# GURU KASHI UNIVERSITY


**B. Voc.in – Artificial Intelligence & Machine Learning**

**Session: 2024-25**

**Department of Computer Science & Engineering**

**Programme Structure**

| **Semester: I** | | | | | | |
|---|---|---|---|---|---|---|
| **Course Code** | **Course Title** | **Type of Course** | **L** | **T** | **P** | **Credits** |
| BMA101 | Programming for Problem Solving | Skill Based | 4 | 0 | 0 | 4 |
| BMA102 | Programming for Problem Solving Lab | Compulsory Foundation | 0 | 0 | 4 | 2 |
| BMA103 | Mathematics-I | Compulsory Foundation | 4 | 0 | 0 | 4 |
| BMA104 | Communication Skills | Skill Based | 4 | 0 | 0 | 4 |
| BMA105 | Communication Skills Lab | Compulsory Foundation | 0 | 0 | 2 | 1 |
| BMA106 | Basics of Artificial Intelligence and Machine Learning | Skill Based | 4 | 0 | 0 | 4 |
| BMA107 | Fundamental of Computer and Information Technology Lab | Skill Based | 0 | 0 | 2 | 1 |
| **Total** | | | **16** | | **08** | **20** |

| Semester: II | | | | | | |
|---|---|---|---|---|---|---|
| **Course Code** | **Course Title** | **Type of Course** | **L** | **T** | **P** | **Credits** |
| BMA201 | Mathematics-II | Compulsory Foundation | 4 | 0 | 0 | 4 |
| BMA202 | Object Oriented Programming Using C++ | Skill based | 3 | 0 | 0 | 3 |
| BMA203 | Web Technology | Skill based | 3 | 0 | 0 | 3 |
| BMA204 | Data Structure & Algorithms | Compulsory Foundation | 4 | 0 | 0 | 4 |
| BMA205 | Digital Electronics | Skill based | 4 | 0 | 0 | 4 |
| BMA206 | Web Technology Lab | Skill based | 0 | 0 | 2 | 1 |
| BMA207 | Object Oriented Programming Using C++ Lab | Skill based | 0 | 0 | 2 | 1 |
| **Value Added Course** | | | | | | |
| BMA208 | Environmental Science | VAC | 2 | 0 | 0 | 2 |
| **Total** | | | **20** | **0** | **04** | **22** |

| Semester: III | | | | | | |
|---|---|---|---|---|---|---|
| **Course Code** | **Course Title** | **Type of Course** | **L** | **T** | **P** | **Credits** |
| BMA301 | Discrete Mathematics | Core | 4 | 0 | 0 | 4 |
| BMA302 | Operating System | Core | 4 | 0 | 0 | 4 |
| BMA303 | Design & Analysis of Algorithms | Core | 4 | 0 | 0 | 4 |
| BMA304 | Computer Organization & Architecture | Core | 4 | 0 | 0 | 4 |
| BMA305 | Operating System Lab | Skill based | 0 | 0 | 4 | 2 |
| BMA306 | Design & Analysis of Algorithms Lab | Skill based | 0 | 0 | 4 | 2 |
| **Open Elective –I** | | | | | | |
| xxx | | Open Elective Course | 2 | 0 | 0 | 2 |
| **Discipline Elective-I(Any one of the following)** | | | | | | |
| BMA307 | Multimedia and Applications | Discipline Elective-I | **3** | **0** | **0** | **3** |
| BMA308 | Cloud Computing | | | | | |
| **Total** | | | **21** | **0** | **10** | **25** |
| **Open Elective – I(Open Elective Courses for other Departments)** | | | | | | |
| BMA309 | Introduction to Artificial Intelligence & Machine Learning | Open Elective Course | 2 | 0 | 0 | 2 |

| Semester: IV | | | | | | |
|---|---|---|---|---|---|---|
| **Course Code** | **Course Title** | **Type of Course** | **L** | **T** | **P** | **Credits** |
| BMA401 | Introduction to Machine Learning with Python | Core | 4 | 0 | 0 | 4 |
| BMA402 | Java Programming | Core | 4 | 0 | 0 | 4 |
| BMA403 | Relational Database Management System | Core | 4 | 0 | 0 | 4 |
| BMA404 | Introduction to Robotics | Core | 4 | 0 | 0 | 4 |
| BMA405 | Relational Database Management System Lab | Skill based | 0 | 0 | 2 | 1 |
| BMA406 | Introduction to Machine Learning with Python Lab | Skill based | 0 | 0 | 4 | 2 |
| BMA407 | Java Programming Lab | Skill based | 0 | 0 | 2 | 1 |
| BMA499 | xxx | MOOC | 0 | 0 | 0 | 3 |
| **Discipline Elective-II(Any one of the following)** | | | | | | |
| BMA408 | Data ware housing & Data Mining | Discipline Elective-II | 3 | 0 | 0 | 3 |
| BMA409 | Big Data | | | | | |
| **Total** | | | **18** | **0** | **8** | **26** |

| Semester: V | | | | | | |
|---|---|---|---|---|---|---|
| **Course Code** | **Course Title** | **Type of Course** | **L** | **T** | **P** | **Credits** |
| BMA501 | Formal Language & Automata Theory | Core | 4 | 0 | 0 | 4 |
| BMA502 | Computer Networks | Core | 4 | 0 | 0 | 4 |
| BMA503 | Deep learning | Core | 4 | 0 | 0 | 4 |
| BMA504 | Deep Learning Lab | Skill based | 0 | 0 | 4 | 2 |
| BMA505 | Project-1 | Skill based | 0 | 0 | 4 | 2 |
| BMA506 | Optimization Techniques in Machine Learning | Core | 4 | 0 | 0 | 4 |
| **BMA599** | **xxx** | **MOOC** | 0 | 0 | 0 | 3 |
| **Elective-III(Any one of the following)** | | | | | | |
| BMA507 | Soft Computing | Discipline Elective-II | **3** | **0** | **0** | **3** |
| BMA508 | Speech and Language Processing | | | | | |
| **Total** | | | **19** | **0** | **8** | **26** |

| Semester: VI | | | | | | |
|---|---|---|---|---|---|---|
| **Course Code** | **Course Title** | **Type of Course** | **L** | **T** | **P** | **Credits** |
| BMA601 | Advanced Machine Learning | Core | 3 | 0 | 0 | 3 |
| BMA602 | Network Security with AI | Core | 3 | 0 | 0 | 3 |
| BMA603 | Data and Visual analytics in AI | Core | 3 | 0 | 0 | 3 |
| BMA604 | Project-II | Skill based | 0 | 0 | 4 | 2 |
| BMA606 | Digital Signal processing | Core | 3 | 0 | 0 | 3 |
| BMA | XXX | MOOC | 0 | 0 | 0 | 3 |
| **Total** | | | **16** | **0** | **8** | **20** |
| **Elective-IV(Any one of the following)** | | | | | | |
| BMA 607 | Deep Learning | Discipline Elective-IV | 3 | 0 | 0 | 3 |
| BMA 608 | Block Chain Designing | | | | | |
| **Value Added Course** | | | | | | |
| BMA 609 | Personality Development programme | VAC | 2 | 0 | 0 | 2 |
| **Total** | | | **21** | **0** | **8** | **22** |

**Evaluation Criteria for Theory Courses**

A. Continuous Assessment: [25 Marks]
   CA1-Surprise Test (Two best out of Three) - (10 Marks)
   CA2-Assignment(s) (10 Marks)
   CA3-Term Paper/Quiz/Presentations (05 Marks)
B. Attendance: [05 marks]
C. Mid Semester Test: [30 Marks]
D. End-Term Exam: [40 Marks]

**Evaluation Criteria for Practical Courses:** Performance of each practical- (10 Marks), Report- (5 Marks)

Practical Viva – (5 Marks)
Total - (20 Marks) (Each Practical)

**Semester: I**

**Course Title: PROGRAMMING FOR PROBLEM SOLVING**

**Course Code: BMA101**

| L | T | P | Credits |
|---|---|---|---|
| 4 | 0 | 0 | 4 |

**Total Hours: 60**

**Learning Outcomes:** After completion of this course, the learner will be able to:

1. Design the algorithms to write programs.
2. Illustrate arrays, pointers and structures to formulate algorithms and programs
3. Apply programming to solve simple numerical method problems, namely rot finding of function, differentiation of function and simple integration
4. Implement conditional branching, iteration and recursion.

**Course Content**

**UNIT I** **18 Hours**

**Introduction to Programming:** Introduction to components of a computer system (disks, memory, processor, where a program is stored and executed, operating system, compilers etc.) - Idea of Algorithm: steps to solve logical and numerical problems. Representation of Algorithm: Flowchart/Pseudo code with examples. From algorithms to programs; source code, variables (with data types) variables and memory Locations, Syntax and Logical Errors in compilation, obj
ect and executable code-

**UNIT II** **18 Hours**

**Arithmetic expressions and precedence:** Conditional Branching and Loops Writing and evaluation of conditionals and consequent branching
Iteration and loops

**Arrays:** Arrays (1-D, 2-D), Character arrays and Strings

**Basic Algorithms:** Searching, Basic Sorting Algorithms (Bubble, Insertion and Selection), Finding roots of Equations, notion of order of complexity through example programs (no formal definition requirement.

**UNIT III** **10 Hours**

**Function:** Functions (including using built in libraries), Parameter passing in functions, call by value, passing arrays to functions: idea of call by reference.

**Recursion:** Recursion as a different way of solving problems. Example programs, such as Finding Factorial, Fibonacci series, Ackerman function etc. Quick sort or Merge sort.

**UNIT IV** **14 Hours**

**Structure:** Structures, Defining structures and Array of Structures

**Pointers:** Idea of pointers, defining pointers, Use of Pointers in self-referential structures, notion of linked list (no implementation)
File handling (only if time is available, otherwise should be done as part of the lab.

**Transaction Modes**

Lecture, Seminar, e-Team Teaching, e-Tutoring, Dialogue, Peer Group Discussion, Mobile Teaching, Self-Learning, Collaborative Learning and Cooperative Learning

**Suggested Readings**


- *Byron Gottfried, Schaum's (1995), Outline of Programming with C, McGraw-Hill.*
- *E. Balaguruswamy (2005) Programming in ANSI C, Tata McGraw-Hill.*

**Course Title: PROGRAMMING FOR PROBLEM SOLVING LAB**

**Course Code: BMA102**

| L | T | P | Credits |
|---|---|---|---|
| 0 | 0 | 4 | 2 |

**Total Hours: 30**

**Learning Outcomes:** After completion of this course, the learner will be able to:

1. Create read and write to and from simple text files.
2. Identify and correct logical errors encountered at run time
3. Apply programming to solve simple numerical method problems, namely rot finding of function, differentiation of function and simple integration.
4. Represent data in arrays, strings and structures and manipulate them through a program

**Course Content**

1. Problem solving using computers
2. Familiarization with programming Environment
3. Variable types and type conversions
4. Simple computational problems using arithmetic expressions
5. Branching and logical expressions
6. Problems involving if-then-else structures
7. Loops, while and for loops
8. Iterative problems e.g., sum of series
9. 1D Arrays: searching, sorting
10. 1DArray manipulation
11. 2D arrays and Strings, memory structure
12. Matrix problems, String operations
13. Functions, call by value
14. Simple functions
15. Numerical methods (Root finding, numerical differentiation, numerical integration)
16. Numerical methods problems
17. Recursion, structure of recursive calls
18. Recursive functions
19. Pointers, structures and dynamic memory allocation
20. Pointers and structures
21. File handling
22. File operations

**Suggested Readings**


- *Byron Gottfried, Schaum's (1995), Outline of Programming with C, McGraw-Hill*
- *E. Balaguruswamy (2005) Programming in ANSI C, Tata McGraw-Hill.*

**Course Title: MATHEMATICS-I**
**Course code: BMA103**

**Total Hours: 60**

**Learning Outcomes:** After completion of this course, the learner will be able to:

1. Apply differential and integral calculus to notions of curvature and to improper integrals. Apart from some other applications they will have a basic understanding of Beta and Gamma functions.
2. Classify of Rolle's Theorem that is fundamental to application of analysis to Engineering problems.
3. Illustrate the Tool of power series and Fourier series for learning advanced Engineering Mathematics.
4. Use of functions of several variables that is essential in most branches of engineering and tools of matrices and linear algebra in a comprehensive manner.

**Course Content**

**UNIT I** **20 Hours**

**Calculus:** Evaluates and involutes; Evaluation of definite and improper integrals; Beta and Gamma functions and their properties; Applications of definite integrals to evaluate surface areas and volumes of revolutions.

Rolle 's Theorem, Mean value theorems, Taylor's and Maclaurin theorems with remainders; Indeterminate forms and Hospital's rule; Maxima and minima.

**Advanced Calculus:** Differentiation: Limit continuity and partial derivatives, directional derivatives, total derivative; Tangent plane and normal line; Maxima, minima and saddle points; Method of Lagrange multipliers; Gradient, curl and divergence.

Integration: Multiple Integration: double and triple integrals (Cartesian and polar), change of order of integration in double integrals, Change of variables (Cartesian to polar), Applications: areas and volumes by (double integration) Center of mass and Gravity (constant and variable densities). Theorems of Green, Gauss and Stokes, orthogonal curvilinear coordinates, Simple applications involving cubes, sphere and rectangular parallelepipeds.

**UNIT II** **10 Hours**

**Trigonometry:** Hyperbolic and circular functions, logarithms of complex number resolving real and imaginary parts of a complex quantity, De Moivre's Theorem.

**Theory of equations**: Relation between roots and coefficients, reciprocal Equations, transformation of equations and diminishing the roots.

**UNIT III** **15 Hours**

**Sequences and series:** Convergence of sequence and series, tests for convergence; Power series, Taylor's series, series for exponential, trigonometric and logarithm functions; Fourier series: Half range sine and cosine series, Parseval's theorem.

**UNIT IV** **15 Hours**

**Algebra:** Vector Space, linear dependence of vectors, basis, dimension; Linear transformations (maps), range and kernel of a linear map, rank and nullity, Inverse of a linear transformation, rank- nullity theorem, composition of linear maps, Matrix associated with a linear map.

Eigen values, eigenvectors, symmetric, skew-symmetric, and orthogonal Matrices, Eigen bases, Diagonalization; Inner product spaces, Gram-Schmidt orthogonalization.

**Transaction Modes**

Lecture, Seminar, e-Team Teaching, e-Tutoring, Dialogue, Peer Group Discussion, Mobile Teaching, Self-Learning, Collaborative Learning and Cooperative Learning

**Suggested Readings**


- *Thomas, G. B. (1992). Calculus and analytic geometry. Massachusetts Institute of Technology, Massachusetts, USA, Addison-Wesley Publishing Company, ISBN: 0-201-60700-X.*
- *UNIT, I. 16MA101 ENGINEERING MATHEMATICS-I LTPC. SNS COLLEGE OF TECHNOLOGY, 7, 19.*
- *Bali, N. P., & Goyal, M. (2010). A Textbook of Engineering Mathematics (PTU, Jalandhar) Sem-III/IV. Laxmi publications.*
- *PO, P. Edition, New Delhi, 2012. 6. Ramana BV, "Higher Engineering Mathematics", Tata McGraw Hill Co. Ltd., 11th Reprint, New Delhi, 2010. DEPARTMENT OF INSTRUMENTATION ENGINEERING ANNA UNIVERSITY, CHENNAI, 24.*

**Course Title: Communication Skills**

**Course Code: BMA104**

| L | T | P | Credits |
|---|---|---|---|
| 4 | 0 | 0 | 4 |

**Total Hours: 45**

**Learning Outcomes:** After completion of this course, the learner will be able to:

1. Develop vocabulary and improve the accuracy in Grammar.
2. Apply the concepts of accurate English while writing and become equally ease at using good vocabulary and language skills.
3. Develop and Expand writing skills through Controlled and guided activities.
4. Compose articles and compositions in English.

