# KUMARAGURU COLLEGE OF TECHNOLOGY

An autonomous Institution affiliated to Anna University, Chennai

# COIMBATORE – 641 049.

# B.Tech., ARTIFICIAL INTELLIGENCE AND DATA SCIENCE

## CURRICULUM AND SYLLABI

## 2021,2022,2023 Admitted Batches

**Powered by**

# Department of Artificial Intelligence and Data Science

## VISION

To embark as a school of innovation in the stream of data science for enabling global education, research and entrepreneurship.

## MISSION

The department is pledged to

- Hone students to excel in the traits of data science technology and professionalism.
- Empower students to develop solutions for mutated technological problems of the society.
- Inculcate industrial and entrepreneurial culture for their professional furtherance.

## PROGRAM EDUCATIONAL OBJECTIVES (PEOs)

The graduates of this program shall have:

1. A successful professional career in industry, government, and academia with capabilities to build innovative solutions using technology as a tool to solve real-world problems.
2. Research capabilities in advanced technologies and shall contribute to a new body of knowledge.
3. A learning mindset to continuously improve their knowledge, through on the job, formal and informal learning opportunities
4. An ethical attitude and shall exhibit effective skills in communication, management, teamwork and leadership.
5. Engineering, problem-solving and critical thinking skills to create social, economical and sustainable impact.

## PROGRAM OUTCOMES (POs)

Graduates of AI & DS programme will have the following abilities:

**PO1: Engineering knowledge:** Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.

**PO2: Problem analysis:** Identity, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

**PO3: Design/development of solutions:** Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.

**PO4: Conduct investigations of complex problems:** Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of theinformation to provide valid conclusions.

**PO5: Modern tool usage:** Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations.

**PO6: The engineer and society:** Apply to reason informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.

**PO7: Environment and sustainability:** Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need forsustainable development.

**PO8: Ethics:** Apply ethical principles and commit to professional ethics and responsibilities and normsof the engineering practice.

**PO9: Individual and teamwork:** Function effectively as an individual, and as a member or leader indiverse teams, and in multidisciplinary settings.

**PO10: Communication:** Communicate effectively on complex engineering activities with the engineering community and with society at large, such as being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.

**PO11: Project management and finance:** Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.

**PO12: Life-long learning:** Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

## PROGRAM SPECIFIC OUTCOMES (PSOs)

After completing their graduation, students of AI & DS will be able to:

**PSO1:** Apply the principles of artificial intelligence and data science that require problem-solving, inference, perception, knowledge representation, and learning.

**PSO2:** Demonstrate the ability to create innovative solutions from idea to product, applying scientific methods and tools.

**PSO3:** Exhibit strong professional skills to function effectively in multi-disciplinary and heterogeneous teams with a growth mindset.

# CURRICULUM OF B.Tech., AI & DS PROGRAM

| Knowledge Disciplines | I - Year | | II - Year | | III - Year | | IV - Year | |
|---|---|---|---|---|---|---|---|---|
| | Sem I | Sem II | Sem III | Sem IV | Sem V | Sem VI | Sem VII | Sem VIII |
| **Fundamental Science** | Engineering Physics (Physics Practicum) (4) | Advanced Physics (3) | | Random Process and Optimization (4) | | | | |
| **Math and Statistics** | Linear Algebra and Calculus (MATLAB Practicum) (4) | Discrete Mathematics (3)<br>Probability and Statistics (R Practicum) (4) | Multivariate Calculusand Forecasting (4) | | | | | |
| **Computer Science** | Introduction to Python (Python Practicum) (3)<br>Introduction to Computational Machines (HW Practicum) (3) | Object-Oriented Programming and Data Structures (Python Practicum) (3) | Algorithms and Optimization of Programs (Python Practicum) (4)<br>Operating System (3) | Computer Networks (3) | Cloud Architecture (AWS Practicum) (4) | | | |
| **Artificial Intelligence** | | Introduction to AI & ML (Python Practicum) (3) | Applied Machine Learning (PyTorch/ Tensorflow) (4) | Neural Networks and Deep Learnings (Keras and MXnet Practicum) (4) | Reinforcement Learning (4) | | | |
| **Data Science** | | Introduction to Data Science (Sheets Practicum) (3) | Data Collection & Data Management (Oracle and SQL Practicum) (3) | Data Mining & Modeling (Rapid Miner Practicum) (3) | Exploratory Data Analysis and Visualization (4) | | | |
| **Advanced Technology** | Disruptive Technologies (2)* | Tech For Good: Achieving The SDG's By The Role Of ICT (2)* | | | Advanced Technology Electives -1 (3) | Advanced Technology Electives-2 (3)<br>Advanced Technology Electives-3 (3)<br>Industrial IoT (4) | Fellowship I (10)<br>Advanced Technology Certification I (4)<br>Externship III (NC) | Fellowship II (9)<br>Advanced Technology Certification I (4) |
| **Arts and Humanities** | Introduction to Indic Culture and Technologies (1)<br>Heritage of Tamils (1) | Growth Lab I (NC)<br>Externship I (NC)<br>Tamils and Technology (1) | Growth Lab II (NC)<br>Tools and Technologies for Wellness (1) | Growth Lab III (NC)<br>Externship II (NC) | Open Elective – 1 (3)<br>Philosophy of Wellness (1) | Open Elective – 2 (3) | | |
| **Business & Entrepreneurship** | Professional Communication (3) | | Principles of Economics (2) | Finance for Engineers (3) | Marketing Fundamentals (3) | | | |
| **Innovation and Design** | Engineering Sprints (3) | Innovation Sprints (3) | Design Sprints (3) | Ideation Sprints (3) | | Applied Design Thinking (4)<br>Prototype Development (4)<br>Minimum Usage Prototype (3) | | |
| **Credits** | 22 | **23** | **24** | **20** | **22** | **24** | **14** | **13** |
| **Total Credits: 162** | | | | | | | | * non CGPA |

**KUMARAGURU COLLEGE OF TECHNOLOGY, COIMBATORE – 641 049**
**REGULATIONS 2018**
**B. Tech., ARTIFICIAL INTELLIGENCE AND DATA SCIENCE**
**List of Courses - Category wise**

| BASIC SCIENCES (BS) | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| **Sl. No** | **Course code** | **Course Title** | **Course Mode** | **CT** | **L** | **T** | **P** | **J** | **C** | **Pre-requisite** |
| 1 | U18PHI1202 | Engineering Physics | Embedded - Theory & Lab | BS | 3 | 0 | 2 | 0 | 4 | |
| 2 | U18MAI1203 | Linear Algebra and Calculus | Embedded - Theory & Lab | BS | 3 | 0 | 2 | 0 | 4 | |
| 3 | U18PHT2203 | Advanced Physics | Theory | BS | 3 | 0 | 0 | 0 | 3 | U18PHI1202 |
| 4 | U18MAT2001 | Discrete Mathematics | Theory | BS | 3 | 0 | 0 | 0 | 3 | |
| 5 | U18MAI2203 | Probability and Statistics | Embedded - Theory & Lab | BS | 3 | 0 | 2 | 0 | 4 | |
| 6 | U18MAI3201 | Multivariate Calculus and Forecasting | Embedded - Theory & Lab | BS | 3 | 0 | 2 | 0 | 4 | U18MAI1203 |
| 7 | U18MAT4105 | Random Process and Optimization | Theory | BS | 3 | 1 | 0 | 0 | 4 | |
| 8 | U18CHT4000 | Environmental Science and Engineering | Theory | BS | 3 | 0 | 0 | 0 | 0 | |
| | | | | | | | | **Total Credits** | **26** | |

| HUMANITIES AND SOCIAL SCIENCES (HS) | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| **Sl. No** | **Course code** | **Course Title** | **Course Mode** | **CT** | **L** | **T** | **P** | **J** | **C** | **Pre-requisite** |
| 1 | U18ENI1202 | Fundamentals of Communication I | Embedded - Theory & Lab | HS | 2 | 0 | 2 | 0 | 3 | |
| 2 | U18AIC1006 | Introduction to Indic Culture and Technologies | One Credit Course | HS | 1 | 0 | 0 | 0 | 1 | |
| 3 | U18AII1205 | Introduction to Python | Embedded - Theory & Lab | ES | 2 | 0 | 2 | 0 | 3 | |
| 4 | U18AII1607 | Engineering Sprints | Embedded - Project & Lab | ES | 0 | 0 | 4 | 2 | 3 | |
| 5 | U18AIP2607 | Growth Lab I | Embedded - Project & Lab | HS | - | - | - | - | - | |
| 6 | U18AIP2708 | Externship I | Project | HS | - | - | - | - | - | |
| 7 | U18AIC3006 | Tools and Technologies for Wellness | One Credit Course | HS | 1 | 0 | 0 | 0 | 1 | |
| 8 | U18AIP3607 | Growth lab II | Embedded - Project & Lab | HS | - | - | - | - | - | |
| 9 | U18AIP4604 | Growth Lab III | Embedded - Project & Lab | HS | - | - | - | - | - | |
| 10 | U18AIP4705 | Externship II | Project | HS | - | - | - | - | - | |
| 11 | U18AIC5005 | Philosophy of Wellness | One Credit | HS | 1 | 0 | 0 | 0 | 1 | |

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| 12 | U18AIP7703 | Externship III | Project | HS | - | - | - | - | - | |
| | | | | | | | | | **Total Credits** | **12** |

| ENGINEERING SCIENCES (ES) | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| **Sl. No** | **Course code** | **Course Title** | **Course Mode** | **CT** | **L** | **T** | **P** | **J** | **C** | **Pre-requisite** |
| 1 | U18AII1204 | Introduction to Computational Machines | Embedded - Theory & Lab | ES | 2 | 0 | 2 | 0 | 3 | |
| 2 | U18AII1205 | Introduction to Python | Embedded - Theory & Lab | ES | 2 | 0 | 2 | 0 | 3 | |
| 3 | U18AII1607 | Engineering Sprints | Embedded - Project & Lab | ES | 0 | 0 | 4 | 2 | 3 | |
| 4 | U18AII2609 | Innovation Sprints | Embedded - Project & Lab | ES | 0 | 0 | 4 | 2 | 3 | |
| 5 | U18AIT3008 | Principles of Economics | Theory | ES | 2 | 0 | 0 | 0 | 2 | |
| 6 | U18AII3609 | Design Sprints | Embedded - Project & Lab | ES | 0 | 0 | 4 | 2 | 3 | |
| 7 | U18AIT4006 | Finance for Engineers | Theory | ES | 3 | 0 | 0 | 0 | 3 | |
| 8 | U18AII4607 | Ideation Sprints | Embedded - Project & Lab | ES | 0 | 0 | 4 | 2 | 3 | |
| 9 | U18AIT5004 | Marketing Fundamentals | Theory | ES | 3 | 0 | 0 | 0 | 3 | |
| | | | | | | | | | | |
| | | | | | | | | | **Total Credits** | **26** |

| PROFESSIONAL CORE (PC) | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| **Sl. No** | **Course code** | **Course Title** | **Course Mode** | **CT** | **L** | **T** | **P** | **J** | **C** | **Pre-requisite** |
| 1 | U18AII2204 | Object-Oriented Programmingand Data Structures | Embedded - Theory & Lab | PC | 2 | 0 | 2 | 0 | 3 | U18AII1205 |
| 2 | U18AII2205 | Introduction to AI & ML | Embedded - Theory & Lab | PC | 2 | 0 | 2 | 0 | 3 | U18AII1205 |
| 3 | U18AII2206 | Introduction to Data Science | Embedded - Theory & Lab | PC | 2 | 0 | 2 | 0 | 3 | |
| 4 | U18AII3202 | Algorithms and Optimization of Programs | Embedded - Theory & Lab | PC | 3 | 0 | 2 | 0 | 4 | U18AII2204 |
| 5 | U18AII3203 | Operating System | Embedded - Theory & Lab | PC | 2 | 0 | 2 | 0 | 3 | |
| 6 | U18AII3204 | Applied Machine Learning | Embedded - Theory & Lab | PC | 3 | 0 | 2 | 0 | 4 | U18AII2205 |
| 7 | U18AII3205 | Data Collection & Data Management | Embedded - Theory & Lab | PC | 2 | 0 | 2 | 0 | 3 | |
| 8 | U18AII4201 | Computer Networks | Embedded - Theory & Lab | PC | 2 | 0 | 2 | 0 | 3 | |
| 9 | U18AII4202 | Neural Networks and Deep Learning | Embedded - Theory & Lab | PC | 3 | 0 | 2 | 0 | 4 | U18AII2205 |
| 10 | U18AII4203 | Data Mining & Modeling | Embedded - Theory & Lab | PC | 2 | 0 | 2 | 0 | 3 | U18MAI2203 |
| 11 | U18AII5201 | Cloud | Embedded - | PC | 3 | 0 | 2 | 0 | 4 | |

| PROFESSIONAL CORE (PC) | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| **Sl. No** | **Course code** | **Course Title** | **Course Mode** | **CT** | **L** | **T** | **P** | **J** | **C** | **Pre-requisite** |
| | | Architecture | Theory & Lab | | | | | | | |
| 12 | U18AII5202 | Exploratory Data Analysis and Visualization | Embedded - Theory & Lab | PC | 3 | 0 | 2 | 0 | 4 | U18MAI2203 |
| 13 | U18AII5203 | Reinforcement Learning | Embedded - Theory & Lab | PC | 3 | 0 | 2 | 0 | 4 | U18AII4202 |
| 14 | U18AII6201 | Applied Design Thinking | Embedded - Theory & Lab | PC | 3 | 0 | 2 | 0 | 4 | |
| 15 | U18AII6202 | Prototype Development | Embedded - Theory & Lab | PC | 3 | 0 | 2 | 0 | 4 | |
| 16 | U18AII6203 | Industrial IoT | Embedded - Theory & Lab | PC | 3 | 0 | 2 | 0 | 4 | |
| | | | | | | | | | | |

| PROFESSIONAL ELECTIVE (PE) | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| **Sl. No** | **Course code** | **Course Title** | **Course Mode** | **CT** | **L** | **T** | **P** | **J** | **C** | **Pre-requisite** |
| 1 | U18AIE5XXX | Advanced Technology Elective 1 | Theory | PE | 3 | 0 | 0 | 0 | 3 | NIL |
| 2 | U18AIE6XXX | Advanced Technology Elective 2 | Theory | PE | 3 | 0 | 0 | 0 | 3 | NIL |
| 3 | U18AIE6XXX | Advanced Technology Elective 3 | Theory | PE | 3 | 0 | 0 | 0 | 3 | NIL |
| | | | | | | | | | **Total Credits** | **9** |

| OPEN ELECTIVE (PE) | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| **Sl. No** | **Course code** | **Course Title** | **Course Mode** | **CT** | **L** | **T** | **P** | **J** | **C** | **Pre-requisite** |
| 1 | U18XXE5XXX | Elective 1 | Theory | OE | 3 | 0 | 0 | 0 | 3 | NIL |
| | | | | | | | | | | |
| | | | | | | | | | | |

| PROFESSIONAL ELECTIVE (PE) LIST | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| **Sl. No** | **Course code** | **Course Title** | **Course Mode** | **CT** | **L** | **T** | **P** | **J** | **C** | **Pre-requisite** |
| 1 | U18AIEX001 | Natural Language Processing | Theory | PE | 3 | 0 | 0 | 0 | 3 | |
| 2 | U18AIEX002 | Introduction to Spatial Computing | Theory | PE | 3 | 0 | 0 | 0 | 3 | |
| 3 | U18AIEX003 | Computer Vision Techniques | Theory | PE | 3 | 0 | 0 | 0 | 3 | |
| 4 | U18AIEX004 | Recommendation system for e-commerce | Theory | PE | 3 | 0 | 0 | 0 | 3 | |
| 5 | U18AIEX005 | Mining BigData | Theory | PE | 3 | 0 | 0 | 0 | 3 | |
| 6 | U18AIEX006 | Neural Computation | Theory | PE | 3 | 0 | 0 | 0 | 3 | |
| 7 | U18AIEX007 | Human-Centered Systems | Theory | PE | 3 | 0 | 0 | 0 | 3 | |
| 8 | U18AIEX008 | Speech Processing | Theory | PE | 3 | 0 | 0 | 0 | 3 | |
| 9 | U18AIE0009 | Startup Fundamentals | Theory | PE | 3 | 0 | 0 | 0 | 3 | |

| MANDATORY COURSE (MC) | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| **Sl. No** | **Course code** | **Course Title** | **Course Mode** | **CT** | **L** | **T** | **P** | **J** | **C** | **Pre-requisite** |
| 1 | U18TLR1001 | Heritage of Tamils | Theory | Mandatory (CGPA) | 1 | 0 | 0 | 0 | 1 | |
| 2 | U18CSR1001 | Disruptive Technologies | Theory | Value Added Course (non CGPA) | 2 | 0 | 0 | 0 | 2 | |
| 3 | U18TLR2001 | Tamils and Technology | Theory | Mandatory (CGPA) | 1 | 0 | 0 | 0 | 1 | |
| 4 | U18MAR0003 | Tech for Good: Achieving the SDG's by the Role of ICT | Embedded - Theory & Lab | Mandatory VAC (non-CGPA) | 1 | 0 | 2 | 0 | 2 | |
| 5 | U18CHT4000 | Environmental Science and Engineering | Theory | Mandatory | 3 | 0 | 0 | 0 | 0 | |
| 6 | U18INT5000 | Constitution of India | Theory | Mandatory | 1 | 0 | 0 | 0 | 0 | |
| | | | | | | | | **Total Credits** | **6** | |

| PROJECT WORK (PW) | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| **Sl. No** | **Course code** | **Course Title** | **Course Mode** | **CT** | **L** | **T** | **P** | **J** | **C** | **Pre-requisite** |
| 1 | U18AIP6604 | Minimum Usage Prototype | Project | PW | 0 | 0 | 0 | 6 | 3 | |
| 2 | U18AIP7701 | Fellowship I | Project | PW | 0 | 0 | 0 | 20 | 10 | |
| 3 | U18AIP8701 | Fellowship II | Project | PW | 0 | 0 | 0 | 18 | 9 | |
| | | | | | | | | **Total Credits** | **22** | |

| PROJECT WORK (PW) | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| **Sl. No** | **Course code** | **Course Title** | **Course Mode** | **CT** | **L** | **T** | **P** | **J** | **C** | **Pre-requisite** |
| 1 | U18AIR7102 | Advanced Technology Certification I | eRIDE | CC | 0 | 0 | 0 | 8 | 4 | |
| 2 | U18AIR8102 | Advanced Technology Certification I | eRIDE | CC | 0 | 0 | 0 | 8 | 4 | |
| | | | | | | | | **Total Credits** | **8** | |

| Professional Electives/Honors - Specialization Track (From 2022 Batch), Professional Elective (2021 Batch) and minors for non-Computing Departments | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| **Sl. No** | **Specialization Track** | **Course code** | **Course Title** | **L** | **T** | **P** | **J** | **C** | **Pre requisite** |
| **1** | Extended Reality | U18CSE0314 | 3D Modeling and Game Design | 2 | 0 | 0 | 2 | 3 | U18AII2204 Object Oriented Programming and Data Structures |
| **2** | | U18CSE0315 | Augmented Reality and Virtual Reality Application Development | 2 | 0 | 0 | 2 | 3 | U18AII2204 Object Oriented Programming and Data Structures |
| **3** | | U18CSE0016 | Advanced Metaverse Technologies | 3 | 0 | 0 | 0 | 3 | NIL |
| **4** | | U18CSE0228 | Game Programming | 2 | 0 | 2 | 0 | 3 | U18AII2204 Object Oriented Programming and Data Structures |
| 5 | IoT, Edge, UAV | U18CSE0217 | Embedded Systems for IoT | 2 | 0 | 2 | 0 | 3 | U18AII1204 Introduction to Computational Machines |
| 6 | | U18CSE0318 | IoT Systems Design | 2 | 0 | 0 | 2 | 3 | U18AII1204 Introduction to Computational Machines |
| 7 | | U18CSE0219 | IoT Application Development | 2 | 0 | 2 | 0 | 3 | U18AII1204 Introduction to Computational Machines |
| 8 | | U18CSE0220 | 3D Printing | 2 | 0 | 2 | 0 | 3 | NIL |
| 9 | | U18CSE0221 | Robotic Operating Systems | 2 | 0 | 2 | 0 | 3 | U18AII3203 - Operating System |
| 10 | | U18CSE0022 | Software Defined Vehicle | 3 | 0 | 0 | 0 | 3 | U18AII1204 Introduction to Computational Machines |

| Professional Electives/Honors - Specialization Track (From 2022 Batch), Professional Elective (2021 Batch) and minors for non-Computing Departments | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| **Sl. No** | **Specialization Track** | **Course code** | **Course Title** | **L** | **T** | **P** | **J** | **C** | **Pre requisite** |
| 11 | Cyber Security | U18CSE0223 | Ethical Hacking and Network Defence | 2 | 0 | 2 | 0 | 3 | U18AII4201 Computer Networks |
| **12** | | U18CSE0024 | Cyber Ethics and Laws | 3 | 0 | 0 | 0 | 3 | NIL |
| **13** | | U18CSE0225 | Secure Software Development | 2 | 0 | 2 | 0 | 3 | U18AII4201 Computer Networks |
| **14** | | U18CSE0226 | Network Security Administration | 2 | 0 | 2 | 0 | 3 | U18AII4201 - Computer Networks |
| **15** | | U18CSE0227 | Digital Forensics | 2 | 0 | 2 | 0 | 3 | U18AII4201 - Computer Networks |
| 16 | Automation and Artificial Intelligence | U18AIE0214 | Generative AI | 2 | 0 | 2 | 0 | 3 | U18AII2205 Introduction to AI & ML |
| 17 | | U18AIE0015 | Responsible AI | 3 | 0 | 0 | 0 | 3 | U18AII2205 Introduction to AI & ML |
| 18 | | U18AIE0212 | Intelligent Automation Systems | 2 | 0 | 2 | 0 | 3 | U18AII2205 Introduction to AI & ML |
| 19 | Data Science, Analytics and Visualization Cohort | U18AIE0217 | Data Processing Techniques | 2 | 0 | 2 | 0 | 3 | U18AII2206 Introduction to Data Science |
| 20 | | U18AIE0218 | Data Modelling | 2 | 0 | 2 | 0 | 3 | U18AII2206 Introduction to Data Science |
| 21 | | U18AIE0220 | Business Intelligence for Decision Making | 2 | 0 | 2 | 0 | 3 | U18AII2206 Introduction to Data Science |
| 22 | | U18AIE0021 | Data Ethics and Privacy | 3 | 0 | 0 | 0 | 3 | U18AII2206 Introduction to Data Science |
| 23 | Cloud Computing | U18ITE0220 | Virtualization and Resource Management | 2 | 0 | 2 | 0 | 3 | U18AII3203 Operating Systems |
| 24 | | U18ITE0222 | Cloud Storage Management | 2 | 0 | 2 | 0 | 3 | U18AII3203 Operating Systems |
| 25 | | U18ITE0323 | Cloud Application Development | 2 | 0 | 0 | 2 | 3 | U18AII4201 Computer Networks |
| 26 | | U18ITE0224 | Cloud Security | 2 | 0 | 2 | 0 | 3 | U18AII4201 Computer Networks |
| 27 | | U18ITE0325 | Cloud Automation | 2 | 0 | 0 | 2 | 3 | U18AII5201 Cloud Architecture |
| 28 | Web and Software Development | U18ITE0226 | Full Stack Software Development | 2 | 0 | 2 | 0 | 3 | U18AII2204 Object Oriented Programming and Data Structures |
| 29 | | U18ITE0227 | UI and UX Design | 2 | 0 | 2 | 0 | 3 | U18AII6202 Prototype Development |
| 30 | | U18ITE0228 | Principles of DevOps | 2 | 0 | 2 | 0 | 3 | U18AII6202 Prototype Development |
| 31 | Network and Distributed Computing | U18ITE0019 | Decentralized Finance | 3 | 0 | 0 | 0 | 3 | U18AII4201 Computer Networks |

**Advanced Technology Certification Courses**

1.IBM Cyber Security Analyst Professional Certificate

2.Deeplearning.ai TensorFlow Developer Professional Certification

3.Google IT Automation with Python Professional Certification

4.Cloud Architecture with Google Cloud Professional Certification

5.IBM AI Engineering Professional Certification

6.IBM Applied AI Professional Certification

7.Data Engineering with Google Cloud Professional Certification

8.SAS Programmer Professional Certification

9.Cloud Engineering with Google Cloud Professional Certification

10. SAS Visual Business Analytics Professional Certificate
11. Professional Certificate program in Digital Transformation
12. Professional Certificate Program in Innovation & Technology
13. Professional Certificate Program in Legal Tech in the Digital Era
14. AWS Certified Cloud Practitioner
15. AWS Certified Solution Architect (Associate)
16. AWS Certified Developer (Associate)
17. AWS Certified Data Analytics (Speciality)
18. AWS Certified Database (Specialty)
19. AWS Certified Machine Learning (Specialty)
20. Tensorflow Certification (TF)

**CURRICULUM -TENTATIVE SEMESTER**

| Semester I (2021 BATCH) | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| **S.No** | **Course code** | **Course Title** | **Course Mode** | **CT** | **L** | **T** | **P** | **J** | **C** | **Pre-requisite** |
| 1 | U18PHI1202 | Engineering Physics | Embedded - Theory & Lab | BS | 3 | 0 | 2 | 0 | 4 | |
| 2 | U18MAI1203 | Linear Algebra and Calculus | Embedded - Theory & Lab | BS | 3 | 0 | 2 | 0 | 4 | |
| 3 | U18AII1204 | Introduction to Computational Machines | Embedded - Theory & Lab | ES | 2 | 0 | 2 | 0 | 3 | |
| 4 | U18AII1205 | Introduction to Python | Embedded - Theory & Lab | ES | 2 | 0 | 2 | 0 | 3 | |
| 5 | U18ENI1202 | Fundamentals of Communication I | Embedded - Theory & Lab | HS | 2 | 0 | 2 | 0 | 3 | |
| 6 | U18AIC1006 | Introduction to Indic Culture and Technologies | One Credit Course | HS | 1 | 0 | 0 | 0 | 1 | |
| 7 | U18AII1607 | Engineering Sprints | Embedded - Project & Lab | ES | 0 | 0 | 4 | 2 | 3 | |
| | | | | | | | | **Total Credits** | **21** | |
| | | | | | | | | **Total Contact Hours/week** | **29** | |

| Semester I (2022 BATCH) | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| **S.No** | **Course code** | **Course Title** | **Course Mode** | **CT** | **L** | **T** | **P** | **J** | **C** | **Pre-requisite** |
| 1 | U18PHI1202 | Engineering Physics | Embedded - Theory & Lab | BS | 3 | 0 | 2 | 0 | 4 | |
| 2 | U18MAI1203 | Linear Algebra and Calculus | Embedded - Theory & Lab | BS | 3 | 0 | 2 | 0 | 4 | |
| 3 | U18AII1204 | Introduction to Computational Machines | Embedded - Theory & Lab | ES | 2 | 0 | 2 | 0 | 3 | |
| 4 | U18AII1205 | Introduction to Python | Embedded - Theory & Lab | ES | 2 | 0 | 2 | 0 | 3 | |
| 5 | U18ENI1202 | Fundamentals of Communication I | Embedded - Theory & Lab | HS | 2 | 0 | 2 | 0 | 3 | |
| 6 | U18AIC1006 | Introduction to Indic Culture and Technologies | One Credit Course | HS | 1 | 0 | 0 | 0 | 1 | |
| 7 | U18AII1607 | Engineering Sprints | Embedded - | ES | 0 | 0 | 4 | 2 | 3 | |

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | Project & Lab | | | | | | | |
| 8 | U18TLR1001 | Heritage of Tamils | Theory | Mandatory (CGPA) | 1 | 0 | 0 | 0 | 1 | |
| | | | | | | | | **Total Credits** | **22** | |
| | | | | | | | | **Total Contact Hours/week** | **30** | |

| **Semester I (2023 BATCH)** | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| **S.No** | **Course code** | **Course Title** | **Course Mode** | **CT** | **L** | **T** | **P** | **J** | **C** | **Pre-requisite** |
| 1 | U18PHI1202 | Engineering Physics | Embedded - Theory & Lab | BS | 3 | 0 | 2 | 0 | 4 | |
| 2 | U18MAI1203 | Linear Algebra and Calculus | Embedded - Theory & Lab | BS | 3 | 0 | 2 | 0 | 4 | |
| 3 | U18AII1204 | Introduction to Computational Machines | Embedded - Theory & Lab | ES | 2 | 0 | 2 | 0 | 3 | |
| 4 | U18AII1205 | Introduction to Python | Embedded - Theory & Lab | ES | 2 | 0 | 2 | 0 | 3 | |
| 5 | U18ENI0202 | Professional Communication | Embedded - Theory & Lab | HS | 2 | 0 | 2 | 0 | 3 | |
| 6 | U18AIC1006 | Introduction to Indic Cultureand Technologies | One Credit Course | HS | 1 | 0 | 0 | 0 | 1 | |
| 7 | U18AII1607 | Engineering Sprints | Embedded - Project & Lab | ES | 0 | 0 | 4 | 2 | 3 | |
| 8 | U18TLR1001 | Heritage of Tamils | Theory | Mandatory (CGPA) | 1 | 0 | 0 | 0 | 1 | |
| 9 | U18CSR1001 | Disruptive Technologies | Theory | Value Added Course (non CGPA) | 2 | 0 | 0 | 0 | 2 | |
| | | | | | | | | **Total Credits** | **22** | |
| | | | | | | | | **Total Contact Hours/week** | **32** | |

| **Semester II (2021 BATCH)** | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| **S.No** | **Course code** | **Course Title** | **Course Mode** | **CT** | **L** | **T** | **P** | **J** | **C** | **Pre-requisite** |
| 1 | U18PHT2203 | Advanced Physics | Theory | BS | 3 | 0 | 0 | 0 | 3 | U18PHI1202 |
| 2 | U18MAT2001 | Discrete Mathematics | Theory | BS | 3 | 0 | 0 | 0 | 3 | |
| 3 | U18MAI2203 | Probability and Statistics | Embedded - Theory & Lab | BS | 3 | 0 | 2 | 0 | 4 | |
| 4 | U18AII2204 | Object-Oriented Programmingand Data Structures | Embedded - Theory & Lab | PC | 2 | 0 | 2 | 0 | 3 | U18AII1205 |
| 5 | U18AII2205 | Introduction to AI & ML | Embedded - Theory & Lab | PC | 2 | 0 | 2 | 0 | 3 | U18AII1205 |
| 6 | U18AII2206 | Introduction to Data | Embedded - | | 2 | 0 | 2 | 0 | 3 | |

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | Science | Theory & Lab | PC | | | | | | |
| 7 | U18AIP2607 | Growth Lab I | Embedded - Project & Lab | HS | - | - | - | - | - | |
| 8 | U18AIP2708 | Externship I | Project | HS | - | - | - | - | - | |
| 9 | U18AII2609 | Innovation Sprints | Embedded - Project & Lab | ES | 0 | 0 | 4 | 2 | 3 | |
| | | | | | | | | | **Total Credits** | **22** |
| | | | | | | | | | **Total Contact Hours/week** | **32** |

| **Semester II (2022 BATCH)** | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| **S.No** | **Course code** | **Course Title** | **Course Mode** | **CT** | **L** | **T** | **P** | **J** | **C** | **Pre-requisite** |
| 1 | U18PHT2203 | Advanced Physics | Theory | BS | 3 | 0 | 0 | 0 | 3 | U18PHI1202 |
| 2 | U18MAT2001 | Discrete Mathematics | Theory | BS | 3 | 0 | 0 | 0 | 3 | |
| 3 | U18MAI2203 | Probability and Statistics | Embedded - Theory & Lab | BS | 3 | 0 | 2 | 0 | 4 | |
| 4 | U18AII2204 | Object-Oriented Programmingand Data Structures | Embedded - Theory & Lab | PC | 2 | 0 | 2 | 0 | 3 | U18AII1205 |
| 5 | U18AII2205 | Introduction to AI & ML | Embedded - Theory & Lab | PC | 2 | 0 | 2 | 0 | 3 | U18AII1205 |
| 6 | U18AII2206 | Introduction to Data Science | Embedded - Theory & Lab | PC | 2 | 0 | 2 | 0 | 3 | |
| 7 | U18AIP2607 | Growth Lab I | Embedded - Project & Lab | HS | - | - | - | - | - | |
| 8 | U18AIP2708 | Externship I | Project | HS | - | - | - | - | - | |
| 9 | U18AII2609 | Innovation Sprints | Embedded - Project & Lab | ES | 0 | 0 | 4 | 2 | 3 | |
| 10 | U18TLR2001 | Tamils and Technology | Theory | Mandatory (CGPA) | 1 | 0 | 0 | 0 | 1 | |
| | | | | | | | | | **Total Credits** | **23** |
| | | | | | | | | | **Total Contact Hours/week** | **33** |

| **Semester II (2023 BATCH)** | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| **S.No** | **Course code** | **Course Title** | **Course Mode** | **CT** | **L** | **T** | **P** | **J** | **C** | **Pre-requisite** |
| 1 | U18PHT2203 | Advanced Physics | Theory | BS | 3 | 0 | 0 | 0 | 3 | U18PHI1202 |
| 2 | U18MAT2001 | Discrete Mathematics | Theory | BS | 3 | 0 | 0 | 0 | 3 | |
| 3 | U18MAI2203 | Probability and Statistics | Embedded - Theory & Lab | BS | 3 | 0 | 2 | 0 | 4 | |
| 4 | U18AII2204 | Object-Oriented Programmingand Data Structures | Embedded - Theory & Lab | PC | 2 | 0 | 2 | 0 | 3 | U18AII1205 |
| 5 | U18AII2205 | Introduction to AI & ML | Embedded - Theory & Lab | PC | 2 | 0 | 2 | 0 | 3 | U18AII1205 |
| 6 | U18AII2206 | Introduction to Data Science | Embedded - Theory & Lab | PC | 2 | 0 | 2 | 0 | 3 | |
| 7 | U18AIP2607 | Growth Lab I | Embedded - Project & Lab | HS | - | - | - | - | - | |
| 8 | U18AIP2708 | Externship I | Project | HS | - | - | - | - | - | |

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| 9 | U18AII2609 | Innovation Sprints | Embedded - Project & Lab | ES | 0 | 0 | 4 | 2 | 3 | |
| 10 | U18MAR0003 | Tech for good: Achieving the sdg's by the role of ICT | Embedded - Theory & Lab | Mandatory VAC (non CGPA) | 1 | 0 | 2 | 0 | 2 | |
| 11 | U18TLR2001 | Tamils and Technology | Theory | Mandatory (CGPA) | 1 | 0 | 0 | 0 | 1 | |
| | | | | | | | | | **Total Credits** | **23** |
| | | | | | | | | | **Total Contact Hours/week** | **36** |

| **Semester III** | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| **S.No** | **Course code** | **Course Title** | **Course Mode** | **CT** | **L** | **T** | **P** | **J** | **C** | **Pre-requisite** |
| 1 | U18MAI3201 | Multivariate Calculus andForecasting | Embedded - Theory & Lab | BS | 3 | 0 | 2 | 0 | 4 | U18MAI1203 |
| 2 | U18AII3202 | Algorithms and Optimization of Programs | Embedded - Theory & Lab | PC | 3 | 0 | 2 | 0 | 4 | U18AII2204 |
| 3 | U18AII3203 | Operating System | Embedded - Theory & Lab | PC | 2 | 0 | 2 | 0 | 3 | |
| 4 | U18AII3204 | Applied Machine Learning | Embedded - Theory & Lab | PC | 3 | 0 | 2 | 0 | 4 | U18AII2205 |
| 5 | U18AII3205 | Data Collection & DataManagement | Embedded - Theory & Lab | PC | 2 | 0 | 2 | 0 | 3 | |
| 6 | U18AIC3006 | Tools and Technologies for Wellness | One Credit Course | HS | 1 | 0 | 0 | 0 | 1 | |
| 7 | U18AIP3607 | Growth lab II | Embedded - Project & Lab | HS | - | - | - | - | - | |
| 8 | U18AIT3008 | Principles of Economics | Theory | ES | 2 | 0 | 0 | 0 | 2 | |
| 9 | U18AII3209 | Design Sprints | Embedded - Project & Lab | ES | 0 | 0 | 4 | 2 | 3 | |
| | | | | | | | | | **Total Credits** | **24** |
| | | | | | | | | | **Total Contact Hours/week** | **35** |

| **Semester IV** | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| **S.No** | **Course code** | **Course Title** | **Course Mode** | **CT** | **L** | **T** | **P** | **J** | **C** | **Pre-requisite** |
| 1 | U18MAT4105 | Random Process and Optimization | Theory | BS | 3 | 1 | 0 | 0 | 4 | |
| 2 | U18AII4201 | Computer Networks | Embedded - Theory & Lab | PC | 2 | 0 | 2 | 0 | 3 | |
| 3 | U18AII4202 | Neural Networks and DeepLearning | Embedded - Theory & Lab | PC | 3 | 0 | 2 | 0 | 4 | U18AII2205 |
| 4 | U18AII4203 | Data Mining & Modeling | Embedded - Theory & Lab | PC | 2 | 0 | 2 | 0 | 3 | U18MAI2203 |
| 5 | U18AIP4604 | Growth Lab III | Embedded - Project & Lab | HS | - | - | - | - | - | |
| 6 | U18AIP4705 | Externship II | Project | HS | - | - | - | - | - | |
| 7 | U18AIT4006 | Finance for Engineers | Theory | ES | 3 | 0 | 0 | 0 | 3 | |
| 8 | U18AII4607 | Ideation Sprints | Embedded - Project & Lab | ES | 0 | 0 | 4 | 2 | 3 | |

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| 9 | U18CHT4000 | Environmental Science and Engineering | Theory | BS | 3 | 0 | 0 | 0 | 0 | |
| | | | | | | | | | **Total Credits** | **20** |
| | | | | | | | | | **Total Contact Hours/week** | **32** |

| **Semester V** | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| **S.No** | **Course code** | **Course Title** | **Course Mode** | **CT** | **L** | **T** | **P** | **J** | **C** | **Pre-requisite** |
| 1 | U18AII5201 | Cloud Architecture | Embedded - Theory & Lab | PC | 3 | 0 | 2 | 0 | 4 | |
| 2 | U18AII5202 | Exploratory Data Analysis and Visualization | Embedded - Theory & Lab | PC | 3 | 0 | 2 | 0 | 4 | U18MAI2203 |
| 3 | U18AII5203 | Reinforcement Learning | Embedded - Theory & Lab | PC | 3 | 0 | 2 | 0 | 4 | U18AII4202 |
| 4 | U18AIE520X | Advanced Technology Elective 1 | Theory | PE | 3 | 0 | 0 | 0 | 3 | |
| 5 | U18XXE5XXX | Elective 1 | Theory | OE | 3 | 0 | 0 | 0 | 3 | |
| 6 | U18AIT5004 | Marketing Fundamentals | Theory | ES | 3 | 0 | 0 | 0 | 3 | |
| 7 | U18AIC5005 | Philosophy of Wellness | One Credit | HS | 1 | 0 | 0 | 0 | 1 | |
| 8 | U18INT5000 | Constitution of India | Theory | Mandatory | 1 | 0 | 0 | 0 | 0 | |
| | | | | | | | | | **Total Credits** | **22** |
| | | | | | | | | | **Total Contact Hours/week** | **26** |

| **Semester VI** | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| **S.No** | **Course code** | **Course Title** | **Course Mode** | **CT** | **L** | **T** | **P** | **J** | **C** | **Pre-requisite** |
| 1 | U18AII6201 | Applied Design Thinking | Embedded - Theory & Lab | PC | 3 | 0 | 2 | 0 | 4 | |
| 2 | U18AII6202 | Prototype Development | Embedded - Theory & Lab | PC | 3 | 0 | 2 | 0 | 4 | |
| 3 | U18AII6203 | Industrial IoT | Embedded - Theory & Lab | PC | 3 | 0 | 2 | 0 | 4 | |
| 4 | U18AIE6XXX | Advanced Technology Elective 2 | Theory | PE | 3 | 0 | 0 | 0 | 3 | |
| 5 | U18AIE6XXX | Advanced Technology Elective 3 | Theory | PE | 3 | 0 | 0 | 0 | 3 | |
| 6 | U18XXEXXXX | Elective 2 | Theory | OE | 3 | 0 | 0 | 0 | 3 | |
| 7 | U18AIP6604 | Minimum Usage Prototype | Project | PW | 0 | 0 | 0 | 6 | 3 | |
| | | | | | | | | | **Total Credits** | **24** |
| | | | | | | | | | **Total Contact Hours/week** | **30** |

| Semester VII | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| **S.No** | **Course code** | **Course Title** | **Course Mode** | **CT** | **L** | **T** | **P** | **J** | **C** | **Pre-requisite** |
| 1 | U18AIP7701 | Fellowship I | Project | PW | 0 | 0 | 0 | 20 | 10 | |
| 2 | U18AIR7102 | Advanced Technology Certification I | eRIDE | CC | 0 | 0 | 0 | 8 | 4 | |
| 3 | U18AIP7703 | Externship III | Project | HS | - | - | - | - | - | |
| | | | | | | | | **Total Credits** | **14** | |
| | | | | | | | | **Total Contact Hours/week** | **28** | |

| Semester VIII | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| **S.No** | **Course code** | **Course Title** | **Course Mode** | **CT** | **L** | **T** | **P** | **J** | **C** | **Pre-requisite** |
| 1 | U18AIP8701 | Fellowship II | Project | PW | 0 | 0 | 0 | 18 | 9 | |
| 2 | U18AIR8102 | Advanced Technology Certification II | eRIDE | CC | 0 | 0 | 0 | 8 | 4 | |
| | | | | | | | | **Total Credits** | **13** | |
| | | | | | | | | **Total Contact Hours/week** | **26** | |

| S.No. | Batch | Total Credits |
|---|---|---|
| 1 | 2023 | 162 |
| 2 | 2022 | 162 |
| 3 | 2021 | 160 |

# SEMESTER I

| U18PHI1202 | ENGINEERING PHYSICS | L | T | P | J | C |
|---|---|---|---|---|---|---|
| | | 3 | 0 | 2 | 0 | 4 |

**Course Objectives:**

- To explain principles of optics.
- To make students understand the basic concepts of Principles of Physics in a broader sense
- To enable a view to lay the foundation for the various engineering courses
- To demonstrate competency and understanding of the concepts found in quantum mechanism, laser, Optical fiber, Waves in one dimension, Wave Optics, Lasers, Fiber Optics and a broad base of knowledge in physics.

**Course Outcomes:**

After successful completion of this course, the students should be able to

| | |
|---|---|
| CO 1: | Enhance the fundamental knowledge in properties of matter and its applications relevant to various applications of Engineering |
| CO 2: | Understanding the phenomenon of heat transfer mechanisms in engineering systems. |
| CO 3: | Acquire knowledge in the basic concepts of quantum mechanics and electron microscopy. |
| CO 4: | Imbibe the concept of lasers, optical fibers and their applications in engineering. |
| CO 5: | Introduce and provide a broad view of acoustics. |
| CO 6: | Apply the NDT techniques and modern engineering tools necessary for Engineering practice. |

**Pre-requisite courses: Not applicable**

**CO/PO Mapping**
(S/M/W indicates the strength of correlation) S-Strong, M-Medium, W-Weak

| COs | Programme Outcomes (POs) | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 | PSO3 |
| CO1 | S | M | M | | | | | | | | | M | | | |
| CO2 | S | M | M | | | | | | | | | M | | | |
| CO3 | S | M | | M | | | | | | | | M | | | |
| CO4 | S | M | | M | | | | | | | | M | | | |
| CO5 | S | M | | | | | | | | | | M | | | |

| | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO6 | S | M | M | | | | | | | | | M | | | |

**Course Assessment Methods:**

**DIRECT**

1. Continuous Assessment Test I, II (Theory component)
2. Open Book Test; Cooperative Learning Report, Assignment; Journal Paper Review, Group Presentation, Project Report, Poster Preparation, Prototype or Product
3. Demonstration etc (as applicable) (Theory component)
4. Pre/Post - Experiment Test/Viva; Experimental Report for each Experiment (lab Component) Model Examination (lab component)
5. End Semester Examination (Theory and lab components)

**INDIRECT**

1. Course-end survey

**Topics covered:**

| **PROPERTIES OF MATTER** | **9 Hours** |
|---|---|

Hooke's Law - Elastic moduli - Relation between elastic constants - Poisson's Ratio – Stress - Strain Diagram and its uses – factors affecting elastic modulus – Bending of beams – Expression for bending moment and depression - Cantilever - Depression of a cantilever - experimental determination of Young's modulus by Non uniform bending – I shape girders

| **THERMAL PHYSICS** | **9 Hours** |
|---|---|

Transfer of heat energy – conduction, convection and radiation – thermal expansion of solids and liquids – expansion joints – bimetallic strips – theory of heat conduction in solids – rectilinear flow of heat – determination of thermal conductivity of a bad conductor - Lee's & Charlton's disc method - Thermal Insulation – classification and properties – heat exchangers - applications – domestic refrigerator – microwave oven.

| **MODERN PHYSICS** | **9 Hours** |
|---|---|

Planck's concept (hypothesis) - Compton effect - Expression for Compton shift - Concept of matter waves - Physical significance of wave function - Schrödinger's wave equation - Time independent and time dependent equation - Eigenvalues and Eigenfunction - Particle in a box (one dimension)- Scanning electron microscope (SEM)- Transmission electron microscope (TEM).

| **APPLIED OPTICS** | **9 Hours** |
|---|---|

LASERS: Absorption and emission - Spontaneous emission - Stimulated emission - Population inversion - Sources of excitation - Active medium - Resonant cavity - Einstein's theory of stimulated emission - Nd-YAG laser - $CO_2$ laser - Semiconductor lasers - Applications – holography, cutting welding , drilling.
Fibre optics: Structure of optical fiber -principle and propagation of light in optical fibers - Numerical aperture and acceptance angle - - Types of optical fibers - Applications - Fiber optic communication system, Fiber endoscope.

| ACOUSTICS AND ULTRASONICS | 9 Hours |
|---|---|

Acoustics: Sound basic definitions - Reverberation - Reverberation time - Sabine's formula - Absorption coefficient and its determination - Factors affecting the acoustics of the buildings and their remedies.
Ultrasonics: Production of ultrasonic waves- Magneto-striction and Piezoelectric methods - Properties -Detection - Thermal and Knut's methods, Determination of velocity of ultrasonic waves in liquids using acoustic grating – applications - A, B, C scan.

| Theory: 30 Hrs | Tutorial: 0 | Total Hours: 45 Hrs |
|---|---|---|

## Lab component Contents:

LIST OF EXPERIMENTS

1. Non-uniform bending – Determination of Young's modulus
2. Compound Pendulum – Determination of acceleration due to gravity
3. Spectrometer – Determination of wavelength of mercury source using grating
4. Air wedge - Determination of thickness of thin sheet
5. Semiconductor Laser:
    a. Determination of wavelength of laser
    b. Determination acceptance angle and numerical aperture of an optical fibre.
    c. Determination of particle size
6. Melde's string – Determination of frequency of a tuning fork
7. Determination of band gap of a semiconductor
8. Luxmeter – Determination of efficiency of solar cell
9. Lee's disc – Determination of thermal conductivity of a bad conductor
10. B-H Curve apparatus – Determination of magnetic susceptibility of a solid material.

Experiments for Demonstration:

1. Hall effect
2. Hardness Test
3. Four probe experiment
4. Ultrasonic interferometer

| Practical: 30 hrs | Tutorial: 0 | Total Hours : 30 Hrs |
|---|---|---|

## Textbooks:


1. Kumar Senthil G, Revised Edition 2020-21, Engineering Physics, VRB Publishers Pvt Ltd., Chennai.
2. Arthur Besier, Shobhit Mahajan, S. Rai Choudhury, 7th Edition, 2015, Concepts of Modern Physics, Mcgraw Hill Education, New Delhi.


