# E.G.S. PILLAY ENGINEERING COLLEGE(Autonomous)

Approved by AICTE, New Delhi | Affiliated to AnnaUniversity, Chennai |

Accredited by NAAC with A‟Grade |Accredited by NBA (CIVIL, CSE, ECE, EEE, IT, MECH)

NAGAPATTINAM – 611 002

## B.Tech – Computer Science & Business Systems [CSBS]

**Full Time Curriculum and Syllabus**

**Third Year –Fifth Semester**

| SEMESTER-V | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| **Course Code** | **Course Name** | **L** | **T** | **P** | **C** | **Hours / Week** | **Maximum Marks** | | | **Category** |
| | | | | | | | **CA** | **ES** | **Total** | |
| | **Theory Course** | | | | | | | | | |
| 1902BS501 | Design and Analysis of Algorithms | 3 | 0 | 0 | 3 | 3 | 50 | 50 | 100 | PC |
| 1902BS502 | Compiler Design | 3 | 0 | 0 | 3 | 3 | 40 | 60 | 100 | PC |
| 1902BS503 | Design Thinking | 3 | 0 | 0 | 3 | 3 | 40 | 60 | 100 | PC |
| 1902BS504 | Fundamentals of Management | 3 | 0 | 0 | 3 | 3 | 40 | 60 | 100 | PC |
| 1902BS505 | Business Strategy | 3 | 0 | 0 | 3 | 3 | 40 | 60 | 100 | PC |
| 1903BS002 | Professional Elective I : Introduction to IoT | 3 | 0 | 0 | 3 | 3 | 40 | 60 | 100 | PE |
| | **Laboratory Course** | | | | | | | | | |
| 1902BS551 | Compiler Design Lab | 0 | 0 | 2 | 1 | 2 | 50 | 50 | 100 | PC |
| 1902BS552 | Mini Project : Design Thinking Lab | 0 | 0 | 4 | 2 | 4 | 100 | - | 100 | PC |
| 1904GE551 | Life Skills: Aptitude I | 0 | 0 | 2 | 1 | 2 | 100 | - | 100 | EEC |
| | **Audit Course** | | | | | | | | | |
| 1901MCX03 | Essence of Indian Traditional Knowledge | 2 | 0 | 0 | 0 | 2 | 100 | - | 100 | MC |
| **Total** | | **19** | **0** | **10** | **22** | **26** | **600** | **400** | **1000** | |

**L–Lecture |T–Tutorial | P–Practical | C–Credit | CA –Continuous Assessment| ES–End Semester**

| 1902BS501 | DESIGN AND ANALYSIS OF ALGORITHMS | L | T | P | C |
|---|---|---|---|---|---|
| | | 3 | 0 | 0 | 3 |

**PREREQUISITE:**

Data Structures and Algorithms

**COURSE OBJECTIVES:**

1. To understand the techniques for analyzing the computer algorithms.
2. To learn the paradigms for designing the algorithms.
3. To analyze the efficiency of various algorithm design techniques / paradigms for the same problem.
4. To understand the limitations of algorithmic power.

| **Module I** | **FUNDAMENTAL ALGORITHMIC STRATEGIES** | **9 Hours** |
|---|---|---|

Characteristics of Algorithm. Analysis of Algorithm: Asymptotic analysis of Complexity Bounds – Best, Average and Worst-Case behaviour; Performance Measurements of Algorithm, Time and Space Trade-Offs, Analysis of Recursive Algorithms through Recurrence Relations: Substitution Method, Recursion Tree Method and Masters' Theorem. Fundamental Algorithmic Strategies: Brute-Force, Heuristics and Greedy methodologies.

| **Module II** | **ADVANCED ALGORITHMIC STRATEGIES** | **9 Hours** |
|---|---|---|

Dynamic Programming, Branch and Bound and Backtracking methodologies. Illustrations of these techniques for Problem-Solving, Bin Packing, Knapsack, and Travelling Salesman Problem.

| **Module III** | **GRAPH AND TREE ALGORITHMS** | **9 Hours** |
|---|---|---|

Traversal algorithms: Depth First Search (DFS) and Breadth First Search (BFS) - Shortest path algorithms - Transitive closure - Minimum Spanning Tree - Topological sorting - Network Flow Algorithm.

| **Module IV** | **TRACTABLE AND INTRACTABLE PROBLEMS** | **9 Hours** |
|---|---|---|

Computability of Algorithms, Computability classes – P, NP, NP-complete and NP-hard. Cook's theorem, Standard NP-complete problems and Reduction techniques.

| **Module V** | **FEATURED ALGORITHMS** | **9 Hours** |
|---|---|---|

**Approximation algorithms, Randomized algorithms, Class of problems beyond NP – P SPACE, Introduction to Quantum Algorithms.**

**TOTAL: 45 HOURS**

**Mode of Assessment: CAT/Assignment/Quiz/Seminar/Presentation/ESE**

**Course Outcomes:**

**1.** Apply the mathematical tools to analyze and derive the running time of the algorithms
**2.** Demonstrate the major algorithm design paradigms.
**3.** Explain major graph algorithms, string matching and geometric algorithms along with their analysis.
**4.** Articulating Randomized Algorithms.
**5.** Explain the hardness of real-world problems with respect to algorithmic efficiency and learning to cope with it

