# CITY ENGINEERING COLLEGE

Approved by AICTE New Delhi & Affiliated by VTU, Belagavi
Doddakallasandra, Off Kanakapura Main Road,
Next to Gokulam Apartment, Bangalore - 560 062.

## Department of Artificial Intelligence and Machine Learning

## *VTU Syllabus for Academic year (2024-2025)*

| Odd Semester | | |
|---|---|---|
| **Sl.No** | **Scheme** | **Semester** |
| 01 | 2021 | 7th |
| 02 | 2022 | 5th |
| 03 | 2022 | 3rd |

| Even Semester | | |
|---|---|---|
| **Sl.No** | **Scheme** | **Semester** |
| 01 | 2021 | 8th |
| 02 | 2022 | 6th |
| 03 | 2022 | 4th |

**VISVESVARAYA TECHNOLOGICAL UNIVERSITY, BELAGAVI**

**B.E. in Artificial Intelligence and Machine Learning**

**Scheme of Teaching and Examinations 2021**

**Outcome-Based Education (OBE) and Choice Based Credit System (CBCS)**

**(Effective from the academic year 2021 - 22)**

**Swappable VII and VIII SEMESTER**

**VII SEMESTER**

| Sl. No | Course and Course Code | Course Title | Teaching Department (TD) and Question Paper Setting Board (PSB) | Teaching Hours /Week | | | | Examination | | | | Credits |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | Theory Lecture | Tutorial | Practical/ Drawing | Self -Study | Duration in hours | CIE Marks | SEE Marks | Total Marks | |
| | | | | L | T | P | S | | | | | |
| 1 | PCC 21AI71 | Advanced AI and ML | Any CS Board Department | 3 | 0 | 0 | | 3 | 50 | 50 | 100 | 3 |
| 2 | PCC 21CS72 | Cloud Computing | | 2 | 0 | 0 | | 3 | 50 | 50 | 100 | 2 |
| 3 | PEC 21XX73X | Professional elective Course-II | | 3 | 0 | 0 | | 3 | 50 | 50 | 100 | 3 |
| 4 | PEC 21XX74X | Professional elective Course-III | | 3 | 0 | 0 | | 3 | 50 | 50 | 100 | 3 |
| 5 | OEC 21XX75X | Open elective Course-II | Concerned Department | 3 | 0 | 0 | | 3 | 50 | 50 | 100 | 3 |
| 6 | Project 21AIP76 | Project work | | Two contact hours /week for interaction between the faculty and students. | | | | 3 | 100 | 100 | 200 | 10 |
| | | | | | | | | **Total** | **350** | **350** | **700** | **24** |

**VIII SEMESTER**

| Sl. No | Course and Course Code | | Course Title | Teaching Department | Teaching Hours /Week | | | | Examination | | | | Credits |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | Theory Lecture | Tutorial | Practical/ Drawing | Self -Study | Duration in hours | CIE Marks | SEE Marks | Total Marks | |
| | | | | | L | T | P | S | | | | | |
| 1 | Seminar 21AI81 | | Technical Seminar | | One contact hour /week for interaction between the faculty and students. | | | | -- | 100 | -- | 100 | 01 |
| 2 | INT 21INT82 | | Research Internship/ Industry Internship | | Two contact hours /week for interaction between the faculty and students. | | | | 03 (Batch wise ) | 100 | 100 | 200 | 15 |
| 3 | NCMC | 21NS83 | National Service Scheme (NSS) | NSS | Completed during the intervening period of III semester to VIII semester. | | | | -- | 50 | 50 | 100 | 0 |
| | | 21PE83 | Physical Education (PE) (Sports and Athletics) | PE | | | | | | | | | |
| | | 21YO83 | Yoga | Yoga | | | | | | | | | |
| | | | | | | | | | **Total** | **250** | **150** | **400** | **16** |

**Professional Elective - II**

| | | | |
|---|---|---|---|
| 21AI731 | Social Network Analysis | 21CS734 | Blockchain Technology |
| 21CS732 | Digital Image Processing | 21CS735 | Internet of Things |
| 21AI733 | Fullstack Development | | |

**Professional Elective - III**

| | | | |
|---|---|---|---|
| 21AI741 | Augmented Reality | 21CS744 | Robotic Process Automation Design and Development |
| 21CS742 | Multiagent Systems | 21CS745 | NoSQL Data Base |
| 21AI743 | Predictive Analytics | | |

| Open Electives - II offered by the Department to other Department students | | | |
|---|---|---|---|
| 21CS751 | Programming in Python | 21CS754 | Introduction to Data Science |
| 21CS752 | Introduction to AI and ML | 21CS755 | |
| 21CS753 | Introduction to Big Data | | |

**Note: PCC:** Professional Core Course, **PEC:** Professional Elective Courses, **OEC**–Open Elective Course, **AEC** –Ability Enhancement Courses.
L –Lecture, T – Tutorial, P- Practical / Drawing, S – Self Study Component, CIE: Continuous Internal Evaluation, SEE: Semester End Examination.

**Note: VII and VIII semesters of IV year of the programme**

**(1)** Institutions can swap VII and VIII Semester Scheme of Teaching and Examinations to accommodate research internship/ industry internship after the VI semester**.**

**(2)** Credits earned for the courses of VII and VIII Semester Scheme of Teaching and Examinations shall be counted against the corresponding semesters whether VII or VIII semester is completed during the beginning of IV year or later part of IV year of the programme.

**PROJECT WORK (21XXP76):** The objective of the Project work is

**(i)** To encourage independent learning and the innovative attitude of the students.
**(ii)** To develop interactive attitude, communication skills, organization, time management, and presentation skills.
**(iii)** To impart flexibility and adaptability.
**(iv)** To inspire team working.
**(v)** To expand intellectual capacity, credibility, judgment and intuition.
**(vi)** To adhere to punctuality, setting and meeting deadlines.
**(vii)** To instil responsibilities to oneself and others.
**(viii)**To train students to present the topic of project work in a seminar without any fear, face the audience confidently, enhance communication skills, involve in group discussion to present and exchange ideas.

**CIE procedure for Project Work:**

**(1) Single discipline:** The CIE marks shall be awarded by a committee consisting of the Head of the concerned Department and two senior faculty members of the Department, one of whom shall be the Guide.

The CIE marks awarded for the project work, shall be based on the evaluation of project work Report, project presentation skill, and question and answer session in the ratio 50:25:25. The marks awarded for the project report shall be the same for all the batch mates.

**(2) Interdisciplinary:** Continuous Internal Evaluation shall be group-wise at the college level with the participation of all guides of the college. Participation of external guide/s, if any, is desirable. The CIE marks awarded for the project work, shall be based on the evaluation of project work Report, project presentation skill, and question and answer session in the ratio 50:25:25. The marks awarded for the project report shall be the same for all the batch mates.

**SEE procedure for Project Work:** SEE for project work will be conducted by the two examiners appointed by the University. The SEE marks awarded for the project work, shall be based on the evaluation of project work Report, project presentation skill, and question and answer session in the ratio 50:25:25.

**TECHNICAL SEMINAR (21XXS81):** The objective of the seminar is to inculcate self-learning, present the seminar topic confidently, enhance communication skill, involve in group discussion for exchange of ideas. Each student, under the guidance of a Faculty, shall choose, preferably, a recent topic of his/her interest relevant to the programme of Specialization.

**(i)** Carry out literature survey, systematically organize the content.
**(ii)** Prepare the report with own sentences, avoiding a cut and paste act.
**(iii)**Type the matter to acquaint with the use of Micro-soft equation and drawing tools or any such facilities.
**(iv)** Present the seminar topic orally and/or through PowerPoint slides.
**(v)** Answer the queries and involve in debate/discussion.
(**vi)** Submit a typed report with a list of references.

The participants shall take part in the discussion to foster a friendly and stimulating environment in which the students are motivated to reach high standards and become self-confident.

**Evaluation Procedure:**

The CIE marks for the seminar shall be awarded (based on the relevance of the topic, presentation skill, participation in the question and answer session, and quality of report) by the committee constituted for the purpose by the Head of the Department. The committee shall consist of three teachers from the department with the senior-most acting as the Chairman.

**Marks distribution for CIE of the course:**

Seminar Report:50 marks
Presentation skill:25 marks
Question and Answer: 25 marks. ■ No SEE component for Technical Seminar

**Non – credit mandatory courses (NCMC):**

**National Service Scheme/Physical Education (Sport and Athletics)/ Yoga:**

**(1)** Securing 40 % or more in CIE,35 % or more marks in SEE and 40 % or more in the sum total of CIE + SEE leads to successful completion of the registered course.

**(2)** In case, students fail to secure 35 % marks in SEE, they has to appear for SEE during the subsequent examinations conducted by the University.

**(3)**In case, any student fails to register for NSS, PE or Yoga/fails to secure the minimum 40 % of the prescribed CIE marks, he/she shall be deemed to have not completed the requirements of the course. In such a case, the student has to fulfill the course requirements during subsequently to earn the qualifying CIE marks subject to the maximum programme period.

**(4)** Successful completion of the course shall be indicated as satisfactory in the grade card. Non-completion of the course shall be indicated as Unsatisfactory.

**(5)** These courses shall not be considered for vertical progression as well as for the calculation of SGPA and CGPA, but completion of the courses shall be mandatory for the award of degree.

**VII Semester**

| ADVANCED AI AND ML | | | |
|---|---|---|---|
| Course Code | 21AI71 | CIE Marks | 50 |
| Teaching Hours/Week (L:T:P: S) | 3:0:0:0 | SEE Marks | 50 |
| Total Hours of Pedagogy | 40 | Total Marks | 100 |
| Credits | 03 | Exam Hours | 03 |

**Course Learning Objectives**

CLO 1. Demonstrate the fundamentals of Intelligent Agents
CLO 2. Illustrate the reasoning on Uncertain Knowledge
CLO 3. Explore the explanation-based learning in solving AI problems
CLO 4. Illustrate the use of KNN
CLO 5. Explore the Text feature Engineering concepts with Applications

**Teaching-Learning Process (General Instructions)**

These are sample Strategies, which teacher can use to accelerate the attainment of the various course outcomes.

1. Lecturer method (L) needs not to be only traditional lecture method, but alternative effective teaching methods could be adopted to attain the outcomes.
2. Use of Video/Animation to explain functioning of various concepts.
3. Encourage collaborative (Group Learning) Learning in the class.
4. Ask at least three HOT (Higher order Thinking) questions in the class, which promotes critical thinking.
5. Adopt Problem Based Learning (PBL), which fosters students' Analytical skills, develop design thinking skills such as the ability to design, evaluate, generalize, and analyse information rather than simply recall it.
6. Introduce Topics in manifold representations.
7. Show the different ways to solve the same problem with different circuits/logic and encourage the students to come up with their own creative ways to solve them.
8. Discuss how every concept can be applied to the real world - and when that's possible, it helps improve the students' understanding.

**Module-1**

**Intelligent Agents**: Agents and Environments, Good Behaviour: The Concept of Rationality, The Nature of Environments, The Structure of Agents

**Problem Solving :** Game Paying

**Text book 1: Chapter 2, Chapter 5 (2.1 to 2.4, 5.1 to 5.6)**

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|---|---|
| **Teaching-Learning Process** | Chalk and board, Active Learning, Problem based learning |

**Module-2**

**Uncertain knowledge and Reasoning:** Quantifying Uncertainty**,** Acting under Uncertainty , Basic Probability Notation, Inference Using Full Joint Distributions, Independence , Bayes' Rule and Its Use The WumpusWorld Revisited,

**Text book 1: Chapter 13**

| | |
|---|---|
| **Teaching-Learning Process** | Chalk and board, Active Learning, Demonstration |

**Module-3**

Neural Network Representation – Problems – Perceptrons – Multilayer Networks and Back Propagation Algorithms – Genetic Algorithms – Hypothesis Space Search – Genetic Programming – Models of Evolution

and Learning.

**Text book 2: chapter 4.1-4.6 & 9.1-9.5**

**Neural networks and genetic algorithms:**
Brief history and Evolution of Neural network, Biological neuron, Basics of ANN, Activation function, MP model.

**Text book 3: chapter 6**

| | |
|---|---|
| **Teaching-Learning Process** | Chalk and board, Problem based learning, Demonstration |

**Module-4**

**Recommender System:**
Datasets, Association rules, Collaborative filtering, User-based similarity, item-based similarity, using surprise library, Matrix factorization

**Text Analytics:**
Overview, Sentiment Classification, Naïve Bayes model for sentiment classification, using TF-IDF vectorizer, Challenges of text analytics

**Text book 4: Chapter 9 and 10**

| | |
|---|---|
| **Teaching-Learning Process** | Chalk& board, Problem based learning |

**Module-5**

**Clustering**
**Introduction,** Types of clustering, Partitioning methods of clustering (k-means, k-medoids), hierarchical methods

**Text book 3: Chapter 13**

Instance Based Learning: Introduction, k-nearest neighbour learning(review), locally weighted regression, radial basis function, cased-based reasoning,

**Text book 2: Chapter 8.1-8.5**

| | |
|---|---|
| **Teaching-Learning Process** | Chalk and board, MOOC |

**Course Outcomes**
At the end of the course the student will be able to:

CO 1. Demonstrate the fundamentals of Intelligent Agents
CO 2. Illustrate the reasoning on Uncertain Knowledge
CO 3. Explore the explanation-based learning in solving AI problems
CO 4. Apply effectively ML algorithms to solve real world problems.
CO 5. Apply Instant based techniques and derive effectively learning rules to real world problems.

**Assessment Details (both CIE and SEE)**

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures not less than 35% (18 Marks out of 50) in the semester-end examination (SEE), and a minimum of 40% (40 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE

(Semester End Examination) taken together

**Continuous Internal Evaluation:**

Three Unit Tests each of **20 Marks (duration 01 hour**)

1. First test at the end of 5th week of the semester
2. Second test at the end of the 10th week of the semester
3. Third test at the end of the 15th week of the semester

Two assignments each of **10 Marks**

4. First assignment at the end of 4th week of the semester
5. Second assignment at the end of 9th week of the semester

Group discussion/Seminar/quiz any one of three suitably planned to attain the COs and POs for **20 Marks** (**duration 01 hours**)

6. At the end of the 13th week of the semester

The sum of three tests, two assignments, and quiz/seminar/group discussion will be out of 100 marks and will be **scaled down to 50 marks**

(to have less stressed CIE, the portion of the syllabus should not be common /repeated for any of the methods of the CIE. Each method of CIE should have a different syllabus portion of the course).

**CIE methods /question paper has to be designed to attain the different levels of Bloom's taxonomy as per the outcome defined for the course.**

**Semester End Examination:**

Theory SEE will be conducted by University as per the scheduled timetable, with common question papers for the subject (**duration 03 hours)**

1. The question paper will have ten questions. Each question is set for 20 marks.
2. There will be 2 questions from each module. Each of the two questions under a module (with a maximum of 3 sub-questions), **should have a mix of topics** under that module.
3. The students have to answer 5 full questions, selecting one full question from each module. Marks scored shall be proportionally reduced to 50 marks

**Suggested Learning Resources:**

**Textbooks:**

1. Artificial Intelligence, A Modern Approach, Stuart J. Russell and Peter Norvig, Third Edition, Pearson, 2010
2. Tom M. Mitchell, Machine Learning, McGraw-Hill Education, 2013
3. Machine Learning, Anuradha Srinivasaraghavan, VincyJoeph, Wiley 2019
4. Machine Learning using Python ,Manaranjan Pradhan, U Dinesh Kumar, Wiley 2019

**Reference:**

1. An Introduction to Multi Agent Systems, Michael Wooldridge, Second Edition, John Wiley & Sons

**Web links and Video Lectures (e-Resources):**

1. https://www.youtube.com/playlist?list=PLwdnzlV3ogoXaceHrrFVZCJKbm_laSHcH
2. https://nptel.ac.in/courses/106/102/106102220/
3. https://www.youtube.com/playlist?list=PL1xHD4vteKYVpaIiy295pg6_SY5qznc77
4. https://nptel.ac.in/courses/106/106/106106139/

**Activity Based Learning (Suggested Activities in Class)/ Practical Based learning**

**VII Semester**

| CLOUD COMPUTING | | | |
|---|---|---|---|
| Course Code | 21CS72 | CIE Marks | 50 |
| Teaching Hours/Week (L:T:P: S) | 2:0:0:0 | SEE Marks | 50 |
| Total Hours of Pedagogy | 24 | Total Marks | 100 |
| Credits | 02 | Exam Hours | 03 |

**Course Learning Objectives:**

CLO 1. Introduce the rationale behind the cloud computing revolution and the business drivers
CLO 2. Introduce various models of cloud computing
CLO 3. Introduction on how to design cloud native applications, the necessary tools and the design tradeoffs.
CLO 4. Realize the importance of Cloud Virtualization, Abstraction`s and Enabling Technologies and cloud security

**Teaching-Learning Process (General Instructions)**

These are sample Strategies, which teachers can use to accelerate the attainment of the various course outcomes.