## Reference Books:


1. Avadhanulu M N , 1992, A textbook of Engineering Physics, S. Chand Publishing
2. Dr. Aparna Y & Dr. Venkateswara Rao K, Laboratory Manual of Engineering Physics, V.G.S Publishers.
3. Brijlal and Subharamaniam, 2004, Properties of matter, S. Chand & Co Ltd., New Delhi.
4. Prakash Satya , 2015, Quantum Mechanics, Pragati Prakashan Publishers.
5. Thyagarajan K, Ghatak Ajoy, 2010, Lasers: Fundamentals and Applications, Springer Science & Business Media.
6. Introduction to Fiber Optics, K. Thyagarajan, Ajoy Ghatak, Second Edition, Springer New York Dordrecht Heidelberg London, 2010.
7. Dale Ensminger and Leonard J. Bond, Ultrasonics: Fundamentals, Technology, Applications, Second Edition, 1988, Marcel Dekker, New York.
8. C. C. Ouseph, U. J. Rao, V. VijayendranS, Practical Physics and Electronics, Viswanathan (Printers & Publishers), Pvt., Ltd.



**Crafted By :** Dr Arul H, M.Sc., PhD., Department of Physics, KCT

| U18MAI1203 | LINEAR ALGEBRA AND CALCULUS | L | T | P | J | C |
|---|---|---|---|---|---|---|
| | | 3 | 0 | 2 | 0 | 4 |

## Course Objectives:

- To explain the main concepts of linear algebra that are used in data analysis and machine learning.
- To improve the student's practical skills of using linear algebra methods in machine learning and data analysis.
- To learn the fundamentals of working with data in vector and matrix form, acquire skills for solving systems of linear algebraic equations and finding the basic matrix decompositions and general understanding of their applicability.

## Course Outcomes:

After successful completion of this course, the students should be able to

| | |
|---|---|
| CO 1: | Identify eigenvalues and eigenvectors, apply Cayley Hamilton theorem to Matrix Manipulation and apply orthogonal diagonalization to convert quadratic form to canonical form which will form the basis for Principal Component Analysis. |
| CO 2: | Understand the concept of vector spaces and perform LU Decomposition and Singular Value Decomposition, that are essential for dimensionality reduction. |
| CO 3: | Apply suitable techniques of differentiation and integration to various functions and identify the maxima and minima of functions of one variable. |
| CO 4: | Solve first order ordinary differential equations and apply them to certain physical situations. |
| CO 5: | Solve higher order ordinary differential equations arising in real world situations. |
| CO 6: | Determine Rank, Inverse, Eigenvalues, Eigenvectors of the given matrix, solve Differential equations and locate Maxima-Minima of the function using MATLAB |

## Pre-requisite courses: Nil

**CO/PO Mapping**
(S/M/W indicates the strength of correlation) S-Strong, M-Medium, W-Weak

| COs | Programme Outcomes (POs) | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 | PSO3 |
| CO1 | S | S | | | | | | | | | | M | | | |
| CO2 | M | M | | | | | | | | | | | | | |
| CO3 | W | W | | | | | | | | | | | | | |
| CO4 | W | W | | | | | | | | | | | | | |
| CO5 | W | W | | | | | | | | | | | | | |
| CO6 | | | | | S | | | | | | | S | | | |

**Course Assessment methods:**

**a) Direct**

1. Continuous Assessment Test I, II (Theory component)
2. Open Book Test; Cooperative Learning Report, Assignment; Journal Paper Review, Group Presentation, Project Report, Poster Preparation, Prototype or Product
3. Demonstration etc (as applicable) (Theory component)
4. Pre/Post - Experiment Test/Viva; Experimental Report for each Experiment (lab Component)
5. Model Examination (lab component)
6. End Semester Examination (Theory and lab components)

**b)Indirect**

1. Course-end survey

**Topics covered:**

| **MATRICES** | **12 Hours** |
|---|---|

Rank of a matrix – Consistency of a system of linear equations - Rouche's theorem -Solution of a system of linear equations - Linearly dependent and independent vectors–Eigenvalues and Eigenvectors of a real matrix – Properties of eigenvalues and eigenvectors – Cayley Hamilton theorem (excluding proof) - Orthogonal matrices – Orthogonal transformation of a symmetric matrix to diagonal form – Reduction of quadratic form to canonical form by orthogonal transformation.

| **VECTOR SPACES** | **12 Hours** |
|---|---|

Vector spaces and subspaces – Linear independence and dependence – Basis and Dimension - Null spaces, column spaces and Linear transformations - LU decomposition method - Singular Value Decomposition method.

| **DIFFERENTIAL AND INTEGRAL CALCULUS** | **9 Hours** |
|---|---|

Representation of functions -Limit of a function-Continuity -Derivatives -Differentiation rules - Maxima and Minima of functions of one variable - Definite and Indefinite integrals - Techniques of Integration: Substitution rule, Integration by parts, Trigonometric integrals, Trigonometric substitutions, Integration of rational functions by partial fraction.

| **FIRST ORDER ORDINARY DIFFERENTIAL EQUATIONS** | **3 Hours** |
|---|---|

Linear differential equations (Leibnitz equation and Bernoulli's equation)

| **HIGHER ORDER ORDINARY DIFFERENTIAL EQUATIONS** | **9 Hours** |
|---|---|

Linear, homogeneous and non- homogeneous differential equations of second and higher order with constant coefficients - Non-homogeneous term of the type $e^{ax}$, sin ax, cos ax, and $x^n$, $e^{ax}$ V(x)

| **Theory: 45 Hrs** | **Tutorial: 0 Hrs** | **Total Hours: 45 Hrs** |
|---|---|---|

## Lab component Contents:

**List of MATLAB Programmes:**

1. Introduction to MATLAB.
2. Matrix Operations - Addition, Multiplication, Transpose, Inverse
3. Rank of a matrix and solution of a system of linear equations
4. Characteristic equation of a Matrix and Cayley-Hamilton Theorem.
5. Eigenvalues and Eigenvectors of Higher Order Matrices
6. Curve tracing
7. Differentiation and Integration
8. Solving first and second order ordinary differential equations.
9. Determining Maxima and Minima of a function of one variable.

| | | |
|---|---|---|
| **Practical: 30 Hrs** | **Tutorial: 0** | **Total Hours : 30 Hrs** |

## Textbooks:


1. Grewal B.S., , 41st Edition, 2011, "Higher Engineering Mathematics", Khanna Publishers, New Delhi.
2. Ramana B.V., 11th Reprint, 2010, "Higher Engineering Mathematics", Tata McGraw Hill Co. Ltd., New Delhi
3. David C. Lay, "Linear Algebra and its Applications", Pearson Education Asia, New Delhi, 5 th Edition, 2016.


## Reference Materials:


1. Kreyzig E., "Advanced Engineering Mathematics", 10th Edition, John Wiley and sons, 2011
2. Venkataraman M.K., "Engineering Mathematics", The National Publishing Co., Chennai, 2003
3. Weir, MD, Hass J, Giordano FR, 12th Edition, 2015, Thomas' Calculus, Pearson education.
4. Thomas G.B. and Finney R.L., "Calculus and Analytic Geometry", 11th Edition, Pearson Education, 2006.
5. Seymour Lipschutz , Marc Lipson, "Schaum Outline of Linear Algebra", McGraw Hill Trade; New Delhi, 6th Edition, 2017



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| U18AII1204 | INTRODUCTION TO COMPUTATIONAL MACHINES | L | T | P | J | C |
|---|---|---|---|---|---|---|
| | | 2 | 0 | 2 | 0 | 3 |

**Course Objectives:**

- To acquire the basic knowledge of digital logic levels and application of knowledge to understand digital electronics circuits
- To prepare students to perform the analysis and design of various digital electronic circuits
- To introduce students to the design issues of embedded systems.
- To provide experience to integrate hardware and software for an embedded system

| **Course Outcomes:** | |
|---|---|
| After successful completion of this course, the students should be able to | |
| CO 1: | Understand the basics of combinational and sequential circuits |
| CO 2: | Explain the hardware and software architecture of embedded systems |
| CO 3: | Understand the network operations and the transport protocols |
| CO 4: | Demonstrate the I/O operations from the basic embedded systems hardware |

**Pre-requisite courses:**

| **CO/PO Mapping** (S/M/W indicates the strength of correlation) S-Strong, M-Medium, W-Weak | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **COs** | **Programme Outcomes (POs)** | | | | | | | | | | | | | | |
| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 | PSO3 |
| CO1 | S | S | | | | | | | | | M | M | M | | |
| CO2 | S | M | S | M | M | M | | | | | M | M | M | | |
| CO3 | S | | S | S | S | M | | | | | M | M | M | | |
| CO4 | S | | M | S | S | M | | | | | M | M | M | | |

**Course Assessment methods:**

**a) Direct**

1. Continuous Assessment Test I, II (Theory component)
2. Open Book Test; Cooperative Learning Report, Assignment; Journal Paper Review, Group Presentation, Project Report, Poster Preparation, Prototype or Product
3. Demonstration etc (as applicable) (Theory component)
4. Pre/Post - Experiment Test/Viva; Experimental Report for each Experiment (lab Component)
5. Model Examination (lab component)
6. End Semester Examination (Theory and lab components)

**b)Indirect**

1. Course-end survey

**Topics covered:**

| BASICS OF DIGITAL ELECTRONICS | 7 Hours |
|---|---|

Introduction to logic gates: Boolean Algebra Theorems - De Morgan's theorem - Logic Gates-Design procedure of Combinational circuits: Adders- Subtractors - Design of sequential circuits, Asynchronous/Ripple counters- Shift registers

| EMBEDDED SYSTEM AND ITS ARCHITECTURE | 8 Hours |
|---|---|

Introduction to Embedded Systems- Architecture of Embedded Systems- Programming for Embedded Systems- The Process of Embedded System Development - Hardware Platforms- Communication Interfaces- Future Trends

| RASPBERRY PI | 7 Hours |
|---|---|

Hardware aspects- Board details - Operating systems - Programming the Pi : Compilers - Python programming for Pi - Hardware interfacing: GPIO interfacing through Python - LED, buzzer, switch and Sensors Interfacing: Pressure, Temperature, Speed

| NETWORKS AND PROTOCOL | 8 Hours |
|---|---|

Introduction to Networks –Components, Categories and Types of Connections – Topologies- ISO/OSI model- Comparison of the OSI and TCP/IP Reference Model- Protocol- Internet Transport (IP)- IP addressing- Transport layer protocols: TCP and UDP-Duties of TCP & UDP-TCP Connection Management-Congestion Control- Quality of Services- Real Time Transport Protocols - Raspberry Pi Interface: Ethernet.

| Theory: 30 Hrs | Tutorial: 0 | Total Hours: 30 Hrs |
|---|---|---|

## Lab Component:

**List of Experiments:**

1. Realization of logical expression using gates
2. Verification of Half adder and Full adder
3. Verification of Half Subtractor and Full Subtractor
4. Asynchronous Decade Counter
5. Interfacing Input & Output devices with RPi
6. Interfacing sensors with RPi
7. Serial Communication using RPi
8. Ethernet Communication using RPis
9. Network Protocol packet Analysis

| Practical: 30 Hrs | Tutorial: 0 | Total Hours : 30 Hrs |
|---|---|---|

**Textbooks:**

1. Mano Morris M, 2008, "Digital Design", 4th Edition, Pearson Education.
2. Dr. K.V.K.K. Prasad, 2003, “Embedded/Real Time Systems Programming Black Book”Behrouz A. Forouzan, 2013, "Data Communications and Networking", 5th Edition, TMH.

**Reference Materials:**

1. Andrew S Tanenbaum, 4th Edition, 2003, "Computer Networks" Pearson Education.
2. Wolfram Donat, , 2014, "Learn Raspberry Pi Programming with Python", Technology in Action Publications.
3. Alex Bradbury and Ben Everard, 2014, "Learning Python with Raspberry Pi",Wiley Publications Pvt., Ltd..

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| U18AII1205 | INTRODUCTION TO PYTHON | L | T | P | J | C |
|---|---|---|---|---|---|---|
| | | 2 | 0 | 2 | 0 | 3 |

**Course Objectives:**

- To learn core Python scripting elements such as variables and flow control structures
- To learn how to use lists, tuples, and dictionaries in Python programs.
- To learn how to identify Python object types.
- To learn how to use indexing and slicing to access data in Python programs.

| **Course Outcomes:** | |
|---|---|
| After successful completion of this course, the students should be able to | |
| CO 1: | Understand the basics of algorithm building for computing and programming |
| CO 2: | Understand the basics of python programming language |
| CO 3: | Apply modularization techniques for problem solving through python |
| CO 4: | Outline the concepts of Lists, Dictionaries and Files |

**Pre-requisite courses: Nil**

| **CO/PO Mapping**<br>(S/M/W indicates the strength of correlation) S-Strong, M-Medium, W-Weak | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **COs** | **Programme Outcomes (POs)** | | | | | | | | | | | | | | |
| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 | PSO3 |
| CO1 | S | S | M | | | | | | | | | | S | M | |
| CO2 | S | S | S | | S | M | | | M | | M | S | M | M | |
| CO3 | S | S | S | S | S | M | | | M | | S | S | S | S | |
| CO4 | S | S | S | S | S | | | | | | S | S | M | M | |

**Course Assessment methods:**

**a) Direct**

1. Continuous Assessment Test I, II (Theory component)
2. Open Book Test; Cooperative Learning Report, Assignment; Journal Paper Review, Group Presentation, Project Report, Poster Preparation, Prototype or Product
3. Demonstration etc (as applicable) (Theory component)
4. Pre/Post - Experiment Test/Viva; Experimental Report for each Experiment (lab Component)
5. Model Examination (lab component)
6. End Semester Examination (Theory and lab components)

**b)Indirect**

1. Course-end survey

**Topics covered:**

| INTRODUCTION TO COMPUTING | 6 Hours |
|---|---|

Algorithms, Building blocks of algorithms (Instructions/statements, state, control flow, functions), Notation (pseudo code, flow chart, programming language), Algorithmic problem solving.

| INTRODUCTION TO PYTHON | 8 Hours |
|---|---|

Python programming language - Debugging - Variables, expressions and statements - Input/Output Statements - Conditional operators and statements - Looping statements - for - while- break and continue statement - Iterations - Strings - String manipulations: subscript operator, indexing, slicing a string

| MODULAR PROGRAMMING | 8 Hours |
|---|---|

Functions- function call- Flow of execution- Parameters and Arguments- Return values - Incremental development - Composition - Recursion - Boolean functions - Checking types - Case study-Interface Designing -Word Play.

| LISTS, DICTIONARIES AND FILES | 8 Hours |
|---|---|

Lists - Basic list operators- Replacing- inserting- removing an element- searching and sorting lists- Dictionaries dictionary literals- adding and removing keys- accessing and replacing values - traversing dictionaries - Tuples - tuples as lists and dictionaries - Comparing tuples - Files - Reading and Writing - Format operator - Filenames and Paths - Catching Exceptions

| Theory : 30 Hrs | Tutorial: 0 | Total Hours: 30 Hrs |
|---|---|---|

## Lab Component:

**List of Experiments:**

1. Introduction to Algorithms, flowcharts and pseudocode
2. Programs for variables and expressions
3. Programs using conditional statements and iterations
4. Programs using string operations
5. Programs using functions with parameters
6. Programs using recursion and Boolean functions
7. Programs using list operations
8. Programs using dictionaries & tuples
9. Programs using files
10. Programs using exceptions

| Practical: 30 Hrs | Tutorial: 0 Hrs | Total Hours : 30 Hrs |
|---|---|---|

**Textbooks:**

1. Downey Allen , 2002, ”Think Python- How to think like a Computer Scientist”, O'Reilly Media Inc.
2. Dusty Phillips, 2015, "Python 3 - Object Oriented Programming", 2nd Edition, Packet Publishing Ltd.

**Reference Materials:**

1. Ashok Namdev Kamthane, Amit Ashok Kamthane, 2018, “Programming and Problem Solving with Python” , Mc-Graw Hill Education.
2. T Jeyapoovan, 2015, “Fundamentals of computing and programming in C”, Vikas Publishing.

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| U18AIC1006 | INTRODUCTION TO INDIC CULTURE AND TECHNOLOGIES | L | T | P | J | C |
|---|---|---|---|---|---|---|
| | | 1 | 0 | 0 | 0 | 1 |

**Course Objectives:**

- To develop a broad understanding of Indian society and intercultural literacy through cultural immersion.
- To deepen knowledge on Indian development, environmental, and cultural issues through coursework, local engagement, and independent projects.

| **Course Outcomes:** | |
|---|---|
| After successful completion of this course, the students should be able to | |
| CO 1: | Understand the various dimensions of Indian Culture and Philosophy |
| CO 2: | Develop appreciation for the contribution of Indians to various science and technologies |

**Pre-requisite courses: Nil**

| **CO/PO Mapping**<br>(S/M/W indicates the strength of correlation) S-Strong, M-Medium, W-Weak | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **COs** | **Programme Outcomes (POs)** | | | | | | | | | | | | | | |
| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 | PSO3 |
| CO1 | | | | | | | M | M | M | | | | | | |
| CO2 | | | | | | | M | M | M | | | | | | |

## Course Assessment methods:

### a) Direct

1. Continuous Assessment Test
2. Quiz

### b)Indirect

1. Course-end survey

**Topics covered:**

| **Foundations of Indic Knowledge** | **3 Hours** |
|---|---|
| Branches of Indian Knowledge - Six Foundational Philosophies of Indian Sciences - Indian Big History: Cosmology - Evolutionary Life Sciences | |
| **Indic Perspective on Health and Well-being** | **3 Hours** |
| Body-Mind-Cognition according to Indian health systems - Technologies used by ancient Indians for | |

well-being of people

| **Indic Ecology and Sustainability** | **3 Hours** |
|---|---|
| Purpose of life and sustainable development - Traditional Indian tools and practices for sustainability: agriculture, energy, waste management, construction | |
| **Indic Values and Modern Technology** | **3 Hours** |
| Value frameworks from the Indian tradition - evaluating modern technology through Indic frameworks - Digital dharma: ethics and responsibility in technology age | |
| **Ancient Indian Technologies** | **3 Hours** |
| Technologies used in Ancient India: Computation, Astronomy, Architecture | |

| **Theory: 15 Hrs** | **Tutorial: 0** | **Total Hours: 15 Hrs** |
|---|---|---|

**Textbooks:**


1. Excel Health Journals, First edition, 2016, Certification of yoga professionals official guidebook, Excel books Pvt Ltd.
2. Vasant Lad, UK ed. edition, 2002, Textbook of Ayurveda: Volume 1 - Fundamental Principles of Ayurveda, Ayurvedic Press.


**Reference Books:**


1. Neeltje Huppes, 2017, Indian Psychology - an experiential approach, Indian Psychology Institute, Puducherry, India.
2. S Balachandar rao, 1999, Indian Astronomy: An Introduction, Universities Press.
3. Swami Harshananda, The Six Systems of Hindu Philosophy, (http://rkmathbangalore.org/Books/TheSixSystemsofHinduPhilosophy.pdf)



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| U18ENI0202 | PROFESSIONAL COMMUNICATION | L | T | P | J | C |
|---|---|---|---|---|---|---|
| | | 2 | 0 | 2 | 0 | 3 |

**Pre-requisite courses:** Nil

**Course Outcomes:**

After successful completion of this course, the students should able to

| | |
|---|---|
| CO1 : | Listen to audio contents related to professional communication and prepare a short note. |
| CO2 : | Discuss with peers on a given topic with original thoughts. |
| CO3 : | Read technical papers, patents and professional documents and extract main themes. |
| CO4 : | Write technical papers, reports, blogs and professionally communicate with relevant stakeholder. |

**CO/PO Mapping**
(S/M/W indicates the strength of correlation) S-Strong, M-Medium, W-Weak

| COs | Programme Outcomes (POs) | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 | PSO3 |
| CO1 | | | | | | | | | S | S | | S | | | |
| CO2 | | | | | | | | | S | S | | S | | | S |
| CO3 | | | | M | | | | | S | S | | S | | | M |
| CO4 | | | | M | | | | | S | S | | S | | | |

**Course Assessment methods:**

**Direct**

- Continuous Assessment of Skills
- Assignment
- Written Test
- End Semester Examination

**Indirect**

- Course-end survey

**Topics covered:**

| UNIT – 1 | 12 Hours |
|---|---|

**Grammar and Vocabulary:** Sentence Construction using Purpose and Function - Cause and Effectexpressions, Common mistakes in conversations and Text Writings.

**Reading:** 21st Century skills. Modes of Communication: L-S-R-W. Types of Communication: Personal and Professional Communication. World's popular Languages - Glimpses of Essential English, Etiquettes in Professional Communication.

**Writing:** Writing E-Mail for Professional interactions - Formatting style and guidelines - crafting compelling subject lines and body text

Practical Component:

**Listening:** Listening to TED / TECH Talks / Speeches of Leaders

**Speaking:** Just - a – minute

Continuous Assessment 1:
Speaking: Introducing Self – Introducing a Chief Guest of Your Choice (10 Marks)

| **UNIT - 2** | **12** Hours |
|---|---|

**Grammar and Vocabulary:** Tenses and Voices.
**Reading:** Note Making (Linear) and Summary Writing.
**Listening:** Listening for Specific Information (Dates, events, place, time etc.)
**Practical Component:**
**Speaking:** (Presentation) Presenting the Recent Happening (at National / International Level) using PPT **Writing:** Drafting letters to an International Institutions for Research collaborations – Drafting letters to foreign companies for commercial partnerships - Drafting a proposal for an event- Product Review.
**Continuous Assessment 2:**
Writing: Writing Emails to an International Client on a New Project proposal (10 Marks)

| **UNIT – 3** | **12** Hours |
|---|---|

**Grammar and Vocabulary:** Concord
**Reading:** Reading - Subskills, Reading and Responding to texts, Cloze TestEncoding
and Decoding Professional Communication: Editorials
**Writing**: Writing Captions, Slogans, and Tagline - Describing gadgets and products - Writing TechnicalInstructions and Recommendations.
**Listening:** Listening to Product Descriptions / Reviews
Practical Component:
Reading: Government Policy, Tender Documents.
Speaking: Describing an Event / Place, Sharing Personal Experiences
**Continuous Assessment 3:**
Writing: Review Writing (1 page) out of three technical papers of your choice (10 Marks)

| **UNIT – 4** | **12 Hours** |
|---|---|

Correction – Competitive Exams, Discourse Markers
**Reading:** Reading and comprehending - Reading a Patent document, analyze the features and extract thetechnical contents.
**Writing:** Paragraph writing (Expository, Narrative, Comparing & Contrasting and Persuasive)
**Listening:** Listening to Short Stories and Presenting Reflections
Practical Component: Group Discussion
Continuous Assessment 4:
Speaking: Group Discussion using a group not more than 6 in a Group (10 Marks)

| **UNIT – 5** | **12 Hours** |
|---|---|

**Grammar and Vocabulary:** Appropriate vocabulary for interpretation of graphics.

**Reading:** Reading and Interpreting Graphical Representations (Line Graphs / Stacked Bar / Infographics) **Writing:** Process Writing (Technical and Non-technical) - Report Writing – (Types and Format, Writing Project Reports) - Itinerary and Travelogue - Writing blogs on professional / core topics
**Listening:** Listening to Technical Context (Technical Videos) and Popular Interviews
Practical Component:
Mock interview (HR )
Continuous Assessment 5:
Speaking: Mock Interview for a Technical Position (10 Marks)

| **Theory: 30 Hrs** | **Tutorial: 0** | **Practical: 30 Hrs** | **Total:60 Hrs** |
|---|---|---|---|

**Reference Books:**


1. Goldsberg D., *Life Skills and Leadership for Engineers*, University of Skinois, Tata McGraw Hill, 2005.
2. Gallo C., *Talk like TED*. St. Martin's Press, 2015.
3. Lewis N., *Word Power Made Easy*, Simon and Schuster, 1979.
4. Raman M., and Sharma S., *Technical Communication – English Skills for Engineers*, Oxford HigherEducation, 2009.
5. Seely J., *Oxford Guide to Effective Writing and Speaking*, Oxford University Press, 1998.
6. British Council Learn English Teens through *https://learnenglishteens.britishcouncil.org/.*

| U18TLR1001 | HERITAGE OF TAMILS | L | T | P | J | C |
|---|---|---|---|---|---|---|
| | | 1 | 0 | 0 | 0 | 1 |

**Pre-requisite courses:** Nil

**Course Outcomes:**

After successful completion of this course, the students should able to

| | |
|---|---|
| CO1 : | Enhance the fundamental knowledge of tamil language and literature |
| CO2 : | Understand the heritage ,rock art paintings to modern art sculpture |
| CO3 : | Acquire essential knowledge in the folk and martial arts |
| CO4 : | Understand the importance of role thinai concept of tamils. |
| **CO5:** | Gain the knowledge of contribution by tamils to indian national movement |

**CO/PO Mapping**
(S/M/W indicates the strength of correlation) S-Strong, M-Medium, W-Weak

| COs | Programme Outcomes (POs) | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 | PSO3 |
| CO1 | | | | | | | | | | | | | | | |
| CO2 | | | | | | | | | | | | | | | |
| CO3 | | | | | | | | | | | | | | | |
| CO4 | | | | | | | | | | | | | | | |

**Course Assessment methods:**

**Direct**

- Continuous Assessment of Skills
- Assignment
- Written Test
- End Semester Examination

**Indirect**

- Course-end survey

**Topics covered:**

**UNIT I LANGUAGE AND LITERATURE**

Language Families in India - Dravidian Languages – Tamil as aClassical Language - Classical Literature in Tamil – Secular Nature of Sangam Literature – Distributive Justice in Sangam Literature - Management Principles in Thirukural - Tamil Epics and Impact of Buddhism & Jainism in Tamil Land - Bakthi Literature Azhwars and Nayanmars - Forms of minor Poetry - Development of Modern literature in Tamil - Contribution of Bharathiyar and Bharathidhasan.

**UNIT II HERITAGE - ROCK ART PAINTINGS TO MODERN ART – SCULPTURE**

Hero stone to modern sculpture - Bronze icons - Tribes and their handicrafts - Art of temple car making - - Massive Terracotta sculptures, Village deities, Thiruvalluvar Statue at Kanyakumari, Making of musical instruments - Mridhangam, Parai, Veenai, Yazh and Nadhaswaram - Role of Temples in Social and Economic Life of Tamils.

**UNIT III FOLK AND MARTIAL ARTS**

Therukoothu, Karagattam, Villu Pattu, Kaniyan Koothu, Oyillattam, Leather puppetry, Silambattam, Valari, Tiger dance - Sports and Games of Tamils.

**UNIT IV THINAI CONCEPT OF TAMILS**

Flora and Fauna of Tamils & Aham and Puram Concept from Tholkappiyam and Sangam Literature - Aram Concept of Tamils - Education and Literacy during Sangam Age - Ancient Cities and Ports of Sangam Age - Export and Import during Sangam Age - Overseas Conquest of Cholas.

**UNIT V CONTRIBUTION OF TAMILS TO INDIAN NATIONAL MOVEMENT AND INDIAN CULTURE**

Contribution of Tamils to Indian Freedom Struggle - The Cultural Influence of Tamils over the other parts of India – Self-Respect Movement - Role of Siddha Medicine in Indigenous Systems of Medicine – Inscriptions & Manuscripts – Print History of Tamil Books.

| **Theory: 15 Hrs** | **Tutorial: 0** | **Practical: 0 Hrs** | **Total:15 Hrs** |
|---|---|---|---|

**Text-cum-reference books**


1. Social Life of Tamils (Dr.K.K.Pillay) A joint publication of TNTB & ESC and RMRL – (in print)
2. Social Life of the Tamils - The Classical Period (Dr.S.Singaravelu) (Published by: International Institute of Tamil Studies.
3. Historical Heritage of the Tamils (Dr.S.V.Subatamanian, Dr.K.D. Thirunavukkarasu) (Published by: International Institute of Tamil Studies).
4. The Contributions of the Tamils to Indian Culture (Dr.M.Valarmathi) (Published by: International Institute of Tamil Studies.)
5. Keeladi - ‘Sangam City Civilization on the banks of river Vaigai’ (Jointly Published by: Department ofArchaeology & Tamil Nadu Text Book and Educational Services Corporation, Tamil Nadu)
6. Studies in the History of India with Special Reference to Tamil Nadu (Dr.K.K.Pillay) (Publishedby: The Author)
7. Porunai Civilization (Jointly Published by: Department of Archaeology & Tamil Nadu Text Bookand Educational Services Corporation, Tamil Nadu)
8. Journey of Civilization Indus to Vaigai (R.Balakrishnan) (Published by: RMRL)

| U18CSR1001 | DISRUPTIVE TECHNOLOGIES | L | T | P | J | C |
|---|---|---|---|---|---|---|
| | | 2 | 0 | 0 | 0 | 2 |

**Course Objectives:**
This course introduces various emerging technologies to enable the students to stay relevant and to thrive towards domain.

**Pre-requisite courses:** Nil

**Course Outcomes:**

After successful completion of this course, the students **should be** able to

| | |
|---|---|
| CO1 : | Understand the emergence of cutting-edge technologies and their impact on the businesses |
| CO2 : | Understand the evolution of techno entrepreneurial ecosystems |
| CO3 : | Analyse the ways in which the disruptive technologies play a pivotal role in solving contemporary and futuristic real-world operations |

**CO/PO Mapping**
(S/M/W indicates the strength of correlation) S-Strong, M-Medium, W-Weak

| COs | Programme Outcomes (POs) | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 | PSO3 |
| CO1 | | | | | | | | | | | | | | | |
| CO2 | | | | | | | | | | | | | | | |
| CO3 | | | | | | | | | | | | | | | |
| CO4 | | | | | | | | | | | | | | | |

**Course Assessment methods:**
**Direct**

1. **Continuous Assessment (50 marks)**

- MCQS (10 questions) on every cohort in Coursera- 9 assessments (one per cohort).
- This can be aggregated to 50 marks.

2. **End Semester Examination (50 marks)**

- Students should register in anyone cohort of their interest and they should do a presentation (individual/2 per team) on what verticals they are interested in for 15 minutes. (poster presentation- one block on their interest, other part can be overall understanding on new technologies)

**Indirect**
- Course-end survey

**Topics covered:**

| | |
|---|---|
| **DATA SCIENCE, ANALYTICS AND VISUALIZATION** | **3 HRS** |

Data as the new oil - Data-Driven Innovation- Big Data Technologies – Data Analysis vs Data Analytics – Data Visualization – Decision making through Data - Ethical and Privacy Challenges - Trends – opportunities – skills.

| | |
|---|---|
| **AUTOMATION & AI** | **3 HRS** |

Information Systems – ERP – CRM – Robotic Process Automation - AI basics - Machine Learning - Neural networks - Deep Learning - Natural Language Processing - Computer Vision - Generative Adversarial Networks (GANs) – Robotics – Ethical AI and Regulatory Considerations - Global Investments – Sustainability - Trends – opportunities – skills.

| | |
|---|---|
| **INTERNET OF THINGS & UNMANNED ARIAL VEHICLES** | **3 HRS** |

Characteristics of IoT – Physical Design of IoT - Logical Design of IoT – Enabling Technologies – IoT Components – IoT Prototyping – IoT Devices – Applications: Home Automation – Industry 4.0 - Smart Cities - Unmanned Aerial Vehicles & types - UAV Technologies: Urban Air Mobility (UAM), Vertically Integrated Drones, Drone Swarms - Counter-Drone Technology- Energy Efficiency and Sustainability - Trends – Opportunities – Skills.

| | |
|---|---|
| **CLOUD & EDGE COMPUTING** | **3 HRS** |

Cloud models – Cloud applications - storage, Collaborative documents, presentations, spreadsheets – SAAS – PAAS – IAAS -Benefits of cloud – Challenges in cloud computing – Edge Computing – Forms of Edge Computing – EDGE VS Cloud - Trends – opportunities – skills.

| | |
|---|---|
| **EXTENDED REALITY** | **4 HRS** |

Basics of XR - XR Landscape - Intro to AR-VR-MR Concepts – Metaverse - MR Strategy & Remote Collaboration – Spatial computing - Challenges and Ethical Considerations – Skills - Trends – opportunities.

| | |
|---|---|
| **NETWORKING & DISTRIBUTED COMPUTING** | **3 HRS** |

Layered Architecture – Networking tools – 5G and Beyond – Software Defined Networks – Network Monitoring and analysis – Distributed Computing – Distributed Sensor Networks – Blockchain fundamentals – DAO - Trends – opportunities – skills.

| | |
|---|---|
| **WEB AND SOFTWARE DEVELOPMENT** | **3 HRS** |

Web Technologies - Web 3.0 – Need for Software Engineering – Full stack development – Mobile application development – front end - backend - Meta Developer Circles & forums - Cross-platform application development – UI & UX - Open-Source development – Responsive Web Design - Trends – opportunities – skills.

| | |
|---|---|
| **CYBERSECURITY** | **4 HRS** |

Fundamentals - Security goals, mechanisms and Services – Cyber Defence – Offensive Cyber Security - Cyber forensics – Malware Analysis – Threat Intelligence - Threat Hunting - Security technologies - Cyber warfare – Cyber Physical System – Trends – opportunities – skills. User behaviour analysis -

| | |
|---|---|
| **INNOVATION AND TECHNOPRENEURSHIP** | **4 HRS** |

Innovation and Creativity - Entrepreneurial Mindset - Identifying Opportunities - Business Planning - Product Development and Innovation - Technology Commercialization - Marketing and Branding - Entrepreneurial Leadership - Entrepreneurial Ecosystems - Trends – opportunities – skills.

| | | | |
|---|---|---|---|
| **Theory: 15 Hrs** | **Tutorial: 0** | **Practical: 0 Hrs** | **Total:15 Hrs** |

**REFERENCES**


1. Davy Cielen, Arno D B Meysman, Mohamed Ali, "Introducing Data Science: Big Data, Machine Learning, and More, Using Python Tools", 2016.
2. S. Russell and P. Norvig, "Artificial Intelligence: A Modern Approach", Prentice Hall, Fourth edition, 2020.
3. Höller, J., Tsiatsis, V., Mulligan, C., Karnouskos, S., Avesand, S., & Boyle, D., " From Machine-to-Machine to the Internet of Things: Introduction to a New Age of Intelligence", Springer, 2019.
4. Daniel Tal and John Altschuld, "Drone Technology in Architecture, Engineering and Construction: A Strategic Guide to Unmanned Aerial Vehicle Operation and Implementation", 2021 John Wiley & Sons, Inc
5. A. B. Lawal, "Cloud Computing Fundamentals: Learn the Latest Cloud Technology and Architecture with Real-World Examples and Applications", A. B. Lawal publication, 2020.
6. Ralf Doerner, Wolfgang Broll, Paul Grimm, Bernhard Jung," Virtual and Augmented Reality (VR/AR),Foundations and Methods of Extended Realities (XR)"Springer Cham
7. Andrew S Tanenaum, David Wetherall, "Computer Networks", Pearson Prentice Hall, Fifth edition, 2011.
8. Joseph J. Bambara, Paul R. Allen, Kedar Iyer, Rene Madsen, Solomon Lederer, Michael Wuehler, "Blockchain: A Practical Guide to Developing Business, Law, and Technology Solutions", McGraw-Hill, 2018.
9. Nico Loubser , "Software Engineering for Absolute Beginners: Your Guide to Creating Software Products", First edition, 2021.
10. William Stallings, "Cryptography and Network Security – Principles and Practices", Pearson Education; Seventh edition, 2017.
11. Pankaj Goyal, "Before You Start Up : How to Prepare to Make Your Startup Dream a Reality", Fingerprint Publishing, 2017.

# SEMESTER II

| U18PHT2203 | ADVANCED PHYSICS | L | T | P | J | C |
|---|---|---|---|---|---|---|
| | | 3 | 0 | 0 | 0 | 3 |

**Course Objectives:**

- To impart knowledge on the concepts of Faraday‘s law, induced emf and Maxwell‘s equations
- To discuss and explain the key concepts and principles of quantum physics
- To impart knowledge on the concepts of magnetostatics, magnetic flux density, scalar and vector potential, and its applications

**Course Outcomes:**

After successful completion of this course, the students should be able to

| | |
|---|---|
| CO 1: | Impart knowledge on the concepts of electrodynamics for various conditions and its applications |
| CO 2: | Understand the behaviour of magnetostatics conditions, materials and its applications |
| CO 3: | Study the importance of various operators and its application in quantum computing |
| CO 4: | Infer the nuclear reactions and its impact in energy models for data processing |
| CO 5: | Explore the types of high energy particles and its characteristic effects |
| CO 6: | Understand the various materials aspects for identify modelling using various tools |

**Pre-requisite courses:** U18PHI1202 - ENGINEERING PHYSICS

**CO/PO Mapping**
(S/M/W indicates the strength of correlation) S-Strong, M-Medium, W-Weak

| COs | Programme Outcomes (POs) | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 | PSO3 |
| CO1 | S | M | M | | | | | | | | | M | | | |
| CO2 | S | M | M | | | | | | | | | M | | | |
| CO3 | S | M | | M | | | | | | | | M | W | | |
| CO4 | S | | | | | | | | | M | | M | | | |
| CO5 | S | M | | | | | | | | M | | M | | | |
| CO6 | S | M | M | | M | | | | | | | M | | | |

**Course Assessment methods:**

**a) Direct**

1. Continuous Assessment Test I, II (Theory component)
2. Open Book Test; Cooperative Learning Report, Assignment; Journal Paper Review, Group Presentation, Project Report, Poster Preparation, Prototype or Product

3. Demonstration etc (as applicable) (Theory component)
4. End Semester Examination (Theory components)

**b)Indirect**

1. Course-end survey

**Topics covered:**

| ELECTRODYNAMICS | 9 Hours |
|---|---|

Poisson's and Laplace's Equations – Electric Polarization – Nature of Dielectric Materials- Maxwell's displacement current – Maxwell's equations – vector and scalar potentials – Gauge invariant – wave equation and plane wave solutions

| MAGNETODYNAMICS | 9 Hours |
|---|---|

Energy Density in Magnetic Fields – Types of Magnetic Materials - Magnetization and Permeability – Magnetic boundary conditions. Hysteresis – Soft and Hard Magnetic Materials – Ferrites-Storage of Magnetic Data, Floppy, tapes and Magnetic Disc Drives

| QUANTUM PHYSICS | 9 Hours |
|---|---|

Introduction to Quantum States - Observables and Operators- Herminian operators-Hamiltonian operators Angular momentum-Spin-orbit coupling- Simon's Algorithm - Grover Search Algorithm

| NUCLEAR AND PARTICLE PHYSICS | 9 Hours |
|---|---|

Nuclear Mass and Binding energy- Stability of the nucleus- Mass defect and packing factor-Introduction to Particle physics- particle accelerators and detectors-Antiparticles properties- Symmetry Functions-Quark model-

| MATERIALS MODELLING | 9 Hours |
|---|---|

Crystal systems-Symmetry in crystals-Plane and Space groups- Types and effects of defects and imperfections-Bonding and Chemical interactions-Reciprocal lattice-Brillioun zone

| Theory: 45 Hrs | Tutorial: 0 Hrs | Total Hours: 45 Hrs |
|---|---|---|

**Textbooks:**


1. D.J. Griffiths, 2016, Introduction to Electromagnetic Theory, Prentice Hall, USA.
2. N. Zettili, 2009, Quantum Mechanics Concepts and Applications, Wiley, USA.
3. P M Mathews and K Venkatesan, A Textbook of Quantum Mechanics (2016), Tata McGraw-Hill, India


**Reference Books:**


1. B. B. Cohen, 2014, "Concepts of Nuclear Physics", TMGH , India
2. C. Kittel, 7th Edn, 1995, Introduction to Solid state Physics. John Wiley & Sons
3. D. Griffiths, 2nd Ed., 2008, "Introduction to Elementary Particles", Wiley-Vch
4. Neil W. Ashcroft, N.David Mermin, 1st Ed., 2003, Solid State Physics, Cengage Learning.



**Crafted By :** Dr Arul H, M.Sc., PhD., Department of Physics, KCT

| U18MAT2001 | DISCRETE MATHEMATICS | L | T | P | J | C |
|---|---|---|---|---|---|---|
| | | 3 | 0 | 0 | 0 | 3 |

**Course Objectives:**

- To introduce concepts of mathematical logic for analyzing propositions and proving theorems.
- To use sets for solving applied problems, and use the properties of set operations algebraically.
- To work with relations and investigate their properties.
- To investigate functions as relations and their properties.
- To introduce basic concepts of graphs, digraphs and trees

| **Course Outcomes:** | |
|---|---|
| After successful completion of this course, the students should be able to | |
| CO 1: | Understand the concepts of set theory and apply them to situations involving inclusion and exclusion. |
| CO 2: | Acquire the knowledge of relations, and analyse equivalence relations and their properties. |
| CO 3: | Understand and analyse the properties of different kinds of functions and solve recurrence relations. |
| CO 4: | Evaluate the validity of logical arguments and construct simple mathematical proofs. |
| CO 5: | Determine whether given graphs are isomorphic and apply Dijkstra's algorithm to find the shortest path. |

**Pre-requisite courses: Nil**

| **CO/PO Mapping**<br>(S/M/W indicates the strength of correlation) S-Strong, M-Medium, W-Weak | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **COs** | **Programme Outcomes (POs)** | | | | | | | | | | | | | | |
| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 | PSO3 |
| CO1 | M | M | | | | | | | | | | | S | W | |
| CO2 | M | | | | | | | | | | | | S | W | |
| CO3 | M | M | | | | | | | | | | | S | W | |
| CO4 | S | S | | | | | | | | | | S | S | | |
| CO5 | S | S | | | | | | | | | | S | | | |

**Course Assessment methods:**

**a) Direct**

1. Continuous Assessment Test I, II (Theory component)
2. Open Book Test; Cooperative Learning Report, Assignment; Journal Paper Review, Group Presentation, Project Report, Poster Preparation, Prototype or Product
3. Demonstration etc (as applicable) (Theory component)
4. End Semester Examination (Theory components)

**b)Indirect**

1. Course-end survey

**Topics covered:**

| | |
|---|---|
| **SET THEORY** | **5 Hours** |
| Algebra of sets – The power set – Ordered pairs and Cartesian product – principle of inclusion and exclusion. | |
| **RELATIONS** | **6 Hours** |
| Relations on sets –Types of relations and their properties - Equivalence relations –Relational matrix and the graph of relation – Operations on relations. | |
| **FUNCTIONS AND RECURRENCE RELATIONS** | **11 Hours** |
| Functions –Type of functions – Injective, surjective and bijective functions –Composition of functions – Inverse functions –Permutation functions - Recurrence relations-Solving linear recurrence relations. | |
| **LOGIC** | **12 Hours** |
| Propositions- Logical operators- Normal forms –Rules of inference-Consistency and inconsistency-Propositional logic- Proofs-Predicates- Quantifiers- Universe of discourse – Logical equivalences and implications for quantified statements-Rules of specification and generalization – Validity of arguments. | |
| **GRAPH THEORY** | **11 Hours** |
| Graphs- Types of graphs- Matrix representation of graphs- Graph isomorphism- Walk – Path - Cycles- Eulerian graphs -Hamiltonian graphs- Planar graphs- Euler formula- Shortest path algorithm: Dijkstra's algorithm | |

| | | |
|---|---|---|
| **Theory: 45 Hrs** | **Tutorial: 0** | **Total Hours: 45 Hrs** |

**Textbooks:**

1. Kenneth H. Rosen, “Discrete Mathematics and its applications: With Combinatorics and Graph Theory (7th Edition)”, Tata McGraw-Hill, 2015.
2. Tremblay J.P., Manohar R., “Discrete Mathematical Structures with applications to Computer Science”, Tata McGraw-Hill, International Edition, 2017

**Reference Books:**

1. Liu C.L, “Elements of Discrete Mathematics”, 4th Edition, McGraw Hill, 2017.
2. Grimaldi, R.P. “Discrete and Combinatorial Mathematics: An Applied Introduction”, 5 th Edition, Pearson Education Asia, Delhi, 2016.
3. Mott J.L, Kandel A. and Baker T.P., “Discrete Mathematics for Computer Scientists and Mathematicians”, 2nd Edition, Prentice Hall India, 2015.
4. Narsingh Deo, “Graph Theory with Applications to Engineering and Computer Science”, Courier Dover Publications, 2017.

**Crafted By :** Dr. Vijeta Iyer, M.Sc., PhD., Department of Mathematics, KCT & Gokul Kumar M.Sc (BITS Pilani), MBA, Co-Founder & CTO, Vusar - AR 3D Design Visualization

| U18MAI2203 | PROBABILITY AND STATISTICS | L | T | P | J | C |
|---|---|---|---|---|---|---|
| | | 3 | 0 | 2 | 0 | 4 |

**Course Objective:**

- To introduce the basic concepts of probability and random variables
- To introduce the basic concepts of two dimensional random variables
- To acquire the knowledge of testing hypotheses for small and large samples which plays an important role in real life problems.
- To introduce the basic concepts of classifications of design of experiments which plays very important roles in the field of engineering and statistical quality control.

**Course Outcomes:**

After successful completion of this course, the students should be able to

| | |
|---|---|
| CO 1: | Understand and apply the concept of probability and random variables and predict probabilities of events in models following normal distribution. |
| CO 2: | Apply the concepts of two dimensional random variables, central limit theorem and estimation, which lay the foundation for Machine Learning and Data Science. |
| CO 3: | Perform hypothesis testing and interpret the results which will form the basis for Data Analysis |
| CO 4: | Understand the principles of design of experiments and perform analysis of variance which will help in Data Analysis. |
| CO 5: | Learn and apply multivariate analysis necessary for Principal Component Analysis. |
| CO 6: | Use R software to solve problems in the above topics |

**Pre-requisite courses:Nil**

**CO/PO Mapping**
(S/M/W indicates the strength of correlation) S-Strong, M-Medium, W-Weak

| COs | Programme Outcomes (POs) | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 | PSO3 |
| CO1 | S | S | | | | | | | | | | | S | | |
| CO2 | S | S | | | | | | | | | | | S | | |
| CO3 | S | M | | | | | | | | | | W | S | M | |
| CO4 | S | S | | | | | | | | | | M | S | | |
| CO5 | M | S | | | | | | | | | | M | S | | |
| CO6 | | | | | S | | | | | | | S | S | S | |

**Course Assessment methods:**

**a) Direct**

1. Continuous Assessment Test I, II (Theory component)
2. Open Book Test; Cooperative Learning Report, Assignment; Journal Paper Review, Group Presentation, Project Report, Poster Preparation, Prototype or Product
3. Demonstration etc (as applicable) (Theory component)
4. Pre/Post - Experiment Test/Viva; Experimental Report for each Experiment (lab Component)
5. Model Examination (lab component)
6. End Semester Examination (Theory and lab components)

**b)Indirect**

1. Course-end survey

**Topics covered:**

| | |
|---|---|
| **PROBABILITY AND RANDOM VARIABLES** | **13 Hours** |
| Axioms of probability - Conditional probability – Total probability – Bayes' theorem Random variable – Distribution function – properties – Probability mass function – Probability density function – moments - Standard Distributions - Binomial, Poisson and Normal distributions | |
| **TWO DIMENSIONAL RANDOM VARIABLES AND ESTIMATION** | **9 Hours** |
| Joint distributions – Marginal and conditional distributions – Expected values of functions of two variables– Correlation and regression (for discrete data only) - Central limit theorem – Statement | |
| **TESTING OF HYPOTHESIS** | **10 Hours** |
| Large sample tests for single mean and difference of means-Small samples tests based on t and F distributions (single mean, difference of means, paired t- test and variance ratio test) – Chisquare test for independence of attributes and goodness of fit. | |
| **DESIGN OF EXPERIMENTS** | **5 Hours** |
| Analysis of Variance (ANOVA) – Completely Randomized Design (CRD) – Randomized Block Design (RBD) | |
| **MULTIVARIATE ANALYSIS** | **8 Hours** |
| Random vectors and matrices – Mean vectors and covariance matrices –Principal components – Population principal components – Principal components from standardized variables. | |

| | | |
|---|---|---|
| **Theory: 45 Hrs** | **Tutorial: 0** | **Total : 45 Hrs** |

**Lab component Contents:**

**List of R Programmes:**

1. Introduction to R programming
2. Application of descriptive statistics – Mean, Median, Mode and standard deviation, Skewness and Kurtosis
3. Applications of Correlation and Regression
4. Application of Normal distribution
5. Application of Student – t test
6. Application of F test
7. Application of Chi-square test
8. ANOVA – one way classification
9. ANOVA - two way classification
10. Box Plots

| Practical: 30 Hrs | Tutorial: 0 | Total Hours : 30 Hrs |
|---|---|---|

**Text Books:**


1. Johnson R. A., Miller & Freund's, Sixth Edition, 2000, "Probability and Statistics for Engineers", Pearson Education, Delhi.
2. Gupta.S.C and Kapoor.V.K, 11th extensively revised edition, 2007 Fundamentals of Mathematical Statistics,, Sultan Chand & Sons.