**REFERENCES:**

1. Aho, J. Hopcroft and J. Ullman, "The Design and Analysis of Computer Algorithms", 4th Edition, Pearson Education, 2009.
2. Thomas H. Cormen, Charles E. Leiserson, R.L. Rivest, "Introduction to Algorithms", Prentice Hall of India Publications, 3rd Edition, 2009.
3. Jon Kleinberg and ÉvaTardos, Algorithm Design, Pearson Education, 1st Edition, 2014.
4. E. Horowitz and S. Sahni, "Fundamental of Computer Algorithms", Computer Science Press, Inc. 1978.
5. Rajeev Motwani, PrabhakarRaghavan; Randomized Algorithms, Cambridge University Press,1995 (Online Print – 2013)
6. Ravindra K. Ahuja, Thomas L. Magnanti, and James B. Orlin, Network Flows: Theory,Algorithms, and Applications, 1st Edition, Pearson Education, 2014.
7. https://nptel.ac.in

| 1902BS502 | COMPILERDESIGN | L | T | P | C |
|---|---|---|---|---|---|
| | | 3 | 0 | 0 | 3 |

**COURSE OBJECTIVES:**

1. To learn the design principles of a Compiler.
2. To learn the various parsing techniques and different levels of translation.
3. To learn how to optimize and effectively generate machine codes.
4. To learn to implement Architecture dependent code improvement.

**MODULE I INTRODUCTION** **9 Hours**

Phases of compilation and overview. Lexical Analysis (scanner): Regular languages, finite automata, regular expressions, relating regular expressions and finite automata, scanner generator(lex,flex).

**MODULE II SYNTAXANALYSIS** **12 Hours**

Parser: Context-free languages and grammars, push-down automata, LL(1) grammars and top-down parsing, operator grammars, LR(O), SLR(1), LR(1), LALR(1) grammars and bottom-up parsing, ambiguity and LR parsing, LALR(1) parser generator (yacc,bison).

**MODULE III SEMANTIC ANALYSIS** **8 Hours**

Attribute grammars, syntax directed definition, evaluation and flow of attribute in a syntax tree. Symbol Table: Basic structure, symbol attributes and management. Run-time environment: Procedure activation, parameter passing, value return, memory allocation, scope. Intermediate Code Generation: Translation of different language features, different types of intermediate forms.

**MODULE IV CODE IMPROVEMENT** **8 Hours**

Control-flow, data-flow dependence etc.; local optimization, global optimization, loop optimization, peep-hole optimization etc.

**MODULE V ARCHITECTURE DEPENDENT CODE IMPROVEMENT** **8 Hours**

Instruction scheduling (for pipeline), loop optimization (for cache memory) etc. Register allocation and target code generation. Advanced topics: Type systems, data abstraction, compilation of Object Oriented features and non-imperative programming languages.

**TOTAL: 45 HOURS**

**COURSE OUTCOMES:**

On the Successful completion of the course, Students will be able to

CO1: Interpret the different phases of compiler.

CO2: Analyse a lexical analyser for a sample language.

CO3: Apply different parsing algorithms to develop the parsers for a given grammar.

CO4: Explain code optimization techniques and a simple code generator.

**REFERENCES:**

1.Alfred V Aho, Monica S. Lam, Ravi Sethi and Jeffrey D Ullman, “Compilers – Principles, Techniques and Tools”, 2nd Edition, Pearson Education,2007.

2. Doug Brown, John Levine, and Tony Mason, “Lex&Yacc Second Edition, O'Reilly & Associates,1995.

**3.**Steven S.Muchnick, Advanced Compiler Design and Implementation‖, Morgan Kaufmann Publishers – Elsevier Science, India, Indian Reprint 2003.

4.V.Raghavan,PrinciplesofCompilerDesign‖,TataMcGrawHillEducationPublishers,2010.

| 1902BS503 | Design Thinking | L | T | P | C |
|---|---|---|---|---|---|
| | | 3 | 0 | 0 | 3 |

**PREREQUISITE:**

The course assumes no prior skill or background in design, art or engineering. It is open to all undergraduates and graduate students with an interest in learning design thinking, and is especially recommended for those students planning social-venture and other kinds of design interventions

**COURSE OBJECTIVES:**

1.Embracing human-centered design means believing that all problems, even the seemingly intractable ones like poverty, gender equality, and clean water, are solvable.

2.Believing that the people who face those problems every day are the ones who hold the key to their answer.

3.Offers problem solvers of any stripe a chance to design with communities, to deeply understand the people they're looking to serve, to dream up scores of ideas, and to create innovative new solutions rooted in people's actual needs.