1. Lecturer method (L) does not mean only traditional lecture method, but different type of teaching methods may be adopted to develop the outcomes.
2. Show Video/animation films to explain functioning of various concepts.
3. Encourage collaborative (Group Learning) Learning in the class.
4. Ask at least three HOT (Higher order Thinking) questions in the class, which promotes critical thinking.
5. Adopt Problem Based Learning (PBL), which fosters students' Analytical skills, develop thinking skills such as the ability to evaluate, generalize, and analyze information rather than simply recall it.
6. Topics will be introduced in a multiple representation.
7. Show the different ways to solve the same problem and encourage the students to come up with their own creative ways to solve them.
8. Discuss how every concept can be applied to the real world - and when that's possible, it helps improve the students' understanding.

**Module-1**

**Introduction**:
Introduction ,Cloud Computing at a Glance, Historical Developments, Building Cloud Computing Environments, Amazon Web Services (AWS), Google AppEngine, Microsoft Azure, Hadoop, Force.com and Salesforce.com, Manjrasoft Aneka

**Textbook 1: Chapter 1: 1.1,1.2 and 1.3**

| **Teaching-Learning Process** | Chalk and board, Active Learning |
|---|---|

**Module-2**

**Virtualization:** Introduction, Characteristics of Virtualized, Environments Taxonomy of Virtualization Techniques, Execution Virtualization, Other Types of Virtualization, Virtualization and Cloud Computing, Pros and Cons of Virtualization, Technology Examples

**Textbook 1 : Chapter 3: 3.1 to 3.6**

| **Teaching-Learning Process** | Chalk and board, Active Learning |
|---|---|

**Module-3**

**Cloud Computing Architecture:** Introduction, Cloud Reference Model, Types of Clouds, Economics of the Cloud, Open Challenges

**Textbook 1: Chapter 4: 4.1 to 4.5**

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|---|---|
| **Teaching-Learning Process** | Chalk and board, Demonstration |

**Module-4**

**Cloud Security**: Risks, Top concern for cloud users, privacy impact assessment, trust, OS security, VM Security, Security Risks posed by shared images and management OS.

**Textbook 2: Chapter 9: 9.1 to 9.6, 9.8, 9.9**

| | |
|---|---|
| **Teaching-Learning Process** | Chalk and board |

**Module-5**

**Cloud Platforms in Industry**
Amazon web services: - Compute services, Storage services, Communication services, Additional services. Google AppEngine: - Architecture and core concepts, Application life cycle, Cost model, Observations.

**Textbook 1: Chapter 9: 9.1 to 9.2**

**Cloud Applications:**
Scientific applications: - HealthCare: ECG analysis in the cloud, Biology: gene expression data analysis for cancer diagnosis, Geoscience: satellite image processing. Business and consumer applications: CRM and ERP, Social networking, media applications.

**Textbook 1: Chapter 10: 10.1 to 10.2**

| | |
|---|---|
| **Teaching-Learning Process** | Chalk and board |

**Course outcome (Course Skill Set)**
At the end of the course the student will be able to:

CO 1. Understand and analyze various cloud computing platforms and service provider.
CO 2. Illustrate various virtualization concepts.
CO 3. Identify the architecture, infrastructure and delivery models of cloud computing.
CO 4. Understand the Security aspects of CLOUD.
CO 5. Define platforms for development of cloud applications

**Assessment Details (both CIE and SEE)**

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures not less than 35% (18 Marks out of 50) in the semester-end examination (SEE), and a minimum of 40% (40 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together

**Continuous Internal Evaluation:**

Three Unit Tests each of **20 Marks (duration 01 hour**)

1. First test at the end of 5th week of the semester
2. Second test at the end of the 10th week of the semester
3. Third test at the end of the 15th week of the semester

Two assignments each of **10 Marks**

4. First assignment at the end of 4th week of the semester
5. Second assignment at the end of 9th week of the semester

Group discussion/Seminar/quiz any one of three suitably planned to attain the COs and POs for **20**

**Marks** (**duration 01 hours**)

6. At the end of the 13th week of the semester

The sum of three tests, two assignments, and quiz/seminar/group discussion will be out of 100 marks and will be **scaled down to 50 marks**

(to have less stressed CIE, the portion of the syllabus should not be common /repeated for any of the methods of the CIE. Each method of CIE should have a different syllabus portion of the course).

**CIE methods /question paper has to be designed to attain the different levels of Bloom's taxonomy as per the outcome defined for the course.**

**Semester End Examination:**

Theory SEE will be conducted by University as per the scheduled timetable, with common question papers for the subject (**duration 03 hours)**

1. The question paper will have ten questions. Each question is set for 20 marks.
2. There will be 2 questions from each module. Each of the two questions under a module (with a maximum of 2 sub-questions), **should have a mix of topics** under that module.
3. The students have to answer 5 full questions, selecting one full question from each module
4. Marks scored shall be proportionally reduced to 50 marks

**Suggested Learning Resources:**

**Textbooks**

1. Rajkumar Buyya, Christian Vecchiola, and Thamrai Selvi Mastering Cloud Computing McGraw Hill Education.
2. Dan C. Marinescu, Cloud Compting Theory and Practice, Morgan Kaufmann, Elsevier 2013

**Reference Books**

1. Toby Velte, Anthony Velte, Cloud Computing: A Practical Approach, McGraw-Hill Osborne Media.
2. George Reese, Cloud Application Architectures: Building Applications and Infrastructure in the Cloud, O'Reilly Publication.
3. John Rhoton, Cloud Computing Explained: Implementation Handbook for Enterprises, Recursive Press.

**Weblinks and Video Lectures (e-Resources):**

- https://www.youtube.com/watch?v=1N3oqYhzHv4
- https://www.youtube.com/watch?v=RWgW-CgdIk0

**Activity Based Learning (Suggested Activities in Class)/ Practical Based learning**

**VII Semester**

| SOCIAL NETWORK ANALYSIS | | | |
|---|---|---|---|
| Course Code | 21AI731 | CIE Marks | 50 |
| Teaching Hours/Week (L:T:P: S) | 3:0:0:0 | SEE Marks | 50 |
| Total Hours of Pedagogy | 40 | Total Marks | 100 |
| Credits | 03 | Exam Hours | 03 |

**Course Learning Objectives**

CLO 1. Understand Semantic Web for social network analysis.
CLO 2. Learn the Representation, Modelling and Aggregating social network data.
CLO 3. Learn the basic algorithms and techniques for detection and decentralization of social network.
CLO 4. Study Human behaviour in social networks and its management.
CLO 5. Visual representation of social network data in different applications.

**Teaching-Learning Process (General Instructions)**

These are sample Strategies, which teachers can use to accelerate the attainment of the various course outcomes.

1. Lecturer method (L) needs not to be only a traditional lecture method, but alternative effective teaching methods could be adopted to attain the outcomes.
2. Use of Video/Animation to explain functioning of various concepts.
3. Encourage collaborative (Group Learning) Learning in the class.
4. Ask at least three HOT (Higher order Thinking) questions in the class, which promotes critical thinking.
5. Adopt Problem Based Learning (PBL), which fosters students' Analytical skills, develop design thinking skills such as the ability to design, evaluate, generalize, and analyse information rather than simply recall it.
6. Introduce Topics in manifold representations.
7. Show the different ways to solve the same problem with different circuits/logic and encourage the students to come up with their own creative ways to solve them.
8. Discuss how every concept can be applied to the real world - and when that's possible, it helps improve the students' understanding.

**Module-1**

**Introduction to Semantic Web:** Limitations of current Web - Development of Semantic Web - Emergence of the Social Web.

**Social Network analysis:** Development of Social Network Analysis - Key concepts and measures in network analysis.

**Electronic sources for network analysis:** Electronic discussion networks, Blogs and online communities - Web-based networks.

**Text book 1: Chapter1 – 1.1, 1.3, 1.4, Chapter2 – 2.2 , 2.3, Chapter3 – 3.1 to 3.3**

| | |
|---|---|
| **Teaching-Learning Process** | Chalk and board, Active Learning, |

**Module-2**

**Knowledge Representation on the Semantic Web:** Ontology and their role in the Semantic Web – Ontology based knowledge Representation - Ontology languages for the Semantic Web - Resource Description Framework and schema - Web Ontology Language.

**Modelling and aggregating social network data:** State-of-the-art in network data representation - Ontological representation of social individuals - Ontological representation of social relationships -

Aggregating and reasoning with social network data.

**Text book 1: Chapter4 – 4.1(4.1.1), 4.2(4.2.1,4.2.2), Chapter5 – 5.1 to 5.4**

| | |
|---|---|
| **Teaching-Learning Process** | Chalk and board, Active Learning, Demonstration |

**Module-3**

**Detecting communities in social networks** - Definition of community - Evaluating communities - Methods for community detection - Tools for detecting communities

**Decentralized online social networks** - Introduction - Challenges for DOSN - The Case for Decentralizing OSNs - General Purpose DOSNs - Specialized Application Centric DOSNs - Social Distributed Systems - Delay-Tolerant DOSN.

**Text book 2: Chapter 12 – 12.2 to 12.5, Chapter 17**

| | |
|---|---|
| **Teaching-Learning Process** | Chalk and board, Problem based learning, Demonstration |

**Module-4**

**Understanding and predicting human behaviour for social communities:** User data management - Inference and Distribution - Enabling new human experiences – The Technologies.

**Managing Trust in Online Social Networks:** Trust in online environment - Trust models based on subjective logic - Trust network analysis - Trust transitivity analysis - Combining trust and reputation - Trust derivation based on trust comparisons.

**Text book 2: Chapter20 - 20.2, 20.3(20.3.1), Chapter22 – 22.3, 22.5, 22.6, 22.7, 22.9, 22.10**

| | |
|---|---|
| **Teaching-Learning Process** | Chalk & board, Problem based learning, MOOC |

**Module-5**

**Visualization of Social Networks**: Social Network Analysis - Visualization - Visualizing online social networks,

**Novel Visualizations and Interactions for Social Networks Exploration:** Visualizing social networks with matrix-based representations - Matrix and Node-Link Diagrams - Hybrid representations.

**Applications of Social Network Analysis**: Applications of Social Network Analysis - Covert networks - Community welfare - Collaboration networks - Co-Citation networks.

**Text Book 2: Chapter 27 – 27.2, 27.3, 27.4, Chapter 28 – 28.5, Chapter 29 – 29.3.3, 29.3.5 to 29.3.7**

| | |
|---|---|
| **Teaching-Learning Process** | Chalk and board, MOOC |

**Course Outcomes**

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

CO 1. Understand the Semantic Web and Electronic sources for social network analysis.
CO 2. Understand the **Representation,** Modelling and Aggregating social network data.
CO 3. Analyse the human behaviour in social network.
CO 4. Apply techniques for detection and decentralization of social network.
CO 5. Illustrate the visual representation of social network data.

**Assessment Details (both CIE and SEE)**

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The

minimum passing mark for the CIE is 40% of the maximum marks (20 marks). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures not less than 35% ( 18 Marks out of 50)in the semester-end examination(SEE), and a minimum of 40% (40 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together

**Continuous Internal Evaluation:**

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2. Second test at the end of the 10th week of the semester
3. Third test at the end of the 15th week of the semester

Two assignments each of **10 Marks**

4. First assignment at the end of 4th week of the semester
5. Second assignment at the end of 9th week of the semester
6. At the end of the 13th week of the semester -Group discussion/Seminar/quiz any one of three suitably planned to attain the COs and POs for **20 Marks** (**duration 01 hours**)

The sum of three tests, two assignments, and quiz/seminar/group discussion will be out of 100 marks and will be **scaled down to 50 marks**

(to have less stressed CIE, the portion of the syllabus should not be common /repeated for any of the methods of the CIE. Each method of CIE should have a different syllabus portion of the course).

**CIE methods /question paper is designed to attain the different levels of Bloom's taxonomy as per the outcome defined for the course.**

**Semester End Examination:**

Theory SEE will be conducted by University as per the scheduled timetable, with common question papers for the subject (**duration 03 hours)**

1. The question paper will have ten questions. Each question is set for 20 marks.
2. There will be 2 questions from each module. Each of the two questions under a module (with a maximum of 3 sub-questions), **should have a mix of topics** under that module.
3. The students have to answer 5 full questions, selecting one full question from each module Marks scored shall be proportionally reduced to 50 marks

**Suggested Learning Resources:**

**Text Books**


1. Peter Mika, "Social Networks and the Semantic Web", First Edition, Springer 2007.
2. Borko Furht, "Handbook of Social Network Technologies and Applications", 1st Edition, Springer, 2010.


**Reference:**


1. Guandong Xu ,Yanchun Zhang and Lin Li, "Web Mining and Social Networking – Techniques and applications", First Edition Springer, 2011.
2. Dion Goh and Schubert Foo, "Social information Retrieval Systems: Emerging Technologies and Applications for Searching the Web Effectively", IGI Global Snippet, 2008.
3. Max Chevalier, Christine Julien and Chantal Soulé-Dupuy, "Collaborative and Social Information Retrieval and Access: Techniques for Improved user Modelling", IGI Global Snippet, 2009.
4. John G. Breslin, Alexander Passant and Stefan Decker, "The Social Semantic Web", Springer, 2009


**Web links and Video Lectures (e-Resources):**

1. https://www.youtube.com/watch?v=IiUDKDxScxI
2. http://www.nitttrc.edu.in/nptel/courses/video/106106146/L21.html
3. https://www.youtube.com/watch?v=DTxE9KV3YrE
4. https://www.youtube.com/watch?v=MQsTxRMy3Xg
5. https://www.youtube.com/watch?v=BQWoMRS5CGA
6. https://onlinecourses.nptel.ac.in/noc20_cs78/preview

**Activity Based Learning (Suggested Activities in Class)/ Practical Based learning**

**VII Semester**

| DIGITAL IMAGE PROCESSING | | | |
|---|---|---|---|
| Course Code | 21CS732 | CIE Marks | 50 |
| Teaching Hours/Week (L:T:P: S) | 3:0:0:0 | SEE Marks | 50 |
| Total Hours of Pedagogy | 40 | Total Marks | 100 |
| Credits | 03 | Exam Hours | 03 |

**Course Learning Objectives**

CLO 1. Understand the fundamentals of digital image processing
CLO 2. Explain the image transform techniques used in digital image processing
CLO 3. Apply different image enhancement techniques on digital images
CLO 4. Evaluate image restoration techniques and methods used in digital imageprocessing
CLO 5. Understand the Morphological Operations and Segmentation used in digital imageprocessing

**Teaching-Learning Process (General Instructions)**

These are sample Strategies, which teachers can use to accelerate the attainment of the various course outcomes.

1. Lecturer method (L) need not to be only a traditional lecture method, but alternative effective teaching methods could be adopted to attain the outcomes.
2. Use of Video/Animation to explain functioning of various concepts.
3. Encourage collaborative (Group Learning) Learning in the class.
4. Ask at least three HOT (Higher order Thinking) questions in the class, which promotes critical thinking.
5. Adopt Problem Based Learning (PBL), which fosters students' Analytical skills, develop design thinking skills such as the ability to design, evaluate, generalize, and analyze information rather than simply recall it.
6. Introduce Topics in manifold representations.
7. Show the different ways to solve the same problem with different circuits/logic and encourage the students to come up with their own creative ways to solve them.
8. Discuss how every concept can be applied to the real world - and when that's possible, it helps improve the students' understanding.

**Module-1**

**Digital Image Fundamentals**: What is Digital Image Processing? Originsof Digital Image Processing, Examples of fields that use DIP, FundamentalSteps in Digital Image Processing, Components of an Image ProcessingSystem, Elements of Visual Perception, Image Sensing and Acquisition, Image Sampling and Quantization, Some Basic Relationships BetweenPixels, Linear and Nonlinear Operations.

**Textbook 1: Chapter 1 and Chapter 2: Sections 2.1 to 2.5, 2.6.2**

| | |
|---|---|
| **Teaching-Learning Process** | Chalk and board, Active Learning, Problem based learning |

**Module-2**

**Spatial Domain:** Some Basic Intensity Transformation Functions, Histogram Processing, Fundamentals of Spatial Filtering, SmoothingSpatial Filters, Sharpening Spatial Filters

**Frequency Domain**: Preliminary Concepts, The Discrete FourierTransform (DFT) of Two Variables, Properties of the 2-D DFT, Filtering inthe Frequency Domain, Image Smoothing and Image Sharpening UsingFrequency Domain Filters, Selective Filtering.

