present / future and past tense) 3. Telephone enquiry: Asking for a phone no. And business hours- Destination particle —ell.

(12)

LIKES AND DISLIKES:

1. Potential verbs (wakarimasu and dekimasu) — —Kara (~ because)ll
2. Adverbs —Asking some one out over the phone-Verbs denoting presence
4. Introduction to Adjectives (na and ii type) -Verb groups — I, II and III — Exercises to group verbs- Please do (te kudasai)
5. Present continuous tenses (te imasu) — Shall I? (~ mashou ka) — Describing a natural phenomenon (It is raining)

(12)

DIFFERENT USAGES OF ADJECTIVES:

1. Comparison —Likes and dislikes —Going to a trip- Need and desire (ga hoshii) — Wanting to... (Tabetai desu)- Going for a certain purpose (mi -ni ikimasu)
2. Choosing from a menu-Adjectives (—ill and —nall type) — Adjectives (Positive and negative useage)

(12)

ROLE PLAYS IN JAPANESE:

1. Framing simple questions & answers
2. Writing Short paragraphs & Dialogues
3. A demonstration on usage of chopsticks and Japanese tea party

(12)

Total P: 60

TEXT BOOKS:

1.Minna no Nihongo, Honsatsu Roma "ji ban (Main Textbook Romanized Version)", . International publisher – 3A Corporation., Tokyo, 2012

REFERENCES:

- 1.Eri Banno et.al "Genki I: An Integrated Course in Elementary Japanese I -Workbook", 1999
- 2.Tae Kim "A Guide to Japanese Grammar: A Japanese Approach to Learning Japanese Grammar", 2014
- 3.Minna No Nihongo "Translation & Grammatical Notes In English Ele

PROFESSIONAL ELECTIVES**19N001 ADVANCED DATA STRUCTURES****3 0 0 3**

AMORTIZED ANALYSIS AND SETS: Amortization - Methods - Applications. Sets: Disjoint Sets - Dynamic Set Operations - Van Emde Boas Trees. (9)

HEAP STRUCTURES: Min - Max Heaps - Deaps - Leftist Heaps - Binomial Heaps - Fibonacci Heaps. (8)

SEARCH TREES: Red-Black Tree - AA Tree - Interval Tree - Splay Trees. (7)

MULTIDIMENSIONAL STRUCTURES K - D Trees - Point Quad Trees - MX- Quad Trees - R - Trees - TV Trees. (9)

RANDOMIZATION: Random Number Generators - Skip Lists - Primality Testing - Treaps. - Probabilistic analysis and Randomization. (12)

Total L: 45**TEXT BOOKS:**

- 1.Thomas H Cormen, Charles E Leiserson, Ronald L Rivest and Clifford Stein, "Introduction to Algorithms", MIT Press, Massachusetts 2009.
- 2.Ellis Horowitz, Sartaj Sahni and Dinesh Mehta, "Fundamentals of Data Structures in C++", University Press, New Delhi, 2013.

REFERENCES:

- 1.Subrahmanian V S, "Principles of Multimedia Database Systems", Morgan Kaufman, USA, 2001.
- 2.Mark Allen Weiss, "Data structures and Algorithm Analysis in C++", Pearson Education, New Delhi, 2006.
- 3.Peter Brass, "Advanced Data Structures", Cambridge University Press, USA, 2008.
- 4.Venkatesan R and Lovelyn Rose S, "Data Structures", 2nd Edition, Wiley India Pvt. Ltd, New Delhi, 2015.

19N002 APPROXIMATION ALGORITHMS**3 0 0 3**

INTRODUCTION AND COMBINATORIAL ALGORITHMS: Definitions - Performance ratios - vertex cover problem - Lower bounding - Greedy set cover problem - Layering - Application to shortest superstring (9)

LINEAR PROGRAMMING DUALITY AND ROUNDING: LP-Duality theorem - Min-max relations and LP-Duality - LP-rounding for set cover problem - randomized rounding - Primal-Dual method for set cover problem (9)

CUTS AND LP RELAXATIONS: Multicut and Integer Multicommodity - Primal-dual scheme for Multicut - Multiway Cut - Randomized rounding algorithm for multiway cut - Multicut in General Graphs - Sum multicommodity flow - LP rounding-based algorithm (9)

SEMIDEFINITE PROGRAMMING: Strict quadratic and vector programs - Properties of positive semidefinite matrices Semidefinite programming problem - Randomized rounding algorithm - Improving the guarantee for MAX-2SAT (9)

HARDNESS OF APPROXIMATION: Reduction, graphs, and hardness factors - PCP theorem - hardness of MAX-3SAT - Hardness of set cover (9)

Total L: 45**TEXT BOOKS:**

- 1.Vijay V. Vazirani, "Approximation Algorithms", Springer Nature (SIE), Berlin, 2010.
- 2.Thomas H Cormen, Charles E Leiserson, Ronald L Rivest, Clifford Stein, "Introduction to Algorithms", 3rd Edition, MIT Press,England, 2009.

REFERENCES:

- 3.David P. Williamson, David P. Shmoys, "The Design of Approximation Algorithms", Cambridge University Press, England, 2011.

4. Ellis Horowitz, Sartaj Sahni, Sanguthevar Rajasekaran, "Fundamentals of Computer Algorithms", 1st Edition, Galgotia Publications, New Delhi, 2010.
5. Bernd Gärtner, Jiri Matousek, "Approximation Algorithms and Semidefinite Programming", Springer, Berlin, 2012.
6. Christos H. Papadimitriou, Kenneth Steiglitz, "Combinatorial Optimization: Algorithms and Complexity", 1st Edition, Dover Publications, New York, 2013.