4.Believing that as long as you stay grounded in what you've learned from people, your team can arrive at new solutions that the world needs.

| Module I | Design thinking basics | 09 Hours |
|---|---|---|

Design thinking process, Process modules – Empathize, Define, Ideate, Prototype & Test, Interview Preparation, Journey Map, Powers of Ten, Why-How Laddering, Point of View, How Might We Questions, Brainstorming, Story telling

| Module II | Inspiration Phase | 12 Hours |
|---|---|---|

Frame Your Design Challenge, Create a Project Plan, Build a Team, Recruiting Tools, Secondary Research, Interview, Group Interview, Expert Interview, Define Your Audience, Conversation Starters, Extremes and Mainstreams, Immersion, Analogous Inspiration, Card Sort, Peers Observing Peers, Collage, Guided Tour, Draw It, Resource Flow, Case Study: Vroom

| ModuleIII | Ideation Phase | 12 Hours |
|---|---|---|

Download Your Learnings, Share Inspiring Stories, Top Five, Find Themes, Create Insight Statements, Explore Your Hunch, How Might We, Create Frameworks, Brainstorm, Brainstorm Rules, Bundle Ideas, Get Visual, Mash-Ups, Design Principles, Create a Concept, Co-Creation Session, Gut Check, Determine, What to Prototype, Storyboard, Role Playing, Rapid Prototyping, Business Model Canvas, Get Feedback, Integrate Feedback and Iterate, Case Study: Asili

| Module IV | Implementation Phase | 12 Hours |
|---|---|---|

Live Prototyping, Roadmap, Resource Assessment, Build Partnerships, Ways to Grow Framework, Staff, Your Project, Funding Strategy, Pilot, Define Success, Keep Iterating, Create a Pitch, Sustainable Revenue, Monitor and Evaluate, Keep Getting Feedback, Case Study: Clean Team

**TOTAL: 45 HOURS**

**Mode of Assessment: CAT/Assignment/Quiz/Seminar/Presentation/ESE**

**Course Outcomes:**

1. Describe Key Concepts and basics of Design Thinking Principles
2. Design by better understanding people, observe their lives, hear their hopes and desires, and get smart on the design challenge.
3. Generate ideas, identify opportunities for design, and test and refine solutions.
4. Develop to bring the solution to life by figuring out how to get idea to market and to maximize its impact in the world.

**FURTHER READING:**

1. Design for Social Impact : How to by IDEO.org
2. Design Thinking ToolKit by IDEO.org
3. The Field guide to Human Centered Design by IDEO.org

| **REFERENCES:** | |
|---|---|
| 1.Creative Confidence: Unleashing the Creative Potential Within Us All Book by David M. Kelley and Tom Kelley, 2013 | |
| 2.Change by Design: How Design Thinking Transforms Organizations and Inspires Innovation Book by Tim Brown, 2009 | |
| 3. The art of Innovation by Tom Kelly, 2011 | |
| 4. Design Thinking for Strategic Innovation: What They Can't Teach You at Business Or Design School Book by Idris Mootee, 2013 | |
| 5. The Design of Everyday Things Book by Don Norman, 1988 | |

| 1902BS504 | FUNDAMENTALS OF MANAGEMENT | L | T | P | C |
|---|---|---|---|---|---|
| | | 3 | 0 | 0 | 3 |

**COURSE OBJECTIVES:**

1. To know various concepts of management.
2. To know about all the management theories and evolution of management.
3. To understand the organizational design and behavior.
4. To know the managerial ethics and leadership.

| MODULE I | MANAGEMENT THEORIES | 9 Hours |
|---|---|---|

Concept and Foundations of Management, Evolution of Management Thoughts [Pre-Scientific Management Era (before 1880), Classical management Era (1880-1930), Neo-classical Management Era (1930-1950), Modern Management era (1950-onwards). Functions of Management- Planning, Organizing, Staffing, Directing, Controlling.

| MODULE II | INDIVIDUAL AND GROUP BEHAVIOUR | 9 Hours |
|---|---|---|

Introduction, Personality, Perception, Learning and Reinforcement, Motivation, Group Dynamics, Power & Influence, Work Stress and Stress Management, Decision Making & Problems in Decision Making.

| MODULE III | ORGANIZATIONAL CULTURE AND DESIGN | 9 Hours |
|---|---|---|

Organizational Culture, Managing Cultural Diversity - Organizational Design: Classical, Neoclassical and Contingency approaches to organizational design; Organizational theory and design, Organizational structure (Simple Structure, Functional Structure, Divisional Structure, Matrix Structure)

| MODULE IV | LEADERSHIP | 9 Hours |
|---|---|---|

Concept, Nature, Importance, Attributes of a leader, developing leaders across the organization and Leadership Grid.

| MODULE V | MANAGERIAL ETHICS AND SOCIAL RESPONSIBILITY | 9 Hours |
|---|---|---|

Ethics and Business, Ethics of Marketing & advertising, Ethics of Finance & Accounting, Decision – making frameworks, Business and Social Responsibility, International Standards, Corporate Governance, Corporate Citizenship, Corporate Social Responsibility.

**TOTAL: 45 HOURS**

**MODE OF ASSESSMENT: ASSIGNMENT/SEMINAR/PRESENTATION/ESE**

1. Decision making and problems in Design making.
2. Leadership Grid

**COURSE OUTCOMES:**

| | |
|---|---|
| CO1: | Report the basic concepts of management, management theories and evolution of management over the years. |
| CO2: | Translate the intricacies of other management functions in a organizational area such as finance, marketing, strategy etc which will be taken up in future terms. |
| CO3: | Develop an understanding about how organizations work its design and behaviour. |
| CO4: | Summarise the managerial ethics and leadership. |

**REFERENCES:**

1. Richard L. Daft, *Understanding the Theory and Design of Organizations*, Cengage Learning India Private Limited; 11th Edition, 2016.