**Textbook 1: Chapter 3: Sections 3.2 to 3.6 and Chapter 4: Sections 4.2, 4.5 to 4.10**

| | |
|---|---|
| **Teaching-Learning Process** | 1. Chalk and board, Active Learning, Demonstration<br>2. Laboratory Demonstration |

| Module-3 | |
|---|---|
| **Restoration:** Noise models, Restoration in the Presence of Noise Onlyusing Spatial Filtering and Frequency Domain Filtering, Linear, Position-Invariant Degradations, Estimating the Degradation Function, InverseFiltering, Minimum Mean Square Error (Wiener) Filtering, ConstrainedLeast Squares Filtering.<br><br>**Textbook 1: Chapter 5: Sections 5.2, to 5.9** | |
| **Teaching-Learning Process** | 1. Chalk and board |
| **Module-4** | |
| **Color Image Processing**: Color Fundamentals, Color Models, Pseudo color Image Processing. Wavelets: Background, Multiresolution Expansions.<br><br>**Morphological Image Processing**: Preliminaries, Erosion and Dilation, Opening and Closing, The Hit-or-Miss Transforms, Some Basic Morphological Algorithms.<br><br>**Text: Chapter 6: Sections 6.1 to 6.3, Chapter 7: Sections 7.1 and 7.2, Chapter 9: Sections 9.1 to 9.5** | |
| **Teaching-Learning Process** | 1.Chalk& board<br>2.Demonstartion of Case study /Application for wavelet transfer method |
| **Module-5** | |
| **Segmentation**: Introduction, classification of image segmentation algorithms, Detection of Discontinuities, Edge Detection, Hough Transforms and Shape Detection, Corner Detection, Principles of Thresholding.<br><br>**Representation and Description:** Representation, Boundary descriptors.<br><br>**Text2: Chapter 9: Sections 9.1, to 9.7 and Text 1: Chapter 11: Sections 11.1and 11.2** | |
| **Teaching-Learning Process** | 1.Chalk and board, MOOC.<br>2. Poster making activity for various image segmentation algorithms |

**Course Outcomes**

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

CO 1. Understand the fundamentals of Digital Image Processing.
CO 2. Apply different Image transformation techniques
CO 3. Analyze various image restoration techniques
CO 4. Understand colour image and morphological processing
CO 5. Design image analysis and segmentation techniques

**Assessment Details (both CIE and SEE)**

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures not less than 35% (18 Marks out of 50) in the semester-end examination (SEE), and a minimum of 40% (40 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together

**Continuous Internal Evaluation:**

Three Unit Tests each of **20 Marks (duration 01 hour**)

1. First test at the end of 5$^{th}$ week of the semester
2. Second test at the end of the 10$^{th}$ week of the semester
3. Third test at the end of the 15$^{th}$ week of the semester

Two assignments each of **10 Marks**

4. First assignment at the end of 4$^{th}$ week of the semester

5. Second assignment at the end of 9th week of the semester

Group discussion/Seminar/quiz any one of three suitably planned to attain the COs and POs for **20 Marks** (**duration 01 hours**)

6. At the end of the 13th week of the semester

The sum of three tests, two assignments, and quiz/seminar/group discussion will be out of 100 marks and will be **scaled down to 50 marks**

(to have less stressed CIE, the portion of the syllabus should not be common /repeated for any of the methods of the CIE. Each method of CIE should have a different syllabus portion of the course).

**CIE methods /question paper has to be designed to attain the different levels of Bloom's taxonomy as per the outcome defined for the course.**

**Semester End Examination:**

Theory SEE will be conducted by University as per the scheduled timetable, with common question papers for the subject (**duration 03 hours)**

1. The question paper will have ten questions. Each question is set for 20 marks.
2. There will be 2 questions from each module. Each of the two questions under a module (with a maximum of 3 sub-questions), **should have a mix of topics** under that module.
3. The students have to answer 5 full questions, selecting one full question from each module Marks scored shall be proportionally reduced to 50 marks

**Textbooks**

1. Rafael C. Gonzalez and Richard E. Woods, Digital Image Processing, Third Ed., Prentice Hall, 2008.
2. S. Sridhar, Digital Image Processing, Oxford University Press, 2nd Edition, 2016

**Reference:**

1. Digital Image Processing- S.Jayaraman, S.Esakkirajan, T.Veerakumar, TataMcGraw Hill 2014.
2. Fundamentals of Digital Image Processing-A. K. Jain, Pearson 2004

**Weblinks and Video Lectures (e-Resources):**

1. https://https://nptel.ac.in/courses/106/105/106105032/
2. https://github.com/PrajwalPrabhuiisc/Image-processing-assignments

**Activity Based Learning (Suggested Activities in Class)/ Practical Based learning**

Demonstration of finding the histogram from grayscale image, to check the low pass filter properties, filtering the images using Gaussian low pass filter, etc… using Python programming

Practical Based Assignment like following or any topic which is in-line with the course requirement. Students shall present and demonstrate their work at the end of semester.

- Program to show rotation, scaling, and translation of an image.
- Read an image and extract and display low-level features such as edges, textures using filtering techniques
- Demonstrate enhancing and segmenting low contrast 2D images.
- To Read an image, first apply erosion to the image and then subtract the result from the original.

**VII Semester**

| FULLSTACK DEVELOPMENT | | | |
|---|---|---|---|
| Course Code | 21AI733 | CIE Marks | 50 |
| Teaching Hours/Week (L:T:P: S) | 3:0:0:0 | SEE Marks | 50 |
| Total Hours of Pedagogy | 40 T | Total Marks | 100 |
| Credits | 03 | Exam Hours | 03 |

**Course Learning Objectives:**

CLO 1. Explain the use of learning full stack web development.
CLO 2. Make use of rapid application development in the design of responsive web pages.
CLO 3. Illustrate Models, Views and Templates with their connectivity in Django for full stack web development.
CLO 4. Demonstrate the use of state management and admin interfaces automation in Django.
CLO 5. Design and implement Django apps containing dynamic pages with SQL databases.

**Teaching-Learning Process (General Instructions)**

These are sample Strategies, which teachers can use to accelerate the attainment of the various course outcomes.

1. Lecturer method (L) does not mean only traditional lecture method, but different type of teaching methods may be adopted to develop the outcomes.
2. Show Video/animation films to explain functioning of various concepts.
3. Encourage collaborative (Group Learning) Learning in the class.
4. Ask at least three HOT (Higher order Thinking) questions in the class, which promotes critical thinking.
5. Adopt Problem Based Learning (PBL), which fosters students' Analytical skills, develop thinking skills such as the ability to evaluate, generalize, and analyze information rather than simply recall it.
6. Topics will be introduced in a multiple representation.
7. Show the different ways to solve the same problem and encourage the students to come up with their own creative ways to solve them.
8. Discuss how every concept can be applied to the real world - and when that's possible, it helps improve the students' understanding.

**Module-1: MVC based Web Designing**

Web framework, MVC Design Pattern, Django Evolution, Views, Mapping URL to Views, Working of Django URL Confs and Loose Coupling, Errors in Django, Wild Card patterns in URLS.

**Textbook 1: Chapter 1 and Chapter 3**

| | |
|---|---|
| **Teaching-Learning Process** | 1. Demonstration using Visual Studio Code<br>2. PPT/Prezi Presentation for Architecture and Design Patterns<br>3. Live coding of all concepts with simple examples |

**Module-2: Django Templates and Models**

Template System Basics, Using Django Template System, Basic Template Tags and Filters, MVT Development Pattern, Template Loading, Template Inheritance, MVT Development Pattern.

Configuring Databases, Defining and Implementing Models, Basic Data Access, Adding Model String Representations, Inserting/Updating data, Selecting and deleting objects, Schema Evolution

**Textbook 1: Chapter 4 and Chapter 5**

| | |
|---|---|
| **Teaching-Learning Process** | 1. Demonstration using Visual Studio Code<br>2. PPT/Prezi Presentation for Architecture and Design Patterns<br>3. Live coding of all concepts with simple examples |

| | |
|---|---|
| | 4. Case Study: Apply concepts learnt for an Online Ticket Booking System |

**Module-3: Django Admin Interfaces and Model Forms**

Activating Admin Interfaces, Using Admin Interfaces, Customizing Admin Interfaces, Reasons to use Admin Interfaces.

Form Processing, Creating Feedback forms, Form submissions, custom validation, creating Model Forms, URLConf Ticks, Including Other URLConfs.

**Textbook 1: Chapters 6, 7 and 8**

| | |
|---|---|
| **Teaching-Learning Process** | 1. Demonstration using Visual Studio Code<br>2. PPT/Prezi Presentation for Architecture and Design Patterns<br>3. Live coding of all concepts with simple examples |

**Module-4: Generic Views and Django State Persistence**

Using Generic Views, Generic Views of Objects, Extending Generic Views of objects, Extending Generic Views.

MIME Types, Generating Non-HTML contents like CSV and PDF, Syndication Feed Framework, Sitemap framework, Cookies, Sessions, Users and Authentication.

**Textbook 1: Chapters 9, 11 and 12**

| | |
|---|---|
| **Teaching-Learning Process** | 1. Demonstration using Visual Studio Code<br>2. PPT/Prezi Presentation for Architecture and Design Patterns<br>3. Live coding of all concepts with simple examples<br>4. Project Work: Implement all concepts learnt for Student Admission Management. |

**Module-5: jQuery and AJAX Integration in Django**

Ajax Solution, Java Script, XHTMLHttpRequest and Response, HTML, CSS, JSON, iFrames, Settings of Java Script in Django, jQuery and Basic AJAX, jQuery AJAX Facilities, Using jQuery UI Autocomplete in Django

**Textbook 2: Chapters 1, 2 and 7.**

| | |
|---|---|
| **Teaching-Learning Process** | 1. Demonstration using Visual Studio Code<br>2. PPT/Prezi Presentation for Architecture and Design Patterns<br>3. Live coding of all concepts with simple examples<br>4. Case Study: Apply the use of AJAX and jQuery for development of EMI calculator. |

**Course outcome (Course Skill Set)**

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

CO 1. Understand the working of MVT based full stack web development with Django.
CO 2. Designing of Models and Forms for rapid development of web pages.
CO 3. Analyze the role of Template Inheritance and Generic views for developing full stack web applications.
CO 4. Apply the Django framework libraries to render nonHTML contents like CSV and PDF.
CO 5. Perform jQuery based AJAX integration to Django Apps to build responsive full stack web applications,

**Assessment Details (both CIE and SEE)**

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is

50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures not less than 35% (18 Marks out of 50) in the semester-end examination (SEE), and a minimum of 40% (40 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together

**Continuous Internal Evaluation:**

Three Unit Tests each of **20 Marks (duration 01 hour**)

1. First test at the end of 5th week of the semester
2. Second test at the end of the 10th week of the semester
3. Third test at the end of the 15th week of the semester

Two assignments each of **10 Marks**

4. First assignment at the end of 4th week of the semester
5. Second assignment at the end of 9th week of the semester

Group discussion/Seminar/quiz any one of three suitably planned to attain the COs and POs for **20 Marks** (**duration 01 hours**)

6. At the end of the 13th week of the semester

The sum of three tests, two assignments, and quiz/seminar/group discussion will be out of 100 marks and will be **scaled down to 50 marks**

(to have less stressed CIE, the portion of the syllabus should not be common /repeated for any of the methods of the CIE. Each method of CIE should have a different syllabus portion of the course).

**CIE methods /question paper has to be designed to attain the different levels of Bloom's taxonomy as per the outcome defined for the course.**

**Semester End Examination:**

Theory SEE will be conducted by University as per the scheduled timetable, with common question papers for the subject (**duration 03 hours)**

1. The question paper will have ten questions. Each question is set for 20 marks.
2. There will be 2 questions from each module. Each of the two questions under a module (with a maximum of 3 sub-questions), **should have a mix of topics** under that module.
3. The students have to answer 5 full questions, selecting one full question from each module Marks scored shall be proportionally reduced to 50 marks

**Suggested Learning Resources:**

**Textbooks**

1. Adrian Holovaty, Jacob Kaplan Moss, The Definitive Guide to Django: Web Development Done Right, Second Edition, Springer-Verlag Berlin and Heidelberg GmbH & Co. KG Publishers, 2009
2. Jonathan Hayward, Django Java Script Integration: AJAX and jQuery, First Edition, Pack Publishing, 2011

**Reference Books**

1. Aidas Bendroraitis, Jake Kronika, Django 3 Web Development Cookbook, Fourth Edition, Packt Publishing, 2020
2. William Vincent, Django for Beginners: Build websites with Python and Django, First Edition, Amazon Digital Services, 2018
3. Antonio Mele, Django3 by Example, 3rd Edition, Pack Publishers, 2020
4. Arun Ravindran, Django Design Patterns and Best Practices, 2nd Edition, Pack Publishers, 2020.

5. Julia Elman, Mark Lavin, Light weight Django, David A. Bell, 1st Edition, Oreily Publications, 2014

**Weblinks and Video Lectures (e-Resources):**

1. MVT architecture with Django: https://freevideolectures.com/course/3700/django-tutorials
2. Using Python in Django: https://www.youtube.com/watch?v=2BqoLiMT3Ao
3. Model Forms with Django: https://www.youtube.com/watch?v=gMM1rtTwKxE
4. Real time Interactions in Django: https://www.youtube.com/watch?v=3gHmfoeZ45k
5. AJAX with Django for beginners: https://www.youtube.com/watch?v=3VaKNyjlxAU

**Activity Based Learning (Suggested Activities in Class)/ Practical Based learning**

1. Real world problem solving - applying the Django framework concepts and its integration with AJAX to develop any shopping website with admin and user dashboards.

**VII Semester**

| BLOCKCHAIN TECHNOLOGY | | | |
|---|---|---|---|
| Course Code | 21CS734 | CIE Marks | 50 |
| Teaching Hours/Week (L:T:P: S) | 3:0:0:0 | SEE Marks | 50 |
| Total Hours of Pedagogy | 40 | Total Marks | 100 |
| Credits | 03 | Exam Hours | 03 |

**Course Learning Objectives**

CLO 1. Explain the fundamentals of distributed computing and blockchain
CLO 2. Discuss the concepts in bitcoin
CLO 3. Demonstrate Ethereum platform

**Teaching-Learning Process (General Instructions)**

These are sample Strategies, which teachers can use to accelerate the attainment of the various course outcomes.

1. Lecturer method (L) need not to be only a traditional lecture method, but alternative effective teaching methods could be adopted to attain the outcomes.
2. Use of Video/Animation to explain functioning of various concepts.
3. Encourage collaborative (Group Learning) Learning in the class.
4. Ask at least three HOT (Higher order Thinking) questions in the class, which promotes critical thinking.
5. Adopt Problem Based Learning (PBL), which fosters students' Analytical skills, develop design thinking skills such as the ability to design, evaluate, generalize, and analyze information rather than simply recall it.
6. Introduce Topics in manifold representations.
7. Show the different ways to solve the same problem with different circuits/logic and encourage the students to come up with their own creative ways to solve them.
8. Discuss how every concept can be applied to the real world - and when that's possible, it helps improve the students' understanding.

**Module-1**

**Blockchain 101:** Distributed systems, History of blockchain, Introduction to blockchain, Types of blockchain, CAP theorem and blockchain, Benefits and limitations of blockchain.

**Decentralization and Cryptography:** Decentralization using blockchain, Methods of decentralization, Routes to decentralization, Decentralized organizations.

**Textbook 1: Chapter 1, 2**

| **Teaching-Learning Process** | Chalk and board, Active Learning – Oral presentations. |
|---|---|

**Module-2**

**Introduction to Cryptography & Cryptocurrencies:** Cryptographic Hash Functions, Hash Pointers and Data Structures, Digital Signatures, Public Keys as Identities, A Simple Cryptocurrency,

**How Bitcoin Achieves Decentralization:** Distributed consensus, Consensus without identity using a block chain, Incentives and proof of work, Putting it all together,

**Textbook 2: Chapter 1, 2**

| **Teaching-Learning Process** | Chalk and board, Demonstration |
|---|---|

**Module-3**

**Mechanics of Bitcoin:** Bitcoin transactions, Bitcoin Scripts, Applications of Bitcoin scripts, Bitcoin blocks, The Bitcoin network, Limitations and improvements

**How to Store and Use Bitcoins:** Simple Local Storage, Hot and Cold Storage, Splitting and Sharing Keys,

Online Wallets and Exchanges, Payment Services, Transaction Fees, Currency Exchange Markets

**Textbook2: Chapter 3,4**

| **Teaching-Learning Process** | Chalk and board, Problem based learning, Demonstration, MOOC |
|---|---|

**Module-4**

**Bitcoin Mining:** The task of Bitcoin miners, Mining Hardware, Energy consumption and ecology, Mining pools, Mining incentives and strategies,

**Bitcoin and Anonymity:** Anonymity Basics, How to De-anonymize Bitcoin, Mixing, Decentralized Mixing, Zerocoin and Zerocash,

**Textbook2: Chapter 5,6**

| **Teaching-Learning Process** | Chalk& board, Problem based learning, MOOC |
|---|---|

**Module-5**

**Smart Contracts and Ethereum 101:**
Smart Contracts: Definition, Ricardian contracts.

**Ethereum 101:** Introduction, Ethereum blockchain, Elements of the Ethereum blockchain, Precompiled contracts.

**Textbook 1: Chapter 10**

| **Teaching-Learning Process** | Chalk and board, MOOC, Practical Demonstration |
|---|---|

**Course Outcomes**

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

CO 1. Describe the concepts of Distrbuted computing and its role in Blockchain
CO 2. Describe the concepts of Cryptography and its role in Blockchain
CO 3. List the benefits, drawbacks and applications of Blockchain
CO 4. Appreciate the technologies involved in Bitcoin
CO 5. Appreciate and demonstrate the Ethereum platform to develop blockchain application.