**Reference Books:**


1. Walpole R. E., Myers S.L. & Keying Ye, 9th edition, 2012, "Probability and Statistics for Engineers and Scientists", Pearson Education Inc.
2. Gupta S.C, and KapurV.K, 4th Edition, 2014, "Fundamentals of Applied Statistics", Sultan Chand, New Delhi.
3. Charles Henry Brase and Corrinne Pellillo Brase , 9th edition, 2007, "Understandable Statistics", D.C. Heath and Company, Toronto.
4. Gareth M. James, Daniela Witten, Trevor Hastie, Robert Tibshirani, 7th edition, "An Introduction to Statistical Learning: With Applications in R".
5. Richard A. Johnson and Dean W. Wichern, 5th Edition, 2012, Applied Multivariate Statistical Analysis, Pearson Education, Asia.
6. Anderson, T. W , 2003, An Introduction to Multivariate Statistical Analysis, John Wiley and Sons



**Crafted By :** Dr. Vijeta Iyer, M.Sc., PhD., Department of Mathematics, KCT & Gokul Kumar M.Sc (BITSPilani), MBA, Co-Founder & CTO, Vusar - AR 3D Design Visualization

| U18AII2204 | OBJECT-ORIENTED PROGRAMMING AND DATA STRUCTURES | L | T | P | J | C |
|---|---|---|---|---|---|---|
| | | 2 | 0 | 2 | 0 | 3 |

**Course Objectives:**

- To understand the importance of Classes & objects along with constructors
- To discuss the principles of inheritance and Class and interface and demonstrate though problem analysis
- assignments how they relate to the design of methods, abstract classes and interfaces and packages
- To introduce the fundamental concept of data structures and to emphasize the importance of data structures in developing and implementing efficient algorithms
- Understand and remember algorithms and its analysis procedure.
- To introduce the concept of data structures through ADT including List, Stack, Queues

| **Course Outcomes:** | |
|---|---|
| After successful completion of this course, the students should be able to | |
| CO 1: | Understand the object oriented programming concepts and GUI |
| CO 2: | Apply Overloading and concept of handling exceptions |
| CO 3: | Demonstrate the concepts of data structures using python |
| CO 4: | Develop the graph, sorting and search techniques of data structures |

**Pre-requisite courses: U18AII1205 Introduction to Python**

| **CO/PO Mapping**<br>(S/M/W indicates the strength of correlation) S-Strong, M-Medium, W-Weak | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **COs** | **Programme Outcomes (POs)** | | | | | | | | | | | | | | |
| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 | PSO3 |
| CO1 | S | S | S | M | S | | | | | | S | S | | | |
| CO2 | S | S | S | S | S | | | | | | S | S | S | S | M |
| CO3 | S | S | S | M | S | | | | | | S | S | S | | |
| CO4 | S | S | S | S | S | | | | | | S | S | | S | S |

**Course Assessment methods:**

**a) Direct**

1. Continuous Assessment Test I, II (Theory component)
2. Open Book Test; Cooperative Learning Report, Assignment; Journal Paper Review, Group Presentation, Project Report, Poster Preparation, Prototype or Product
3. Demonstration etc (as applicable) (Theory component)
4. Pre/Post - Experiment Test/Viva; Experimental Report for each Experiment (lab Component)
5. Model Examination (lab component)
6. End Semester Examination (Theory and lab components)

**b)Indirect**

1. Course-end survey

**Topics covered:**

| **OBJECT ORIENTED CONCEPTS IN PYTHON** | **8 Hours** |
|---|---|

Introduction - Classes and Objects - Creating Python Classes - Classes and Functions - Pure Functions- Classes and Methods - Inheritance: Basic Inheritance, Multiple Inheritance - Polymorphism - Class Diagrams - Data Encapsulation - GUI - Event-driven programming paradigm; tkinter module, creating simple GUI; buttons, labels, entry fields, dialogs; widget attributes - sizes, fonts, colors layouts, nested frames.

| **EXCEPTIONS** | **7 Hours** |
|---|---|

Operator Overloading - The Basics- Indexing and Slicing- Index Iteration-Iterable Objects- Membership- Attribute AccessObject Destruction- Exceptions - Exception Basics-Catching Exceptions- Raising Exceptions- UserDefined ExceptionsThe try/except/else Statement- The try/finally Statement- Unified try/except/finally- The Raise Statement- Exception Objects- Nesting Exception.

| **DATA STRUCTURES** | **7 Hours** |
|---|---|

Abstract Data Types (ADT) - Linked List Implementation - Doubly-Linked Lists - Circularly Linked Lists - Applications of Lists - Stack ADT - Implementation of Stack and its Applications - Queue ADT - Implementation of Queue and its Applications - Tree ADT - Tree Traversals - Binary Tree ADT - Expression Trees - Applications of Trees - Binary Search tree ADT .

| **GRAPHS, SORTING AND SEARCHING TECHNIQUES** | **8 Hours** |
|---|---|

Graph and its Representations - Graph Traversals - Heap - Binary Heap - Applications of Priority Queues, Preliminaries - Insertion Sort - Shell sort - Heap sort - Merge sort - Quick sort - Linear Search - Binary Search

| **Theory: 30 Hrs** | **Tutorial: 0** | **Total: 30 Hrs** |
|---|---|---|

**Lab Component:**

**List of Experiments:**

1. Class & Object
2. Inheritance
3. Access Specifier and Abstract Class
4. Exception
5. Constructor Overloading, Operator Overloading
6. Implementation of Stack and Queue
7. Implementation Linked list, Circular Linked List, Double Linked
8. Implementation of Binary Search Tree
9. Implementation of Sorting Algorithms

| Practical: 30 Hrs | Tutorial: 0 | Total Hours : 30 Hrs |
|---|---|---|

**Textbooks:**


1. Allen Downey , 2002, ”Think Python- How to think like a Computer Scientist”, O'Reilly Media, Inc.
2. Dusty Phillips, 2nd Edition, 2015, "Python 3 - Object Oriented Programming", Packet Publishing Ltd.


**Reference Books:**


1. Kenneth Lambert, 2nd Edition, 2018, “Fundamentals of Python: Data Structures” .
2. Thomas H. Cormen, Charles E. Leiserson, 3rd Edition, 2009, “ Introduction to Algorithms”.
3. Eric Matthes, 2nd Edition, 2019, “Python Crash Course: A Hands-On, Project-Based Introduction to Programming”.



**Crafted By :** Dorai Thodla, B.E (CEG, Guindy), Founder & CTO, iMORPH, California and
Gokul Kumar, M.Sc (BITS Pilani), MBA, Co-Founder & CTO,
Vusar - AR 3D Design Visualization, California

| U18AII2205 | INTRODUCTION TO AI & ML | L | T | P | J | C |
|---|---|---|---|---|---|---|
| | | 2 | 0 | 2 | 0 | 3 |

**Course Objective:**

- To introduce the basic concepts, theories and state-of-the-art techniques of artificial intelligence.
- To introduce basic concepts and applications of machine learning.
- To learn the application of machine learning /A.I algorithms in the different fields of engineering, science, medicine, finance etc.

**Course Outcomes:**

After successful completion of this course, the students should be able to

| | |
|---|---|
| CO 1: | Understand the basic concepts of machine learning and some typical applications |
| CO 2: | Understanding how to build and validate models and improve them iteratively |
| CO 3: | Understand the core concepts of Artificial Intelligence and Applications |
| CO 4: | Apply knowledge representation with artificial intelligence using FOL and Predicate logic |

**Pre-requisite courses: U18AII1205 Introduction to Python**

**CO/PO Mapping**
(S/M/W indicates the strength of correlation) S-Strong, M-Medium, W-Weak

| COs | Programme Outcomes (POs) | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 | PSO3 |
| CO1 | S | S | S | M | S | | | | | | S | S | M | M | M |
| CO2 | S | S | S | S | S | | | | | | S | S | M | S | S |
| CO3 | S | S | | | | | | | | | M | S | M | S | S |
| CO4 | S | S | S | M | | | | | | | S | S | M | S | S |

**Course Assessment methods:**

**a) Direct**

1. Continuous Assessment Test I, II (Theory component)
2. Open Book Test; Cooperative Learning Report, Assignment; Journal Paper Review, Group Presentation, Project Report, Poster Preparation, Prototype or Product
3. Demonstration etc (as applicable) (Theory component)
4. Pre/Post - Experiment Test/Viva; Experimental Report for each Experiment (lab Component)
5. Model Examination (lab component)
6. End Semester Examination (Theory and lab components)

**b)Indirect**

1. Course-end survey

**Topics covered:**

| INTRODUCTION TO MACHINE LEARNING | 8 Hours |
|---|---|

Introduction - Machine Learning Process - Supervised Learning - Regression - Linear Regression - Predicting - Polynomial Regression - Classification - Feature Engineering - Logistic Regression - kNN classification - SVM - Naive bayes - Decision tree and Random forest classifier - Unsupervised Learning - Clustering techniques.

| ANALYSIS OF MODELS | 8 Hours |
|---|---|

Model representation, decision boundary, cost function, gradient descent, regularization, evaluating a hypothesis (Model selection), training/validation/testing procedures, bias/variance, learning curves, Accuracy and Error measures, evaluating the accuracy of a classifier or predictor, Confusion metric, precision, recall, ROC curve and AUC score, Parameter Tuning.

| ARTIFICIAL INTELLIGENCE : PROBLEM SOLVING | 6 Hours |
|---|---|

Introduction to AI, Control strategies, Search strategies, Production system characteristics - Specialized production system- Problem solving methods - Problem graphs, Matching, Indexing and Heuristic functions -Hill Climbing- Depth first and Breadth first, Constraints satisfaction Problem.

| KNOWLEDGE REPRESENTATION AND REASONING | 8 Hours |
|---|---|

Game playing - Knowledge representation, Knowledge representation using Predicate logic, Introduction to predicate calculus, Resolution, Use of predicate calculus, Knowledge representation using other logic-Structured representation of knowledge.- First order logic – Syntax and Semantics – Knowledge Engineering in First Order Logic – Inference in First Order Logic.

| Theory: 30 Hrs | Tutorial: 0 Hrs | Total Hours: 30 Hrs |
|---|---|---|

**Lab Component:**

**List of Experiments:**

1. Implement python program to perform operations like mean, median, mode, standard deviation, percentile and various data distributions
2. Try to open a csv file and sort the content with respect to one column using python
3. Implement a python program to perform linear regressions for a dataset that prevails in csv format
4. Implement a python program to perform logistic regression
5. Write a program to implement k-Nearest Neighbour algorithm to classify any dataset. Print both correct and wrong predictions. Python ML library classes can be used for this problem.
6. Assume that K=3
7. Write a program to construct a Support Vector Machine considering medical data. Use this model to demonstrate the diagnosis of heart patients using the standard Heart Disease Data Set. You can use Python ML library classes/API.
8. Assuming a set of documents that need to be classified, use the naïve Bayesian Classifier model to perform this task. Built-in Java classes/API can be used to write the program. Calculate the accuracy, precision, and recall for your data set.
9. Assuming a set of data that need to be classified, use a decision tree model to perform this task. Preferably use any dataset like medical, titanic dataset or others to evaluate the accuracy
10. Implement a python program to perform Hill climbing algorithm

| Practical: 30 Hrs | Tutorial: 0 | Total: 30 Hrs |
|---|---|---|

**Textbooks:**


1. Alexey Grigorev, 2020, "Machine Learning Bookcamp", MEAP.
2. Shai Shalev-Shwartz, Shai Ben-David, 2014, "Understanding Machine Learning From Theory to Algorithms", Cambridge University Press


**Reference Book:**


1. Kevin Night and Elaine Rich, Nair B., 2008, "Artificial Intelligence (SIE)", McGraw Hill.



**Crafted By :** Dorai Thodla, B.E (CEG, Guindy), Founder & CTO, iMORPH, California and
Gokul Kumar, M.Sc (BITS Pilani), MBA, Co-Founder & CTO, Vusar - AR 3D Design Visualization, California

**Reviewed By :** Derrick Jose, B.E (BITS Pilani), CEO & Founder, Flutura, Texas

| U18AII2206 | INTRODUCTION TO DATA SCIENCE | L | T | P | J | C |
|---|---|---|---|---|---|---|
| | | 2 | 0 | 2 | 0 | 3 |

**Course Objective:**

- To introduce the basic concepts of data science
- To enable students to handle various dataset
- To train the applications of data science and perform data transformations

| **Course Outcomes:** | |
|---|---|
| After successful completion of this course, the students should be able to | |
| CO 1: | Understand the various aspects of data science and the skill sets necessary for a data scientist |
| CO 2: | Explain the concepts of data storage and Big Data |
| CO 3: | Illustrate the different types of process and tools used in data science |
| CO 4: | Apply the principles of Data Science for analysis using Google Sheets and Excel |

**Pre-requisite courses:Nil**

| **CO/PO Mapping** (S/M/W indicates the strength of correlation) S-Strong, M-Medium, W-Weak | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **COs** | **Programme Outcomes (POs)** | | | | | | | | | | | | | | |
| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 | PSO3 |
| CO1 | S | | | | | | | | | | | M | M | S | M |
| CO2 | S | S | | M | | | | | | | S | S | W | | |
| CO3 | S | S | S | M | S | | | | | | S | S | W | | |
| CO4 | S | S | S | | S | | | | | | S | S | W | S | M |

**Course Assessment methods:**

**a) Direct**

1. Continuous Assessment Test I, II (Theory component)
2. Open Book Test; Cooperative Learning Report, Assignment; Journal Paper Review, Group Presentation, Project Report, Poster Preparation, Prototype or Product
3. Demonstration etc (as applicable) (Theory component)
4. Pre/Post - Experiment Test/Viva; Experimental Report for each Experiment (lab Component)
5. Model Examination (lab component)
6. End Semester Examination (Theory and lab components)

**b)Indirect**

1. Course-end survey

**Topics covered:**

| **BASICS OF DATA SCIENCE** | **10 Hours** |
|---|---|

Data Science: Steps in doing Data Science - Data Science relation to other fields- Data Science and Information Science- Computational Thinking - Skills and tools needed to do Data Science - Storing data - Combining bytes into larger structures - Creating data sets - Identifying data problem - Understanding data sources - Exploring data models- Introduction to Big Data

| **DATA HANDLING** | **10 Hours** |
|---|---|

Structured and unstructured data - Challenges with unstructured data - Data collection: Open data - multimodal data - Data Preprocessing: Data Cleaning - Data Integration, Data Transformation - Data Reduction - Data Discretization

| **EXCEL FOR DATA SCIENCE** | **10 Hours** |
|---|---|

Elementary data handling: Types - Data Transformation - Filtering -Pivot tables - Graphical Methods - Descriptive statistics - Random sampling - Probability distributions using functions- Binomial - poisson - Normal - Geometric - Negative binomial - exponential - gamma - beta- lognormal - pmf and cmd- Hypothesis testing using Data Analysis Pack - Z test and t-test.

| **Theory: 30 Hrs** | **Tutorial: 0 Hrs** | **Total Hours: 30 Hrs** |
|---|---|---|

## Lab Component:

## List of Experiments:

1. Basic Statistics and Visualization
2. Data distribution
3. Reading and Writing different types of dataset
4. Correlation and Covariance
5. Regression Model
6. Implementation of Pivot table
7. Implementation of Probability Distribution using Function
8. Implementation of Hypothesis

| **Practical: 30 Hrs** | **Tutorial: 0** | **Total Hours: 30 Hrs** |
|---|---|---|

## Textbooks:


1. Jeffrey S. Saltz, Jeffrey M. Stanton, 2018, An Introduction to Data Science, SAGE Publications
2. Chirag Shah, 2020, A Hands-On Introduction to Data Science, Cambridge University Press


## Reference Books:


1. Ash Narayan Sah, 2009, Data Analysis Using Microsoft Excel, Excel books
2. Joel Grus, 2015, “Data Science from Scratch”.



**Crafted By :** Gokul Kumar, M.Sc (BITS Pilani), MBA, Co-Founder & CTO, Vusar - AR 3D Design Visualization, California

**Reviewed By :** Adarsh Natarajan, MBA (IIM B), CEO & Founder, AIndra Systems

| U18MAR0003 | TECH FOR GOOD: ACHIEVING THE SDG'S BY THE ROLE OF ICT | L | T | P | J | C |
|---|---|---|---|---|---|---|
| | | 1 | 0 | 2 | 0 | 2 |

**Pre-requisite courses:** Nil

**Course Outcomes:**

After successful completion of this course, the students should able to

| | |
|---|---|
| CO1 : | Understand the key concepts and practices of this exciting and ever-changing field. |
| CO2 : | Investigate the role that ICT plays in achieving the UN Sustainable Development Goals(SDGs). |
| CO3 : | Explore the rapid and dynamic growth of the internet, mobile phone usage, big data, AI and other trends that are helping to implement and measure sustainable development around the world. |

**CO/PO Mapping**
(S/M/W indicates the strength of correlation) S-Strong, M-Medium, W-Weak

| COs | Programme Outcomes (POs) | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 | PSO3 |
| CO1 | | | | | | | | | | | | | | | M |
| CO2 | | | | | | | | | | | | | | | M |
| CO3 | | | | | | | | | | | | | | | M |

**Course Assessment methods:**
**Direct**
Continuous Assessment
**Indirect**
Course-end survey
**Topics covered:**

| **Module 1:** | **10 Hrs** |
|---|---|

Welcome to the Digital Age ,Three Approaches to ICT for the SDGs, Technology for Governments and Citizens, Open Government Approach, Case Study: Aadhaar in India, The Challenges of Digital Government, ICT Infrastructure : Innovations in Infrastructure Building Smart Sustainable Cities, ICT Innovations in Health - Evidence in Action: Success Stories of ICT and Health, Emerging Challenges and Opportunities..

| **Module 2:** | **10 Hrs** |
|---|---|

The Ecosystem of ICT for Education, Measuring ICT and Education: Frameworks, Data and Indicators, Rethinking ICT for Education Policies,Promoting Financial Inclusion, ICT for Enabling Access to Credit,The Challenges of ICT-enabled Financial Inclusion, Measurement and Metrics for ICT and theSDGs , Managing Data for the SDGs, ICT Innovation for Statistical Development,Engaging with Data: Communications and Citizen Empowerment, ICT for Monitoring the SDGs .

| **Module 3:** | **10 Hrs** |
|---|---|

Artificial Intelligence for Development, Implications for Discrimination and Exclusion, The Human Side of AI: Risks and Ethics ,Concerns for our Digital Future, Privacy and the Importance of Trust ,Knowing your Data Rights ,Cybersecurity, Combatting Disinformation , The Way Forward , The New Workforce: Six Points about the Future of Work ,The Open Movement ,Closing Thoughts on ICT for the SDGs

| | | | |
|---|---|---|---|
| **Theory: 15 Hrs** | **Tutorial: 0** | **Practical: 30 Hrs** | **Total:45 Hrs** |

**References**:


1. Ramanathan, U. (2015). Considering Social Implications of Biometric Registration. IEEE Technology and Society Magazine.
2. Tannam, E. (2018, Jul. 26). How can smart cities make data a public good before time runs out? Silicon Republic.
3. Garvie, C., Beydoya, A., & Frankle, J. (2016, Oct. 18). The Perpetual Line-Up: Unregulated Police Face Recognition in America. perpetuallineup.org. Georgetown Law Center on Privacy & Technology. [Executive Summary and Introduction only.]
4. Hollister, S. (2018, Jul. 27). Congressmen demand answers after Amazon facial recognition matches them to mugshots.
5. Raso, F., Hilligoss, H., Krishnamurthy, V., Bavitz, C., & Kim, L. (2018). Human Rights & Artificial Intelligence: Opportunities & Risks. Berkman Klein Center for Internet & Society at Harvard University.
6.Raso, F., Hilligoss, H., Krishnamurthy, V., Bavitz, C., & Kim, L. (2018). Human Rights & Artificial Intelligence: Opportunities & Risks. Berkman Klein Center for Internet & Society at Harvard University.
7. Zadek, S., & Bayat-Renoux, F. (2018). "Harnessing Digital Finance for Sustainable Development." Financing the UN Development System: Opening Doors. (Pages 130-131only)

| U18TLR2001 | TAMILS AND TECHNOLOGY | L | T | P | J | C |
|---|---|---|---|---|---|---|
| | | 1 | 0 | 0 | 0 | 1 |

**Pre-requisite courses:** Nil

**Course Outcomes:**

After successful completion of this course, the students should able to

| | |
|---|---|
| CO1 : | Enhance the fundamental knowledge of weaving and ceramic Technology |
| CO2 : | Understand the heritage ,rock art paintings to modern art sculpture |
| CO3 : | Acquire essential knowledge in the folk and martial arts |
| CO4 : | Understand the importance of role thinai concept of Tamils |
| CO5: | Gain the knowledge of contribution by Tamils to Indian national movement and Indian culture |

**CO/PO Mapping**
(S/M/W indicates the strength of correlation) S-Strong, M-Medium, W-Weak

| COs | Programme Outcomes (POs) | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 | PSO3 |
| CO1 | | | | | | | | | | | | | | W | W |
| CO2 | | | | | | | | | | | | | | W | W |
| CO3 | | | | | | | | | | | | | | W | W |
| CO4 | | | | | | | | | | | | | | W | W |
| CO5 | | | | | | | | | | | | | | | |

**Course Assessment methods:**

**Direct**

1. Continuous Assessment Test I, II
2. Two Assignments
3. End Semester Examination

**Indirect**

1. Course-end survey

**Topics covered:**

**UNIT I WEAVING AND CERAMIC TECHNOLOGY**

Weaving Industry during Sangam Age – Ceramic technology – Black and Red Ware Potteries (BRW) – Graffiti on Potteries.

**UNIT II DESIGN AND CONSTRUCTION TECHNOLOGY**

Designing and Structural construction House & Designs in household materials during Sangam Age - Building materials and Hero stones of Sangam age – Details of Stage Constructions in Silappathikaram - Sculptures and Temples of Mamallapuram - Great Temples of Cholas and other worship places - Temples of Nayaka Period - Type study (Madurai Meenakshi Temple)- Thirumalai Nayakar Mahal - Chetti Nadu Houses, Indo - Saracenic architecture at Madras during British Period.

| UNIT III MANUFACTURING TECHNOLOGY | |
|---|---|
| Art of Ship Building - Metallurgical studies - Iron industry - Iron smelting,steel -Copper and gold-Coins as source of history - Minting of Coins – Beads making-industries Stone beads - Glass beads - Terracotta beads -Shell beads/ bone beats - Archeological evidences - Gem stone types described in Silappathikaram. | |
| **UNIT IV AGRICULTURE AND IRRIGATION TECHNOLOGY** | |
| Dam, Tank, ponds, Sluice, Significance of Kumizhi Thoompu of Chola Period, Animal Husbandry - Wells designed for cattle use - Agriculture and Agro Processing - Knowledge of Sea - Fisheries – Pearl - Conche diving - Ancient Knowledge of Ocean - Knowledge Specific Society. | |
| **UNIT V SCIENTIFIC TAMIL & TAMIL COMPUTING** | |
| Development of Scientific Tamil - Tamil computing – Digitalization of Tamil Books – Development of Tamil Software – Tamil Virtual Academy – Tamil Digital Library – Online Tamil Dictionaries – Sorkuvai Project. | |
| **Theory: 15 Hrs** **Tutorial: 0** **Practical: 0 Hrs** | **Total:15 Hrs** |

**TEXT-CUM-REFERENCE BOOKS**

1. Social Life of Tamils (Dr.K.K.Pillay) A joint publication of TNTB & ESC and RMRL – (in print)
2. Social Life of the Tamils - The Classical Period (Dr.S.Singaravelu) (Published by: International Institute of Tamil Studies.
3. Historical Heritage of the Tamils (Dr.S.V.Subatamanian, Dr.K.D. Thirunavukkarasu) (Published by: International Institute of Tamil Studies).
4. The Contributions of the Tamils to Indian Culture (Dr.M.Valarmathi) (Published by: International Institute of Tamil Studies.)
5. Keeladi - 'Sangam City C ivilization on the banks of river Vaigai' (Jointly Published by: Department ofArchaeology & Tamil Nadu Text Book and Educational Services Corporation, Tamil Nadu)
6. Studies in the History of India with Special Reference to Tamil Nadu (Dr.K.K.Pillay) (Published by: The Author)
7. Porunai Civilization (Jointly Published by: Department of Archaeology & Tamil Nadu Text Bookand Educational Services Corporation, Tamil Nadu) 12. Journey of Civilization Indus to Vaigai (R.Balakrishnan) (Published by: RMRL) – Reference Book.

# SEMESTER III

| U18MAI3201 | MULTIVARIATE CALCULUS AND FORECASTING | L | T | P | J | C |
|---|---|---|---|---|---|---|
| | | 3 | 0 | 2 | 0 | 4 |

**Course Objectives:**

- To enable learning of Multivariate calculus as it's one of the most important data science skills and multivariate calculus is used everywhere in Machine Learning Projects.
- To demonstrate an understanding of Calculus beyond the manipulation of symbols,
- To enable classification or regression when operations are related with multiple variables
- To understand the theory and methods of Calculus to solve a variety of problems in terms of multivariate dataset

| **Course Outcomes:** | |
|---|---|
| After successful completion of this course, the students should be able to | |
| CO 1: | Evaluate the total derivative of a function, expand the given function as a series and locate the maximum and minimum for multivariate functions which is an important part of data science. |
| CO 2: | Solve higher order partial differential equations arising in real world situations. |
| CO 3: | Evaluate double and triple integrals in Cartesian coordinates and apply them to calculate area and volume. |
| CO 4: | Evaluate gradient, divergence and curl which form the basis of gradient descent and apply them to real life problems. |
| CO 5: | Analyze and apply the knowledge of time series and interpolation to predict the future values. |
| CO 6: | Determine multiple integrals, vector differentials, vector integrals using MATLAB. |

**Pre-requisite courses: U18MAI1203 LINEAR ALGEBRA AND CALCULUS**

| **CO/PO Mapping**<br>(S/M/W indicates the strength of correlation) S-Strong, M-Medium, W-Weak | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **COs** | **Programme Outcomes (POs)** | | | | | | | | | | | | | | |
| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 | PSO3 |
| CO1 | S | S | | | | | | | | | | M | S | | |
| CO2 | W | | | | | | | | | | | | S | | |
| CO3 | W | W | | | | | | | | | | W | S | | |
| CO4 | M | M | | | | | | | | | | | S | | |
| CO5 | M | | | | | | | | | | | M | S | | |
| CO6 | | | | | S | | | | | | | S | S | S | |

**Course Assessment methods:**

**a) Direct**

1. Continuous Assessment Test I, II (Theory component)
2. Open Book Test; Cooperative Learning Report, Assignment; Journal Paper Review, Group Presentation, Project Report, Poster Preparation, Prototype or Product
3. Demonstration etc (as applicable) (Theory component)
4. Pre/Post - Experiment Test/Viva; Experimental Report for each Experiment (lab Component)
5. Model Examination (lab component)
6. End Semester Examination (Theory and lab components)

**b)Indirect**

1. Course-end survey

**Topics covered:**

| | |
|---|---|
| **FUNCTIONS OF SEVERAL VARIABLES** | **9 Hours** |
| Partial derivatives – Homogeneous functions and Euler's theorem –Total derivative – Taylor's series expansion – Maxima and minima of functions of two variables – Constrained maxima and minima: Lagrange's multiplier method with single constraints – Jacobians. | |
| **PARTIAL DIFFERENTIAL EQUATIONS** | **5 Hours** |
| Linear Homogeneous partial differential equations of second and higher order with constant coefficients | |
| **MULTIPLE INTEGRALS** | **9 Hours** |
| Double integration – Cartesian coordinates – Change of order of integration – Triple integration in Cartesian coordinates – Applications: Area as double integral and Volume as triple integral. | |
| **VECTOR CALCULUS** | **10 Hours** |
| Gradient, divergence and curl – Directional derivative – Irrotational and Solenoidal vector fields - Green's theorem in a plane, Gauss divergence theorem and Stoke's theorem (Only statements excluding proofs) | |
| **TIME SERIES AND INTERPOLATION** | **12 Hours** |
| Time series - components - Trend-Determination of trend by moving averages – Least square method-Seasonal Variations-Ratio to moving average method.<br><br>Interpolation – Newton's forward and backward interpolation – Newton's divided difference interpolation – Lagrange's interpolation. | |

| | | |
|---|---|---|
| **Theory : 45 Hrs** | **Tutorial : 0** | **Total Hours: 45 Hrs** |

## Lab component Contents:

**List of MATLAB Programmes:**

1. Determining Maxima and Minima of a function of two variables.
2. Evaluating double integral with constant and variable limits.
3. Area as double integral
4. Evaluating triple integral with constant and variable limits
5. Volume as triple integral
6. Evaluating gradient, divergence and curl
7. Evaluating line integrals and work done
8. Verifying Green's theorem in the plane

| Practical : 30 Hrs | Tutorial : 0 | Total Hours: 30 Hrs |
|---|---|---|

## Textbooks:


1. Grewal B.S., "Higher Engineering Mathematics", Khanna Publishers, New Delhi, 44th Edition, 2014.
2. Ramana B.V., "Higher Engineering Mathematics", Tata McGraw Hill Co. Ltd., New Delhi, 11th Reprint, 2010.
3. Grewal B.S. and Grewal J.S., "Numerical methods in Engineering and Science", 9th Edition, Khanna Publishers, New Delhi, 2007.
4. Montgomery D.C., Johnson. L.A., Gardiner J.S., "Forecasting and Time series Analysis", McGraw Hill, 1990.


## Reference Books:


1. Kreyzig E., "Advanced Engineering Mathematics", 10th Edition, John Wiley and sons, 2011.
2. Venkataraman M.K., "Engineering Mathematics", The National Publishing Co., Chennai,2003
3. Weir, MD, Hass J, Giordano FR: Thomas' "Calculus", Pearson education 12th Edition, 2015.
4. Thomas G.B. and Finney R.L., "Calculus and Analytic Geometry", 11th Edition, Pearson Education, 2006.
5. Gerald, C. F. and Wheatley, P. O.,"Applied Numerical Analysis", 7th Edition, Pearson Education Asia, New Delhi, 20073.
6. Grewal B.S. and Grewal J.S., "Numerical methods in Engineering and Science", 9th Edition, Khanna Publishers, New Delhi, 2007.
7. Montgomery D.C., Johnson. L.A., Gardiner J.S., "Forecasting and Time series Analysis", McGraw Hill, 1990..



**Crafted By :** Dr. K. Maheswari, M.Sc., PhD., Department of Mathematics, KCT

| U18AII3202 | ALGORITHMS AND OPTIMIZATION OF PROGRAMS | L | T | P | J | C |
|---|---|---|---|---|---|---|
| | | 3 | 0 | 2 | 0 | 4 |

**Course Objectives:**

- To teach paradigms and approaches used to analyze and design algorithms and to appreciate the impact of algorithm design in practice.
- To make students understand how the worst-case time complexity of an algorithm is defined, how asymptotic notation is used to provide a rough classification of algorithms.
- To explain different computational models (e.g., divide-and-conquer), order notation and various complexity measures (e.g., running time, disk space) to analyze the complexity/performance of different algorithms.
- To teach various advanced design and analysis techniques such as greedy algorithms, dynamic programming & Know the concepts of tractable and intractable problems and the classes P, NP and NP-complete problem

**Course Outcomes:**

After successful completion of this course, the students should able to

| | |
|---|---|
| CO 1: | Understand techniques for effective problem solving in computing |
| CO 2: | Design different paradigms of problem solving to illustrate clever and efficient ways to solve a given problem. |
| CO 3: | Identify and apply for rigorously proving correctness of the algorithm for a variety of problems. |
| CO 4: | Implement to show the efficiency of the algorithm over the naive techniques |

**Pre-requisite courses: U18AII2204 OBJECT-ORIENTED PROGRAMMING ANDDATA STRUCTURES**

**CO/PO Mapping**
(S/M/W indicates the strength of correlation) S-Strong, M-Medium, W-Weak

| COs | Programme Outcomes (POs) | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 | PSO3 |
| CO1 | S | | | | | | | | | | | M | M | | |
| CO2 | S | S | | M | | | | | | | S | S | M | | |
| CO3 | S | S | S | M | S | | | | | | S | S | M | | |
| CO4 | S | S | S | | S | | | | | | S | S | M | | |

**Course Assessment methods:**

**a) Direct**

1. Continuous Assessment Test I, II (Theory component)
2. Open Book Test; Cooperative Learning Report, Assignment; Journal Paper Review, Group Presentation, Project Report, Poster Preparation, Prototype or Product
3. Demonstration etc (as applicable) (Theory component)
4. Pre/Post - Experiment Test/Viva; Experimental Report for each Experiment (lab Component)
5. Model Examination (lab component)
6. End Semester Examination (Theory and lab components)

**b)Indirect**

1. Course-end survey

**Topics covered:**

| ANALYSIS OF ALGORITHMS | 7 Hours |
|---|---|

Introduction Role of Algorithms in computing, Analyzing algorithms and Designing algorithms, Algorithm Design techniques: Divide and Conquer – Merge Sort and Quicksort. **Time complexity:** Growth of Function: Asymptotic notation, Standard notations and common functions Complexity analysis-Time and space tradeoffs in algorithms, Using recurrence relations to analyze recursive algorithms, Master Theorem(Without Proof).

| ADVANCED DESIGN AND OPTIMIZATION | 8 Hours |
|---|---|

Algorithm design techniques - Brute-force – Sequential search, Dynamic Programming – Rod cutting problem, Greedy algorithms – Activity Selection Problem; Divide-and-conquer – Strassen's Matrix Multiplication; Backtracking – 8 queens problem; Branch and- bound – Traveling Salesman Problem, 0/1 Knapsack Problem-String Matching Algorithms - Geometric algorithms - Approximation algorithms.

| TREES, GRAPHS AND HASHING | 8 Hours |
|---|---|

Non-Linear Data Structures: General Tree; Binary trees, Binary Search Tree: Traversals Graphs: Introduction, Representations of graphs (adjacency list, adjacency matrix)
Hashing: Hash tables, including collision-avoidance strategies, MD5 Hashing, Hashing in SSH. DFS and BFS, Shortest-path algorithms (Single source shortest path. Dijkstra's and Floyd's algorithms); Minimum spanning tree (Prim's and Kruskal's algorithms)

| COMPLEXITY CLASS | 7 Hours |
|---|---|

COMPLEXITY CLASS: P, NP and NP -Completeness Problems (without proofs). **Case Study**: Implement a program that resolves any real time problem and optimize the same script in which its time and space complexity is reduced linearly or exponentially.

| Theory : 30 Hrs | Tutorial : 0 | Total Hours: 30 Hrs |
|---|---|---|

## Lab component Contents:

**List of Experiments:**

1. Implementation of Sorting algorithms
2. Implementation of Warshall's algorithm
3. Designing Knapsack problem
4. Shortest paths Algorithm
5. Minimum cost spanning tree
6. Implementation of travelling salesman problem
7. Implement N Queens problem using Backtracking

| Practical : 30 Hrs | Tutorial : 0 | Total Hours: 30 Hrs |
|---|---|---|

## Textbooks:


1. Design and Analysis of Algorithms by Sartaj Sahni and Ellis Horwitz, Galgotia Publications 2015.
2. Anany Levitin, Introduction to the Design and Analysis of Algorithms, Pearson Education , 2012
3. Thomas H Cormen, Charles E Leiserson, Ronald L Rivest and Clifford Stein, Introduction to Algorithms, Third Edition, Prentice Hall of India,New Delhi, 2010


## Reference Books:


1. J. Klienberg and E. Tardos, Algorithm Design, Pearson Education Limited , 2014
2. Algorithms, by Dasgupta, Papadimitrou and Vazirani, McGraw-Hill Education, 2006.
3. Computer Algorithms, by Horowitz, Sahni, and Rajasekaran, Silicon Press, 2007.

| U18AII3203 | OPERATING SYSTEM | L | T | P | J | C |
|---|---|---|---|---|---|---|
| | | 2 | 0 | 2 | 0 | 3 |

**Course Objective**

•To learn the mechanisms of OS to handle processes and threads and their Communication

•To learn the mechanisms involved in memory management in contemporary OS

•To gain knowledge on distributed operating system concepts that includes architecture, Mutual exclusion algorithms, deadlock detection algorithms and agreement protocols

•To know concept and working principle of open-source OS

| **Course Outcomes:** | |
|---|---|
| After successful completion of this course, the students should be able to | |
| CO 1: | Apply the concepts of CPU scheduling and Process synchronization |
| CO 2: | Experiment creation of different virtual machines in a hypervisor |
| CO 3: | Simulate the principles of memory management |
| CO 4: | Examine the features of various open source operating systems |

**Course Assessment methods:**

**a) Direct**

1. Continuous Assessment Test I, II (Theory component)
2. Open Book Test; Cooperative Learning Report, Assignment; Journal Paper Review, Group Presentation, Project Report, Poster Preparation, Prototype or Product
3. Demonstration etc (as applicable) (Theory component)
4. Pre/Post - Experiment Test/Viva; Experimental Report for each Experiment (lab Component)
5. Model Examination (lab component)
6. End Semester Examination (Theory and lab components)

**b)Indirect**

1. Course-end survey

**Pre-requisite courses:Nil**

| **CO/PO Mapping** (S/M/W indicates the strength of correlation) S-Strong, M-Medium, W-Weak | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **COs** | **Programme Outcomes (POs)** | | | | | | | | | | | | | | |
| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 | PSO3 |
| CO1 | S | | | | | | | | | | | M | M | | |
| CO2 | S | S | | M | | | | | | | S | S | M | | |
| CO3 | S | S | S | M | S | | | | | | S | S | M | | |
| CO4 | S | S | S | | S | | | | | | S | S | S | | |

**Topics covered:**

| INTRODUCTION AND PROCESS CONCEPT | 7 Hours |
|---|---|

Operating System Structure - Operating System Operations - Process Management - Memory Management - Storage Management - Protection and Security - System Structures: Operating System Services - User and Operating System Interface - System Calls - Types of System Calls - Process Scheduling - Operations on Processes - Inter-process Communication.

| MULTITHREADED PROGRAMMING AND PROCESS SCHEDULING | 8 Hours |
|---|---|

Overview of threads - Multicore programming - Multithreading Models - Threading Issues - Basic Concepts of process scheduling - Scheduling Criteria - Scheduling Algorithms - Multiple Processor Scheduling - Synchronization - The Critical-Section Problem - Peterson's Solution Synchronization Hardware - Semaphores - Classic problems of Synchronization - Monitors

| DEADLOCK AND MEMORY MANAGEMENT STRATEGIES | 7 Hours |
|---|---|

System Model - Deadlock Characterization - Methods for Handling Deadlock - Deadlock Prevention - Deadlock Avoidance - Deadlock Detection - Recovery from Deadlock. Swapping - Contiguous Memory Allocation - Paging - Structure of the Page Table- Segmentation.

| OPEN SOURCE SOFTWARE SYSTEMS | 8 Hours |
|---|---|

Basic UNIX Commands - File Filters: File Related Commands - Piping -Joining - awk and backup Commands - Processes in Linux: User Process and Terminal Handling. Users and Account Management: Configuration - Creating - Testing - Removing - Allocating - System Logging: Logging – Accounting. Compiling and Debugging: Compiling C and C++ Programs under Linux - GNU Debugger: Debugger using GDB - Make: Syntax of makefiles - Automake and Autoconf.

| Theory : 30 Hrs | Tutorial : 0 | Total Hours: 30 Hrs |
|---|---|---|

## Lab component Contents:

**List of Experiments:**

1. Develop programs for process creation and communication.
2. To Creation of process and child process
3. Demonstration of inter-process communication Creation of Zombie and Orphan process Creation of threads
4. Demonstration of shared memory concept
5. Simulation of the CPU scheduling algorithms
6. Demonstration of Semaphores
7. Implementation of Producer-Consumer problem
8. Simulation of Bankers algorithm for deadlock avoidance
9. Creation of virtual machine in a hypervisor

| Practical : 30 Hrs | Tutorial : 0 | Total Hours: 30 Hrs |
|---|---|---|

**Textbooks:**

1. William Stallings, “Operating Systems – Internals and Design Principles”, 7th Edition, Prentice Hall, 2011.
2. Andrew S. Tanenbaum, “Modern Operating Systems”, Second Edition, Addison Wesley, 2001.

**Reference Books:**

1. Charles Crowley, “Operating Systems: A Design-Oriented Approach”, Tata Mc Graw Hill Education”, 1996.
2. D M Dhamdhere, “Operating Systems: A Concept-Based Approach”, Second Edition, Tata Mc Graw-Hill Education, 2007.

| U18AII3204 | APPLIED MACHINE LEARNING | L | T | P | J | C |
|---|---|---|---|---|---|---|
| | | 3 | 0 | 2 | 0 | 4 |

**Course Objectives:**

· To train in terms of Machine Learning Problems and its forms

· To make students understand statistical analysis for classification

· To explain different fuzzy inference systems

· To teach various advanced techniques in business intelligent systems

**Course Outcomes:**

After successful completion of this course, the students should able to

| | |
|---|---|
| CO 1: | Understand different methodologies to create application using statistical models |
| CO 2: | Design the test procedures to assess the efficacy of the developed model. |
| CO 3: | Identify and apply appropriate machine learning models for analyzing the data for a variety of problems. |
| CO 4: | Implement different algorithms for business intelligence |

**Pre-requisite courses:** U18AII2205 INTRODUCTION TO AI & ML

**CO/PO Mapping**
(S/M/W indicates the strength of correlation) S-Strong, M-Medium, W-Weak

| COs | Programme Outcomes (POs) | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 | PSO3 |
| CO1 | S | | | | M | | M | | | | | M | S | M | M |
| CO2 | S | S | | M | | | | S | | | S | S | S | M | M |
| CO3 | S | S | S | M | S | | | S | | M | S | S | S | M | M |
| CO4 | S | S | S | | S | | | | | | S | S | S | M | M |

**Course Assessment methods:**

**a) Direct**

1. Continuous Assessment Test I, II (Theory component)
2. Open Book Test; Cooperative Learning Report, Assignment; Journal Paper Review, Group Presentation, Project Report, Poster Preparation, Prototype or Product
3. Demonstration etc (as applicable) (Theory component)
4. Pre/Post - Experiment Test/Viva; Experimental Report for each Experiment (lab Component)
5. Model Examination (lab component)
6. End Semester Examination (Theory and lab components)

**b) Indirect**

1. Course-end survey

**Topics covered:**

| INTRODUCTION | 8 Hours |
|---|---|
| Real-world use cases of Machine Learning. Introduction to SciKit-Learn. Machine learning LifeCycle an implement a multi-variable regression problem with the scikit-learn library | |
| **LINEAR REGRESSION AND LOGISTIC REGRESSION** | **18 Hours** |
| Understanding cost function and gradient descent. Overfitting and Underfitting K-Nearest Neighbours Classification and Regression Linear Regression: Least Squares, Ridge, Lasso and Polynominal Regression Logistic Regression: SVM and Hyperparameter tuning and Implementing SVM using scikit-learn | |
| **MODEL EVALUATION** | **7 Hours** |
| How and why should we evaluate models? Model Evaluation and Selection methods, Precision-Recall and ROC Curves Confusion Matrices, Regression Evaluation, Optimizing Classifiers for Different Evaluation Metrics | |
| **NAIVE BAYES, DECISION TREES AND RANDOM FOREST** | **12 Hours** |
| Naive Bayes Classifiers, Decision Tree, Training and Visualizing a Decision Tree, Entropy and The CART Training Algorithm, Random Forests, Implement Random forest with a real-world use case and understand th basics of random forest, Boosting - AdaBoost and Gradient Boosting, Capstone Project | |

| Theory: 45 Hrs | Tutorial : 0 | Total Hours: 45 Hrs |
|---|---|---|

## Lab component Contents:

**List of Experiments:**

1. Implementing multi variable regression problem
2. Evaluating cost function and gradient descent
3. Implementing K NN
4. Implementing SVM
5. Evaluating Precision, Recall
6. Implementing Decision Tree
7. Implementing Random forest
8. Implementing Adaboost
9. Implementing Gradient boosting

| Practical : 30 Hrs | Tutorial : 0 | Total Hours: 30 Hrs |
|---|---|---|

**Textbooks:**

1. 1.Aurélien Géron "Hands-On Machine Learning with Scikit-Learn and TensorFlow" Publisher(s): O'Reilly Media, Inc 2017.

**Reference Books:**

1. M.Gopal, “Applied Machine Learning”, McGraw Hill Education (15 May 2018).
2. David Forsyth “Applied Machine Learning” Springer; 1st edition (12 July 2019).
3. Mohd. Shafi Pathan, Nilanjan Dey, Parikshit N. Mahalle, Sanjeev Wagh, "Applied Machine Learning for Smart Data Analysis", CRC Press, 2019.

| U18AII3205 | DATA COLLECTION AND DATA MANAGEMENT | L | T | P | J | C |
|---|---|---|---|---|---|---|
| | | 2 | 0 | 2 | 0 | 3 |

**Course Objectives:**

- To learn and practice data modelling using the entity relationship and developing database designs.
- To understand the concept of non structured data handling in data science
- To introduce the tools required to manage and analyze big data like Hadoop, NoSql MapReduce
- To enable students to have skills that will help them to solve complex real-world problems in for decision support

| **Course Outcomes:** | |
|---|---|
| After successful completion of this course, the students should be able to | |
| CO 1: | Explain basic database concepts, applications, data models, schemas and instances |
| CO 2: | Understand the concept of handling unstructured data |
| CO 3: | Explain the various data collection methodologies such as map ,filter and List comprehension |
| CO 4: | Apply mapreduce in real world applications |

**Pre-requisite courses: Nil**

| **CO/PO Mapping** (S/M/W indicates the strength of correlation) S-Strong, M-Medium, W-Weak | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **COs** | **Programme Outcomes (POs)** | | | | | | | | | | | | | | |
| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 | PSO3 |
| CO1 | S | | | | | | | | | | | M | | | |
| CO2 | S | S | | | M | | | S | | | S | S | | | |
| CO3 | S | S | | S | M | S | | | | | | | | | |
| CO4 | S | S | | S | | S | | | M | | | S | S | S | M |

**Course Assessment methods:**

**a) Direct**

1. Continuous Assessment Test I, II (Theory component)
2. Open Book Test; Cooperative Learning Report, Assignment; Journal Paper Review, Group Presentation, Project Report, Poster Preparation, Prototype or Product
3. Demonstration etc (as applicable) (Theory component)
4. Pre/Post - Experiment Test/Viva; Experimental Report for each Experiment (lab Component)
5. Model Examination (lab component)
6. End Semester Examination (Theory and lab components)

**b) Indirect**

1. Course-end survey

**Topics covered:**

| INTRODUCTION TO DATABASE AND RELATIONAL DATABASE | 9 Hours |
|---|---|

Introduction - Purpose of database systems - Views of data - Database Development Life cycle - Architecture of DBMS - Key Principles of RDBMS- Database Design and Relational Database- ETL Concepts - ER Model - Constraints - ER-Diagrams - Design Issues - Weak Entity Sets - UML - Converting ER Model to Relational Database Design - Normalization - NF - 2NF - 3NF - multivalued dependency and 4 NF

| UNSTRUCTURED DATA HANDLING | 7 Hours |
|---|---|

Introduction to unstructured data - XML and JSON - NoSQL databases - MongoDB - Web crawling and web APIs - Regular expressions- Information retrieval - Scoring - weighting - vector space

| DATA COLLECTION AND PROCESSING | 7 Hours |
|---|---|

Map - Filter - List manipulations - List Comprehensions - Nested Data and Nested Iterations- Structuring Nested Data - Shallow Copies - Deep Copies - Extracting from Nested Data - Example of Nested Iteration

| INTRODUCTION TO MAPREDUCE | 7 Hours |
|---|---|

Cloud computing and data centers - Hadoop API - Mapreduce programming model- Algorithms Using MapReduce - Extensions to MapReduce - The Communication Cost Model - Complexity Theory for MapReduce

| Theory: 30 Hrs | Tutorial : 0 | Total Hours: 30 Hrs |
|---|---|---|

## Lab component Contents:

**List of Experiments:**

1. Processing CSV Data using python(Kaggle data)
2. Processing JSON Data using python
3. Processing XLS Data using python
4. Implementation of MongoClient using python
5. Implementation of Map & Filter
6. Implementation of List Comprehension
7. File Management tasks in Hadoop
8. Analyse time-temperature statistics and generate report with max/min temperature in Hadoop

| Practical : 30 Hrs | Tutorial : 0 | Total Hours: 30 Hrs |
|---|---|---|

**Textbooks:**

1. Abraham Silberschatz, Henry F. Korth and S. Sudarshan, Database System Concepts , McGraw -Hill, 2015
2. C.J.Date, A.Kannan and S.Swamynathan, "An Introduction to Database Systems", Eighth Edition, Pearson Education, 2006.