2. Mahajan. J.P., "Management Theory and Practices", 3rd Edition, Ane Books Pvt Ltd. 2011.

3. Stephen P. Robbins, Timothy A. Judge, NeharikaVohra, "Organizational Behavior*",* Pearson, 2013.

4. Harold Koontz, Weihrich, "Essentials of Management: An International, Innovation, and Leadership Perspective", 10th Edition, Tata McGraw Hill, 2015.

| 1902BS505 | BUSINESS STRATEGY | L | T | P | C |
|---|---|---|---|---|---|
| | | 3 | 0 | 0 | 3 |

**PREREQUISITE:**

**COURSE OBJECTIVES:**

1. To makes the students to understand the concepts of strategic management and strategy formation process.
2. To helps students to understand different types of strategies.
3. To enable students to implement and evaluate the strategies.

| Module I | Introduction to Strategic Management | 15 Hours |
|---|---|---|

Concept of strategic management, vision, mission, objectives and goals, schools of thought in strategic management, strategic content, strategic management process and practice, SWOT Analysis, business definition.

| Module II | Internal Environment of Firms Intellectual Assets and External Environments of Firms Competitive Strategy | 15 Hours |
|---|---|---|

Core competence as the Root of competitive advantage, business process and capabilities-based approach to strategy, five process of industry attractiveness that shape strategy, the concept of strategic groups, and industry life cycle, generic strategies and the value chain.

| Module III | Corporate Strategy, Growth Strategies and Strategy Implementation | 15 Hours |
|---|---|---|

The motive of diversification, Related and Unrelated Diversification, Business portfolio Analysis, Expansion, Integration and Diversification, Strategic Alliances, Join ventures, and mergers & Acquisitions, Mckensy's 7S Framework, Strategic Control and corporate Governance, strategic Implementation, Strategic Evaluation and Control.

**TOTAL: 45 HOURS**

**Mode of Assessment: CAT/Assignment/Quiz/Seminar/Presentation/ESE**

1. SWOT Analysis
2. Five process of industry attractiveness that shape strategy

**Course Outcomes:**

1. Interpret theory and concepts of strategic management.
2. Report different types of business strategies.
3. Develop and implement the strategic management processes.

**REFERENCES:**

1.Robert M. Grant (2012). Contemporary Strategic management, Blackwell, 7th edition.

2.Porter ME. Competitive Strategy: Techniques for analyzing Industries and Competitor. New York: Free Press, 1980

| 1902BS551 | COMPILER DESIGN LAB | L | T | P | C |
|---|---|---|---|---|---|
| | | 0 | 0 | 2 | 1 |

**COURSE OBJECTIVES:**

1. To learn the design principles of a Compiler
2. To learn the various parsing techniques and different levels of translation.
3. To learn how to optimize and effectively generate machine codes.
4. To learn to implement Architecture dependent code improvement

**LIST OF EXPERIMENTS:**

**EXPERIMENT 1**

Implementation of lexical analyzer using C and LEXTOOL.

**EXPERIMENT 2**

Implementation of a calculator that takes an expression (with digits, + and *), computes and prints its value, using YACC.

**EXPERIMENT 3**

Implementation of a parser using LEX and YACC.

**EXPERIMENT 4**

Implementation of symbol table.

**EXPERIMENT 5**

Implementation of Predictive parsing.

**EXPERIMENT 6**

Implementation of Shift Reduce Parsing Algorithm

**EXPERIMENT 7**

Implementation of LR parsing.

**EXPERIMENT 8**

**Implement the front end of a compiler that generates the three address code for a simple language with: One data type integer, arithmetic operators, relational operators,variable declaration statement, one conditional construct, one iterative construct and assignment statement.**

**EXPERIMENT 9**

Implement the back end of the compiler which takes the three address code as input and produces assembly language instructions that can be assembled and run using an 8086 assembler. The target assembly instructions can be simple move, add, sub, andjump.

**EXPERIMENT 10**

Implementation of the code optimizer phase of a compiler that eliminates dead code and common sub-expressions.

**TOTAL: 30 HOURS**

**COURSE OUTCOMES:**

- CO1: Demonstrate the different phases of compiler.
- CO2: Analyse a lexical analyser for a sample language.
- CO3: Apply different parsing algorithms to develop the parsers for a given grammar
- CO4: Explain code optimization techniques and a simple code generator.

**REFERENCES:**

1. Alfred V Aho, Monica S. Lam, Ravi Sethi and Jeffrey D Ullman, "*Compilers – Principles, Techniques and Tools*", 2nd Edition, Pearson Education,2007.

2.Doug Brown, John Levine, and Tony Mason, "Lex&Yacc Second Edition, O'Reilly & Associates,1995.

3.Steven S.Muchnick, Advanced Compiler Design and Implementation‖, Morgan Kaufmann Publishers – Elsevier Science, India, Indian Reprint 2003.