19N003AUGMENTED REALITY

3 0 0 3

INTRODUCTION TO IMMERSIVE TECHNOLOGIES AND GEOMETRY OF VIRTUAL WORLDS: Introduction to Immersive Technologies - Reality, Virtuality and Immersion - VR, AR, MR: similarities and differences - Current trends and state of the art in immersive technologies, developing platforms and consumer devices - Geometric modelling - Matrix algebra and 2D rotations - 3D rotations and yaw, pitch, and roll – Quaternions - Converting and multiplying rotations - Homogeneous transforms - Eye transforms - Canonical view transform. (9)

TRACKING FOR AUGMENTED REALITY & VIRTUAL REALITY: Overview - Orientation tracking - Tilt drift correction - Yaw drift correction - Camera tracking - Perspective n-point problem – Filtering - Motion tracking and navigation - Navigation and Manipulation Interfaces. (9)

VISUAL RENDERING: Visual Rendering - Overview - Shading models – Rasterization - Pixel shading - Distortion shading - Post-rendering image warp - Rendering Architecture - 3D rendering for Immersive Environments. (9)

HUMAN PERCEPTION FOR AUGMENTED REALITY & VIRTUAL REALITY: Interfaces - Overview – Locomotion – Manipulation - System control - Social interaction – Human Perception and Cognition - User Centered Design - User Experience - Ethical Code of Conduct - VR Health and Safety Issues. (9)

APPLICATIONS OF VR: Applications of VR in Medical applications, Military applications - Robotics applications - Robot Programming and Robot Teleoperation - Big Data Visualization - VR Technology in Film & TV Production - Demonstration of Digital Entertainment by VR - VR Technology in Physical Exercises and Games. (9)

Total L: 45

TEXT BOOKS:

1. Kent Norman (Ed), Wiley Handbook of Human Computer Interaction, Wiley 2017.
2. Dieter Schmalstieg and Tobias Höllerer, Augmented Reality: Principles & Practice, Pearson Education India, 2016.

REFERENCES:

1. Grigore C. Burdea, Philippe Coiffet, Virtual Reality Technology, Wiley 2016.
2. Alan Craig, William Sherman and Jeffrey Will, Developing Virtual Reality Applications, Foundations of Effective Design, Morgan Kaufmann, 2009.
3. Alan B. Craig, Understanding Augmented Reality, Concepts and Applications, Morgan Kaufmann, 2013.
4. Burdea, G. C. and P. Coffet. Virtual Reality Technology, Second Edition. Wiley-IEEE Press, 2006.
5. Steve Aukstakalnis, "Practical Augmented Reality: A Guide to the Technologies, Applications, and Human Factors for AR and VR (Usability)", Addison-Wesley publisher, 1st Edition, 2016.

19N004BLOCKCHAIN TECHNOLOGY

3 0 0 3

INTRODUCTION: Distributed System, P2P system, Hadoop Distributed File System, Distributed Hash Table, ASIC resistance, issues, Distributed Ledger Technology- Private, public and permissioned ledgers - Cryptographic primitives- public key cryptography- Digital Signature Algorithm -Hashing- Blockchain evolution- Structure of blockchain – Life of Blockchain application - consensus – Byzantine General problem and Fault Tolerance. (11)

BITCOIN AND CRYPTOCURRENCY: Block Hash - structure of block – syntax, structures, and validation - transaction life cycle- transaction types – Hash computation and Merkle Hash Tree -Bit coin and importance- Creation of coins– Bitcoin P2P Network-, Bitcoin protocols - Mining strategy and rewards – PoW and PoS – Difficulty, hash rate– Wallets- Double spending – forking- Token, Coinbase (12)

ETHEREUM: Distributed applications (Dapps), Smart contracts, Ethereum Virtual Machines, Ethereum high level design, Ethereum addresses, Ethereum accounts, Transactions, Currency, Gas, Tokens, Decentralized autonomous organizations(DAOs), Bitcoin vs Ethereum – Trie- Solidity programming – writing smart contracts – remix IDE – TestNet- sample exercises - issues in solidity programming (12)

HYPERLEDGER: Fabric- Architecture, Identities and Policies, Membership and Access Control, Channels, Transaction Validation, Writing smart contract using Hyperledger Fabric. (5)

APPLICATIONS: Know Your Customer (KYC), Food Security, Mortgage over Blockchain, Blockchain enabled Trade, Cross border payments - AI applications - swarm learning (5)

Total L: 45

TEXT BOOKS:

1. Imran Bashir, 'Mastering Blockchain: Deeper insights into decentralization, cryptography, Bitcoin, and popular Blockchain frameworks', Packt Publishing Limited 2017.
2. Arvind Narayanan, Joseph Bonneau, Edward Felten, Andrew Miller, and Steven Goldfeder. 'Bitcoin and cryptocurrency technologies: a comprehensive introduction', Princeton University Press, 2016

REFERENCES:

