राजीव गाँधी राष्ट्रीय विमानन विश्वविद्यालय

Rajiv Gandhi National Aviation University, Amethi

B.Tech. in Artificial Intelligence and Data Science (Aviation Systems)
Course Code: BS101
Course Title: Mathematics I (Applied Linear Algebra and Calculus)
L–T–P–C: 3–1–0–4
Year: First Year
Semester: I

Course Contents

1. Applied Linear Algebra: Vector spaces, subspaces, spanning set, linear independence, basis and dimension. Linear transformations, range and null space, rank-nullity theorem, matrix of a linear transformation. Matrix Algebra: Elementary operations and their use in getting the rank, inverse of a matrix and solution of linear simultaneous equations, Orthogonal, symmetric, skew-symmetric, Hermitian, skew-Hermitian, normal and unitary matrices and their elementary properties, Eigenvalues and Eigenvectors of a matrix, Cayley-Hamilton theorem, Diagonalization of a matrix, Jordan canonical form. Inner product spaces: Inner products, orthogonality, Gram-Schimdt orthogonalization. Quadratic forms. Singular value decompositions.

2. Calculus: Limit and continuity of one variable function. Limit, continuity and differentiability of functions of two variables, Tangent plane and normal, Change of variables, chain rule, Jacobians, Taylor's Theorem for two variables, Extrema of functions of two or more variables, Lagrange's method of undetermined multipliers. Riemann integral for one variable functions, Double and Triple integrals, Change of order of integration. Change of variables, Applications of Multiple integrals such as surface area and volume.

Text /Reference Books:

Textbooks:

1. Thomas, G. B., Hass, J., Heil, C. and Weir M. D., "Thomas' Calculus", 14th Ed., Pearson Education, 2018
2. Kreyszig, E., "Advanced Engineering Mathematics", 10th Ed., Wiley India Pvt. Ltd, 2015

Reference Books:

1. Jain, R. K. and Iyenger, S. R. K., "Advanced Engineering Mathematics", 5th Ed., Narosa Publishing House, 2017
2. Axler, S., "Linear Algebra Done Right", 3rd Ed., Springer Nature, 2015
3. Strang, G., "Linear Algebra and Its Applications" 4th Ed., Cengage India Private Limited, 2005

राजीव गाँधी राष्ट्रीय विमानन विश्वविद्यालय

Rajiv Gandhi National Aviation University (RGNAU)

B.Tech. in Artificial Intelligence and Data Science (Aviation Systems)
Course Code: BS102
Course Title: Physics for Avionics
L–T–P–C: 3–0–2–4
Year: First Year
Semester: I

Course Contents

1. Gradient,Divergence,Curl and Laplacian, Line,Surface and Volume in integrals,Gauss-divergence and Stokes theorems, Spherical/polar and Cylindrical coordinate systems.
2. Electrostatics: Electric field and Gauss's law, Electrostatic potential,Multipole expansion, Electrostatic energy, Conductors,Uniqueness theorem, Laplace's solution, Image method, Electrostatic boundary conditions, Electrostatic Fields in matter, Capacitors.
3. Magnetostatics: Lorentz force law, Continuity equation, The Biot- Savart's law, Ampere's law, Magnetic vector potential, Magnetism in materials, Magnetostatic boundary conditions.
4. Electrodynamics:Electromotive force,Faraday's law and Lenz's law, Inductance,Displacement current, Maxwell's equations, Electromagnetic (EM) waves in vacuum and media.