4.V.Raghavan,PrinciplesofCompilerDesign‖,TataMcGrawHillEducationPublishers,2010.

| 1902BS552 | Design Thinking Lab (Mini Project) | L | T | P | C |
|---|---|---|---|---|---|
| | | 0 | 0 | 4 | 2 |

**PREREQUISITE:**

The course assumes no prior skill or background in design, art or engineering. It is open to all undergraduates and graduate students with an interest in learning design thinking, and is especially recommended for those students planning social-venture and other kinds of design interventions

**COURSE OBJECTIVES:**

1. Cultivate the mindset and skills of successful entrepreneurs
2. Lead innovative teams
3. Develop and refine your strategy in today's fast-changing, dynamic markets
4. Grow your customer base through inbound and outbound marketing

**Course Outcomes:**

1. Describe Key Concepts and basics of Design Thinking Principles
2. Design by better understanding people, observe their lives, hear their hopes and desires, and get smart on the design challenge.
3. Generate ideas, identify opportunities for design, and test and refine solutions.
4. Develop to bring the solution to life by figuring out how to get idea to market and to maximize its impact in the world.

**LIST OF EXPERIMENTS [SUGGESSTED]**

1. Frame a Design Challenge
2. Plan Research
3. Build an Interview Guide
4. Conduct Research
5. Point of View Statements
6. Cluster Into Themes
7. Create Insight Statements
8. Brainstorm
9. Select Best Ideas
10. Describe the Ideas
11. Create a Storyboard
12. Determine What to Prototype
13. Test Prototype & Get Feedback
14. Business Model Canvas
15. Create an Action Plan
16. Resource Assessment
17. Create a Pitch
18. Reflect

**Total Hours:60**

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|---|
| **Mode of Assessment:PAT/ESE/Presentation/…** |
| **FURTHER READING:** |
| 1. Design for Social Impact : How to by IDEO.org<br>2. Design Thinking ToolKit by IDEO.org<br>3. The Field guide to Human Centered Design by IDEO.org |
| **REFERENCES:** |
| 1.Creative Confidence: Unleashing the Creative Potential Within Us All Book by David M. Kelley and Tom Kelley, 2013 |
| 2.Change by Design: How Design Thinking Transforms Organizations and Inspires Innovation Book by Tim Brown, 2009 |
| 3. The art of Innovation by Tom Kelly, 2011 |
| 4. Design Thinking for Strategic Innovation: What They Can't Teach You at Business Or Design School Book by Idris Mootee, 2013 |
| 5. The Design of Everyday Things Book by Don Norman, 1988 |

| 1901MCX03 | ESSENCE OF INDIAN TRADITIONAL KNOWLEDGE | L | T | P | C |
|---|---|---|---|---|---|
| | | 2 | 0 | 0 | 0 |

**COURSE OBJECTIVES:** The course will introduce the students to

1. To get a knowledge in Indian Culture
2. To Know Indian Languages and Literature and the fine arts in India
3. To explore the Science and Scientists of Medieval and Modern India

**MODULE I** **INTRODUCTION TO CULTURE** **6 Hours**

Culture, civilization, culture and heritage, general characteristics of culture, importance of culture in human literature, Indian Culture, Ancient India, Medieval India, Modern India

**MODULE II** **INDIAN LANGUAGES, CULTURE AND LITERATURE** **6 Hours**

Indian Languages and Literature-I: the role of Sanskrit, significance of scriptures to current society, Indian philosophies, other Sanskrit literature, literature of south India Indian Languages and Literature-II: Northern Indian languages & literature

**MODULE III** **RELIGION AND PHILOSOPHY** **6 Hours**

Religion and Philosophy in ancient India, Religion and Philosophy in Medieval India, Religious Reform Movements in Modern India (selected movements only)

**MODULE IV** **FINE ARTS IN INDIA (ART, TECHNOLOGY& ENGINEERING)** **6 Hours**

Indian Painting, Indian handicrafts, Music, divisions of Indian classic music, modern Indian music, Dance and Drama, Indian Architecture (ancient, medieval and modern), Science and Technology in India, development of science in ancient, medieval and modern India

**MODULE V** **EDUCATION SYSTEM IN INDIA** **6 Hours**

Education in ancient, medieval and modern India, aims of education, subjects, languages, Science and Scientists of Ancient India, Science and Scientists of Medieval India, Scientists of Modern India.

**TOTAL** **30 Hours**

**Mode of Assessment: CAT/Assignment/Quiz/Seminar/Presentation/ESE**

**COURSE OUTCOMES:** After successful completion of the course, the students will be able to

| | |
|---|---|
| CO1 | Understand philosophy of Indian culture. |
| CO2 | Distinguish the Indian languages and literature. |
| CO3 | Learn the philosophy of ancient, medieval and modern India. |
| CO4 | Acquire the information about the fine arts in India. |
| CO5 | Know the contribution of scientists of different eras. |