**Reference Books:**

1. Atul Kahate, "Introduction to Database Management Systems", Pearson Education, New Delhi, 2006.
2. Alexis Leon and Mathews Leon, "Database Management Systems", Vikas Publishing House Private Limited, New Delhi,
3. Raghu Ramakrishnan, "Database Management Systems", Fourth Edition, Tata McGraw Hill, 2010.
4. G.K.Gupta,"Database Management Systems", Tata McGraw Hill, 2011.
5. Rob Cornell, "Database Systems Design and Implementation", Cengage Learning, 2011.

| U18AIC3006 | TOOLS AND TECHNOLOGIES FOR WELLNESS | L | T | P | J | C |
|---|---|---|---|---|---|---|
| | | 1 | 0 | 0 | 0 | 1 |

**Course Objectives:**

- To understand the concept of ayurveda
- To explain how Asana, Pranayama, Ayurvedic knowledge and Mindfulness for well-being is useful in day to day life

| **Course Outcomes:** | |
|---|---|
| After successful completion of this course, the students should be able to | |
| CO 1: | Understand the various tools like Asana, Pranayama, Ayurvedic knowledge and Mindfulness for well-being |
| CO 2: | Develop a practical understanding of the various tools |

**Pre-requisite courses: Nil**

| **CO/PO Mapping** (S/M/W indicates the strength of correlation) S-Strong, M-Medium, W-Weak | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **COs** | **Programme Outcomes (POs)** | | | | | | | | | | | | | | |
| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 | PSO 3 |
| CO1 | | | | | | | M | M | M | | | | | | |
| CO2 | | | | | | | M | M | M | | | | | | |

**Course Assessment methods:**

**a) Direct**

1. Continuous Assessment Test
2. Quiz

**b)Indirect**

1. Course-end survey

## Topics covered:

| **FOUNDATIONS OF WELLNESS** | **3 Hours** |
|---|---|

What is wellness- Looking at wellness from various viewpoints of Body - Emotions and Cognition and across cultures- Introduction to tools: Yogic practices - Mindfulness and other contemplative practices

| **PHYSICAL DIMENSION** | **3 Hours** |
|---|---|

Understanding the various aspects of the physical body - problems and issues and tools for physical well-being

| | |
|---|---|
| **EMOTIONAL DIMENSION** | **3 Hours** |
| Understanding emotions - stress - mental health - Tools for emotional well-being | |
| **ENERGY AND COGNITIVE DIMENSION** | **3 Hours** |
| Understanding Cognitive executive functions, cognitive biases and challenges and tools for enhanced cognitive capabilities | |
| **TRANSCENDENTAL DIMENSION** | **3 Hours** |
| Understanding the science of happiness and transcending the limitations of the physical, emotional and cognitive dimensions. | |

| | | |
|---|---|---|
| **Theory: 15 Hrs** | **Tutorial: 0** | **Total Hours: 15 Hrs** |

**Text Books:**


1. Certification of yoga professionals official guidebook- First edition, Excel books Pvt Ltd., 2016
2. Harvard Medical School Guide to Yoga, Marlynn Wei, James E. Groves



**Crafted By :** Smrithi Rekha Adinarayanan, MS (State University of New York), co-founder of Anaadi Foundation, Palani

| U18AIT3008 | PRINCIPLES OF ECONOMICS | L | T | P | J | C |
|---|---|---|---|---|---|---|
| | | 2 | 0 | 0 | 0 | 2 |

## Course Objectives:

- To familiarize the students with the basic concept of microeconomics
- To make student understand the demand and supply analysis in business applications
- To familiarise students with the production and cost structure under different stages of production
- To understand the pricing and output decisions under various market structure
- To help students understand and apply the various decision tools to understand the market structure

## Course Outcomes:

After successful completion of this course, the students should be able to

| | |
|---|---|
| CO 1: | Understand the conceptual foundations and analytical methods used in micro economics |
| CO 2: | Explain the basics of consumer behavior, behavior of firms and market equilibrium |
| CO 3: | Understand the market structures of perfect competition, oligopoly and monopolies |

**Pre-requisite courses: Nil**

**CO/PO Mapping**
(S/M/W indicates the strength of correlation) S-Strong, M-Medium, W-Weak

| COs | Programme Outcomes (POs) | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 | PSO3 |
| CO1 | | | | | | | M | M | M | | | | | W | S |
| CO2 | | | | | | | M | M | M | | | | | W | S |
| CO3 | | | | | | | M | M | M | | | | | W | S |

## Course Assessment methods:

### a) Direct

1. Continuous Assessment Test I, II (Theory component)
2. Open Book Test; Cooperative Learning Report, Assignment; Journal Paper Review, Group Presentation, Project Report, Poster Preparation, Prototype or Product
3. Demonstration etc (as applicable) (Theory component)
4. End Semester Examination (Theory)

### b)Indirect

1. Course-end survey

## Topics covered:

| | |
|---|---|
| **INTRODUCTION OF ECONOMICS** | **4 hours** |
| Scope - Relationship with other Disciplines | |
| **MICROECONOMICS** | **7 hours** |
| Firms and Managerial Objectives - Demand - Law of Demand - Determinants of demand - Elasticity of demand - Law of diminishing marginal utility - Exceptions of Demand - Demand forecasting techniques (only theory) - Supply - Law of Supply - Elasticity of Supply | |
| **PRODUCTION FUNCTIONS** | **6 hours** |
| Short and long run laws of production - law of returns 6 to scale - Cost - types of cost - Short and long run cost output relationship - Economies and diseconomies of Scale | |
| **MARKET STRUCTURE** | **6 hours** |
| Perfect Competition- monopoly- duopoly - oligopoly - 6 Monopolistic market structures - characteristics & Price - Output determination- Pricing Methods | |
| **MACROECONOMICS** | **7 hours** |
| Nature & importance. National Income - concepts - GNP - GDP - NNP - Business cycle - Phases of Business Cycle - Controlling Trade Cycle - Inflation - Indian Financial System - Fiscal Policy - Monetary Policy | |

| | | |
|---|---|---|
| **Theory: 30 Hrs** | **Tutorial: 0** | **Total Hours: 30 Hrs** |

## Textbooks:

1.Piyali Ghosh Geetika, Purba Roy Chowdhury (2017),Managerial Economics, 3 e, McGraw- Hill Education D N Diwedi (2009). Managerial Economics. Seventh Edition, Vikas Publication

## Reference Books:

1. D. N. Gujarati and D.C. Porter, Essentials of Econometrics, McGraw Hill, 4th edition, InternationalEdition, 2009.
2. Christopher Dougherty, Introduction to Econometrics, Oxford University Press, 3rd edition, Indian edition, 2007.
3. Jan Kmenta, Elements of Econometrics, Indian Reprint, Khosla Publishing House,2nd edition, 2008.

# SEMESTER IV

| U18MAT4105 | RANDOM PROCESS AND OPTIMIZATION | L | T | P | J | C |
|---|---|---|---|---|---|---|
| | | 3 | 1 | 0 | 0 | 4 |

**Course Objectives:**

- To make students understand Discrete and Continuous Random
- variables, Random Processes and their applications in data science
- To Understand about the correlation Functions
- To understand the functional relationship between random inputs and outputs with the use of Random Process Techniques

**Course Outcomes:**

After successful completion of this course, the students should be able to

| | |
|---|---|
| CO 1: | Analyze various random processes with practical applications |
| CO 2: | Analyze correlation related to various random processes and establish the properties of spectral densities |
| CO 3: | Analyze and apply appropriate queuing models in domain specific situations |
| CO 4: | Apply linear programming models to domain specific situations. |
| CO 5: | Determine the extreme values of functions without constraint and with equality constraints |

**Pre-requisite courses:Nil**

**CO/PO Mapping**
(S/M/W indicates the strength of correlation) S-Strong, M-Medium, W-Weak

| COs | Programme Outcomes (POs) | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 | PSO3 |
| CO1 | M | M | | | | | | | | | | | S | | |
| CO2 | S | S | | | | | | | | | | S | S | | |
| CO3 | M | M | | | | | | | | | | M | S | | |
| CO4 | S | M | | | | | | | | | | | S | | |
| CO5 | M | M | | | | | | | | | | | S | | |

**Topics covered:**

| RANDOM PROCESSES | 9+3 Hours |
|---|---|

Random Process – Stationary Process – Wide sense stationary and Ergodic processes– Gaussian Random Process – Markov process–Markov chain–Poisson process

| CORRELATION AND SPECTRAL DENSITIES | 9+3 Hours |
|---|---|

Auto correlation - Cross correlation - Properties – Power spectral density – Cross spectral density - Properties – Wiener-Khinchine relation – Relationship between cross power spectrum and cross correlation function

| **QUEUEING MODELS** | **9+3 Hours** |
|---|---|

Markovian Queues – Single and Multi-server Models – Little's formula – Machine Interference Model – Self Service Queue.

| **LINEAR PROGRAMMING** | **9+3 Hours** |
|---|---|

The phases of OR study – formation of an L.P model – graphical solution – simplex algorithm – artificial variables technique -Big M method

| **CLASSICAL OPTIMIZATION THEORY** | **9+3 Hours** |
|---|---|

Unconstrained extremal problems – Equality constraints – Lagrange's method – Inequality constraints - Kuhn -Tucker conditions – Quadratic programming – Simple problems.

| **Theory: 45 Hrs** | **Tutorials: 15 Hrs** | **Total Hours: 60 Hrs** |
|---|---|---|

**Text Book:**


1. Taha H.A., "Operations Research: An Introduction", 10th Edition, Pearson Education, 2017.
2. Peebles. P.Z., "Probability, Random Variables and Random Signal Principles", Tata McGraw Hill, 4th Edition, New Delhi, 2002.


**Reference Books:**


1. Cooper. G.R., Mc Gillem. C.D., "Probabilistic Methods of Signal and System Analysis", 3 rd Indian Edition, Oxford University Press, New Delhi, 2012.
2. Miller S.L. and Childers D.G., "Probability and Random Processes with Applications to Signal Processing and Communications", 2nd Edition, Academic Press, 2012.
3. Stark H, and Woods J.W., "Probability and Random Processes with Applications to Signal Processing", 3rd Edition, Pearson Education, Asia, 2002.
4. Wagner H.M., "Operations Research", Prentice Hall of India, 2011.
5. Bhaskar S., "Operations Research", Anuradha Agencies, 2 nd Edition, 2014.

| U18AII4201 | COMPUTER NETWORKS | L | T | P | J | C |
|---|---|---|---|---|---|---|
| | | 2 | 0 | 2 | 0 | 3 |

**Course Objectives:**

- To study the basic taxonomy and terminology of the computer networking and enumerate the layers of OSI model and TCP/IP model.
- To acquire knowledge of Application layer and Presentation layer paradigms and protocols
- To study Session layer design issues, Transport layer services, and protocols
- To gain core knowledge of Network layer routing protocols and IP addressing.
- To study data link layer concepts, design issues, and protocols
- To study the fundamentals and basics of Physical layer, and will apply them in real time applications.

**Course Outcomes:**

After successful completion of this course, the students should be able to

| | |
|---|---|
| CO 1: | Understand the functionality and protocols operating in each layer of OSI reference model |
| CO 2: | Design error control, flow control and routing protocols |
| CO 3: | Construct network traffic characteristics and congestion control mechanism |
| CO 4: | Apply terror control, flow control and routing protocols |

**Pre-requisite courses:Nil**

**CO/PO Mapping**
(S/M/W indicates the strength of correlation) S-Strong, M-Medium, W-Weak

| COs | Programme Outcomes (POs) | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 | PSO3 |
| CO1 | S | | | | | | | | | | | M | M | | |
| CO2 | S | S | | | M | | | S | | S | | S | M | | |
| CO3 | S | S | | S | M | S | | | | S | | | M | | |
| CO4 | S | | | S | | S | | | | | | S | M | | |

**Course Assessment methods:**
**a) Direct**

1. Continuous Assessment Test I, II (Theory component)
2. Open Book Test; Cooperative Learning Report, Assignment; Journal Paper Review, Group Presentation, Project Report, Poster Preparation, Prototype or Product
3. Demonstration etc (as applicable) (Theory component)
4. Pre/Post - Experiment Test/Viva; Experimental Report for each Experiment (lab Component)
5. Model Examination (lab component)
6. End Semester Examination (Theory and lab components)

**b)Indirect**

1. Course-end survey

## Topics covered:

| DATA COMMUNICATIONS AND DATA LINK LAYER | 8 Hours |
|---|---|

Data Communication – The OSI Model – TCP/IP Protocol Suite – Addressing – Transmission Media – Networkingdevices – Network Topologies. Encoding - Error Detection – Reliable Transmission – MAC protocols – CSMA/CD – CSMA/CA

| NETWORK LAYER | 8 Hours |
|---|---|

Circuit Switching – Packet Switching – Bridges and LAN Switches: Spanning Tree algorithm – Internetworking – IPv4 - Subnetting – IPv6 – Routing Techniques: Distance vector (RIP) – Link state (OSPF) — Interdomain Routing (BGP).

| TRANSPORT LAYER | 8 Hours |
|---|---|

UDP – TCP – Congestion Control and Resource Allocation: TCP Congestion Control – Congestion Avoidance Mechanisms – Quality of Service: Integrated Services – Differentiated Services – Network Traffic Analysis Bidirectional Protocols: Piggybacking - User Datagram Protocol - Transmission Control Protocol - Congestion Control

| APPLICATION LAYER | 6 Hours |
|---|---|

Domain Name System – Electronic Mail (SMTP, MIME, IMAP) – File Transfer (FTP) – WWW (HTTP) -TLS/SSL -IP Security

| Theory: 30 Hrs | Tutorial : 0 | Total Hours: 30 Hrs |
|---|---|---|

## Lab component Contents:

**List of Experiments:**

1. Develop client server based TCP applications using UNIX socket programming functions.
2. Develop client server based UDP applications using UNIX socket programming functions.
3. Simulation of data link and network layer protocols.
4. Performance analysis of TCP and UDP protocol using simulation tool.
5. Performance analysis of routing protocols using simulation tool.
6. Demonstrate the working of network tools such as Ping, TCPDump, Traceroute, Netstat, IPconfig.
7. Analyze the network traffic using Wireshark tool/Packet tracer tool.

| Practical : 30 Hrs | Tutorial : 0 | Total Hours: 30 Hrs |
|---|---|---|

**Textbooks:**

1. Larry L. Peterson, Bruce S. Davie, “Computer Networks: A Systems Approach”, Fifth edition, Morgan Kaufmann Publishers Inc., 2011.
2. William Stallings, “Data and Computer Communications”, Tenth edition, Pearson Education, 2013.

**Reference Books:**

1. Behrouz A Forouzan, “Data Communications and Networking”, Fifth edition, Tata McGraw–Hill, New Delhi, 2013.
2. James F. Kurose, Keith W. Ross, “Computer Networking, A Top–Down Approach Featuring the Internet”, Sixth edition, Pearson Education, 2012.

| U18AII4202 | Neural Networks and Deep Learning | L | T | P | J | C |
|---|---|---|---|---|---|---|
| | | 3 | 0 | 2 | 0 | 4 |

**Course Objectives:**

· To teach paradigms and approaches representations and classifications

· To make students understand architectural designs and propagation algorithms

· To explain different belief networks and convolution neural networks

· To teach various advanced techniques in Recurrent Neural Networks, BPTT, Natural language Processing, Regression and deep networks

| **Course Outcomes:** | |
|---|---|
| After successful completion of this course, the students should able to | |
| CO 1: | Understand different methodologies to create application using deep nets |
| CO 2: | Design the test procedures to assess the efficacy of the developed model. |
| CO 3: | Identify and apply appropriate deep learning models for analyzing the data for a variety of problems. |
| CO 4: | Implement different deep learning algorithms |

**Pre-requisite courses:** U18AII2205 INTRODUCTION TO AI & ML

| **CO/PO Mapping**<br>(S/M/W indicates the strength of correlation) S-Strong, M-Medium, W-Weak | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **COs** | **Programme Outcomes (POs)** | | | | | | | | | | | | | | |
| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 | PSO3 |
| CO1 | S | | | | | | | | M | | | M | M | M | M |
| CO2 | S | S | | M | | | | | | | S | S | M | S | S |
| CO3 | S | S | S | M | S | | M | | M | | S | S | M | S | S |
| CO4 | S | S | S | | S | | | | | | S | S | M | S | S |

**Course Assessment methods:**

**a) Direct**

1. Continuous Assessment Test I, II (Theory component)
2. Open Book Test; Cooperative Learning Report, Assignment; Journal Paper Review, Group Presentation, Project Report, Poster Preparation, Prototype or Product
3. Demonstration etc (as applicable) (Theory component)
4. Pre/Post - Experiment Test/Viva; Experimental Report for each Experiment (lab Component)
5. Model Examination (lab component)
6. End Semester Examination (Theory and lab components)

**b)Indirect**

1. Course-end survey

**Topics covered:**

| CONVOLUTIONAL NEURAL NETWORKS | 10 Hours |
|---|---|

Architectural Overview, Motivation, Layers, Filters, Parameter sharing, Regularization, Popular CNN Architectures: ResNet, AlexNet – Applications

| RECURRENT AND RECURSIVE NETS | 12 Hours |
|---|---|

Recurrent Neural Networks, Bidirectional RNNs, Encoder-decoder sequence to sequence architectures - BPTT for training RNN, Long Short Term Memory Networks, Computer Vision - Speech Recognition - Natural language Processing, Case studies in classification, Regression and deep networks.

| DEEP LEARNING ARCHITECTURES | 12 Hours |
|---|---|

Machine Learning and Deep Learning, Representation Learning, Width and Depth of Neural Networks, Learning Algorithms: Capacity - Overfitting - Underfitting - Bayesian Classification - Activation Functions: RELU, LRELU, ERELU, Unsupervised Training of Neural Networks, Restricted and Deep Boltzmann Machines , Auto Encoders

| ADVANCED NEURAL NETWORKS | 11 Hours |
|---|---|

Deep Feedforward Networks : Gradient based learning - Hidden Units - Architectural design – Back Propagation algorithms - Regularization for deep learning: Dataset Augmentation - Noise Robustes –Semi supervised learning -Multitask learning - Deep Belief networks -Generative Adversial Networks by Keras MXnet

| Theory : 45 Hrs | Tutorial: 0 | Total Hours: 45 Hrs |
|---|---|---|

## Lab component Contents:

**List of Experiments:**

1. Develop programs for data representation.
2. Estimating depth and width of Neural Networks
3. Training of Unsupervised Neural Networks
4. Implementing Gradient based learning
5. Implementing Backpropagation algorithms
6. Implementing Deep Belief networks
7. Visualize data by Computer Vision
8. Implementing RNN

| Practical : 45 Hrs | Tutorial : 0 | Total Hours: 30 Hrs |
|---|---|---|

**Text Books:**

1. Ian Goodfellow, Yoshua Bengio, and Aaron Courville, “Deep Learning”, First Edition, MIT Press, 2016.
2. Nikhil Buduma and Nicholas Lacascio, “Fundamentals of Deep Learning”, First Edition, O.Reilly, 2017

**Reference Books:**

1. Josh Patterson, Adam Gibson "Deep Learning: A Practitioner's Approach", O'Reilly Media, 2017
2. Laura Graesser, Wah Loon Keng "Foundations of Deep Reinforcement Learning: Theory and Practice in Python" Addison-Wesley Professional -2020
3. Jon Krohn, Grant Beyleveld, Aglaé Bassens "Deep Learning Illustrated: A Visual, Interactive Guide toArtificial Intelligence", 1st edition Addison-Wesley Professional 2019

| U18AII4203 | DATA MINING AND MODELING | L | T | P | J | C |
|---|---|---|---|---|---|---|
| | | 2 | 0 | 2 | 0 | 3 |

**Course Objectives:**

· To train the basic concepts and techniques of Data Mining.

· To introduce mathematical statistics foundations of the Data Mining Algorithms.

· To include a wide range of clustering, estimation, prediction, and classification algorithms.

· To experiment basic principles, concepts and applications of cluster analysis

| **Course Outcomes:** | |
|---|---|
| After successful completion of this course, the students should be able to | |
| CO 1: | Understand about data mining basics,issues and the working principle of classification technique. |
| CO 2: | Explain the basic concepts of Association Rule Mining and evaluate the working of various Association Rule Mining algorithms |
| CO 3: | Implement classification and prediction techniques |
| CO 4: | Analyze the working of different clustering algorithms |

**Pre-requisite courses:**U18MAI2203 – Probability and Statistics

| **CO/PO Mapping** (S/M/W indicates the strength of correlation) S-Strong, M-Medium, W-Weak | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **COs** | **Programme Outcomes (POs)** | | | | | | | | | | | | | | |
| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 | PSO3 |
| CO1 | S | | | | | | | | | | | M | S | M | M |
| CO2 | S | S | | | M | | | S | | | S | S | S | M | M |
| CO3 | S | S | | S | M | S | | | | | S | S | S | M | M |
| CO4 | S | S | | S | | S | | | | | S | S | S | M | M |

**Course Assessment methods:**

**a) Direct**

1. Continuous Assessment Test I, II (Theory component)
2. Open Book Test; Cooperative Learning Report, Assignment; Journal Paper Review, Group Presentation, Project Report, Poster Preparation, Prototype or Product
3. Demonstration etc (as applicable) (Theory component)
4. Pre/Post - Experiment Test/Viva; Experimental Report for each Experiment (lab Component)
5. Model Examination (lab component)
6. End Semester Examination (Theory and lab components)

**b)Indirect**

1. Course-end survey

**Topics covered:**

| INTRODUCTION TO DATA MINING | 7 Hours |
|---|---|

Data Mining Goals Stages of the Data Mining Process - Data Mining Techniques - Knowledge Representation Methods Applications Data preprocessing: Data cleaning - Data transformation - Data reduction - Discretization and generating concept hierarchies - Real time data processing in Kaggle - OLAP - OLTP.

| MINING FREQUENT PATTERNS, ASSOCIATION AND CORRELATIONS | 8 Hours |
|---|---|

Mining Frequent Patterns - Associations and Correlations - Mining Methods - Mining various Kinds of Association Rules - Correlation Analysis - Constraint Based Association Mining

| CLASSIFICATION | 7 Hours |
|---|---|

Classification and Prediction - Basic Concepts - Decision Tree Induction - Bayesian Classification - Rule Based Classification - Classification by Backpropagation - Associative Classification - Lazy Learners - Other Classification Methods - Prediction CaseStudies: Implementation in Rapidminer, Weka

| CLUSTER ANALYSIS | 8 Hours |
|---|---|

Cluster Analysis - Types of Data - Categorization of Major Clustering Methods - K-means - Partitioning Metho Hierarchical Methods - Density-Based Methods - Grid Based Methods - Model-Based Clustering Methods - Cluste High Dimensional Data - Constraint - Based Cluster Analysis - Outlier Analysis and Data Mining Applications.

| Theory : 30 Hrs | Tutorial : 0 | Total Hours: 30 Hrs |
|---|---|---|

## Lab component Contents:

### List of Experiments:

1. Demonstration of preprocessing on different dataset
2. Demonstration of preprocessing on different dataset
3. Demonstration of Association rule process using apriori algorithm
4. Demonstration of classification rule process using decision tree algorithm
5. Demonstration of classification rule process using naïve bayes algorithm
6. Demonstrate performing Regression on data sets
7. Demonstration of clustering rule process using simple k-means

| Practical : 30 Hrs | Tutorial : 0 | Total Hours: 30 Hrs |
|---|---|---|

**Text Books:**


1. Pang-Ning Tan, Michael Steinbach, Vipin Kumar: Introduction to Data Mining, Pearson, F impression,2014
2. Jiawei Han, Micheline Kamber, Jian Pei: Data Mining -Concepts and Techniques, 3rd Edition, Mor Kaufmann Publisher, 2012


**Reference Books:**


1. Sam Anahory, Dennis Murray: Data Warehousing in the Real World, Pearson, Tenth Impression, 2012.
2. Michael.J.Berry, Gordon.S.Linoff: Mastering Data Mining, Wiley Edition, second edtion, 2012.
3. Hand, Mannila, and Smyth,Principles of Data Mining, MIT Press, 2001.
4. Hastie,Tibshirani, and Friedman, Springer,The Elements of Statistical Learning- Data Mining, Infere and Prediction, 2001.
5. Chakrabarti, Morgan Kaufmann, Mining the Web - Discovering Knowledge from Hypertext Data, 2003
6. I. H. Witten and E. Frank, Data Mining: Practical Machine Learning Tools and Techniques with J Implementations,2005.

| U18AIT4006 | FINANCE FOR ENGINEERS | L | T | P | J | C |
|---|---|---|---|---|---|---|
| | | 3 | 0 | 0 | 0 | 3 |

**Course Objectives:**

- To acquire knowledge of economics to facilitate the process of economic decision making
- To acquire knowledge on basic financial management aspects
- To develop the skills to analyze financial statements

**Course Outcomes:**

After successful completion of this course, the students should be able to

| | |
|---|---|
| CO 1: | Understand key accounting concepts, terms, and principles. |
| CO 2: | Learn complex accounting transactions and how they relate to accounting principles. |
| CO 3: | Implement software development budgeting |

**Pre-requisite courses: Nil**

**CO/PO Mapping**
(S/M/W indicates the strength of correlation) S-Strong, M-Medium, W-Weak

| COs | Programme Outcomes (POs) | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 | PSO3 |
| CO1 | | | | | | | M | M | M | | | | | S | S |
| CO2 | | | | | | | M | M | M | | | | | S | S |
| CO3 | | | | | | | M | M | M | | | | | S | S |

**Topics covered:**

| BASICS OF ACCOUNTING | 9 hours |
|---|---|

Introduction to basic accounting concepts. Accounting terminologies, Accounting fundamentals, debits & credits Accounts payable & Receivables, Accounting cycle,Inventory accounting & Cost accounting

| FINANCIAL REPORTS | 9 hours |
|---|---|

Overview of financial reporting. Types of financial reports. The balance sheet equation - Assets, Liabilities, and Stockholders' Equity. Bookkeeping and managing transactions into book entry.

| CLASSIFICATION | 8 hours |
|---|---|

Classification of cash flows into operating, investing, and financing activities. Preparing and

analyzing the Statement of Cash Flows. Earnings, Cash from Operations, EBITDA,and Free Cash Flow.

| ACCOUNTING VERTICALS | 9 hours |
|---|---|

Links between accounting, measurement, and financial statements.Key business ratios that can be calculated using your Income Statement and Balance Sheet. Interpret two key financial statements (Income Statement and Balance Sheet) that drive business decisions.

| AGILE S/W DEVELOPMENT BUDGETING | 10 hours |
|---|---|

Types of budget estimate, Requirements definition and analysis, Recommended technological stack, Functional and nonfunctional requirements, Project plan, Cost estimation, dos and don'ts of software development budgeting

| Theory : 45 Hrs | Tutorial : 0 | Total Hours: 45 Hrs |
|---|---|---|

## Textbooks:


1. “An Easy Introduction to Financial Accounting: A Self-study Guide” by V.G. Narayanan


## Reference Books:


1. Christopher Dougherty, Introduction to Econometrics, Oxford University Press, 3rd edition, Indian edition, 2007.
2. Jan Kmenta, Elements of Econometrics, Indian Reprint, Khosla Publishing House,2nd edition,2008.

| U18CHT4000 | Environmental Science and Engineering (Common to All branches) | L | T | P | J | C |
|---|---|---|---|---|---|---|
| | | 3 | 0 | 0 | 0 | 0 |

**Pre-requisite courses:** Nil

**Course Outcomes:**

After successful completion of this course, the students should able to

| | |
|---|---|
| CO1 : | Analyze the impact of engineering solutions in a global and societal context. |
| CO2 : | Discuss contemporary issues that results in environmental degradation and would attempt to provide solutions to overcome those problems. |
| CO3 : | Highlight the importance of ecosystem and biodiversity. |
| CO4 : | Consider issues of environment and sustainable development in his/her personal and professional undertakings. |
| CO5: | Paraphrase the importance of conservation of resources. |
| CO6: | Play an important role in transferring a healthy environment for future generations. |

**CO/PO Mapping**
(S/M/W indicates the strength of correlation) S-Strong, M-Medium, W-Weak

| COs | Programme Outcomes (POs) | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 | PSO3 |
| CO1 | | M | | | | | S | | M | | | | | | |
| CO2 | | | | | | M | | | | M | | | | | |
| CO3 | | | | | | | M | | | | | | | | |
| CO4 | | | | | | M | S | | | | | | | | S |
| CO5 | | | | | | | S | | | | | | | | |
| CO6 | | | W | | | | S | | | | | M | | | |

**Course Assessment methods:**

**Direct**

1. Internal Test I
2. Internal Test II
3. Assignment
4. Group presentation
5. End Semester Exam

**Indirect**

1. Course-end survey

**Topics covered:**

| INTRODUCTION TO ENVIRONMENTAL STUDIES AND NATURAL RESOURCES | 14 Hours |
|---|---|

Definition, scope and importance – Need for public awareness – Forest resources: Use and over-exploitation, deforestation, case studies – Timber extraction, mining, dams and their effects on forests and tribal people.

Water resources: Use and overutilization of surface and ground water, conflicts over water, dams – benefits and problems – Water conservation, rain water harvesting, watershed management.

Mineral resources: Use and exploitation, environmental effects of extracting and using mineral resources, case studies.

Food resources: World food problems, changes caused by agriculture and overgrazing, effects of modern agriculture, fertilizer-pesticide problems, case studies.

Energy resources: Growing energy needs, renewable and nonrenewable energy sources, use of alternate energy sources, case studies.

Land resources: Land as a resource, land degradation, man induced landslides, soil erosion and desertification, Wasteland reclamation – Role of an individual in conservation of natural resources.

| ECOSYSTEMS AND BIODIVERSITY | 9 Hours |
|---|---|

**ECOSYSTEM:** Concept of an ecosystem – Structure and function of an ecosystem: Producers, consumers and decomposers, Food chain, Food web, Energy flow in the ecosystem and Ecological pyramids – Ecological succession – Introduction, types, characteristic features, structure and function of the (a) Forest ecosystem (b) Grassland ecosystem (c) Desert ecosystem (d) Aquatic ecosystems (ponds, streams, lakes, rivers, oceans, estuaries).

**BIODIVERSITY:** Introduction to Biodiversity – Definition: genetic, species and ecosystem diversity – Bio geographical classification of India – Value of biodiversity: consumptive use, productive use, social, ethical, aesthetic values – India as a mega-diversity nation – Hot-spots of biodiversity – Threats to biodiversity: habitat loss, poaching of wildlife, man-wildlife conflicts – Endangered and endemic species of India – Conservation of biodiversity: In-situ and Ex-situ conservation of biodiversity.

| ENVIRONMENTAL POLLUTION | 8 Hours |
|---|---|

Definition – Causes, effects and control measures of: (a) Air pollution – Organic and inorganic pollution – cyclone separator, electrostatic precipitator (b) Water pollution (c) Heavy metal pollution (d) Noise pollution (e) Thermal pollution (f) Nuclear hazards – Role of an individual in prevention of pollution – Pollution case studies – Solid waste and hazardous Management: Causes, effects and control measures from factories, small scale and large scale industries – Waste minimization – Disaster management: floods, earthquake, cyclone and landslides.

| SOCIAL ISSUES AND THE ENVIRONMENT | 7 Hours |
|---|---|

From Unsustainable to Sustainable development – Urban problems related to energy – Resettlement and rehabilitation of people; its problems and concerns, case studies – Issues and possible solutions – Climate change, global warming, acid rain, ozone layer depletion – Environment Production 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 – Human Rights.

| HUMAN POPULATION AND THE ENVIRONMENT | 7 Hours |
|---|---|

Population growth and explosion – Welfare Program – Environment and human health – Communicable disease – Role of Information Technology in Environment and human health – Case studies.

| Theory: 45 Hrs | Tutorial: 0 | Practical: 0 | Project: 0 | Total:45 Hrs |
|---|---|---|---|---|

**REFERENCES**


1. G. Tyler Miller and Scott Spoolman, ‘Environmental Science’, Fourteenth Edition, Brooks Cole, 2012.
2. Gilbert M. Masters and Wendell P. Ela, ‘Introduction to Environmental Engineering and Science’, Third Edition, Pearson Education, 2013.
3. BharuchaErach, ‘The Biodiversity of India’, Mapin Publishing Pvt. Ltd., Ahmedabad, 2002.
4. Trivedi R.K and P.K.Goel, ‘Introduction to Air Pollution’, Techno-Science Publications, 2003.
5. Trivedi R.K., ‘Handbook of Environmental Laws, Rules, Guidelines, Compliances and Standards’, Vol. I and II, Enviro Media, 1996.
6. Cunningham, W.P.Cooper and T.H.Gorhani, ‘Environmental Encyclopedia’, Jaico Publication House, Mumbai, 2001.
7. Wager K.D., ‘Environmental Management’, W.B. Saunders Co., Philadelphia, USA, 1998.
8. Colin R. Townsend, Michael Begon and John L. Harper, ‘Essentials of Ecology’, Third Edition, Blackwell Publishing, 2008.

# SEMESTER V

| U18AII5201 | CLOUD ARCHITECTURE | L | T | P | J | C |
|---|---|---|---|---|---|---|
| | | 3 | 0 | 2 | 0 | 4 |

**Course Objectives:**

- To make students understand the concept of cloud computing.
- To have knowledge on the various issues in cloud computing
- To understand the functional relationship between cloud computing and stakeholders
- To appreciate the emergence of cloud as the next generation computing paradigm.

**Course Outcomes:**

After successful completion of this course, the students should able to

| | |
|---|---|
| CO1: | Analyze the main concepts, key technologies, strengths and limitations of cloud |
| CO2: | Analyze and understand various queuing models |
| CO3: | To understand and use the architecture of compute and storage cloud, service and delivery models. |
| CO4: | Apply the core issues of cloud computing such as resource management and security. |

**Pre-requisite courses: Nil**

**CO/PO Mapping**
(S/M/W indicates the strength of correlation) S-Strong, M-Medium, W-Weak

| COs | Programme Outcomes (POs) | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 | PSO3 |
| CO1 | M | | | M | | | | | | | | | S | M | |
| CO2 | S | | | S | | S | | | | | | S | S | M | |
| CO3 | M | S | | M | | | | | | | | M | S | M | |
| CO4 | S | | | M | | | | | | | M | | S | M | |

**Course Assessment methods:**

**a) Direct**

1. Continuous Assessment Test I, II (Theory component)
2. Open Book Test; Cooperative Learning Report, Assignment; Journal Paper Review, GroupPresentation,Project Report, Poster Preparation, Prototype or Product
3. Demonstration etc (as applicable) (Theory component)
4. End Semester Examination (Theory component)

**b) Indirect**

1. Course-end survey

**Topics covered:**

| | |
|---|---|
| **INTRODUCTION** | **10 Hrs** |

Introduction to Cloud Computing – Definition of Cloud – Evolution of Cloud Computing – Underlying Principles of Parallel and Distributed Computing – Cloud Characteristics – Elasticity in Cloud – On-demand Provisioning.

| | |
|---|---|
| **CLOUD ENABLING TECHNOLOGIES** | **10 Hrs** |

Service Oriented Architecture – REST and Systems of Systems – Web Services – Publish- Subscribe Model – Basics of Virtualization – Types of Virtualization – Implementation Levels of Virtualization – Virtualization Structures – Tools and Mechanisms – Virtualization of CPU – Memory – I/O Devices –Virtualization Support and Disaster Recovery.

| | |
|---|---|
| **QUEUEING MODELS** | **12 Hrs** |

Layered Cloud Architecture Design – NIST Cloud Computing Reference Architecture – Public, Private and Hybrid Clouds - laaS – PaaS – SaaS – Architectural Design Challenges – Cloud Storage – Storage-as-a-Service – Advantages of Cloud Storage – Cloud Storage Providers – S3.

| | |
|---|---|
| **CLOUD ARCHITECTURE, SERVICES AND STORAGE** | **13 Hrs** |

Inter Cloud Resource Management – Resource Provisioning and Resource Provisioning Methods – Global Exchange of Cloud Resources – Security Overview – Cloud Security Challenges – Software-as-a-Service Security – Security Governance – Virtual Machine Security – IAM – Security Standards. Hadoop – MapReduce – Virtual Box - Google App Engine – Programming Environment for Google App Engine — Open Stack- Federation Services

| | | |
|---|---|---|
| **Theory: 45 Hrs** | **Tutorial: 0** | **Total Hours: 45 Hrs** |

**Lab Experiments:**

1. Install Virtualbox/VMware Workstation with different flavours of linux or windows OS on top of windows7 or 8.
2. Install a C compiler in the virtual machine created using virtual box and execute Simple Programs
3. Install Google App Engine. Create hello world app and other simple web applications using python/java.
4. Use GAE launcher to launch the web applications.
5. Simulate a cloud scenario using CloudSim and run a scheduling algorithm that is not present in CloudSim.
6. Find a procedure to transfer the files from one virtual machine to another virtual machine.
7. Find a procedure to launch virtual machine using trystack (Online Openstack Demo Version)
   Install Hadoop single node cluster and run simple applications like wordcount

| | | |
|---|---|---|
| **Practical: 30 Hrs** | **Tutorial: 0** | **Total Hours: 30 Hrs** |

## Text Books:


1. Kai Hwang, Geoffrey C. Fox, Jack G. Dongarra, "Distributed and Cloud Computing, From Parallel Processing to the Internet of Things", Morgan Kaufmann Publishers, 2012.
2. Rittinghouse, John W., and James F. Ransome, ―Cloud Computing: Implementation, Management and Security‖, CRC Press, 2017


## Reference Books:


1. Rajkumar Buyya, Christian Vecchiola, S. ThamaraiSelvi, ―Mastering Cloud Computing‖, Tata Mcgraw Hill, 2013.
2. Toby Velte, Anthony Velte, Robert Elsenpeter, "Cloud Computing - A Practical Approach‖, Tata Mcgraw Hill, 2009.
3. George Reese, "Cloud Application Architectures: Building Applications and Infrastructure in the Cloud: Transactional Systems for EC2 and Beyond (Theory in Practice), O'Reilly, 2009.

| U18AII5202 | EXPLORATORY DATA ANALYSIS AND VISUALIZATION | L | T | P | J | C |
|---|---|---|---|---|---|---|
| | | 3 | 0 | 2 | 0 | 4 |

**Course Objectives:**

- To teach paradigms and approaches used to analyze data
- To make students understand how the analysis is applied
- To explain different visualization techniques
- To implement and experiment various analytic models for visualization

**Course Outcomes:**

After successful completion of this course, the students should able to

| | |
|---|---|
| CO1: | Understand the main principles of visual perception |
| CO2: | Design core skills for visual analysis |
| CO3: | Identify and apply visualization techniques for various data analysis tasks |
| CO4: | Apply and implement the visualization concepts in various streams |

**Pre-requisite courses:** U18MAI2203 – Probability and Statistics

**CO/PO Mapping**
(S/M/W indicates the strength of correlation) S-Strong, M-Medium, W-Weak

| COs | Programme Outcomes (POs) | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 | PSO3 |
| CO1 | S | | | M | | | | | | M | | | M | | L |
| CO2 | S | | | S | | S | | | | | | S | M | | L |
| CO3 | M | S | M | | | | S | | M | | | M | M | | L |
| CO4 | S | | | M | | | | | | | M | | M | | L |

**Course Assessment methods:**

a) **Direct**
   1. Continuous Assessment Test I, II (Theory component)
   2. Open Book Test; Cooperative Learning Report, Assignment; Journal Paper Review, Group Presentation,Project Report, Poster Preparation, Prototype or Product
   3. Demonstration etc (as applicable) (Theory component)
   4. End Semester Examination (Theory component)

b) **Indirect**
   1. Course-end survey

**Topics covered:**

| | |
|---|---|
| **ANALYSIS TECHNIQUES** | **10 Hrs** |
| Elements, Variables, and Data categorization- Levels of Measurement- Data management and indexing- Introduction to statistical learning and R-Programming- Measures of central tendency- Measures of location of dispersions- Practice and analysis with R- Basic Analysis Techniques | |
| **SKILLS FOR VISUAL ANALYSIS** | **13 Hrs** |
| Information visualization – effective data analysis – traits of meaningful data – visual perception – making abstract data visible – building blocks of information visualization – analytical interaction – analytical navigation – optimal quantitative scales – reference lines and regions – trellises and crosstabs – multiple concurrent views – focus and context – details on demand – over-plotting reduction – analytical patterns – pattern examples. | |
| **TIME-SERIES, RANKING, AND DEVIATION ANALYSIS** | **10 Hrs** |
| Time-series analysis – time-series patterns – time-series displays – time-series best practices – part-to-whole and ranking patterns – part-to-whole and ranking displays – best practices – deviation analysis – deviation analysis displays – deviation analysis best practices | |
| **DISTRIBUTION, CORRELATION, AND MULTIVARIATE ANALYSIS** | **12 Hrs** |
| Distribution analysis – describing distributions – distribution patterns – distribution displays –distribution analysis best practices – correlation analysis – describing correlations – correlation patterns – correlation displays – correlation analysis techniques and best practices – multivariate analysis – multivariate patterns – multivariate displays – multivariate analysis techniques and best practices | |

| | | |
|---|---|---|
| **Theory: 45 Hrs** | **Tutorial: 0** | **Total Hours: 45 Hrs** |

**Lab Experiments:**

1. Implementation of data charts
2. Implementation of data visualization techniques
3. Designing multivariate patterns
4. Visual encoding of data
5. Dashboard designing
6. Implementation of multivariate displays
7. Implement over plotting

| | | |
|---|---|---|
| **Practical: 30 Hrs** | **Tutorial: 0** | **Total Hours: 30 Hrs** |

## Text Books:


1. Stephen Few, "Now you see it: Simple Visualization techniques for quantitative analysis",Analytics Press, 2019.
2. Stephen Few, "Information dashboard design: The effective visual communication of data",O'Reilly, 2016.
3. Edward R. Tufte, "The visual display of quantitative information", Second Edition, GraphicsPress, 2019


## Reference Books:


1. Nathan Yau, "Data Points: Visualization that means something", Wiley, 2013.
2. Ben Fry, "Visualizing data: Exploring and explaining data with the processing environment",O'Reilly, 2008.
3. Gert H. N. Laursen and Jesper Thorlund, "Business Analytics for Managers: Taking business intelligence beyond reporting", Wiley, 2010.
4. Evan Stubbs, "The value of business analytics: Identifying the path to profitability", Wiley, 2019

| U18AII5203 | REINFORCEMENT LEARNING | L | T | P | J | C |
|---|---|---|---|---|---|---|
| | | 3 | 0 | 2 | 0 | 4 |

**Course Objectives:**

- To teach basics purpose and concepts of Reinforcement Learning
- To make students understand the nature of the problems and solve it through Reinforcement Learning
- To make students to utilize Reinforcement Learning Algorithms for solving Uncertainty problems
- To teach the techniques to build system of agents applying deep learning architectures

**Course Outcomes:**

After successful completion of this course, the students should able to

| | |
|---|---|
| CO1: | Understand the underpinnings to structure classical solutions for Reinforcement Learning problem |
| CO2: | Apply deep learning architectures to train agents navigating from virtual world from sensory data. |
| CO3: | Analyze basic Reinforcement Learning algorithms for simple sequential decision making and control problems in uncertain conditions |
| CO4: | Build system of agents to demonstrate collaboration or cooperation |

**Pre-requisite courses:** U18AII4202 – Neural Networks and Deep Learning

**CO/PO Mapping**
(S/M/W indicates the strength of correlation) S-Strong, M-Medium, W-Weak

| COs | Programme Outcomes (POs) | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 | PSO3 |
| CO1 | S | | | M | | | | | | | | S | S | | |
| CO2 | S | | | M | | | | | | | | S | S | S | |
| CO3 | S | S | M | | S | | | | | | | S | | S | S |
| CO4 | S | S | S | S | S | S | | | | | | S | S | S | S |

**Course Assessment methods:**

**a) Direct**

1. Continuous Assessment Test I, II (Theory component)
2. Open Book Test; Cooperative Learning Report, Assignment; Journal Paper Review, Group Presentation,Project Report, Poster Preparation, Prototype or Product
3. Demonstration etc (as applicable) (Theory component)
4. End Semester Examination (Theory component)

**b) Indirect**

1. Course-end survey

**Topics covered:**

| | |
|---|---|
| **FOUNDATIONS OFREINFORCEMENT LEARNING** | **11 Hrs** |
| Reinforcement Learning - A Preamble - Reinforcement Learning Frameworks: Problems and Solutions -Dynamic Programming - Monte Carlo Methods - Temporal-Difference Methods - Reinforcement Learning in Continuous Space. Case Study: Classic Problem of Gym's Taxi using openAI & V2 Task | |
| **VALUE-BASED METHODS** | **10 Hrs** |
| Build and Train Neural Networks, Convolutional Neural Networks - Bandit Algorithms - Deep Q-Learning – Deep Q-Network - Double Deep Q-Network - Dueling-DQN - Prioritized Replay. Case Study: Leveraging Neural Networks to predict machine failures that learns intelligent behaviors from sensory data. | |
| **POLICY-BASED METHODS** | **13 Hrs** |
| Theory behind Evolutionary Algorithms, Stochastic Policy Search, REINFORCE Algorithms - Improving Policy Gradient Methods - Generalised Advantage Estimation - Policy Optimization methods: Trust Region Policy Optimization (TRPO), Proximal Policy Optimization (PPO) - Actor-Critic Methods: Deep Deterministic Policy Gradient (DDPG) Case Study: Deep Reinforcement Learning for Robotics (Robotic arm/ four legged creaturewalk) | |
| **MULTI-AGENT REINFORCEMENT LEARNING** | **11 Hrs** |
| Hierarchical Reinforcement Learning - Markov Games for Multiplayer Games -Agent training in Collaborative and Competitive Setting Case Study: Intuition behind DeepMind's Alphazero | |

| | | |
|---|---|---|
| **Theory: 45 Hrs** | **Tutorial: 0** | **Total Hours: 45 Hrs** |

**Lab Experiments:**

1. Implementation of Markov Decision Process
2. Implementation of Temporal Difference Algorithm for estimating values
3. Implementation of Q-Learning
4. Implementation of Model- Based approach (DYNA)
5. Implementation of Policy-Based approach (actor-critic)
6. Capstone Project

| | | |
|---|---|---|
| **Practical: 30 Hrs** | **Tutorial: 0** | **Total Hours: 30 Hrs** |

## Text Books:


1. Richard S Sutton and Andrew G Barto,"Reinforcement Learning- An Introduction", 2nd Edition, MIT Press, 2018.
2. Laura Graesser, "Foundations of Deep Reinforcement Learning: Theory and Practice in Python", Addison Wesley Data &Analytics series, 2020


## Reference Books:


1. Csaba Szepesvári, Morgan & Claypool, "Algorithms for Reinforcement Learning", Morgan & Claypool Publishers, 2010
2. Dimitri Bertsikas and John G. Tsitsiklis , "Neuro Dynamic Programming".Athena Scientific. 1996

| U18AIT5004 | MARKETING FUNDAMENTALS | L | T | P | J | C |
|---|---|---|---|---|---|---|
| | | 3 | 0 | 0 | 0 | 3 |

**Course Objectives:**

- To familiarize the students with the basic concept of marketing
- To familiarize with the basic techniques of marketing management
- To help students understand and apply the various digital marketing tools.