**Assessment Details (both CIE and SEE)**

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures not less than 35% (18 Marks out of 50) in the semester-end examination (SEE), and a minimum of 40% (40 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together

**Continuous Internal Evaluation:**

Three Unit Tests each of **20 Marks (duration 01 hour**)

1. First test at the end of 5th week of the semester
2. Second test at the end of the 10th week of the semester
3. Third test at the end of the 15th week of the semester

Two assignments each of **10 Marks**

4. First assignment at the end of 4th week of the semester
5. Second assignment at the end of 9th week of the semester

Group discussion/Seminar/quiz any one of three suitably planned to attain the COs and POs for **20 Marks** (**duration 01 hours**)

6. At the end of the 13th week of the semester

The sum of three tests, two assignments, and quiz/seminar/group discussion will be out of 100 marks and will be **scaled down to 50 marks**

(to have less stressed CIE, the portion of the syllabus should not be common /repeated for any of the methods of the CIE. Each method of CIE should have a different syllabus portion of the course).

**CIE methods /question paper has to be designed to attain the different levels of Bloom's taxonomy**

**as per the outcome defined for the course.**

**Semester End Examination:**

Theory SEE will be conducted by University as per the scheduled timetable, with common question papers for the subject (**duration 03 hours)**

1. The question paper will have ten questions. Each question is set for 20 marks.
2. There will be 2 questions from each module. Each of the two questions under a module (with a maximum of 3 sub-questions), **should have a mix of topics** under that module.
3. The students have to answer 5 full questions, selecting one full question from each module Marks scored shall be proportionally reduced to 50 marks

**Suggested Learning Resources:**

**Textbooks**

1. Mastering Blockchain - Distributed ledgers, decentralization and smart contracts explained, Imran Bashir, Packt Publishing Ltd, Second Edition, ISBN 978-1-78712-544-5, 2017.
2. Arvind Narayanan, Joseph Bonneau, Edward W. Felten, Andrew Miller, Steven Goldfeder and Jeremy Clark., Bitcoin and Cryptocurrency Technologies: A Comprehensive Introduction. Princeton University Press, 2016.

**Reference:**

1. Mastering Bitcoins: Unlocking Digital Cryptocurrencies by Andreas Antonopoulos. O'Reilly Media, Inc, 2013.

**Weblinks and Video Lectures (e-Resources):**

1. http://bitcoinbook.cs.princeton.edu/?_ga=2.8302578.1344744326.1642688462-86383721.1642688462
2. https://nptel.ac.in/courses/106/105/106105184/
3. https://ethereum.org/en/developers/
4. https://developer.ibm.com/components/hyperledger-fabric/tutorials/

**Activity Based Learning (Suggested Activities in Class)/ Practical Based learning**

**VII Semester**

| INTERNET OF THINGS | | | |
|---|---|---|---|
| Course Code | 21CS735 | CIE Marks | 50 |
| Teaching Hours/Week (L:T:P: S) | 3:0:0:0 | SEE Marks | 50 |
| Total Hours of Pedagogy | 40 | Total Marks | 100 |
| Credits | 03 | Exam Hours | 03 |

**Course Learning Objectives**

CLO 1. Understand about the fundamentals of Internet of Things and its building blocks along with their characteristics.
CLO 2. Understand the recent application domains of IoT in everyday life.
CLO 3. Understand the protocols and standards designed for IoT and the current research on it.
CLO 4. Understand the other associated technologies like cloud and fog computing in the domain of IoT.
CLO 5. Improve their knowledge about the various cutting-edge technologies in the field IoT and machine learning applications.
CLO 6. Gain insights about the current trends of machine learning and AI techniques used in IoT to orient towards the present industrial scenario.

**Teaching-Learning Process (General Instructions)**

These are sample Strategies, which teachers can use to accelerate the attainment of the various course outcomes.

1. Lecturer method (L) need not to be only a traditional lecture method, but alternative effective teaching methods could be adopted to attain the outcomes.
2. Use of Video/Animation to explain functioning of various concepts.
3. Encourage collaborative (Group Learning) Learning in the class.
4. Ask at least three HOT (Higher order Thinking) questions in the class, which promotes critical thinking.
5. Adopt Problem Based Learning (PBL), which fosters students' Analytical skills, develop design thinking skills such as the ability to design, evaluate, generalize, and analyze information rather than simply recall it.
6. Introduce Topics in manifold representations.
7. Show the different ways to solve the same problem with different circuits/logic and encourage the students to come up with their own creative ways to solve them.
8. Discuss how every concept can be applied to the real world - and when that's possible, it helps improve the students' understanding.

**Module-1**

**Emergence of IoT:** Introduction, Evolution of IoT, Enabling IoT and the Complex Interdependence of Technologies, IoT Networking Components, Addressing Strategies in IoT.

**Textbook 1: Chapter 4 – 4.1 to 4.5**

| **Teaching-Learning Process** | Chalk and board, Active Learning, Problem based learning |
|---|---|

**Module-2**

**IoT Sensing and Actuation:** Introduction, Sensors, Sensor Characteristics, Sensorial Deviations, Sensing Types, Sensing Considerations, Actuators, Actuator Types, Actuator Characteristics.

**Textbook 1: Chapter 5 – 5.1 to 5.9**

| **Teaching-Learning Process** | Chalk and board, Active Learning, Demonstration |
|---|---|

**Module-3**

**IoT Processing Topologies and Types:** Data Format, Importance of Processing in IoT, Processing Topologies, IoT Device Design and Selection Considerations, Processing Offloading.

**Textbook 1: Chapter 6 – 6.1 to 6.5**

| **Teaching-Learning Process** | Chalk and board, Problem based learning, Demonstration |
|---|---|

**Module-4**

**IoT Connectivity Technologies:** Introduction, IEEE 802.15.4, Zigbee, Thread, ISA100.11A, WirelessHART, RFID, NFC, DASH7, Z-Wave, Weightless, Sigfox, LoRa, NB-IoT, Wi-Fi, Bluetooth

**Textbook 1: Chapter 7 – 7.1 to 7.16**

| **Teaching-Learning Process** | Chalk & board, Problem based learning |
|---|---|

**Module-5**

**IoT Communication Technologies:** Introduction, Infrastructure Protocols, Discovery Protocols, Data Protocols, Identification Protocols, Device Management, Semantic Protocols

**IoT Interoperability:** Introduction, Taxonomy of interoperability, Standards, Frameworks

**Textbook 1: Chapter 8 – 8.1, 6.2, 8.3, 8.4, 8.5, 8.6, .7**
**Textbook 1: Chapter 9 – 9.1, 9.2, 9.3**

| **Teaching-Learning Process** | Chalk and board, MOOC |
|---|---|

**Course Outcomes**

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

CO 1. Understand the evolution of IoT, IoT networking components, and addressing strategies in IoT.
CO 2. Analyze various sensing devices and actuator types.
CO 3. Demonstrate the processing in IoT.
CO 4. Apply different connectivity technologies.
CO 5. Understand the communication technologies , protocols and interoperability in IoT.

**Assessment Details (both CIE and SEE)**

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures not less than 35% (18 Marks out of 50) in the semester-end examination (SEE), and a minimum of 40% (40 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together

**Continuous Internal Evaluation:**

Three Unit Tests each of **20 Marks (duration 01 hour**)

1. First test at the end of 5th week of the semester
2. Second test at the end of the 10th week of the semester
3. Third test at the end of the 15th week of the semester

Two assignments each of **10 Marks**

4. First assignment at the end of 4th week of the semester
5. Second assignment at the end of 9th week of the semester
6. At the end of the 13th week of the semester- Group discussion/Seminar/quiz any one of three suitably planned to attain the COs and POs for **20 Marks** (**duration 01 hours**)

The sum of three tests, two assignments, and quiz/seminar/group discussion will be out of 100 marks and will be **scaled down to 50 marks**

(to have less stressed CIE, the portion of the syllabus should not be common /repeated for any of the methods of the CIE. Each method of CIE should have a different syllabus portion of the course).

**CIE methods /question paper has to be designed to attain the different levels of Bloom's taxonomy as per the outcome defined for the course.**

**Semester End Examination:**

Theory SEE will be conducted by University as per the scheduled timetable, with common question papers for the subject (**duration 03 hours)**

1. The question paper will have ten questions. Each question is set for 20 marks.

2. There will be 2 questions from each module. Each of the two questions under a module (with a maximum of 3 sub-questions), **should have a mix of topics** under that module.
3. The students have to answer 5 full questions, selecting one full question from each module Marks scored shall be proportionally reduced to 50 marks

**Suggested Learning Resources:**

**Textbooks**

1. Sudip Misra, Anandarup Mukherjee, Arijit Roy, "Introduction to IoT", Cambridge University Press 2021.

**Reference:**

1. S. Misra, C. Roy, and A. Mukherjee, 2020. Introduction to Industrial Internet of Things and Industry 4.0. CRC Press.
2. Vijay Madisetti and Arshdeep Bahga, "Internet of Things (A Hands-on-Approach)",1st Edition, VPT, 2014.
3. Francis daCosta, "Rethinking the Internet of Things: A Scalable Approach to Connecting Everything", 1st Edition, Apress Publications, 2013.

**Weblinks and Video Lectures (e-Resources):**

1. https://nptel.ac.in/noc/courses/noc19/SEM1/noc19-cs31/

**Activity Based Learning (Suggested Activities in Class)/ Practical Based learning**

**VII Semester**

| AUGMENTED REALITY | | | |
|---|---|---|---|
| Course Code | 21AI741 | CIE Marks | 50 |
| Teaching Hours/Week (L:T:P: S) | 3:0:0:0 | SEE Marks | 50 |
| Total Hours of Pedagogy | 40 | Total Marks | 100 |
| Credits | 03 | Exam Hours | 03 |

**Course Learning Objectives**

CLO 1. Understand the importance of Augmented reality
CLO 2. Understand and analyse the importance of Tracking system.
CLO 3. Compare and contrast the computer vision for Augmented reality and its applications
CLO 4. Analyse and understand Registration and camera simulation of visual coherence.
CLO 5. Acquire knowledge of Situated Visualization

**Teaching-Learning Process (General Instructions)**

These are sample Strategies, which teachers can use to accelerate the attainment of the various course outcomes.

1. Lecturer method (L) needs not to be only the traditional lecture method, but alternative effective teaching methods could be adopted to attain the outcomes.
2. Use of Video/Animation to explain the functioning of various concepts.
3. Encourage collaborative (Group Learning) Learning in the class.
4. Ask at least three HOT (Higher order Thinking) questions in the class, which promotes critical thinking.
5. Adopt Problem Based Learning (PBL), which fosters students' Analytical skills, develop design thinking skills such as the ability to design, evaluate, generalize, and analyse information rather than simply recall it.
6. Introduce Topics in manifold representations.
7. Show the different ways to solve the same problem with different circuits/logic and encourage the students to come up with their own creative ways to solve them.
8. Discuss how every concept can be applied to the real world - and when that's possible, it helps improve the students' understanding.

**Module-1**

**Introduction to Augmented Reality**
What Is Augmented Reality - Defining augmented reality, history of augmented reality, Examples, Displays-Multimodal Displays, Visual Perception, Requirements and Characteristics, Spatial Display Model

**Text book 1: Chapter 1,2**

| | |
|---|---|
| **Teaching-Learning Process** | Chalk and board, Active Learning, Problem based learning |

**Module-2**

**Tracking:** Tracking, Calibration, and Registration, Characteristics of Tracking Technology, Stationary Tracking Systems, Mobile Sensors, Optical Tracking, Sensor Fusion

**Text book 1: Chapter 3**

| | |
|---|---|
| **Teaching-Learning Process** | Chalk and board, Active Learning, Demonstration |

**Module-3**

**Computer Vision for Augmented Reality**-Marker Tracking, Multiple-Camera Infrared Tracking, Natural Feature Tracking by Detection, Incremental Tracking, Simultaneous Localization and Mapping, Outdoor Tracking

Calibration and Registration-Camera Calibration, Display Calibration, Registration

**Text book 1: Chapter 4,5**

| | |
|---|---|
| **Teaching-Learning Process** | Chalk and board, Problem based learning, Demonstration |

**Module-4**

**Visual Coherence:** Registration, Photometric Registration, Common Illumination, Diminished Reality, Camera Simulation, Stylized Augmented Reality

**Text book 1: Chapter 6**

| | |
|---|---|
| **Teaching-Learning Process** | Chalk& board, Problem based learning |

**Module-5**

**Situated Visualization:** Challenges, Visualization Registration, Annotations and Labeling, X-Ray Visualization, Spatial Manipulation, Information Filtering
Interaction-Output Modalities, Input Modalities, Tangible Interfaces

**Text Book 1: Chapter 7,8**

| | |
|---|---|
| **Teaching-Learning Process** | Chalk and board, MOOC |

**Course Outcomes**

At the end of the course the student will be able to:
CO1:Understand the importance of Augmented reality
CO2: Comprehend and analyse the Tracking system.
CO3: Compare and Contrast the computer vision for Augmented reality
CO4: Analyse and understand Registration and camera simulation of visual coherence.
CO5: Acquire knowledge of Situated Visualization

**Assessment Details (both CIE and SEE)**

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures not less than 35% ( 18 Marks out of 50)in the semester-end examination(SEE), and a minimum of 40% (40 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together

**Continuous Internal Evaluation:**

Three Unit Tests each of **20 Marks (duration 01 hour**)

1. First test at the end of 5th week of the semester
2. Second test at the end of the 10th week of the semester
3. Third test at the end of the 15th week of the semester

Two assignments each of **10 Marks**

4. First assignment at the end of 4th week of the semester
5. Second assignment at the end of 9th week of the semester

Group discussion/Seminar/quiz any one of three suitably planned to attain the COs and POs for **20 Marks** (**duration 01 hours**)

6. At the end of the 13th week of the semester

The sum of three tests, two assignments, and quiz/seminar/group discussion will be out of 100 marks and

will be **scaled down to 50 marks**

(to have less stressed CIE, the portion of the syllabus should not be common /repeated for any of the methods of the CIE. Each method of CIE should have a different syllabus portion of the course).

**CIE methods /question papers are designed to attain the different levels of Bloom's taxonomy as per the outcome defined for the course.**

**Semester End Examination:**

Theory SEE will be conducted by University as per the scheduled timetable, with common question papers for the subject (**duration 03 hours)**

1. The question paper will have ten questions. Each question is set for 20 marks.
2. There will be 2 questions from each module. Each of the two questions under a module (with a maximum of 3 sub-questions), **should have a mix of topics** under that module.
3. The students have to answer 5 full questions, selecting one full question from each module Marks scored shall be proportionally reduced to 50 marks

**Suggested Learning Resources:**

**Text Books**

1. Augmented Reality: Principles and Practice by Dieter SCHMALSTIEG,Tobias HOLLERER

**Reference:**

1. Augmented Reality: Principles & Practice by Schmalstieg / Hollerer, Pearson Education India; First edition (12 October 2016),ISBN-10: 9332578494
2. Sanni Siltanen- Theory and applications of marker-based augmented reality. Julkaisija – Utgivare Publisher. 2012. ISBN 978-951-38-7449-0
3. Allan Fowler-AR Game Development‖, 1st Edition, A press Publications, 2018, ISBN 978-1484236178

**Web links and Video Lectures (e-Resources):**

e-Books:

1. https://www.vttresearch.com/sites/default/files/pdf/science/2012/S3.pdf
2. https://docs.microsoft.com/en-us/windows/mixed-reality/
3. https://docs.microsoft.com/enus/archive/msdnmagazine/2016/november/hololensintroduction-to-the-hololens

**Activity Based Learning (Suggested Activities in Class)/ Practical Based learning**

**VII Semester**

| MULTIAGENT SYSTEMS | | | |
|---|---|---|---|
| Course Code | 21CS742 | CIE Marks | 50 |
| Teaching Hours/Week (L:T:P: S) | 3:0:0:0 | SEE Marks | 50 |
| Total Hours of Pedagogy | 40 | Total Marks | 100 |
| Credits | 03 | Exam Hours | 03 |

**Course Learning Objectives**

CLO 1. To introduce the concept of a multi agent systems and Distributed Constraints
CLO 2. Explore the main issues surrounding the computer and extended form games.
CLO 3. Develop cooperative learning, stochastic games
CLO 4. Exhibit the awareness about protocols about multi agent resource allocation and auctions
CLO 5. Construct voting mechanism design.

**Teaching-Learning Process (General Instructions)**

These are sample Strategies, which teachers can use to accelerate the attainment of the various course outcomes.

1. Lecturer method (L) need not to be only a traditional lecture method, but alternative effective teaching methods could be adopted to attain the outcomes.
2. Use of Video/Animation to explain functioning of various concepts.
3. Encourage collaborative (Group Learning) Learning in the class.
4. Ask at least three HOT (Higher order Thinking) questions in the class, which promotes critical thinking.
5. Adopt Problem Based Learning (PBL), which fosters students' Analytical skills, develop design thinking skills such as the ability to design, evaluate, generalize, and analyze information rather than simply recall it.
6. Introduce Topics in manifold representations.
7. Show the different ways to solve the same problem with different circuits/logic and encourage the students to come up with their own creative ways to solve them.
8. Discuss how every concept can be applied to the real world - and when that's possible, it helps improve the students' understanding.