Text /Reference Books:

1. D. J. Griffiths, Introduction to Electrodynamics, 3rd Edition, PHI Learning, 2009.
2. J. R. Reitz, F. J. Milford, R.W. Christy: Foundations of Electromagnetic Theory, 4th Edition, Pearson Addison Wesley, 2009.
3. A. Mahajan, A. Rangwala, Electricity and Magnetism, 1st Edition, Tata McGraw Hill, 1988.
4. E. M. Purcell, Berkeley Physics Course, Electricity and Magnetism, Volume 2, 2nd Edition, Tata McGraw Hill, 2007.
5. R. P. Feynman, R.B. Leighton, and M. Sands, The Feynman Lectures on Physics -Vol II, Narosa Publishing House, 2010

राजीव गाँधी राष्ट्रीय विमानन विश्वविद्यालय

Rajiv Gandhi National Aviation University, Amethi

B.Tech. in Artificial Intelligence and Data Science (Aviation Systems)
Course Code: PC101
Course Title: Computer Programming
L–T–P–C: 3–0–2–4
Year: First Year
Semester: I

Course Contents

1.**Introduction to Programming and Python:** Introduction to computers and programming, Algorithm and flowchart concepts, Overview of programming languages, Features of Python, Installation and environment setup, Python interpreter and IDEs (IDLE, VS Code, Jupyter Notebook), Writing and executing first Python program

2.**Python Basics and Data Types:** Tokens, identifiers, and keywords, Variables and assignment, Input and output statements, Built-in data types: int, float, complex, bool, string, Type conversion, Operators and expressions, Comments and documentation

3.Control Structures: Conditional statements: if, if-else, if-elif-else, Nested conditions, Looping: for, while, break, continue, pass, Pattern generation, Introduction to basic algorithmic problems

4.Data Structures in Python: Strings and string operations, Lists: creation, indexing, slicing, methods, Tuples and sets, Dictionaries , Applications in data handling, Introduction to NumPy arrays (basic operations)

5.Functions and Modular Programming: Built-in and user-defined functions, Function arguments and return values, Lambda functions, Recursion, Modules and packages, Code reusability

6.File Handling and Exception Management: File operations: open, read, write, append, close, Working with CSV and text files, Introduction to JSON, Exception handling: try, except, else, finally, Custom exceptions

7.**Introduction to Data Analysis and Visualization:** Basics of Pandas, DataFrames and Series, Data loading and cleaning, Basic statistical operations, Introduction to Matplotlib, Simple plots for aviation-related data

Text /Reference Books:

1. John V Guttag, Introduction to Computation and Programming Using Python, 2 Edition, Prentice Hall India & MIT Press, 2014.

2. Mark Lutz. Learning Python: Powerful Object-Oriented Programming: 5th Edition, OReilly/SPD, 2013

Web resources:

1. https://docs.python.org/3/ Python 3.6 online documentation.
2. https://docs.python.org/3/tutorial/index.html Python online tutorial.
3. https://docs.python.org/3/tutorial/index.html Python online tutorial.

राजीव गाँधी राष्ट्रीय विमानन विश्वविद्यालय

Rajiv Gandhi National Aviation University (RGNAU)

B.Tech. in Artificial Intelligence and Data Science (Aviation Systems)

Course Code: HS101
Course Title: Professional Communication
L–T–P–C: 3–0–0–3
Year: First Year
Semester: I

Course Contents

Objectives: Content Functional English: conversation skills – asking questions, requests, doubts, engage in conversation – different types of communication-verbal and non-verbal, body language. Teaching Grammar: grammar games, exercise. Teaching Vocabulary: Language games, exercise. Reading and appreciating stories, poems, essays – listening and appreciating video lectures – comprehensive questions and answers.

Lab: Presentation skills – appreciation of videos, songs – role plays – debates – extemporizes – group presentations – introduction to technical writing – technical writing, how to write minutes, report, and project proposal

Text /Reference Books:

1. Garner, A., Conversationally Speaking: Tested New Ways to Increase Your Personal and Social Effectiveness, McGraw-Hill (1997).

2. Bechtle, M., Confident Conversation: How to Communicate Successfully in Any Situation, Revell (2008). 3. Brown, S. and Smith, D., Active Listening with Speaking, Cambridge Univ. Press (2007).