1. Bina Ramamurthy, 'Block Chain in Action', Manning Publications, 1st edition, 2020
2. Josh Thompson, 'Blockchain: The Blockchain for Beginnings, Guild to Blockchain Technology and Blockchain Programming', Create Space Independent Publishing Platform, 2017.
3. S. Shukla, M. Dhawan, S. Sharma, S. Venkatesan, 'Blockchain Technology: Cryptocurrency and Applications', Oxford University Press, 2019.
4. Joseph Bonneau et al, SoK: Research perspectives and challenges for Bitcoin and cryptocurrency, IEEE Symposium on security and Privacy, 2015

19N005COMPILER DESIGN

3 0 0 3

INTRODUCTION TO COMPILERS: Translators - Compilation and Interpretation - The Phases of Compiler – Errors Encountered in Different Phases - The Grouping of Phases - Compiler Construction Tools - JIT. (7)

LEXICAL ANALYSIS: Need and Role of Lexical Analyzer - Input Buffering - Lexical Errors - Expressing Tokens by Regular Expression - Finite Automata: NFA- DFA - Converting NFA to DFA - Minimization of DFA- Converting Regular Expression to DFA. LEX Tool: Structure of LEX Program – Design of Lexical Analyzer for a Sample Language. (9)

SYNTAX ANALYSIS:Need and Role of the Parser - Context Free Grammars - Top-Down Parsing: Recursive Descent Parser - Predictive Parser. Bottom-Up Parsers: Shift Reduce Parser - LR Parser - LR (0) Item - Construction of SLR Parsing Table - CLR Parser - LALR Parser. Error Handling and Recovery in Syntax Analyzer – YACC Tool: Structure of YACC Program – Design of a Syntax Analyzer for a Sample Language. (10)

INTERMEDIATE CODE GENERATION: Benefits- Intermediate Languages - Generation of Three Address Code – Declarations - Assignment Statements - Arrays - Boolean Expressions - Backpatching - Flow of Control Statements – Procedure calls. (9)

RUN-TIME ENVIRONMENT, CODE OPTIMIZATION AND GENERATION:Source Language Issues – Storage Organization - Storage Allocation - Symbol Tables. Principal Sources of Optimization - Optimization of Basic Blocks - Global Optimization - Global Data Flow Analysis - Issues in Design of A Code Generator - A Simple Code Generator Algorithm. (10)

Total L: 45

TEXT BOOKS:

1. Alfred V Aho, Monica Lam, Ravi Sethi, Jeffrey D Ullman, "Compilers - Principles, Techniques and Tools", Essex Pearson, Harlow, 2014
2. V Raghavan, "Principles of Compiler Design", 2nd Edition, TMH, 2016

REFERENCES:

1. Dick Grone, Henri E Bal, Cerial J H Jacobs, Koen G Langendoen, "Modern Compiler Design", John Wiley & Sons, USA,2000.
2. O.G. Kakde, "Compiler Design", 5th Edition, An Imprint of Laxmi Publications Pvt. Ltd., 2015
3. Sudha Sadasivam G, "Compiler Design", Scitech Publications (India) Private Limited, Chennai, 2010.
4. Dhamdhare D M, "Compiler Construction Principles & Practice", Macmillan India Limited, New Delhi, 1997.

19N006COMPUTER VISION AND IMAGE PROCESSING

3 0 0 3

IMAGE REPRESENTATION: Digital images – Digital Image formats - Problems in digital image – 3D structure from 2D Images – Pixels and Neighborhoods – Applying masks to Images – Binary image morphology – Region properties – Region adjacency Graphs – Thresholding Grayscale image – Histograms for Threshold selection. (9)

IMAGE FILTERING AND ENHANCEMENT: Grey level mapping – Removal of small image regions – Image smoothing – Median filtering – Determining edges using differencing masks – Gaussian filtering and LOG edge detection – Canny edge detector – Mask and matched filters - Color: RGB basics for color – Color histogram – Color segmentation - Shading - Texture: Texels and Statistics – Texel based texture description - Texture segmentation.(9)

MOTION SEQUENCING AND IMAGE SEGMENTATION: Motion phenomena and applications – Image subtraction – Computing motion vectors – Computing paths of moving points – Detecting changes in video - Segmentation: Identifying regions – Representing regions – Identifying contours – Fitting models to segments – Segmentation using Motion Coherence. (9)

3D SENSING AND OBJECT COMPUTATION: Representation of 2D data – representation of Points – Affine mapping functions – Perceiving 3D from 2D images – Perspective imaging model – Depth perception from stereo – General stereo configuration – 3D affine transformation – camera model – Best affine calibration matrix – 3D object reconstruction. (9)

CASE STUDY: Veggie Vision: A system for checking out vegetables – Identification humans via the Iris of an Eye – Advanced Driver Assistance systems (ADAS) using multi sensors and cameras. (9)

Total L: 45

TEXT BOOKS:

1. Linda G. Shapiro, George C. Stockman, "Computer Vision" Pearson Prentice Hall, 2011
2. R. Szeliski, "Computer Vision: Algorithms and Applications", Springer, 2011.

REFERENCES:

1. E. R. Davies, "Computer & Machine Vision", 4th Edition, Academic Press, 2012.
2. Jan Erik Solem, "Programming Computer Vision with Python: Tools and algorithms for analyzing images", O'Reilly Media, 2012.
3. Mark Nixon, Alberto S. Aquado, "Feature Extraction & Image Processing for Computer Vision", 3rd Edition, Academic Press, 2012.
4. Simon J. D. Prince, "Computer Vision: Models, Learning, and Inference", Cambridge University Press, 2012.