**Module-1: Multiagent Problem Formulation**

Utility, Markov Decision Processes, Planning
**Distributed Constraints**: Distributed Constraint Satisfaction, Distributed Constraint Optimization

**Textbook 1: Chapters 1 &2, Textbook 2: Chapter 1**

| | |
|---|---|
| **Teaching-Learning Process** | 1. PPT – Decision Processes, Planning<br>2. Demonstration of constraints and their optimization |

**Module-2: Standard and Extended Form Games**

Games in Normal Form, Games in Extended Form, Self-interested agents, Characteristic Form Games, Coalition Formation

**Textbook 1: Chapters 3 & 4, Textbook 2: Chapter 3**

| | |
|---|---|
| **Teaching-Learning Process** | 1. PPT – Games in different forms<br>2. Demonstration of coalition formation |

**Module-3: Learning in Multiagent Systems**

The Machine Learning Problem, Cooperative Learning, Repeated Games, Stochastic Games, General Theories for Learning Agents, Collective Intelligence

**Textbook 1: Chapters 5**

| | |
|---|---|
| **Teaching-Learning Process** | 1. PPT – Cooperative learning, Collective intelligence<br>2. Demonstration of stochastic games |

**Module-4: Negotiation**

The Bargaining Problem, Monotonic Concession Protocol, Negotiation as Distributed Search, Ad-hoc Negotiation Strategies, The Task Allocation Problem.
**Protocols for Multiagent Resource Allocation: Auctions:** Simple Auctions, Combinatorial Auctions

**Textbook 1: Chapters 6&7,**
**Textbook 2: Chapter 11**

| | |
|---|---|
| **Teaching-Learning Process** | 1. PPT – Bargaining problems<br>2. Demonstration of different auctions for resource allocation |

**Module-5: Voting and Mechanism Design**

The Voting Problem, Mechanism Design. **Nature-Inspired Approaches:** Ants and Termites, Immune System

**Textbook 1: Chapters 8&10,**
**Textbook 2: Chapter 10**

| | |
|---|---|
| **Teaching-Learning Process** | 1. PPT – Voting Problem<br>2. Demonstration of nature inspired Approaches |

**Course Outcomes**

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

CO 1. Demonstrate the decision process with different constraints
CO 2. Analyze games in different forms
CO 3. Apply the cooperative learning in developing games
CO 4. Analyze different negotiation strategies of Multi-Agent System
CO 5. Design and develop solutions for voting problems

**Assessment Details (both CIE and SEE)**

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures not less than 35% (18 Marks out of 50) in the semester-end examination (SEE), and a minimum of 40% (40 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together

**Continuous Internal Evaluation:**

Three Unit Tests each of **20 Marks (duration 01 hour**)

1. First test at the end of 5th week of the semester
2. Second test at the end of the 10th week of the semester
3. Third test at the end of the 15th week of the semester

Two assignments each of **10 Marks**

4. First assignment at the end of 4th week of the semester
5. Second assignment at the end of 9th week of the semester

Group discussion/Seminar/quiz any one of three suitably planned to attain the COs and POs for **20 Marks** (**duration 01 hours**)

6. At the end of the 13th week of the semester

The sum of three tests, two assignments, and quiz/seminar/group discussion will be out of 100 marks and will be **scaled down to 50 marks**

(to have less stressed CIE, the portion of the syllabus should not be common /repeated for any of the methods of the CIE. Each method of CIE should have a different syllabus portion of the course).

**CIE methods /question papers are designed to attain the different levels of Bloom's taxonomy as per the outcome defined for the course.**

**Semester End Examination:**

Theory SEE will be conducted by University as per the scheduled timetable, with common question papers for the subject (**duration 03 hours)**

1. The question paper will have ten questions. Each question is set for 20 marks.
2. There will be 2 questions from each module. Each of the two questions under a module (with a maximum of 3 sub-questions), **should have a mix of topics** under that module.
3. The students have to answer 5 full questions, selecting one full question from each module Marks scored shall be proportionally reduced to 50 marks

**Suggested Learning Resources:**

**Textbooks**

1. Fundamentals of Multiagent Systems by Jos´e M. Vidal, 2006, available online http://jmvidal.cse.sc.edu/papers/mas.pdf.
2. Multiagent Systems: Algorithmic, Game-Theoretic, and Logical Foundations, By YoavShoham, Kevin Leyton-Brown, Cambridge University Press, 2008, 2nded http://www.masfoundations.org/mas.pdf

**Reference:**

1. Multiagent Systems : A Modern Approach to Distributed Artificial Intelligence Gerhard Weiss The MIT Press 2000

**Weblinks and Video Lectures (e-Resources):**

1. https://nptel.ac.in/courses/106/105/106105077/
2. https://www.youtube.com/watch?v=O2su1u2AXG0.
3. https://www.coursera.org/lecture/modeling-simulation-natural-processes/multi-agent-systems-kAKyC

**Activity Based Learning (Suggested Activities in Class)/ Practical Based learning**

**VII Semester**

| PREDICTIVE ANALYTICS | | | |
|---|---|---|---|
| Course Code | 21AI743 | CIE Marks | 50 |
| Teaching Hours/Week (L:T:P: S) | 3:0:0:0 | SEE Marks | 50 |
| Total Hours of Pedagogy | 40 | Total Marks | 100 |
| Credits | 03 | Exam Hours | 03 |

**Course Learning Objectives**

CLO 1. Comprehend the fundamental principles of analytics for business
CLO 2. Explore various techniques for predictive modelling
CLO 3. Analyse the data transformation of different predictors
CLO 4. Examine how predictive analytics can be used in decision making
CLO 5. Apply predictive models to generate predictions for new data

**Teaching-Learning Process (General Instructions)**

These are sample Strategies, which teachers can use to accelerate the attainment of the various course outcomes.

1. Lecturer method (L) needs not to be only a traditional lecture method, but alternative effective teaching methods could be adopted to attain the outcomes.
2. Use of Video/Animation to explain functioning of various concepts.
3. Encourage collaborative (Group Learning) Learning in the class.
4. Ask at least three HOT (Higher order Thinking) questions in the class, which promotes critical thinking.
5. Adopt Problem Based Learning (PBL), which fosters students' Analytical skills, develop design thinking skills such as the ability to design, evaluate, generalize, and analyse information rather than simply recall it.
6. Introduce Topics in manifold representations.
7. Show the different ways to solve the same problem with different circuits/logic and encourage the students to come up with their own creative ways to solve them.
8. Discuss how every concept can be applied to the real world - and when that's possible, it helps improve the students' understanding.

**Module-1**

**Introduction to Predictive analytics –** Business analytics: types, applications, Analytical Techniques, Tools

**Predictive Modelling:** Propensity Models, Cluster Models,Applications.

**Text book 1: Chapter 1, 2.**

| | |
|---|---|
| **Teaching-Learning Process** | Chalk and board, Active Learning |

**Module-2**

**Modelling Techniques**: Statistical Modelling, Machine Learning, Empirical Bayes Method,Point Estimation.

**Text book 1: Chapter 3,4**

| | |
|---|---|
| **Teaching-Learning Process** | Chalk and board, Active Learning |

**Module-3**

**Data Pre-processing:** Data Transformations for Individual Predictors, Data Transformation for Multiple Predictors, Dealing with Missing Values, Removing Predictors,Adding Predictors, Binning Predictors. Over-Fitting and Model Tuning.

**Text book 2: 3, 4**

| | |
|---|---|
| **Teaching-Learning Process** | Chalk and board, Active Learning |

**Module-4**

**Regression Models:** Measuring Performance in Regression Models - Linear Regression and Its Cousins - Non-Linear Regression Models - Regression Trees and Rule-Based Models Case Study: Compressive Strength of Concrete Mixtures.

**Text book 2: Chapter 5,6,7,8**

| | |
|---|---|
| **Teaching-Learning Process** | Chalk& board, Active Learning, MOOC |

**Module-5**

**Classification Models:** Measuring Performance in Classification Models - Discriminant Analysis and Other Linear Classification Models - Non-Linear Classification Models - Classification Trees and Rule-Based Models – Model Evaluation Techniques**.**

**Text Book 2: Chapter 11,12,13,14**

| | |
|---|---|
| **Teaching-Learning Process** | Chalk and board, MOOC |

**Course Outcomes**

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

CO 1. Understand the importance of predictive analytics, able to prepare and process data for the models
CO 2. Apply the statistical techniques for predictive models
CO 3. Comprehend the transformation of data in the predictors.
CO 4. Apply regression and classification models for decision making and evaluate the performance
CO 5. Apply and build the time series forecasting models in a variety of business contexts

**Assessment Details (both CIE and SEE)**

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures not less than 35% ( 18 Marks out of 50)in the semester-end examination(SEE), and a minimum of 40% (40 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together

**Continuous Internal Evaluation:**

Three Unit Tests each of **20 Marks (duration 01 hour**)

1. First test at the end of 5th week of the semester
2. Second test at the end of the 10th week of the semester
3. Third test at the end of the 15th week of the semester

Two assignments each of **10 Marks**

4. First assignment at the end of 4th week of the semester
5. Second assignment at the end of 9th week of the semester

Group discussion/Seminar/quiz any one of three suitably planned to attain the COs and POs for **20 Marks** (**duration 01 hours**)

6. At the end of the 13th week of the semester

The sum of three tests, two assignments, and quiz/seminar/group discussion will be out of 100 marks and will be **scaled down to 50 marks**

(to have less stressed CIE, the portion of the syllabus should not be common /repeated for any of the methods of the CIE. Each method of CIE should have a different syllabus portion of the course).

**CIE methods /question paper is designed to attain the different levels of Bloom's taxonomy as per the outcome defined for the course.**

**Semester End Examination:**

Theory SEE will be conducted by University as per the scheduled timetable, with common question papers for the subject (**duration 03 hours)**

1. The question paper will have ten questions. Each question is set for 20 marks.
2. There will be 2 questions from each module. Each of the two questions under a module (with a maximum of 3 sub-questions), **should have a mix of topics** under that module.
3. The students have to answer 5 full questions, selecting one full question from each module. Marks scored shall be proportionally reduced to 50 marks

**Suggested Learning Resources:**

**Text Books**

1. Jeffrey S. Strickland, Predictive Analytics using R,2014
2. Max Kuhn and Kjell Johnson, Applied Predictive Modeling, 1st edition Springer, 2013.

**Reference:**

1. Dean Abbott, Applied Predictive Analytics: Principles and Techniques for the Professional Data Analyst, 1st Edition Wiley, 2014.

**Web links and Video Lectures (e-Resources):**

1. https://www.coursera.org/lecture/fundamentals-of-data-analysis/introduction-to-predictive-analytics-u4H61

**Activity Based Learning (Suggested Activities in Class)/ Practical Based learning**

**VII Semester**

| ROBOTIC PROCESS AUTOMATION DESIGN AND DEVELOPMENT | | | |
|---|---|---|---|
| Course Code | 21CS744 | CIE Marks | 50 |
| Teaching Hours/Week (L:T:P: S) | 3:0:0:0 | SEE Marks | 50 |
| Total Hours of Pedagogy | 40 | Total Marks | 100 |
| Credits | 3 | Exam Hours | 3 |

**Course Learning Objectives**

CLO 1. To understand basic concepts of RPA
CLO 2. To Describe RPA, where it can be applied and how its implemented
CLO 3. To Describe the different types of variables, Control Flow and data manipulation techniques
CLO 4. To Understand Image, Text and Data Tables Automation
CLO 5. To Describe various types of Exceptions and strategies to handle

**Teaching-Learning Process (General Instructions)**

These are sample Strategies, which teachers can use to accelerate the attainment of the various course outcomes.

1. Lecturer method (L) need not to be only a traditional lecture method, but alternative effective teaching methods could be adopted to attain the outcomes.
2. Use of Video/Animation to explain functioning of various concepts.
3. Encourage collaborative (Group Learning) Learning in the class.
4. Ask at least three HOT (Higher order Thinking) questions in the class, which promotes critical thinking.
5. Adopt Problem Based Learning (PBL), which fosters students' Analytical skills, develop design thinking skills such as the ability to design, evaluate, generalize, and analyze information rather than simply recall it.
6. Introduce Topics in manifold representations.
7. Show the different ways to solve the same problem with different circuits/logic and encourage the students to come up with their own creative ways to solve them.
8. Discuss how every concept can be applied to the real world - and when that's possible, it helps improve the students' understanding.

**Module-1**

**RPA Foundations**- What is RPA – Flavors of RPA- History of RPA- The Benefits of RPA- The downsides of RPA- RPA Compared to BPO, BPM and BPA – Consumer Willingness for Automation- The Workforce of the Future- RPA Skills-On-Premise Vs. the Cloud- Web Technology- Programming Languages and Low Code- OCR-Databases-APIs- AI-Cognitive Automation-Agile, Scrum, Kanban and Waterfall0 DevOps-Flowcharts.

**Textbook 1: Ch 1, Ch 2**

| **Teaching-Learning Process** | Chalk and board, Active Learning, Problem based learning |
|---|---|

**Module-2**

**RPA Platforms**- Components of RPA- RPA Platforms-About Ui Path- About UiPath - The future of automation - Record and Play - Downloading and installing UiPath Studio -Learning Ui Path Studio- - Task recorder - Step-by-step examples using the recorder.

**Textbook 2: Ch 1, Ch 2**

| **Teaching-Learning Process** | Chalk and board, Active Learning, Demonstration |
|---|---|

**Module-3**

**Sequence, Flowchart, and Control Flow**-Sequencing the workflow-Activities-Control flow, various types of loops, and decision making-Step-by-step example using Sequence and Flowchart-Step-by-step

example using Sequence and Control flow-Data Manipulation-Variables and Scope-Collections-Arguments – Purpose and use-Data table usage with examples-Clipboard management-File operation with step-by-step example-CSV/Excel to data table and vice versa (with a step-by-step example).

**Textbook 2: Ch 3, Ch 4**

| **Teaching-Learning Process** | Chalk and board, Problem based learning, Demonstration |
|---|---|

**Module-4**

**Taking Control of the Controls**- Finding and attaching windows- Finding the control- Techniques for waiting for a control- Act on controls – mouse and keyboard activities- Working with UiExplorer- Handling events- Revisit recorder- Screen Scraping- When to use OCR- Types of OCR available- How to use OCR- Avoiding typical failure points.

**Textbook 2: Ch 5**

| **Teaching-Learning Process** | Chalk& board, Problem based learning |
|---|---|

**Module-5**

Exception Handling, Debugging, and Logging- Exception handling- Common exceptions and ways to handle them- Logging and taking screensHOT- Debugging techniques- Collecting crash dumps- Error reporting- Future of RPA

**Textbook 2: Ch 8**
**Textbook 1: Ch 13**

| **Teaching-Learning Process** | Chalk and board, MOOC |
|---|---|

**Course Outcomes**

CO 1. To Understand the basic concepts of RPA
CO 2. To Describe various components and platforms of RPA
CO 3. To Describe the different types of variables, control flow and data manipulation techniques
CO 4. To Understand various control techniques and OCR in RPA
CO 5. To Describe various types and strategies to handle exceptions

**Assessment Details (both CIE and SEE)**

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures not less than 35% (18 Marks out of 50) in the semester-end examination (SEE), and a minimum of 40% (40 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together

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Three Unit Tests each of **20 Marks (duration 01 hour**)

1. First test at the end of 5th week of the semester
2. Second test at the end of the 10th week of the semester
3. Third test at the end of the 15th week of the semester

Two assignments each of **10 Marks**

4. First assignment at the end of 4th week of the semester
5. Second assignment at the end of 9th week of the semester

Group discussion/Seminar/quiz any one of three suitably planned to attain the COs and POs for **20 Marks** (**duration 01 hours**)

6. At the end of the 13th week of the semester

The sum of three tests, two assignments, and quiz/seminar/group discussion will be out of 100 marks and will be **scaled down to 50 marks**

(to have less stressed CIE, the portion of the syllabus should not be common /repeated for any of the

methods of the CIE. Each method of CIE should have a different syllabus portion of the course).