राजीव गाँधी राष्ट्रीय विमानन विश्वविद्यालय

Rajiv Gandhi National Aviation University (RGNAU)

B.Tech. in Artificial Intelligence and Data Science (Aviation Systems)

Course Code: ES102
Course Title: Engineering Drawing and Workshop
L–T–P–C: 0–0–3–2
Year: First Year
Semester: I

Course Contents

Module 1: Introduction to Engineering Drawing Principles of Engineering Graphics and their significance, usage of Drawing instruments, lettering, Conic sections including the Rectangular Hyperbola (General method only); Cycloid, Epicycloid, Hypocycloid and Involute; Scales – Plain, Diagonal and Vernier Scales;

Module 2: Orthographic Projections Principles of Orthographic Projections-Conventions - Projections of Points and lines inclined to both planes; Projections of planes inclined Planes - Auxiliary Planes;

Module 3: Projections of Regular Solids Covering those inclined to both the Planes- Auxiliary Views; Draw simple annotation, dimensioning and scale. Floor plans that include: windows, doors, and fixtures such as WC, bath, sink, shower, etc.

Module 4: Sections and Sectional Views of Right Angular Solids Prism, Cylinder, Pyramid, Cone – Auxiliary Views; Development of surfaces of Right Regular Solids - Prism, Pyramid, Cylinder and Cone; Draw the sectional orthographic views of geometrical solids, objects from industry and dwellings (foundation to slab only).

Module 5: Isometric Projections Principles of Isometric projection – Isometric Scale, Isometric Views, Conventions; Isometric Views of lines, Planes, Simple and compound Solids; Conversion of Isometric Views to Orthographic Views and Vice-versa, Conventions; 42 AICTE Model Curriculum for UG Degree Course in Computer Science and Engineering (Artificial Intelligence and Data Science (AI&DS))

Module 6: Overview of Computer Graphics Listing the computer technologies that impact on graphical communication, Demonstrating knowledge of the theory of CAD software [such as: The Menu System, Toolbars (Standard, Object Properties, Draw, Modify and Dimension), Drawing Area (Background, Crosshairs, Coordinate System), Dialog boxes and windows, Shortcut menus (Button Bars), The Command Line (where applicable), The Status Bar, Different methods of zoom as used in CAD, Select and erase objects.; Isometric Views of lines, Planes, Simple and compound Solids];

Module 7: Customisation & CAD Drawing Consisting of set up of the drawing page and the printer,

including scale settings, Setting up of units and drawing limits; ISO and ANSI standards for coordinate dimensioning and tolerancing; Orthographic constraints, Snap to objects manually and automatically; Producing drawings by using various coordinate input entry methods to draw straight lines, Applying various ways of drawing circles;

Module 8: Dimensioning, annotations, and text styles, Layer creation, management, and customization, Editing and modification of drawings, Printing and plotting, CAD modeling of parts and assemblies, Wireframe, surface, and solid modeling (parametric and non-parametric), 2D documentation from 3D models, Planar projection theory and spatial visualization exercises.

Textbooks / References

1. Bhatt N.D., Panchal V.M. & Ingle P.R., (2014), Engineering Drawing, Charotar Publishing House.
2. Jain Pradeep, (2019) Engineering Graphics and Design, Khanna Book Publishing Company
3. Shah, M.B. & Rana B.C. (2008), Engineering Drawing and Computer Graphics, Pearson Education.
4. Agrawal B. & Agrawal C. M. (2012), Engineering Graphics, TMH Publication
5. Narayana, K.L. & P Kannaiah (2008), Text book on Engineering Drawing, Scitech Publishers.

राजीव गाँधी राष्ट्रीय विमानन विश्वविद्यालय

Rajiv Gandhi National Aviation University, Amethi

B.Tech. in Artificial Intelligence and Data Science (Aviation Systems)

Course Code: ES101

Course Title: Basic Electrical and Electronics Engineering

L–T–P–C: 3–0–2–4

Year: First Year

Semester: I

Course Contents

1. **Elements of Electrical Circuits:** Resistance (R), Inductance (L), Capacitance (C); voltage and current sources (independent and dependent/controlled sources). DC circuits, Kirchhoff's Current Law (KCL), Kirchhoff's Voltage Law (KVL), network theorems, mesh and nodal analysis.