**Course Outcomes:**

After successful completion of this course, the students should able to

| | |
|---|---|
| CO1: | Understand the basic concepts, and techniques of marketing management |
| CO2: | Explain the basics of marketing mix elements |
| CO3: | Understand and solve marketing problems in the complex and fast changing business environment. |

**Pre-requisite courses: Nil**

**CO/PO Mapping**
(S/M/W indicates the strength of correlation) S-Strong, M-Medium, W-Weak

| COs | Programme Outcomes (POs) | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 | PSO3 |
| CO1 | S | | M | | | | | | M | | | | | S | S |
| CO2 | | S | M | | | | | | M | | | | | S | S |
| CO3 | | | M | | | | | | M | | | | | S | S |

**Course Assessment methods:**

a) **Direct**
1. Continuous Assessment Test I, II (Theory component)
2. Open Book Test; Cooperative Learning Report, Assignment; Journal Paper Review, Group Presentation,Project Report, Poster Preparation, Prototype or Product
3. Demonstration etc (as applicable) (Theory component)
4. End Semester Examination (Theory component)

b) **Indirect**
1. Course-end survey

**Topics covered:**

| | |
|---|---|
| **INTRODUCTION TO MARKETING** | **10 Hrs** |
| Introduction to Marketing and Marketing Management, Difference between Marketing & Selling, Customer Value, Customer satisfaction & Delight, Value Chain. | |
| **MARKET OPPORTUNITIES** | **12 Hrs** |
| Marketing Plan, Demand Forecasting – Techniques, 7P's of Marketing, MIS, Environmental Scanning, Market Segmenting-Targeting-Positioning, Target Marketing. | |
| **PRODUCT CONCEPTS** | **10 Hrs** |
| Product Decisions - concept of a Product - Product mix decisions – Product Line- Width-Depth, Differentiation Strategies, Integrated Marketing Communication, CRM | |
| **DIGITAL MARKETING** | **13 Hrs** |
| SEO, SEM, Social Media and Content Marketing, Branding, Marketing Analytics | |
| **Theory: 45 Hrs** | **Tutorial: 0** | **Total : 45 Hrs** |

## Text Book:


1. Marketing Management Text and Cases, Tapan K Panda, Excel Books, 2020.


## Reference Books:


1. Philip Kotler, marketing management- analysis planning and control, Prentice Hall of India, New Delhi, 2018.
2. Ramaswamy. V S & Namakumari. S, marketing management-planning implementation and control, Macmillan Business Books, New Delhi, 2012.

| U18AIC5005 | PHILOSOPHY OF WELLNESS | L | T | P | J | C |
|---|---|---|---|---|---|---|
| | | 1 | 0 | 0 | 0 | 1 |

**Course Objectives:**

- Understand the underlying Philosophy of Wellness
- Look at connections between Modern science and Yogic Sciences

**Course Outcomes:**

After successful completion of this course, the students should able to

| | |
|---|---|
| CO1: | Understand the fundamental concepts of physical education, health and fitness |
| CO2: | Analyze and provide a general understanding on nutrition, first aid and stress management. |
| CO3: | Understand the awareness regarding hypo-kinetic diseases, and various measures of mental fitness and health assessment. |

**Pre-requisite courses: Nil**

**CO/PO Mapping**
(S/M/W indicates the strength of correlation) S-Strong, M-Medium, W-Weak

| COs | Programme Outcomes (POs) | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 | PSO3 |
| CO1 | S | | | S | | | | | M | | | | | | |
| CO2 | | S | | | | | | | M | | | | | | |
| CO3 | | | | | | M | | | M | | | | | | |

**Course Assessment methods:**

**a) Direct**

1. Continuous Assessment Test I
2. Open Book Test; Cooperative Learning Report, Assignment;
3. Demonstration etc (as applicable) (Theory component)

**b) Indirect**

1. Course-end survey
2.

**Topics covered:**

| COGNITION & LEARNING AND YOGIC PSYCHOLOGY - MODERN TOOLS FOR YOGIC RESEARCH | 8 Hrs |
|---|---|

Introduction to Wellness Management- Dimensions of Wellness-Healthy People- Introduction to Fitness Management Muscular Fitness for Body and Mind- Getting the Jump on Nutrition-Maintaining a Healthy Emotional

| UNDERLYING PHILOSOPHICAL CONTEXT & ANALYSING YOGIC DATA | 7 Hrs |
|---|---|

Aging and Longivity- Live in the Present - Think About Tomorrow- Personal Motivation- Goal Setting- happiness- Analysis of yogic data.

| Theory: 15 Hrs | Tutorial: 0 | Total Hours: 15 Hrs |
|---|---|---|

**Text Book:**

1. Cognitive Psychology: theory, process and methodology, Dawn McBride and Cooper Cutting, Second Edition, Neuroscience by Dale Purves, 2018.

| U18INT5000 | CONSTITUTION OF INDIA | L | T | P | J | C |
|---|---|---|---|---|---|---|
| | | 1 | 0 | 0 | 0 | 0 |

**Course Objectives:**

- 

**Course Outcomes:**

After successful completion of this course, the students should able to

CO1: Gain Knowledge about the Constitutional Law of India

CO2: Understand the Fundamental Rights and Duties of a citizen

CO3: Apply the concept of Federal structure of Indian Government

CO4: Analyze the Amendments and Emergency provisions in the Constitution

CO5: Develop a holistic approach in their life as a Citizen of India

**Pre-requisite courses: Nil**

**CO/PO Mapping**

(S/M/W indicates the strength of correlation) S-Strong, M-Medium, W-Weak

| COs | Programme Outcomes (POs) | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 | PSO3 |
| CO1 | | | | | | M | | | W | | | S | | | |
| CO2 | | | | | | S | | S | | | | M | | | |
| CO3 | | | | | | | | | M | S | | W | | | |
| CO4 | | | | | | | | W | M | | | M | | | |
| | | | | | | M | | M | | | | S | | | |

**Course Assessment methods:**

**Direct**

1. Group Activity / Quiz/ Debate / Case studies
2. Class test / Assignment

**Indirect**

1. Course-end survey

**Topics covered:**

**Module.1: Introduction to Indian Constitution** **4 hours**

Meaning of the constitution law and constitutionalism - Historical perspective of the Constitution · characteristics of the Constitution of India

**Module.2:Fundamental Rights** **8 hours**

Scheme of the fundamental rights - Right to Equality - Fundamental Right under Article 19 - Scope of the Right to Life and Liberty - Fundamental Duties and its legal status - Directive Principles of State Policy – Its importance and implementation

**Module.3:Federal Structure** **8 hours**

Federal structure and distribution of legislative and financial powers between the Union and the States - Parliamentary Form of Government in India - The constitutional powers and status of the President of India

**Module.4:Amendment to Constitution** **6 hours**

Amendment of the Constitutional Powers and Procedure - The historical perspectives of theconstitutional amendments in India

| **Module.5:Emergency Provisions** | **4 hours** |
|---|---|

National Emergency, President Rule, Financial Emergency Local Self Government – Constitutional Scheme in India

| **Theory: 30** | **Tutorial: 0** | **Practical: 0** | **Project: 0** | **Total: 30 Hrs** |
|---|---|---|---|---|

## REFERENCES


**1.Constitution of India - Ministry of Law & Justice – PDF format**
awmin.nic.in/coi/coiason29july08.pdf
**2. Introduction to the Constitution of India by DurgadasBasu**
1. The Constitution of India – Google free material - www.constitution.org/cons/india/const.html
**4. Parliament of India – PDF format**
*download.nos.org/srsec317newE/317EL11.pdf*
5. The Role of the President of India – By Prof.Balkrishna
**6. Local Government in India – E Book - Pradeep Sachdeva**
https://books.google.com/books/.../Local_Government_in_In...

# SEMESTER VI

| U18AII6201 | APPLIED DESIGN THINKING | L | T | P | J | C |
|---|---|---|---|---|---|---|
| | | 3 | 0 | 2 | 0 | 4 |

**Course Objectives:**

- To apply a scientific method to define & test various hypotheses to mitigate the inherent risks in product innovations.
- To design the solution concept based on the proposed value defined for the target customer exploring various alternate solutions to achieve value-price fit.
- To develop skills in empathizing, critical thinking, analysing, storytelling & pitching.
- To apply system thinking to reverse engineer a product/prototype and understand its internal components and their correlations

**Course Outcomes:**

After successful completion of this course, the students should able to

| | |
|---|---|
| CO1: | Apply and define hypotheses to mitigate the risks in product innovations |
| CO2: | Design proposed value for the target customer exploring various alternate solutions to achieve value-price fit. |
| CO3: | Develop skills in empathizing, critical thinking, analysing, storytelling & pitching. |
| CO4: | Apply system thinking to reverse engineer a product/prototype and understand its internal components and their correlations |

**Pre-requisite courses: Nil**

**CO/PO Mapping**
(S/M/W indicates the strength of correlation) S-Strong, M-Medium, W-Weak

| COs | Programme Outcomes (POs) | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 | PSO3 |
| CO1 | M | | | M | | | | | | | | W | S | S | |
| CO2 | | S | S | M | | | | | | | | W | S | S | |
| CO3 | | S | | M | | | | | M | | | W | S | S | |
| CO4 | S | | S | M | M | | | | M | | | W | S | S | |

**Course Assessment methods:**

**a) Direct**

1. Continuous Assessment Test I, II (Theory component)
2. Open Book Test; Cooperative Learning Report, Assignment; Journal Paper Review, Group Presentation, Project Report, Poster Preparation, Prototype or Product
3. Demonstration etc (as applicable) (Theory component)
4. End Semester Examination (Theory component)

**b) Indirect**

1. Course-end survey

**Topics covered:**

| | |
|---|---|
| **DESIGN THINKING PRINCIPLES** | **10 Hrs** |

Exploring Human centered Design - Understanding the Innovation process, Discovering areas of opportunity, Interviewing & empathy building techniques, Mitigate validation risk - Case studies

| | |
|---|---|
| **CUSTOMER CENTRIC INNOVATION** | **12 Hrs** |

Importance of customer centric innovation - Problem Validation and Customer Discovery - Understanding problem significance and problem incidence - Customer Validation. Target user, User persona & user stories. Activity: Customer development process - Customer interviews and field visits

| | |
|---|---|
| **APPLIED DESIGN THINKING TOOLS** | **10 Hrs** |

Concept of Minimum Usable Prototype [MUP] - MUP challenge brief - Designing & Crafting the value proposition - Deriving the Solution concept [MUP] iteratively - Activity: Ideate, Prototype and Test

| | |
|---|---|
| **SYSTEM THINKING & REVERSE ENGINEERING** | **13 Hrs** |

System Thinking, Understanding Systems, Examples and Understandings, Complex Systems, Reverse Engineering Methodology, Identify building blocks/Components - Re-Engineering a complex system

| | | |
|---|---|---|
| **Theory: 45 Hrs** | **Tutorial: 0** | **Total Hours: 45 Hrs** |

**Lab Component:**

**Choose any real time use case, apply and experiment the following:**

1. Develop empathy with target users
2. Define the problem statement
3. Ideate through brain storming and reverse engineering
4. Create prototype
5. Test the model

| | | |
|---|---|---|
| **Practical : 30 Hrs** | **Tutorial: 0** | **Total Hours: 30 Hrs** |

**Text Books:**

1. Daren J. Eich, “Innovation Step-by-Step How to create & develop ideas for your challenge”, Amazon Asia-Pacific Holdings Private Limited, 2014.

**Reference Books:**

1. Roger Martin , “The Design of Business- Why design thinking is the next competitive advantage”, Harvard Business Review Press, 2009.

| U18AII6202 | PROTOTYPE DEVELOPMENT | L | T | P | J | C |
|---|---|---|---|---|---|---|
| | | 3 | 0 | 2 | 0 | 4 |

**Course Objectives:**

- Create quick UI/UX prototypes for customer needs
- Develop web application to test product traction / product feature
- Develop 3D models for prototyping various product ideas
- Tools and Techniques to create prototypes in a quick iterative methodology

**Course Outcomes:**

After successful completion of this course, the students should able to

| | |
|---|---|
| CO1: | Create quick UI/UX prototypes for customer needs |
| CO2: | Develop web application to test product traction / product feature |
| CO3: | Develop 3D models for prototyping various product ideas |
| CO4: | Tools and Techniques to create prototypes in a quick iterative methodology |

**Pre-requisite courses: Nil**

**CO/PO Mapping**

(S/M/W indicates the strength of correlation) S-Strong, M-Medium, W-Weak

| COs | Programme Outcomes (POs) | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 | PSO3 |
| CO1 | M | | | S | | | | | | | | W | | S | M |
| CO2 | M | S | S | S | | | | | | | | W | | S | M |
| CO3 | M | S | | S | | | | | W | | | W | | S | M |
| CO4 | M | | S | S | S | | | | W | | | W | | S | M |

**Course Assessment methods:**

**a) Direct**

a. Continuous Assessment Test I, II (Theory component)
b. Open Book Test; Cooperative Learning Report, Assignment; Journal Paper Review, Group Presentation, Project Report, Poster Preparation, Prototype or Product
c. Demonstration etc (as applicable) (Theory component)
d. End Semester Examination (Theory component)

**b) Indirect**

Course-end survey

**Topics covered:**

| | |
|---|---|
| **UI/UX** | **12 Hrs** |

Fundamental concepts in UI & UX - Tools - Fundamentals of design principles - Psychology and Human factors for User Interface Design - Layout and composition for Web, Mobile and Devices - Typography - Information architecture - Colour theory - Design process flow, wireframes, best practices in industry - User engagement ethics - Design alternatives

| | |
|---|---|
| **APP DEVELOPMENT** | **12 Hrs** |

SDLC - Introduction to App Development - Types of Apps - web Development - understanding Stack - Frontend - backend - Working with Databases - Introduction to API - Introduction to Cloud services - Cloud environment Setup- Reading and writing data to cloud - Embedding ML models to Apps - Deploying application.

| | |
|---|---|
| **INDUSTRIAL DESIGN** | **11 Hrs** |

Introduction to Industrial Design - Points, lines and planes - Sketching and concept generation - Sketch to CAD - Introduction to CAD tools - Types of 3D modeling - Basic 3D Modeling Tools - Part creation - Assembly - Product design and rendering basics - Dimensioning & Tolerancing

| | |
|---|---|
| **RAPID PROTOTYPING** | **10 Hrs** |

Need for prototyping - Domains in prototyping - Difference between actual manufacturing and prototyping - Rapid prototyping methods - Tools used in different domains - Mechanical Prototyping: 3D Printing and classification - Laser Cutting and engraving - RD Works - Additive manufacturing - Electronic Prototyping: Basics of electronic circuit design - lumped circuits - Electronic Prototyping - Working with simulation tool - simple PCB design with EDA

| | | |
|---|---|---|
| **Theory: 45 Hrs** | **Tutorial: 0** | **Total Hours: 45 Hrs** |

**Lab Component:**

1. Prepare SRS report
2. Prepare SAR report
3. Create sketches and diagrams for UseCase
4. Design a prototype for the UseCase
5. Building proof of concept
6. Create test cases

| | | |
|---|---|---|
| **Practical : 30 Hrs** | **Tutorial: 0** | **Total Hours: 30 Hrs** |

**Text Book:**

1. Peter Fiell, Charlotte Fiell , “Industrial Design A-Z”, TASCHEN America Llc, 2006.

**Reference Book:**

1. Steve Krug, “Don’t Make Me Think”, Revisited, Third edition, Pearson, 2015.

| U18AII6203 | INDUSTRIAL IoT | L | T | P | J | C |
|---|---|---|---|---|---|---|
| | | 3 | 0 | 2 | 0 | 4 |

**Course Objectives:**

- To teach basics purpose and the evolution and types of Autonomous Vehicles
- To enable students to understand the characteristics of technology involved in building Autonomous vehicles
- To make the students to analyze various automation levels

**Course Outcomes:**

After successful completion of this course, the students should able to

| | |
|---|---|
| CO1: | Identify appropriate AI techniques to solve industrial automation problems through sensors and actuators. |
| CO2: | Understand the Industrial IoT Architecture. |
| CO3: | Understand the idea of business transformation using connected cars. |
| CO4: | Demonstrate and explore the concepts behind Connected Motions. |

**Pre-requisite courses:** Nil

**CO/PO Mapping**
(S/M/W indicates the strength of correlation) S-Strong, M-Medium, W-Weak

| COs | Programme Outcomes (POs) | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 | PSO3 |
| CO1 | S | S | | M | | | | | | | | S | S | S | |
| CO2 | S | S | | M | | | | | | | | S | S | S | |
| CO3 | S | S | S | M | | | | | W | | | S | S | S | |
| CO4 | S | S | S | | | | | | | | | S | S | S | |

**Course Assessment methods:**

**a) Direct**

1. Continuous Assessment Test I, II (Theory component)
2. Open Book Test; Cooperative Learning Report, Assignment; Journal Paper Review, Group Presentation,Project Report, Poster Preparation, Prototype or Product
3. Demonstration etc (as applicable) (Theory component)
4. End Semester Examination (Theory component)

**b) Indirect**

1. Course-end survey

**Topics covered:**

| | |
|---|---|
| **INDUSTRY 4.0** | **10 Hrs** |

Automation- Principles and Strategies of Automation - Basic Elements- Levels of Automation- Smart Automation- introduction to Industry 4.0- Reason for Adopting Industry 4.0 - Definition -Main Concepts and Components of Industry 4.0-Technologies of Industry 4.0 - Big Data - Artificial Intelligence (AI) - Industrial Internet of Things - Cyber Security - Cloud -Augmented Reality-Robotics

| | |
|---|---|
| **INTRODUCTION TO INDUSTRIAL IoT** | **12 Hrs** |

Basics of Industrial IoT - IIoT Architecture Layers - Introduction to IIoT End Point Gateway, Fog Layer and iSMAC Layers - Difference between traditional SCADA/DCS architectures and IIoT architectures - Business Transformation Potential – Case Study: Connected Cars.

| | |
|---|---|
| **COMPONENTS OF IoT** | **10 Hrs** |

Control Units - Sensors - Basics of Sensors and actuators - Examples and working principles of sensors and actuators - Communication modules - Power Sources - Communication Technologies - RFID - Bluetooth - Zigbee - Wifi - Rflinks - Mobile Internet - Wired Communication - Locomotion - key issues for locomotion, leg configurations and stability, wheeled mobile robots, wheeled locomotion-the design space.

| | |
|---|---|
| **ROBOTICS AND VISION SYSTEMS** | **13 Hrs** |

Introduction - Transformations - Forward Kinematics - Inverse Kinematics - Design considerations: Motor sizing, selection of motors based on torque and speed characteristics - Hardware Interface & Assembly - Introduction to ROS framework and prerequisites - ROS Tools and Utilities - Simulation - ROS Motion - Image basics - Image Processing - Histograms - Smoothing and blurring/filtering - Thresholding - Gradients and Edge detection - Contours - Camera calibration - Integration of image processing tool with ROS - Applications.

| | | |
|---|---|---|
| **Theory: 45 Hrs** | **Tutorial: 0** | **Total : 45 Hrs** |

**Lab Experiments:**

1. Usage of Sensors and Actuators
2. Lane Detection
3. Gesture Controlled Robots
4. Smart Home Automation
5. Fruit Detection

| | | |
|---|---|---|
| **Practical : 30 Hrs** | **Tutorial: 0** | **Total : 30 Hrs** |

## Text Books:


1. Michael J. Hamill, "Industrial Communications and Control Protocols", PDH center, 2011.
2. Charalampos Doukas , "Building Internet of Things with the Arduino", Create space, 2012.
3. Qusay F.Hassan, Atta ur Rehman Khan and Sajjid A. Madani, "Internet of things - Challenges, Advances and Applications", CRC Press, 2018.


## Reference Books:


1. Jan Holler, Vlasios Tsiatsis, Catherine Mulligan, Stamatis Karnouskos, Stefan Avesand, David Boyle, "FromMachine-to-Machine to the Internet of Things", Academic Press, 2014.
2. Marco Schwartz, "Internet of Things with Arduino Cookbook", Packt Publishing, 2016.
3. James Anderson, Kalra Nidhi, Karlyn Stanly, "Autonomous Vehicle Technology: A Guide for Policymakers",Rand Co, 2014.
4. Lawrence. D. Burns, Christopher Shulgan, "Autonomy - The quest to build the driverless car and how it willreshape our world", Harper Collins Publishers, 2018.

# PROGRAMME ELECTIVES

| U18AIE0001 | NATURAL LANGUAGE PROCESSING | L | T | P | J | C |
|---|---|---|---|---|---|---|
| | | 3 | 0 | 0 | 0 | 3 |

**Course Objectives:**

· To teach basics of natural language processing

· To make students understand Convolutional Neural Net architecture

· To make students understand architectural designs of Recurrent Neural Networks

· To teach various advanced techniques Generative Adversarial Nets, Deep Generative models

**Pre-requisite courses:** U18AII4202 Neural Networks and Deep Learning

**Course Outcomes:**

After successful completion of this course, the students should able to

| | |
|---|---|
| CO1 : | Understand the basics of natural language processing using statistical approach |
| CO2 : | Understand to use neural networks in natural language processing |
| CO3 : | Apply appropriate deep learning models for text analytics |
| CO4 : | Understand advanced neural networks in language analytics |

**CO/PO Mapping**

(S/M/W indicates the strength of correlation) S-Strong, M-Medium, W-Weak

| COs | Programme Outcomes (POs) | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 | PSO3 |
| CO1 | S | S | | M | | | | | | | | S | S | | |
| CO2 | S | S | | M | | | | | | | | S | S | | |
| CO3 | S | S | S | M | | | | | W | | | S | S | S | |
| CO4 | S | S | S | | | | | | | | | S | S | S | |

**Course Assessment methods:**

**a) Direct**

1. Continuous Assessment Test I, II (Theory component)
2. Open Book Test; Cooperative Learning Report, Assignment; Journal Paper Review, Group Presentation,Project Report, Poster Preparation, Prototype or Product
3. Demonstration etc (as applicable) (Theory component)
4. End Semester Examination (Theory component)

**b) Indirect**

1. Course-end survey

## Topics covered:

| NATURAL LANGUAGE PROCESSING | 10 Hours |
|---|---|
| Natural Language Processing Basics: Syntax – Semantics – Introduction to Statistical NLP, Operations on a corpus, word vector, word embeddings, Glove, Probability and NLP, Vector Space models, Sequence learning, Machine translation, Preprocessing, Statistical properties of words- deep learning for NLP- Applications of deep learning to NLP. | |
| **CONVOLUTIONAL NEURAL NETWORKS** | **12 Hours** |
| Classification tasks in NLP-Window-based Approach for language modelling -Window-based Approach for NER, POS tagging, and Chunking- Convolutional Neural Net for NLP- Max-margin Training- Scaling Softmax - Adaptive input and output. | |
| **RECURRENT NEURAL NETWORK ARCHITECTURES** | **10 Hours** |
| Basic RNN structures- Language modeling with RNNs- Backpropagation through time- Text generation with RNN LM- Issues with Vanilla RNNs- Exploding gradient- Gated Recurrent Units (GRUs) and LSTMs- Bidirectional RNNs- Multi-layer RNNs- Sequence labeling with RNNs- Sequence classification with RNNs- Attention, Variants | |
| **GANS, ADVERSARIAL NLP AND DEEP GENERATIVE MODELS** | **13 Hours** |
| Generative adversarial nets (GANs)- Domain adversarial nets (DANs)- Adversarial attacks in NLP- Defense: Training with adversarial examples- Consistency regularization- Cross-view consistency, Variational inference, Autoencoders, Variational autoencoders, Conditional VAEs, Vector Quantized VAEs, Variational Generative adversarial nets- Multi-task Learning for NLP | |
| **Theory: 45 Hrs** | **Tutorial: 0** | **Practical: 0 Hrs** | **Total: 15 Hrs** |

## Text Books:


1. Ian Goodfellow, Yoshua Bengio, and Aaron Courville, “Deep Learning”, First Edition, MIT Press, 2016.
2. Sunil Patel, “Deep Learning for Natural Language Processing”, BPB Publications, 2021.


## Reference Books:


1. Goldberg Yoav, “Neural Network Methods in Natural Language Processing”, Morgan and Claypool publishers.
2. Karthiek Reddy Bokka; Shubhangi Hora; Tanuj Jain; Monicah Wambugu, " Deep Learning for Natural Language Processing", Packt Publishing.

| U18AIE0002 | INTRODUCTION TO SPATIAL COMPUTING | L | T | P | J | C |
|---|---|---|---|---|---|---|
| | | 3 | 0 | 0 | 0 | 3 |

**Course Objectives:**

- To distinguish traditional relational data and spatial data.
- To understand spatial design issues and data models.
- To make use of technologies to build applications combined with geographical data.
- To understand spatial information services and XR.

**Pre-requisite courses:** U18AII4202 Neural Networks and Deep Learning

**Course Outcomes:**

After successful completion of this course, the students should able to

| | |
|---|---|
| CO1 : | Understand the foundations of spatial data and its storage. |
| CO2 : | Identify the spatial design issues and data models for real world problems |
| CO3 : | Use advanced technologies to build applications combined with geographical data |
| CO4 : | Extend knowledge on spatial information services and XR |

**CO/PO Mapping**

(S/M/W indicates the strength of correlation) S-Strong, M-Medium, W-Weak

| COs | Programme Outcome (POs) | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 | PSO3 |
| CO1 | S | S | | | | | | | | | | M | | | |
| CO2 | S | S | | M | | | | | | | | M | | S | |
| CO3 | S | S | S | S | M | | | | | | | M | S | S | |
| CO4 | S | S | S | S | S | | | | | | | M | S | | |

**Course Assessment methods:**

**c) Direct**

1. Continuous Assessment Test I, II (Theory component)
2. Open Book Test; Cooperative Learning Report, Assignment; Journal Paper Review, Group Presentation,Project Report, Poster Preparation, Prototype or Product
3. Demonstration etc (as applicable) (Theory component)
4. End Semester Examination (Theory component)

**d) Indirect**

1. Course-end survey

## Topics covered:

| **Introduction** | **10 hours** |
|---|---|
| Geo-spatial science, systems and services, spatial concepts and data models: field vs object based, spatial query languages. Fundamental spatial algorithms: space filling curves, voronoi diagrams. Spatial storage and indexing: Grid files, Quadtrees and R-trees, query processing, join strategies, and optimization. | |
| **Spatial modeling** | **12 Hours** |
| Conceptual, logical and physical level design issues, spatial data models, Sequenced semantics, Spatial databases, Query processing in spatial network databases, spatial data mining: classification, association and clustering. | |
| **Spatial statistics** | **13 Hours** |
| Hot-spot and distributions using Arc. Conceptualization of spatial relationships: spatial autocorrelation by distance, autocorrelation, nearest neighbor, hot-spot analysis. Exploratory regression, OLS, Geographically weighted regression, Spatial computing systems: Geographic Information Systems: Open Source GRASS GIS, ESRI ArcGIS family | |
| **Application services and XR** | **10 Hours** |
| Virtual globes, location-based services, enterprise consulting. Application programming interfaces: HTML5 - Geolocation API, Google Maps API, Bing Maps API, Flickr location API, Twitter location API, Extending reality with spatial computing- audio visual technology, interaction technology, virtual prototypes. | |
| **Theory: 45 Hrs** **Tutorial: 0** | **Practical: 0 Hrs** **Total: 15 Hrs** |

**Text Books:**


1. Paul Longley and Michael Batty, “Spatial Analysis: Modeling in a GIS Environment”, Wiley, 1994
2. Shashi Shekhar and Sanjay Chawla, “Spatial Databases: A Tour”, Pearson, 2002


**Reference Books:**


1. Shaowen Wang, Michael F. Goodchild, “Cyber GIS for Geospatial Discovery and Innovation”, Springer, 2019.
2. Shashi Shekhar, Pamela Vold, “Spatial Computing”, The MIT press, 2020

| U18AIE0003 | COMPUTER VISION TECHNIQUES | L | T | P | J | C |
|---|---|---|---|---|---|---|
| | | 3 | 0 | 0 | 0 | 3 |

**Course Objectives:**

· To teach basics concepts of computer vision

· To provides a pathway for students to gain the knowledge and skills to apply machine learning to students work

· To teach the capabilities, challenges, and consequences of deep learning

**Pre-requisite courses:** Nil

**Course Outcomes:**

After successful completion of this course, the students should able to

| | |
|---|---|
| CO1 : | Understand how computer vision has evolved and become familiar with its exciting applications |
| CO2 : | Build a convolutional neural network, including recent variations such as residual networks |
| CO3 : | Apply convolutional networks to visual detection and recognition tasks and use neural style transfer to generate art |
| CO4 : | Apply these techniques to a variety of image, video, and other 2D or 3D data |

**CO/PO Mapping**

(S/M/W indicates the strength of correlation) S-Strong, M-Medium, W-Weak

| COs | Programme Outcomes (POs) | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 | PSO3 |
| CO1 | S | S | | M | | | | | | | | S | S | | |
| CO2 | S | S | | M | | | | | | | | S | S | | |
| CO3 | S | S | S | M | | | | | W | M | | S | S | S | |
| CO4 | S | S | S | | | | | | | | M | S | S | S | |

**Course Assessment methods:**

**a) Direct**

1. Continuous Assessment Test I, II (Theory component)
2. Open Book Test; Cooperative Learning Report, Assignment; Journal Paper Review, Group Presentation, Project Report, Poster Preparation, Prototype or Product
3. Demonstration etc (as applicable) (Theory component)
4. End Semester Examination (Theory component)

**b) Indirect**

1. Course-end survey

| INTRODUCTION AND OVERVIEW | 10 Hours |
|---|---|
| Introduction to Image Formation- Capture and Representation- Linear Filtering- Correlation Edge- Blobs- CornerDetection- Scale Space and Scale Selection | |
| **FOUNDATIONS OF CONVOLUTIONAL NEURAL NETWORKS** | **12 Hours** |
| Computer Vision- Edge Detection- Padding- Strided Convolutions- Convolutions Over Volume- One Layer of aConvolutional Network- Simple Convolutional Network- Pooling Layers | |
| **OBJECT DETECTION** | **10 Hours** |
| Object Localization- Landmark Detection- Object Detection- Convolutional Implementation of Sliding Windows- Bounding Box Predictions- Intersection Over Union- Non-max Suppression- Anchor Boxes- YOLOAlgorithm- Semantic Segmentation with U-Net- U-Net Architecture Intuition | |
| **SPECIAL APPLICATIONS: FACE RECOGNITION & NEURAL STYLE TRANSFER** | **13 Hours** |
| Face Recognition- One Shot Learning- Siamese Network- Triplet Loss- Face Verification and Binary Classification- Neural Style Transformation- Cost Function- Content Cost Function- Style Cost Function- 1D and 3D Generalizations | |
| **Theory: 45 Hrs** **Tutorial: 0** **Practical: 0 Hrs** | **Total: 45 Hrs** |

**Text Books:**


1. Vaibhav Verdhan, "Computer Vision Using Deep Learning: Neural Network Architectures with Python, Keras, and TensorFlow: Neural Network Architectures with Python and Keras", Apress; 1st ed. edition, 2021.
2. Salman Khan, Hossein Rahmani, Syed Afaq Ali Shah, Mohammed Bennamoun, “A Guide to Convolutional Neural Networks for Computer Vision”, Morgan & Claypool Publishers, 2018.


**Reference Books:**


1. Benjamin Planche, Eliot Andres, "Hands-On Computer Vision with TensorFlow 2: Leverage deep learning to create powerful image processing apps with TensorFlow 2.0 and Keras", Packt Publishing Limited, 2019.
2. Rajalingappaa Shanmugamani, "Deep Learning for Computer Vision: Expert techniques to train advanced neural networks using TensorFlow and Keras", Packt Publishing Limited, 2018.

| U18AIE0004 | RECOMMENDATION SYSTEM FOR e-COMMERCE | L | T | P | J | C |
|---|---|---|---|---|---|---|
| | | 3 | 0 | 0 | 0 | 3 |

**Course Objectives:**

- To understand the basic concepts of recommender systems.
- To categorize the types of recommender systems.
- To evaluate the recommender systems based on various metrics.
- To inspect advanced e-commerce applications of recommender systems.

**Pre-requisite courses:** U18AII2205 Introduction to AI & ML

**Course Outcomes:**

After successful completion of this course, the students should able to

| | |
|---|---|
| CO1 : | Understand the basic concepts of recommender systems |
| CO2 : | Categorize types of recommender systems |
| CO3 : | Evaluate recommender systems based on various metrics |
| CO4 : | Analyze advanced e-commerce applications of recommender systems |

**CO/PO Mapping**

(S/M/W indicates the strength of correlation) S-Strong, M-Medium, W-Weak

| COs | Programme Outcomes (POs) | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 | PSO3 |
| CO1 | S | M | | | | | | | | | | M | S | | M |
| CO2 | M | S | S | M | | | | | | | | M | S | | |
| CO3 | M | S | S | M | | | | | | | | M | S | M | |
| CO4 | M | S | S | S | | | | | | | | M | S | M | |

**Course Assessment methods:**

**a) Direct**

1. Continuous Assessment Test I, II (Theory component)
2. Open Book Test; Cooperative Learning Report, Assignment; Journal Paper Review, Group Presentation, Project Report, Poster Preparation, Prototype or Product
3. Demonstration etc (as applicable) (Theory component)
4. End Semester Examination (Theory component)

**b) Indirect**

1. Course-end survey

**Topics covered:**

| INTRODUCTION | 8 Hours |
|---|---|
| Introduction: Evolution and Basic taxonomy of recommender systems, Recommender system functions, Recommendation Techniques, Recommender Systems and Human Computer Interaction, Applications of recommendation systems, merits and demerits of recommendation systems in e-commerce | |
| **CONTENT-BASED RECOMMENDATION** | **13 Hours** |
| High level architecture of content-based systems, Advantages and drawbacks of content-based filtering, Item representation, methods for learning user profiles. Knowledge based recommendation: Knowledge representation and reasoning, Constraint based recommenders, Case based recommenders. | |
| **COLLABORATIVE FILTERING AND MODEL EVALUATION** | **14 Hours** |
| User-based nearest neighbor recommendation, Item-based nearest neighbor recommendation, Model based and pre-processing-based approaches, Matrix factorization models, Neighborhood models. Evaluating Recommender System: Introduction, General properties of evaluation research, Evaluation designs, Evaluation on historical datasets, Error metrics, Decision-Support metrics, User-Centered metrics. | |
| **RECOMMENDER SYSTEMS AND COMMUNITIES** | **10 Hours** |
| Communities, collaboration and recommender systems in personalized web search, social tagging recommender systems, Trust and recommendations, Group recommender systems, Context-Aware Recommender Systems, Hybrid approaches, Active learning in recommender systems.Case study - amazon, Netflix, YouTube | |
| **Theory: 15 Hrs** **Tutorial: 0** **Practical: 0 Hrs** **Total:15 Hrs** | |

**Text Books:**


1. Francesco Ricci, Lior Rokach, Bracha Shapira, Paul B. Kantor, Recommender Systems Handbook, Springer
2. C.C. Aggarwal, Recommender Systems: The Textbook, Springer, 2016.


**Reference Books:**


1. Jannach D., Zanker M. and FelFering A., Recommender Systems: An Introduction, Cambridge University Press.
2. Manouselis N., Drachsler H., Verbert K., Duval E., Recommender Systems For Learning, Springer.

| U18AIE5005 | MINING BIGDATA | L | T | P | J | C |
|---|---|---|---|---|---|---|
| | | 3 | 0 | 0 | 0 | 3 |

**Course Objective**

- To develop skills to both design and critique visualizations
- To make students understand and work on Hadoop Framework and Eco systems
- To teach basic concept of mining data streams
- To teach fundamentals of Link Analysis & Mining Social Network Graphs

**Pre-requisites:** U18AII4203 Data Mining and Modeling

| **Course Outcomes:** | |
|---|---|
| After successful completion of this course, the students should able to | |
| CO1 : | Choose tools to carry out exploratory data analysis and produce effective visualization of given data. |
| CO2 : | Perform parallel data processing and duplication with Hadoop and Map-Reduce. |
| CO3 : | Identify suitable data model and algorithms for mining mass data set. |
| CO4 : | Apply link analysis & mining social network graphs in real time problem |

**CO/PO Mapping**

(S/M/W indicates the strength of correlation) S-Strong, M-Medium, W-Weak

| COs | Programme Outcomes (POs) | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO 2 | PSO 3 |
| CO1 | S | | | | | | | | M | | | M | S | | |
| CO2 | S | S | | M | | | | | | | S | S | S | | |
| CO3 | S | S | S | M | S | | M | | M | | S | S | S | S | S |
| CO4 | S | S | S | | S | | | | | | S | S | S | S | S |

**Course Assessment methods:**

**a) Direct**

1. Continuous Assessment Test I, II
2. Open Book Test; Cooperative Learning Report, Assignment; Journal Paper Review, Group Presentation, Project Report, Poster Preparation, Prototype or Product Demonstration etc (as applicable)Pre/Post -
3. End Semester Examination

**b) Indirect**

1. Course-end survey

**Topics covered:**

| INTRODUCTION TO EDA | 10 Hours |
|---|---|

Mathematics foundations, Statistical inference – Statistical modeling, Probability distributions, Fitting a model, Exploratory Data Analysis(EDA) and data visualization - Basic tools (Plots, Graphs and Summary statistics) of EDA, Data science process, Data visualization – Basic principles, ideas and tools for visualization, Analytic processes and tools - Analysis Vs Reporting

| BIG DATA | 12 Hours |
|---|---|

Big data platform – Challenges of conventional systems - Intelligent data analysis - Transition to big data databases- Map reduce - Map Tasks- Grouping by Key - Reduce Tasks- Combiners

| MINING DATA STREAMS | 10 Hours |
|---|---|

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 window – Decaying window – Real-time analytics platform (RTAP) applications.

| LINK ANALYSIS & MINING SOCIAL NETWORK GRAPHS | 13 Hours |
|---|---|

PageRank- Representing Transition Matrices- PageRank Iteration Using MapReduce- Use of Combiners to Consolidate the Result Vector - Topic-Sensitive PageRank- Biased Random Walk- Inferring Topics from Words - Link Spam - Architecture of a Spam Farm - Analysis of a Spam Farm - Combating Link Spam - TrustRank - Spam Mass

| Theory : 45 Hrs | Tutorial : 0 | Total Hours: 45 Hrs |
|---|---|---|

**Textbooks:**


1. Jure Leskovec, Anand Rajaraman, and Jeffrey David Ullman, "Mining of Massive Datasets", 2nd edition, Cambridge University Press, 2014
2. Scott E, "The Model Thinker- What You Need to Know to Make Data Work for You" First Edition New York: Basic Books, 2018


**Reference Books:**


1. Cathy O'Neil and Rachel Schutt, “Doing Data Science, Straight Talk From The Frontlin”, O'Reilly. 2014.
2. Foster Provost and Tom Fawcett, “Data Science for Business: What You Need to Know about Data Mining and Data-analytic Thinking”, ISBN 1449361323, 2013.
3. Kevin P. Murphy,” Machine Learning: A Probabilistic Perspective”, ISBN 0262018020, EMC Education Services, Wiley, 2015

| U18AIE0006 | NEURAL COMPUTATION | L | T | P | J | C |
|---|---|---|---|---|---|---|
| | | 3 | 0 | 0 | 0 | 3 |

**Course Objectives:**

· To enable students to formalize biological facts into mathematical models.
· To provide an introduction to theories of neural computation.
· To enable students to investigate computations by neurons.
· To make students familiar with neural network models.

**Course Outcomes:**

After successful completion of this course, the students should able to

| | |
|---|---|
| CO 1: | Understand the basics of neurology and computational neuroscience. |
| CO 2: | Apply information theory and coding principles to model neurons. |
| CO 3: | Analyze the working of neurons in various neural network architectures. |
| CO 4: | Compare and contrast the working of neurons through different types of learning. |

**Pre-requisite courses: U18AII4202 Neural Network and Deep Learning**

**CO/PO Mapping**
(S/M/W indicates the strength of correlation) S-Strong, M-Medium, W-Weak

| COs | Programme Outcomes (POs) | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 | PSO3 |
| CO1 | S | M | M | | | | | | | | | S | S | | |
| CO2 | S | M | M | | | | | | | | | S | S | S | S |
| CO3 | S | S | M | M | | | | | | | | S | S | | |
| CO4 | S | S | M | M | | | | | | | | S | S | | |

**Course Assessment methods:**

**a) Direct**

1. Continuous Assessment Test I, II (Theory component)
2. Open Book Test; Cooperative Learning Report, Assignment; Journal Paper Review, Group Presentation,Project Report, Poster Preparation, Prototype or Product
3. Demonstration etc (as applicable) (Theory component)
4. End Semester Examination (Theory component)

**b) Indirect**

1. Course-end survey

**Topics covered:**

| INTRODUCTION & BASIC NEUROLOGY | 8 Hours |
|---|---|

Overview – Neurons and Membranes – Spikes and Cables – Synapses and Dendrites – Synaptic Plasticity –Computational Neuroscience – Descriptive and Interpretive Models - Hebbian Learning – Neural Code – Neural Encoding & Decoding.

| INFORMATION THEORY & NEURAL CODING | 13 Hours |
|---|---|

Information and Entropy – Calculating Information in Spike Trains – Coding Principles - Computation and Logical Units – Biological Visual Systems – Sparse Coding and Predictive Coding – Dynamical Systems Theory: Fixed Points, Nullclines – Computational Maps – Markov Network – Neural Correlations and Synchrony

| NEURAL NETWORK MODELS | 13 Hours |
|---|---|

Attractor Network and Memory - Deep Belief Net – Causal Inference – Neural Network: Perceptron - Deep Network and Brain – Convolutional Neural Networks – Recurrent Neural Networks.

| LEARNING FROM SUPERVISION AND REWARDS | 11 Hours |
|---|---|

Biological Plausible Learning – Hierarchical Inference - Attention and Self-Attention – Prediction – Probabilistic Inference – Inference Mechanisms – Reinforcement Learning – Curiosity and Imagination – Emotion and Consciousness.

| Theory : 45 Hrs | Tutorial : 0 | Total Hours: 45 Hrs |
|---|---|---|

**Textbooks:**


1. Trappenberg T.P. (TTP), "Fundamentals of computational neuroscience", 2nd edition, OxfordUniversity Press 2009.
2. Dayan, P and Abbott, L (DP), "Theoretical Neuroscience", MIT Press. 2001.
3. Sterling, P. and Laughlin, S., "Principles of Neural Design", MIT Press, 2015.
4. W. Gerstner, W.M. Kistler, R. Naud and L. Paninski, "Neuronal Dynamics - from single neurons tonetworks and models of cognition", Cambridge Univ. Press. 2014


**Reference Books:**


1. Michael. A. Arbib, "The Handbook of Brain Theory and Neural Network", MIT Press, 1995.
2. Hertz J, Krogh A, Palmer RG (HKP), "Introduction to the theory of neural computation",Addison Wesley 1991.
3. Gordon M. Shepherd M.D., "The Synaptic Organization of the Brain", 5th Edition, OxfordUniversity Press, 2004

| U18AIE0007 | HUMAN-CENTERED SYSTEMS | L | T | P | J | C |
|---|---|---|---|---|---|---|
| | | 3 | 0 | 0 | 0 | 3 |

**Course Objectives:**

- To teach basics concepts of human centered systems
- To provides a pathway for students to gain the knowledge and skills to apply human centered systems in students work
- To teach the capabilities, challenges, and consequences of human centered systems

**Course Outcomes:**

After successful completion of this course, the students should able to

| | |
|---|---|
| CO 1: | Understand basic concepts in Human Centered Systems |
| CO 2: | Build user centered system to solve real time problems |
| CO 3: | Demonstrate a broad knowledge of contemporary issues and challenges in HCS |
| CO 4: | Design user interfaces and experiences grounded in known principles of usability and HCS |

**Pre-requisite courses:** Nil

**CO/PO Mapping**
(S/M/W indicates the strength of correlation) S-Strong, M-Medium, W-Weak

| COs | Programme Outcomes (POs) | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 | PSO3 |
| CO1 | S | S | | M | | | | | | | M | S | S | | M |
| CO2 | S | S | | M | | | | | | | | S | S | S | |
| CO3 | S | S | S | M | | | | M | | M | | S | S | | |
| CO4 | S | S | S | | | | | M | | | | S | S | S | |

**Course Assessment methods:**

**a) Direct**

a. Continuous Assessment Test I, II (Theory component)
b. Open Book Test; Cooperative Learning Report, Assignment; Journal Paper Review, Group Presentation, Project Report, Poster Preparation, Prototype or Product
c. Demonstration etc (as applicable) (Theory component)
d. End Semester Examination (Theory component)

**b) Indirect**

a. Course-end survey

**Topics covered:**

| **INTRODUCTION TO HUMAN-CENTERED SYSTEMS** | **13 Hours** |
|---|---|

Introduction- logistics- overview- matrix operations- probability- Different flavors of mathematical models- importance and evolution of Human centered system- software quality and usability- software design and interactiondesign

| **MODELS IN HUMAN-CENTERED DESIGN** | **10 Hours** |
|---|---|

Mentals models- conceptual model and system image- gulf of execution and gulf of evaluation- metaphors- principles- guidelines and rules

| **UCD** | **10 Hours** |
|---|---|

Basic elements of User Center Design- models for interaction design- steps for UCD- user and need identification- requirements specifications

| **PROTOTYPING** | **13 Hours** |
|---|---|

Characteristics of a prototype- Lo-fi and Hi-fi prototypes- prototyping techniques- prototyping tools- evaluation paradigms and techniques- user observation- interviews and surveys- user modeling- experience designing- affective computing- perceptual systems and ambience intelligence

| **Theory : 45 Hrs** | **Tutorial : 0** | **Total Hours: 45 Hrs** |
|---|---|---|

**Textbooks:**


1. Ideo, "Human Centered Design Toolkit", Authorhouse publisher, 2nd edition, 2011
2. Guy Boy, "Orchestrating Human-Centered Design", Springer, 2012


**Reference Books:**


1. Ideo, "The Field Guide to Human-Centered Design", IDEO.ORG, 2015.
2. Ethan Beute, "Human-Centered Communication: A Business Case Against Digital Pollution", FastCompany Press, 2021.

| U18AIE0008 | SPEECH PROCESSING | L | T | P | J | C |
|---|---|---|---|---|---|---|
| | | 3 | 0 | 0 | 0 | 3 |

**Course Objectives:**

· To teach basics of speech processing and dialog systems

· To make students understand the language modeling

· To make students understand the concepts of Automated Speech Recognition and Speech Conversion

· To make students extract social meaning in the context provided.