**Course Content**

**UNIT I** **20 Hours**

**Vocabulary Building:** The concept of Word Formation, Root words from foreign languages and their use in English, Acquaintance with prefixes and suffixes from foreign languages in English to form derivatives. Synonyms, antonyms, and standard abbreviations.

**UNIT II** **15 Hours**

**Basic Writing Skills:** Sentence Structures, use of phrases and clauses in sentences, Importance of proper punctuation, creating coherence, organizing principles of paragraphs in documents, Techniques for writing precisely.

**UNIT III** **10 Hours**

**Identifying Common Errors in Writing:** Subject-verb agreement, Noun-pronoun agreement, Misplaced modifiers, Articles, Prepositions, Redundancies, Cliché

**UNIT IV** **15 Hours**

**Nature and Style of sensible Writing:** Describing, Defining, Classifying, providing examples or evidence, writing introduction and conclusion

**Writing Practices:** Comprehension, Précis Writing, Essay Writing.

**Transaction Modes**

Lecture, Seminar, e-Team Teaching, e-Tutoring, Dialogue, Peer Group Discussion, Mobile Teaching, Self-Learning, Collaborative Learning and Cooperative Learning.

**Suggested Readings**


- *Swan, Michael. (1995). Practical English. OUP.*
- *Wood, F.T. (2007). Remedial English Grammar. Macmillan.*
- *Zinsser, W. (2001). On Writing Well. Harper Resource Book.*
- *Lyons, L. H. &Heasly, B. (2006). Study Writing. Cambridge University Press.*
- *Kumar, S &Lata, P. (2011). Communication Skills. Oxford University Press.*
- *CIEFL, Hyderabad. Exercises in Spoken English. Parts. I-III. Oxford University Press.*

**Course Title: COMMUNICATION SKILLS LAB**

**Course Code: BMA105**

| L | T | P | Credits |
|---|---|---|---|
| 0 | 0 | 2 | 1 |

**Total Hours: 15**

**Learning Outcomes:** After completion of this course, the learner will be able to:

1. Illustrate the importance of pronunciation and apply the same day to day conversation.
2. Apply verbal and non-verbal communication techniques in the Professional Environment.
3. Develop coherence, cohesion and competence in Oral discourse.
4. Evaluate the interview process confidently.

**Course Content**

**Oral Communication**

(This unit involves interactive practice sessions in Language Lab)

- Listening Comprehension
- Pronunciation, Intonation, Stress and Rhythm
- Common Everyday Situations: Conversations and Dialogues
- Communication at Workplace
- Interviews
- Formal Presentations

**Course Title: Basics of Artificial Intelligence and Machine Learning**
**Course Code: BMA106**

| L | T | P | Credits |
|---|---|---|---|
| 4 | 0 | 0 | 4 |

**Total Hours-60**

**Learning Outcomes:** After completion of this course, the learner will be able to:

1. Design expert system by using AI tools.
2. Compare and develop expert system with the help of Neural Networks
3. Understand the concept of expert system using Machine Learning.
4. Create an expert system using Fuzzy Logic.

**Course Content**

**UNIT I** **20 Hours**

**Introduction:** What is AI, Importance of AI, Early work in AI, Applications of AI, Knowledge and its definition. Knowledge Representation: Prepositional logic, FOPL, Properties of Well-formed formulas, Conversion to Clausal form, Inference rules, Resolution principle.

**Structured Knowledge:** Introduction, Associate frame structures, Conceptual dependencies and scripts.

**UNIT II** **15 Hours**

**Knowledge Organization and Manipulation:** Concepts, Uninformed or Blind search, informed search, Searching- And-OR graphs, Pattern Recognition, Recognition Classification process, Classification patterns, Recognizing and understanding speech.

**Generative AI**: How does generative AI work? Generative AI models, what are Dall-E, ChatGPT and Bard, use cases, benefits and its limitations, Ethics and bias, Generative AI vs. AI, Generative AI history.

**UNIT III** **10 Hours**

**Planning:** planning as search, partial order planning, construction and use of planning graphs. Decision-Making: basics of utility theory, decision theory, sequential decision problems, elementary game theory and sample applications.

**UNIT IV** **15 Hours**

**Expert System:** Definition, Rule based architecture, dealing with uncertainty, Knowledge acquisition and validation, knowledge system building tools.

**Knowledge Acquisition:** Types of learning, General Learning model, Performance measures. Learning nearest neighbor, naive Bayes, and decision tree classifiers.

**Transaction Modes**

Lecture, Seminar, e-Team Teaching, e-Tutoring, Dialogue, Peer Group Discussion, Mobile Teaching, Self-Learning, Collaborative Learning and Cooperative Learning

**Suggested Readings**

- *Dan W. Patterson. (1990). Introduction to Artificial Intelligence and Expert Systems.PHI Publication.*
- *Peter Jackson. (1998). Introduction to Expert System. AddisonWesley.*

**Course Title: Fundamental of Computer and Information Technology Lab**

**Course Code: BMA107**

| L | T | P | Credits |
|---|---|---|---|
| 0 | 0 | 2 | 1 |

**Total Hours: 15**

**Course learning outcomes: On successful completion of this course, students will be able to:**

1. Understanding the concept of input and output devices of Computers
2. Study to use the Internet safely, legally, and responsibly.
3. Understand an operating system and its working, and solve common problems related to operating systems
4. Learn basic word processing, Spreadsheet and Presentation Graphics Software skills

**Course Content**

1. Various Components of a Computer.
2. Introduction to Microsoft Word & Presentation
3. Make a simple presentation on your college,
4. use 3D effects , on prescribed presentation
5. Applications of Ms-Office Ms-Word
6. Ms-Excel
7. Ms-PowerPoint
8. Create web pages for your college using different tags.
9. web Browser and E- Mail
10. Conversion of a word documents into PDF/ Image conversion using image file format.

**Semester: II**

**Course Title: MATHEMATICS –II**

**Course Code: BMA201**

| L | T | P | Credits |
|---|---|---|---|
| 4 | 0 | 0 | 4 |

**Total Hours: 60**

**Learning Outcomes**: After completion of this course, the learner will be able to:

1. Demonstrate the methods of forming and solving Ordinary differential equations and solve linear differential equations with constant and variable coefficients
2. Explain the concept of differential equation and classifies the differential equations with respect to their order and linearity.
3. Solve first-order ordinary and exact differential equations and converts separable and homogeneous equations to exact differential equations by integrating factors.
4. Apply the method of undetermined coefficients to solve the non-homogeneous linear differential equations with constant coefficients.

**Course Content**

**UNIT I** **14 Hours**

**First order ordinary differential equations:** Exact, linear and Bernoulli's equations, Euler's equations, Equations not of first degree: equations solvable for p, equations solvable for y, equations solvable for x and Clairaut's type.

**Ordinary differential equations of higher orders**: Second order linear differential equations with variable coefficients, method of variation of parameters, Cauchy-Euler equation; Power series solutions; Legendre polynomials, Bessel functions of the first kind and their properties.

**UNIT II** **15 Hours**

**Complex Variable – Differentiation:** Differentiation, Cauchy-Riemann equations, analytic functions, harmonic functions, finding harmonic conjugate; elementary analytic functions (exponential, trigonometric, logarithm) and their properties; Conformal mappings, Mobius transformations and their properties.

**UNIT III** **15 Hours**

**Complex Variable – Integration:** Contour integrals, Cauchy-Goursat theorem (without proof), Cauchy Integral formula (without proof), Liouville's theorem and Maximum-Modulus theorem (without proof); Taylor's series, zeros of analytic functions, singularities, Laurent's series; Residues, Cauchy Residue theorem (without proof), Evaluation of definite integral involving sine and cosine, Evaluation of certain improper integrals using the Bromwich contour.

**UNIT IV** **16 Hours**

**Transform Calculus:** Laplace Transform, Properties of Laplace Transform, Laplace transform of periodic functions.

Finding inverse Laplace transform by different methods, convolution theorem. Evaluation of Integrals by Laplace transform, solving ODEs and PDEs by Laplace Transform method, Fourier transforms.

**Transaction Modes**

Lecture, Seminar, e-Team Teaching, e-Tutoring, Dialogue, Peer Group Discussion, Mobile Teaching, Self-Learning, Collaborative Learning and Cooperative Learning

**Suggested Readings**


- *Thomes, G.B.and Finney, R.L. (2010) Calculus and Analytic Geometry; Ninth Edition; Pearson Education*
- *Kreyszig, E. (1998) Advanced Engineering Mathematics; Eighth Edition, John Wiley and sons.*
- *Grewal, B.S. (1965) Higher Engineering Mathematics; Khanna Publishers, New Delhi.*
- *Babu Ram (2009) Advance Engineering Mathematics; First Edition; Pearson Education.*
- *Richard Courant and Fritz John (2012) Introduction to Calculus and Analysis, Volume II, V Springer Publica*

**Course Title: OBJECT ORIENTED PROGRAMMING USING C++**

**Course Code: BMA202**

| L | T | P | Credits |
|---|---|---|---|
| 3 | 0 | 0 | 3 |

**Total Hours: 45**

**Learning Outcomes:** After completion of this course, the learner will be able to:

1. Describe the procedural and object-oriented paradigm with concepts of streams, classes, functions, data and objects.
2. Illustrate dynamic memory management techniques using pointers, constructors, destructors, etc.
3. Construct the concept of function overloading, operator overloading, virtual functions and polymorphism
4. Classify inheritance with the understanding of early and late binding, usage of exception handling and generic programming.

**Course Content**

**UNIT I** **10 Hours**

**Object-Oriented Programming Concepts:** Introduction, comparison between procedural programming paradigm and object-oriented programming paradigm, basic concepts of object-oriented programming — concepts of an object and a class, interface and implementation of a class, operations on objects, relationship among objects, abstraction, encapsulation, data hiding, inheritance, overloading, polymorphism, messaging.

**UNIT II** **15 Hours**

**Standard Input/output:** Concept of streams, hierarchy of console stream classes, input/output using overloaded operators >> and << and member functions of i/o stream classes, formatting output, formatting using ions class functions and flags, formatting using manipulators.

**Classes and Objects:** Specifying a class, creating class objects, accessing class members, access specifies, and static members, use of const keyword, friends of a class, empty classes, nested classes, local classes, abstract classes, container classes, bit fields and classes.

**UNIT III** **11 Hours**

**Pointers and Dynamic Memory Management:** Declaring and initializing pointers, accessing data through pointers, pointer arithmetic, memory allocation (static and dynamic), dynamic memory management using new and delete operators, pointer to an object, this pointer, pointer related problems - dangling/wild pointers, null pointer assignment, memory leak and allocation failures. Constructors/Destructors and

Operator Overloading and Type Conversion: Need for constructors and destructors, copy constructor, dynamic constructors, explicit constructors, destructors, constructors and destructors with static members, initialize lists. Overloading operators, rules for overloading operators, overloading of various operators, type conversion - basic type to class type, class type to basic type, class type to another class type.

**UNIT IV** **9Hours**

**Inheritance and Virtual functions & Polymorphism:** Introduction, defining derived classes, forms of inheritance, ambiguity in multiple and multipath inheritance, virtual base class, object slicing, overriding member functions, object composition and delegation, order of execution of constructors and destructors. Concept of binding - early binding and late binding, virtual functions, pure virtual functions, abstract classes, virtual destructors

**Transaction Modes**

Lecture, Seminar, e-Team Teaching, e-Tutoring, Dialogue, Peer Group Discussion, Mobile Teaching, Self-Learning, Collaborative Learning and Cooperative Learning.

**Suggested Readings**


- *Lafore R. (1992). Object Oriented Programming in C++. WaiteGroup.*
- *BjarneStroustrup. (1985). The C++ Programming Language. AddisonWesley.*
- *Herbert Schildt. (1994). The Complete Reference to C++ Language. McGrawHill-Osborne.*

*Lippman F. B. (1997). C++ Primer. AddisonWesle*

**Course Title: WEB TECHNOLOGY**

**Course Code: BMA203**

| L | T | P | Credits |
|---|---|---|---|
| 3 | 0 | 0 | 3 |

**Learning Outcomes:** After completion of this course, the learner will be able to:

1. History and development of the World Wide Web and associated technologies.
2. The client-server architecture of the World Wide Web and its communication protocol HTTP/HTTPS.
3. Formats and languages used in modern web-pages: HTML, XHTML, CSS, XSLT, JavaScript, DOM
4. Programming web pages with JavaScript/DOM (client) and Good design, universal design, multi-platform web applications

**Course Content**

**UNIT I** **10 Hours**

**Introduction to Web Technologies:** Web Fundamentals: Overview of the World Wide Web, client-server architecture, and HTTP/HTTPS protocols. Web Development Languages: Introduction to HTML, CSS, and JavaScript. Web Browsers and Servers: Functions and components of web browsers and web servers.

Web Standards and Accessibility: Importance of web standards (W3C) and practices for web accessibility.

**UNIT II** **10 Hours**

**HTML and CSS:** HTML Basics: Structure of HTML documents, common HTML tags, and attributes, HTML Forms: Creating forms, form elements, and validation,

CSS Basics: Introduction to CSS, selectors, properties, and values, Layout Techniques: Using CSS for layout design, including box model, flexbox, and grid layout.

**UNIT III** **10 Hours**

**JavaScript and DOM Manipulation:** JavaScript Basics: Variables, data types, operators, and control structures, Functions and Events: Defining functions, event handling, and DOM events, DOM Manipulation: Accessing and modifying the Document Object Model (DOM) using JavaScript, AJAX and Fetch API: Making asynchronous requests and handling responses using AJAX and the Fetch API.

**UNIT IV** **15 Hours**

**Web Development Frameworks:** Introduction to Web Frameworks: Overview of client-side and server-side frameworks, Client-Side Frameworks: Introduction to frameworks like React, Angular, or Vue.js., Server-Side Technologies: Basics of server-side frameworks such as Node.js, Express, or Django.

**Transaction Modes**

Lecture, Seminar, e-Team Teaching, e-Tutoring, Dialogue, Peer Group Discussion, Mobile Teaching, Self-Learning, Collaborative Learning and Cooperative Learning.

**Suggested Readings**


- Jackson, J. C. (2006). Web Technologies. Pearson India.
- Gopalan, N. P., & ADIKESAVAN, T. (2014). Web Technology: A Developer's Perspective. PHI Learning Pvt. Ltd.
- Allsopp, J. (2009). Developing with web standards. New Riders.
- Wilde, E. (2012). Wilde's WWW: technical foundations of the World Wide Web. Springer Science & Business Media.

**Course Title: DATA STRUCTURE & ALGORITHMS**

**Course Code: BMA204**

| L | T | P | Credits |
|---|---|---|---|
| 4 | 0 | 0 | 4 |

**Total Hours: 60**

**Learning Outcomes:** After completion of this course, the learner will be able to:

1. Describe how arrays, records, linked structures, stacks, queues, trees and graphs are represented in memory and used by algorithms
2. Design a program that use arrays, records, linked structures, stacks, queues and trees.
3. Develop knowledge of applications of data structures including the ability to implement algorithms for the creation, insertion, deletion, searching and sorting of each data structure.
4. Classify the concept of recursion, give examples of its use, describe how it can be implemented using a stack

**Course Content**

**UNIT I** **10 Hours**

**Introduction:** Basic Terminologies, Elementary Data Organizations, Data Structure Operations insertion, deletion, traversal etc.; Analysis of an Algorithm, Asymptotic Notations, Time-Space trade off. Searching: Linear Search and Binary Search Techniques and their complexity analysis.