19N007CLOUD COMPUTING

3 0 0 3

INTRODUCTION TO CLOUD COMPUTING: The Vision of Cloud Computing - Defining a Cloud - A Cloud Computing Reference Model - Characteristics and Benefits - Challenges Ahead - Historical Developments - Types of Clouds - Building Cloud Computing Environments - Computing Platforms and Technologies. (9)

VIRTUALIZATION: Introduction - Hypervisors - Main Categories of Virtualization: Full - Para - Application Server - Application - Network - Storage – Service - Benefits of Virtualization - Cost of Virtualization - Virtualization Drawbacks – Case Study: GCP - Creation of virtual machines- Google Kubernetes Engine (9)

CLOUD COMPUTING ARCHITECTURE AND SERVICE MANAGEMENT: Economics of the Cloud - Storage as a Service - Database as a Service - Information as a Service - Process as a Service - Application as a Service - Platform as a Service - Integration as a Service - Security as a Service - Management as a Service - Testing as a Service - Infrastructure as a Service (9)

CLOUD APPLICATIONS: Scientific Applications - Gene Expression Data Analysis for Cancer Diagnosis - Business and Consumer Applications - Social Networking - Media Applications. (9)

MACHINE LEARNING AND ARTIFICIAL INTELLIGENCE TASKS IN CLOUD: AI Platform - Case study: Train and deploy a TensorFlow model to AI Platform in GCP, Cloud Speech API – Case study: Create an API key - Create a Speech API request - Call the Speech API request, Reinforcement Learning - Case study: fundamental concepts of Reinforcement Learning in GCP. (9)

Total L: 45

TEXT BOOKS:

1. Rajkumar Buyya, Christian Vecchiola, Thamarai Selvi, "Mastering Cloud Computing", Tata McGraw Hill Education Private Limited, New Delhi, 2017.
2. Ted Hunter, Steven Porter, Legorie Rajan PS, "Building Google Cloud Platform Solutions: Develop scalable applications from scratch and make them globally available in almost any language", Packt Publishing Limited, ISBN: 1838647430, March 2019

REFERENCES:

1. Ekaba Bisong, "Building Machine Learning and Deep Learning Models on Google Cloud Platform", Apress, ISBN: 978-1-4842-4470-8, 2019.
2. KC Tung, "Learn TensorFlow Enterprise: Build, manage, and scale machine learning workloads seamlessly using Google's TensorFlow Enterprise", Packt Publishing, 2020.
3. Anand Deshpande, Manish Kumar, Vikram Chaudhari, "Hands-On Artificial Intelligence on Google Cloud Platform: Build intelligent applications powered by TensorFlow, Cloud AutoML, BigQuery, and Dialogflow", ISBN-13: 978-1789538465, Packt Publishing, 2020.
4. Diane Barrett and Gregory Kipper, "Virtualization and Forensics: A Digital Forensic Investigators Guide to Virtual Environment", Elsevier, USA, 2010.
5. David S Linthicum, "Cloud Computing and SOA Convergence in Your Enterprise", Pearson, USA, 2010.

19N008EVOLUTIONARY COMPUTING ALGORITHMS

3 0 0 3

INTRODUCTION: Challenges in Solving Complex Problems - Evolutionary algorithms: Principles, Historical development, Features, Classification and Components, Advantages, Applications. (8)

HEURISTIC SEARCH: Problem representation as search - Generate and Test - Breadth First Search - Depth First Search - Hill Climbing: Principles, Local and Global maxima, Ridges, Plateau - Steepest Ascent - Simulated annealing: Annealing schedule, Parameter Selection. (8)

GENETIC ALGORITHM: Biological Background - Simple Genetic Algorithm (SGA) - Representation types - Recombination Types - Mutation types - GA Algorithm - Schema Theorem - Variations of GA: Adaptive GA, Real Coded GA - Differential Evolution: Principles, Mutation, Crossover, Selection. (9)

SWARM INTELLIGENCE: Particle Swarm Optimization: Swarms, Operating principles, PSO Algorithm, Neighborhood Topologies - Variations of PSO: Binary, weighted - Ant Colony Optimization: Ant foraging behavior, Theoretical Considerations, ACO Algorithm, Variations of ACO: Elitist Ant System (EAS), MinMax Ant System (MMAS) and Rank Based Ant Colony System (RANKAS). (10)

MULTI-OBJECTIVE OPTIMIZATION AND MEMETIC ALGORITHMS: Multi-Objective Principles - Classical Methods - Challenges - Evolutionary algorithms for multi-objective optimization - Multimodal function optimization - Non-Dominated Sorting Genetic Algorithm (NSGA): Non-elitist, elitist - Controlled elitism in NSGA - Memetic Algorithms: Need - Template - Design Issues - Considerations for Discrete and Combinatorial Optimization problems. (10)

Total L: 45

TEXT BOOKS:

1. Eiben A E and Smith J E, "Introduction to Evolutionary Computing", Second edition, Springer, Heidelberg, 2015.
2. Rich E and Knight K, "Artificial Intelligence", Tata McGraw Hill Education Private Limited, India, 2011.

REFERENCES:

1. Deb K, "Multi-Objective Optimization Using Evolutionary Algorithms", Wiley-Blackwell, USA, 2008.
2. Kennedy J and EberhartRC, "Swarm Intelligence", Morgan Kaufmann Publishers, USA,2001.
3. Dorigo M and StutzleT, "Ant Colony optimization", Prentice Hall of India, New Delhi, 2005.
4. DeJong KA, "Evolutionary Computation: A Unified Approach", Prentice Hall of India, New Delhi, 2006.