**CIE methods /question paper has to be designed to attain the different levels of Bloom's taxonomy as per the outcome defined for the course.**

**Semester End Examination:**

Theory SEE will be conducted by University as per the scheduled timetable, with common question papers for the subject (**duration 03 hours)**

1. The question paper will have ten questions. Each question is set for 20 marks.
2. There will be 2 questions from each module. Each of the two questions under a module (with a maximum of 3 sub-questions), **should have a mix of topics** under that module.
3. The students have to answer 5 full questions, selecting one full question from each module. Marks scored shall be proportionally reduced to 50 marks

**Suggested Learning Resources:**

**Textbooks**

1. Tom Taulli , The Robotic Process Automation Handbook : A Guide to Implementing RPA Systems, 2020, ISBN-13 (electronic): 978-1-4842-5729-6, Publisher : Apress
2. Alok Mani Tripathi, Learning Robotic Process Automation, Publisher: Packt Publishing Release Date: March 2018 ISBN: 9781788470940

**Reference:**

1. Frank Casale, Rebecca Dilla, Heidi Jaynes, Lauren Livingston, "Introduction to Robotic Process Automation: a Primer", Institute of Robotic Process Automation.
2. Richard Murdoch, Robotic Process Automation: Guide To Building Software Robots, Automate Repetitive Tasks & Become An RPA Consultant
3. Srikanth Merianda,Robotic Process Automation Tools, Process Automation and their benefits: Understanding RPA and Intelligent Automation

**Weblinks and Video Lectures (e-Resources):**

- https://www.uipath.com/rpa/robotic-process-automation

**Activity Based Learning (Suggested Activities in Class)/ Practical Based learning**

**VII Semester**

| NOSQL DATABASE | | | |
|---|---|---|---|
| Course Code: | 21CS745 | CIE Marks | 50 |
| Teaching Hours/Week (L:T:P:S) | 3:0:0:0 | SEE Marks | 50 |
| Total Hours of Pedagogy | 40 | Total Marks | 100 |
| Credits | 03 | Exam Hours | 03 |

**Course Objectives:**

CLO 1. Recognize and Describe the four types of NoSQL Databases, the Document-oriented, KeyValue
CLO 2. Pairs, Column-oriented and Graph databases useful for diverse applications.
CLO 3. Apply performance tuning on Column-oriented NoSQL databases and Document-oriented NoSQL Databases.
CLO 4. Differentiate the detailed architecture of column oriented NoSQL database, Document database and Graph Database and relate usage of processor, memory, storage and file system commands.
CLO 5. Evaluate several applications for location based service and recommendation services. Devise an application using the components of NoSQL.

**Teaching-Learning Process (General Instructions)**

These are sample Strategies, which teachers can use to accelerate the attainment of the various course outcomes.

1. Lecturer methods (L) need not to be only traditional lecture methods, but alternative effective teaching methods could be adopted to attain the outcomes.
2. Use of Video/Animation to explain functioning of various concepts.
3. Encourage collaborative (Group Learning) Learning in the class.
4. Ask at least three HOT (Higher order Thinking) questions in the class, which promotes critical thinking.
5. Adopt Problem Based Learning (PBL), which fosters students' Analytical skills, develop design thinking skills such as the ability to design, evaluate, generalize, and analyze information rather than simply recall it.
6. Introduce Topics in manifold representations.
7. Show the different ways to solve the same problem and encourage the students to come up with their own creative ways to solve them.
8. Discuss how every concept can be applied to the real world - and when that's possible, it helps improve the students' understanding.

**Module-1**

Why NoSQL? The Value of Relational Databases, Getting at Persistent Data, Concurrency, Integration, A (Mostly) Standard Model, Impedance Mismatch, Application and Integration Databases, Attack of the Clusters, The Emergence of NoSQL,

Aggregate Data Models; Aggregates, Example of Relations and Aggregates, Consequences of Aggregate Orientation, Key-Value and Document Data Models, Column-Family Stores, Summarizing Aggregate-Oriented Databases.

More Details on Data Models; Relationships, Graph Databases, Schemaless Databases, Materialized Views, Modeling for Data Access,

**Textbook1: Chapter 1,2,3**

| **Teaching-Learning Process** | Active learning |
|---|---|

**Module-2**

Distribution Models; Single Server, Sharding, Master-Slave Replication, Peer-to-Peer Replication, Combining Sharding and Replication.

Consistency, Update Consistency, Read Consistency, Relaxing Consistency, The CAP Theorem, Relaxing Durability, Quorums.

Version Stamps, Business and System Transactions, Version Stamps on Multiple Nodes

**Textbook1: Chapter 4,5,6**

| **Teaching-Learning Process** | Active Learning and Demonstrations |
|---|---|

**Module-3**

Map-Reduce, Basic Map-Reduce, Partitioning and Combining, Composing Map-Reduce Calculations, A Two Stage Map-Reduce Example, Incremental Map-Reduce

Key-Value Databases, What Is a Key-Value Store, Key-Value Store Features, Consistency, Transactions, Query Features, Structure of Data, Scaling, Suitable Use Cases, Storing Session Information, User Profiles, Preference, Shopping Cart Data, When Not to Use, Relationships among Data, Multioperation Transactions, Query by Data, Operations by Sets

**Textbook1: Chapter 7,8**

| **Teaching-Learning Process** | Active Learning, Problem solving based |
|---|---|

**Module-4**

Document Databases, What Is a Document Database?, Features, Consistency, Transactions, Availability, Query Features, Scaling, Suitable Use Cases, Event Logging, Content Management Systems, Blogging Platforms, Web Analytics or Real-Time Analytics, E- Commerce Applications, When Not to Use, Complex Transactions Spanning Dif erent Operations, Queries against Varying Aggregate Structure

**Textbook1: Chapter 9**

| **Teaching-Learning Process** | Active learning |
|---|---|

**Module-5**

Graph Databases, What Is a Graph Database?, Features, Consistency, Transactions, Availability, Query Features, Scaling, Suitable Use Cases, Connected Data, Routing, Dispatch, and Location-Based Services, Recommendation Engines, When Not to Use.

**Textbook1: Chapter 11**

| **Teaching-Learning Process** | Active learning |
|---|---|

**Course Outcomes (Course Skill Set)**

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

CO1. Demonstrate an understanding of the detailed architecture of Column Oriented NoSQL databases, Document databases, Graph databases.

CO2. Use the concepts pertaining to all the types of databases.

CO3. Analyze the structural Models of NoSQL.

CO4. Develop various applications using NoSQL databases.

**Assessment Details (both CIE and SEE)**

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures not less than 35% (18 Marks out of 50) in the semester-end examination (SEE), and a minimum of 40% (40 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together

**Continuous Internal Evaluation:**

Three Unit Tests each of **20 Marks (duration 01 hour**)

1. First test at the end of 5$^{th}$ week of the semester
2. Second test at the end of the 10$^{th}$ week of the semester
3. Third test at the end of the 15$^{th}$ week of the semester

Two assignments each of **10 Marks**

4. First assignment at the end of 4th week of the semester
5. Second assignment at the end of 9th week of the semester

Group discussion/Seminar/quiz any one of three suitably planned to attain the COs and POs for **20 Marks** (**duration 01 hours**)

6. At the end of the 13th week of the semester

The sum of three tests, two assignments, and quiz/seminar/group discussion will be out of 100 marks and will be **scaled down to 50 marks**

(to have less stressed CIE, the portion of the syllabus should not be common /repeated for any of the methods of the CIE. Each method of CIE should have a different syllabus portion of the course).

**CIE methods /question paper has to be designed to attain the different levels of Bloom's taxonomy as per the outcome defined for the course.**

**Semester End Examination:**

Theory SEE will be conducted by University as per the scheduled timetable, with common question papers for the subject (**duration 03 hours)**

1. The question paper will have ten questions. Each question is set for 20 marks.
2. There will be 2 questions from each module. Each of the two questions under a module (with a maximum of 3 sub-questions), **should have a mix of topics** under that module.
3. The students have to answer 5 full questions, selecting one full question from each module Marks scored shall be proportionally reduced to 50 marks

**Suggested Learning Resources:**

**Textbooks**

1. Sadalage, P. & Fowler, NoSQL Distilled: A Brief Guide to the Emerging World of Polyglot Persistence, Pearson Addision Wesley, 2012

**Reference Books**

1. Dan Sullivan, "NoSQL For Mere Mortals", 1st Edition, Pearson Education India, 2015. (ISBN- 13: 978-9332557338)
2. Dan McCreary and Ann Kelly, "Making Sense of NoSQL: A guide for Managers and the Rest of us", 1st Edition, Manning Publication/Dreamtech Press, 2013. (ISBN-13: 978-9351192022)
3. Kristina Chodorow, "Mongodb: The Definitive Guide- Powerful and Scalable Data Storage", 2nd Edition, O'Reilly Publications, 2013. (ISBN-13: 978-9351102694)

**Weblinks and Video Lectures (e-Resources):**

1. https://www.geeksforgeeks.org/introduction-to-nosql/ ( and related links in the page)
2. https://www.youtube.com/watch?v=0buKQHokLK8 (How do NoSQL databases work? Simply explained)
3. https://www.techtarget.com/searchdatamanagement/definition/NoSQL-Not-Only-SQL (What is NoSQL and How do NoSQL databases work)
4. https://www.mongodb.com/nosql-explained (What is NoSQL)
5. https://onlinecourses.nptel.ac.in/noc20-cs92/preview (preview of Bigdata course contains NoSQL)

**Activity Based Learning (Suggested Activities in Class)/ Practical Based learning**

- Real world problem solving using group discussion.

**VII Semester**

| PROGRAMMING IN PYTHON | | | |
|---|---|---|---|
| Course Code | 21CS751 | CIE Marks | 50 |
| Teaching Hours/Week (L:T:P: S) | 3:0:0:0 | SEE Marks | 50 |
| Total Hours of Pedagogy | 40 | Total Marks | 100 |
| Credits | 03 | Exam Hours | 03 |

**Course Learning Objectives**

CLO 1. To understand why Python is a useful scripting language for developers
CLO 2. To read and write simple Python programs
CLO 3. To learn how to identify Python object types.
CLO 4. To learn how to write functions and pass arguments in Python.
CLO 5. To use Python data structures –- lists, tuples, dictionaries.

**Teaching-Learning Process (General Instructions)**

These are sample Strategies, which teachers can use to accelerate the attainment of the various course outcomes.

1. Lecturer method (L) need not to be only a traditional lecture method, but alternative effective teaching methods could be adopted to attain the outcomes.
2. Use of Video/Animation to explain functioning of various concepts.
3. Encourage collaborative (Group Learning) Learning in the class.
4. Ask at least three HOT (Higher order Thinking) questions in the class, which promotes critical thinking.
5. Adopt Problem Based Learning (PBL), which fosters students' Analytical skills, develop design thinking skills such as the ability to design, evaluate, generalize, and analyze information rather than simply recall it.
6. Introduce Topics in manifold representations.
7. Show the different ways to solve the same problem with different circuits/logic and encourage the students to come up with their own creative ways to solve them.
8. Discuss how every concept can be applied to the real world - and when that's possible, it helps improve the students' understanding.

**Module-1**

**INTRODUCTION DATA, EXPRESSIONS, STATEMENTS:08 Hours**
Introduction: Creativity and motivation, understanding programming, Terminology: Interpreter and compiler, Running Python, The First Program; Data types: Int, float, Boolean, string, and list, variables, expressions, statements, Operators and operands.

**Textbook 1: Chapter 1.1,1.2,1.3,1.6, Chapter 2.1-2.6**
**Textbook 2: Chapter 1**

| **Teaching-Learning Process** | Chalk and board, Active Learning |
|---|---|

**Module-2**

**CONTROL FLOW, LOOPS:**
Conditionals: Boolean values and operators, conditional (if), alternative (if-else), chained conditional (if-elif-else); Iteration: while, for, break, continue, pass statement.

**Textbook 1: Chapter 3.1-3.6, chapter 5**

| **Teaching-Learning Process** | Chalk and board, Active Learning, Demonstration |
|---|---|

**Module-3**

**FUNCTIONS AND STRINGS:**
Functions: Function calls, adding new functions, definition and uses, local and global scope, return values. Strings: strings, length of string, string slices, immutability, multiline comments, string functions and methods;

**Textbook 1: Chapter 6**
**Textbook 2: Chapter 3**

| **Teaching-Learning Process** | Chalk and board, Active Learning, Demonstration |
|---|---|

**Module-4**

**LISTS, TUPLES, DICTIONARIES:08 Hours**
**Lists:**List operations, list slices, list methods, list loop, mutability, aliasing, cloning lists, listparameters, list comprehension;

**Tuples:** tuple assignment, tuple as return value, tuple comprehension;

**Dictionaries:** operations and methods, comprehension;

**Textbook 2: Chapter 10,11,12**

| **Teaching-Learning Process** | Chalk& board, Active Learning |
|---|---|

**Module-5**

**REGULAR EXPRESSIONS,FILES AND EXCEPTION:**
**Regular expressions:**Character matching in regular expressions, extracting data using regular expressions, Escape character

**Files and exception**: Text files, reading and writing files, command line arguments, errors andexceptions, handling exceptions, modules.

**Textbook 1: Chapter 11.1,11.2,11.4**
**Textbook 2: Chapter 14**

| **Teaching-Learning Process** | Chalk and board, MOOC |
|---|---|

**Suggested Course Outcomes**

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

CO 1. Understand Python syntax and semantics and be fluent in the use of Python flow control and functions.
CO 2. Demonstrate proficiency in handling Strings and File Systems.
CO 3. Represent compound data using Python lists, tuples, Strings, dictionaries.
CO 4. Read and write data from/to files in Python Programs

**Assessment Details (both CIE and SEE)**

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures not less than 35% (18 Marks out of 50) in the semester-end examination (SEE), and a minimum of 40% (40 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together

**Continuous Internal Evaluation:**

Three Unit Tests each of **20 Marks (duration 01 hour**)

1. First test at the end of 5th week of the semester
2. Second test at the end of the 10th week of the semester
3. Third test at the end of the 15th week of the semester

Two assignments each of **10 Marks**

4. First assignment at the end of 4th week of the semester
5. Second assignment at the end of 9th week of the semester

Group discussion/Seminar/quiz any one of three suitably planned to attain the COs and POs for **20 Marks** (**duration 01 hours**)

6. At the end of the 13th week of the semester

The sum of three tests, two assignments, and quiz/seminar/group discussion will be out of 100 marks and will be **scaled down to 50 marks**

(to have less stressed CIE, the portion of the syllabus should not be common /repeated for any of the

methods of the CIE. Each method of CIE should have a different syllabus portion of the course).

**CIE methods /question paper has to be designed to attain the different levels of Bloom's taxonomy as per the outcome defined for the course.**

**Semester End Examination:**

Theory SEE will be conducted by University as per the scheduled timetable, with common question papers for the subject (**duration 03 hours)**

1. The question paper will have ten questions. Each question is set for 20 marks.
2. There will be 2 questions from each module. Each of the two questions under a module (with a maximum of 3 sub-questions), **should have a mix of topics** under that module.
3. The students have to answer 5 full questions, selecting one full question from each module Marks scored shall be proportionally reduced to 50 marks

**Textbooks**

1. Charles R. Severance, "Python for Everybody: Exploring Data Using Python 3", 1st Edition, CreateSpace Independent Publishing Platform, 2016. http://do1.dr-chuck.com/pythonlearn/EN_us/pythonlearn.pdf
2. Allen B. Downey, "Think Python: How to Think Like a Computer Scientist", 2ndEdition, Green Tea Press, 2015. (Chapters 15, 16, 17) http://greenteapress.com/thinkpython2/thinkpython2.pdf

**REFERENCE BOOKS:**

1. R. Nageswara Rao, "Core Python Programming", dreamtech
2. Python Programming: A Modern Approach, Vamsi Kurama, Pearson
3. Python Programming , Reema theraja, OXFORD publication

**Weblinks and Video Lectures (e-Resources):**

1. https://www.w3resource.com/python/python-tutorial.php
2. https://data-flair.training/blogs/python-tutorials-home/
3. https://www.youtube.com/watch?v=c235EsGFcZs
4. https://www.youtube.com/watch?v=v4e6oMRS2QA
5. https://www.youtube.com/watch?v=Uh2ebFW8OYM
6. https://www.youtube.com/watch?v=oSPMmeaiQ68
7. https://www.youtube.com/watch?v=_uQrJ0TkZlc
8. https://www.youtube.com/watch?v=K8L6KVGG-7o

**Activity Based Learning (Suggested Activities in Class)/ Practical Based learning**

Real world problem solving: Demonstration of projects developed using python language

**VII Semester**

| INTRODUCTION TO AI AND ML | | | |
|---|---|---|---|
| Course Code | 21CS752 | CIE Marks | 50 |
| Teaching Hours/Week (L:T:P: S) | 3:0:0:0 | SEE Marks | 50 |
| Total Hours of Pedagogy | 40 | Total Marks | 100 |
| Credits | 03 | Exam Hours | 03 |

**Course Learning Objectives**

CLO1. Understands the basics of AI, history of AI and its foundations, basic principles of AI for problem solving

CLO2. Explore the basics of Machine Learning & Machine Learning process, understanding data

CLO3. Understand the Working of Artificial Neural Networks

**Teaching-Learning Process (General Instructions)**

These are sample Strategies, which teachers can use to accelerate the attainment of the various course outcomes.

1. Lecturer method (L) need not to be only a traditional lecture method, but alternative effective teaching methods could be adopted to attain the outcomes.
2. Use of Video/Animation to explain functioning of various concepts.
3. Encourage collaborative (Group Learning) Learning in the class.
4. Ask at least three HOT (Higher order Thinking) questions in the class, which promotes critical thinking.
5. Adopt Problem Based Learning (PBL), which fosters students' Analytical skills, develop design thinking skills such as the ability to design, evaluate, generalize, and analyze information rather than simply recall it.
6. Introduce Topics in manifold representations.
7. Show the different ways to solve the same problem with different circuits/logic and encourage the students to come up with their own creative ways to solve them.
8. Discuss how every concept can be applied to the real world - and when that's possible, it helps improve the students' understanding.