**UNIT II** **20 Hours**

**Stacks and ADT Stack and its operations:** Algorithms and their complexity analysis, Applications of Stacks: Expression Conversion and evaluation – corresponding algorithms and complexity analysis. ADT queue, Types of Queues: Simple Queue, Circular Queue, Priority Queue; Operations on each Types of Queues: Algorithms and their analysis.

**Linked Lists:** Singly linked lists, Representation in memory, Algorithms of several operations, Traversing, Searching, Insertion into, Deletion from linked list; Linked representation of Stack and Queue, Header nodes, doubly linked list, operations on it and algorithmic analysis; Circular Linked Lists, all operations their algorithms and the complexity analysis.

**UNIT III** **15 Hours**

**Trees:** Basic Tree Terminologies, Different types of Trees: Binary Tree, Threaded Binary Tree, Binary Search Tree, AVL Tree; Tree operations on each of the trees and their

algorithms with complexity analysis. Applications of Binary Trees. B Tree, B+ Tree, definitions, algorithms and analysis.

**UNIT IV** **15 Hours**

**Sorting and Hashing:** Objective and properties of different sorting algorithms, Selection Sort, Bubble Sort, Insertion Sort, Quick Sort, Merge Sort, Heap Sort; Performance and Comparison among all the methods, Hashing. Graph: Basic Terminologies and Representations, Graph search and traversal algorithms and complexity analysis.

**Transaction Modes**

Lecture, Seminar, e-Team Teaching, e-Tutoring, Dialogue, Peer Group Discussion, Mobile Teaching, Self-Learning, Collaborative Learning and Cooperative Learning.

**Suggested Readings**


- *Mark Allen Weiss. (1995). Algorithms, Data Structures, and Problem Solving with C++ Algorithms. Addison-Wesley.*
- *R. G Dromey (2006). How to Solve it by Computer. Pearson Educatio*

**Course Title: DIGITAL ELECTRONICS**

**Course code: BMA205**

| L | T | P | Credits |
|---|---|---|---|
| 4 | 0 | 0 | 4 |

**Total Hours: 60**

**Learning Outcomes:** After completion of this course, the learner will be able to:

1. Understand the used of fundamentals concepts and techniques in digital electronics
2. Examine the structure of various number systems and its application in digital design.
3. Analyze and design various combinational and sequential circuits.
4. Categorize a digital logic and apply it to solve real life problems.

**Course Content**

**UNIT I** **12 Hours**

**Fundamentals of Digital Systems and logic families:** Digital signals, digital circuits, AND, OR, NOT, NAND, NOR and Exclusive-OR operations, Boolean algebra, examples officiate, number systems-binary, signed binary, octal hexadecimal number, binary arithmetic, one's and two's complements arithmetic, codes, error detecting and correcting codes, characteristics of digital lcs, digital logic families, TTL, Schottky TTL and CMOS logic, interfacing CMOS and TTL, Tri-state logic.

**UNIT II** **18 Hours**

**Standard representation for logic functions:** K-map representation and simplification of logic functions using K-map, minimization of logical functions. Don't care conditions, Multiplexer, De- Multiplexer/Decoders, Adders, Sub-tractors, BCD arithmetic, carry look ahead adder, serial adder, ALU, elementary ALU design, popular MSI chips, digital comparator, parity checker/generator, code converters, priority encoders, decoders/drivers for display devices, Q-M method of function realization.

**UNIT III** **18 Hours**

**Sequential circuits and systems :**A 1-bit memory, the circuit properties of Bus table latch, the clocked SR flip flop, J- K-T and D- Types flip flops, applications of flip flops, shift registers, applications of shift registers, serial to parallel converter, parallel to serial converter, ring counter, sequence generator, ripple (Asynchronous) counters, synchronous counters, counters design using flip flops, special counter IC's, asynchronous sequential counters, application counters, A/D and D/Converters

**Digital to analog converters:** weighted resistor/converter, R-2R Ladder D/A converter, Specifications for D/A converters, examples of D/A converter lcs, sample and hold circuit, analog to digital converters: quantization and encoding, parallel comparator

A/D converter, successive approximation A/D converter, counting A/D converter, dual slope A/D converter, A/D converter using voltage to frequency and voltage to time conversion, specifications of A/D converters, example of A/D converters

**UNIT IV** **12 Hours**

**Semiconductor memories and Programmable logic devices:** Memory organization and operation, expanding memory size, classification and characteristics of memories, sequential memory, read only memory (ROM), read and write memory (RAM), content addressable memory (CAM), charge de coupled device memory (CCD), commonly used memory chips, ROM as a PLD, Programmable logic array, Programmable array logic, complex Programmable logic devices (CPLDS), Field Programmable Gate Array (FPGA).

**Transaction Modes**

Lecture, Seminar, e-Team Teaching, e-Tutoring, Dialogue, Peer Group Discussion, Mobile Teaching, Self-Learning, Collaborative Learning and Cooperative Learning

**Suggested Readings**


- *R. P. Jain. (2009). Modern Digital Electronics. McGraw Hill Education.*
- *M. M. Mano. (2016). Digital logic and Computer design. Pearson Education India.*
- *A. Kumar. (2016). Fundamentals of Digital Circuits. Prentice Hall India.*

**Course Title: WEB TECHNOLOGY LAB**

**Course Code: BMA206**

| L | T | P | Credits |
|---|---|---|---|
| 0 | 0 | 2 | 1 |

**Total Hours-15**

**Learning Outcomes:** After completion of this course, the learner will be able to:

1. To gain the knowledge, usage and applicability of various scripting languages.
2. To attain the knowledge of connecting to a database and then by implementing simple projects.
3. To use various scripting approaches depending upon the time to complete, cost security and reliability of the software project.

**Course Content**

1. Advanced HTML & CSS: Create responsive web layouts using advanced HTML5 and CSS3features, including Flex box and CSS Grid.
2. JavaScript and Front-End Frameworks: Develop interactive web applications using modern JavaScript (ES6+) and front-end frameworks like React or Angular.
3. Server-Side Development: Build and integrate server-side applications using Node.js or another server-side technology, implementing RESTful APIs.
4. Database Integration: Design and connect web applications to databases using SQL or NoSQL databases, handling data storage and retrieval.

**Course Title: OBJECT ORIENTED PROGRAMMING USING C++ LAB**

**Course Code: BMA207**

| L | T | P | Credits |
|---|---|---|---|
| 0 | 0 | 2 | 1 |

**Total Hours- 15**

**Learning Outcomes:** After completion of this course, the learner will be able to:

1. Develop solutions for a range of problems using objects and classes.
2. Implement the concept of constructors, destructors and operator overloading
3. Apply algorithmic problems including type casting,
4. Understand the concept of Inheritance and polymorphism.

**Course Content**

1. Program to show the of use cin, cout practical
2. Program to implement the operators
3. Program based on decision making statement (if else)
4. Program based on the loops(while,do while)
5. Program based on loops(for),switch statement
6. Program based on structures and enumerated data types
7. Program based functions, overloaded functions
8. Program to show usage of storage classes.
9. Program to show usage of function overloading, default arguments
10. Program to show usage of classes, objects
11. Program to show usage of constructors, destructors
12. Program to manipulate arrays and array of objects
13. Program to manipulate strings.
14. Program to show usage of inheritance of various type (multiple, multilevel etc.)
15. Program to show usage of unary operator overloading
16. Program to show usage of binary operator overloading
17. Program for conversion from basic to user defined data type
18. Program for conversion from user defined to basic
19. Program to show usage of basics of pointers
20. Program to show usage of pointers and arrays.
21. Program to show usage of pointers, function arguments
22. Program to show usage of new, delete, memory management
23. Program to show usage of virtual function
24. Program to show usage of friend, static function
25. Program to show usage of overloaded assignment operator, this pointer

26. Program to read & write contents of a text file
27. Program to show usage of file pointers.
28. Program to show usage of command line arguments
29. Program to show usage of overloading of right & left shift operators.
30. Program to show usage of exception handling mechanism
31. Program to show usage of uncaught exception (), the exception and bad exception classes
32. Program to show usage of templates
33. Program to show usage of generic classes
34. Implementation of File handling
35. Implementation of Wrapper classes
36. Implementation of container classes

**Course Title: ENVIRONMENTAL SCIENCES**
**Course Code: BMA208**

| L | T | P | Credits |
|---|---|---|---|
| 2 | 0 | 0 | 2 |

**Total hours: 30**

**Learning Outcomes:** After completion of this course, the learner will be able to:

1. Identify environmental problems arising due to engineering and technological activities and the science behind those problems.
2. Estimate the population - economic growth, energy requirement and demand
3. Analyze material balance for different environmental systems.
4. Realize the importance of ecosystem and biodiversity for maintaining ecological balance. Identify the major pollutants and abatement devices for environmental management and sustainable development

**Course Content**

**UNIT-I** **5 Hours**

**Introduction:** Definition and scope and importance of multidisciplinary nature of environment. Need for public awareness.

**Natural Resources:** Natural Resources and associated problems, use and over exploitation, case studies of forest resources and water resources.

**UNIT-II** **10 Hours**

**Ecosystems:** Concept of Ecosystem, Structure, interrelationship, producers, consumers and decomposers, ecological pyramids-biodiversity and importance. Hot spots of biodiversity.

**Environmental Pollution:** Definition, Causes, effects and control measures of air pollution, Water pollution, Soil pollution, Marine pollution, Noise pollution, Thermal pollution, nuclear hazards. Solid waste Management: Causes, effects and control measure of urban and industrial wastes. Role of an individual in prevention of pollution. Pollution case studies. Disaster Management: Floods, earthquake, cyclone and landslides.

**UNIT-III** **10 Hours**

Social Issues and the Environment from Unsustainable to Sustainable development, urban problems related to energy, Water conservation, rain water harvesting, watershed management. Resettlement and rehabilitation of people; its problems and concerns.

Case studies. Environmental ethics: Issues and possible solutions. Climate change, global warming, acid rain, ozone layer depletion, nuclear accidents and holocaust. Case studies. Wasteland reclamation. Consumerism and waste products. Environment Protection Act. Air (Prevention and Control of Pollution) Act. Water (Prevention and control of pollution) Act. Wildlife Protection Act, Forest Conservation Act, Issues involved in enforcement of environmental legislation Public awareness.

**UNIT-IV** **5 Hours**

Human Population and the Environment, Population growth, variation among nations. Population explosion – Family Welfare Programme. Environment and human health, Human Rights, Value Education, HIV/AIDS. Women and child Welfare. Role of Information Technology in Environment and human health. Case studies.

**Transaction Mode**

Lecture, Seminar, e-Team Teaching, e-Tutoring, Dialogue, Peer Group Discussion, Mobile Teaching, Self-Learning, Collaborative Learning and Cooperative Learning.

Suggested Readings:


- *Goyal, A. (2020) Environmental Studies. Notion Press, New Delhi.*
- *Kaur, N & Goyal, A. (2014) Disaster Management. PBS Education, Jalandhar.*
- *Agarwal, K. C.(1998) Environment Biology, Nidi Publ. Ltd. Bikaner.*
- *Jadhav, H & Bhosale, V.M. (2001) Environment Protection and Laws. Himalaya Pub House, Delhi*
- *Rao M. N. & Datta A.K.(1997) Waste Water Treatment. Oxford & IBH Publ. Co. Pvt. Ltd.*

**Semester: III**

**Course Title: DISCRETE MATHEMATICS**

**Course Code: BMA301**

| L | T | P | Credits |
|---|---|---|---|
| 4 | 0 | 0 | 4 |

**Total Hours-60**

**Learning Outcomes:** After completion of this course, the learner will be able to:

1. Use mathematically correct terminology and notations
2. Construct correct direct and indirect proofs.
3. Use division into cases in a proof.
4. Analysis the counter examples.

**Course Content**

**UNIT I** **15 Hours**

**Sets, Relation and Function:** Operations and Laws of Sets, Cartesian Products, Binary Relation, Partial Ordering Relation, Equivalence Relation, Image of a Set, Sum and Product of Functions, Bijective functions, Inverse and Composite Function, Size of a Set, Finite and infinite Sets, Countable and uncountable Sets, Cantor's diagonal argument and The Power Set theorem, Schroeder-Bernstein theorem.

**Principles of Mathematical Induction:** The Well-Ordering Principle, Recursive definition, The Division algorithm: Prime Numbers, The Greatest Common Divisor: Euclidean Algorithm, The Fundamental Theorem of Arithmetic.

**UNIT II** **15 Hours**

Basic counting techniques-inclusion and exclusion, pigeon-hole principle, permutation and combination. Propositional Logic: Syntax, Semantics, Validity and Satisfiability, Basic Connectives and Truth Tables, Logical Equivalence: The Laws of Logic, Logical Implication, Rules of Inference, The use of Quantifiers. Proof Techniques: Some Terminology, Proof Methods and Strategies, Forward Proof, Proof by Contradiction, Proof by Contraposition, Proof of Necessity and Sufficiency.

**UNIT III** **15 Hours**

**Algebraic Structures and Morphism:** Algebraic Structures with one Binary Operation, Semi- Groups, Monoids, Groups, Congruence Relation and Quotient Structures, Free and Cyclic Monoids and Groups, Permutation Groups, Substructures, Normal Subgroups, Algebraic Structures with two Binary Operation, Rings, Integral Domain and Fields. Boolean algebra and Boolean Ring, Identities of Boolean Algebra, Duality, Representation of Boolean Function, Disjunctive and Conjunctive Normal Form.

**UNIT IV** **15 Hours**

**Graphs and Trees:** Graphs and their properties, Degree, Connectivity, Path, Cycle, Sub Graph, Isomorphism, Aurelian and Hamiltonian Walks, Graph Coloring, Coloring maps and Planar Graphs, Coloring Vertices, Coloring Edges, List Coloring, Perfect Graph, definition properties and Example, rooted trees, trees and sorting, weighted trees and prefix codes, Bi- connected component and Articulation Points, Shortest distances.

**Transaction Modes**

Lecture, Seminar, e-Team Teaching, e-Tutoring, Dialogue, Peer Group Discussion, Mobile Teaching, Self-Learning, Collaborative Learning and Cooperative Learning

**Suggested Readings**


- *J.P. Tremblay and R. Manohar. (1997). Discrete Mathematical Structure and Its Application to Computer Science". TMG Edition,Tatamcgraw-Hill.*
- *Norman L. Biggs. (2010). Discrete Mathematics. 2nd Edition, Oxford University Press. Schaum's Outlines Series, Seymour Lipschutz, MarcLipson.*
- *Mott, Abraham Kandel. (2011). Discrete Mathematic. TataMcGraw-Hill.*

**Course Title: OPERATING SYSTEM**

**Course Code: BMA302**

| L | T | P | Credits |
|---|---|---|---|
| 4 | 0 | 0 | 4 |

**Total Hours-60**

**Learning Outcomes:** After completion of this course, the learner will be able to:

1. Design the algorithms to write programs.
2. Understand the concept of arrays, pointers and structures to formulate algorithms and programs
3. Apply programming to solve simple numerical method problems, namely rot finding
4. Describe the Function, differentiation of function and simple integration

**Course Content**

**UNIT I** **15 Hours**

**Introduction:** Concept of Operating Systems, Generations of Operating systems, Types of Operating Systems, OS Services, System Calls, Structure of an OS - Layered, Monolithic, Microkernel Operating Systems, Concept of Virtual Machine. Case study on UNIX and WINDOWS Operating System**.**

**Processes:** Definition, Process Relationship, Different states of a Process, Process State transitions, Process Control Block (PCB), Context switching

**Thread:** Definition, Various states, Benefits of threads, Types of threads, Concept of multithreads,

**UNIT II** **15 Hours**

**Process Scheduling:** Foundation and Scheduling objectives, Types of Schedulers, Scheduling criteria: CPU utilization, Throughput, Turnaround Time, Waiting Time, Response Time; Scheduling algorithms: Pre-emptive and Non-pre-emptive, FCFS, SJF, RR; Multiprocessor scheduling: Real Time scheduling: RM and EDF.