2. **Fundamentals of AC Power Systems:** Introduction to alternating current, basic concepts of AC circuits, behavior of resistor, capacitor, and inductor in AC circuits, reactance and impedance, sinusoidal steady-state analysis, and power in AC circuits.

3. **Electrical Machines:** Basic concepts of transformers and rotating electrical machines.

4. **Electronic Devices:** P–N junction diode characteristics, diode circuits (clippers and clampers), applications in rectifiers and power supplies. Bipolar Junction Transistor (BJT): characteristics, DC and AC analysis, common emitter and common collector configurations, applications of BJT as amplifiers and switches.

5. **Operational Amplifiers:** Introduction to operational amplifiers, characteristics and specifications, and applications to various circuits.

Textbooks / References

1. R. J. Smith and R. C. Dorf, Circuits, Devices and Systems, Wiley, 5th Edition, 1992.
2. E. Hughes, Electrical Technology, Pearson, 7th Edition.
3. Bobrow, Fundamentals of Electrical Engineering, Oxford University Press.
4. W. H. Hayt, J. E. Kemmerly, and S. M. Durbin, Engineering Circuit Analysis, 6th Edition, Tata McGraw-Hill, 2006.
5. R. Prasad, Fundamentals of Electrical Engineering, PHI Learning, 3rd Edition, 2014.
6. R. L. Boylestad and L. Nashelsky, Electronic Devices and Circuit Theory, Pearson Education.
7. Vincent Del Toro, Electrical Engineering Fundamentals, Pearson Education.
8. A. E. Fitzgerald, D. E. Higginbotham, and A. Grabel, Basic Electrical Engineering, Tata McGraw-Hill.
9. E. Hughes, Electrical and Electronic Technology, Pearson Education.
10. C. K. Alexander and M. N. O. Sadiku, Electric Circuits.

11. A. E. Fitzgerald, C. Kingsley, and S. Umans, Electric Machinery, Tata McGraw-Hill.
12. M. G. Say, Performance and Design of AC Machines.

राजीव गाँधी राष्ट्रीय विमानन विश्वविद्यालय

Rajiv Gandhi National Aviation University, Amethi

B.Tech. in Artificial Intelligence and Data Science (Aviation Systems)
Course Code: BS201
Course Title: Mathematics II (Probability and Statistics)
L–T–P–C: 3–1–0–4
Year: First Year
Semester: II

Course Contents

1. Random experiments, Sample space, Axiomatic definition of probability, Conditional probability, Total probability theorem, Bayes' theorem, Independent events

2. Random variable (discrete and continuous), Cumulative Distribution function (CDF) of a random variable, Symmetric Random variable, Probability mass function, Probability density function, Mathematical expectation and moments. Percentiles, Skewness, Kurtosis.

3. Generating function: probability generating function, and moment generating function, characteristic function. Moment inequalities (Markov and Chebyshev, Jensen) and their applications.

4. Some special univaraite distributions: discrete and continuous. Joint CDF. Joint, marginal and conditional PMF and PDF, Independence of random variables, Joint and conditional moments, Covariance and Correlation. Distribution of functions of random variables, Jacobian method for distribution of functions of random variables. Bivariate normal distribution. Convergence in distribution, Convergence in probability, Weak law of large numbers and Central limit theorem.

5. Random sample, Sampling Distributions: χ^2, t-, and F-Distributions. Sample moments ($\bar{X}, S^2$) and their distributions. Methods of estimation: Method of moments, method of maximum likelihood.

6. Confidence intervals for the parameters of univariate normal and two independent normal distributions. Null and alternative hypotheses (simple and composite), Hypothesis tests, Type-I and Type-II errors. Critical region. Level of significance, power of a test. Goodness of fit (χ^2 test).

Text /Reference Books:

Textbooks:

1. Rohatgi, V. K., & Saleh, A. M. E.. An introduction to probability and statistics. John Wiley & Sons.
2. Ross, S. M.. Introduction to probability and statistics for engineers and scientists. Academic press.