**REFERENCES:**

1. Kapil Kapoor, “Text and Interpretation: The India Tradition”, ISBN: 81246033375, 2005
2. “Science in Samskrit”, Samskrita Bharti Publisher, ISBN 13: 978-8187276333, 2007
3. NCERT, “Position paper on Arts, Music, Dance and Theatre”, ISBN 81-7450 494-X, 200
4. S. Narain, “Examinations in ancient India”, Arya Book Depot, 1993
5. Satya Prakash, “Founders of Sciences in Ancient India”, Vijay Kumar Publisher, 1989
6. M. Hiriyanna, “Essentials of Indian Philosophy”, Motilal Banarsidass Publishers, ISBN 13: 978- 8120810990, 2014

**LISTOF ELECTIVES**

| PROFESSIONAL ELECTIVE COURSES | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| **Course Code** | **Course Name** | **L** | **T** | **P** | **C** | **Hours / Week** | **Maximum Marks** | | | **Category** |
| | | | | | | | **CA** | **ES** | **Total** | |
| **PE-1[5$^{th}$Semester]** | | | | | | | | | | |
| 1903BS001 | Cognitive Science and Analytics | 3 | 0 | 0 | 3 | 3 | 40 | 60 | 100 | PE |
| 1903BS002 | Introduction to IOT | 3 | 0 | 0 | 3 | 3 | 40 | 60 | 100 | PE |
| 1903BS003 | Cryptology | 3 | 0 | 0 | 3 | 3 | 40 | 60 | 100 | PE |
| 1903BS004 | Computational Finance and Modelling | 3 | 0 | 0 | 3 | 3 | 40 | 60 | 100 | PE |

| 1903BS001 | **COGNITIVE SCIENCE AND ANALYTICS** | **L** | **T** | **P** | **C** |
|---|---|---|---|---|---|
| | | **3** | **0** | **0** | **3** |

**PREREQUISITE:**

**COURSE OBJECTIVES:**

1. To understand the way in which cognitive science is methodologically distinctive while at the same time is an interdisciplinary field where established fields of research—including Psychology, Computer Science, Linguistics, Neuroscience.
2. To develop skills in analyzing, interpreting, and assessing the empirical data and research techniques that contribute to cognitive science.
3. To understand central modeling techniques in cognitive science, including traditional computational approaches, neural network/deep learning approaches, and dynamical approaches.

| **Module I** | **Introduction to Cognitive Science** | **8 Hours** |
|---|---|---|

Introduction to the study of cognitive sciences. Neural Network Models- language: definition Affordances Categories and concepts; Concept learning: Linguistic knowledge: Syntax, semantics, (and pragmatics) Direct perception, Logic; Machine learning.

| **Module II** | **Concept Hierarchies** | **9 Hours** |
|---|---|---|

A brief history of cognitive science. Processing of sensory information in the brain, Linguistic knowledge: Syntax, semantics, (and pragmatics), Ecological Psychology, constructing memories Methodological concerns in philosophy, Discretization and generating concept hierarchies, Data Mining System, Generative linguistic, Affordance learning in robotics, Explicit vs. implicit memory

| **Module III** | **Anatomy of brain** | **8 Hours** |
|---|---|---|

Artificial intelligence and psychology, Brain Imaging, Brain and language, Affordance learning in robotics, Information processing (three-boxes) model of memory Structure and constituents of the brain fMRI,MEG, Language disorders, Development Information processing (three-boxes) model of memory.

| **Module IV** | **Memory Models** and **Sensory Information fusion** | **10 Hours** |
|---|---|---|

**Memory Models:** Brief history of neuroscience, PET, EEG Lateralization Child and robotic development Sensory memory; Short term memory Mathematical models, Multisensory integration in cortex, Lateralization, Attention and related concepts, long term memory; Rationality

**Sensory Information fusion:** Mathematical models Information fusion, the great past tense debate, Human visual attention, Bounded rationality; Prospect theory; Heuristics and biases Looking at brain signals.

| **Module V** | **Modelling and Information processing** | **10 Hours** |
|---|---|---|

**Modelling:** From sensation to cognition, The great past tense debate, Computational models of attention, Reasoning in computers, Cybernetics, Cognitivist and emergent stand points, Computational models of attention, Key points in social cognition.

**Information processing:** Processing of sensory information in the brain. From physics to meaning, Analog vs. Digital: Code duality. A robotic perspective, Applications of computational models of attentional Context and social judgment; Schemas; Social signals.

**TOTAL: 45 HOURS**

**Mode of Assessment:CAT/Assignment/Quiz/Seminar/Presentation/ESE**

**Course Outcomes:**

1. Explain the basic principles and process of cognitive science
2. Interpret learning model and apply the same to appropriate real world applications
3. Demonstrate qualitative and quantitative skill and critical thinking on cognitive science by applying suitable methodology to real world applications
4. Summarize and apply declarative and logic models.
5. Envisage the concept of cognitive learning.