**Inter-process Communication:** Critical Section, Race Conditions, Mutual Exclusion, Hardware Solution, Strict Alternation, Peterson's Solution, The Producer\ Consumer Problem, Semaphores, Event Counters, Monitors, Message Passing, Classical IPC Problems: Reader's & Writer Problem, Dinning Philosopher Problematic.

**Deadlocks:** Definition, Necessary and sufficient conditions for Deadlock, Deadlock Prevention, and Deadlock Avoidance: Banker's algorithm, Deadlock Recovery

**UNIT III** **15 Hours**

**Memory Management:** Basic concept, Logical and Physical address map, Memory allocation: Contiguous Memory allocation– Fixed and variable partition–Internal and External fragmentation and Compaction; Paging: Principle of operation – Page allocation –Hardware support for paging, Protection and sharing, Disadvantages of paging. Failures and recovery management.

**Virtual Memory:** Basics of Virtual Memory – Hardware and control structures – Locality of reference, Page fault, Working Set, Dirty page/Dirty bit – Demand paging, Page Replacement algorithms: Optimal, First in First Out (FIFO), Second Chance (SC), Not recently used (NRU) and Least Recently used (LRU).

**UNIT IV** **15 Hours**

**I/O Hardware:** I/O devices, Device controllers, Direct memory access Principles of I/O Software: Goals of Interrupt handlers, Device drivers, Device independent I/O software, Secondary-Storage Structure: Disk structure, Disk scheduling algorithms

**File Management:** Concept of File, Access methods, File types, File operation, Directory structure, File System structure, Allocation methods (contiguous, linked, indexed), Free-space management (bit vector, linked list, grouping), directory implementation (linear list, hash table), efficiency and performance.

**Transaction Modes**

Lecture, Seminar, e-Team Teaching, e-Tutoring, Dialogue, Peer Group Discussion, Mobile Teaching, Self-Learning, Collaborative Learning and Cooperative Learning

**Suggested Readings**


- *Charles Crowley. (1996). Operating System; A Design-oriented Approach. 1st Edition, Irwin Publishing.*
- *Gary J.Nutt, Addison. (2002). Operating Systems: A Modern Perspective. 2nd Edition Wesley.*
- *Maurice Bach, Prentice-Hall of India (1986). Design of the Unix Operation Systems. 8th Edition.*
- *Daniel P. Bovet, Marco Cesati, O'Reilly and Associates. (2005). Understanding the Linux Kernel. 3rd Edition*
- *Waddington, D. G., and D. Hutchison. (1999): "Resource partitioning in general purpose operating systems." ACM SIGOPS Operating Systems Review 33, no. 4*
- *Abraham Silberschatz,( 2021) Peter Baer Galvin, Greg Gagne, "Operating System Principles", 10th edition.*


***Web Links***

- *https://www.techtarget.com/whatis/definition/operating-system*
- *https://www.coursera.org/courses?query= operating system*
- *https://www.cse.iitb.ac.in/~mythili- operating-system*
- *https://computer.howstuffworks.com/web-operating-system.htm*

**Course Title: DESIGN & ANALYSIS OF ALGORITHMS**

**Course Code: BMA303**

| L | T | P | Credits |
|---|---|---|---|
| 4 | 0 | 0 | 4 |

**Total Hours: 60**

**Learning Outcomes:** After completion of this course, the learner will be able to:

1. Describe the greedy paradigm and develop the greedy algorithms.
2. Implement and examine the divide-and-conquer paradigm.
3. Develop the dynamic programming algorithms and evaluate their computational complexity.
4. Analysis the graphs to find shortest path.

**Course Content**

**UNIT I** **15 Hours**

**Introduction:** Algorithm and its importance, Mathematical foundations- Growth functions, Complexity analysis of algorithms.

**Divide and Conquer:** Basic technique and its application on Binary Search, Finding Maximum and Minimum and on sorting techniques such as Merge Sort, Quick Sort.

**UNIT II** **15 Hours**

**Greedy Algorithms:** General method, using greedy algorithm to solve Knapsack problem, Minimum-Cost spanning trees problem, Single source shortest path problem and Travelling salesperson problem.

**Dynamic Programming:** Introduction to dynamic programming and application of the algorithm to solve multistage graphs, all pair's shortest path problem and Knapsack problem.

**UNIT III** **14 Hours**

**Backtracking:** General backtracking algorithm, Application of backtracking to 8 Queens' problem, Sum of subsets, Graph coloring, Hamiltonian cycles and Knapsack problem.

**String Matching Algorithms:** Introduction, Brute Force algorithm, Rabin-Karp algorithm, KMP algorithm, and Boyer-Moore algorithm.

**UNIT IV** **16 Hours**

**NP-completeness and Approximation Algorithms:** Introduction to P, NP, NP-hard and Complete problems, Examples of NP-complete problems, Introduction to approximation algorithms, Absolute approximations, E-approximations . **Approximation algorithms using linear programming, randomization, and specialized techniques**.

**Transaction Modes**

Lecture, Seminar, e-Team Teaching, e-Tutoring, Dialogue, Peer Group Discussion, Mobile Teaching, Self-Learning, Collaborative Learning and Cooperative Learning

**Suggested Readings**


- *Ellis Horowitz, Sartaj Sahni and Sanguthevar Rajasekaran, "Fundamentals of Computer Algorithms" Galgotia Publications (Year 2002).*
- *Thomas H. Cormen, Charles E. Leiserson, Ronald Rivest, and Clifford Stein, "Introduction to Algorithms", MIT Press Year 1990.*
- *Sanjoy Dasgupta, Christos Papadimitriou, and Umesh Vazirani, "Algorithms", McGraw-Hill Education 2006.*
- *Michael T. Goodrich and Roberto Tamassia, "Algorithm Design: Foundations, Analysis, and Internet Examples", Wiley (Year 2002).*
- *Alfred V. Aho, John E. Hopcroft, and Jeffrey. D. Ullman, "The Design and Analysis of Computer Algorithms", Pearson Education 1974. 6. John Kleinberg and Eva Tardos, "Algorithm Design", Pearson Education 2005.*
- *T. H. CORMEN, C. E. LEISERSON, R. L. RIVEST, AND C. STEIN. Introduction to Algorithms, MIT Press, New York, 3rd edition, 2009.*
- *S. DASGUPTA, C. PAPADIMITRIOU, AND U. VAZIRANI. Algorithms, McGraw-Hill, New York, 2008*


***Web Links***

- *https://www.classcentral.com/course/swayam-Design-and-analysis-of-algorithms-*
- *https://vssut.ac.in/lecture_notes/lecture1428551222. Design-and-analysis-of-algorithms-*
- *https://sites.northwestern.edu/hartline/eecs-336-Design-analysis-of-algorithms.*

**Course Title: Computer Organization & Architecture**

**Course Code: BMA304**

| L | T | P | Credits |
|---|---|---|---|
| 4 | 0 | 0 | 4 |

**Total Hours-60**

**Learning Outcomes:** After completion of this course, the learner will be able to:

1. Understand the basic concept of computer fundamentals, Number system, Boolean algebra, Karnaugh map and Perform problems
2. Explain the concept of stored program, role of operating system, Instruction sets and Addressing modes and Demonstrate problems on Addressing modes.
3. Use of control unit and various I/O operations
4. Classify the concept of Instruction pipeline, RISC, CISC

**Course Content**

**UNIT I** **15 Hours**

**Functional blocks of a computer:** CPU, memory, input-output subsystems, control unit. Instruction set architecture of a CPU – registers, instruction execution cycle, RTL0interpretation of instructions, addressing modes, instruction set. Case study – instruction sets of some common cpus.

**Data representation:** signed number representation, fixed and floating-point representations, character representation. Computer arithmetic – integer addition and subtraction, ripple carry adder, carry look-ahead adder, etc. Multiplication – shift-and add, Booth multiplier, carry save multiplier, etc. Division restoring and non-restoring techniques, floating point arithmetic.

**UNIT II** **15 Hour**

**Introduction to x86 architecture:** CPU control unit design: hardwired and micro-program design approaches, Case study – design of a simple hypothetical CPU.

**Memory system design:** semiconductor memory technologies, memory organization.

**Peripheral devices and their characteristics:** Input-output subsystems, I/O device interface, I/O transfers-program controlled, interrupt driven and DMA, privileged and non-privileged instructions, software interrupts and exceptions. Programs and processes–role of interrupts in process state transitions, I/O device interfaces – SCII, US

**UNIT III** **14 Hours**

**Pipelining:** Basic concepts of pipelining, through put and speedup, pipeline hazards.

**Parallel Processors:** Introduction to parallel-processors, Concurrent access to Memory and cache coherency.

**UNIT IV** **16 Hours**

**Memory organization:** Memory interleaving, concept of hierarchical memory

organization, cache memory, cache size vs. Block size, mapping functions, replacement algorithms, write policies.

**Transaction Modes** Lecture, Seminar, e-Team Teaching, e-Tutoring, Dialogue, Peer Group Discussion, Mobile Teaching, Self-Learning, Collaborative Learning and Cooperative Learning

**Suggested Readings**


- *John P. Hayes. (1988). Computer Architecture and Organization. 3rd Edition, WCB/McGraw- Hill.*
- *William Stallings. (2016). Computer Organization and Architecture. Designing for Performance. 10th Edition, Pearson Education.*
- *Vincent P. Heuring and Harry F. Jordan. (2004). Computer System Design and Architecture, 2nd Edition by Pearson Education.*

**Course Title: OPERATING SYSTEM LAB**

**Course Code: BMA305**

| L | T | P | Credits |
|---|---|---|---|
| 0 | 0 | 4 | 2 |

**Total Hours-30**

**Learning Outcomes:** After completion of this course, the learner will be able to:

1. Acquire the knowledge of Linux operating system.
2. Develop and debug the various Linux commands.
3. Perform various shell commands.
4. Discuss shell programming & its concepts.

**Course Content**

**Installation Process of various operating systems**

1. **Commands for files & directories:** cd, ls, cp, md, rm, mkdir, rmdir. Creating and viewing files using cat. File comparisons. Disk related commands: checking disk free spaces. Processes in Linux, connecting processes with pipes, background processing, managing multiple processes. Manual help. Background process: changing process priority, scheduling of processes at command, batch commands, kill, ps, who, sleep. Printing commands, grep, fgrep, find, sort, Cal, banner, touch, file. File related commands ws, sat, cut, grep.
2. **Administrative commands:** ACCEPT DATE, LIBVOLUME, EXPORT commands, IMPORT commands, LOCK commands, MOVE commands, QUERY commands, REGISTER commands, ACTIVATE POLICYSET (Activate a new policy set), ASSIGN DEFMGMTCLASS)AUDIT commands, LDAPDIRECTORY, BACKUP commands , BEGIN EVENTLOGGING (Begin logging events), CANCEL commands, CHECKIN LIBVOLUME (Check a storage volume into a library), CHECKOUT LIBVOLUME (Check a storage volume out of a library), CLEAN DRIVE (Clean a drive), COMMIT (Control committing of commands in a macro), COPY commands, DEFINE commands, DELETE commands, DISABLE commands, DISMOUNT command, DISPLAY OBJNAME (Display a full object name), ENABLE commands, EXPORT commands, IMPORT commands, LOCK commands, MOVE commands, QUERY commands, REGISTER commands, PERFORM LIBACTION, PING SERVER, QUERY ,QUIT, RECLAIM STGPOOL, RECONCILE VOLUMES, REGISTER, REMOVE commands, RENAME commands, REPLICATE NODE, REPLY, RESET PASSEXP, PASSEXP, RESET , RESTART EXPORT, RESTORE commands, MACRO, MIGRATE STGPOOL, REVOKE commands, ROLLBACK, RUN, SET commands, SELECT, SETOPT, SHRED DATA (Shred data), SETOPT, SUSPEND EXPORT UNLOCK commands, UPDATE commands, VALIDATE commands, VARY, AUDIT commands, BACKUP commands, CANCEL commands, COPY commands.

3. **Shell Programming:** Basic of shell programming, various types of shell, Shell Programming in bash, conditional & looping statement, case Statement, parameter passing and arguments, shell variables, shell keywords, creating shell programs for automate system tasks, report printing.

**Course Title: DESIGN & ANALYSIS OF ALGORITHMS LAB**

**Course Code: BMA306**

| L | T | P | Credits |
|---|---|---|---|
| 0 | 0 | 4 | 2 |

**Total Hours-30**

**Learning Outcomes**: After completion of this course, the learner will be able to:

1. Examine randomized algorithms.
2. Analyze the performance of algorithms.
3. Describe and implement the dynamic-programming paradigm.
4. Examine and recognize the greedy paradigm.

**Course Content**

1. Write a program to implement bubble sort algorithm by comparing its complexity.
2. Write a program to implement linear search algorithm by comparing it complexity.
3. Write a program to implement binary search algorithm by comparing its complexity.
4. Write a program to implement PUSH operation in stacks.
5. Write a program to implement POP operation in stacks.
6. Write a program to implement Queues.
7. Write a program to insert an element in the beginning of the link list.
8. Write a program to delete an element from the middle of the link list.
9. Write a program to implement the concept of queen's problem.

**Course Title: Multimedia and Applications**

**Course Code: BMA307**

| L | T | P | Credits |
|---|---|---|---|
| 3 | 0 | 0 | 3 |

**Total Hours:45**

**Course Learning Outcome Outcomes**: On successful completion of this course, the students will be able to:

1. Describe technical characteristics and performance of multimedia system and terminals.
2. Design creative approach in application of multimedia devices, equipment and systems
3. Interpret and analyze measurement results obtained on the multimedia system and components,
4. Describe the development process and applications of the multimedia systems
5. Carry out experiments and measurements on the multimedia systems in laboratory conditions on real components

**Course Content**

**Unit-I** **10Hours**

**Introduction To Multimedia Technology -** computers, communication and entertainment framework for multimedia system, features of multimedia system, Multimedia Hardware devices& software development tools, M/M devices, presentation devices and the user interface, M/M presentation and authoring.

**Unit-II** **15Hours**

**Digital Representation Of Sound And Image**:-Digital representation of sound and transmission, Basics of Video, ,Types of Video Signals, Analog Video, Digital Video, brief survey of speech recognition and generation, digital video and image compression, JPEG image compression standard, MPEG motion video compression, DVI technology, timbered media representation and delivery.

**Unit-III** **10Hours**

**M/M Software**:-M/M software environments, limitations of workstation operating systems, M/M system services, OS support for continuous media applications, media stream protocol, M/M file system and information representation system, and data models for M/M and hypermedia information.

**Application of M/M**:-Application of M/M, intelligent M/M system.

**Unit-IV** **10Hours**

**Virtual Reality System**: Desktop VR, virtual reality OS, distributed virtual environment system, virtual environmental displays and orientation tracking, visually coupled systems requirements, intelligent VR software systems.

**Multimedia Communication:** Building Communication network, Application Subsystem, Transport Subsystem, QOS, Resource Management, Distributed Multimedia Systems.

**Uses:** Applications of environments in various fields such as medical entertainment, manufacturing, business, education etc.

**Suggested Readings**

1. **Stephen McGloughlim**, "Multimedia on the Web", PHI.
2. **Villamil-Casanova &Nolina**, "Multimedia production, planning & Delivery", PHI.
3. **Lozano,** "Multimedia sound & video", PHI.
4. **J. Jeefcoate,** "Multimedia in Practice Tech & application".