3. Montgomery, D. C., & Runger, G. C.. Applied statistics and probability for engineers. John wiley & sons.

Reference books:-

1. An Introduction to Probability and Statistics by V.K. Rohatgi and A.K. Md. E. Saleh
2. Probability and Statistical Inference by Hogg, R.V., Tanis, E.A. and Zimmerman D. L.
3. Probability and Statistics in Engineering by W.W. Hines, D.C. Montgomery, D.M. Goldsman, C.M. Borror

राजीव गाँधी राष्ट्रीय विमानन विश्वविद्यालय

Rajiv Gandhi National Aviation University (RGNAU)

B.Tech. in Artificial Intelligence and Data Science (Aviation Systems)

Course Code: PC201
Course Title: Data Structures and Algorithm
L–T–P–C: 3–0–2–4
Year: First Year
Semester: II

Course Contents

1. Introduction and Algorithm Analysis: Definition and characteristics of algorithms, Problem solving approaches, Algorithm design steps, Time and space complexity, Asymptotic notations, Best, average, and worst case analysis, Performance measurement

2. Linear Data Structures – Arrays and Linked Lists: Arrays: representation, operations, applications, Multidimensional arrays, Dynamic arrays, Linked Lists: Singly linked list, Doubly linked list, Circular linked list, Operations: insertion, deletion, traversal, searching, Applications in scheduling and buffering

3. Stacks and Queues: Stack: concept and operations, Stack implementation using array and linked list, Applications: expression evaluation, recursion, backtracking, Queue: types and operations, Circular queue, Deque (double-ended queue), Priority queue, Applications in task scheduling and network traffic

4. Trees and Binary Search Trees: Basic terminology and properties of trees, Binary trees, Tree traversals: inorder, preorder, postorder, level order, Binary Search Trees (BST): insertion, deletion, searching, Height-balanced trees (Introduction to AVL trees), Heap: min-heap and max-heap, Heap applications and priority scheduling

5. Hashing and Searching Techniques: Hashing concepts, Hash functions, Collision resolution techniques: Chaining, Open addressing, Searching algorithms: Linear search, Binary search, Applications in database indexing

6. Sorting Algorithms: Internal vs external sorting, Comparison-based sorting: Bubble sort, Selection sort, Insertion sort, Merge sort, Quick sort, Non-comparison sorting: Counting sort, Radix sort (introduction), Performance comparison

7. Graphs and Graph Algorithms: Graph terminology and representations, Adjacency matrix and adjacency list, Graph traversal: BFS and DFS, Minimum Spanning Tree: Kruskal's algorithm, Prim's algorithm, Shortest path:, Dijkstra's algorithm, Applications in route optimization

8. Advanced Algorithmic Techniques: Divide and Conquer, Greedy method, Dynamic Programming, Backtracking, Introduction to NP-complete problems, Applications in optimization and AI systems

Textbooks / References

1. Text book: Introduction to Algorithms, third edition, Thomas H. Cormen, Charles E. Leiserson, Ronald L. Rivest, Clifford Stein.
2. Data Structures and Algorithms in Python, Michael T. Goodrich, Roberto Tamassia, Michael H. Goldwasser, John Wiley and Sons.
3. E. Balaguruswamy, Programming in ANSI C, Tata McGraw-Hill.
4. Data Structures and Algorithms Using Python, Rance D. Necaise, Wiley.
5. Data Structure and Algorithmic Thinking with Python - Narasimha Karumanchi, CareerMonk Publications.
6. Art of Computer Programming Volumes 1-4, Addison-Wesley Professional, 2011.