| **FURTHER READING:** | |
|---|---|
| **REFERENCES:** | |
| 1. PradeepKumarMallick, Samarjeet Borah," Emerging Trends and Applications in CognitiveComputing", 2019, IGI Global Publishers. | |
| 2. Jose Luis Bermudez, "Cognitive Science: An Introduction to the Science of the Mind", 2020, Cambridge University Press, New York. | |
| 3. Hall, P., Phan, W., & Whitson, K. (2016). Evolution of Analytics. O'Reilly Media Incorporated. | |
| 4. Cherkassky, V., &Mulier, F. M. (2007). Learning from data: concepts, theory, and methods.John Wiley & Sons. | |
| 5. Hair, J. F., Anderson, R. E., Tatham, R. L., & Black, W. C. (1998). Multivariate data analysis.Englewood Cliff. New Jersey, USA, 5(3), 207-2019. | |

| 1903BS002 | INTRODUCTION TO IOT | L | T | P | C |
|---|---|---|---|---|---|
| | | 3 | 0 | 0 | 3 |

**PREREQUISITE:**

**COURSE OBJECTIVES:**

1.To impart necessary and practical knowledge of components of internet of things

2.Develop skills required to build real-life IOT based projects

| Module I | Introduction to IOT | 9 Hours |
|---|---|---|

Architectural Overview, Design principles and needed capabilities, IoT applications, Sensing, Actuation, Basics of Networking,M2M and IoT Technology Fundamentals-Devices and Gateways, Data management, Business processes in IoT, Everything as a service(XaaS),Role of cloud in IoT, Security aspects in IoT.

| Module II | Elements of IOT | 9 Hours |
|---|---|---|

Hardware components-Computing(Arduino, Raspberry Pi),Communication, sensing, Actuation, I/O interfaces. Software Components-Programming API's(using Python/Node.js/Arduino) for Communication Protocols-MQTT ,ZigBee, Bluetooth, CoAP, UDP,TCP.

| Module III | Architecture | 9 Hours |
|---|---|---|

IoT reference architectures, Industrial Internet Reference Architecture, Edge Computing, IoT Gateways, Data Ingestion and Data Processing Pipelines, Data Stream Processing

| Module IV | Networking and Communication for IOT | 9 Hours |
|---|---|---|

Recap of OSI 7 Layers Architecture and mapping to IOT architecture, Introduction to Proximity networking technologies(zigbee, blue-tooth, serial communication)

| Module V | IOT Data Processing and Storage | 9 Hours |
|---|---|---|

Time Series Data and their Characteristics, Time series databases, basic time series analytics, data summarization and sketching, dealing with noisy and missing data, anomaly and outlier detection

**TOTAL: 45 HOURS**

**Mode of Assessment: Assignment//Seminar/Presentation/ESE**

**Course Outcomes:**

1. Report the basic principles and concepts of IOT use cases, applications.
2. Summarize basic concepts of Architecture of IOT.
3. Use sensor and Industrial Systems.
4. Implement Networking and communications for IOT.
5. Comprehend IOT data processing and storage

**REFERENCES:**

1. Samuel Greengard, The Internet of Things, MIT Press Essential Knowledge Series,2015

2.Andrew K Dennis, Raspberry Pi Computer Architecture Essentials, Packt Publishing,2016

3.Vijay Madisetti, Arshdeep Bahga, Internet of things," A Hands on Approach", University Press

| 1903BS003 | **CRYPTOLOGY** | **L** | **T** | **P** | **C** |
|---|---|---|---|---|---|
| | | **3** | **0** | **0** | **3** |

**PREREQUISITE:**

**COURSE OBJECTIVES:**

1. To learn the emerging concept of cryptography and algorithms.
2. To defend the security attacks on information systems using secure algorithms and authentication process.
3. To categorize and analyze the key concept and cryptanalysis and quantum cryptography.

| **Module I** | **Introduction to Cryptography** | **9 Hours** |
|---|---|---|

Introduction to Cryptography: Elementary number theory, Pseudo-random bit generation, Elementary Cryptosystems.
Basic security services: confidentiality, integrity, availability, non-repudiation, privacy.

| **Module II** | **Basic Symmetric Key Cryptosystems** | **9 Hours** |
|---|---|---|

Stream Cipher: Basic Ideas, Hardware and Software Implementations, Examples with some prominent cipher: A5/1, Grain family, RC4, Salsa and ChaCha, HC128, SNOW family, ZUC.

| **Module III** | **Advanced Symmetric Key Cryptosystems & Public key Cryptosystems** | **9 Hours** |
|---|---|---|

Block Ciphers: DES, AES, Modes of Operation; Hash Functions; Authentication.
RSA, ECC; Digital signatures.

| **Module IV** | **Basic Security Applications & Advanced Security Applications** | **9 Hours** |
|---|---|---|

Electronic commerce (anonymous cash, micro-payments), Key management, Zero-knowledge protocols.
Cryptology in Contact Tracing Applications, Issues related to Quantum Cryptanalysis Electronic.

| **Module V** | **Post-Quantum Cryptography** | **9 Hours** |
|---|---|---|

Post-Quantum Cryptography, Public-key Post Quantum Cryptographic Algorithms, Stateful Hash-Based Signatures, Threshold Cryptography.

**TOTAL: 45 HOURS**

**Mode of Assessment: CAT/Assignment/Quiz/Seminar/Presentation/ESE**

**Course Outcomes:**

1. Infer the need of security to introduced strong cryptosystems.
2. Analyze the cryptographic algorithms for information security.
3. Identify the authentication schemes for membership authorization.
4. Identify the requirements for secure communication and challenges related to the secure applications.
5. Identify the need of quantum cryptographic solutions.