19N009 GRAPH THEORY

3 0 0 3

INTRODUCTION: Review on Definition and Basic Terminologies of Graphs – Representations of Graphs – Walks in Graphs and Digraphs- Subgraphs-Vertex Degrees - Path and Cycles - Regular and Bipartite Graphs- Representations of graphs – adjacency and incidence lists – adjacency and incidence matrices -Graph Traversals-Applications: Four Cubes Problem- Social Networks. (9)

EULERIAN AND HAMILTONIAN GRAPHS: Exploring and Travelling – Eulerian Graphs – Konigsberg bridge problem - Hamiltonian Graphs – Applications: Dominoes – Chinese Postman Problem - Travelling salesman problem (8)

PATHS AND CONNECTIVITY: Connected Graphs and Digraphs-Menger's Theorem for Graphs-Applications: Reliable Telecommunication Networks. Network flows and applications- Flows and cuts in Networks, Maximum-flow problem, flows and connectivity– applications (10)

VERTEX-COLORING: Vertex-coloring - chromatic number of a graph, vertex coloring algorithms – sequential vertex coloring, largest degree first algorithm, applications - scheduling problem, fast register allocation for computer programming. (10)

MATCHING AND FACTORS: Matching, Perfect matching, Tutte's 1-factor theorem, weighted Bipartite matching, Hall's theorem. (8)

Total L: 45

TEXTBOOKS:

1. Jonathan L. Gross and Jay Yellen, Graph Theory and its Applications, CRC Press, New York, 2016.
2. Douglas B West, Graph Theory, Prentice Hall, New Delhi, 2017.

REFERENCES:

1. Bondy J.A. and Murty U.S.R., Graph Theory, Springer, London, 2016.
2. Narsingh Deo, Graph Theory with Applications to Engineering And Computer Science, Prentice Hall, New Delhi 2017.
3. Joan M Aldous and Robin J Wilson, "Graphs and Applications- An Introductory Approach, Springer-Verlag", New York, 2014.
4. Reinhard Diestel," Graph Theory", Springer-Verlag, Berlin Heidelberg, 2012.
5. Willian Kocay, Donald L. Kreher, Graphs, Algorithms, and Optimization, CRC Press, 2013.

19N010HUMAN COMPUTER INTERACTION

3 0 0 3

HCI FOUNDATION: The Human - The Computer - The Interaction - Paradigms for Interaction. (8)

USABILITY ENGINEERING: Definition - UI Generations - Evaluation - Lifecycle - Classification of Users - Prototyping - Usability Testing Stages. (9)

GUIDELINES IN HCI: Principles to Support Usability - HCI Golden Rules - Shneiderman's Eight Golden Rules - Norman's Model of Interaction. (8)

DESIGN PROCESS: UI Design Process - Task Oriented Design - Object Oriented Design - CSCW UI Design - Case Studies. (10)

WEB AND MOBILE UI>: Principles for Web and Mobile UI - Web UI Patterns - Mobile User Characteristics - Mobile Devices: Taxonomy - Anatomy - Mobile Design Principles - Mobile UI Design Patterns. (10)

Total L :45

TEXT BOOKS:

1. Dix A, Finlay J, Abowd G D and Beale R, "Human Computer Interaction", Third Edition, Pearson Education, USA, 2018.
2. Linda McAulay, "HCI for Software Designers", International Thompson Computer Press, USA, 2005.

REFERENCES:

1. NPTEL, "HCI", <http://www.nptel.ac.in/syllabus/106103115/>
2. Bill Scott and Theresa Neil, "Designing Web Interfaces", O'Reilly, 2011
3. Barbara Ballaer, "Designing the Mobile User Experience", Wiley, USA, 2015.
4. Ben Shneiderman, Catherine Plaisant, Maxine Cohen and Steven Jacobs, "Designing the User Interface: Strategies for effective HCI", Pearson, USA, 2015.

19N011 INFORMATION RETRIEVAL

3 0 0 3

INTRODUCTION: Boolean retrieval - IR problem - Inverted index - Processing Boolean queries - Extended Boolean model and ranked retrieval - Document delineation - Determining vocabulary of terms - Skip pointers – Search structures for dictionaries - Wildcard queries - Spelling and phonetic correction (9)

INDEX CONSTRUCTION: Blocked sort-based indexing - Single-pass in-memory indexing - Distributed indexing - Dynamic indexing - Statistical properties of terms in IR - Dictionary compression - Postings file compression (9)

VECTOR SPACE MODEL AND EVALUATION: Term frequency and weighting - Vector space model - Queries as vectors - Computing vector scores - IR system evaluation - Standard text collections - Evaluation of unranked and ranked retrieval sets (9)

PROBABILISTIC AND LANGUAGE MODELS: Probability ranking principle - Binary independence model - Appraisal of probabilistic models - Language models - Query likelihood models - Merits and demerits of language models (9)

WEB SEARCH: Web characteristics - Search user experience - Index size and estimation - Near-duplicates and shingling - Web crawler features and architecture - URL frontier - Link analysis - Web as a graph - PageRank algorithm - Hubs and authorities (9)

Total L: 45

TEXT BOOKS:

1. Manning C, Raghavan P, Schütze H, "Introduction to Information Retrieval", Cambridge University Press, New Delhi, 2008.
2. Ricardo Baeza-Yates, Berthier Ribeiro-Neto, "Modern Information Retrieval: The Concepts and Technology behind Search", Addison Wesley, USA, 2011.