**Pre-requisite courses:** U18AII4202 Neural Networks and Deep Learning

**Course Outcomes:**

After successful completion of this course, the students should able to

| | |
|---|---|
| CO1 : | Understand speech production and perception process |
| CO2 : | Categorize and analyze speech signals in time and frequency domain. |
| CO3 : | Interpret the idea for building neural chatbots and personal voice assistants. |
| CO4 : | Explain the process of speech conversions and voice conversions. |

**CO/PO Mapping**

(S/M/W indicates the strength of correlation) S-Strong, M-Medium, W-Weak

| COs | Programme Outcomes (POs) | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 | PSO3 |
| CO1 | S | S | M | M | M | | | | | | | S | S | | |
| CO2 | S | S | | S | W | | | | | | | S | S | | |
| CO3 | S | S | S | S | M | | | | | | | S | S | | |
| CO4 | S | S | S | | M | | | | | | | S | S | | |

**Course Assessment methods:**

**a) Direct**

1. Continuous Assessment Test I, II (Theory component)
2. Open Book Test; Cooperative Learning Report, Assignment; Journal Paper Review, Group Presentation, Project Report, Poster Preparation, Prototype or Product
3. Demonstration etc (as applicable) (Theory component)
4. End Semester Examination (Theory component)

**b) Indirect**

1. Course-end survey

**Topics covered:**

| INTRODUCTION & DIALOG SYSTEMS | 12 Hours |
|---|---|

Acoustics and its types – Phonetics – Audio File Analysis – Digitization and Recording of Speech – Human-Speech Production - Task-oriented Dialogs – Dialog System Design – GUS & Frame based Dialog System – Neural Chatbots – Encoder-Decoder Model – End-to-End Neural Approach.Case Study: GoButler, Alexa Skills Kit

| AUTOMATED SPEECH RECOGNITION | 10 Hours |
|---|---|

Audio Signals & its Types – Signal Sampling and Theorem – Acoustic Modeling – Language Modeling – Building a Natural Language Model – Hidden Markov Model in ASR – HMM-DNN Systems – Spectrum Analysis - Case Study: Speech-Brain ASR Toolkit

| SPEECH-TO-TEXT & TEXT-TO-SPEECH | 13 Hours |
|---|---|

Speech-to-Text: Modeling – Data Exploration and Data Visualization – Transcription Model using Deep Speech ,Text-to-Speech: Text Analysis and its methods – Stemming and Lemmatization – Stop Words – Phonetic Analysis – Prosodic Analysis – Waveform Synthesis – Wave Analysis of Heart Beat Sound – Voice Builder - Case Study: Voice Building using Text Personal Voice Assistant.

| MULTILINGUAL SPEECH PROCESSING & VOICE CONVERSION | 10 Hours |
|---|---|

Multilingual Speech Processing: Understanding Multilingual – Issues in Multilingual – Encoding Characters – Multilingual Speech Models. Voice Conversion: Introduction – Phonetic SID Systems – Speaker Identification & De-Identification Case Study: Social Meaning Extraction: Interpersonal stance. Flirtation. Intoxication.

| Theory : 45 Hrs | Tutorial : 0 | Total Hours: 45 Hrs |
|---|---|---|

**Textbooks:**


1. Ian Goodfellow, Yoshua Bengio, and Aaron Courville, “Deep Learning”, First Edition, MIT Press, 2016.
2. Sunil Patel, “Deep Learning for Natural Language Processing”, BPB Publications, 2021.


**Reference Books:**


1. Goldberg Yoav, “Neural Network Methods in Natural Language Processing”, Morgan and Claypool publishers.
2. Karthiek Reddy Bokka; Shubhangi Hora; Tanuj Jain; Monicah Wambugu, " Deep Learning for NaturalLanguage Processing", Packt Publishing

| U18AIE0009 | STARTUP FUNDAMENTALS | L | T | P | J | C |
|---|---|---|---|---|---|---|
| | | 3 | 0 | 0 | 0 | 3 |

**Course Objectives:**

- To develop an entrepreneurial mindset that will help them identify, assess, shape & act on opportunities in a variety of contexts & organization.
- To demonstrate the potential of an innovative idea to create economic value, as a startup.
- To understand the scientific process to explore a viable business model to build a scale business.
- To acquire knowledge on the fundamental concepts of Intellectual Property to Draft the Patent for a product.

**Course Outcomes:**

After successful completion of this course, the students should able to

| | |
|---|---|
| CO1: | Identify, assess, shape & act on opportunities in a variety of contexts & organization. |
| CO2: | Demonstrate the potential of an innovative idea to create economic value, as a startup. |
| CO3: | Understand the scientific process to explore a viable business model to build a scale business. |
| CO4: | Acquire knowledge on the fundamental concepts of Intellectual Property to Draft the Patent for a product. |

**Pre-requisite courses: Nil**

**CO/PO Mapping**

(S/M/W indicates the strength of correlation) S-Strong, M-Medium, W-Weak

| COs | Programme Outcome (POs) | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | PO 1 | PO 2 | PO 3 | PO 4 | PO5 | PO6 | PO7 | PO8 | PO 9 | PO10 | PO11 | PO1 2 | PSO 1 | PSO 2 | PSO3 |
| CO 1 | M | | | S | | | | | | | | W | | S | S |
| CO 2 | | S | S | S | | | | | | | | W | | S | S |
| CO 3 | S | S | | S | | | | | W | | | W | | S | S |
| CO 4 | | | S | S | | | | | W | | | W | | S | S |

**Course Assessment methods:**

**a) Direct**

1. Continuous Assessment Test I, II (Theory component)
2. Open Book Test; Cooperative Learning Report, Assignment; Journal Paper Review, Group Presentation,Project Report, Poster Preparation, Prototype or Product
3. Demonstration etc (as applicable) (Theory component)
4. End Semester Examination (Theory component)

**b) Indirect**

1. Course-end survey

**Topics covered:**

| | |
|---|---|
| **ENTREPRENEURIAL MINDSET & METHOD** | **11 Hours** |
| Introduction to Innovation-led, tech-powered entrepreneurship - Understand from research the attributes of an expert entrepreneur - Effectuation principles - Dealing with the unknowns - Case studies of startup failures. | |
| **IDEA TO ENTERPRISE** | **12 Hours** |
| Design and Planning of Product Concept - Business Model - Business Planning - Building Proof of Product and Value Testing - Target Market and Revenue Planning | |
| **MINIMUM VIABLE BUSINESS** | **12 Hours** |
| Framework for Minimum Viable Business - Disruptive Innovation - Theory of Disruption - Competitive advantage - Building proof of viable business model - Demystifying Scalability - Pitch Clinic | |
| **IPR AND PATENT DRAFTING** | **10 Hours** |
| Intellectual Property 101- Introduction and the need for Intellectual Property Rights, Prior Art Search & Case studies of IPR. Fundamentals of Patent Drafting - Invention as a concept - Keywords formation - Structure of patent - Key attributes in patent drafting - Drafting provisional specifications - Drafting complete specifications - Draft claims - Case studies on patent drafting | |

| | | |
|---|---|---|
| **Theory: 30 Hrs** | **Tutorial: 0** | **Total Hours: 30 Hrs** |

**Text Books:**


1. Steven Blank and Bob Dorf, “The Startup Owner’s Manual: The Step-by-Step Guide for Building a Great Company”, K&S Ranch, 2012.


**Reference Books:**


1. Dr.Saras Sarasvathy, “Effectuation: Elements of Entrepreneurial Expertise”, New Horizons in Entrepreneurship series, 2008.
2. WIPO Intellectual Property Handbook - https://www.wipo.int/edocs/pubdocs/en/intproperty/489/wipo_pub_489.pdf

# Extended Reality

| U18CSE0314 | 3D MODELING AND GAME DESIGN | L | T | P | J | C |
|---|---|---|---|---|---|---|
| | | 2 | 0 | 0 | 2 | 3 |

**Course Outcomes:**

After successful completion of this course, the students should able to

| | |
|---|---|
| CO1: | Understand the foundational knowledge of 3D modeling and apply on a real time scenario in creating object and environment[K3]. |
| CO2: | Design and analyse the usage of Game objects and Assets using Physics and Lights[K4]. |
| CO3: | Apply Navigations, Particle systems and audio develop simple games[K3]. |

**Pre-requisite courses:** U18AII2204 Object Oriented Programming and Data Structures
**l**

| CO/PO Mapping (S/M/W indicates the strength of correlation) S-Strong, M-Medium, W-Weak | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| COs | Programme Outcome (POs) | | | | | | | | | | | | | | |
| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 | PSO3 |
| CO1 | S | | S | | S | | | | | | | M | | | |
| CO2 | M | S | S | | | | M | M | | | | | | S | M |
| CO3 | | | M | S | | S | | M | S | S | W | | | S | S |

**Course Assessment methods:**

**c) Direct**

1. Continuous Assessment Test I, II (Theory component)
2. Open Book Test; Cooperative Learning Report, Assignment; Journal Paper Review, Group Presentation,Project Report, Poster Preparation, Prototype or Product
3. Demonstration etc (as applicable) (Theory component)
4. End Semester Examination (Theory component)

**d) Indirect**

1. Course-end survey

**Topics covered:**

| **BUILDING BLOCKS** | **6 Hours** |
|---|---|

3D space- 3D objects- viewports and cPlane basics- selecting objects- solid object creation- outputting images- Boolean modeling and figured space- object snaps and transforms- Boolean modeling- Clipping plane.

| **OBJECT AND SURFACE MODELING** | **6 Hours** |
|---|---|

Profile modeling – surface- cPlane- revolve- object modeling- project and pull- curves from objects- trimming surfaces- surface modeling – lofting- surface filleting and blending- surface from edge curves- patch surfaces.

| **GAME OBJECTS AND ASSETS** | **6 Hours** |
|---|---|

Native Game Objects -Manipulating Game Objects - Components in the Game engine – Fundamentals working concept - Materials- Defining the Role of the Prefab - Textures: UV Mapping and Texturing Techniques - Discovering the Standard Shader.

| **IMPLEMENTATION OF ASSETS WITH PHYSICS AND LIGHTING** | **6 Hours** |
|---|---|

Creating Hierarchies - Using Empty Game Objects as Pivots -Understanding the Physics System – Rigid body Components - Colliders - Scripting Collision Events - Lighting in Games- Analyzing the Different Lights and Properties.

| **NAVIGATION AND ANIMATIONS** | **6 Hours** |
|---|---|

Animation in Game Development - Creating Animation in the Editor-Refining Animation- NavMesh - NavMesh Agent - NavMesh Obstacle-Creating the Player Controller Game Object- Particles in Video Games-Analyzing Existing Particle Effects-Audio in Game Development - Audio Effects.

**PROJECT:**

Projects involving 3D modeling using Blender and design simple games with effective audio, light, animation, and appropriate understanding of physics in Real time environment.

| **Theory: 30 Hrs** | **Tutorial: 0** | **Project: 30** | **Total : 60 Hrs** |
|---|---|---|---|

**REFERENCES**


1. "The Ultimate Guide to Game Development with Unity" by Unity Technologies,2023.
2. The Art of Game Design: A Book Of Lenses, THIRD EDITION, Jesse Schell, CRC Press; 3rd edition , 2019.
3. Paris Buttfield-Addison, Jon Manning, Tim Nugent, “Unity Game Development Cookbook”, O'Reilly Media, Inc. 2019.
4. 3D Modeling for Beginners: Learn Everything You Need to Know About 3d Modeling!, Danan Thilakanathan,2016.


**ONLINE LEARNING MATERIALS**

1. https://www.coursera.org/learn/introduction-to-3d-modeling
2. https://www.coursera.org/specializations/game-design-and-development
3. https://www.coursera.org/learn/game-design
4. Control physics with C# in Unity (coursera.org)
5. Create basic behavior with C# in Unity (coursera.org)
6. The Complete Guide to 3D Modeling with Blender | Udemy

| U18CSE0315 | AUGMENTED REALITY AND VIRTUAL REALITY APPLICATION DEVELOPMENT | L | T | P | J | C |
|---|---|---|---|---|---|---|
| | | 3 | 0 | 0 | 0 | 3 |

**Course Outcomes:**

After successful completion of this course, the students should able to

CO1: Attain a foundational understanding and difference of Augmented and Virtual reality technologies[K3].

CO2: Develop skills in placing assets, managing scale, addressing occlusion, and implementing realistic lighting in AR and VR projects. [K6]

CO3: Apply AR and VR in practical scenarios and conducting AR/VR based visualization case studies for product development. [K3]

**Pre-requisite courses:** U18AII2204 Object Oriented Programming and Data Structures

**CO/PO Mapping**

(S/M/W indicates the strength of correlation) S-Strong, M-Medium, W-Weak

| COs | Programme Outcome (POs) | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 | PSO3 |
| CO1 | S | | M | | S | | | | | | | M | | | |
| CO2 | M | M | S | S | | | M | M | | | | | | S | M |
| CO3 | | | S | S | | S | | M | S | S | W | | | S | S |

**Course Assessment methods:**

**e) Direct**

1. Continuous Assessment Test I, II (Theory component)
2. Open Book Test; Cooperative Learning Report, Assignment; Journal Paper Review,Group Presentation,Project Report, Poster Preparation, Prototype or Product
3. Demonstration etc (as applicable) (Theory component)
4. End Semester Examination (Theory component)

**f) Indirect**

1. Course-end survey

**Topics covered:**

| AUGMENTED AND VIRTUAL REALITY BASICS | 8 Hours |
|---|---|

Introduction to Augmented Reality -MAR Market, Actors, and Value Chain - Application vs. Browser -MAR System Architecture- Difference between AR and VR, Challenges with AR, AR systems and functionality, Augmented reality methods, visualization techniques for augmented reality, enhancing interactivity in AR environments, evaluating AR systems.
Virtual Reality and Virtual Environment: Introduction, Computer graphics, Real time computer graphics, Flight Simulation, Virtual environment requirement, benefits of virtual reality, Historical development of VR, Scientific Landmark.

| AR AND VR TECHNOLOGIES | 8 Hours |
|---|---|

Placing and positioning assets - Scale and size of assets - Occlusion -Lighting for increased realism - Solid augmented assets – context awareness - tracking in AR - outside-in tracking - motion tracking - environmental understanding - feature points - plane finding – light estimation - anchors - interface issues and lack of UI metaphors -technical constraints – 3D barriers - computer vision limitations -constraints of occlusion and shading.
Levels of Immersion in VR Systems - Sensorimotor Contingency -Sensorimotor Contingency in VR - Introduction to the Three Illusions: Place Illusion (PI), Plausibility Illusion (Psi) - Necessary Conditions for Psi - Break of Presence - Presence, Immersion, PI, and Psi - The Pinocchio Illusion - The Rubber Hand Illusion - Psychological Effects of Embodiment Illusion - Visual-Tactile and Visual-Motor Synchrony.

| AR CORE | 7 Hours |
|---|---|

Android OS - limitations of low light conditions on AR on mobile -simple surfaces challenge AR – user flow - working with tech limitations - preparing your tools - design draft. surface detection and creating plane - user interaction - placing with anchor points - occlusion between virtual assets - light estimation - virtual light to real light - multiplane detection and spatial mapping - processing needs in mobile AR - breaking immersion - framing as a creative device.

| VR SYSTEMS AND HARDWARES | 7 Hours |
|---|---|

The Virtual world space-positioning the virtual observer- perspective projection, human vision, stereo perspective projection, 3D clipping, Colour theory. Illumination models- Reflection models- Shading algorithms, Radiosity, Hidden Surface Removal- Realism -Stereographic image. VR Hardware- sensor hardware, Head-coupled displays, Acoustic hardware.

**REFERENCES**


1. Linowes, J., &Babilinski, K. (2017). Augmented Reality for Developers: Build Practical Augmented Reality Applications with Unity, ARCore, ARKit, and Vuforia. Packt Publishing Ltd.
2. XR Development with Unity-A beginner's guide to creating virtual, augmented, and mixed reality experiences using Unity by Anna Braun, Raffael Rizzo(2022).
3. Mastering Augmented Reality: A Comprehensive Guide to Learn Augmented Reality by Cybellium Ltd, Kris Hermans (2023)
4. Peddie, J. (2017). Augmented Reality: where we will all live. Springer.
5. Ong, S. (2017). Beginning windows mixed reality programming. Berkeley, CA: Apress. Doi, 10, 978-1.
6. “The VR Book: Human-Centered Design for Virtual Reality (ACM Books)”by Jason Jerald (2015).

**ONLINE LEARNING MATERIALS**

1. https://www.coursera.org/learn/ar |Coursera
2. https://www.coursera.org/professional-certificates/meta-ar-developer |Coursera
3. https://www.coursera.org/specializations/extended-reality-for-everybody|Coursera
4. https://www.coursera.org/specializations/virtual-reality
5. https://www.coursera.org/learn/introduction-virtual-reality
6. https://www.coursera.org/learn/making-virtual-reality-game
7. https://www.coursera.org/learn/3d-models-virtual-reality
8. https://www.coursera.org/learn/intro-augmented-virtual-mixed-extended-reality-technologies-applications-issues

**PROJECT** **30 Hours**

To Design and Integration of 3D Spatial audio and sound effects to the objects developed and exploring creative possibilities with AR Core, implement AR/VR navigation system (UX), AR/VR interaction system (UX), Applying AR/VR technologies in real time applications.

| | | |
|---|---|---|
| **Theory: 30 Hrs** | **Project: 30** | **Total: 60 Hours** |

| U18CSE0016 | ADVANCED METAVERSE TECHNOLOGIES | L | T | P | J | C |
|---|---|---|---|---|---|---|
| | | 3 | 0 | 0 | 0 | 3 |

**Course Outcomes:**

After successful completion of this course, the students should able to

CO1: Acquire knowledge to differentiate various Extended reality technologies in Metaverse

CO2: Apply Metaverse Experiences with depth understanding on devices and interoperability.

CO3: Analyze Metaverse in various application domains.

CO4: Develop the Metaverse environment with the integration of other technologies.

**Pre-requisite courses: Nil**

**CO/PO Mapping**

(S/M/W indicates the strength of correlation) S-Strong, M-Medium, W-Weak

| COs | Programme Outcome (POs) | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | PO 1 | PO 2 | PO 3 | PO 4 | PO5 | PO6 | PO7 | PO8 | PO 9 | PO10 | PO11 | PO1 2 | PSO 1 | PSO 2 | PSO 3 |
| CO 1 | S | | M | | | | | | | | | M | | | |
| CO 2 | M | M | S | S | | | M | M | | | | S | | S | M |
| CO 3 | | S | S | M | S | M | | | | | | | | | |
| CO 4 | S | | S | | | S | | M | S | S | W | | | S | S |

**Course Assessment methods:**

**g) Direct**

1. Continuous Assessment Test I, II (Theory component)
2. Open Book Test; Cooperative Learning Report, Assignment; Journal Paper Review, Group Presentation,Project Report, Poster Preparation, Prototype or Product
3. Demonstration etc (as applicable) (Theory component)
4. End Semester Examination (Theory component)

**h) Indirect**

1. Course-end survey

**Topics covered:**

| THE FOUNDATION OF XR & METAVERSE | 7 Hours |
|---|---|

The Brain Science behind VR - Understanding Augmented Reality (AR), Virtual Reality (VR), Mixed Reality (MR), Web XR - Differences & Similarities of VR/AR/MR-XR in Metaverse.

| EXPERIENCE WITH METAVERSE | 8 Hours |
|---|---|

Metaverse-Experiences in metaverse-Avatars in metaverse-Interoperability in the metaverse-connections and communications-Devices to access the metaverse.

| APPLICATIONS OF METAVERSE | 8 Hours |
|---|---|

Educational potential in metaverse-Learning in the metaverse-Health and architecture in metaverse-Arts, entertainment, and sports in the metaverse-Building a safe metaverse.

| TECHNOLOGIES IN METAVERSE | 11 Hours |
|---|---|

Web 3.0-Artificial Intelligence (AI) in Metaverse- Cyber Security aspects / How safe is Metaverse - Blockchain, NFT (non-fungible token) and crypto currency -Metaverse and NFTs - Metaverse Use Cases - Top Metaverse platforms - Current Challenges in Mass adoption of XR - Impact of 5G in XR - Role of Microsoft, Apple and Facebook in Metaverse

| INTERACTING IN METAVERSE | 11 Hours |
|---|---|

On-premise/Local hosting - Cloud Hosting & Streaming services - Distribution via Application Stores - Understanding UI & UX Design Essentials for AR/VR - Types of Navigation - Types of interaction (Understanding Hand controllers, gesture, gaze and voice controls) - Avatar implementations in VR (Torso/Full body) - AR/VR/Metaverse 3D Assets creation Tools Overview - 3D assets creation for VR/AR (Native polygonal modeling, Converting CAD models, 3D Scanning, Photogrammetry)

| Theory: 45 Hrs | Tutorial: 0 | Total Hours: 45 Hrs |
|---|---|---|

**REFERENCES**


1. “The Metaverse: And How it Will Revolutionize Everything" by Matthew Ball. published in 2022.
2. Metaverse for Beginners: The Ultimate Guide to Understanding and Investing in Web 3.0, NFTs, Crypto Gaming, and Virtual Reality by Donn Newman in 2022
3. The Fourth Transformation: How Augmented Reality & Artificial Intelligence Will Change Everything by Robert Scoble, Shel Israel published in 2016


**ONLINE LEARNING MATERIALS**

1. https://www.coursera.org/learn/what-is-the-metaverse| Coursera
2. Metaverse Web 3.0 and DeFi: A Fintech Masterclass| Udemy

**U18CSE0228 GAME PROGRAMMING**

**COURSE OUTCOMES**

**After successful completion of this course, the students should be able to**

**CO1:** Develop a solid understanding of game programming by writing and executing basic scripts, and implementing Object Oriented Programming concepts.

**CO2:** Implement game mechanics and interactions, including player controls, physics, and scoring systems.
**CO3:** Design and script user-friendly UI elements and menus, handling user input and events effectively, by creating an interactive game interface.
**CO4:** Apply advanced programming techniques, including AI behaviors, serialization, and coroutines, to develop complex gameplay systems

**Pre–requisite:** U18AII2204 Object Oriented Programming and Data Structures

| Cos | CO/PO MAPPING (S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak | | | | | | | | | | | | CO/PSO Mapping | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | PROGRAMME OUTCOMES (POs) | | | | | | | | | | | | PSOs | | |
| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 | PSO3 |
| CO1 | | S | | | | | | | | | | | | M | |
| CO2 | | S | | M | | | | | | | | | | S | M |
| CO3 | | S | | M | S | | | | M | | | | | S | M |
| CO4 | | S | | | S | | | | M | | M | | M | S | M |

**THEORY COMPONENT CONTENT**

**OVERVIEW OF C# PROGRAMMING LANGUAGE 6 HOURS**

Introduction to the Game Editor and C# scripting environment, Setting up editor for C# development , Basic syntax and data types in C# ,Writing and executing simple scripts ,OOPS concepts, Implementing OOP concepts , Design patterns and best practices in C# programming.

**SCRIPTING GAME MECHANICS AND INTERACTIONS 6 HOURS**

Implementing player controls and character movement, Collision detection and physics interactions, Handling user input for game interactions, Scripting game mechanics such as scoring, health and inventory systems, Debugging and optimizing scripts for better performance.

**SCRIPTING UI ELEMENTS AND MENUS 6 HOURS**

Introduction to UI system, Scripting UI elements such as buttons, text fields, and sliders, Creating interactive menus and user interfaces, Handling UI events and user input, Designing and implementing user-friendly UI for games.

**ADVANCED C# PROGRAMMING TECHNIQUES 6 HOURS**

Delegates, events, and lambda expressions in C#, Exception handling and error management, Working with collections and LINQ queries, Serialization and data persistence, Introduction to coroutines and asynchronous programming.

**SCRIPTING GAMEPLAY SYSTEMS AND AI 6 HOURS**

Implementing AI behaviours using finite state machines and behaviour trees, Scripting gameplay systems for enemy behaviour, pathfinding, and decision-making, Creating dynamic and interactive game environments, Integrating audio, animations, and visual effects with C# scripts, Testing, debugging, and optimizing gameplay scripts

**LAB CONTENTS: 30 Hours**

1. Basic Script Setup and Syntax
2. Understanding Unity's Component System
3. Basic Player Movement
4. Understanding and Using Collections
5. Creating and Managing GameObjects
6. Handling Collisions and Triggers
7. Scriptable Objects for Data Management.
8. Advanced Player Interaction
9. Physics and Forces
10. Final Project: Integrating All Concepts

| | | | | |
|---|---|---|---|---|
| **Theory: 30** | **Tutorial: 0** | **Practical: 30** | **Project:** | **Total: 60 Hours** |

**REFERENCES**


1. Joe Hocking ,"Unity in Action: Multiplatform Game Development in C#", Manning Publications 2018.
2. Simon Jackson ,"Mastering Unity 2D Game Development", Packt Publishing ,2014
3. Paris Buttfield-Addison, Jon Manning, and Tim Nugent," Unity Game Development Cookbook: Essentials for Every Game", O'Reilly Media, 2019.
4. Harrison Ferrone," Learning C# by Developing Games with Unity", Packt Publishing, 2018.


**ONLINE LEARNING MATERIALS**

1. https://learn.unity.com/
2. https://community.unity.com/

# IoT, Edge, UAV

| U18CSE0217 | EMBEDDED SYSTEMS FOR IOT | L | T | P | J | C |
|---|---|---|---|---|---|---|
| | | 2 | 0 | 2 | 0 | 3 |

**Course Outcomes:**

After successful completion of this course, the students should able to

| | |
|---|---|
| CO1: | Identify the internal architecture and programming of an embedded processor. [K3] |
| CO2: | Utilize the basic architecture of Internet of Things based Devices [K3] |
| CO3: | Make use of hardware platforms and AI Enabled Boards for application development. [K3] |
| CO4: | Choose the software platforms to process the IoT Data.[K3] |
| CO5: | Build an embedded and IoT Solution for real world scenarios[K5] |

**Pre-requisite courses:** U18AII1204 Introduction to Computational Machines

**CO/PO Mapping**
(S/M/W indicates the strength of correlation) S-Strong, M-Medium, W-Weak

| COs | Programme Outcome (POs) | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | PO 1 | PO 2 | PO 3 | PO 4 | PO5 | PO6 | PO7 | PO8 | PO 9 | PO10 | PO11 | PO1 2 | PSO 1 | PSO 2 | PSO 3 |
| CO 1 | S | S | | S | M | | | | | | | | S | | |
| CO 2 | S | | S | | | | | | | | | | S | | |
| CO 3 | S | M | M | M | | | | | | | | | | S | |
| CO 4 | S | | S | | S | M | | M | | M | | | S | | |
| CO 5 | S | S | | M | M | S | | | M | | | | S | | M |

**Course Assessment methods:**

**i) Direct**

1. Continuous Assessment Test I, II (Theory component)
2. Open Book Test; Cooperative Learning Report, Assignment; Journal Paper Review, Group Presentation,Project Report, Poster Preparation, Prototype or Product
3. Demonstration etc (as applicable) (Theory component)
4. End Semester Examination (Theory component)

**j) Indirect**

1. Course-end survey

**Topics covered:**

| EMBEDDED AND MICROCONTROLLER CONCEPTS | 7 Hours |
|---|---|

Introduction to embedded processors-Categories of embedded processors-Architecture-Introduction to PIC microcontrollers, architecture and memory organization, registers, I/O ports, interrupts, timer, instruction sets, Embedded Communication Protocols – UART, USART,I2C, SPI, Modbus-Introduction to Real-Time Operating Systems (RTOS)- RTOS Architecture: Layered Architecture of an RTOS -Kernel Components and Their Functions-Real-Time Operating System Services

| INTERNET OF THINGS | 5 Hours |
|---|---|

Introduction to Internet of Things (IoT), Functional Characteristics, IoT building blocks - Architecture and working - Elements of an IoT ecosystem-IOT Application Development Cycle-Technology drivers, Business drivers, Trends and implications -Recent Trends in the Adoption of IoT, Role of cloud in IoT. IoT Enabling Technologies

| HARDWARE PLATFORMS FOR IOT | 6 Hours |
|---|---|

Development Boards -Arduino, Raspberry Pi, ESP8266, AI Enabled Boards (Jetson Boards for IoT development), Sensors and actuators -Types-Functions, and applications: Gateways-connectivity options for Short range/Long range Communication- IoT device communication protocols Overview.

| SOFTWARE DEVELOPMENT FOR IOT | 6 Hours |
|---|---|

IDEs for IoT prototyping- Arduino Programming - Arduino functions- Interfacing with sensors and actuators-Libraries -Input/Output From Pins - Raspberry Pi platform -Environmental - Programming and interfacing with basic hardware components. Open Platforms- Platforms Overview- IBM Watson IoT—Bluemix, Eclipse IoT, AWS IoT, Microsoft Azure IoT Suite, Google Cloud IoT

| APPLICATION DEVELOPMENT | 6 Hours |
|---|---|

Development of IoT Applications - Cloud platforms for IoT, Cloud data logging and monitoring, Interfacing with web services.
IOT Prototyping - Home Automation –Smart Agriculture – Smart Cities – Smart Healthcare.

| LAB CONTENTS: | 30 Hours |
|---|---|

To understand the IoT tools and Platforms. Build a basic home automation system. IoT solution for agriculture, IoT-based smart parking system, Smart Cities - Smart Waste Management, Smart Street Lights, Healthcare - Baby Monitoring.
Sample Experiment:

1. Embedded C Programming and Interfacing with various peripherals
2. Integration of Actuators with node MCU (Servo motor/Relay).
3. Capture Image with node MCU.
4. Explore different communication methods with IoT devices (Zigbee, GSM, Bluetooth).
5. Make use of cloud platform to log the data.
6. Build a basic home automation system using IoT devices.
7. Develop an IoT solution for agriculture.
8. Design an IoT-based smart parking system.

| Theory: 30 Hrs | Tutorial: 0 | Practical: 30 | Total Hours: 60 Hrs |
|---|---|---|---|

**REFERENCES:**


1. Perry Xiao, Designing Embedded Systems and the Internet of Things (IoT) with the ARM mbed, 1119363993,Wiley, First Edition, 2018.
2. Robert Barton, Patrick Grossetete, David Hanes, Jerome Henry, Gonzalo Salgueiro, "IoT Fundamentals: Networking Technologies, Protocols, and Use Cases for the Internet of Things", CISCO Press, 2017.
3. Raj Kamal , " Internet of Things: Architecture and Design", McGraw Hill.2nd edition June 2022.
4. Arduino Programming in 24 hours, Richard Blum, 1st Edition, ISBN: 978-0672337123, Sams Tech Yourself Publishing.2014
5. Adrian Mcewen, Hakin Cassimally, "Designing The Internet of Things", First Edition, Wiley, 2014


**ONLINE COURSES:**

1. https://onlinecourses.nptel.ac.in/noc22_cs53/preview
2. https://www.coursera.org/learn/iot-wireless-cloud-computing
3. https://www.udemy.com/course/complete-guide-to-build-iot-things-from-scratch-to-market/

| U18CSE0318 | IOT SYSTEMS DESIGN | L | T | P | J | C |
|---|---|---|---|---|---|---|
| | | 2 | 0 | 0 | 2 | 3 |

**Course Outcomes:**

After successful completion of this course, the students should able to

| | |
|---|---|
| CO1: | Choose relevant IoT reference architecture for providing a standardized framework for design and implementation of solutions. [K3] |
| CO2: | Design and implement IoT systems by selecting appropriate communication protocols to enable seamless data exchange between devices [K3] |
| CO3: | Demonstrate proficiency in managing and processing IoT data for real time scenarios. [K3] |
| CO4: | Articulate the issues and challenges involved in integration of large scale IoT system. [K3]. |

**Pre-requisite courses:** U18AII1204 Introduction to Computational Machines

**CO/PO Mapping**

(S/M/W indicates the strength of correlation) S-Strong, M-Medium, W-Weak

| COs | Programme Outcome (POs) | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | PO 1 | PO 2 | PO 3 | PO 4 | PO5 | PO6 | PO7 | PO8 | PO 9 | PO10 | PO11 | PO1 2 | PSO 1 | PSO 2 | PSO 3 |
| CO 1 | S | S | | | | | | | | | | | S | M | |
| CO 2 | S | S | | | | | | | | | | | | S | |
| CO 3 | | S | S | | M | | | | | M | | M | S | | M |
| CO 4 | | S | S | | M | | | | | M | | M | | M | S |

**Topics covered:**

| IOT ARCHITECTURE | 6 Hours |
|---|---|

Types of IOT Architecture - Three-Tier IoT Architecture, Five-Tier IoT Architecture, Hierarchical IoT Architecture - Mesh IoT Architecture, Microservices IoT Architecture, Serverless IoT Architecture

| IOT PROTOCOLS | 6 Hours |
|---|---|

Application Layer Protocols-MQTT , CoAP , HTTP , AMQP . Network Layer Protocol- IPv6, 6LoWPAN, RPL. Data Link Layer Protocols-ZigBee, BLE. Physical Layer Technologies-RFID-LoRa

| DATA MANAGEMENT AND PROCESSING | 6 Hours |
|---|---|

Data Management -Data Ingestion-Edge and Fog Computing in Large-Scale IoT-Big Data Technologies for IoT-IoT Analytics

| INTEGRATION AND STANDARDS | 6 Hours |
|---|---|

IoT Network Topologies- Scalability, reliability, and latency requirements-IoT Middleware-Interoperability and Standards -API Design for IoT Integration -Case Studies and Industry Practices

| INTEGRATING LARGE-SCALE IOT SYSTEMS | 6 Hours |
|---|---|

Overview of Large-Scale IoT Systems-Challenges and Opportunities, Architectural Considerations-Scalable IoT Architectures-Distributed Systems and Microservices- IoT Security-Case Studies- Use cases in Industrial IoT.

| PROJECT COMPONENT: | 30 Hours |
|---|---|

Design and develop prototypes by applying suitable architecture models and protocols in scenarios like cloud-based smart facility management, healthcare, environment monitoring systems, etc.

| Theory: 30 Hrs | Tutorial: 0 | Project: 30 | Total Hours: 60 Hrs |
|---|---|---|---|

**REFERENCES :**


1. Cirani, S., Ferrari, G., Picone, M., & Veltri, L., “Internet of Things Architectures, Protocols and Standards”, Wiley, 2018.
2. Höller, J., Tsiatsis, V., Mulligan, C., Karnouskos, S., Avesand, S., & Boyle, D., “ From Machine-to-Machine to the Internet of Things: Introduction to a New Age of Intelligence”, Springer, 2019.
3. Gravina, R. (Ed.), Palau, C. E. (Ed.), Manso, M. (Ed.), Liotta, A. (Ed.), Fortino, G. (Ed.), “Integration, Interconnection, and Interoperability of IoT Systems (Internet of Things)”, Springer, 2018.
4. Hanes, D., Salgueiro, G., Grossetete, P., Barton, R., Henry, J., “IoT Fundamentals: Networking Technologies, Protocols, and Use Cases for the Internet of Things”, Cisco Press,2017.


**ONLINE COURSES :**

1. https://www.coursera.org/programs/coursera-for-campus-faculty-ovg1y/learn/m2m-iot-interface-design-embedded-systems?source=search
2. https://www.coursera.org/programs/coursera-for-campus-faculty-ovg1y/learn/iot-networking?source=search
3. https://www.coursera.org/programs/coursera-for-campus-faculty-ovg1y/learn/iot-systems-and-industrial-automation-course-1?source=search
4. https://www.coursera.org/learn/advanced-iot-systems-and-industrial-applications-course-3
5. https://onlinecourses.nptel.ac.in/noc22_cs53/preview

| U18CSE0219 | IOT APPLICATION DEVELOPMENT | L | T | P | J | C |
|---|---|---|---|---|---|---|
| | | 2 | 0 | 2 | 0 | 3 |

**Course Outcomes:**

After successful completion of this course, the students should able to

| | |
|---|---|
| CO1: | Apply the concept of IoT for application development [K3] |
| CO2: | Build context-aware and gestural interfaces for IoT applications[K3] |
| CO3: | Construct prototype using wireframes for different device interfaces[K3] |
| CO4: | Make use of different testing strategies for IoT applications[K3] |
| CO5: | Develop an appropriate deployment architecture for an IoT project[K3] |

**Pre-requisite courses:** U18AII1204 Introduction to Computational Machines

**CO/PO Mapping**

(S/M/W indicates the strength of correlation) S-Strong, M-Medium, W-Weak

| COs | Programme Outcome (POs) | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 | PSO3 |
| CO1 | S | | M | | S | | | | | | | | S | M | M |
| CO2 | S | | M | | | | | | | | | | M | | |
| CO3 | S | S | | | M | | | | M | | | | S | | |
| CO4 | S | | | S | | | | M | | | | | | M | |

**Topics covered:**

**INTRODUCTION** **5 Hours**

Overview of IOT Application Development - UI/UX Considerations -Feasibility Study- Architecture and Design- **User Interface for Device Management** - Testing and Quality Assurance- Deployment- Monitoring and Optimization- End-of-Life Planning.

**USER INTERFACE DESIGN** **7 Hours**

User-centred design principles- Device Control Interfaces- Multi-Device Interaction - Responsive Design for Various Screens -Navigation design- Voice and Natural Language Interfaces-Grid systems and layout-Typography in UI design-Color theory and its application- Creating effective user flows- Error Handling and Feedback- Context-Aware Interfaces- Gestural Interfaces.

**PROTOTYPING AND WIRE FRAMING** **6 Hours**

Prototyping tools-Types of Prototypes- key elements of wireframes-creating basic wireframes- Device Interface Prototyping- Sensor Data Visualization- Interaction Flows- Mobile and Web Application Wire framing- Voice and Gesture Interaction Prototypes- Edge Computing Integration- Error Handling and Feedback Prototypes- Remote Monitoring Interfaces.

**IOT TESTING** **6 Hours**

Challenges -Unit Testing for IoT Components- Integration Testing for IoT Device -Security Testing for IoT Devices and networks- End to End Testing - Automation Framework and Tools - Metrics of Performance testing- Device and Power Management

**APPLICATION DEPLOYMENT** **6 Hours**

IoT Deployment Strategies and Project Planning-Deployment Considerations- Challenges and Risks -Deployment Architecture-Configure and set up edge devices - Cloud Platform - Connectivity and Communication-Data Handling and Storage-Deployment Testing-Monitoring and Management.

**_ LAB COMPONENT**

Create a real-time IoT application by integrating UI/UX design tools (Sketch, Figma). Utilize wireframing techniques to prototype and visualize the IoT application's layout and operations. Deploy the IoT project to make it operational and accessible by users.

**Sample Experiments:**

1. Set up a basic IoT ecosystem with microcontrollers and sensors.
2. Simulate a small-scale smart factory using IoT devices
3. Develop prototypes for Smart City applications such as Smart Street Lights or Smart Waste Management.
4. Design a user interface that adjusts to various screen sizes.
5. Implement responsive design using CSS and HTML
6. Use tools like InVision or Marvel to create interactive prototypes for an IoT application
7. Design wireframes for the user interfaces of specific IoT applications (e.g., Smart Home Control).

**Theory: 30 Hrs** **Tutorial: 0** **Practical: 30** **Total Hours: 60 Hrs**

**REFERENCES**


1. "Building the Internet of Things: Implement New Business Models, Disrupt Competitors, Transform Your Industry" by Maciej Kranz, ISBN: 978-1-119-28568-7, 2016.
2. "Prototyping: A Practitioner's Guide" by Todd Zaki Warfel,2009.
3. Designing in Figma: The Complete Guide to Designing with Reusable Components and Styles in Figma , Eugene Fedorenko, 2020
4. "Designing Connected Products: UX for the Consumer Internet of Things" by Claire Rowland, Elizabeth Goodman, Martin Charlier, and Ann Light, 2015
5. "IOT Deployment Handbook: A practical Guide to Implementing Successful IOT Projects" By Richard G. Brown, 2022


**Online Course Links:**

1. https://www.coursera.org/programs/coursera-for-campus-faculty-vg1y/learn/iot?source=search
2. https://www.coursera.org/programs/coursera-for-campus-faculty-ovg1y/specializations/interaction-design?source=search
3. https://www.udacity.com/course/ux-design-for-mobile-developers--ud849
4. https://www.coursera.org/programs/coursera-for-campus-faculty-ovg1y/learn/prototyping-design?source=search
5. https://www.coursera.org/programs/coursera-for-campus-faculty-ovg1y/learn/iot-systems-and-industrial-automation-course-1?source=search
6. https://www.udemy.com/course/master-the-secrets-of-figma-a-complete-beginners-course/

| U18CSE0220 | 3D PRINTING | L | T | P | J | C |
|---|---|---|---|---|---|---|
| | | 2 | 0 | 2 | 0 | 3 |

**Course Objectives:**

**Course Outcomes:**

After successful completion of this course, the students should able to

CO1: Make use of 3D printing technologies and realize the applications[K3]

CO2: Identify 3D printing process chain in additive manufacturing.[K3].

CO3: Develop proficiency in using 3D modelling software.[K3]

CO4: Identify various issues involves in common 3D printing techniques [K3]

CO5: Apply the concepts of advanced 3D printing techniques to develop applications [K3]

**Pre-requisite courses: Nil**

**CO/PO Mapping**

(S/M/W indicates the strength of correlation) S-Strong, M-Medium, W-Weak

| COs | Programme Outcome (POs) | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 | PSO3 |
| CO1 | S | | | | M | | | | | | | | S | | |
| CO2 | | S | | | M | | | | | | | M | | | S |
| CO3 | | M | | | M | | | | | | | M | | S | M |
| CO4 | S | | | | M | | | | | M | | | S | | |

**Topics covered:**

**INTRODUCTION TO 3D PRINTING** **5 Hours**

Overview of 3D Printing technology - Historical background and advancements - Applications and real-world examples - Additive manufacturing techniques - Fused Deposition Modeling (FDM) - Stereolithography (SLA) - Digital Light Processing (DLP) -Selective Laser Sintering (SLS) - Direct Metal Laser Sintering (DMLS) - Other Types (MSLA, BJP, EBM, LOM) - Variations of FDM 3D Printing Machines

**3D PRINTING PROCESS CHAIN & PHOTOPOLYMERIZATION PROCESSES** **7 Hours**

Steps in Additive manufacturing - Design for 3D printing - Software in 3D Printing - Materials for 3D Printing - Post-processing and finishing techniques; Introduction to Photopolymerization Processes - Photopolymerization Materials - Reaction Rates - Vector Scan SL - SL Resin Curing Process - SL Scan Patterns - Vector Scan Micro Stereolithography - Mask Projection Photopolymerization Technologies and Processes - Two-Photon SL

**3D DESIGNING** 6 **Hours**

Introduction to 3D modeling software - Creating 3D Models - Designing basic geometric shapes - CAD software and tools - Parametric modeling - Creating complex structures and assemblies; Preparing Models for 3D Printing - Design considerations for 3D printing - Mesh repair and optimization - File formats for 3D printing - Slicing software and its features - Layer height and resolution settings - Support structures; Print bed adhesion techniques – Orientation – Rafts.

**TROUBLESHOOTING AND CALIBRATION** **6 Hours**

Components of FDM & Stereolithography printers - Identifying and resolving common print issues - Adjusting print settings for optimal results - Materials Handling Issues - Hardware & Software Calibrations.

**ADVANCED 3D PRINTING TECHNIQUES** **6 Hours**

Multi-Material Unit (MMU) and Multi-Color Printing - Overview of 3D scanning technologies - Point cloud data and mesh generation - Reverse engineering and modification of existing models - High-resolution printing - Large-scale printing - Applications - Industrial applications - Medical and healthcare applications - Automotive and aerospace industries - Art, Architecture, Fashion & Food - Education and prototyping.

**LAB CONTENTS:** **30 Hours**

This lab component focuses on teaching students the fundamentals of 3D printing and design, using various printing techniques, materials, and post-processing methods. Students will engage in hands-on experiments to understand the complete process of 3D printing, from design to troubleshooting.

**Sample Experiments:**

1. 3D Modeling with Basic Shapes: Introduction to 3D modeling software and creation of basic geometric shapes.
2. FDM Printing Basics and SLA Comparison: Use an FDM printer for a simple model, then print the same model with an SLA printer for comparison.
3. Calibrating and Optimizing 3D Printers: Learn to calibrate FDM printers, including bed leveling and extruder settings. Also, cover basic SLA printer settings.
4. Model Correction and Preparation: Identify and correct common 3D model issues, preparing the model for efficient printing.
5. Orientation and Support Structure Analysis: Experiment with model orientations and support structures for both FDM and SLA printing.
6. Choosing the Best Printing Method: Analyze a 3D model to determine the most suitable printing method, considering the model's geometry and application.
7. Post-Processing Techniques: Learn post-processing techniques for both FDM (like sanding and painting) and SLA prints (including resin curing and support removal).
8. Troubleshooting 3D Printers: Identify and resolve common issues in both FDM and SLA printing.
9. Material Analysis and Application: Study different printing materials for FDM and SLA, understanding their properties, strengths, and use cases.
10. Efficiency and Precision in 3D Printing: Focus on recreating a provided 3D model with precision and optimizing print settings for efficiency within a time limit.

| | | | |
|---|---|---|---|
| **Theory: 30 Hrs** | **Tutorial: 0** | **Practical: 30** | **Total Hours: 60 Hrs** |

**REFERENCES**


1. "Mastering 3D Printing:A Guide to Modeling,Printing and Prototyoing" by Joan Horvath,Rich Camerona,published in May 2020.
2. 3D Printing Failures: How to Diagnose and Repair ALL Desktop 3D Printing Issues" by Sean Aranda and David Feeney published in January 2020.
3 ."Additive Manufacturing Technologies: Rapid Prototyping to Direct Digital Manufacturing by Ian Gibson, David W Rosen, Brent Stucker published in 2010.
4. "Rapid Prototyping: Principles & Applications" by Chua Chee Kai, Leong Kah Fai published in January 2010


**ONLINE COURSES**

1. https://www.coursera.org/specializations/rapid-prototyping-using-3d-printing
2. https://www.coursera.org/learn/3d-printing-applications#modules.
3. https://www.coursera.org/specializations/3d-printing-additive-manufacturing
4. https://www.udemy.com/course/3d-printing-for-beginners/
5. https://www.udemy.com/course/3d-printing-from-start-to-finish/
6. https://www.udemy.com/course/learn-3d-printing/

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| U18CSE0221 | ROBOTIC OPERATING SYSTEMS | L | T | P | J | C |
|---|---|---|---|---|---|---|
| | | 2 | 0 | 2 | 0 | 3 |

**Course Outcomes:**

After successful completion of this course, the students should able to

CO1: Apply the concepts of ROS to enable the development of robotic system [K3]

CO2: Implement ROS topics and messages for efficient data transfer between nodes. [K3]

CO3: Utilize ROS visualization tools, such as RViz, to analyze and debug ROS applications. [K3]

CO4: Develop ROS perception packages for object detection, recognition, and tracking.[K3]

CO5: Apply ROS drivers for tasks such as sensor data acquisition, robot navigation, and object manipulation [K3]

**Pre-requisite courses:** U18AII3203 - Operating System

**CO/PO Mapping**

(S/M/W indicates the strength of correlation) S-Strong, M-Medium, W-Weak

| COs | Programme Outcome (POs) | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 | PSO3 |
| CO1 | S | | | | M | | | | | | | | | S | |
| CO2 | | S | | | M | | | | | | | | M | | |
| CO3 | | | | | S | | | | | | | | | S | |
| CO4 | | S | | | M | | | | | | | | | M | |
| CO5 | S | | | | M | | | | | | | | | | M |

**Topics covered:**

| **INTRODUCTION** | **6 Hours** |
|---|---|

Introduction to ROS-Installation of ROS on different platforms-ROS basic concepts-Components: Nodes, topics, messages, and services- ROS communication architecture-ROS Packages and Ecosystem

| **ROS TOOLS AND ENVIRONMENT** | **6 Hours** |
|---|---|

ROS Tools and Environment- command-line tools- ROSIDEs- ROS Integrated Development Environments (IDEs)- graphical tools for visualization and debugging- Rviz, Rqt, and Gazebo-Creating and managing ROS workspaces-Version control with ROS

| **ROS COMMUNICATION** | **6 Hours** |
|---|---|

ROS nodes and communication - ROS Topics - Publishing and subscribing to topics-Working with ROS topics and messages-ROS services and parameters-ROS launch files for managing multiple nodes-ROS Middleware-ROS Libraries

| **ADVANCED ROS TOPICS** | **5 Hours** |
|---|---|

Perception in ROS- Perception libraries (OpenCV, PCL)- Integration of sensors: Cameras, Lidar, IMU - Basic computer vision techniques in ROS Robot Navigation and Control
- ROS navigation stack-Path planning algorithms-Simulating and executing robot navigation-ROS control stack

| **ROS AND ROBOT DRIVERS** | **5 Hours** |
|---|---|

ROS and Robot Drivers-Writing drivers to interface hardware with ROS-Interfacing Sensors and Actuators-Connecting sensors and actuators to the ROS ecosystem-Integration with Robot Platforms- Working with popular robot platforms.