**REFERENCES:**

1. W. Stallings, Cryptography and Network Security: Principles and Practice, 7th Edition, Pearson, 2017.
2. A.J. Menezes, P.C. van Oorschot, and S.A Vanstone, Handbook of Applied Cryptography, CRC Press, 2011.
3.C.S. Mukherjee, D .Roy, S.Maitra, Design & Cryptanalysis of ZUC – A Stream Cipher in Mobile Telephony. Springer,2020
4. D.R.Stinson, Cryptography, Theory and Practice. CRC Press, 2014.

| 1903BS004 | COMPUTATIONAL FINANCE AND MODELLING | L | T | P | C |
|---|---|---|---|---|---|
| | | 3 | 0 | 0 | 3 |

**PREREQUISITE:**

**COURSE OBJECTIVES:**

1. To study financial data analysis and modelling
2. To acquire quantitative finance skills, application of tools and techniques
3. To advance knowledge in designing, developing and testing of computational finance models

| Module I | Financial Markets and Instruments | 7 Hours |
|---|---|---|

Financial Products and Markets: Introduction to the financial markets and the products which are traded in them: Equities, indices, foreign exchange, and commodities. Options contracts and strategies for speculation and hedging-an introduction. Statistical Analysis of Financial Returns: Fat-tailed and skewed distributions, outliers, stylized facts.

| Module II | Mathematical Finance | 7 Hours |
|---|---|---|

Numerical methods relevant to integration, differentiation and solving the partial differential equations of mathematical finance: examples of exact solutions including Black Scholes and its relatives, finite difference methods including algorithms and question of stability and convergence, treatment of near and far boundary conditions, the connection with binomial models, interest rate models, early exercise, and the corresponding free boundary problems, and a brief introduction to numerical methods for solving multi-factor models

| Module III | Financial derivatives | 7 Hours |
|---|---|---|

Black-Scholes framework: Black-Scholes PDE: simple European calls and puts; put-call parity. The PDE for pricing commodity and currency options. Discontinuous payoffs - Binary and Digital options. The Greeks: theta, delta, gamma, vega& rho and their role in hedging. The mathematics of early exercise – American options: perpetual calls and puts; optimal exercise strategy and the smooth pasting condition. Volatility considerations - actual, historical, and implied volatility.

| Module IV | Data simulation and analysis | 7 Hours |
|---|---|---|

Simulation including random variable generation, variance reduction methods and statistical analysis of simulation output. Pseudo random numbers, Linear congruential generator, Mersenne twister RNG. The use of Monte Carlo simulation in solving applied problems on derivative pricing discussed in the current finance literature. The technical topics addressed include importance sampling, Monte Carlo integration, Simulation of Random walk and approximations to diffusion processes, martingale control variables stratification, and the estimation of the "Greeks".

| Module V | Volatility Estimation | 6 Hours |
|---|---|---|

Volatility, implied volatility surface, and volatility estimation using high frequency data. Volatility estimation, models- ARCH-GARCH-other advanced models. CBOE VIX and India VIX indices. Volatility smile.

| Module VI | Options and applications | 4 Hours |
|---|---|---|

Application areas include the pricing of American options, pricing interest rate dependent claims, and credit risk. The use of importance sampling for Monte Carlo simulation of VaR for portfolios of options.

| Module VII | Options and alternative models | 5 Hours |
|---|---|---|

Copulas, Hedging in incomplete markets, American Options, Exotic options, Electronic trading, Jump Diffusion Processes, High-dimensional covariance matrices, Extreme value theory, Statistical Arbitrage.

| **Module VIII** | **Contemporary Issues** | **2 Hours** |
|---|---|---|
| Industry expert Lecture on recent trends | | |
| | | **TOTAL: 45 HOURS** |
| **Mode of Assessment:CAT/Assignment/Quiz/Seminar/Presentation/ESE** | | |
| **Course Outcomes:**<br>1. Analyse the given financial data and bring insights<br>2. Explain the mathematical foundations of finance<br>3. Interpret of financial markets and instruments<br>4. Discuss option pricing models and its applications<br>5. Measure and managing various types of financial risks<br>6. Design and test computational finance models | | |
| **FURTHER READING:** | | |
| | | |
| **REFERENCES:** | | |
| 1. Paul Wilmott, Paul Wilmott on Quantitative Finance, 3 Volume Set, 2013, 2nd edition, wiley | | |
| 2. JoergKienitz and Daniel Wetterau, Financial Modelling: Theory, Implementation and Practice with MATLAB, 2012, 1st edition, Wiley Finance Series. | | |
| 3. Dan Stefanica., A Primer for the Mathematics Of Financial Engineering, 2011, 2nd Edition FE Press, New York. | | |
| 4. John C. Hull and Sankarshan Basu, Options, futures & other derivatives, 2018, 10th edition, Pearson India. | | |
| 5. Tsay, Ruey S. Analysis of Financial Time Series, 2011, 3rd edition, John Wiley & Sons. | | |
| 6. R. Seydel: Tools for Computational Finance, 2017, 6th edition, Springer. | | |
| 7. David Ruppert, Statistics and Data Analysis for Financial Engineering, 2011, Springer. | | |