REFERENCES:

1. Bruce Croft W, Metzler D, Strohman T, "Search Engines: Information Retrieval in Practice", Addison Wesley, USA, 2009.
2. Gerald K, "Information Retrieval Architecture and Algorithms", Springer, Heidelberg, 2013.
3. Stefan Büttcher, Charles L. A. Clarke, Gordon V. Cormack, "Information Retrieval: Implementing and Evaluating Search Engines", MIT Press, Cambridge, USA, 2016.
4. Hang Li, "Learning to Rank for Information Retrieval and Natural Language Processing", 2nd Edition, Morgan & Claypool Publishers, USA, 2014.

19N012 NETWORK DATA ANALYTICS

3 0 0 3

GRAPH THEORY IN NETWORK ANALYSIS: Representing Networks - Graphs and Networks - Paths and Cycles - Components and Connected sub graphs - Neighborhood - Degree and Network Density - Eigenvectors and Eigen values - Degree Distributions - Cliquishness, Cohesiveness, and Clustering – Centrality (7)

NETWORK MODELS AND LINK ANALYSIS: The Small-World Phenomenon: Six Degrees of Separation - Decentralized Search - Power Laws - Rich-Get-Richer Models - The Long Tail - The Problem of Ranking - Link Analysis Using Hubs and Authorities – PageRank (8)

COMMUNITY DETECTION IN SOCIAL NETWORK: Triadic Closure - The Strength of Weak Ties - Homophily - Affiliation - Betweenness Measures and Graph Partitioning- Communities and Blocks - Methods for Identifying

Community Structures - Stochastic Block Models and Communities - Maximum-Likelihood Estimation of Communities (10)

GAME THEORY IN NETWORK ANALYSIS: Introduction to game theory - Best Responses and Dominant Strategies - Nash Equilibrium - Multiple Equilibria: Coordination Games (10)

ECONOMIC NETWORK ANALYSIS: Auctions: Types of Auctions - Second-Price Auctions - Matching Markets: Bipartite Graphs and Perfect Matching - Sponsored Search Markets: Advertising Tied to Search Behavior - Advertising as a Matching Market – The VCG principle - Equilibria of the Generalized Second-Price Auction (10)

Total L: 45

TEXT BOOKS:

1. David Easley, Jon Kleinberg, "Networks, Crowds and Markets", Cambridge University Press, 2016.
2. Matthew O. Jackson, "Social and Economic Networks", Princeton University Press, 2015.

REFERENCES:

1. Jure Leskovec, Anand Rajaraman, Jeff Ullman, "Mining of Massive Datasets", Cambridge University Press, 2014.
2. Charu C Agarwal, "Social Networks Data Analytics", Springer, USA, 2011.
3. John Scott, Peter J. Carrington, "Sage Handbook of Social Network Analysis", SAGE Publications, 2011
4. Valente, Thomas, "Social Networks and Health: Models, Methods and Applications. New York: Oxford University Press, 2010
5. Guandong Xu and Lin Li, "Social Media Mining and Social Network Analysis: Emerging Research "IGI Global,2013.

19N013RANDOMIZED ALGORITHMS

3 0 0 3

RANDOMIZED AND PROBABILISTIC METHODS: Randomized algorithms, Karger's mincut algorithm, Las Vegas and Monte Carlo algorithms, Computational models and Complexity classes. **PROBABILISTIC METHODS:** overview - maximum satisfiability - finding a large cut -Expander Graphs (12)

DEVIATION AND INEQUALITIES: Occupancy problem, Markov and Chebyshev inequalities - randomized selection - coupon collector's problem, the Chernoff bound, routing in a parallel computer - a wiring problem (10)

MARKOV CHAINS AND RANDOM WALKS: Markov Chains: Definition, Markov Chains with two states, transition probabilities, transition matrix, ChapmanKolmogorov equations, time - homogeneous chains, initial distribution, branching processes. Random walk on graphs - connectivity in undirected graphs - Expanders and Rapidly mixing random walks. (9)

APPLICATIONS: Data Structure and Graph Algorithms : Random Treaps, Primality Testing, Skip Lists - Hash tables - Fast mincut. Parallel and Distributed Algorithms: Sorting on a PRAM - Maximal Independent sets (9)

DERANDOMIZATION: The method of Conditional Probabilities - Derandomizing maxcut algorithm - Constructing pairwise independent values modulo a prime - Pairwise independent - large cut (5)

Total L: 45

TEXTBOOKS:

1. Rajeev Motwani and prabhakar Raghavan, "Randomized Algorithms", Cambridge University Press, Cambridge, 2014.
2. Micheal Mitzenmacher and Eli Upfal, "Probability & Computing: Randomization and Probabilistic Techniques in Algorithms and Data Analysis", Cambridge University Press, Cambridge, 2017.

REFERENCES:

1. Mark Allen Weiss, "Data Structures and Algorithm Analysis in C", 2nd Edition, Pearson Education, 2014.
2. Thomas H Cormen, Charles E Leiserson and Ronald L Rivest, "Introduction to Algorithms", MIT Press, Cambridge, 2018.
3. Jon Kleinberg and Eve Tardos, "Algorithm Design", Pearson Education, 2014.
4. Noga Alon, Joel H Spencer, "The Probabilistic Method", 4th Edition, Wiley-Interscience, 2016.