**Module-1**

**Introduction:** What is AI, The foundation of Artificial Intelligence, The history of Artificial Intelligence**,** Intelligent Agents: Agents and Environments, Good Behaviour: The concept of rationality, the nature of Environments, the structure of Agents.

**Textbook 1: Chapter: 1 and 2**

| **Teaching-Learning Process** | Chalk and board, Active Learning, Problem based learning |
|---|---|

**Module-2**

**Problem solving by searching:** Problem solving agents, Example problems, Searching for solutions, Uniformed search strategies, Informed search strategies, Heuristic functions

**Textbook 1: Chapter: 3**

| **Teaching-Learning Process** | Chalk and board, Active Learning, Demonstration |
|---|---|

**Module-3**

**Introduction to machine learning:** Need for Machine Learning, Machine Learning Explained, and Machine Learning in relation to other fields, Types of Machine Learning. Challenges of Machine Learning, Machine Learning process, Machine Learning applications.

**Understanding Data:** What is data, types of data, Big data analytics and types of analytics, Big data analytics framework, Descriptive statistics, univariate data analysis and visualization

**Textbook 2: Chapter: 1 and 2.1 to 2.5**

| **Teaching-Learning Process** | Chalk and board, Problem based learning, Demonstration |
|---|---|

**Module-4**

**Understanding Data**
Bivariate and Multivariate data, Multivariate statistics **,** Essential mathematics for Multivariate data, Overview hypothesis, Feature engineering and dimensionality reduction techniques,

**Basics of Learning Theory:** Introduction to learning and its types**,** Introduction computation learning theory, Design of learning system, Introduction concept learning.

**Similarity-based learning**: Introduction to Similarity or instance based learning, Nearest-neighbour learning**,** weighted k- Nearest **-** Neighbour algorithm**.**

**Textbook 2: Chapter: 2.6 to 2.10, 3.1 to 3.4, 4.1 to 4.3**

| **Teaching-Learning Process** | Chalk& board, Problem based learning |
|---|---|

**Module-5**

**Artificial Neural Network:** Introduction, Biological neurons, Artificial neurons, Perceptron and learning theory, types of Artificial neural Network**,** learning in multilayer Perceptron, Radial basis function neural network, self-organizing feature map,

**Textbook 2: Chapter: 10**

| **Teaching-Learning Process** | Chalk and board, MOOC |
|---|---|

**Course Outcomes**
At the end of the course the student will be able to:

CO 1. Design intelligent agents for solving simple gaming problems.
CO 2. Have a good understanding of machine leaning in relation to other fields and fundamental issues and
Challenges of machine learning
CO 3. Understand data and applying machine learning algorithms to predict the outputs.
CO 4. Model the neuron and Neural Network, and to analyze ANN learning and its applications.

**Assessment Details (both CIE and SEE)**
The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures not less than 35% (18 Marks out of 50) in the semester-end examination (SEE), and a minimum of 40% (40 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together

**Continuous Internal Evaluation:**
Three Unit Tests each of **20 Marks (duration 01 hour**)

1. First test at the end of 5th week of the semester
2. Second test at the end of the 10th week of the semester
3. Third test at the end of the 15th week of the semester

Two assignments each of **10 Marks**

4. First assignment at the end of 4th week of the semester
5. Second assignment at the end of 9th week of the semester

Group discussion/Seminar/quiz any one of three suitably planned to attain the COs and POs for **20 Marks** (**duration 01 hours**)

6. At the end of the 13th week of the semester

The sum of three tests, two assignments, and quiz/seminar/group discussion will be out of 100 marks and will be **scaled down to 50 marks**
(to have less stressed CIE, the portion of the syllabus should not be common /repeated for any of the methods of the CIE. Each method of CIE should have a different syllabus portion of the course).
**CIE methods /question paper has to be designed to attain the different levels of Bloom's taxonomy as per the outcome defined for the course.**

**Semester End Examination:**
Theory SEE will be conducted by University as per the scheduled timetable, with common question

papers for the subject (**duration 03 hours)**

1. The question paper will have ten questions. Each question is set for 20 marks.
2. There will be 2 questions from each module. Each of the two questions under a module (with a maximum of 3 sub-questions), **should have a mix of topics** under that module.
3. The students have to answer 5 full questions, selecting one full question from each module. Marks scored shall be proportionally reduced to 50 marks

**Textbooks**

1. Stuart Russel, Peter Norvig: "Artificial Intelligence A Modern Approach", 3rd Edition, Pearson Education, 2015.
2. S. Sridhar, M Vijayalakshmi "Machine Learning". Oxford ,2021

**REFERENCE BOOKS:**

1. Elaine Rich, Kevin Knight: "Artificial Intelligence", 3rd Edition, Tata McGraw Hill, 2009, ISBN-10: 0070087709
2. Nils J. Nilsson: "Principles of Artificial Intelligence", Elsevier, 1980, ISBN: 978-3-540-11340-9.

**Weblinks and Video Lectures (e-Resources):**

http://stpk.cs.rtu.lv/sites/all/files/stpk/materiali/MI/Artificial%20Intelligence%20A%20Modern%20Approach.pdf.

1. http://www.getfreeebooks.com/16-sites-with-free-artificial-intelligence-e books/https://www.tutorialspoint.com/artificial_intelligence/artificial_intelligence_overview.htm
2. Problem solving agent:https://www.youtube.com/watch?v=KTPmo-KsOis.
3. https://www.youtube.com/watch?v=X_Qt0U66aH0&list=PLwdnzlV3ogoXaceHrrFVZCJKbm_laSHcH
4. https://www.javatpoint.com/history-of-artificial-intelligence
5. https://www.tutorialandexample.com/problem-solving-in-artificial-intelligence
6. https://techvidvan.com/tutorials/ai-heuristic-search/
7. https://www.analyticsvidhya.com/machine-learning/
8. https://www.hackerearth.com/practice/machine-learning/machine-learning-algorithms/ml-decision-tree/tutorial/
9. https://www.javatpoint.com/unsupervised-artificial-neural-networks

**Activity Based Learning (Suggested Activities in Class)/ Practical Based learning**

Real world problem solving: Demonstration of projects related to AI and ML.

**VII Semester**

| INTRODUCTION TO BIG DATA | | | |
|---|---|---|---|
| Course Code | 21CS753 | CIE Marks | 50 |
| Teaching Hours/Week (L:T:P: S) | 3:0:0:0 | SEE Marks | 50 |
| Total Hours of Pedagogy | 40 | Total Marks | 100 |
| Credits | 03 | Exam Hours | 03 |

**Course Learning Objectives**

CLO 1. Understand Hadoop Distributed File system and examine MapReduce Programming
CLO 2. Explore Hadoop tools and manage Hadoop with Sqoop
CLO 3. Appraise the role of data mining and its applications across industries
CLO 4. Identify various Text Mining techniques

**Teaching-Learning Process (General Instructions)**

These are sample Strategies, which teachers can use to accelerate the attainment of the various course outcomes.

1. Lecturer method (L) need not to be only a traditional lecture method, but alternative effective teaching methods could be adopted to attain the outcomes.
2. Use of Video/Animation to explain functioning of various concepts.
3. Encourage collaborative (Group Learning) Learning in the class.
4. Ask at least three HOT (Higher order Thinking) questions in the class, which promotes critical thinking.
5. Adopt Problem Based Learning (PBL), which fosters students' Analytical skills, develop design thinking skills such as the ability to design, evaluate, generalize, and analyze information rather than simply recall it.
6. Introduce Topics in manifold representations.
7. Show the different ways to solve the same problem with different circuits/logic and encourage the students to come up with their own creative ways to solve them.
8. Discuss how every concept can be applied to the real world - and when that's possible, it helps improve the students' understanding.

**Module-1**

**Hadoop Distributed file system**:HDFS Design, Features, HDFS Components, HDFS user commands Hadoop MapReduce Framework**:** The MapReduce Model, Map-reduce Parallel Data Flow,Map Reduce Programming

**Textbook 1: Chapter 3,5,68hr**

| **Teaching-Learning Process** | Chalk and board, Active Learning, Problem based learning |
|---|---|

**Module-2**

**Essential Hadoop Tools:**Using apache Pig, Using Apache Hive, Using Apache Sqoop, Using Apache Apache Flume, Apache H Base

**Textbook 1: Chapter 78hr**

| **Teaching-Learning Process** | Chalk and board, Active Learning, Demonstration |
|---|---|

**Module-3**

**Data Warehousing:** Introduction, Design Consideration, DW Development Approaches, DW Architectures

**Data Mining:** Introduction, Gathering, and Selection, data cleaning and preparation, outputs ofData Mining, Data Mining Techniques

**Textbook 2: Chapter 4,5**

| **Teaching-Learning Process** | Chalk and board, Problem based learning, Demonstration |
|---|---|

**Module-4**

**Decision Trees:** Introduction, Decision Tree Problem, Decision Tree Constructions, Lessons from Construction Trees. Decision Tree Algorithm

**Regressions:** Introduction, Correlations and Relationships, Non-Linear Regression, Logistic Regression, Advantages and disadvantages.

**Textbook 2: Chapter 6,7**

| **Teaching-Learning Process** | Chalk& board, Problem based learning |
|---|---|

**Module-5**

**Text Mining**: Introduction, Text Mining Applications, Text Mining Process, Term Document Matrix, Mining the TDM, Comparison, Best Practices

**Web Mining:** Introduction, Web Content Mining, Web Structured Mining, Web Usage Mining, Web Mining Algorithms.

**Textbook 2: Chapter 11,14**

| **Teaching-Learning Process** | Chalk and board, MOOC |
|---|---|

**Suggested Course Outcomes**

At the end of the course the students will be able to:

CO 1. Master the concepts of HDFS and MapReduce framework.
CO 2. Investigate Hadoop related tools for Big Data Analytics and perform basic
CO 3. Infer the importance of core data mining techniques for data analytics
CO 4. Use Machine Learning algorithms for real world big data.

**Assessment Details (both CIE and SEE)**

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures not less than 35% (18 Marks out of 50) in the semester-end examination (SEE), and a minimum of 40% (40 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together

**Continuous Internal Evaluation:**

Three Unit Tests each of **20 Marks (duration 01 hour**)

1. First test at the end of 5$^{th}$ week of the semester
2. Second test at the end of the 10$^{th}$ week of the semester
3. Third test at the end of the 15$^{th}$ week of the semester

Two assignments each of **10 Marks**

4. First assignment at the end of 4$^{th}$ week of the semester
5. Second assignment at the end of 9$^{th}$ week of the semester

Group discussion/Seminar/quiz any one of three suitably planned to attain the COs and POs for **20 Marks** (**duration 01 hours**)

6. At the end of the 13$^{th}$ week of the semester

The sum of three tests, two assignments, and quiz/seminar/group discussion will be out of 100 marks and will be **scaled down to 50 marks**

(to have less stressed CIE, the portion of the syllabus should not be common /repeated for any of the methods of the CIE. Each method of CIE should have a different syllabus portion of the course).

**CIE methods /question paper has to be designed to attain the different levels of Bloom's taxonomy as per the outcome defined for the course.**

**Semester End Examination:**

Theory SEE will be conducted by University as per the scheduled timetable, with common question papers for the subject (**duration 03 hours)**

1. The question paper will have ten questions. Each question is set for 20 marks.
2. There will be 2 questions from each module. Each of the two questions under a module (with a

maximum of 3 sub-questions), **should have a mix of topics** under that module.

3. The students have to answer 5 full questions, selecting one full question from each module Marks scored shall be proportionally reduced to 50 marks

**Textbooks**

1. Douglas Eadline,"Hadoop 2 Quick-Start Guide: Learn the Essentials of Big DataComputing in the Apache Hadoop 2 Ecosystem", 1st Edition, Pearson Education,2016.
2. Anil Maheshwari, "Data Analytics", 1st Edition, McGraw Hill Education,2017

**Weblinks and Video Lectures (e-Resources):**

1. https://nptel.ac.in/courses/106/104/106104189/
2. https://www.youtube.com/watch?v=mNP44rZYiAU
3. https://www.youtube.com/watch?v=qr_awo5vz0g
4. https://www.youtube.com/watch?v=rr17cbPGWGA
5. https://www.youtube.com/watch?v=G4NYQox4n2g
6. https://www.youtube.com/watch?v=owI7zxCqNY0
7. https://www.youtube.com/watch?v=FuJVLsZYkuE

**Activity Based Learning (Suggested Activities in Class)/ Practical Based learning**

Real world problem solving: Demonstration of Big Data related projects

Exploring the applications which involves big data.

**VII Semester**

| INTRODUCTION TO DATA SCIENCE | | | |
|---|---|---|---|
| Course Code | 21CS754 | CIE Marks | 50 |
| Teaching Hours/Week (L:T:P: S) | 3:0:0:0 | SEE Marks | 50 |
| Total Hours of Pedagogy | 40 | Total Marks | 100 |
| Credits | 03 | Exam Hours | 03 |

**Course Learning Objectives**

CLO 1. To provide a foundation in data Science terminologies
CLO 2. To familiarize data science process and steps
CLO 3. To Demonstrate the data visualization tools
CLO 4. To analyze the data science applicability in real time applications.

**Teaching-Learning Process (General Instructions)**

These are sample Strategies, which teachers can use to accelerate the attainment of the various course outcomes.

1. Lecturer method (L) need not to be only a traditional lecture method, but alternative effective teaching methods could be adopted to attain the outcomes.
2. Use of Video/Animation to explain functioning of various concepts.
3. Encourage collaborative (Group Learning) Learning in the class.
4. Ask at least three HOT (Higher order Thinking) questions in the class, which promotes critical thinking.
5. Adopt Problem Based Learning (PBL), which fosters students' Analytical skills, develop design thinking skills such as the ability to design, evaluate, generalize, and analyze information rather than simply recall it.
6. Introduce Topics in manifold representations.
7. Show the different ways to solve the same problem with different circuits/logic and encourage the students to come up with their own creative ways to solve them.
8. Discuss how every concept can be applied to the real world - and when that's possible, it helps improve the students' understanding.

**Module-1**

**PREPARING AND GATHERING DATA AND KNOWLEDGE**
Philosophies of data science - Data science in a big data world - Benefits and uses of data science and big data - facts of data: Structured data, Unstructured data, Natural Language, Machine generated data, Audio, Image and video streaming data - The Big data Eco system: Distributed file system, Distributed Programming framework, Data Integration frame work, Machine learning Framework, NoSQL Databases, Scheduling tools, Benchmarking Tools, System Deployment, Service programming and Security.

**Textbook 1: Ch 1.1 to 1.4**

| **Teaching-Learning Process** | Chalk and board, Active Learning, PPT Based presentation |
|---|---|

**Module-2**

**THE DATA SCIENCE PROCESS-**Overview of the data science process- defining research goals and creating project charter, retrieving data, cleansing, integrating and transforming data, exploratory data analysis, Build the models, presenting findings and building application on top of them.

**Textbook 1:,Ch 2**

| **Teaching-Learning Process** | Chalk and board, Active Learning, PPT Based presentation |
|---|---|

**Module-3**

**MACHINE LEARNING:** Application for machine learning in data science- Tools used in machine learning- Modeling Process – Training model – Validating model – Predicting new observations –Types of machine learning Algorithm : Supervised learning algorithms, Unsupervised learning algorithms.

**Textbook 1: Ch 3.1 to 3.3**

| | |
|---|---|
| **Teaching-Learning Process** | Chalk and board, Active Learning, PPT Based presentation, Video |

**Module-4**

**VISUALIZATION–**Introduction to data visualization – Data visualization options – Filters – MapReduce – Dashboard development tools.

**Textbook 1: Ch 9**

| | |
|---|---|
| **Teaching-Learning Process** | Chalk and board, Active Learning, PPT Based presentation, MOOC |

**Module-5**

**CASE STUDIES** Distributing data storage and processing with frameworks - Case study: e.g, Assessing risk when lending money.

**Textbook 1: Ch 5.1, 5.2**

| | |
|---|---|
| **Teaching-Learning Process** | Chalk and board, Active Learning, PPT Based presentation, Video |

**Course Outcomes**

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

CO 1. Describe the data science terminologies
CO 2. Apply the Data Science process on real time scenario.
CO 3. Analyze data visualization tools
CO 4. Apply Data storage and processing with frameworks

**Assessment Details (both CIE and SEE)**

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures not less than 35% (18 Marks out of 50) in the semester-end examination (SEE), and a minimum of 40% (40 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together

**Continuous Internal Evaluation:**

Three Unit Tests each of **20 Marks (duration 01 hour**)

1. First test at the end of 5th week of the semester
2. Second test at the end of the 10th week of the semester
3. Third test at the end of the 15th week of the semester

Two assignments each of **10 Marks**

4. First assignment at the end of 4th week of the semester
5. Second assignment at the end of 9th week of the semester

Group discussion/Seminar/quiz any one of three suitably planned to attain the COs and POs for **20 Marks** (**duration 01 hours**)

6. At the end of the 13th week of the semester

The sum of three tests, two assignments, and quiz/seminar/group discussion will be out of 100 marks and will be **scaled down to 50 marks**

(to have less stressed CIE, the portion of the syllabus should not be common /repeated for any of the methods of the CIE. Each method of CIE should have a different syllabus portion of the course).