**Course Title: Cloud Computing**
**Course Code: BMA308**

| L | T | P | Cr |
|---|---|---|---|
| 3 | 0 | 0 | 3 |

**Total Hours: 45**

**Course Learning Outcome: On successful completion of this course, the students will be able to:**

1. Design Vision, Reference Model, Benefits, Limitations, Open Challenges, Grid and Utility Computing.
2. Demonstrate Service Models, Deployment Models, Cloud Entities, Cloud Clients, and Cloud Programming Models.
3. Describe Cloud Security: Infrastructure Security, Data Security, Identity and Access Management, Privacy Management, Security as a Service on Cloud
4. Resource Provisioning, Bill Management, Multitenancy and Isolation, Service Level Agreement (SLA) and Quality of Service (QoS)
5. Infrastructure Security, Data Security, Identity and Access Management, Privacy Management, Security as a Service on Cloud.

**Course Content**

**UNIT-I** **10 Hours**

**Cloud Computing:** Overview, Applications, Intranet and the Cloud, First Movers on the cloud, the need for Cloud Computing, Benefits of cloud Computing, Limitations of the

Cloud Computing, security concerns and regulatory issues, over view of different cloud computing applications which are implemented, Business case for implementing a Cloud.

**UNIT-II** **10 Hours**

**Cloud computing and Service Models:** Public, Private, and Hybrid Clouds, Cloud Ecosystem and Enabling Technologies, Infrastructure-as- a- Service (IaaS), Platform- and Software-as-a-Service (Paas, SaaS). Architectural Design of Compute and Storage Clouds: A Generic Cloud architecture Design, Layered Cloud Architectural development, Architectural Design Challenges. Cloud Standards: Applications, Client, Infrastructure, Services.

**UNIT-III** **10 Hours**

**Cloud Computing Mechanisms:** Software as a service: Overview, Driving Forces, Company offerings, Industries, Software services, Overview Mobile Device Integration, Providers, Microsoft Online Application development, Google, Microsoft, Intuit Quick base, Cast Iron Cloud, Bungee Connect, Development Platforms: Google, Sales Force, Azure, Trouble shooting, Application management

**UNIT-IV** **10 Hours**

**Local Clouds**: Virtualization, server solutions, Thin Clients

**Migrating to the clouds**: Cloud services for individuals, Mid-market, and Enterprise wide, Migration, best practices, analyzing the service.

**Suggested Readings**

1. Mastering Cloud Computing, RajkumarBuyya, Christian Vecchiola, and ThamaraiSelvi, Tata McGraw Hill, ISBN-13: 978-1-25-902995-0, New Delhi, India,Feb 2013.

2. Cloud Computing Bible, Barrie Sosinsky, Wiley India Pvt. Ltd, ISBN-13: 978- 81-265-2980-3, New Delhi, India, 2011.

3. Cloud Computing: Principles and paradigms, Raj Kumar Buyya, James Broberg, AndrezeiM.Goscinski, Wiley India Pvt. Ltd, ISBN-13: 978-81-265- 4125-6, New Delhi, India, 2011.

**REFERENCE BOOKS:**

1. Cloud Computing for Dummies, Fern Halper, Hurwitz, Robin Bloor, Marcia Kaufman, Wiley India Pvt. Ltd, ISBN-13: 978-0-47-0597422, New Delhi, India, 2011.

2. Dr. Saurabh Kumar, Cloud Computing: Insights into New-Era Infrastructure, Wiley India Pvt. Ltd, and ISBN-13: 978-8-12-6528837, New Delhi, India, 2011.

**Course Title: INTRODUCTION TO ARTIFICIAL INTELLIGENCE & MACHINE LEARNING**

**Course Code: BMA309**

| L | T | P | Credits |
|---|---|---|---|
| 2 | 0 | 0 | 2 |

**Total Hours-30**

**Learning Outcomes:** After completion of this course, the learner will be able to:

5. Design expert system by using AI tools.
6. Compare and develop expert system with the help of Neural Networks
7. Understand the concept of expert system using Machine Learning.
8. Create an expert system using Fuzzy Logic.

**Course Content**

**UNIT I** **10 Hours**

**Introduction:** What is AI, Importance of AI, Early work in AI, Applications of AI, Knowledge and its definition. Knowledge Representation: Prepositional logic, FOPL, Properties of Well-formed formulas, Conversion to Clausal form, Inference rules, Resolution principle.

**Structured Knowledge:** Introduction, Associate frame structures, Conceptual dependencies and scripts.

**UNIT II** **8 Hours**

**Knowledge Organization and Manipulation:** Concepts, Uninformed or Blind search, informed search, Searching- And-OR graphs, Pattern Recognition, Recognition Classification process, Classification patterns, Recognizing and understanding speech.

**Generative AI**: How does generative AI work? Generative AI models, what are Dall-E, ChatGPT and Bard, use cases, benefits and its limitations, Ethics and bias, Generative AI vs. AI, Generative AI history.

**UNIT III** **6 Hours**

**Planning:** planning as search, partial order planning, construction and use of planning graphs. Decision-Making: basics of utility theory, decision theory, sequential decision problems, elementary game theory and sample applications.

**UNIT IV** **6 Hours**

**Expert System:** Definition, Rule based architecture, dealing with uncertainty, Knowledge acquisition and validation, knowledge system building tools.

**Knowledge Acquisition:** Types of learning, General Learning model, Performance measures. Learning nearest neighbor, naive Bayes, and decision tree classifiers.

**Transaction Modes**

Lecture, Seminar, e-Team Teaching, e-Tutoring, Dialogue, Peer Group Discussion, Mobile Teaching, Self-Learning, Collaborative Learning and Cooperative Learning

**Suggested Readings**

- *Dan W. Patterson. (1990). Introduction to Artificial Intelligence and Expert Systems.PHI Publication.*
- *Peter Jackson. (1998). Introduction to Expert System. AddisonWesley.*

**Semester: IV**

| **Course Title: Introduction to Machine Learning with Python** | **L** | **T** | **P** | **Credits** |
|---|---|---|---|---|
| **Course Code: BMA401** | **4** | **0** | **0** | **4** |

**Total Hours- 60**

**Learning Outcomes**: After completion of this course, the learner will be able to:

1. The students will be able to handle various datatypes and datasets in python.
2. They will also be able to implement various machine learning models in python.

**Course Content**

**UNIT I** **10 Hours**

Introduction to Python: Data Types, Operators, Expression, Indexing & Slicing, Strings, Conditionals, Functions, Control Flow, Nested Loops, Sets & Dictionaries.

**UNIT II** **20 Hours**

Introduction to Machine Learning: Machine Learning Vs Statistical Modelling, Supervised vs Unsupervised Learning, Supervised Learning Classification, Unsupervised Learning, Reinforcement Learning, Applications, Python libraries suitable for Machine Learning: Pandas, Numpy, Scikit-learn, visualization libraries: matplotlib etc.

**UNIT III** **15 Hours**

Regression: Simple Linear Regression, Multiple Linear Regression, Non-linear Regression, Model Evaluation in Regression Models, Evaluation Metrics in Regression Models

Classification: Introduction to Classification, K-Nearest Neighbour, Decision Trees, Logistic Regression, Support Vector Machines, Logistic regression vs Linear regression, Evaluation Metrics in Classification.

**UNIT IV** **15 Hours**

Unsupervised Learning: Intro to Clustering, K-Means Clustering, Hierarchical Clustering, Density-Based Clustering, Content-based recommender systems, Collaborative Filtering.

**Transaction Modes**

Lecture, Seminar, e-Team Teaching, e-Tutoring, Dialogue, Peer Group Discussion, Mobile Teaching, Self-Learning, Collaborative Learning and Cooperative Learning.

**Suggested Readings**


- Kevin Murphy, Machine Learning: A Probabilistic Perspective, MIT Press, 2012
- Trevor Hastie, Robert Tibshirani, Jerome Friedman, The Elements of Statistical Learning, Springer (2009) (freely available online)
- Christopher Bishop, Pattern Recognition and Machine Learning, Springer, 2007.
- Tamodt, Agnar, and Enric Plaza. "Case-based reasoning: Foundational issues, methodological variations, and system approaches." AI communications

**Course Title: JAVA PROGRAMMING**

**Course Code: BMA402**

| L | T | P | Credits |
|---|---|---|---|
| 4 | 0 | 0 | 4 |

**Total Hours: 60**

**Learning Outcomes:** After completion of this course, the learner will be able to:

1. Discuss the basic concepts of java like if-else, control structures, array and strings.
2. Classify the structure and model of the Java programming language.
3. Synthesize Java programming language for various programming technologies
4. Develop software in the Java programming language on different platforms.

**Course Content**

**UNIT I** **15 Hours**

**An overview of Java:** Object oriented programming, Two paradigms, abstraction, the OOP principles, Java class libraries

**Date types, variables and arrays:** Integers, floating-point types, characters, Boolean, Iterates, Variable, Data types and casting, array operators.

**Operators:** Arithmetic operators, bit wise operators, relational operators, Boolean logical operators, assignment operators, operator precedence

**Control Statement:** Java's selection Statement, iteration Statement, jumps Statement.

**Introduction to classes:** Class fundamentals, declaring object reference variable, introducing methods, constructors, the keywords, garbage collection, the finalize () method.

**Methods and Classes:** Overloading methods, using objects as parameters, recursion.

**UNIT II** **15Hours**

**Inheritance:** Inheritance basics, using super, method overriding, dynamic method dispatch, using abstract Classes, using final with inheritance, Package and Interfaces, Package protection, importing packages

**Exception handling:** Exception handling fundamentals, Exception types, Uncaught Exceptions, using try and catch, multiple catch clauses, nested try Statement throw, and finally Java built in exception creating your own exception, sub classes, using exceptions

**UNIT III** **15 Hours**

**Multithreaded Programming:** The Java thread model, the main thread, creating thread, creating multiple thread, using is alive () and join (). Thread priorities, synchronization, inter thread communications, suspending resuming and stopping thread using multithreading.

**String handling:** The string constructor, string length, special string operator character extraction, string comparison, searching string, modifying string, data conversion, changing the case of characters, string buffer.

**UNIT IV** **15Hours**

**Networking:** Networking basics, Java and the Internet Address, TCP/IP client Sockets URL, URL connection, TCP/IP server Sockets, the Applet Class. Stream API

**The Applet Class:** Architecture displays method, The HTML APPLET, Passing parameters to Applet. The get Documentation Base () and get Code Base () methods Applet Context and Show Document ().

**Micro servicing**: Standards and Syntax, Advantages of Micro services, Java Micro Services Framework, Spring Cloud and Spring Boot, Different strategies used in Micro service deployment, Domain-Driven Design containers in Microservices, Contract Testing, Monolithic, SOA, and Micro Services Architecture, Docker, DC, Bounded Context

**Transaction Modes**

Lecture, Seminar, e-Team Teaching, e-Tutoring, Dialogue, Peer Group Discussion, Mobile Teaching, Self-Learning, Collaborative Learning and Cooperative Learning

**Suggested Readings**


- *McGraw-Hill. (1999). Java 2 Computer Reference. Tata McGraw Hill.*
- *Horstmann. (2018). Core Java-I. Addison Wesley.*
- *E Balagurusami. (2006). Programming with JAVA. Tata McGraw-Hill Education.*
- *Ken Arnold, James Gosling and David Holmes, "The Java Programming Language", 4th ed, 2005.*
- *Bruce Eckel, "Thinking in Java", 4th ed, 2007.*


**Web Links**

- *https://www.codementor.io/@sureshatta/11-websites-that-help- Java Programming*
- *https://www3.ntu.edu.sg/home/ehchua/programming/howto/References.html- Java Programming*
- *https://www.tradepub.com/free-offer/advanced-java-tutorial/w_java34?sr=hicat&_t=hicat:827- Java Programming*

**Course Title: RELATIONAL DATABASE MANAGEMENT SYSTEM**

**Course Code: BMA403**

| L | T | P | Credits |
|---|---|---|---|
| 4 | 0 | 0 | 4 |

**Total Hours: 60**

**Learning Outcomes:** After completion of this course, the learner will be able to:

1. Develop the queries using SQL, solutions to a broad range of query and data update problems.
2. Describe various database concepts and database management system software.
3. Understand the major DBMS components and their function.
4. Design a model an application's data requirements using conceptual modeling tools like ER diagrams and design database schemas based on the conceptual model.

**Course Content**

**UNIT I** **15 Hours**

**Database Management:** Introduction, Types of DBMS and their advantages and disadvantages, Characteristics of Database Approach, Data Models, Data Abstraction and Knowledge Representation, Database Language.

**DBMS Architecture and Data Independence:** Attributes and Keys, Relationships, Relationship Types, Roles, ER Diagrams, Relational Model concepts, functional dependence.

**UNIT II** **15 Hours**

**SQL, PL SQL, SQL *PLUS, Managing Database and Queries:** Creating, Defining and Modifying Table structure, Update Operations and Dealing with Constraint Violations, Basic Relational Algebra Operations, Example of Queries in Relational Algebra, The Tuple Relational Calculus, The Domain Relational Calculus, granting and revoking privileges.

**UNIT III** **15 Hours**

**Normalization:** Overview of Recovery and Backup, Normalization & its forms.

**Transaction:** Processing Concurrency control, ACID property, Serializability of scheduling, Locking and timestamp-based schedulers, multi-version and optimistic Concurrency Control schemes. Database recovery.

**UNIT IV** **15 Hours**

**Database Security:** Authentication, Authorization and access control, DAC, MAC and RBAC models, Intrusion detection, Integrity in Data Base. Types of Integrity, SQL injection.

**SQL Server:** Introduction to SQL Server and Oracle Server, Indexes, Views, Cursors, Packages, Triggers, Stored Procedures.

**No SQL**: Introduction to NoSQL, Key Features, Advantages and Disadvantages of NoSQL, Types of NoSQL database.

**Non-relational data and NoSQL**: Document data stores, columnar data stores, Key/value data stores, Graph data stores, Object data stores, External index data stores, typical requirements.

**Transaction Modes**

Lecture, Seminar, e-Team Teaching, e-Tutoring, Dialogue, Peer Group Discussion, Mobile Teaching, Self-Learning, Collaborative Learning and Cooperative Learning

**Suggested Readings**


- *J. D. Ullman,Computer Science Press. (2016). Principles of Database and Knowledge–Base Systems. Vol1*
- *R. Elmasri and S. Navathe,Pearson Education.(1905). Fundamentals of Database System.5th Edition*
- *Serge Abiteboul, Richard Hull, Victor Vianu,Addison-Wesley. (1995). Foundations of Databases Reprint.*
- *Peter Rob and Carlos Coronel, Database Systems Design, Implementation and Management, Thomson Learning-Course Technology, Seventh Edition, 2007.*
- *Shio Kumar Singh, Database Systems Concepts, Designs and Application, Pearson Education, Second Edition, 2011.*


**Web Links**

- https://cloud.google.com/learn/- Relational Database Management System
- https://codeinstitute.net/global/blog/what-is-a-relational-database-management-system/- Relational Database Management System
- https://zenkit.com/en/blog/everything-you-need-to-know-about-web-databases/- Relational Database Management System

**Course Title: Introduction to Robotics**

**Course Code: BMA404**

| L | T | P | Credits |
|---|---|---|---|
| 4 | 0 | 0 | 4 |

**Total Hours-60**

**Learning Outcomes:** After completion of this course, the learner will be able to:
1. Understand the basics of robotics
2. Understand game playing concepts involving robotics and AI.
3. Apply robotics to create robot driven systems.
4. Analyze and co-relate robotics with AI and use in real-world applications

**Course Content**

**UNIT I** **15 Hours**

Introduction: Introduction to Robotics Fundamentals of Robotics, Robot Kinematics: Position Analysis, Dynamic Analysis and Forces, Robot Programming languages & systems: Introduction, the three levels of robot programming, requirements of a robot programming language, problems peculiar to robot programming languages.