19N014RECOMMENDER SYSTEMS

3 0 0 3

INTRODUCTION:Recommender system functions- Understanding user ratings - Applications of recommendation systems- Issues with recommender systems – Recommender Systems as a Multi-Disciplinary Field. (9)

RECOMMENDATION TECHNIQUES:Collaborative Filtering: User-based nearest neighbor recommendation, Item-based nearest neighbor recommendation, Model Based Techniques- Content-based recommendation - Knowledge based recommendation: Knowledge representation and reasoning – Overspecialization. (10)

HYBRID RECOMMENDATION SYSTEM:Opportunities for hybridization- Monolithic hybridization design- Parallelized hybridization design- Pipelined hybridization design. (10)

EVALUATING RECOMMENDER SYSTEMS:General Properties of evaluation – evaluation design – Evaluation on historical dataset – Alternate evaluation designs. (8)

SECURITY ISSUES IN RECOMMENDER SYSTEMS:Attack dimensions – Attack types – Evaluation of effectiveness and countermeasures – Privacy aspects – Case study: Personalized recommendations on the mobile internet.(8)

Total L:45

TEXTBOOKS:

1. Jannach D., Zanker M. and FelFering A., Recommender Systems: An Introduction, Cambridge University Press, 2011, First Edition.

REFERENCES:

1. Ricci F., Rokach L., Shapira D., Kantor B.P., Recommender Systems Handbook, Springer, 2011, First Edition.
2. Manouselis N., Drachsler H., Verbert K., Duval E., Recommender Systems For Learning, Springer, 2013, First Edition.

19N015 SEMANTIC WEB TECHNOLOGY

3 0 0 3

SEMANTIC WEB VISION AND STRUCTURED WEB DOCUMENTS: Introduction to Semantic web - Evolution of web Semantic Web Technologies - Recommended Layered Architectures. Structured web documents- The XML Language: Structuring - Namespaces - Addressing and Querying XML Documents - Processing. (9)

DESCRIBING WEB RESOURCES: Introduction - RDF: Basic Ideas - `-Based Syntax. RDF Schema: Basic Ideas - RDF and RDF Schema in RDF Schema - An Axiomatic Semantics for RDF and RDF Schema – Querying in SPARQL (9)

ONTOLOGY ENGINEERING AND OWL: Introduction - Constructing Ontologies Manually - Reusing Existing Ontologies - Using Semi-automatic Methods - On-to-Knowledge Semantic Web Architecture –OWL Language – Ontology Examples- OWL In OWL - Future Extensions. (9)

LOGIC AND INFERENCE: Rules - Monotonic Rules: Syntax - Semantics - Representing Family Relationships. Non monotonic Rules: Syntax - Brokered Trade as an Example - Monotonic and Non monotonic Rule Markup. (9)

TOOLS AND APPLICATIONS: Development tools for semantic web- Jena Framework- Semantic Wikis-Semantic web service, Horizontal Information Products at Elsevier - Data Integration at Audi - Skill Finding at Swiss Life. (9)

Total L: 45

TEXT BOOKS:

1. Grigoris Antoniou, Frank vanHarmelen, "Semantic Web Primer", MIT press, USA, 2008.
2. Michael C Daconta, Leo J Obrst, Kevin T Smit, "The Semantic Web: A Guide to the Future of XML, Web Services, and Knowledge Management", Wiley, USA, 2003.

REFERENCES:

1. Pascal Hitzler, Markus Krotzsch, Sebastian Rudolph, "Foundations of Semantic Web Technologies", CRC Press, 2009.
2. John Hebel, Matthew Fisher, Ryan Blace, Andrew Perez-Lopez, "Semantic Web Programming", 1st Edition, Wiley, 2009.
3. Liyang Yu, "A Developer's Guide to the Semantic Web", First, Springer, 2011.
4. Ducharme B, "Learning SPARQL", 1st Edition, O'Reilly Media, 2011.

OPEN ELECTIVES

19N001DESIGN THINKING

3 0 0 3

INTRODUCTION: Design thinking overview - Design Process – Principles of Design Thinking – Problems Best suited for Design Thinking – Visualization tool. **Case Study:** Problem Identification in AI (9)

EMPATHIZE:Information Gathering – Analysis – Storytelling tool- Innovation- Ideation Finding and Evaluating Ideas – Mind Mapping Tool. **Case Study:** Analysing the Identified Problem. (9)

DESIGNING PROTOTYPES: Tasks in Prototyping – Understanding Different Prototypes - Developing different prototypes – Demonstration – Prototyping Tools. **Case Study:** Prototyping the solution. (9)

TESTING AND EVALUATION: Testing Prototypes – Evaluation – Improving solution – Strategic Opportunities. **Case Study:** Evaluating the solution. (9)

APPLICATIONS: Artificial Intelligent Application - HealthCare and Science – Education- Transportation - Finance – Technology (9)

Total L: 45

TEXT BOOKS:

1. Andrew Pressman "Design Thinking A Guide to Creative Problem Solving for Everyone", Routledge Publication, 2019.
2. Muller-Roterberg "Design thinking for dummies" John Wiley & Sons,2020.