**LAB COMPONENT**

Create a simple ROS package with a publisher and a subscriber node-Extend the package to include a service, Expand the package to include an action server that moves a robot forward for a specified duration- Computer Vision with ROS- Integration with Hardware -Use RViz to visualize the movement of a robot as it receives commands from the publisher.

**Sample Experiments:**

1. Installation and Create a ROS workspace.
2. Create and run a simple ROS node-Publish and subscribe to ROS topics.
3. ROS Tools-Use Rviz for visualization.-Experiment with Rqt tools.
    a. Working with Launch Files:-Create a launch file to start multiple nodes-Pass parameters through launch files.
4. Design a simple robot using URDF
    a. Simulate the robot in Gazebo
    b. ROS Services and Actions:
5. Implement a simple ROS service
    a. Create and use a ROS action server.
    b. Navigation in ROS
    c. Set up the ROS Navigation Stack
    d. Implement basic path planning
6. Computer Vision with ROS
    a. Use OpenCV with ROS for image processing.
7. Integration with Hardware:
    a. Interface with a real-world sensor (e.g., Lidar or IMU) using ROS.
    b. Control actuators or motors using ROS commands.

| | | |
|---|---|---|
| **Theory: 30 Hrs** | **Tutorial: 0 Practical:30** | **Total Hours: 60 Hrs** |

**REFERENCES**


1. Programming Robots with ROS: A Practical Introduction to the Robot Operating System, O'Reilly Media; by Morgan Quigley , Brian Gerkey , William D. Smart ,1st edition , 2015
2. Robot Operating System (ROS): The Complete Beginner's Guide" - Morgan Quigley, Apress; 1st edition , 2018
3. Robot Operating System (ROS) for Absolute Beginners: Robotics Programming Made Easy,Lentin Joseph,Apress, 1st edition ,2018,
4. ROS Robotics By Example , Carol Fairchild , Dr. Thomas L. Harman, Packt Publishing Limited,2016


**ONLINE COURSES:**

1. https://www.edx.org/learn/robotics/delft-university-of-technology-hello-real-world-with-ros-robot-operating-system
2. https://www.udemy.com/course/ros-essentials/
3. https://www.udemy.com/course/self-driving-and-ros-learn-by-doing-odometry-control/
4. https://www.udemy.com/course/ros-for-beginners/
5. https://www.coursera.org/learn/intro-self-driving-cars?specialization=self-driving-cars

| U18CSE0022 | SOFTWARE DEFINED VEHICLE | L | T | P | J | C |
|---|---|---|---|---|---|---|
| | | 3 | 0 | 0 | 0 | 3 |

**Course Objectives:**

**Course Outcomes:**

After successful completion of this course, the students should able to

| | |
|---|---|
| CO1: | Identify the Software Defined Vehicle concepts and realize the paradigm shift from hardware to software centric vehicle design [K3] |
| CO2: | Make use of core principles of SDV architecture, including the separation of hardware and software and the layered software stacks [K3] |
| CO3: | Utilize the Model-Based Development (MBD) and AUTOSAR Standard for automotive software development [K3] |
| CO4: | Apply the key technologies in Self-Driving Vehicles to create a robust and reliable autonomous system [K3] |

**Pre-requisite courses:** U18AII1204 Introduction to Computational Machines

**CO/PO Mapping**

(S/M/W indicates the strength of correlation) S-Strong, M-Medium, W-Weak

| COs | Programme Outcome (POs) | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 | PSO3 |
| CO1 | S | S | | | | | | | | | | | M | | |
| CO2 | S | S | | | | | | | | | | | | | M |
| CO3 | | | S | | M | | | M | | | | M | | S | |
| CO4 | | | S | | M | | | M | | | | M | | S | |

**Topics covered:**

| INTRODUCTION | 9 Hours |
|---|---|

Overview of software-defined vehicles - Historical perspective and evolution - Essential system basics - Support processes for electronic systems and software development.

| IN-VEHICLE SOFTWARE ARCHITECTURE | 9 Hours |
|---|---|

Software architectures - ECUs (Electronic Control Units) and their functions - Bus systems – CAN: Concepts, Components, Applications – LIN: Concept, Components - Event Triggered and Time Triggered Protocol - TTCAN - FlexRay - Evaluation of Automotive Software Architectures.

| AUTOMOTIVE SOFTWARE DEVELOPMENT | 9 Hours |
|---|---|

Software development life cycle - Automotive Software Development - Core process for electronic systems and software engineering - Methods and tools for development - Model-Based Development (MBD) and AUTOSAR Standard - Detailed Design of Automotive Software.

| SDV ENABLING TECHNOLOGIES | 9 Hours |
|---|---|

Levels of automation - Sensor technologies (LiDAR, RADAR, cameras) – Perception, Localization, Mapping, Decision Making, Planning and Control Systems - Over-the-Air (OTA) Updates - Regulatory Compliance

| Theory: 45 Hrs | Tutorial: 0 | Total Hours: 45 Hrs |
|---|---|---|

**REFERENCES:**


1. Jörg Schäuffele (Author), Thomas Zurawka,"Automotive Software Engineering: Principles, Processes, Methods, and Tools", Society of Automotive Engineers, 2016
2. Miroslaw Staron, "Automotive Software Architectures An Introduction", Springer, 2017.
3. Colt Correa, John Simon, Martin Gubow, Samir Bhagwat, "Automotive Ethernet: The Definitive Guide", Intrepid Control Systems, 2nd edition, 2023.
4. Marco Di Natale, Haibo Zeng, Paolo Giusto, Arkadeb Ghosal, "Understanding and Using the Controller Area Network Communication Protocol Theory and Practice", Springer New York, NY,2012.
5. Navet, Nicolas, and Françoise Simonot-Lion, eds. "Automotive embedded systems handbook". CRC press, 2017.
6. Paret, Dominique. "Multiplexed networks for embedded systems: CAN, LIN, flexray, safe-by-wire...", John Wiley & Sons, 2007.


**ONLINE RESOURCES:**

1. https://www.coursera.org/learn/intro-self-driving-cars

# CYBER SECURITY

| U18CSE0223 | ETHICAL HACKING AND NETWORK DEFENCE | L | T | P | J | C |
|---|---|---|---|---|---|---|
| | | 2 | 0 | 2 | 0 | 3 |

**Course Outcomes:**

After successful completion of this course, the students should able to

CO1: Illustrate the legal and ethical requirements related to ethical hacking (K3)

CO2: Interpret the vulnerabilities, mechanisms to identify vulnerabilities, threats, attacks (K3)

CO3: Perform penetration & security testing to identify the vulnerabilities in the application (K4)

CO4: Examine the different tools and techniques that ethical hackers employ (K4)

**Pre-requisite courses:** U18AII4201 Computer Networks

**CO/PO Mapping**

(S/M/W indicates the strength of correlation) S-Strong, M-Medium, W-Weak

| COs | Programme Outcome (POs) | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 | PSO3 |
| CO1 | S | M | | | | | | | | | | | | | |
| CO2 | S | M | | | M | M | M | | | | | | | | |
| CO3 | S | M | | | M | M | M | M | | | | | | | |
| CO4 | S | M | | | M | | | | | | | | | | S |

**Topics covered:**

| ETHICAL HACKING OVERVIEW & VULNERABILITIES | 6 Hours |
|---|---|

Understanding the importance of security, Concept of ethical hacking and essential Terminologies Threat, Attack, Vulnerabilities, Target of Evaluation, Exploit. Phases involved in hacking.

| FOOTPRINTING & PORT SCANNING | 6 Hours |
|---|---|

Footprinting - Introduction to foot printing, Understanding the information gathering methodology of the hackers, tools used for the reconnaissance phase. Port Scanning - Introduction, using port scanning tools, ping sweeps, Scripting enumeration-Introduction, enumerating windows OS & Linux OS

| SYSTEM HACKING | 6 Hours |
|---|---|

Aspect of remote password guessing, Role of eavesdropping, Various methods of password cracking, Keystroke Loggers, Understanding Sniffers, Comprehending Active and Passive Sniffing, ARP Spoofing and Redirection, DNS and IP Sniffing, HTTPS Sniffing. Side-channel Attacks on Cryptographic Hardware: Basic Idea, Current-measurement based Side-channel Attacks. Hardware Trojans: Hardware Trojan Nomenclature and Operating Modes, Countermeasures Such as Design and Manufacturing Techniques to Prevent/Detect Hardware Trojans

| HACKING WEB SERVICES & SESSION HIJACKING | 6 Hours |
|---|---|

Web application vulnerabilities, application coding errors, SQL injection into Back-end Databases, cross-site scripting, cross-site request forging, authentication bypass, web services and related flaws, protective http headers Understanding Session Hijacking, Phases involved in Session Hijacking, Types of Session Hijacking, Session Hijacking Tools

| HACKING WIRELESS NETWORKS | 6 Hours |
|---|---|

Introduction to 802.11, Role of WEP, Cracking WEP Keys, Sniffing Traffic, Wireless DOS attacks, WLAN Scanners, WLAN Sniffers, Hacking Tools, Securing Wireless Networks

**SAMPLE LAB EXPERIMENTS:**

1. Working with Trojans, Backdoors
2. Foot Printing & port scanning
3. Password guessing and Password Cracking.
4. Understanding Data Packet Sniffers
5. Implement the SQL injection attack.
6. Denial of Service and Session Hijacking using Tear Drop, DDOS attack.
7. Wireless and mobile hacking and security

| Theory: 30 Hrs | Tutorial: 0 | Practical:30 | Total Hours: 30 Hrs |
|---|---|---|---|

**REFERENCES**


1. Kimberly Graves, "Certified Ethical Hacker", Wiley India Pvt Ltd, 2013
2. Michael T. Simpson, "Hands-on Ethical Hacking & Network Defense", Course Technology, 2016
3. Rajat Khare, "Network Seuciryt and Ethical Hacking", Luniver Press, 2006
4. Ramachandran V, BackTrack 5 Wireless Penetration Testing Beginner's Guide (3rd ed.). Packt Publishing, 2011
5. Thomas Mathew, "Ethical Hacking", OSB publishers, 2003
6. Debdeep Mukhopadhyay and Rajat Subhra Chakraborty, "Hardware Security: Design, Threats, and Safeguards", CRC Press, 2015


**ONLINE LEARNING MATERIALS**

1. **https://www.coursera.org/learn/ethical-hacking-essentials-ehe**

| U18CSE0024 | CYBER ETHICS AND LAWS | L | T | P | J | C |
|---|---|---|---|---|---|---|
| | | 3 | 0 | 0 | 0 | 3 |

**Course Outcomes:**

After successful completion of this course, the students should able to

CO1: Demonstrate a comprehensive understanding of electronic business models, including e-commerce, mobile commerce and its legal issues (K3)

CO2: Interpret Cyber Ethics and its significance in the context of technology and information systems. (K3)

CO3: Develop a solid foundation in the principles and concepts of cyber laws (K3)

CO4: Illustrate information Technology act and legislation addressing cybercrime, including laws pertaining to unauthorized access, hacking, identity theft, and online fraud ulation. (K3)

**Pre-requisite courses: Nil**

**CO/PO Mapping**

(S/M/W indicates the strength of correlation) S-Strong, M-Medium, W-Weak

| COs | Programme Outcome (POs) | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 | PSO3 |
| CO1 | M | | | | | | | | | | | | | | |
| CO2 | M | | | | | M | | | | | | | | | |
| CO3 | M | | | | | | | | | | | | | | |
| CO4 | M | | | | | M | | | | | | | | | M |

**Topics covered:**

**ELECTRONIC BUSINESS AND LEGAL ISSUES** **9 Hours**

Evolution and developmennt in E-commerce, paper vs paper less contracts E-Commerce models- B2B, B2C, E security. Business, taxation, electronic payments, supply chain, EDI, E-markets, Emerging Trends.

**CYBER ETHICS** **9 Hours**

The Importance of Cyber Law, Significance of cyber Ethics, Need for Cyber regulations and Ethics. Ethics in Information society, Introduction to Artificial Intelligence Ethics: Ethical Issues in AI and core Principles, Introduction to Block chain Ethics.

**INTRODUCTION TO CYBER LAW** **9 Hours**

Evolution of computer Technology, emergence of cyber space. Cyber Jurisprudence, Jurisprudence and law, Doctrinal approach, Consensual approach, Real Approach, Cyber Ethics, Cyber Jurisdiction, Hierarchy of courts, Civil and criminal jurisdictions, Cyberspace-Web space, Web hosting and web Development agreement, Legal and Technological Significance of domain Names, Internet as a tool for global access

**INFORMATION TECHNOLOGY ACT** **9 Hours**

Overview of IT Act, 2000, Amendments and Limitations of IT Act, Digital Signatures, Cryptographic Algorithm, Public Cryptography, Private Cryptography, Electronic Governance, Legal Recognition of Electronic Records, Legal Recognition of Digital Signature, Certifying Authorities, Cyber Crime and Offences, Network Service Providers Liability, Cyber Regulations Appellate Tribunal, Penalties and Adjudication.

**CYBER LAW AND RELATED LEGISLATION** **9 Hours**

Patent Law, Trademark Law, Copyright, Software – Copyright or Patented, Domain Names and Copyright disputes, Electronic Data Base and its Protection, IT Act and Civil Procedure Code, IT Act and Criminal Procedural Code, Relevant Sections of Indian Evidence Act, Relevant Sections of Bankers Book Evidence Act, Relevant Sections of Indian Penal Code, Relevant Sections of Reserve Bank of India Act, Law Relating To Employees And Internet, Alternative Dispute Resolution , Online Dispute Resolution (ODR).

**Theory: 45 Hrs** **Tutorial: 0** **Total Hours: 45 Hrs**

**REFERENCES**


1. Cyber Laws: Intellectual property & E Commerce, Security- Kumar K, dominant Publisher, 2011
2. Cyber Ethics 4.0, Christoph Stuckelberger, Pavan Duggal, by Globethics, 2018.
3. Information Security policy & Implementation Issues, PHI, 2003.
4. Legal Dimensions of Cyber Space, Verma S, K, Mittal Raman, Indian Law Institute, New Delhi, 2004.
5. Cyber Law- The law of Internet, Jonthan Rosenoer, Springer, 2011.
6. The right to Information Act 2005, S. R. Bhansali, Sudhir Naib, OUP India, 2011.
7. Cyber Crimes and Law Enforcement, Vasu Deva, Commonwealth Publishers, New Delhi, 2017.


**ONLINE LEARNING MATERIALS**

1. https://www.coursera.org/videos/business-of-cybersecurity-capstone/ OxfpG?query=CYBER+LAWS+AND+ETHICS
2. https://www.coursera.org/learn/business-of-cybersecurity-capstone/
3. https://www.coursera.org/programs/coursera-for-campus-faculty-ovg1y/learn/-security-principles

| U18CSE0225 | SECURE SOFTWARE DEVELOPMENT | L | T | P | J | C |
|---|---|---|---|---|---|---|
| | | 2 | 0 | 2 | 0 | 3 |

**Course Outcomes:**

After successful completion of this course, the students should able to

CO1: Demonstrate various vulnerabilities related to memory attacks. (K3)

CO2: Apply security principles in software development. (K3)

CO3: Evaluate the extent of risks. (K3)

CO4: Apply security principles in the testing phase of software development. (K3)

CO5 Use tools for securing software. (K3)

**Pre-requisite courses:** U18AII4201 Computer Networks

**CO/PO Mapping**

(S/M/W indicates the strength of correlation) S-Strong, M-Medium, W-Weak

| COs | Programme Outcome (POs) | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 | PSO3 |
| CO1 | S | M | | | | | | | | | | | | | |
| CO2 | S | M | | | M | | | | | | | | M | | M |
| CO3 | S | M | | | M | | | | | | | | M | | |
| CO4 | S | M | | | M | | | | | | | | | | M |
| CO5 | S | | | | S | | | | | | | | | | |

**Topics covered:**

| | |
|---|---|
| **NEED OF SOFTWARE SECURITY AND LOW-LEVEL ATTACKS** | **6 Hours** |

Introduction - Software Assurance and Software Security –Threats to software security - Sources of software insecurity - Benefits of Detecting Software Security - Properties of Secure Software – Secure SDLC- Memory-Based Attacks: Low-Level Attacks Against Heap and Stack - Defense Against Memory-Based Attacks

| | |
|---|---|
| **SECURE SOFTWARE DESIGN** | **7 Hours** |

Requirements Engineering for secure software - SQUARE process Model – Requirements elicitation and prioritization- Isolating The Effects of Untrusted Executable Content – Stack Inspection – Policy Specification Languages – Vulnerability Trends – Buffer Overflow – Code Injection - Session Hijacking. Secure Design - Threat Modeling and Security Design Principles

| | |
|---|---|
| **SECURITY RISK MANAGEMENT** | **5 Hours** |

Risk Management Life Cycle – Risk Profiling – Risk Exposure Factors – Risk Evaluation and Mitigation – Risk Assessment Techniques – Threat and Vulnerability Management

| | |
|---|---|
| **SECURITY TESTING** | **4 Hours** |

Governance and security - Adopting an enterprise software security framework - Security and project management - Maturity of Practice

| | |
|---|---|
| **SECURE PROJECT MANAGEMENT** | **4 Hours** |

Governance and security - Adopting an enterprise software security framework - Security and project management - Maturity of Practice

**SAMPLE LAB EXPERIMENTS:**

1. Implement the SQL injection attack.
2. Implement the Buffer Overflow attack.
3. Implement Cross Site Scripting and Prevent XSS.
4. Perform Penetration testing on a web application to gather information about the system, then
5. initiate XSS and SQL injection attacks using tools like Kali Linux.
6. Develop and test the secure test cases
7. Penetration test using kali Linux

| | | |
|---|---|---|
| **Theory: 30 Hrs** | **Tutorial: 0 Practical: 30** | **Total Hours: 60 Hrs** |

**REFERENCES:**


1. Julia H. Allen, “Software Security Engineering”, Pearson Education, 2009
2. Evan Wheeler, “Security Risk Management: Building an Information Security Risk Management Program from the Ground Up”, First edition, Syngress Publishing, 2011
3. Chris Wysopal, Lucas Nelson, Dino Dai Zovi, and Elfriede Dustin, “The Art of Software Security Testing: Identifying Software Security Flaws (Symantec Press)”, Addison-Wesley Professional, 2006
4. Robert C. Seacord, “Secure Coding in C and C++ (SEI Series in Software Engineering)”, Addison-Wesley Professional, 2005.
5. Jon Erickson, “Hacking: The Art of Exploitation”, 2nd Edition, No Starch Press, 2008.
6. Mike Shema, “Hacking Web Apps: Detecting and Preventing Web Application Security Problems”, First edition, Syngress Publishing, 2012
7. Bryan Sullivan and Vincent Liu, “Web Application Security, A Beginner's Guide”, Kindle Edition, McGraw Hill, 2012
8. Lee Allen, “Advanced Penetration Testing for Highly-Secured Environments: The Ultimate Security Guide (Open Source: Community Experience Distilled)”, Kindle Edition, Packt Publishing,2012.

| U18CSE0226 | NETWORK SECURITY ADMINISTRATION | L | T | P | J | C |
|---|---|---|---|---|---|---|
| | | 2 | 0 | 2 | 0 | 3 |

**Course Objectives:**

**Course Outcomes:**

After successful completion of this course, the students should able to

CO1: Identify types of security attacks, services and mechanisms (K3)

CO2: Interpret the implementation of Internetwork security model and its standards (K3)

CO3: Illustrate Email privacy system and compare Pretty Good Privacy (PGP) and S/MIME (K3)

CO4: Interpret the primary components of a Three-Tier Architecture and explain how they work together firewall environment. (K3)

CO5: Explain how communication is secured and how traffic is routed in firewall environment (K3)

**Pre-requisite courses:** U18AII4201 Computer Networks

**CO/PO Mapping**

(S/M/W indicates the strength of correlation) S-Strong, M-Medium, W-Weak

| COs | Programme Outcome (POs) | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 | PSO3 |
| CO1 | S | S | | | S | | | | | | | | M | | |
| CO2 | S | M | M | | | | | | | | | | | | |
| CO3 | S | M | | | | | | | | | | | | | |
| CO4 | S | S | | | S | | | | | | | | | M | |

**Topics covered:**

| NETWORK SECURITY BASICS | 6 Hours |
|---|---|

Security Attacks (Interruption, Interception, Modification and Fabrication), Security Services (Confidentiality, Authentication, Integrity, Non-repudiation, access Control and Availability) and Mechanisms, A model for Internetwork security, Internet Standards and RFCs, Buffer overflow & format string vulnerabilities, TCP session hijacking, ARP attacks, route table modification, UDP hijacking, and man-in-the-middle attacks.

| NETWORK SECURITY ALGORITH | 6 Hours |
|---|---|

Conventional Encryption Principles, Conventional encryption algorithms, cipher block modes of operation, location of encryption devices, key distribution Approaches of Message Authentication, Secure Hash Functions and HMAC

| EMAIL SECURITY | 6 Hours |
|---|---|

Email privacy: Good Privacy (PGP) and S/MIME.IP Security Overview, IP Security Architecture, Authentication Header, Encapsulating Security Payload, Combining Security Associations and Key Management

| NETWORK SECURITY MANAGEMENT | 6 Hours |
|---|---|

Deploying Smart Console - Security Management Server - Security Gateway - Configuring Objects in Smart Console-Establishing Secure Internal Communication - Managing Administrator Access - Managing Licenses - Creating a Security Policy -Configuring Order Layers.

| NETWORK SECURITY CONFIGURATION | 6 Hours |
|---|---|

Configuring a Shared Inline Layer - Configuring NAT - Integrating Security with a Unified Policy - Elevating Security with Autonomous -Threat Prevention - Configuring a Locally Managed Site-to-Site VPN - Elevating Traffic View - Monitoring System States - Maintaining the Security Environment.

**SAMPLE LAB EXPERIMENT:**

1. Deploying Smart Console
2. Installing a Security Management Server and Security Gateway
3. Managing Administrator Access
4. Configuring Objects in Smart Console
5. Creating a Security Policy
6. Configuring NAT
7. Integrating Security with a Unified Policy
8. Elevating Security with Autonomous Threat Prevention
9. Configuring a Locally Managed Site-to-Site VPN
10. Elevating Traffic View
11. Monitoring System States and Maintaining the Security Environment

| Theory: 30 Hrs | Tutorial: 0 Practical: 30 | Total Hours: 60 Hrs |
|---|---|---|

**REFERENCES**


1. Network Security Essentials (Applications and Standards) by William Stallings Pearson Education 2018.
2. Hack Proofing your network by Ryan Russell, Dan Kaminsky, Rain Forest Puppy, Joe Grand, David Ahmad, Hal Flynn Ido Dubrawsky, Steve W.Manzuik and Ryan Permeh, Wiley Dreamtech Published by Syngress, 2002
3. Network Security and Cryptography: Bernard Menezes, CENGAGE Learning, 2010
4. Network Security - Private Communication in a Public World by CharlienKaufman, Radia Perlman and Mike Speciner, Pearson/PHI 2002
5. Cryptography and network Security, Third edition, Stallings, PHI/Pearson 4. Principles of Information Security, Whitman, Cengage Learning, 2006


**ONLINE LEARNING MATERIALS**

1. https://www.checkpoint.com/mind/secureacademy#

| U18CSE0227 | DIGITAL FORENSICS | L | T | P | J | C |
|---|---|---|---|---|---|---|
| | | 2 | 0 | 2 | 0 | 3 |

**Course Outcomes:**

After successful completion of this course, the students should able to

CO1: Illustrate the digital forensics process and digital evidence acquisition. (K3)

CO2: Explain file systems and data recovery procedures. (K3)

CO3: Demonstrate computer, network and mobile forensics with specialized tools. (K3)

CO4: Analyze malware and report the relevant incident. (K3)

CO5: Utilize the forensics toolkit for efficient investigation and understand the legal aspects of digital forensics. (K3)

**Pre-requisite courses:** U18AII4201 Computer Networks

**CO/PO Mapping**

(S/M/W indicates the strength of correlation) S-Strong, M-Medium, W-Weak

| COs | Programme Outcome (POs) | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 | PSO3 |
| CO1 | M | M | | | M | | | | | | | | | | |
| CO2 | M | M | | | | | | | | | | | | | |
| CO3 | M | M | | | M | | | | | | | | | | M |
| CO4 | M | M | | M | M | | | | | | | | | | |
| CO5 | M | | | | M | | | | | | | | | | M |

**Topics covered:**

| OVERVIEW OF DIGITAL FORENSICS | 6 Hours |
|---|---|

Understanding the role of digital forensics in investigations. Legal and Ethical Considerations: Adhering to legal and ethical standards in digital investigations. Digital Forensics Process: Introduction to the forensic investigation process.

**Digital Evidence Acquisition:** Types of Digital Evidence: Identifying and classifying digital evidence. Evidence Acquisition Tools: Using tools for acquiring data from different devices. Forensic Imaging: Creating forensic images of storage media

**FILE SYSTEMS AND DATA RECOVERY** **6 Hours**

File System Analysis: Understanding file systems and their structures. Deleted File Recovery: Techniques for recovering deleted files. File Carving: Extracting files from unallocated space.

| COMPUTER, NETWORK AND MOBILE DEVICE FORENSICS | 6 Hours |
|---|---|

Computer Forensics: Investigating computers for evidence- Network Forensics: Analysing network traffic and logs- Memory Forensics: Examining volatile memory for evidence.
Mobile Device Investigation: Extracting evidence from smartphones and tablets. App and Cloud Forensics: Investigating applications and cloud-based services. Challenges in Mobile Forensics: Addressing unique challenges in mobile investigations.

| MALWARE ANALYSIS | 6 Hours |
|---|---|

Introduction to Malware - Understanding different types of malware- Static and Dynamic Analysis: Analysing malware behaviour and code.
Responding to malware incidents- Incident Response and Forensic Tools- Incident Response Planning: Preparing for and responding to security incidents. Introduction to bug bounty – Working of bug bounty - Bug bounty program examples – Setting up bug bounty program.

| AUTOMATED FORENSICS | 6 Hours |
|---|---|

Introduction to popular forensic tools- Automated Forensics: Leveraging automation for efficient investigations-Automated Forensics: Leveraging automation for efficient investigations.

**Legal Aspects of Digital Forensics:** Expert Witness Role: Preparing for and testifying in court- Digital Forensics Laws and Regulations: Understanding legal frameworks - Case Studies: Analysing legal cases involving digital forensics.

**SAMPLE LAB EXPERIMENT:**

1. Use Autopsy tools to Identify and classify the digital evidence.
2. Demonstrate the data recovery techniques.
3. Demonstrate the process of analysing the network traffic and logs.
4. Demonstration of extracting the evidence from mobile phone.
5. Analyse the malware behaviour and its code.

| Theory: 30 Hrs | Tutorial: 0 Practical: 30 | Total Hours: 60 Hrs |
|---|---|---|

**REFERENCES**


1. Digital Forensics by André Årnes, Released July 2017,Publisher(s): Wiley, ISBN: 9781119262381.
2. Digital forensics and cybercrime : 10th International EAI Conference, ICDF2C 2018, New Orleans, LA, USA, September 10-12, 2018, Proceedings.
3. Cybercrime and Digital Forensics : An cybercrime And Digital Forensics : An Introduction, 3rd Edition May 2022 by Adam M. Bossler, Kathryn C. Seigfried-Spellar, Thomas J. Holt.


**ONLINE LEARNING MATERIALS**


1. https://www.coursera.org/learn/digital-forensics-concepts
2. https://www.udemy.com/course/ifci-expert-cybercrime-investigators-course/?gad_source=1&gclid=CjwKCAiApuCrBhAuEiwA8VJ6JtQFDivymnmlFeE1agIwADZlrJE8xv8piHikMZLKreNBO9e0AlAL-hoCVbsQAvD_BwE&matchtype=b&utm_campaign=LongTail_la.EN_cc.INDIA&utm_content=deal4584&utm_medium=udemyads&utm_source=adwords&utm_term=_._ag_84769189328_._ad_670210149092_._kw_digital+forensics+course_._de_c_._dm__._pl__._ti_kwd-323936302499_._li_9298970_._pd__._
3. https://www.open.edu/openlearn/science-maths-technology/digital-forensics/content-section-0?active-tab=content-tab
4. https://www.edx.org/learn/computer-forensics/rochester-institute-of-technology-computer-forensics
5. What Is a Bug Bounty? [3 Bug Bounty Program Examples] (hackerone.com)

# Automation and Artificial Intelligence

| U18AIE0214 | GENERATIVE AI | L | T | P | J | C |
|---|---|---|---|---|---|---|
| | | 2 | 0 | 2 | 0 | 3 |

**Course Outcomes:**

After successful completion of this course, the students should able to

CO1: Acquire insights into the key technological trends driving generative AI models (K3)

CO2: Acquire the ability to apply effective prompt engineering techniques to enhance the performance and control the behaviour of generative AI models (K4)

CO3: Build, train and apply generative models and develop familiarity with platforms (K4)

CO4: Ability to comprehend ethical issues and limitations of generative AI models(K3)

**Pre-requisite courses:** U18AII2205 Introduction to AI & ML

**CO/PO Mapping**

(S/M/W indicates the strength of correlation) S-Strong, M-Medium, W-Weak

| COs | Programme Outcome (POs) | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 | PSO3 |
| CO1 | M | M | | | | | | | M | | | M | | | |
| CO2 | | S | S | M | S | M | S | S | M | M | S | M | S | M | M |
| CO3 | | | S | M | S | M | S | S | M | M | S | M | S | M | M |
| CO4 | | | | M | | M | S | S | M | | | M | | | M |

**Topics covered:**

| INTRODUCTION TO GENERATIVE AI | 5 Hours |
|---|---|

Capabilities - History and Evolution -Benefits- Challenges - Applications of Generative AI – Tools for Text, Image Code, Audio and Video generation– Economic Potential of Generative AI - Use cases

| PROMPT ENGINEERING TECHNIQUES AND APPROACHES | 6 Hours |
|---|---|

Prompt Creation -Writing effective prompts -Techniques for using text prompts: Zero shot and few-shot prompt techniques – Prompt engineering approaches: Interview pattern, Chain-of Thought, Tree-of Thought - Benefits of using text prompts - Challenges in generating meaningful and coherent prompts.

| MODELS FOR GENERATIVE AI | 7 Hours |
|---|---|

Basics of Sequential data processing – Building blocks of Generative AI - Discriminative modelling – Generative modelling –Recurrent Neural Networks – Long Short-Term Memory (LSTM) Networks - Generative Adversarial Networks (GANs) - Variational Autoencoders (VAEs) – Transformer–based Models - Diffusion models- Applications

| PLATFORMS FOR GENERATIVE AI | 7 Hours |
|---|---|

Introduction to Platforms – Features of platforms – Capabilities -Applications - Pre-trained Models - Challenges – Generation of Text to Text – Generation of Text to Image – Text to Code Generation – Explainable AI – Benefits – Use cases.

| ETHICAL ISSUES AND LIMITATIONS OF GENERATIVE AI | 5 Hours |
|---|---|

Limitations of Generative AI – Issues and concerns – Considerations for Responsible Generative AI – Economic Implications – Social Implications – Future and professional Growth of Generative AI.

**LAB COMPONENT**

Sample List of Experiments:

1. Generate text using Generative AI
2. Text Generation using ChatGPT and Bard
3. Image Generation using GPT and Stable Diffusion
4. Code Generation
5. Experimenting with Prompts
6. Approaches in Prompt Engineering
    - Chain-of-Thought Approach
    - Interview Pattern Approach
    - Tree-of-Thought Approach
7. Effective Text Prompts for Image Generation
8. Develop AI Applications with the Foundation Models
9. Develop AI Applications for Code Generation

| Theory: 30 Hrs | Tutorial: 0 Practical: 30 | Total Hours: 60 Hrs |
|---|---|---|

## REFERENCES


1. Deep Learning: Teaching Machines to Paint, Write, Compose and Play, David Foster, 2023. 2nd edition. O'Reilly Media, Inc.
2. Deep Learning, Ian Goodfellow, Yoshua Bengio, Aaron Courville, MIT Press, 2016.
3. Hands-on Generative Adversarial Networks with Keras, Rafael Valle. Packt Publisher, 2019


## ONLINE LEARNING MATERIALS


1. https://www.coursera.org/learn/generative-ai-introduction-and-applications?specialization=generative-ai-for-everyone
2. https://www.coursera.org/learn/generative-ai-prompt-engineering-for-everyone?specialization=generative-ai-for-everyone
3. https://www.coursera.org/learn/generative-ai-foundation-models-and-platforms?specialization=generative-ai-for-everyone
4. https://www.coursera.org/learn/generative-ai-ethical-considerations-and-implications?specialization=generative-ai-for-everyone

| U18AIE0015 | RESPONSIBLE AI | L | T | P | J | C |
|---|---|---|---|---|---|---|
| | | 3 | 0 | 0 | 0 | 3 |

**Course Objectives:**

**Course Outcomes:**

After successful completion of this course, the students should able to

CO1: Comprehend the fundamental concepts of AI, recognize ethical considerations, and analyze biases and limitations through real-world case studies.(K3)

CO2: Apply ethical theories and principles to implement responsible AI practices, emphasizing accountability, responsibility, and transparency.(K3)

CO3: Evaluate the importance of interpretability, categorize methods, and apply them to models, ensuring effective communication of results(K3)

CO4: Attain a comprehensive understanding of data privacy principles, employ effective privacy-preserving techniques in AI applications, and critically assess real-world instances emphasizing the equilibrium between privacy and utility(K4)

CO5: Assess ethical reasoning approaches, design moral agents, and implement ethical deliberation, governance, and inclusion for responsible AI practices(K4)

**Pre-requisite courses:** U18AII2205 Introduction to AI & ML

**CO/PO Mapping**

(S/M/W indicates the strength of correlation) S-Strong, M-Medium, W-Weak

| COs | Programme Outcome (POs) | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 | PSO3 |
| CO1 | S | M | M | M | S | | S | | S | | S | S | S | S | |
| CO2 | S | M | M | M | S | | S | | S | | S | S | S | S | |
| CO3 | S | M | M | M | S | | S | | S | | S | S | S | S | |
| CO4 | S | M | M | M | S | | S | | S | | S | S | S | S | |
| CO5 | S | M | M | M | S | | S | | S | | S | S | S | S | |

**Topics covered:**

| INTRODUCTION | 11 Hours |
|---|---|

Autonomy – Adaptability – Interaction – Need for Ethics in AI - Fairness and Bias: Sources of Biases – Exploratory data analysis, limitations of a dataset – Group fairness and individual fairness – Counterfactual fairness - AI harms – AI risks : Case Study

| ETHICAL DECISION MAKING | 8 Hours |
|---|---|

Seven Principles of Responsible AI - Ethical theories – Values - Ethics in practice – Implementing Ethical Reasoning – The ART of AI : Accountability, Responsibility, Transparency

| INTERPRETABILITY AND EXPLAINABILITY | 10 Hours |
|---|---|

Importance of Interpretability – Taxonomy of Interpretability Methods – Scope of Interpretability – Evaluation of Interpretability – Interpretable Models: Linear Regression – Logistic Regression – Decision Tree.

| PRIVACY PRESERVATION | 8 Hours |
|---|---|

Introduction to data privacy - Methods of protecting data - Importance of balancing data privacy and utility - Attack model – Privacy Preserving Learning - Differential Privacy – Federated Learning – Case Study.

| ENSURING RESPONSIBLE AI | 8 Hours |
|---|---|

Approaches to Ethical Reasoning by AI – Designing Artificial Moral Agents – Implementing Ethical Deliberation – Levels of Ethical Behaviour – The ethical status of AI system – Governance for Responsible AI – Codes of Conduct – Inclusion and Diversity

| Theory: 30 Hrs | Tutorial: 0 | Total Hours: 30 Hrs |
|---|---|---|

**REFERENCES**


1. Virginia Dignum, "Responsible Artificial Intelligence: How to Develop and Use AI in a Responsible Way" Springer Nature, 2019.
2. Christoph Molnar "Interpretable Machine Learning".Lulu, 1st edition, 2019.
3. Beena Ammanath, " Trustworthy AI", Wiley, 2022.
4. Adnan Masood, Heather Dawe, Dr. Ehsan Adeli, " Responsible AI in the Enterprise", Packt Publishing, 2023.


**ONLINE LEARNING MATERIAL**

1. https://www.coursera.org/programs/coursera-for-campus-faculty-ovg1y/learn/introduction-to-responsible-ai?source=search.
2. https://www.coursera.org/programs/coursera-for-campus-faculty-ovg1y/learn/responsible-ai-in-generative-ai?source=search

**U18AIE0212 INTELLIGENT AUTOMATION SYSTEM**

**COURSE OUTCOMES:**

**After successful completion of this course, the students should be able to**

**CO1:** Analyze and articulate the benefits of implementing automation in production systems [K4]

**CO2:** Identify industries best-suited for RPA adoption and evaluate case studies showcasing successful RPA implementations [K4]

**CO3:** Develop automation solutions with practical examples using Sequence and Flowchart activities [K3]

**CO4:** Implement best practices in recording and selector strategies to optimize automation workflows [K3]

**Pre–requisite:** U18AII2205 Introduction to AI & ML

| COs | CO/PO MAPPING (S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak | | | | | | | | | | | | CO/PSO Mapping | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | PROGRAMME OUTCOMES (POs) | | | | | | | | | | | | PSOs | | |
| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 | PSO3 |
| CO1 | M | S | M | S | | | M | M | | | | M | | M | M |
| CO2 | M | S | M | S | M | | M | M | | | | M | | M | M |
| CO3 | S | M | S | M | | | | | | | | M | | S | |
| CO4 | S | M | S | M | | | | | | | | M | | S | |

**THEORY COMPONENT CONTENT**

**INTRODUCTION TO AUTOMATION 7 Hours**

Automation in production system-Automation principles and strategies-Basic elements of an automated system-advanced automation Functions-levels of Automation-Hardware components for automation-sensors and actuators- Benefits of Automation -Limitations to Automation.

**RPA AND ITS PLATFORMS 7 Hours**

Introduction to Robotic Process Automation- Benefits of RPA- Overview of Industries Best-Suited for RPA- Advancements in RPA and Its Integration with AI. Components of RPA- RPA Platforms-About Ui Path- The future of automation.

**WORKFLOW AND CONTROL FLOW 8 Hours**

Sequencing the workflow Activities-Control flow, various types of loops, and decision-making using Sequence and Flowchart-Data Manipulation-Variables and Scope Collections-Arguments -Data table usage with examples -Clipboard Management-File operation mouse and keyboard activities- Working with UiExplorer- Handling events- Screen Scraping.

**RECORDERS, SELECTORS 8 Hours**

UiPath Studio Recording -Recorder Overview-Components of Recording Wizard-Comparison of Recording Types-Automatic Recording Activities-Manual Recording activities -Basic Recorder-Desktop Recorder-Web Recorder-Selector-Selector Editor-Selectors with wild cards-UI Explorer in Selector-UI Explorer Window-Full Selectors and Partial Selectors-Errors, Exception and Debugging.

**LAB CONTENTS**

Sample list of Experiments:

1. Study on UI path Tool
2. Recording Modes
3. Notepad/Word Automation
4. Screen Scrapping Techniques to extract text from Images/Web/Document
5. YouTube Search Engine-BMI Calculator Robot-Excel Automation Basics
6. Fees Concession Robot
7. PDF Automation
8. Invoice Automation Robot
9. Exception Handling / Running Multiple Robots
10. Data Scrapping (Web) with AI Techniques in UiPath
11. Gmail Automation Robot
12. Orchestrator - UiPath Dashboard

| | | | | |
|---|---|---|---|---|
| **Theory: 30** | **Tutorial:0** | **Practical: 30** | **Project :0** | **Total:60 Hours** |

**REFERENCES**


1. M.P.Groover, "Automation, Production Systems and Computer Integrated Manufacturing", 4th edition, Pearson Education, 2016.
2. Tom Taulli, The Robotic Process Automation Handbook : A Guide to Implementing RPA Systems,2020, ISBN-13 (electronic): 978-1-4842-5729-6, Publisher : A press,
3. Frank Casale, Rebecca Dilla, Heidi Jaynes ,Lauren Livingston, "Introduction to Robotic Process Automation: a Primer", Institute of Robotic Process Automation.2015.
4. Richard Murdoch, Robotic Process Automation: Guide To Building Software Robots, Automate Repetitive Tasks & Become An RPA Consultant,2018.


**ONLINE LEARNING MATERIALS**

1. https://www.coursera.org/specializations/roboticprocessautomation
2. https://www.coursera.org/professional-certificates/google-it-automation.

# Data Science, Analytics and Visualization

| U18AIE0217 | DATA PROCESSING TECHNIQUES | L | T | P | J | C |
|---|---|---|---|---|---|---|
| | | 2 | 0 | 2 | 0 | 3 |

**Course Outcomes:**

After successful completion of this course, the students should able to

CO1: Analyze the data processing concepts in data science .(K4)

CO2: Apply the Real time data processing in machine learning model(K3)

CO3: Illustrate the change Data capture Techniques And Strategies in Incremental Processing.(K4)

CO4: Apply the Learning algorithms for incremental processing in data.(K3)

CO5: Correlating the Traditional disk system with In-Memory Database(K4)

**Pre-requisite courses:** U18AII2206 Introduction to Data Science

**CO/PO Mapping**

(S/M/W indicates the strength of correlation) S-Strong, M-Medium, W-Weak

| COs | Programme Outcome (POs) | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 | PSO3 |
| CO1 | S | S | | | | M | | | S | | S | S | | | |
| CO2 | S | S | | S | | | | | | | | | | S | |
| CO3 | S | | S | | | | | | | | | | | | |
| CO4 | S | | | S | | | | | | | | | | S | |
| CO5 | | | | | | | | | | | | | | | |

**Topics covered:**

| THEORY COMPONENT CONTENT DATA PROCESSING | 8 Hours |
|---|---|

Overview of Data processing in Datascience–Importance of Efficiency and Scalability –, challege in Big Data Processing– Parallel and Distributed Processing – Apache hadoop– Map reduce – Integration of Data mining system with a Data warehouse–Major issues in Data Mining–Data Preprocessing.

| REAL TIME DATA PROCESSING | 7 Hours |
|---|---|

Streaming Data Architectures–Message Brokers –Pub/Sub Systems– Queues– Apache-kafka for Real Time Data streaming– Producers-consumers-Kafka connect for Data Integration-stream processing-Frame works-Real Time analytics -Machine learning models

| INCREMENTAL PROCESSING | 8 Hours |
|---|---|

Incremental processing in Data science–Change Data Capture Techniques(CDC)-Strategies-Delta Processing for incremental updates- Incremental Learning algorithms.

| SAMPLE LAB CONTENTS | 30 Hours |
|---|---|

1. Implement a program using the environment Apache Flink
2. Implementation of producer and consumer program using kafka
3. Implement a simple flink streaming application.
4. Explore and connect flink application to kafka for Real time data ingestion
5. Design and Deploy simple strom topology
6. Develop a real-time analytics application with a simple machine learning model.
7. Implement mechanisms for model updates in response to streaming data changes.

| Theory: 30 Hrs | Tutorial: 0 | Practical:30 | Total Hours: 60 Hrs |
|---|---|---|---|

**REFERENCES**


1. Practical Real-time Data Processing and Analytics: Distributed Computing and Event Processing using Apache Spark, Flink, Storm, and Kafka by shilpi Saxena and sharub gupta 1st Edition, Kindle Edition 2017
2. "Data Warehouse ETL Toolkit: Practical Techniques for Extracting, Cleaning, Conforming, and Delivering Data" by Ralph Kimball and Joe Caserta 1st Edition 2004
3. Building a Scalable Data Warehouse with Data Vault 2.0" by Dan Linstedt 2015
4. High Performance Spark: Best Practices for Scaling and Optimizing Apache Spark by Holden karau,Rachel warren 2017 1st edition


**ONLINE LEARNING MATERIALS**

1. https://www.coursera.org/videos/big-data-integration-processing/zBKt2?query=IN+MEMEORY+DATA+PROCESSING&source=search
2. https://www.coursera.org/videos/machine-learning-accounting-python/j3M5H?source=search&source=search&query=data%20preprocessing

| U18AIE0218 | DATA MODELING | L | T | P | J | C |
|---|---|---|---|---|---|---|
| | | 2 | 0 | 2 | 0 | 3 |

**Course Outcomes:**

After successful completion of this course, the students should able to

CO1: Apply MySQL Workbench to design database model(K3)

CO2: Apply logical Data model to design Patterns(K3)

CO3: Design Geospatial data models for applications involving location-based analytics(K6)

CO4: Analyze and choose appropriate NoSQL and NewSQL databases for specific modeling requirements.(K4)

**Pre-requisite courses:** U18AII2206 Introduction to Data Science

**CO/PO Mapping**

(S/M/W indicates the strength of correlation) S-Strong, M-Medium, W-Weak

| COs | Programme Outcome (POs) | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 | PSO3 |
| CO1 | | | | | S | | | | | | | | | | |
| CO2 | | | | | S | | | | | | | | S | | |
| CO3 | S | S | S | | | S | | | | | | | | | |
| CO4 | S | S | S | | S | | | | | | | | S | | |

**Topics covered:**

| INTRODUCTION TO ADVANCED DATA MODELING | 6 Hours |
|---|---|

Overview of Data Modeling in Data science– Importance of Advanced data Modeling – Types of data Model– Dimensional modelling-Design-MySQL Workbench- Build Data model using MySQL workbench– Forward Engineering Feature-Converting Data model into Database schema,MySQL to reverse Engineering schema

| LOGICAL DATA MODEL | 6 Hours |
|---|---|

Cross enterprise Analysis- Modern Driven analysis-Baseline data patterns-complex data Patter Generation of Entity types-Transition from meta data to data-static vs dynamic Entitytypes-c coupling -cohesion.

| ADVANCED DATA PATTERNS | 6 Hours |
|---|---|

Advanced subtype variations-Multi recursive networks-conditional Recursions-Rules based en types-state Transition rules-Meta patterns.

| GRAPH AND TEMPORAL DATA MODELING | 6 Hours |
|---|---|

Graph Databases – Nodes – Edges – Properties– Graph query Languages – Understanding Tempo Databases – Valid time vs Transition Time– Temporal Datamining Techniques – Temporal qu languages; No-SQL-New SQL: CAP theorem – Document-based: MongoDB data model and CR operations.

| GEOSPATIAL AND METADATA MODELING | 6 Hours |
|---|---|

Representing geospatial data in models-Geospatial Query Language-Applications in Mapping and Location-based Analytics-Metadata Definition and Importance-Encryption and Masking in Data Models-Access Controls and Authorization

| SAMPLE LAB CONTENTS | 30 Hours |
|---|---|

1. Explore a sample dataset and identify dimensions and facts.
2. Design and Implement schema for a dataset using MySQL workbench.
3. Design and implement a graph Data model for any dataset.
4. Implement a temporal data model for historical dataset
5. create Geospatial data models for location analyses
6. Explore the GEOJSON to represent spatial data.
7. create and manage a metadata for given dataset

| Theory: 30 Hrs | Tutorial: 0 Practical: 30 | Total Hours: 30 Hrs |
|---|---|---|

**REFERENCES**


1. The Data Warehouse Toolkit: The Definitive Guide to Dimensional Modeling". Authors: Ralph Kimball and Margy Ross 2013 3rd Edition
2. Designing Data-Intensive Applications: The Big Ideas Behind Reliable, Scalable, and Maintainable Systems (Greyscale Indian Edition) 2017.
3. Data Modeling Made Simple: A Practical Guide for Business & IT Professionals Authors:Steve Hoberman: 2nd Edition.2009


**ONLINE LEARNING MATERIALS**


1. https://www.coursera.org/lecture/advanced-data-modeling/introduction-to-advanced-data-modeling-eqENZ
2. https://www.coursera.org/learn/sql-data-science
3. https://www.coursera.org/learn/advanced-data-modeling
4. https://www.coursera.org/learn/nosql-databases
5. https://www.coursera.org/specializations/databases-for-data-scientists

| U18AIE0220 | BUSINESS INTELLIGENCE FOR DECISION MAKING | L | T | P | J | C |
|---|---|---|---|---|---|---|
| | | 2 | 0 | 2 | 0 | 3 |

**Course Objectives:**

**Course Outcomes:**

After successful completion of this course, the students should able to

CO1: Analyze the real world business problems and model with analytical solutions.(K4)

CO2: Evaluate the business processes for extracting Business Intelligence(K4)

CO3: Apply predictive analytics for business fore-casting.(K3)

CO4: Apply analytics for supply chain and logistics management(K3)

CO5: Use analytics for marketing and sales.(K3)

**Pre-requisite courses:** U18AII2206 Introduction to Data Science

**CO/PO Mapping**

(S/M/W indicates the strength of correlation) S-Strong, M-Medium, W-Weak

| COs | Programme Outcome (POs) | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 | PSO3 |
| CO1 | S | S | | | S | S | | | | S | | S | | | |
| CO2 | | | | S | | | | | | | | | | | |
| CO3 | | | S | | | S | | | | | | | | | |
| CO4 | | | S | | S | | | | | | | | S | S | S |
| CO5 | | | S | | S | | | | | | | | S | S | M |

**Topics covered:**

| INTRODUCTION TO BUSINESS ANALYTICS | 6 Hours |
|---|---|

Analytics and Data Science – Types of Analytics – Business Problem Definition – Data Collectio Data Preparation – Hypothesis Generation – Modeling – Validation and Evaluation – Interpretatio Deployment and Iteration

| BUSINESS INTELLIGENCE | 6 Hours |
|---|---|

Data Warehouses and Data Mart - Knowledge Management –Types of Decisions - Decision Mak Process - Decision Support Systems – Business Intelligence –OLAP – Analytic functions.

| BUSINESS FORECASTING AND COMPETITIVE ANALYSIS | 6 hours |
|---|---|

Introduction to Business Forecasting and Predictive analytics - Logic and Data Driven Models – D Mining and Predictive Analysis Modelling –Machine Learning for Predictive analytics-Indus analysis- Profit Frontier, Risk vs Return, Competition Positioning- Enterprise Diagnosis

| ANALYTICS | 6 Hours |
|---|---|

Human Resources – Planning and Recruitment – Training and Development - Supply chain netwo Planning Demand, Inventory and Supply – Logistics – Analytics applications in HR- Applying Analytics to make a prediction of the demand for talent.

| MARKETING & SALES ANALYTIC | 6 Hours |
|---|---|

Marketing Strategy, Marketing Mix, Customer Behaviour –selling Process – Sales Planning Analytics applications in Marketing and Sales - predictive analytics for customers' behaviour marketing and sales.

| SAMPLE LAB CONTENTS | 30 Hour |
|---|---|

1. Explore the interface and basic features of the BI tool(Qlik)
2. Load and visualize a sample dataset.
3. Import a dataset into the BI tool. And Cleanse data by handling missing values, outliers, and inconsistencies.
4. Transform data to suit BI reporting requirements and Design a dashboard with key performance indicators (KPIs).
5. Develop interactive dashboards for dynamic data exploration.
6. Integrate data from various sources for comprehensive analysis
7. Implement advanced chart types (treemaps, heatmaps, etc.).
8. Apply BI tools for forecasting and predictive analytics.

| Theory: 30 Hrs | Tutorial: 0 Practical: 30 | Total Hours: 60 Hrs |
|---|---|---|

**REFERENCES**


1. R. Evans James, Business Analytics, 2nd Edition, Pearson, 2017
2. R N Prasad, Seema Acharya, Fundamentals of Business Analytics, 2nd Edition, Wiley, 2016
3. Philip Kotler and Kevin Keller, Marketing Management, 15th edition, PHI, 2016
4. VSP RAO, Human Resource Management, 3rd Edition, Excel Books, 2010.
5. Mahadevan B, "Operations Management -Theory and Practice",3rd Edition, Pearson Education,2018.