**UNIT II** **10 Hours**

Need of AI in Robotics: History, state of the art, Need for AI in Robotics. Thinking and acting humanly, intelligent agents, structure of agents.

**UNIT III** **15 Hours**

Game Playing: AI and game playing, plausible move generator, static evaluation move generator, game playing strategies, problems in game playing.

**UNIT IV** **20 Hours**

Robotics fundamentals: Robot Classification, Robot Specification, notation, kinematic representations and transformations, dynamics techniques; trajectory planning and control.

Robotics and Its applications: DDD concept, Intelligent robots, Robot anatomy-Definition, law of robotics, History and Terminology of Robotics-Accuracy and repeatability of Robotics-Simple problems-Specifications of Robot-Speed of Robot, Robot joints and links-Robot classifications-Architecture of robotic systems-Robot Drive systems-Hydraulic, Pneumatic and Electric system

**Suggested References:**

1. Robotics, Vision and Control: Fundamental Algorithms in MATLAB, Peter Corke, Springer, 2011.

2. Robotics: Everything You Need to Know About Robotics from Beginner to Expert, Peter McKinnon, Createspace Independent Publishing Platform, 2016.
3. Introduction to AI Robotics, Second Edition, By Robin R. Murphy, MIT press, 2001.
4. Artificial Intelligence for Robotics: Build intelligent robots that perform human tasks using AI techniques, Francis X. Govers, Packt Publishers, 2018.

**Course Title:**

**RELATIONAL DATABASE MANAGEMENT SYSTEM LAB**

**Course Code: BMA405**

| L | T | P | Credits |
|---|---|---|---|
| 0 | 0 | 2 | 1 |

**Total Hours: 15**

**Learning Outcomes:** After completion of this course, the learner will be able to:

1. Explain the features of database management systems and Relational database.
2. Design conceptual models of a database using ER modeling or real-life Applications and also construct queries in Relational Algebra.
3. Create and populate a RDBMS for a real-life application, with constraints and keys, using SQL.
4. compile any type of information from a data base by formulating complex queries in SQL.

**Course Content**

**List of Experiments:**

1. Introduction to SQL and installation of SQL Server / Oracle.
2. Data Types, Creating Tables and Retrieval of Rows using Select Statement, Conditional Retrieval of Rows, Alter and Drop Statement.
3. Working with Null Values, matching a Pattern from a Table, Ordering the Result of a Query, Aggregate Functions, Grouping the Result of a Query, Update and Delete Statement.
4. Set Operators, Nested Queries, Joins, Sequences.
5. Views, Indexes, Database Security and Privileges: Grant and Revoke Commands, Commit and Rollback Commands.
6. PL/SQL Architecture, Assignments and Expressions, Writing PL/SQL Code, Referencing, Non-SQL parameters.
7. Stored Procedures and Exception Handling.
8. Triggers and Cursor Management in PL/SQL.
9. Suggested Tools – My SQL, DB2, Oracle, SQL Server 2012

**Course Title:**

**Introduction to Machine Learning with python LAB**

**Course Code: BMA406**

| L | T | P | Credits |
|---|---|---|---|
| 0 | 0 | 4 | 2 |

**Total Hours: 30**

**Learning Outcomes:** After completion of this course, the learner will be able to:
The students will be able to handle various datatypes and datasets in python. They will also be able to implement various machine learning model sin python.

**Course Content**

**List of Experiments:**

1. Classification and regression algorithms.
2. Artificial Neural Network (with back-propagation).
3. Mathematical computing with Python packages like: numpy, Mat- plotLib, pandas Tensor Flow, Keras.
5. Implement basic ML models like SVM, KNN, K-Means, Logistic Regression, Linear Regression

**Course Title: JAVA PROGRAMMING LAB**

**Course Code: BMA407**

| L | T | P | Credits |
|---|---|---|---|
| 0 | 0 | 2 | 1 |

**Total Hours: 15**

**Learning Outcomes:** After completion of this course, the learner will be able to:

1. Solve the computational problems using basic statements like if-else, control structures, array, and strings.
2. Learn about the user requirements for software functionality and Run software applications in Java programming language.
3. Know about basic principles of creating Java applications with Applet programming.
4. Develop a given program using the basic elements like Control and Conditional statements

**Course Content**

**List of Programs:**

1. Introduction to JAVA, its features & basic program
2. Write a program for Operators in JAVA
3. Write a program to show use of IF-Else Statements in JAVA
4. Write a program use switch case in JAVA
5. Write a program to use looping in JAVA
6. Write a program to use methods in JAVA
7. Write a program to create class and objects
8. Write a program to use Method Overloading a method overriding
9. Write a program to use Final Keyword.
10. Write a program to show Implementation of Array.
11. Write a program to show Implementation of Inheritance
12. Write a program to show creation and use of package
13. Write a program to show use of Interface
14. Write a program to apply replace, concate methods on String.
15. Write a program to sort strings of array
16. Write a program to Show Implementation of Threads
17. Write a program to create applet
18. Write a program to create applet with passing parameters
19. Write a program to show use of Exception Handling
20. Write a program to make usage of JAVA lang.awt package and design GUI.
21. Usage of event handling in Java GUI (Graphical user interface) programs.

**Course Title: Data ware Housing & Data Mining**

**Course Code: BMA408**

| L | T | P | Credits |
|---|---|---|---|
| 3 | 0 | 0 | 3 |

**Total Hours: 45**

**Course Learning Outcome: On successful completion of this course, the students will be able to:**

1. Design and deploy appropriate classification techniques
2. Cluster the high dimensional data for better organization of the data
3. Discover the knowledge imbibed in the high dimensional system
4. Evolve Multidimensional Intelligent model from typical system
5. Evaluate various mining techniques on complex data objects

**Course Content**

**UNIT-1** **10 Hours**

Need for strategic information, difference between operational and Informational data stores Data warehouse definition, characteristics, Data warehouse role and structure, OLAP Operations, Data mart, Different between data mart and data warehouse, Approaches to build a data warehouse, Building a data warehouse, Metadata & its types.

**UNIT-II** **10 Hours**

**Data Pre-processing:** Need, Data Summarization, Methods. De-normalization, Multidimensional data model, Schemas for multidimensional data (Star schema, Snowflake Schema, Fact Constellation Schema, Difference between different schemas. Data warehouse architecture, OLAP servers, Indexing OLAP Data, OLAP query processing, Data cube computation

**UNIT-III** **10 Hours**

**Data Mining:** Definition, Data Mining process, Data mining methodology, Data mining tasks, Mining various Data types & issues. Attribute-Oriented Induction, Association rule mining, Frequent itemset mining, The Apriori Algorithm, Mining multilevel association rules.

**UNIT-IV** **15 Hours**

Overview of classification, Classification process, Decision tree, Decision Tree Induction, Attribute Selection Measures. Overview of classifier's accuracy, Evaluating classifier's accuracy, Techniques for accuracy estimation, increasing the accuracy of classifier. Introduction to Clustering, Types of clusters, Clustering methods, Data visualization & various data visualization tools.

**Suggested Readings**

1. Data Warehousing, Data Mining &Olap by Berson, Tata McGraw- Hill.

2. Han J., Kamber M. and Pei J., Data mining concepts and techniques, Morgan Kaufmann Publishers (2011) 3rd ed.

3. Pudi V., Krishana P.R., Data Mining, Oxford University press, (2009) 1st ed.

4. Adriaans P., Zantinge D., Data mining, Pearson education press (1996), 1st Ed.

5. Pooniah P., Data Warehousing Fundamentals, Willey interscience Publication, (2001)

**Course Title: Big Data**

**Course Code: BMA409**

| L | T | P | Cr |
|---|---|---|---|
| 3 | 0 | 0 | 3 |

**Total Hours:45**

**Course Learning Outcome Outcomes**: On successful completion of this course, the students will be able to:

1. Develop a dynamic webpage by using java script.
2. Connect a java program to a DBMS.
3. Design a well formed and valid XML and DHTML document.
4. Write a server side java application called Servlet to update and delete operations on DBMS table.
5. Design a page for internal links; when the user clicks on different links on the web page it should go to the appropriate locations/sections in the same page.

**Course Content**

**UNIT-I** **10 Hours**

Introduction to Big Data: Overview of Big Data, Stages of analytical evolution, Challenges of Conventional Systems, Intelligent data analysis, Nature of Data, Analytic Processes and Tools, Analysis vs. Reporting, Modern Data Analytic Tools, Statistical Concepts: Sampling Distributions - Re-Sampling, Statistical Inference - Prediction Error

**UNIT-II** **10 Hours**

Mining Data Streams: Introduction To Streams Concepts, Stream Data Model and Architecture, Stream Computing, Sampling Data in a Stream, Filtering Streams, Counting Distinct Elements in a Stream, Estimating Moments, Counting Oneness in a Window, Decaying Window, Real time Analytics Platform(RTAP) Applications

**UNIT-III** **15 Hours**

Hadoop: History of Hadoop, The Hadoop Distributed File System, Components of Hadoop, Analyzing the Data with Hadoop, Scaling Out- Hadoop Streaming, Design of HDFS-Java interfaces to HDFSBasics, Developing a Map Reduce Application, How Map Reduce Works, Anatomy of a Map Reduce Job run-Failures, Job Scheduling-Shuffle and Sort, Task execution, Map Reduce Types and Formats, Map Reduce Features

**UNIT-IV** **10 Hours**

Frameworks: Applications on Big Data Using Pig and Hive, Data processing operators in Pig Hive services, HiveQL, Querying Data in Hive, Fundamentals of HBase and Zookeeper, Visualizations: Visual data analysis techniques, interaction techniques. Systems and applications

**Suggested Readings**


1. Michael Berthold, David J. Hand.(2007*). Intelligent Data Analysis. Springer.*
2. Chris Eaton, Dirk DeRoos, Tom Deutsch, George Lapis, Paul Zikopoulos.(2012).*Understanding Big Data: Analytics for Enterprise ClassHadoop and* Tom White, Hadoop.(2012). *The Definitive Guide Third Edition. O'reillyMedia.*
3. AnandRajaraman and Jeffrey David Ullman.(2012). *Mining of Massive Datasets.* Cambridge UniversityPress.
4. Bill Franks. (2012*). Taming the Big Data Tidal Wave: Finding Opportunitiesin Huge Data Streams with Advanced B Analytics.* JohnWiley&sons.


**Semester: V**

**Course Title: FORMAL LANGUAGE & AUTOMATA THEORY**

**Course Code: BMA501**

| L | T | P | Credits |
|---|---|---|---|
| 4 | 0 | 0 | 4 |

**Total Hours: 60**

**Learning Outcomes:** After completion of this course, the learner will be able to:

1. Write a formal notation for strings, languages and machines.
2. Design finite automata to accept a set of strings of a language.
3. Formulate the context free grammars to generate strings of context free language.
4. Determine equivalence of languages accepted by Push Down Automata and languages

**Course Content**

**UNIT I** **15 Hours**

**Formal Languages:** Basics of strings, alphabets, grammar, formal language, Chomsky classification of languages, languages and their relation, operations on languages, Closure properties of language classes.

**Regular grammar:** Regular grammars, Regular expressions, Algebraic method using Arden's theorem, Equivalence of Finite Automata and Regular expressions, Properties of regular languages, pumping lemma.

**UNIT II** **15 Hours**

**Theory of Computation:** Deterministic Finite Automata, Acceptance by Finite Automata, Transition systems, Non-Deterministic Finite Automata, Equivalence of DFA and NDFA, Moore and Mealy machines, Equivalence of Moore and Mealy machine, Minimization of Finite Automata, Applications and limitations of Finite Automata.

**UNIT III** **15 Hours**

**Context Free Language:** Derivation, ambiguity, simplification of context free grammar, normal forms- Chomsky Normal Form, Greibach Normal Form, pumping lemma. Context Sensitive Language, The model of Linear Bounded Automata, Relation between Linear Bounded Automata and Context Sensitive Language

**UNIT IV** **15 Hours**

**Push down Automata:** Description and Definition, acceptance by Push down Automata, Equivalence of Push down Automata and context free grammars and languages.

**Turing Machine:** Definition and Model, Representation of Turing Machine, Design of Turing Machine, Variants of Turing Machine, Decidability and Recursively Enumerable Languages, Halting Problem, Post Correspondence Problem.

**Transaction Modes**

Lecture, Seminar, e-Team Teaching, e-Tutoring, Dialogue, Peer Group Discussion, Mobile Teaching, Self-Learning, Collaborative Learning and Cooperative Learning

**Suggested Readings**


- *Harry R. Lewis and Christos H. Papadimitriou. (1998). Elements of the Theory of Computation.*
- *Pearson Education Asia.*
- *Dexter C. Kozen. (1997). Automata and Computability. Undergraduate Texts in Computer*
- *Science, Springer.*
- *Michael Sipser. (1997). Introduction to the Theory of Computation.PWS Publishing.*
- *John Martin. (2007). Introduction to Languages and The Theory of Computation. Tata McGrawHill.*
- *Hopcroft J.E., Ullman J.D. (2006). Introduction to Automata Theory, Languages, and Computation (3rd Edn). Reading, MA: Addison-Wesley.*
- *Lewis F.D. (2007). Essentials of Theoretical Computer Science.*


**Web Links**

- *https://stackoverflow.com/questions/17252374/what-are-the-best-sites-to-learn-about- Formal Language & Automata Theory*
- *https://www.udemy.com/course/formal-languages-and-automata-theory-e/- Formal Language & Automata Theory*
- *https://eecs.wsu.edu/~ananth/CptS317- Formal Language & Automata Theory*

**Course Title: COMPUTER NETWORKS**

**Course Code: BMA502**

| L | T | P | Credits |
|---|---|---|---|
| 4 | 0 | 0 | 4 |

**Total Hours - 60**

**Learning Outcomes:** After completion of this course, the learner will be able to:

1. Understand the fundamentals of computer networking.
2. Learn the basic terminology of the computer networking area.
3. Analysis the various congestion control algorithms.
4. Describe the functions of the different layer of the OSI Protocol.

**Course Content**

**UNIT I** **12 Hours**

**Data Communication Components:** Representation of data and its flow Networks, Various Connection Topology, Protocols and Standards, OSI model, Transmission Media, LAN: Wired LAN, Wireless LANs, Connecting LAN and Virtual LAN.

**Techniques for Bandwidth utilization:** Multiplexing - Frequency division, Time division and Wave division, Concepts on spread spectrum.

**UNIT II** **18 Hours**

**Data Link Layer and Medium Access Sub Layer:** Error Detection and Error Correction - Fundamentals, Block coding, Hamming Distance, CRC; Flow Control and Error control protocols - Stop and Wait, Go back – N ARQ, Selective Repeat ARQ, Sliding Window, Piggybacking, Random Access, Multiple access protocols -Pure ALOHA, Slotted ALOHA, CSMA/CDCDMA/CA

**Network Layer:** Switching, Logical addressing – IPV4, IPV6; Address mapping – ARP, RARP, BOOTP and DHCP–Delivery, Forwarding and Unicast Routing protocols.

**UNIT III** **15 Hours**

**Transport Layer:** Process to Process Communication, User Datagram Protocol (UDP), Transmission Control Protocol (TCP), SCTP Congestion Control; Quality of Service, QoS improving techniques: Leaky Bucket and Token Bucket algorithm.

**UNIT IV** **15 Hours**

**Application Layer:** Domain Name Space (DNS), DDNS, TELNET, EMAIL, File Transfer Protocol (FTP), WWW, HTTP, SNMP, Bluetooth, Firewalls, and Basic concepts of Cryptography.