राजीव गाँधी राष्ट्रीय विमानन विश्वविद्यालय

Rajiv Gandhi National Aviation University, Amethi

B.Tech. in Artificial Intelligence and Data Science (Aviation Systems)
Course Code: PC202
Course Title: Foundation of Machine Learning and Data Science
L–T–P–C: 3–0–2–4
Year: First Year
Semester: II

Prerequisite: Mathematics I (Applied Linear Algebra and Calculus) [BS101]

Course Contents

1. Sources and Types of Data, Descriptive and Inferential statistics, Measures of central tendency, Quartiles and percentiles, Measures of dispersion
2. Data Modeling, Data Handling and Data Visualization using Python, Characteristics of Data, Statistical Description of Data, Data Preprocessing, Review of probability Theory and Random Variables, Expectation and Variance.
3. Sampling and Estimation, confidence Intervals.
4. Applied Linear Algebra: Vector Spaces, Eigen Value and Singular Value Decommissions, Dimensionality Reduction.
5. Applied Optimization: Convexity and Gradient Descent towards minimum.
6. Typology of data science problems and solution frameworks.

Text /Reference Books:

1. Mathematics for Machine Learning - by Marc Peter Deisenroth, A. Aldo Faisal, Cheng Soon Ong, Cambridge University Press, (2020).
2. Applied statistics and probability for engineers – by Douglas Montgomery
3. Grus, J. (2019). Data Science from Scratch: First Principles with Python (2nd Edition). O'Reilly Media. • McKinney, W. (2018).
4. Python for Data Analysis: Data Wrangling with Pandas, NumPy, and IPython (2nd Edition). O'Reilly Media.
5. Linear Algebra and Learning from Data (2019)-by Gilbert Strang
6. Mastering python for data science- by Samir Madhavan
7. https://onlinecourses.nptel.ac.in/noc21_cs69/preview
8. https://study.iitm.ac.in/ds/course_pages/BSSE2002.html

राजीव गाँधी राष्ट्रीय विमानन विश्वविद्यालय

Rajiv Gandhi National Aviation University (RGNAU)

B.Tech. in Artificial Intelligence and Data Science (Aviation Systems)
Course Code: ES201
Course Title: Digital Logic and Microprocessor
L–T–P–C: 3–0–2–4, **Year:** First Year, **Semester:** II

Course Contents

1. Digital systems and binary numbers: binary, octal, hexadecimal numbers; base conversion and complements of numbers; signed and unsigned numbers; binary codes; binary storage and registers;

2. **Boolean algebra and logic gates:** postulates, theorems and properties of Boolean algebra; Boolean functions, canonical and standard forms; logic gates and integrated circuits; minimization of Boolean functions using algebraic, Karnaugh map and Quine – McClausky methods; product of sum simplification; NAND and NOR implementation, Exclusive-OR function; Introduction to Hardware Description Language;

3. **Combinational Circuits:** design procedure; design of adder, subtractor, multiplier, comparator, decoders and encoders, multiplexers, analysis of combinational circuits; HDL models for combinational circuits;

4. **Synchronous sequential logic:** sequential circuits; storage elements latches and flip-flops; SR, JK, D, T flip-flops; clocked sequential circuits; master-slave flip-flop, edge-level triggering considerations; HDL models for sequential circuits and design procedure; registers and counters; HDL models for registers and counters;

5. Memory and programmable logic: random access memory, memory decoding, error detection and correction, read only memory, programmable logic arrays and sequential programmable devices;

6. Design at register transfer level: RTL notation, algorithmic state machines; sequential binary multiplier, control logic, design of multiplexers, HDL description of design examples; race condition free design; introduction to System Verilog;

7. Introduction to 8085/86 Architecture and Assembly Language : Machine instructions and addressing modes, ALU, data-path and control unit, instruction pipelining.

Textbooks / References

1. Digital Design – with an introduction to the Verilog HDL, VHDL, and SystemVerilog by M. Morris Mano and Michael D Cilette.
2. Computer System Architecture by M. Morris Mano, Pearson education.