**ONLINE LEARNING MATERIALS**

1. https://www.coursera.org/learn/data-analytics-business
2. https://www.coursera.org/learn/foundations-of-business-intelligence
3. https://www.coursera.org/specializations/bi-foundations-sql-etl-data-warehouse

| U18AIE0021 | DATA ETHICS AND PRIVACY | L | T | P | J | C |
|---|---|---|---|---|---|---|
| | | 3 | 0 | 0 | 0 | 3 |

**Course Objectives:**

**Course Outcomes:**

After successful completion of this course, the students should able to

CO1: Develop an awareness of the impact of data-related decisions on individuals and society (K6)

CO2: Identify the challenges and consequences of Biased datasets. (K4)

CO3: Examine the importance of Data security and Accuracy (K3)

CO4: Apply the aspects of distributed data and associated risks(K3)

CO5: Apply the knowledge of encryption for data(K3)

**Pre-requisite courses:** U18AII2206 Introduction to Data Science

**CO/PO Mapping**

(S/M/W indicates the strength of correlation) S-Strong, M-Medium, W-Weak

| COs | Programme Outcome (POs) | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 | PSO3 |
| CO1 | S | | M | | | | | | | M | | M | | M | |
| CO2 | S | | M | | | | | | | M | | M | | M | |
| CO3 | | S | | M | | | | | | | | | | | S |
| CO4 | | S | | M | | | | | | | | | | | S |

**Topics covered:**

| THEORY COMPONENT CONTENT DATA BIAS | 8 Hours |
|---|---|

Introduction,- Data vs Information vs Facts- Algorithmic Bias- Privacy- Biased Datasets- Purpos Corporation/AI- Fairness, Predictive Analytics & Mistakes- Surveillance & Power- Dispa Treatment/Impact

| ETHICS IN DATA SCIENCE | 9 Hours |
|---|---|

Ethics in data management- Role of AI Ethics in Corp- Privacy & Shared Responsibil Surveillance/Power and Shared Responsibility- Disparate Treatment/Impact- Economics of Tr Transparency vs accountability.

| ACCURACY AND PRIVACY | 10 Hours |
|---|---|

Creating & Measuring Accuracy- Data Science Ethics- Data Science Hate Privacy- Respecting Data Science- Misconceptions About Data Science Ethics- Accountability and Governance- Data Provenance and Aggregation

| PRIVACY ATTACKS | 9 Hours |
|---|---|

Defining Differential Privacy- Privacy Loss- Privacy attacks- Types of privacy attacks- Priva Aware Machine Learning and Data Science- Architecting Privacy in Data and Machine Learni Open Source Libraries for PPML Projects- Distributed Data- Federated Learning

| DATA ENCRYPTION FOR PRIVACY | 9 Hours |
|---|---|

Encrypted Computation- Types of Encrypted Computation- Real-World Encrypted Computati Navigating the Legal Side of Privacy- GDPR: An Overview- Privacy and Practica Considerations- Getting Practical: Managing Privacy and Security Risk

| Theory: 45 Hrs | Tutorial: 0 | Practical: 0 | Total Hours: 45 Hrs |
|---|---|---|---|

**REFERENCES**


1. Katharine Jarmul, Practical Data Privacy Released April 2023 Publisher(s): O'Reilly Media, Inc. ISBN: 9781098129460
2. Loukides, Mike, Hilary Mason, and DJ Patil. 2018. Ethics and Data Science. Sebastopol, CA: O'Reilly Media.


**ONLINE LEARNING MATERIALS**

1. https://www.coursera.org/learn/data-science-ethics
2. https://www.coursera.org/learn/northeastern-data-privac

# Cloud Computing

| U18ITE0220 | VIRTUALIZATION AND RESOURCE MANAGEMENT | L | T | P | J | C |
|---|---|---|---|---|---|---|
| | | 2 | 0 | 2 | 0 | 3 |

**Course Objectives:**

**Course Outcomes:**

After successful completion of this course, the students should able to

CO1: Analyze the use of different resource virtualizations used in cloud environment (K4).

CO2: Apply the factors of cloud economics on migration and development (K3).

CO3: Develop applications in different public cloud platform (K3).

CO4: Select appropriate service model for an application(K3).

CO5: Choose a suitable cloud service provider based on application domain(K3).

**Pre-requisite courses:** U18AII3203 Operating System

**CO/PO Mapping**

(S/M/W indicates the strength of correlation) S-Strong, M-Medium, W-Weak

| COs | Programme Outcome (POs) | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 | PSO3 |
| CO1 | S | | | | M | | | M | | | M | S | | | |
| CO2 | S | M | | | | | | | | | M | S | | | |
| CO3 | S | | | M | | | M | M | M | | | S | | | M |
| CO4 | S | M | | | M | | | | | | M | S | | | M |
| CO5 | S | | M | M | | | | M | | | M | | | | M |

**Topics covered:**

| **VIRTUALIZATION** | **4 Hours** |
|---|---|

Roles of Virtualization, Hypervisor, Types of Virtualization – Server virtualization – Storage virtualization – Network virtualization – Desktop virtualization – Application Virtualization.

| **CLOUD ECONOMICS AND MIGRATION** | **5 Hours** |
|---|---|

Cost models and optimization, Economies of Scale, Resource Optimization, Reduced Capital Expenditure - Total Cost of Ownership (TCO), Cost Transparency and Management, Risk Mitigation and Security, Performance vs. Cost Trade-offs.
Cloud Migration Strategies, Iterative Seven-step Model of Migration into the Cloud, Assessment and Planning, Choosing the Right Cloud services and Provider, Change Management and Training, Performance and Monitoring, Testing and Validation, Backups, Post-Migration Optimization.

| **INFRASTRUCUTURE AS A SERVICE** | **7 Hours** |
|---|---|

Compute: AWS EC2, Azure Virtual Machines, Google Compute Engine. Containers – Microservices, Docker, Kubernetes containers. Storage: Amazon EBS, Amazon S3, Azure disk storage, Google cloud storage. Autoscaling – AWS autoscaling, Azure app service, Google compute engine. Load balancing – AWS ELB, Azure traffic manager, Google cloud load balancer. Network: Amazon VPC, Azure virtual network, Google cloud VPN.

| **PLATFORM AS A SERVICE** | **7 Hours** |
|---|---|

PaaS: Serverless computing - AWS Lambda, Azure functions, Google Cloud functions, AWS Apprunner, Elastic beanstalk, Google App engine, Google Cloud Functions, Amazon RDS, DynamoDB, Azure SQL database, Azure CosmosDB, Google cloud SQL, Google cloud database.

| **SOFTWARE AS A SERVICE** | **7 Hours** |
|---|---|

Amazon chime, Workmail, Workdocs, Microsoft 365, Microsoft power platform, Azure active directory, Azure DevOps, Azure IoT central, Azure cost management, Google Maps platform, Google workspace, Google analytics, Google cloud identity, Google Cloud search, Firebase.

**LAB CONTENTS:** Few exercise related to AWS, Azure, Google platform services that fall under IaaS, PaaaS and SaaS.

Sample Exercises:

1. Demonstrate the virtualization by enabling the OS virtualization on single machine by creating instances oracle virtual box/VMware.
2. Installation of VM Ware/ virtual box and implement multiple OS.
3. Creating VMs in public cloud.
4. Deploying application in Docker/Kubernetes.
5. Static Web site hosting
6. Dynamic Website hosting
7. Balancing network traffic using load balancer
8. Scale the Compute resource with auto scaling
9. E-mail notification using serverless architecture.
10. Configuring a cloud network

| **Theory: 30 Hrs** | **Tutorial: 0 Practical: 30** | **Total Hours: 60 Hrs** |
|---|---|---|

**REFERENCES:**


1. Dr. Rajesh Kumar Pathak , “Cloud Computing Fundamentals, Notion Press, 2023.
2. A. B. Lawal, “Cloud Computing Fundamentals: Learn the Latest Cloud Technology and Architecture with Real-World Examples and Applications”, A. B. Lawal publication, 2020.
3. Rajkumar Buyya, Christian Vecchiola, S.Thamarai Selvi, “Mastering Cloud Computing: Foundations and Applications Programming”, Morgan Kaufmann publications, 2013.
4. Cloudonomics: The Business Value of Cloud Computing" by Joe Weinman, John Wiley & Sons Inc, 2012.
5. Mastering AWS Development" by Uchit Vyas, Ingram short title, 2015.
6. Microsoft Azure Essentials - Fundamentals of Azure, Second Edition" by Michael Collier and Robin Shahan, Microsoft Press, 2015.
7. Google Cloud Platform for Developers: Build highly scalable cloud solutions with the power of Google Cloud Platform" by Ted Hunter and Steven Porter, Packt Publishing Limited, 2018.


**ONLINE LEARNING MATERIALS**

1. https://www.coursera.org/learn/cloud-computing-basics
2. https://www.coursera.org/learn/meta-cloud-computing
3. https://www.coursera.org/learn/cloud-computing-foundations-duke
4. https://www.coursera.org/browse/information-technology/cloud-computing
5. https://www.mygreatlearning.com/cloud-computing/courses
6. http://www.infocobuild.com/education/audio-video-courses/computer-science/CloudComputing-IIT-Kharagpur/lecture-12.html
7. https://www.coursera.org/specializations/aws-fundamentals
8. https://www.coursera.org/learn/cloud-azure-intro
9. https://www.coursera.org/learn/gcp-infrastructure-foundation

| U18ITE0222 | CLOUD STORAGE MANAGEMENT | L | T | P | J | C |
|---|---|---|---|---|---|---|
| | | 2 | 0 | 2 | 0 | 3 |

**Course Outcomes:**

After successful completion of this course, the students should able to

CO1: Make use of cloud storage technologies in applications (K3).

CO2: Correlate different storage networking technologies (K3).

CO3: Make use of the design principles of virtualization techniques in cloud resource management (K3)

CO4: Analyze different cloud storage life cycle strategies (K4).

CO5: Select appropriate backup and recovery strategies (K3).

**Pre-requisite courses:** U18AII3203 Operating System

**CO/PO Mapping**

(S/M/W indicates the strength of correlation) S-Strong, M-Medium, W-Weak

| COs | Programme Outcome (POs) | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 | PSO3 |
| CO1 | S | | | | | M | | | M | | M | | M | | |
| CO2 | M | M | M | | | | | | | M | | M | | M | |
| CO3 | M | S | S | | | | M | | | | | | | M | |
| CO4 | M | | | | M | | | | | | | | | M | |

**Topics covered:**

| INTRODUCTION TO CLOUD STORAGE | 7 Hours |
|---|---|

Overview of cloud storage concepts - Advantages and challenges of cloud storage - Comparison of traditional storage vs. cloud storage, Evolution of Storage Architecture, Data Center Infrastructure, **Storage Technologies :** Block, file, and object storage - Storage protocols (iSCSI, NFS, SMB, etc.) - Data replication, snapshots, and backups in the cloud.

| STORAGE NETWORKING TECHNOLOGIES | 8 Hours |
|---|---|

Network-Attached Storage: General-Purpose Servers versus NAS Devices, Benefits of NAS, File Systems and Network File Sharing, Components of NAS, NAS I/O Operation, NAS Implementations, NAS File-Sharing Protocols, Factors Affecting NAS Performance , File-Level Virtualization. Fibre Channel Storage Area Networks: Fibre Channel Overview, The SAN and Its Evolution, Components of FC SAN, FC Connectivity, Switched Fabric Ports, Fibre Channel Architecture, Fabric Services, Switched Fabric Login Types, Zoning, FC SAN Topologies, Virtualization in SAN. IP SAN and FCoE: iSCSI, FCIP, FCoE

| LIFE CYCLE MANAGEMENT AND SECURITY | 8 Hours |
|---|---|

Introduction to storage tiers **,** Different Storage Classes Offered by Cloud Providers - Choosing the Right Storage Class for Different Use Cases - Access Control and Security - Identity and Access Management (IAM) - Encryption in Transit and at Rest

| BACKUP AND DISASTER RECOVERY | 7 Hours |
|---|---|

Introduction to Business Continuity: Information Availability, BC Terminology, BC Planning Life Cycle, Failure Analysis, Business Impact Analysis, BC Technology Solutions. Backup and Archive: Backup Purpose, Backup Considerations, Backup Granularity, Recovery Considerations, Backup Methods, Backup Architecture, Backup and Restore Operations, Backup, Backup in NAS Environments, Backup Targets, Data Deduplication for Backup, Backup in Virtualized Environments, Data Archive, Archiving Solution Architecture

**LAB CONTENTS**

Attaching volume to instances, Creating snapshots from volumes, Migrating a file among different storage classes, Managing access control over a file/storage, Enabling client and server-side encryption for an object.

**Sample Exercise:**

1. Attaching volume to instances.
2. Creating snapshots for volumes.
3. Migrating a file among different storage classes.
4. Managing access control over a file/storage.
5. Enabling client and server side encryption for an object.

| Theory: 30 Hrs | Tutorial: 0 Practical: 30 | Total Hours: 60 Hrs |
|---|---|---|

**REFERENCES**


1. Data Intensive Storage Services for Cloud Environments by Athanasios Voulodimos, Dimosthenis P. Kyriazis, Spyridon V. Gogouvitis, Theodora Varvarigou, Business Science Reference, 2013.
2. Cloud Storage Management in Contemporary IT Environments by Michael O'Dell and Michael Corey, Packt Publishing, 2012.
3. Borko Furht, Armando Escalante Handbook of Cloud Computing, Springer Science+Business Media, LLC 2010
4. Information Storage and Management by Emc Education S, John Wiley & Sons, Incorporated, 2012.


**ONLINE LEARNING MATERIALS**


1. https://www.coursera.org/learn/data-storage-microsoft-azure
2. https://www.udemy.com/course/introduction-to-cloud-storage-apps-a-beginners-course/
3. https://www.coursera.org/learn/cloud-storage-big-data-analysis-sql

https://www.classcentral.com/course/linkedin-learning-learning-cloud-computing-cloud-storage-30444

| U18ITE0323 | CLOUD APPLICATION DEVELOPMENT | L | T | P | J | C |
|---|---|---|---|---|---|---|
| | | 2 | 0 | 2 | 0 | 3 |

**Course Outcomes:**

After successful completion of this course, the students should able to

| | |
|---|---|
| CO1: | Analyse the use cases for cloud application development (K4) |
| CO2: | Compare web and cloud application and analyze appropriate cloud platforms requirements (K3) |
| CO3: | Build applications using APIs and Cloud services (K3) |
| CO4: | Apply agile application development and manage application life cycle using DevOps (K3) |

**Pre-requisite courses:** U18AII4201 Computer Networks

**CO/PO Mapping**

(S/M/W indicates the strength of correlation) S-Strong, M-Medium, W-Weak

| COs | Programme Outcome (POs) | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 | PSO3 |
| CO1 | | M | M | | | | | | | | | | M | | |
| CO2 | | M | M | | S | | | | | M | | | M | | |
| CO3 | M | | | | S | | | | | | | S | | M | |
| CO4 | | S | | | M | | | | | M | | | | M | |

**Topics covered:**

| INTRODUCTION TO APLLICATION DESIGN | 6 Hours |
|---|---|

Business case for implementing cloud application, Requirements, collection for cloud applicat development, Cloud service models and deployment models, Open challenges in Cloud Computi Cloud inter-operability and standards, scalability and fault tolerance, security, trust and privacy.

| APPLICATION DEVELOPMENT FRAMEWORK | 8 Hours |
|---|---|

Accessing the clouds: Web application vs Cloud Application, Frameworks: Model View Contro (MVC), Struts, Spring. Cloud platforms in Industry – Google AppEngine, Microsoft Azu Openshift, CloudFoundry

| CLOUD SERVICE DELIVERY ENVIRONMENT AND API | 8 Hours |
|---|---|

Storing objects in the Cloud, Session management, Working with third party APIs: Overview interconnectivity in Cloud ecosystems. Facebook API, Twitter API, Google API. **Architecting the Cloud :** Best practices Best practices in architecture cloud applications in AWS cloud, Ama Simple Queue Service (SQS), RabbitMQ, Amazon Simple Notification Service (Amazon SN multi-player online game hosting on cloud resources, Building content delivery networks us clouds.

| DEVOPS IN CLOUD | 8 Hours |
|---|---|

Continuous Integration/Continuous Deployment (CI/CD), collaboration among developme operations, and other stakeholders, Agile and lean principles: Embracing agile methodologies a lean practices to enable faster development and delivery cycles. Automating development pipelir Monitoring and Logging, Implementing monitoring solutions for cloud applicatic Containerization: Docker basics and container orchestration with Kubernetes.

**PROJECT:**

Projects involving Google AppEngine, Microsoft Azure, Openshift, Cloud Foundry services will be done

| Theory: 30 Hrs | Tutorial: 0 | Project: 30 | Total Hours: 60 Hrs |
|---|---|---|---|

## REFERENCES


1. Cloud Application Architectures: Building Applications and Infrastructure in the Cloud by George Reese, Oreilly Publication, 2021.
2. Continuous Delivery: Reliable Software Releases through Build, Test, and Deployment Automation by Jez Humble and David Farley, 2020.


## ONLINE LEARNING MATERIALS

1. https://www.coursera.org/specializations/ibm-cloud-application-development-foundations
2. https://www.udemy.com/course/cloud-computing-development-essentials/
3. https://www.coursera.org/learn/cloud-native-devops-agile-nosql?specialization=ibm-cloud-application-development-foundations
4. https://www.edx.org/certificates/professional-certificate/ibm-cloud-and-application-development-foundations

| U18ITE0224 | CLOUD SECURITY | L | T | P | J | C |
|---|---|---|---|---|---|---|
| | | 2 | 0 | 2 | 0 | 3 |

**Course Outcomes:**

After successful completion of this course, the students should able to

CO1: Analyze the security breaches of IaaS, PaaS and SaaS. (K4)

CO2: Apply various data encryption methods and security mechanisms to get the administrative control using IAM service.(K3)

CO3: Inspect compliance, governance and risk management (K4)

CO4: Make use of CI/CD pipeline in application security (K3).

CO5: Analyze security in edge computing (k4)

**Pre-requisite courses:** U18AII4201 Computer Networks

**CO/PO Mapping**

(S/M/W indicates the strength of correlation) S-Strong, M-Medium, W-Weak

| COs | Programme Outcome (POs) | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 | PSO3 |
| CO1 | | | | M | | | | | | | | | | | M |
| CO2 | | | M | | | M | | | | | | M | | | |
| CO3 | | | | | S | M | | M | | | | | | M | |
| CO4 | | S | | M | | | | | | | | | | M | |
| CO5 | | M | | | M | | | | | | | | | M | |
| CO6 | | | | M | | | | | | | | | | | M |

**Topics covered:**

| INTRODUCTION TO CLOUD SECURITY | 6 Hours |
|---|---|

Overview of cloud computing and its security challenges - Importance of cloud security for organizations - Shared responsibility model in cloud security. **Cloud Service Models and Security:** Security considerations for IaaS, PaaS, and SaaS, Risks and security measures specific to each service model, Case studies highlighting security vulnerabilities in cloud services

| CLOUD SECURITY ARCHITECTURE AND DATA PROTECTION | 6 Hours |
|---|---|

Designing secure cloud architectures, Identity and access management (IAM) in the cloud Network security in a cloud environment. Encryption techniques for data at rest and in transit Key management best practices, Data loss prevention (DLP) strategies in the cloud

| COMPLIANCE, GOVERNANCE, AND RISK MANAGEMENT | 6 Hours |
|---|---|

Compliance requirements in the cloud (e.g., GDPR, HIPAA), Risk assessment and management in cloud environments, Implementing governance frameworks for cloud security, Cloud-specific threats and vulnerabilities, Security monitoring and logging in the cloud, Incident response planning and execution in cloud environments.

| SECURE DEVELOPMENT AND DEVSECOPS | 6 Hours |
|---|---|

Security considerations in cloud-native application development, Implementing security in CI/ pipelines, Best practices for DevSecOps in the cloud.

| EMERGING TRENDS AND FUTURE OF CLOUD SECURITY | 6 Hours |
|---|---|

Edge computing and its security implications, Zero-trust security models in the cloud, Fut directions and trends in cloud security

**LAB CONTENTS**

Securing Free tier account, IAM, account bills, instances within Virtual Private Cloud, Role ba access control with cloud platform IAM, Instance with firewall rules , Data encryption a decryption using cloud platforms, restricting access to storage, Configuring networking firewall an application

Sample exercises:

1. Securing free tier account in cloud platform
2. Securing free tier account in cloud platform with IAM user
3. Creating IAM role, Group.
4. Securing free tier account setting billing in cloud platform
5. Securing instances in cloud platform within Virtual Private Cloud
6. Implementing role based access control with cloud platform IAM
7. Securing instances with firewall rules
8. Data encryption and decryption using cloud platforms
9. Securing and restricting access to storage
10. Configuring networking firewall for an application

| Theory: 30 Hrs | Tutorial: 0 Practical: 30 | Total Hours: 60 Hrs |
|---|---|---|

## REFERENCES


1. Cloud Security Attacks, Techniques, Tools and Challenges by Preeti Mishra, Emmanuel S Pilli, R C Joshi · 2021
2. Cloud Security: Concepts, Applications and Perspectives by Brij B. Gupta · 2021
3. Securing the Cloud: Cloud Computer Security Techniques and Tactics by Vic (J.R.) Winkler
4. Cloud Security: A Comprehensive Guide to Secure Cloud Computing by Ronald L. Krutz, Russell Dean Vines · 2010
5. Cloud Security and Privacy: An Enterprise Perspective on Risks and Compliance (Theory in Practice) 1st Edition, by Tim Mather (Author), Subra Kumaraswamy (Author), Shahed Latif (Author) 2009.


## ONLINE LEARNING MATERIALS


1. https://www.coursera.org/learn/cloud-security-basics
2. https://www.coursera.org/learn/sscp-4th-ed-course-6
3. https://www.coursera.org/learn/cloud-data-security
4. https://www.checkpoint.com/cyber-hub/cloud-security/what-is-cloud-security/
5. https://www.zscaler.com/resources/security-terms-glossary/what-is-cloud-security
6. https://medium.com/@goodycyb/exploring-cloud-security-in-depth-labs-and-insights-for-aws-and-gcp-50ca038478c4
7. https://goodycyb.hashnode.dev/

| U18ITE0325 | CLOUD AUTOMATION | L | T | P | J | C |
|---|---|---|---|---|---|---|
| | | 2 | 0 | 2 | 0 | 3 |

**Course Outcomes:**

After successful completion of this course, the students should able to

CO1: Identify appropriate cloud automation tools for an application (K3).

CO2: Take part in automating DevOps using tools (K4)

CO3: Make use of storage automation in an application (K3).

CO4: Apply automation tools in monitoring services (K3)

CO5 Utilize tools for the cloud resource scaling and management (K3)

**Pre-requisite courses: U18AII5201 Cloud Architecture**

**CO/PO Mapping**

(S/M/W indicates the strength of correlation) S-Strong, M-Medium, W-Weak

| COs | Programme Outcome (POs) | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 | PSO3 |
| CO1 | S | M | | M | M | M | | | | M | | | M | M | |
| CO2 | M | | | | | | | | M | | M | | | | |
| CO3 | S | S | | | | | | | | | | M | | M | |
| CO4 | M | | | | M | | | | | | | | | M | |
| CO5 | M | S | | | M | | | | | | M | | M | | |

**Topics covered:**

| INTRODUCTION CLOUD AUTOMATION | 7 Hours |
|---|---|

Benefits of cloud automation - Types of cloud automation tools - Use cases for cloud automation. Managing and provisioning infrastructure through code (using tools like Terraform, Ansible, Puppet, Chef), Automating code integration and verification through tools like Jenkins, GitLab CI, or CircleCI, Automating the deployment process to push code changes into production environments reliably.

| CLOUD RESOURCE SCALLING AND STORAGE AUTOMATION | 8 Hours |
|---|---|

Automating resource allocation, de-allocation, and right-sizing of resources based on usage. Kubernetes - Salt -CircleCI - Ansible and puppet, AWS DataSync, Azure Data Factory.

| CLOUD AUTOMATION TOOLS FOR DEVOPS | 7 Hours |
|---|---|

DuploCloud - Puppet - Heroku -HashiCorp, Monitoring and Logging Tools – Prometheus, Grafana, Docker, Raygun, Splunk, Git, Ansible, Jenkins, Bamboo.

| CLOUD DEPLOYMENT AUTOMATION | 8 Hours |
|---|---|

NetApp Cloud Volumes ONTAP - CFEngine -VMware vs Realize Automation - Cisco Intelligent - Automation for Cloud - Microsoft Azure Automation - Google Cloud Deployment Manager - AWS CloudFormation - IBM Cloud Schematics

**PROJECT**

Projects involving different cloud platform services like Puppet, Heroku, HashiCorp and monitoring & Logging Tools – Prometheus, Grafana, Docker, Raygun, Splunk, Git, Ansible, Jenkins, Bamboo.

| Theory: 30 Hrs | Tutorial: 0 | Project: 30 | Total Hours: 60 Hrs |
|---|---|---|---|

## REFERENCES


1. Mikael Krief,, “Learning DevOps: The complete guide to accelerate collaboration with Jenkins, Kubernetes, Terraform and Azure DevOps”, Packt Publishing; 1st edition, 2019.
2. Marcelo Pinheiro, “Mastering DevOps Automation”, Packt Publishing Limited, 2018.
3. Jeff Geerling, “Ansible for DevOps: Server and Configuration Management for Humans”, Midwestern Mac, LLC; 1st edition, 2015.
4. John Rhoton and James Stanger, “Cloud Automation and DevOps: Transforming Your IT Environment, 2015.


## ONLINE LEARNING MATERIALS

1. https://www.coursera.org/learn/automation-in-aws
2. https://www.coursera.org/learn/gcp-infrastructure-scaling-automation
3. https://www.udemy.com/course/aws-cloud-security-proactive-way/
4. https://www.edx.org/learn/computer-programming/google-cloud-elastic-google-cloud-infrastructure-scaling-and-automation

# Web and Software Development

| U18ITE0226 | FULL STACK SOFTWARE DEVELOPMENT | L | T | P | J | C |
|---|---|---|---|---|---|---|
| | | 2 | 0 | 2 | 0 | 3 |

**Course Outcomes:**

After successful completion of this course, the students should able to

CO1: Create a Web Server with Node.js for a simple application. (K3)

CO2: Develop a Web Application in Express.js Framework. (K3)

CO3: Build an application with Node.js and MongoDB. (K3)

CO4: Deploy the developed application in GitHub repository. (K3)

**Pre-requisite courses:** U18AII2204 Object Oriented Programming and Data Structures

**CO/PO Mapping**

(S/M/W indicates the strength of correlation) S-Strong, M-Medium, W-Weak

| COs | Programme Outcome (POs) | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 | PSO3 |
| CO1 | S | M | M | | S | | | | | | M | M | | | |
| CO2 | S | M | M | | S | | | | | | M | M | | M | |
| CO3 | S | M | M | | S | | | | | | M | M | | M | |
| CO4 | | | | | S | M | M | M | M | M | M | M | | | M |

**Topics covered:**

| INTRODUCTION TO FULL STACK DEVELOPMENT & VERSION CONTROL | 6 Hours |
|---|---|

Overview of HTML, CSS, JavaScript, and Bootstrap.
Web Development Stack - Full Stack – Introduction – Types: MERN, MEAN, MEVN, LAMP, Ruby on Rails, Django, NET, JAMSTACK
Version Control – Need - Popular version control tools like Git - create a GitHub account - Use the GitHub web interface to create a repository - add a file to Git and commit the changes – Git commands.

| INTRODUCTION TO NODE.JS | 6 Hours |
|---|---|

Introduction to Node.js - Server-Side JavaScript and Node.js - Creating a Web Server with Node.js - Working with Node.js Modules - Overview of Node Package Manager

| SERVER-SIDE JAVASCRIPT | 6 Hours |
|---|---|

Asynchronous I/O with Callback Programming - Creating Callback Functions - Using Anonymous Callback Functions in Node.js - Issues with Callbacks - Working with JSON – Handling errors and debugging Node.js applications.

| EXPRESS WEB APPLICATION FRAMEWORK | 6 Hours |
|---|---|

Extending Node.js - Working with Third Party Node.js Extensions - Introduction to Web Frameworks - Express Web Application Framework - Working with Back-end JavaScript Frameworks and Express - Routing, Middleware, and Templating - Authentication in Node JS - Middleware & Routers - HTTP Methods and Rest APIs.

| MONGODB AND DEPLOYMENT OF NODE.JS APPLICATIONS | 6 Hours |
|---|---|

NoSQL databases and MongoDB - Setting up a MongoDB development environment - Building MongoDB schema and models with Mongoose – Connecting Node.js application with MongoDB – Testing and Deploying Node.js applications with server configurations.

**LAB CONTENTS**

**Sample List of Lab Experiments:**

1. Create your own Node.js module and import and use modules in your web server application.
2. Develop asynchronous functions with callbacks, error handling, and control flow using callbacks.
3. Demonstrate JSON file data read and write using Node.js.
4. Create a RESTful API to serve JSON data.
5. Demonstrate RESTful endpoints using Express and HTTP methods to handle GET, POST, PUT, and DELETE requests.
6. Integrate a template engine (e.g., EJS or Pug) with Express and Render dynamic HTML views using templates.
7. Implement user authentication in your Express application.
8. Explore and integrate third-party Node.js extensions into your Express app and showcase the benefits of using extensions for specific features.
9. Create a multi-page web application with authentication, routing, and RESTful APIs.
10. Create a simple Employee Management Application with MongoDB and Node.js.

| | | | |
|---|---|---|---|
| **Theory: 30 Hrs** | **Tutorial: 0** | **Practical: 30** | **Total Hours: 60 Hrs** |

**REFERENCES**


1. "Mastering HTML, CSS & JavaScript Web Publishing" by Laura Lemay, Rafe Colburn, Jennifer Kyrnin, BPB Publications, 2016.
2. "Node.js Web Development: Server-side web development " by David Herron, 5th Edition, 2020
3. "Node.js in Action" by Alex Young, Bradley Meck, Mike Cantelon, Tim Oxley, Marc Harter, T.J. Holowaychuk, and Nathan Rajlich, Manning, 2nd Edition, 2017
4. "Node.js Design Patterns" by Luciano Mammino and Mario Casciaro, 3rd Edition, 2022.
5. "Web Development with MongoDB and Node JS" by Mithun Satheesh, Bruno Joseph D'mello, Jason Krol, Packt Publishing Limited; 2nd edition, 2015.
6. "Web Development with Node and Express" by Ethan Brown, O'Reilly Media, Inc. 2nd Edition, 2019.
7. "Pro Git" by Scott Chacon, Ben Straub, Apress, 2nd edition, 2014.


**ONLINE LEARNING MATERIALS**

1. Introduction to Web Development with HTML, CSS, JavaScript | Coursera
2. Getting Started with Git and GitHub | Coursera
3. Developing Back-End Apps with Node.js and Express | Coursera
4. Introduction to MongoDB | Coursera
5. [Project] Build a CRUD Node.js and MongoDB employee management web-app | Coursera

| U18ITE0227 | **UI AND UX DESIGN** | **L** | **T** | **P** | **J** | **C** |
|---|---|---|---|---|---|---|
| | | **2** | **0** | **2** | **0** | **3** |

**Course Overview**

This course focuses on understanding UI/UX principles, designing industry-standard interfaces, applying research and strategy techniques, and integrating wireframing and prototyping skills to solve real-world problems

**COURSE OUTCOMES**

**After successful completion of this course, the students should be able to**

| | |
|---|---|
| **CO1:** | Understand the difference between UI and UX design to explain the significance of empathy techniques in gathering user insights.[K2] |
| **CO2:** | Apply UI design principles to implement visual design standards and UI components to enhance user interaction.[K3] |
| **CO3:** | Understand UX research techniques to align user and business goals with the industry based design process. [K2] |
| **CO4:** | Apply wireframing and prototyping techniques to create and test responsive designs [K3] |
| **CO5:** | Apply essential concepts of Figma to create interactive user centered design.[K3] |

**Pre-requisite :** U18AII6202 Prototype Development

| COs | **CO/PO MAPPING** (S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | **PROGRAMME OUTCOMES (POs)** | | | | | | | | | | | | **PSOs of AI&DS** | | |
| | **PO 1** | **PO 2** | **PO 3** | **PO 4** | **PO 5** | **PO 6** | **PO 7** | **PO 8** | **PO 9** | **PO 10** | **PO 11** | **PO 12** | **PSO1** | **PSO2** | **PSO3** |
| **CO1** | S | | M | | | | | | | M | | M | | | |
| **CO2** | S | | M | | | | | | | M | | M | | M | |
| **CO3** | | S | | M | | | | | | | | | | | |
| **CO4** | | S | | M | | | | | | | | | | | |
| **CO5** | S | | M | | | | | | | M | | M | | | |

**Course Assessment methods**

| **Direct** |
|---|
| 1. Continuous Assessment Test I, II<br>2. Lab Assignment, Lab assessment, Open book test, Written tests (Theory)<br>3. End Semester Examination |
| **Indirect** |
| 1. Course-end survey |

| **THEORY COMPONENT CONTENTS** | |
|---|---|
| **UNIT I -INDUSTRY-RELEVANT DESIGN THINKING** | **6 Hours** |
| Understanding UI vs. UX Design, Design Thinking Framework, Innovative Thinking Methods, Empathy Techniques for User Insights. | |
| **UNIT II- UI DESIGN PRINCIPLES FOR INDUSTRY** | **6 Hours** |
| Visual Design Standards, UI Components and Design Patterns, User Interaction and Engagement,<br>Branding Integration and Style Guides. | |
| **UNIT III -UX RESEARCH AND STRATEGY IN THE INDUSTRY** | **6 Hours** |
| UX Fundamentals for Business Impact Design Process, Industry Research Techniques,Aligning User and Business Goals. | |
| **UNIT IV -WIREFRAMING, PROTOTYPING AND TESTING** | **6 Hours** |
| Sketching Principles - Sketching Red Routes - Responsive Design – Wireframing - Creating Wireflows - Building a Prototype - Building High-Fidelity Mockups - Designing Efficiently with Tools - Interaction Patterns - Conducting Usability Tests - Other Evaluative User Research Methods - Synthesizing Test Findings - Prototype Iteration. | |
| **UNIT V -LOW CODE -NO CODE TOOLS** | **6 Hours** |
| Low code- No code Tools Essential Concepts of Figma - Setup and Configure Figma - Images, Shapes, and Tools - Working with Figma - Figma Components - Styles and Libraries in Figma - Cards and Layout Grids in Figma . | |

| LAB CONTENTS: | 30 Hours |
|---|---|

**Sample Experiments:**

1. Designing a Responsive layout for an societal application.
2. Exploring various UI Interaction Patterns
3. Developing an interface with proper UI Style Guides
4. Developing Wireflow diagram for application using open source software
5. Exploring various open source collaborative interface Platform
6. Hands on Design Thinking Process for a new product
7. Brainstorming feature for proposed product
8. Defining the Look and Feel of the new Project
9. Create a Sample Pattern Library for that product (Mood board, Fonts, Colors based on UI principles)
10. Identify a customer problem to solve.
11. Designing a User Interface with Figma
12. Creating and Managing Layout Grids and Components in Figma.

| Theory: 30 | Tutorial: 0 | Practical: 30 | Project: 0 | Total: 60 Hours |
|---|---|---|---|---|

**REFERENCES:**


1. "Joel Marsh, *UX for Beginners*, O'Reilly, 2022.
2. Jon Yablonski, *Laws of UX: Using Psychology to Design Better Products & Services*, O'Reilly, 2021.
3. Don Norman, *The Design of Everyday Things: Revised and Expanded Edition*, Basic Books, 2013.
4. Steve Krug, *Don't Make Me Think: A Common Sense Approach to Web Usability*, New Riders, 2014.
5. Jeffrey Zeldman and Ethan Marcotte, *Responsive Web Design*, A Book Apart, 2011.
6. Kim Goodwin, *Designing for the Digital Age: How to Create Human-Centered Products and Services*, Wiley, 2009.


**ONLINE COURSES:**

1. https://www.coursera.org/learn/designing-user-interfaces-and-experiences-uiux

| U18ITE0228 | **Principles of DevOps** | **L** | **T** | **P** | **J** | **C** |
|---|---|---|---|---|---|---|
| | | **2** | **0** | **2** | **0** | **3** |

## Course Overview

The objective of this course is to understand the fundamentals of DevOps engineering and be fully proficient with DevOps terminologies, concepts, benefits, and deployment options to meet real world software development requirements.

| **COURSE OUTCOMES**<br>**After successful completion of this course, the students should be able to** | |
|---|---|
| **CO1:** | Apply DevOps principles to meet software development requirements.[K3] |
| **CO2:** | Understand different actions performed through Version control tools like Git[K2] |
| **CO3:** | Apply the microservices architecture in the DevOps Environment.[K3] |
| **CO4:** | Apply continuous integration and continuous deployment using Jenkins and docker[K3] |
| **CO5:** | Analyze the use of configuration management tools like Ansible to distinguish between different approaches to infrastructure. [K4] |

**Pre-requisite :** U18AII6202 Prototype Development

| COs | **CO/PO MAPPING**<br>(S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | **PROGRAMME OUTCOMES (POs)** | | | | | | | | | | | | **PSOs of AI&DS** | | |
| | **PO1** | **PO2** | **PO3** | **PO4** | **PO5** | **PO6** | **PO7** | **PO8** | **PO9** | **PO10** | **PO11** | **PO12** | **PSO1** | **PSO2** | **PSO3** |
| **CO1** | S | | M | | | | | | | M | | M | | | |
| **CO2** | S | | M | | | | | | | M | | M | | M | |
| **CO3** | | S | | M | | | | | | | | | | M | |
| **CO4** | | S | | M | | | | | | | | | | | |
| **CO5** | | | | | M | | | | | | | M | | M | |

## Course Assessment methods

| **Direct** |
|---|

| |
|---|
| 4. Continuous Assessment Test I, II<br>5. Lab Assignment, Lab assessment, Open book test, Written tests (Theory)<br>6. End Semester Examination |
| **Indirect** |
| 1. Course-end survey |

| | |
|---|---|
| **THEORY COMPONENT CONTENTS** | |
| Introduction To Devops | **6 Hours** |
| Overview of DevOps-DevOps Lifecycle-Essential Characteristics of DevOps- Tools and Technologies-Social Coding Principle-Version control systems: Git and GitHub-Importance of version control in CICD pipeline. | |
| Microservices | **6 Hours** |
| Monolith vs SOA vs Microservices - Microservices- Microservices Patterns - Introduction to Serverless Computing- Introduction to the FaaS Model- The Serverless Framework. | |
| Continuous Integration Using Jenkins | **6 Hours** |
| Essentials of Continuous Integration- Jenkins tool Management- Installing Jenkins- Architecture-Creating a Jenkins Job- Configuration- Customizing Jenkins with plugins- database user creation Creating a Jenkins Build and Jenkins workspace | |
| Configuration Management | **6 Hours** |
| Introduction - Infrastructure as Code- Configuration Management Tools- Automating Infrastructure Provisioning-Introduction to Ansible – Installation and Configuration- Ansible Architecture, Ansible and Infrastructure Management | |
| Continuous Deployment: | **6 Hours** |
| Overview of Docker-Benefits of Docker Workflow- Process Simplification-Architecture- Docker Containers-Docker Workflow- Anatomy of Dockerfile-Building an Image-Running an Image-Custom base Images, Storing Images. | |
| **LAB CONTENTS:** | **30 Hours** |

| | | | | |
|---|---|---|---|---|
| **Theory: 30** | **Tutorial: 0** | **Practical: 30** | **Project: 0** | **Total: 60 Hours** |

1.Version Control with Git and GitHub.

2. Continuous Integration with Jenkins

3. Customizing Jenkins with Plugins

4. Infrastructure as Code with Ansible

5. Creating and Running Docker Containers.

6. Continuous Deployment with Docker and Jenkins.

7. Configuration Management and Infrastructure Provisioning with Ansible

8. Building and Managing Docker Workflows

**REFERENCES:**

1. Beginning Git and GitHub: A Comprehensive Guide to Version Control, Project Management, and Teamwork for the New Developer", Second Edition, 2019. 6.

2. Jeff Geerling, "Ansible for DevOps: Server and configuration management for humans", First Edition, 2015.

3. David Johnson, "Ansible for DevOps: Everything You Need to Know to Use Ansible for DevOps", Second Edition, 2016. 5. Mariot Tsitoara.

**ONLINE COURSES:**

1) https://www.coursera.org/professional-certificates/devops-and-software-engineering
2) https://www.coursera.org/learn/intro-to-devops?specialization=devops-and-software-engineering
3) https://www.coursera.org/learn/intro-to-devops?specialization=devops-and-software-engineering
4) https://www.jenkins.io/user-handbook.pd

# Network and Distributed Computing

**U18ITE0019 DECENTRALIZED FINANCE**

## COURSE OUTCOMES

**After successful completion of this course, the students should be able to**

**CO1:** Interpret the features of decentralized finance required to build its infrastructure. [K3]

**CO2:** Examine key trends and basic primitives of decentralized finance to design innovative financial solutions. [K3]

**CO3:** Apply diverse DeFi operations for providing blockchain-based financial solutions. [K3]

**CO4:** Identify the risks associated with decentralized finance. [K3]

**CO5:** Analyse ethical and regulatory issues associated with Decentralized Finance. [K4]

**Pre-requisite: U18AII4201 Computer Networks**

| COs | CO/PO MAPPING (S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak | | | | | | | | | | | | CO/PSO Mapping | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | PROGRAMME OUTCOMES (POs) | | | | | | | | | | | | PSOs | | |
| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 | PSO3 |
| CO1 | M | | | | | | | | | | | | | | |
| CO2 | S | M | | | | | | | | | | M | | | M |
| CO3 | S | M | | | | | M | | M | M | | | | | M |
| CO4 | M | | | M | | M | | M | M | M | | | | | |
| Co5 | M | | | M | | M | | M | M | M | | | | | M |

## THEORY COMPONENT CONTENT

**DECENTRALIZED FINANCE(DEFI) INFRASTRUCTURE 8 Hours**

Issues in Centralized Finance – History and Overview of Decentralized Finance - Overview of Cryptocurrency – Cryptographic hashing – Proof of work – Smart Contracts – Gas - Stable coins – Tokenomics – Altcoins - Blockchain and DeFi

**DEFI PRIMITIVES 8 Hours**

Transactions – Fungible tokens – Non Fungible tokens – custody – Supply adjustment – Incentives – Swap – Collateralized loans – Flash loan - Problems solved by DeFi- Ineffeciency – Limited Access – Opacity – Centralized control and lack of Interoperability

**DEFI OPERATIONS 10 Hours**

Credit /Lending and borrowing protocols – Decentralized Exchanges – Derivatives – Tokenization – Hot and cold wallets – Moving centralized exchanges funds to blockchain - Automated market makers – Bridging – Staking - Oracles

**DECENTRALIZED IDENTITY AND SECURITY 10 Hours**

Decentralized Identity (DID) – Security risks and measures in DeFi – Smart contract risk - Governance risk – Oracle risk – scaling risk – DEX risk – Custodial risk – Regulatory risk. Smart Contract Auditing – Yield Farming strategies – Liquidity mining

**REGULATORY AND ETHICAL CONSIDERATIONS** **9 Hours**

Global Regulations – Ethical issues – DAO – Government mechanisms – Crypto hackers – DeFi Usecases -Case study: Crypto Exchange Platforms and Gitcoin

| | | | | |
|---|---|---|---|---|
| **Theory:45** | **Tutorial:0** | **Practical:0** | **Project:0** | **Total: 45 Hours** |

**REFERENCES**


1. Campbell R. Harvey, Ashwin Ramachandran, Joey Santoro, Vitalik Buterin, "DeFi and the Future of Finance", Wiley 1st Edition.
2. Melanie Swan, Blockchain: Blueprint for a new economy, Shroff Publisher/O'Reilly Publisher.
3. Ron Quaranta, Blockchain in Financial Markets and Beyond: Challenges and Applications, Risk Books Publisher.
4. Richard Hayen, Blockchain & FinTech: A Comprehensive Blueprint to Understanding Blockchain & Financial Technology - Bitcoin, FinTech, Smart Contracts, Cryptocurrency, Risk Books Publisher.


**ONLINE LEARNING MATERIALS**

1. https://www.udemy.com/course/masteringdefi/
2. https://www.coursera.org/specializations/decentralized-finance-duke
3. https://101blockchains.com/ebooks/decentralized-finance-defi-guide/