**Transaction Modes**

Lecture, Seminar, e-Team Teaching, e-Tutoring, Dialogue, Peer Group Discussion, Mobile Teaching, Self-Learning, Collaborative Learning and Cooperative Learning

**Suggested Readings**


- *Andrew S. Tanenbaum, Pearson New International Edition. (2013). Computer Networks. 8th Edition.*

- *Prentice Hall of India. (2015). Internetworking with TCP/IP Volume 1. 6th Edition Douglas Comer.*
- *W. Richard Stevens, Addison-Wesley, United States of America. (2005). TCP/I Illustrated. Volume1.*
- *Kurose, J.F. and K.W. Ross (2003) Computer Networking: A Top Down Approach Featuring the Internet, Addison Wesley.*
- *Mir, N.F. (2006) Computer and Communication Networks, Prentice Hall*

**Course Title: Deep Learning**

**Course Code: BMA503**

| L | T | P | Credits |
|---|---|---|---|
| 4 | 0 | 0 | 4 |

**Total Hours-60**

**Learning Outcomes:** After completion of this course, the learner will be able to:
To introduce the fundamentals of deep learning and the main research activities in this field. To learn architectures and optimization methods for deep neural network training

**Course Contents:**

**UNIT I** **12 Hours**

Introduction: History of Deep Learning, McCulloch Pitts Neuron, Multilayer Perceptrons (MLPs), Representation Power of MLPs, Sigmoid Neurons, Feed Forward Neural Networks, Back propagation.

**UNIT II** **12 Hours**

Module 2: Activation functions and parameters, Gradient Descent (GD), Momentum Based GD, Nesterov Accelerated GD, Stochastic GD, Principal Component Analysis and its interpretations, Singular Value Decomposition, Parameters v/s Hyper-parameters

**UNIT III** **18 Hours**

Auto-encoders & Regularization, Auto encoders and relation to PCA, Regularization in auto encoders, Denoising auto encoders, Sparse auto encoders, Regularization: Bias Variance Tradeoff, L2 regularization, Early stopping, Dataset augmentation, Encoder Decoder Models, Attention Mechanism, Attention over images, Batch Normalization

**UNIT IV** **18 Hours**

Deep Learning Models : Introduction to CNNs, Architecture, Convolution/pooling layers, CNN Applications, LeNet, AlexNet, ZF-Net, VGGNet, GoogLeNet, ResNet. Introduction to RNNs, Back propagation through time (BPTT), Vanishing and Exploding Gradients, Truncated BPTT, GRU, LSTMs

Deep Learning Applications : Image Processing, Natural Language Processing, Speech recognition, Video Analytics

**Suggested Readings**

1.Deep Learning, Ian Goodfellow Yoshua Bengio Aaron Courville, MIT Press, 2017

2.Neural Networks and Deep Learning, Michael Nielsen,, Determination Press

**Reference Books**

1. Deep Learning Step by Step with Python, N D Lewis, 2016

**Course Title: Deep Learning LAB**

**Course Code: BMA504**

| L | T | P | Credits |
|---|---|---|---|
| 0 | 0 | 4 | 2 |

**Total Hours: 30**

**Learning Outcomes:** After completion of this course, the learner will be able to:

1. Understand the methods and terminologies involved in deep neural network, differentiate the learning methods used in Deep-nets.
2. Identify and apply suitable deep learning approaches for given application.
3. Design and develop custom Deep-nets for human intuitive applications
4. Design of test procedures to assess the efficiency of the developed model.

**Course Content**

**List of Programs:**

1. Demonstration and implementation of Shallow architecture, using Python, Tensorflow and Keras.
2. Hyper parameter tuning and regularization practice -
   - Multilayer Perceptron (BPN)
   - Mini-batch gradient descent
3. Convolution Neural Network application using Tensorflow and Keras,
   - Classification of MNIST Dataset using CNN
   - Face recognition using CNN
4. Object detection using Transfer Learning of CNN architectures
5. Image denoising (Fashion dataset) using Auto Encoders
   - Handling Color Image in Neural Network aka Stacked Auto Encoders (Denoising)
6. Text processing, Language Modeling using RNN
7. Transfer Learning models for classification problems
8. Sentiment Analysis using LSTM
9. Image generation using GAN

**Course Title: PROJECT -I**

**Course Code: BMA505**

| L | T | P | Credits |
|---|---|---|---|
| 0 | 0 | 4 | 2 |

**Total Hours: 30**

**Learning Outcomes:** After completion of this course, the learner will be able to:

1. Use latest multimedia devices and programming software.
2. Design and construct a hardware and software system, component or process to meet desired needs.
3. Understand the multidisciplinary applications Problems.
4. Examine work as professionals, with portfolio ranging from data management, network configuration, designing hardware, database and software design to management and administration of entire systems.

**Course Content**

1. Project should include following phases: System Analysis and Design
2. Coding - Implementation Testing
3. It should be a working project Must have a future perspective
4. The Domain of project can be from: Databases
5. Application software
6. System software
7. Multimedia
8. Web Applications, etc.

A complete project report must be submitted along with softcopy of project. Project report may include Requirements of Project, Flow Chart, DFD's, Coding and Test Results

**Course Title: Optimization Techniques in Machine Learning**

**Course Code: BMA506**

| L | T | P | Credits |
|---|---|---|---|
| 4 | 0 | 0 | 4 |

**Total Hours: 60**

**Learning Outcomes:**

1. The students will be able to understand and analyze how to deal with changing data.
2. They will also be able to identify and interpret potential unintended effects in your project.
3. They will understand and define procedures to operationalize and maintain your applied machine learning model.

**Course Contents:**

**UNIT I** **18 Hours**

Introduction : What is optimization, Formulation of LPP, Solution of LPP: Simplex method, Basic Calculus for optimization: Limits and multivariate functions, Derivatives and linear approximations: Single variate functions and multivariate functions.

**UNIT II** **10 Hours**

Machine Learning Strategy : ML readiness, Risk mitigation, Experimental mindset, Build/buy/partner, setting up a team,Understanding and communicating change.

**UNIT III** **12 Hours**

Responsible Machine Learning :

AI for good and all, Positive feedback loops and negative feedback loops, Metric design and observing behaviours, Secondary effects of optimization, Regulatory concerns.

**UNIT IV** **20 Hours**

Machine Learning in production and planning :

Integrating info systems, users break things, time and space complexity in production, when to retain the model? Logging ML model versioning, Knowledge transfer, Reporting performance to stakeholders.

Care and feeding of your machine learning model :

MLPL Recap, Post deployment challenges, QUAM monitoring and logging, QUAM Testing, QUAM maintenance, QUAM updating, Separating Datastack from Production, Dashboard Essentials and Metrics monitoring.

**Text Books/Suggested References:**

1. Jeeva Jose, Introduction to Machine Learning, Khanna Book Publishing 2020.
2. Rajiv Chopra, Machine Learning, Khanna Book Publishing 2021
3. Optimization for Machine Learning, Suvrit Sra, Sebastian Nowozin and Stephen J. Wright, MIT Press, 2011.
4. Optimization in Machine Learning and Applications, Suresh Chandra Satapathy, Anand J. Kulkarni, Springer, 2019.

**Course Title: SOFT COMPUTING**

**Course Code: BMA507**

| L | T | P | Credits |
|---|---|---|---|
| 3 | 0 | 0 | 3 |

**Total Hours-45**

**Learning Outcomes:** After completion of this course, the learner will be able to:

1. Determine Working of a simple Genetic Algorithm and the related definitions: Representation/Encoding Schemes, initializing a GA population
2. Analysis the concept of Neural Networks.
3. Examine the Genetic Algorithm variations: Scaling fitness, Niching and speciation, Crowding Technique for Multimodal Problems.
4. Understand the basic terminology and definitions, Model of an artificial neuron, Sigmoid function, Neural Network Architectures, Characteristics of neural networks, Learning methods, Rosenblatt's Perception

**Course Content**

**UNIT– I** **10 Hours**

**Working of a simple Genetic Algorithm and the related definitions:** Representation/ Encoding Schemes, initializing a GA population, evaluation function, genetic operators, study of parameters of genetic algorithms and its performance, sampling and selection mechanisms, mathematical foundations of genetic algorithms, schemata theorem and building block hypothesis, optimizing numerical functions using GA.

**UNIT– II** **10 Hours**

**Genetic Algorithm Variations:** Scaling fitness, Niching and speciation, Crowding Technique for Multimodal Problems, Multi-Objective Genetic Algorithms, Master Slave and Distributed Genetic Algorithms, Designing GAs for numerical optimization, knapsack problem, travelling salesperson and other similar problems.

**UNIT– III** **15 Hours**

**Neural Networks:** Basic terminology and definitions, Model of an artificial neuron, Sigmoid function, Neural Network Architectures, Characteristics of neural networks, Learning methods, Rosenblatt's Perceptron, Fixed increment perceptron learning algorithm for a classification problem, Examples of learning of AND/OR gate by perception, XOR problem. Back Propagation Neural Networks Architecture of a back propagation network, Model for multi-layer perceptron, Back propagation learning, Delta or gradient descent learning rule and effect of learning rate, Back propagation learning algorithm.

**UNIT– IV** **10 Hours**

**Fuzzy Sets:** Basic terminology and definitions, Operations on Fuzzy sets, MF formulations and parameterization, Derivatives of parameterized MFs, Fuzzy numbers,

Extension principal and fuzzy relations, Linguistic variables, Fuzzy If-Then Rules, Fuzzy reasoning and compositional rule of inference.

**Software and Tools to be learnt:** MATLAB tool boxes on global optimization, neural networks and fuzzy logic, R Programming, GALIB 247 and KEEL

**Transaction Modes**

Lecture, Seminar, e-Team Teaching, e-Tutoring, Dialogue, Peer Group Discussion, Mobile Teaching, Self-Learning, Collaborative Learning and Cooperative Learning

**Suggested Readings**

- *Ordinal Optimization: Soft Optimization for Hard Problems" by Yu-Chi Ho and Qian-Chuan Zhao.*
- *"Soft Computing: New Trends and Applications (Advanced Textbooks in Control and Signal Processing)" by L Fortuna and G Rizzotto.*
- *"Soft Computing for Control of Non-Linear Dynamical Systems (Studies in Fuzziness and Soft Computing)" by Oscar Castillo and Patricia Melin.*

**Course Title: Speech and Language Processing**

**Course Code: BMA508**

| L | T | P | Credits |
|---|---|---|---|
| 3 | 0 | 0 | 3 |

**Total Hours-45**

**Learning Outcomes:**

1. Be competent with fundamental concepts for natural language processing and automatic speech recognition
2. To understand technologies involved in developing speech and language applications.
3. To demonstrate the use of deep learning for building applications in speech and natural language processing

**Course Outcomes**

At the end of this course, student will be able to:

1. Describe the importance of different NLP modules in Text processing and fundamentals of speech production
2. Describe ways to represent speech and text
3. Demonstrate the working of sequence models for text
4. Use signal processing techniques to analyze/represent the speech signal
5. Execute trials of speech/language systems

**UNIT I** **15 hours**

Introduction to Natural Language Processing :

Overview of NLP - Introduction to Levels of NLP - Morhpology: Derivational & Inflectional Morphology - POS tagging - Parsing: Shallow and Dependency Parsing, Semantics: Word Level Semantics and Thematic roles.

Text Preprocessing & Feature Representation:

Introduction to Corpora, Sentence Segmentation, Stemming: Porter Stemmer, Bag of words and Vector Space Model, Topic Modeling, N-gram Language Model, Smoothing, Word Embeddings: Word2Vec, Glove and Fasttext.

**UNIT II** **10 hours**

Applications of NLP-1

Sentiment Classification using ML & DL models, Named Entity Recognition - CRF and LSTMs, Text Summarization - Statistical and Deep Learning models.

Applications of NLP-2:

Machine Translation - Encoder & Decoder Model, Attention Models, Question Answering - Knowledge based Q&A and Deep Learning models for Q&A.

**UNIT III** **10 hours**

Introduction to Speech Processing:

Fundamentals of speech production – Perception of sound – Vocal tract model – Phonetics - Short-Time analysis of the signal – Energy – Zero crossing – Autocorrelation – Short time Fourier analysis.

Feature Representaion of Speech Signal:

Mel Frequency Cepstral Coeffecients, Perceptual linear prediction (PLP), Linear prediction cepstral coefficients (LPCC), Gammatone Frequency Cepstral Coefficients (GFCC), i-vector.

**UNIT IV** **10 hours**

Automatic Speech and Speaker Recognition:

Automatic Speech recognition formulation: Isolated word recognition – Large vocabulary continuous speech recognition - HMM/GMM based speech recognition – DNN/HMM model -- CNN based speech recognition - RNN language Models – Evaluation metrics, Speaker Item 66/29 - Annexure - 25

Proceedings of the 66th Academic Council (16.06.2022) 664 recognition model – Alexa/Google assistant-based application development.

**Semester: VI**

**Course Title: Advanced Machine Learning**

**Course Code: BMA601**

| L | T | P | Credits |
|---|---|---|---|
| 4 | 0 | 0 | 4 |

**Total Hours-60**

**Learning Outcomes:**

1. Have a good understanding of the fundamental issues and challenges of machine learning: data, model selection, model complexity, etc
2. Appreciate the underlying mathematical relationships within and across Machine Learning algorithms and the paradigms of supervised and un-supervised learning
3. Design and implement various machine learning algorithms in a range of real-world applications

**Course Content**

**UNIT I** **15 Hours**

Linear Regression: Simple Linear Regression, Regression Line, Multiple Linear Regression, Multicollinearity, Model Assessment and Comparison, Variable Selection using RFE.

Logistic Regression: Univariate Logistic Regression, Sigmoid Curve, Odds and Log Odds, Multivariate Logistic Regression, Confusion Matrix and Accuracy, Model Evaluation

**UNIT II** **15 Hours**

Advanced Regression: Generalized Linear Regression, Regularized Regression, Ridge and Lasso Regression, Feature Selection

Naive Bayes: Conditional Probability, Bayes Theorem, Naïve Bayes for Categorical Data, Naïve Bayes for Text Classification

**UNIT III** **15 Hours**

Support Vector Machine:

Concept of hyperplane in 2D and 3D, Maximal Margin Classifier, Soft Margin Classifier, Slack variable, SVM kernels.

Tree Models: Decision Trees, Regression with Decision Trees, Algorithms for Decision Tree Construction, Truncation and Pruning, Random Forests.

**UNIT IV** **15 Hours**

Clustering: K-Means Clustering, Hierarchical Clustering, K-mode Clustering, DB scan Clustering.

Principal Component Analysis: Building blocks of PCA, PCA algorithm, Scree Plots.

**TEXT BOOKS**

T1: Mitchell T.M., Machine Learning, McGraw Hill (1997).

T2: Andreas C. Miller, Sarah Guido, Introduction to Machine Learning with Python, O'REILLY (2001).

**REFERENCE BOOKS**

R1: Bishop C., Pattern Recognition and Machine Learning, Springer-Verlag (2006).

**Course Title: NETWORK SECURITY**

**Course Code: BMA602**

| L | T | P | Credits |
|---|---|---|---|
| 4 | 0 | 0 | 4 |

**Total Hours: 60**

**Learning Outcomes:** After completion of this course, the learner will be able to:

1. Identify the different types of network devices and their functions within a network.
2. Describe network architectures and classifications.
3. Summarize the intrusion detection and its solutions to overcome the attacks.
4. Describe various network applications, and network security considerations.

**Course Contents**

**UNIT I** **12 Hours**

**Introduction:** Overview of computer networks, seven-layer architecture, TCP/IP suite of protocols, etc.MAC protocols for high-speed LANS, MANS and wireless LANs. (For Example, FDDI, DQDB, HIPPI, Gigabit Ethernet, Wireless Ethernet, etc.)