REFERENCES:

1. Alyssa Gallagher and Kami Thordarson, "Design Thinking in Play: An Action Guide for Educators", ASCD Book, 2020
2. Robert Curedale, "Design Thinking Process & Methods" Design Community College, 5th Edition, 2019.
3. Brown.T, "Change by design: How design thinking transforms organizations and inspires innovation", HarperCollins,2009.
4. Harvard Business Review. "Better brainstorming" <https://hbr.org/2018/03/better-brainstorming>

19NO02 ETHICS OF ARTIFICIAL INTELLIGENCE

3 0 0 3

INTRODUCTION TO ETHICS OF AI: Overview of Narrow AI, General AI and Responsible AI - Laws and Regulation- Ethics of the Ethics of AI- Ethical Issues and relationship with artificial entities- Exploring the Ethical Considerations in Indian context. **Frameworks and Modes:** AI Governance by Human rights- Incompatible incentives of private sector AI - Normative Modes: Codes and Standards- Professional Norms in the Governance of AI -Legal and Regulatory Approaches for Managing AI Systems in India (9)

CONCEPTS AND ISSUES: Justice in Artificial Intelligence: Limits, Failings, and Ethics of Fairness - Accountability in computer Systems- Transparency-Responsibility and AI- Ethical Analysis and design- The future of work in the age of AI- Sentiment AIs - Autonomy –Algorithmic Governance and Law. (9)

PERSPECTIVES AND APPROACHES: Perspectives and Approaches of computer science- Social Failure modes in technology - Human centred Approach to AI Ethics: perspective from Cognitive science - Integrating ethical and economic values- Fairness through the lens of Directed Acyclic Graphs: a Statistical Modelling Perspective- Designing for other worlds- Perspectives and Approaches AI in ethics: East Asia – Middle East- Policy framework for trustworthy AI. (9)

ADDRESSING ETHICAL ISSUE IN AI: Ethical theories - purpose of AI- Ethical principles of AI –Options at the policy and organisational levels- guidance mechanisms –AI ethics stakeholders -Principles for Responsible Management of AI Systems in India (9)

NEAR FUTURE OF AI: Mass Unemployment- autonomous Weapons – Ethical Matrix –Ethics of Artificial Lover-Long term impact of super intelligence: Alignment of advanced machine learning systems- moral machines-Designing AI with Rights, Consciousness, Self-Respect, and Freedom. Applications: Transport, Defence, Healthcare, Law, Education, Robot Teaching, Social organization of work, Smart City. (9)

Total L: 45

TEXTBOOKS

1. Markus D. Dubber, Frank Pasquale, Sunit Das, The Oxford Handbook of Ethics of AI, Oxford University Press, USA, 2020
2. Bernd Carsten Stahl, Artificial intelligence for a better future: An Ecosystem Perspective on the ethics of AI and Emerging digital Technologies, Springer, UK, 2021.

REFERENCES

1. S. Matthew Liao, Ethics of Artificial Intelligence, Oxford University Press, USA, 2020.
2. Virginia Dignum, Responsible Artificial Intelligence, Springer, Switzerland, 2019.
3. Steven John Thompson, Machine Law, Ethics, and Morality in the Age of Artificial Intelligence, IGI Global, USA 2021.
4. Christoph Bartneck, Christoph Lütge, Alan Wagner, Sean Welsh, An Introduction to Ethics in Robotics and AI, Springer, Switzerland 2021.
5. Niti Aayog, "Responsible AI", Govt of India, 2021.

19NO03 INTELLECTUAL PROPERTY RIGHTS

3 0 0 3

PATENTABLE INVENTIONS: What are inventions? Why people invent —how to pitch an invention –Commercial implications of patent protecting an invention Introduction To Patents - Requirements For Patentability – Novelty, Inventive step, Industrial Application - Types of Patent Applications - Provisional And Complete Specification - Structure of Provisional And Complete Specifications - Sections And Rules of the Indian Patent Act – Non patentable Inventions (7)

TYPES OF INTELLECTUAL PROPERTY: Patents, Trademarks, Copyrights, Industrial Designs, Geographical Indication (GI), Trade Secrets, Integrated Circuit Layout Designs (SICLDR) - Process of patenting and development: Technological research, innovation, patenting, international cooperation on intellectual property, procedure for grants of patents, patenting under PCT. (8)

PATENTABILITY SEARCHING: What is patentability search – Patent information and databases- outcome of search – Limitations of patentability search – Patent search report - Practical Exercises: Prior art Searching and Reporting using open source and commercial tools – Disclosing an Invention- Comparing inventions with their closest prior arts (9)

PATENT DRAFTING: Title of the invention - Field of the invention - Background art - Objects of the invention - Patent citations and prior art in the background of the invention- Patent of addition - Divisional application - Introduction to claims - Types of claims - Significance and scope of claims Structure of claims - Drafting and interpretation of claims (12)

DEVELOPMENTS IN IPR: Scope of patent rights, licensing and transfer of technology, New developments in IPR: Administration of patent system, IPR of computer software Practical Exercise: How to draft a provision specification of your own inventive ideas? (9)

Total L: 45

TEXT BOOKS:

1. Robert P. Merges, Peter S. Menell, Mark A. Lemley, "Intellectual Property in New Technological Age", 2016.
2. Patent IPR Licensing- Technology Commercialization – Innovation Marketing: Guide Book for Researchers, Innovators, Indian Innovators Association, 2017.

REFERENCES:

1. NPTEL Online course on Patent Drafting, <https://nptel.ac.in/courses/109/106/109106128>
2. Halbert, "Resisting Intellectual Property", Taylor & Francis Ltd, 2007.
3. Mayall, "Industrial Design", McGraw Hill, 1992.
4. Niebel, "Product Design", McGraw Hill, 1974.