राजीव गाँधी राष्ट्रीय विमानन विश्वविद्यालय

Rajiv Gandhi National Aviation University (RGNAU)

B.Tech. in Artificial Intelligence and Data Science (Aviation Systems)

Course Code: HS201
Course Title: Human Values and Ethics
L–T–P–C: 2–0–0–2
Year: First Year
Semester: II

Course Contents

1. **Introduction to Human Values and Ethics** : Core human values: integrity, honesty, respect, responsibility, empathy; Ethics, morals, and values: basic distinctions; Ethical reasoning and decision-making; Human values in the digital & Artificial Intelligence (AI) Era
2. **Ethics and Moral Philosophy**: Basic Theories: Basic ethical principles, moral developments, deontology, utilitarianism, virtue theory, rights theory, casuist theory, moral absolution, moral rationalism, moral pluralism, ethical egoism, feminist consequentialism, moral issues, moral dilemmas, moral autonomy; Cross-cultural Ethics in AI: Navigating western and eastern Moral frameworks
3. **Ethics in Artificial Intelligence and Responsible AI** : Ethical characteristics of AI systems and socio-technical responsibility; Ethics across the AI lifecycle: data, model development, deployment, and monitoring; Privacy, consent, data dignity, and ethical data governance; Accountability, liability, and professional responsibility of AI engineers; AI safety, human control, and value alignment; Social, economic, and environmental impacts of AI
4. **Human Values in AI Systems**: Bias, fairness, and non-discrimination; Privacy, consent, and data dignity; Transparency, explainability, and trust; Human autonomy and control in AI-assisted decisions
5. **Law, Society, and Technology** : Technology and social change; Cyber ethics and digital citizenship; AI regulation and governance (overview); Intellectual property, data ownership ; Environmental impact of AI and sustainability; Global issues in professional ethics
6. **Emotional Intelligence and Ethical Behaviour**: Self-awareness, self-regulation, and empathy; Emotional intelligence in teamwork and leadership; Managing ethical stress and value conflicts; Responsible communication in digital environments
7. **Professional Practices in Engineering** : Engineering professions in the digital and AI-driven economy; Professional identity and ethical norms in multidisciplinary and global teams 6; Roles, responsibilities, and moral accountability of engineers in high-impact technologies; Ethical obligations related to safety, reliability, and societal well-being; Professional codes of ethics and industry standards (IEEE, ACM, etc.).

Textbooks / References

Textbooks:

1. Professional Ethics: R. Subramanian, Oxford University Press, 2015.
2. Shukla, T., Yadav, A., & Chauhan, G. S. (2018). Human values and professional ethics. Cengage India.

Reference Books:

1. Engineering Ethics, Concepts Cases: Charles E Harris Jr., Michael S Pritchard, Michael J Rabins, 4e, Cengage learning, 2015.
2. Business Ethics concepts & Cases: Manuel G Velasquez, 6e, PHI, 2008.

राजीव गाँधी राष्ट्रीय विमानन विश्वविद्यालय

Rajiv Gandhi National Aviation University (RGNAU)

B.Tech. in Artificial Intelligence and Data Science (Aviation Systems)

Course Code: BS202
Course Title: Optimization Techniques
L–T–P–C: 3–0–0–3
Year: First Year
Semester: II

Prerequisite: Familiarity with basics of probability and statistics, and linear algebra

Course Contents

1. **Background**: convex analysis, linear and matrix algebra, probability theory
2. **Preliminaries**: applications, optimality and duality conditions
3. **First Order Methods** :Subgradient methods, Proximal methods, Multiplicative weights update, mirrored descent
4. **Second Order Methods:** Newton method, Quasi-Newton methods, L-BFGS
5. **Stochastic Optimization Problems:** Notion of regret, online to batch conversion, Methods offering vanishing regret - OGD, EG, OMD
6. **Non-convex Optimization Problems:** Applications - sparse recovery, affine rank minimization, low-rank matrix completion, Convex approaches - relaxation-based methods, Non-convex approaches - projected gradient descent, alternating minimization
7. **Special topics** (a subset would be chosen depending on interest and available time): Accelerated first order methods, Bayesian methods, Coordinate methods, Cutting plane methods, Interior point methods, Optimization methods for deep learning, Parallel and distributed methods, Robust optimization problems and methods, Stochastic mini-batch methods, Submodular optimization problems and methods, Variance reduced stochastic methods, Zeroth order methods.