**UNIT II** **10 Hours**

**Fast Access Technologies:** ADSL, Cable Modem, etc. IP Multicasting, Multicast routing protocols, address assignments, session discovery, etc.

**UNIT III** **20 Hours**

**Ipv6:** Basic Protocol, extensions and options, support for QoS, security, etc., neighbors' discovery, auto configuration, routing. Changes to other protocols. Application Programming Interface for IPV6.Mobility in networks. Mobile IP, Difference between Private and Public IP addresses Security related issues, Firewall History,

**Cryptography and its Types**: Introduction**, Features of Cryptography,** Steganography, Classical Cryptography and Quantum Cryptography, Custom Building Cryptography Algorithms (Hybrid Cryptography), Cryptology ,Encryption, PRG, PRF and PRP in Cryptography, Caesar Cipher in Cryptography.

**UNIT IV** **18 Hours**

**TCP/IP protocol:** TCP Extension for high-speed networks, transaction-oriented applications. Other new options in TCP. Network security at various layers. Secure-HTTP, SSL, ESP, Authentication header, distribution protocols, Digital signatures, digital certificates.

**Transaction Modes**

Lecture, Seminar, e-Team Teaching, e-Tutoring, Dialogue, Peer Group Discussion, Mobile Teaching, Self-Learning, Collaborative Learning and Cooperative Learning

**Suggested Readings**


- *William Stallings (2010). Network Security Essentials: Applications and Standards, Prentice Hall.*
- *Michael T. Goodrich and Roberto Tamassia (2011). Introduction to Computer Security, Addison Wesley.*
- *Alfred J. Menezes, Paul C. van Oorschot and Scott A. Vanstone. (2001). Handbook of Applied Cryptography, CRC Press.*

**Course Title: Data and Visual analytics in AI**

**Course Code: BMA603**

| L | T | P | Credits |
|---|---|---|---|
| 4 | 0 | 0 | 4 |

**Total Hours-60**

**Learning Outcomes:**

1. Have a good understanding of the fundamental issues and challenges of machine learning: data, model selection, model complexity, etc
2. Appreciate the underlying mathematical relationships within and across Machine Learning algorithms and the paradigms of supervised and un-supervised learning
3. Design and implement various machine learning algorithms in a range of real-world applications

**Course Content**

**UNIT I** **18 Hours**

Introduction

Data for Graphics, Design principles, Value for visualization, Categorical, time series, and statistical data graphics, Introduction to Visualization Tools

Graphics Pipeline and Aesthetics and Perception

Introduction, Primitives: vertices, edges, triangles, Model transforms: translations, rotations, scaling, View transform, Perspective transform, window transform, Graphical Perception Theory, Experimentation, and the Application, Graphical Integrity, Layering and Separation, Color and Information, Using Space

**UNIT II** **12 Hours**

Graphics Pipeline and Aesthetics and Perception

Introduction, Primitives: vertices, edges, triangles, Model transforms: translations, rotations, scaling, View transform, Perspective transform, window transform, Graphical Perception Theory, Experimentation, and the Application, Graphical Integrity, Layering and Separation, Color and Information, Using Space

**UNIT III** **15 Hours**

Visualization Design

Visual Display of Quantitative Information, Data-Ink Maximization, Graphical Design, Exploratory Data Analysis, Heat Map

Collaboration

Graph Visualization and Navigation, Online Social Networks, Social Data Analysis, Collaborative Visual Analytics, Text, Map, Geospatial data

**UNIT IV** **15 Hours**

Multidimensional Data and Interaction : Query, Analysis and Visualization of Multi-Dimensional Relational Databases, Interactive Exploration, tSNE, Interactive Dynamics for Visual Analysis, Visual Queries, Finding Patterns in Time Series Data, Trend visualization, Animation, Dashboard, Visual Storytelling

**Text Books/Suggested References:**

1. The Visual Display of Quantitative Information by E. Tufte, Graphics Press, 2nd Edition, 2001
2. Beginner's Guide for Data Analysis using R Programming, Jeeva Jose, Khanna Publishing 2019.
3. Data Visualization Handbook by J. Koponen, J. Hildén, CRC Press, 2019
4. The Book of Trees: Visualizing Branches of Knowledge by M. Lima, Princeton Architectural Press, 2014
5. Handbook of Graph Drawing and Visualization by R. Tamassia, CRC Press, 2013
6. Interactive Data Visualization for the Web by S. Murray O'Reilly Press, 2nd Edition, 2017.

**Course Title: PROJECT -II**

**Course Code: BMA604**

| L | T | P | Credits |
|---|---|---|---|
| 0 | 0 | 4 | 2 |

**Total Hours: 30**

**Learning Outcomes:** After completion of this course, the learner will be able to:

1. Use latest multimedia devices and programming software.
2. Design and construct a hardware and software system, component or process to meet desired needs.
3. Classify the multidisciplinary Problems of project.
4. Work as professionals, with portfolio ranging from data management, network configuration, designing hardware, database and software design to management and administration of entire systems.

**Course Content**

Project should include following phases: System Analysis and Design
Coding - Implementation Testing, It should be a working project Must have a future perspective.

The Domain of project can be from:
Databases
Application software
System software
Multimedia
Web Applications, etc.

A complete project report must be submitted along with softcopy of project. Project report may include Requirements of Project, Flow Chart, DFD's, Coding and Test Results

**Course Title: Digital Signal Processing**

**Course Code: BMA605**

| L | T | P | Credits |
|---|---|---|---|
| 4 | 0 | 0 | 4 |

**Total Hours: 60**

**Learning Outcomes**: After completion of this course, the learner will be able to:

1. Determine the hardware and operating system requirements for digital forensics
2. Compare and Analysis of digital forensics by organization of data and metadata in computer systems.
3. Analyze file recovery and hidden file extraction techniques and Integrate security of computer systems with digital forensics and evaluate its performance.
4. Identify various types of forensics in the arena of information technology and Critic the computer crimes by studying the security Laws and legal Landscape around the world.

**Course Content**

**UNIT I** **15 Hours**

Introduction to Digital Forensics: digital crimes, digital investigation, evidence, extraction, preservation etc.; overview of hardware and operating systems: structure of storage media/devices, Windows/Macintosh/Linux registry, boot process; disk and file system analysis, data acquisition of physical storage devices

**UNIT II** **15 Hours**

Data recovery: identifying hidden data, recovering deleted files; digital evidence controls: uncovering attacks that evade detection by event viewer, task manager and other windows GUI tools; disk imaging, recovering swap files, temporary and cache files; automating analysis and extending capabilities.

**UNIT III** **18 Hours**

Network Forensics: collecting and analyzing network-based evidence, reconstructing web browsing, email activity, intrusion detection, tracking offenders, windows registry changes, etc.; Mobile Network forensics: introduction, investigations, collecting evidences, where to seek digital data for further investigations; Email and database forensics; memory acquisition

**UNIT IV** **12 Hours**

Computer crime and legal issues: intellectual property, privacy issues, criminal justice system for forensic, audit/investigative situations and digital crime scene, investigative procedure/standards for extraction, preservation and deposition of legal evidence in a court of law.

**Transaction Modes**

Lecture, Seminar, e-Team Teaching, e-Tutoring, Dialogue, Peer Group Discussion, Mobile Teaching, Self-Learning, Collaborative Learning and Cooperative Learning.

**Suggested Readings**

- *Thomas J Holt, Adam M Bossler, Kathryn C Seigfried-Spellar, Cybercrime and Digital Forensics: An Introduction, Routledge, 2015.*
- *Cory Altheide and Harlan Carvey, Digital Forensics with Open-Source Tools, Elsevier publication, April 2011.*
- *B. Nelson, A. Phillips, F. Enfinger, C. Steuart, Guide to Computer Forensics and Investigations 4 th edition, Thomson, 2009.*
- *Campbell, A. (2011) Report of the Fingerprint Inquiry Scotland*
- *Miller, C. G. (2013) 'Fingerprint identification not infallible, nor scientific & based on fraud', cliffordmiller law,*

***Web lINKS***

- *https://nij.ojp.gov/digital-evidence-and-forensics- Digital Forensics*
- *https://dl.acm.org/doi/fullHtml/10.1145/3503047.3503082- Digital Forensics*

**Course Title: Deep Learning**

**Course Code: BMA606**

| L | T | P | Credits |
|---|---|---|---|
| 3 | 0 | 0 | 3 |

**Total Hours: 45**

**Learning Outcomes:**

After completion of this course, the learner will be able to:

1. Understand the methods and terminologies involved in deep neural network, differentiate the learning methods used in Deep-nets.
2. Identify and apply suitable deep learning approaches for given application.
3. Design and develop custom Deep-nets for human intuitive applications
4. Design of test procedures to assess the efficiency of the developed model.

**Course Content**

**UNIT I** **10 Hours**

Introduction

History of Deep Learning, McCulloch Pitts Neuron, Multilayer Perceptrons (MLPs), Representation Power of MLPs, Sigmoid Neurons, Feed Forward Neural Networks, Back propagation

**UNIT II** **15 Hours**

Activation functions and parameters

Gradient Descent (GD), Momentum Based GD, Nesterov Accelerated GD, Stochastic GD,

Principal Component Analysis and its interpretations, Singular Value Decomposition, Parameters

v/s Hyper-parameters

**UNIT III** **10 Hours**

Auto-encoders & Regularization

Auto encoders and relation to PCA, Regularization in auto encoders, Denoising auto encoders,

Sparse auto encoders, Regularization: Bias Variance Tradeoff, L2 regularization, Early stopping,

Dataset augmentation, Encoder Decoder Models, Attention Mechanism, Attention over images,

Batch Normalization

**UNIT IV** **10 Hours**

Deep Learning Models

Introduction to CNNs, Architecture, Convolution/pooling layers, CNN Applications, LeNet, AlexNet, ZF-Net, VGGNet, GoogLeNet, ResNet. Introduction to RNNs, Back propagation through time (BPTT), Vanishing and Exploding Gradients, Truncated BPTT, GRU, LSTMs

Deep Learning Applications

Image Processing, Natural Language Processing, Speech recognition, Video Analytics

**Course Title: BLOCK CHAIN ARCHITECTURE DESIGN**

**Course Code: BMA607**

| L | T | P | Credits |
|---|---|---|---|
| 3 | 0 | 0 | 3 |

**Total Hours: 45**

**Learning Outcomes:** After completion of this course, the learner will be able to:

1. Understand the basic concepts and technology used for block chain
2. Describe the primitives of the distributed computing and cryptography related to block chain.
3. Apply security features in block chain technologies.
4. Use smart contract in real world applications.

**Course Content**

**UNIT1** **10 Hours**

**Introduction to Block chain:** Digital Money to Distributed Ledgers, Design Primitives: Protocols, Security, Consensus, Permissions, And Privacy. Block chain Architecture and Design: Basic crypto primitives: Hash, Signature,) Hash chain to Block chain, Basic consensus mechanisms

**UNIT II** **10Hours**

**Consensus:** Requirements for the consensus protocols, Proof of Work (PoW), Scalability aspects of Block chain consensus protocols Permissioned Block Chain Design goals, Consensus protocols for Permissioned Block chain.

**UNIT III** **15 Hours**

**Hyper ledger Fabric (A):** Decomposing the consensus process, Hyper ledger fabric components, Chain code Design and Implementation

**Hyper ledger Fabric (B):** Beyond Chain code: fabric SDK and Front End (b) Hyper ledger composer tool

**UNIT IV** **10 Hours**

**Use case 1:** Block chain in Financial Software and Systems (FSS): (i) Settlements, (ii) KYC, (iii) Capital markets, (iv) Insurance

**Use case 2:** Block chain in trade/supply chain: (i) Provenance of goods, visibility, trade/supply chain finance, invoice management discounting, etc 08 V

**Use case 3:** Block chain for Government: (i) Digital identity, land records and other kinds of record keeping between government entities, (ii) public distribution system social welfare systems Block Chain Cryptography, Privacy and Security on Block chain.

**Transaction Modes**

Lecture, Seminar, e-Team Teaching, e-Tutoring, Dialogue, Peer Group Discussion, Mobile Teaching, Self-Learning, Collaborative Learning and Cooperative Learning.

**Suggested Readings**


- *Narayanan, Bonneau, Felten, Miller and Goldfeder, "Bitcoin and Cryptocurrency Technologies – A Comprehensive Introduction", Princeton University Press (2016).*
- *Josh Thompson, 'Block chain: The Block chain for Beginnings, Guild to Block Chain Technology and Block Chain Programming', Create Space Independent Publishing Platform, 2017.*
- *Imran Bashir, "Mastering Block chain: Distributed ledger technology, decentralization, and smart contracts explained", Packt Publishing, 2017.*
- *Merunas Grincalaitis, "Mastering Ethereum: Implement Advanced Block Chain Applications Using Ethereum-supported Tools, Services, and Protocols", Packet Publishing, 2018.*

**Course Title: PERSONALITY DEVELOPMENT PROGRAMME**

**Course Code: BMA608**

| L | T | P | Credits |
|---|---|---|---|
| 2 | 0 | 0 | 2 |

**Total Hours:30**

**Course Learning Outcome:** On successful completion of this course, the students will be able to:

1. Assess the commercial viability of new technologies, business opportunities and existing companies
2. Plan, organize, and execute a project or new venture with the goal of bringing new products and service to the market
3. Carry out scientific research in the field of entrepreneurship
4. Improved your interpersonal and collaborative skills
5. Write scientific reports and communicate the results in a professional manner

**UNIT-I** **10Hours**

**Introduction to Generic Skills:** Importance of Generic Skill Development (GSD), Global and Local Scenario of GSD, Life Long Learning (LLL) and associated importance of GSD.

**Managing Self:** Knowing Self for Self Development- Self-concept, personality, traits, multiple intelligence such as language intelligence, numerical intelligence, psychological intelligence etc., Managing Self – Physical- Personal grooming, Health, Hygiene, Time Management, Managing Self – Intellectual development -Information Search: Sources of information, Reading: Purpose of reading, different styles of reading, techniques of systematic reading, Note Taking: Importance of note taking, techniques of note taking, Writing: Writing a rough draft, review and final draft. Managing Self – Psychological, Stress, Emotions, Anxiety-concepts and significance, Techniques to manage the above.

**UNIT-II** **5Hours**

**Managing in Team:** Team - definition, hierarchy, team dynamics, Team related skills-sympathy, empathy, co-operation, concern, lead and negotiate, work well with people from culturally diverse background, Communication in group - conversation and listening skills.

**UNIT-III** **10 Hours**

**Task Management:** Task Initiation, Task Planning, Task execution, Task close out, Exercises/case studies on task planning towards development of skills for task management

**Problem Solving:** Prerequisites of problem solving- meaningful learning, ability to apply knowledge in problem solving, Different approaches for problem solving. Steps followed in problem solving. Exercises/case studies on problem solving.

**UNIT-IV** **5Hours**

**Entrepreneurship:** Introduction, Concept/Meaning and its need, Competencies/qualities of an entrepreneur, Entrepreneurial Support System e.g., District Industry Centres (DICs), Commercial Banks, State Financial Corporations, Small Industries Service Institute (SISIs), Small Industries Development Bank of India (SIDBI), National Bank of Agriculture and Rural Development (NABARD), National Small Industries Corporation (NSIC) and other relevant institutions/organizations at State/National level. Market Survey and Opportunity Identification (Business Planning)- How to start a small scale industry, Procedures for registration of small-scale industry, List of items reserved for exclusive manufacture in small-scale industry, Assessment of demand and supply in potential areas of growth, understanding business opportunity, Considerations in product selection, Data collection for setting up small ventures. Project Report Preparation- Preliminary Project Report, Techno-Economic Feasibility Report, Exercises regarding “Project Report Writing” for small projects.