Text /Reference Books:

1. S. Bubeck, Convex Optimization: Algorithms and Complexity, Foundations and Trends in Machine Learning, 8(3-4): 231-357, 2015.
2. T. Hastie, R. Tibshirani and M. J. Wainwright, Statistical Learning with Sparsity: the Lasso and Generalizations, Chapman and Hall/CRC Press, 2015. http://web.stanford.edu/~hastie/StatLearnSparsity/
3. E. Hazan. Introduction to Online Convex Optimization. Draft, 2015. http://ocobook.cs.princeton.edu/
4. S. Sra, S. Nowozin, and S. Wright (eds). Optimization for Machine Learning, The MIT Press, 2011.
5. Y. Nesterov, Introductory lectures on convex optimization, Kluwer-Academic, 2003.
6. S. Boyd and L. Vandenberghe, Convex Optimization, The Cambridge University Press, 2003.
7. D. Bertsekas, Nonlinear programming, Athena Scientific, 1999.
8. Selection of papers from leading conferences and journals in optimization, as well as applied areas such as signal processing, information theory, and machine learning.

राजीव गाँधी राष्ट्रीय विमानन विश्वविद्यालय

Rajiv Gandhi National Aviation University (RGNAU)

B.Tech. in Artificial Intelligence and Data Science (Aviation Systems)

Course Code: PC203
Course Title: Object Oriented Programming
L–T–P–C: 2–0–2–3
Year: First Year
Semester: II

Course Contents

1. Beginning with OOP Language: Review of Tokens, Expressions, Operators & Control Structures. Scope Resolution Operator, Member Dereferencing Operator, Reference Variables.
2. Review of Functions, Function Overloading, Inline Functions, Default Arguments.
3. Classes & Objects: Specifying a Class, Defining Member Functions, creating Class Objects, Accessing Class Members. Access Specifies – Public, Private, and Protected Classes, Its Members, Objects and Memory Allocation
4. Static Members, the Const Keyword and Classes, the Static Objects. Friend Function & its Usage Empty Classes, Nested Classes, Local Classes.
5. Constructors & Destructors: Need for Constructors and Destructors, Copy Constructors, Dynamic Constructors, Destructors, Constructors and Destructors with Static Members.
6. Operator Overloading & Type Conversion: Defining Operator Overloading, Rules for Overloading Operators, Overloading of Unary Operators and various Binary Operators with Friend Functions and Member Functions. Type Conversion – Basic Type to Class Type, Class Type to Basic Type, Class Type to another Class Type.
7. Inheritance: Introduction, Defining Derived Classes, Forms of Inheritance, Ambiguity in Multiple and Multipath Inheritance, Virtual Base Class, Overriding Member Functions, Order of Execution of Constructors and Destructors Virtual Functions & Polymorphism: Virtual Functions, Pure Virtual Functions, Abstract Classes, Introduction to Polymorphism
8. Pointers & Dynamic Memory Management: Understanding Pointers, Accessing Address of a Variable, Declaring & Initializing Pointers, Pointer to a Pointer, Pointer to a Function, Dynamic Memory Management – New and Delete Operators, this Pointer.
9. Console I/O: Concept of Streams, Hierarchy of Console Stream Classes, Unformatted I/O Operations, Managing Output with Manipulators.
10. Working with Files: Opening, Reading, Writing, Appending, Processing & Closing different Type of Files, Command Line Arguments
11. Standard Template Library (STL) of C++

Textbooks / References

1. Object Oriented Programming with C++ by E. Balagurusamy, McGraw-Hill Education (India)
2. ANSI and Turbo C++ by Ashoke N. Kamthane, Pearson Education Reference Books:
3. Big C++ - Wiley India 2. C++: The Complete Reference- Schildt, McGraw-Hill Education (India)
4. C++ and Object Oriented Programming – Jana, PHI Learning.
5. Object Oriented Programming with C++ - Rajiv Sahay, Oxford
6. Mastering C++ - Venugopal, McGraw-Hill Education (India)
7. "Accelerated C++: Practical Programming by Example" by Andrew Koenig and Barbara E. Moo