**CIE methods /question paper has to be designed to attain the different levels of Bloom's taxonomy as per the outcome defined for the course.**

**Semester End Examination:**

Theory SEE will be conducted by University as per the scheduled timetable, with common question papers for the subject (**duration 03 hours)**

1. The question paper will have ten questions. Each question is set for 20 marks.
2. There will be 2 questions from each module. Each of the two questions under a module (with a maximum of 3 sub-questions), **should have a mix of topics** under that module.
3. The students have to answer 5 full questions, selecting one full question from each module Marks scored shall be proportionally reduced to 50 marks

**Textbooks**

1. Introducing Data Science, Davy Cielen, Arno D. B. Meysman and Mohamed Ali,Manning Publications, 2016.

**Reference Books**

1. Doing Data Science, Straight Talk from the Frontline, Cathy O'Neil, Rachel Schutt, O' Reilly, 1st edition, 2013.
2. Mining of Massive Datasets, Jure Leskovec, Anand Rajaraman, Jeffrey David Ullman, Cambridge University Press, 2nd edition, 2014
3. An Introduction to Statistical Learning: with Applications in R, Gareth James, Daniela Witten, Trevor Hastie, Robert Tibshirani, Springer, 1st edition, 2013
4. Think Like a Data Scientist, Brian Godsey, Manning Publications, 2017.

**Weblinks and Video Lectures (e-Resources):**

1. https://www.simplilearn.com/tutorials/data-science-tutorial/what-is-data-science
2. https://www.youtube.com/watch?v=N6BghzuFLIg
3. https://www.coursera.org/lecture/what-is-datascience/fundamentals-of-data-science-tPgFU
4. https://www.youtube.com/watch?v=ua-CiDNNj30

**Activity Based Learning (Suggested Activities in Class)/ Practical Based learning**

Real world problem solving using Data science techniques and demonstration of data visualization methods with the help of suitable project.

**B.E. in Artificial Intelligence and Machine Learning**

**Scheme of Teaching and Examinations2022**

Outcome Based Education (OBE) and Choice Based Credit System (CBCS)

**V SEMESTER**

| Sl. No | Course and Course Code | | Course Title | Teaching Department (TD) and Question Paper Setting Board (PSB) | Teaching Hours /Week | | | | Examination | | | | Credits |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | Theory Lecture | Tutorial | Practical / Drawing | SDA | Duration in hours | CIE Marks | SEE Marks | Total Marks | |
| | | | | | L | T | P | S | | | | | |
| 1 | PCC | BCS501 | Software Engineering & Project Management | TD: CS<br>PSB : CS | 4 | 0 | 0 | | 03 | 50 | 50 | 100 | 4 |
| 2 | IPCC | BCS502 | Computer Networks | TD : AI<br>PSB : AI | 3 | 0 | 2 | | 03 | 50 | 50 | 100 | 4 |
| 3 | PCC | BCS503 | Theory of Computation | TD : AI<br>PSB : AI | 3 | 2 | 0 | | 03 | 50 | 50 | 100 | 4 |
| 4 | PCCL | BAIL504 | Data Visualization Lab | TD : AI<br>PSB : AI | 0 | 0 | 2 | | 03 | 50 | 50 | 100 | 1 |
| 5 | PEC | BXX515x | Professional Elective Course | TD : AI<br>PSB : AI | 3 | 0 | 0 | | 03 | 50 | 50 | 100 | 3 |
| 6 | PROJ | BAI586 | Mini Project | TD : AI<br>PSB : AI | 0 | 0 | 4 | | 03 | 100 | | 100 | 2 |
| 7 | AEC | BRMK557 | Research Methodology and IPR | TD: HSM<br>PSB : HSM | 2 | 2 | 0 | | 02 | 50 | 50 | 100 | 3 |
| 8 | HSMS | BCS508 | Environmental Studies and E-waste Management | TD: HSM<br>PSB : HSM | 1 | 0 | 0 | | 01 | 50 | 50 | 100 | 1 |
| 9 | MC | BNSK559 | National Service Scheme (NSS) | NSS coordinator | 0 | 0 | 2 | | | 100 | | 100 | 0 |
| | | BPEK559 | Physical Education (PE) (Sports and Athletics) | Physical Education Director | | | | | | | | | |
| | | BYOK559 | Yoga | Yoga Teacher | | | | | | | | | |
| | | | | | | | | | **Total** | **500** | **300** | **800** | **22** |

**Professional Elective Course**

| | | | |
|---|---|---|---|
| BAI515A | Computer Vision | BCS515C | Unix System Programming |
| BAI515B | Information Retrieval | BCS515D | Distributed Systems |
| | | BAI515E | Exploratory Data Analysis |

| |
|---|
| **PCC**: Professional Core Course, **PCCL**: Professional Core Course laboratory, **UHV**: Universal Human Value Course, **MC**: Mandatory Course (Non-credit), **AEC**: Ability Enhancement Course, **SEC**: Skill Enhancement Course, **L:** Lecture, **T**: Tutorial, **P**: Practical **S= SDA**: Skill Development Activity, **CIE**: Continuous Internal Evaluation, **SAI**: Semester End Evaluation. **K :** The letter in the course code indicates common to al the stream of engineering. **PROJ**: Project /Mini Project. **PEC**: Professional Elective Course |
| **Professional Core Course (IPCC):** Refers to Professional Core Course Theory Integrated with practicals of the same course. Credit for IPCC can be 04 and its Teaching–Learning hours (L : T : P) can be considered as (3 : 0 : 2) or (2 : 2 : 2). The theory part of the IPCC shall be evaluated both by CIE and SEE. The practical part shall be evaluated by only CIE (no SEE). However, questions from the practical part of IPCC shall be included in the SEE question paper. For more details, the regulation governing the Degree of Bachelor of Engineering /Technology (B.E./B.Tech.) 2022-23<br>**National Service Scheme /Physical Education/Yoga:** All students have to register for any one of the courses namely National Service Scheme (NSS), Physical Education (PE)(Sports and Athletics), and Yoga(YOG) with the concerned coordinator of the course during the first week of III semesters. Activities shall be carried out between III semester to the VI semester (for 4 semesters). Successful completion of the registered course and requisite CIE score is mandatory for the award of the degree. The events shall be appropriately scheduled by the colleges and the same shall be reflected in the calendar prepared for the NSS, PE, and Yoga activities. These courses shall not be considered for vertical progression as well as for the calculation of SGPA and CGPA, but completion of the course is mandatory for the award of degree. |
| **Mini-project work:** Mini Project is a laboratory-oriented/hands on course that will provide a platform to students to enhance their practical knowledge and skills by the development of small systems/applications etc. Based on the ability/abilities of the student/s and recommendations of the mentor, a single discipline or a multidisciplinary Mini- project can be assigned to an individual student or to a group having not more than 4 students.<br>**CIE procedure for Mini-project:**<br>**(i) Single discipline:** The CIE marks shall be awarded by a committee consisting of the Head of the concerned Department and two faculty members of the Department, one of them being the Guide. The CIE marks awarded for the Mini-project work shall be based on the evaluation of the project report, project presentation skill, and question and answer session in the ratio of 50:25:25. The marks awarded for the project report shall be the same for all the batches mates.<br>**(ii) Interdisciplinary:** Continuous Internal Evaluation shall be group-wise at the college level with the participation of all the guides of the project.<br>The CIE marks awarded for the Mini-project, shall be based on the evaluation of the project report, project presentation skill, and question and answer session in the ratio 50:25:25. The marks awarded for the project report shall be the same for all the batch mates.<br>**No SEE component for Mini-Project.** |
| **Professional Elective Courses (PEC):** A professional elective (PEC) course is intended to enhance the depth and breadth of educational experience in the Engineering and Technology curriculum. Multidisciplinary courses that are added supplement the latest trend and advanced technology in the selected stream of engineering. Each group will provide an option to select one course. The minimum number of students' strengths for offering a professional elective is 10. However, this conditional shall not be applicable to cases where the admission to the program is less than 10. |

| Software Engineering & Project Management | | Semester | V |
|---|---|---|---|
| Course Code | **BCS501** | CIE Marks | 50 |
| Teaching Hours/Week (L:T:P: S) | 4:0:0:0 | SEE Marks | 50 |
| Total Hours of Pedagogy | 52 hours | Total Marks | 100 |
| Credits | 04 | Exam Hours | 03 |
| Examination nature (SEE) | **Theory** | | |

**Course objectives:**

This course will enable students to,

- Outline software engineering principles and activities involved in building large software programs. Identify ethical and professional issues and explain why they are of concern to Software Engineers.
- Describe the process of requirement gathering, requirement classification, requirement specification and requirements validation.
- Recognize the importance of Project Management with its methods and methodologies.
- Identify software quality parameters and quantify software using measurements and metrics. List software quality standards and outline the practices involved.

**Teaching-Learning Process (General Instructions)**

These are sample Strategies; that teachers can use to accelerate the attainment of the various course outcomes.

1. Lecturer method (L) need not be only a traditional lecture method, but alternative effective teaching methods could be adopted to attain the outcomes.
2. Use of Video/Animation to explain functioning of various concepts.
3. Encourage collaborative (Group Learning) Learning in the class.
4. Ask at least three HOT (Higher order Thinking) questions in the class, which promotes critical thinking.
5. Adopt Problem Based-Learning (PBL), which fosters student's Analytical skills, develop design thinking skills such as the ability to design, evaluate, generalize, and analyze information rather than simply recall it.

**MODULE-1** **10 hours**

**Software and Software Engineering**: The nature of Software, The unique nature of WebApps, Software Engineering, The software Process, Software Engineering Practice, Software Myths.

**Process Models:** A generic process model, Process assessment and improvement, Prescriptive process models: Waterfall model, Incremental process models, Evolutionary process models, Concurrent models, Specialized process models. Unified Process , Personal and Team process models

**Textbook 1: Chapter 1: 1.1 to 1.6, Chapter 2: 2.1 to 2.5**

**MODULE-2** **12 hours**

**Understanding Requirements**: Requirements Engineering, Establishing the ground work, Eliciting Requirements, Developing use cases, Building the requirements model, Negotiating Requirements, Validating Requirements.

**Requirements Modeling Scenarios, Information and Analysis classes**: Requirement Analysis, Scenario based modeling, UML models that supplement the Use Case, Data modeling Concepts, Class-Based Modeling.

**Requirement Modeling Strategies** : Flow oriented Modeling , Behavioral Modeling.

**Textbook 1: Chapter 5: 5.1 to 5.7, Chapter 6: 6.1 to 6.5, Chapter 7: 7.1 to 7.3**

**MODULE-3** **10 hours**

**Agile Development:** What is Agility?, Agility and the cost of change. What is an agile Process?, Extreme Programming (XP), Other Agile Process Models, A tool set for Agile process .
**Principles that guide practice:** Software Engineering Knowledge, Core principles, Principles that guide each framework activity.

**Textbook 1: Chapter 3: 3.1 to 3.6, Chapter 4: 4.1 to 4.3**

| MODULE-4 | 10 hours |
|---|---|

**Introduction to Project Management:** Introduction, Project and Importance of Project Management, Contract Management, Activities Covered by Software Project Management, Plans, Methods and Methodologies, Some ways of categorizing Software Projects, Stakeholders, Setting Objectives, Business Case, Project Success and Failure, Management and Management Control, Project Management life cycle, Traditional versus Modern Project Management Practices.
**Project Evaluation:** Evaluation of Individual projects, Cost–benefit Evaluation Techniques, Risk Evaluation
**Textbook 2: Chapter 1: 1.1 to 1.17 , Chapter 2: 2.4 to 2.6**

| MODULE-5 | 10 hours |
|---|---|

**Software Quality:** Introduction, The place of software quality in project planning, Importance of software quality, Defining software quality, Software quality models, product versus process quality management.
**Software Project Estimation:** Observations on Estimation, Decomposition Techniques, Empirical Estimation Models.

**Textbook 2: Chapter 13: 13.1 to 13.5, 13.7, 13.8, Text Book 1: Chapter 26: 26.5 to 26.7**

**Course Outcomes**

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

- **Differentiate** process models to judge which process model has to be adopted for the given scenarios.
- **Derive** both functional and nonfunctional requirements from the case study.
- **Analyze** the importance of various software testing methods and agile methodology.
- **Illustrate** the role of project planning and quality management in software development.
- **Identify** appropriate techniques to enhance software quality.

## Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks out of 50) and for the SEE minimum passing mark is 35% of the maximum marks (18 out of 50 marks). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures a minimum of 40% (40 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together.

**Continuous Internal Evaluation:**

- For the Assignment component of the CIE, there are 25 marks and for the Internal Assessment Test component, there are 25 marks.
- The first test will be administered after 40-50% of the syllabus has been covered, and the second test will be administered after 85-90% of the syllabus has been covered
- Any two assignment methods mentioned in the 22OB2.4, if an assignment is project-based then only one assignment for the course shall be planned. The teacher should not conduct two assignments at

the end of the semester if two assignments are planned.

- For the course, CIE marks will be based on a scaled-down sum of two tests and other methods of assessment.

**The Internal Assessment Test question paper is designed to attain the different levels of Bloom's taxonomy as per the outcome defined for the course.**

**Semester-End Examination:**

Theory SEE will be conducted by University as per the scheduled timetable, with common question papers for the course (**duration 03 hours).**

1. The question paper will have ten questions. Each question is set for 20 marks.
2. There will be 2 questions from each module. Each of the two questions under a module (with a maximum of 3 sub-questions), **should have a mix of topics** under that module.
3. The students have to answer 5 full questions, selecting one full question from each module.

Marks scored shall be proportionally reduced to 50 marks. .

**Suggested Learning Resources:**

**Textbooks**

1. Roger S. Pressman: Software Engineering-A Practitioners approach, 7th Edition, Tata McGraw Hill.
2. Bob Hughes, Mike Cotterell, Rajib Mall: Software Project Management, 6th Edition, McGraw Hill Education, 2018.

**Reference Book:**

3. Pankaj Jalote: An Integrated Approach to Software Engineering, Wiley India.
4. "Software Engineering: Principles and Practice", Hans van Vliet, Wiley India, 3rd Edition, 2010.

**Web links and Video Lectures (e-Resources):**

- https://onlinecourses.nptel.ac.in/noc20_cs68/preview
- https://onlinecourses.nptel.ac.in/noc24_mg01/preview

**Activity Based Learning (Suggested Activities in Class)/Practical-Based Learning**

- Demonstration of Agile tool: The students are expected to learn any of the popular agile tool. (10 marks)
- Field Survey (In Team): The students' team may of the size of 2 or 4. Students are expected to visit their library and understand the Library Automation Software. **OR** they have to understand the working of ERP or any inventory management, and then they have to prepare a report and then to be submitted to the concerned staff. Prepare a document/report which includes all the phases of SDLC and to be submitted accordingly (15 marks)

| COMPUTER NETWORKS | | Semester | V |
|---|---|---|---|
| Course Code | **BCS502** | CIE Marks | 50 |
| Teaching Hours/Week (L:T:P: S) | 3:0:2:0 | SEE Marks | 50 |
| Total Hours of Pedagogy | 40 hours Theory + 8-10 Lab slots | Total Marks | 100 |
| Credits | 04 | Exam Hours | 03 |
| Examination nature (SEE) | Theory/practical | | |

**Course objectives:**

This course will enable students to,

- Study the TCP/IP protocol suite, switching criteria and Medium Access Control protocols for reliable and noisy channels.
- Learn network layer services and IP versions.
- Discuss transport layer services and understand UDP and TCP protocols.
- Demonstrate the working of different concepts of networking layers and protocols.

**Teaching-Learning Process (General Instructions)**

These are sample Strategies; that teachers can use to accelerate the attainment of the various course outcomes.

1. Lecturer method (L) need not to be only traditional lecture method, but alternative effective teaching methods could be adopted to attain the outcomes.
2. Use of Video/Animation to explain functioning of various concepts.
3. Encourage collaborative (Group Learning) Learning in the class.
4. Ask at least three HOT (Higher order Thinking) questions in the class, which promotes critical thinking.
5. Adopt Problem Based Learning (PBL), which fosters student's Analytical skills, develop design thinking skills such as the ability to design, evaluate, generalize, and analyze information rather than simply recall it.

**MODULE-1**

Introduction: Data Communications, Networks, Network Types, Networks Models: Protocol Layering, TCP/IP Protocol suite, The OSI model, Introduction to Physical Layer: Transmission media, Guided Media, Unguided Media: Wireless. Switching: Packet Switching and its types.

**Textbook:** Ch. 1.1 - 1.3, 2.1 - 2.3, 7.1 – 7.3, 8.3.

**MODULE-2**

Data Link Layer: Error Detection and Correction: Introduction, Block Coding, Cyclic Codes. Data link control: DLC Services: Framing, Flow Control, Error Control, Connectionless and Connection Oriented, Data link layer protocols, High Level Data Link Control. Media Access Control: Random Access, Controlled Access. Check Sum and Point to Point Protocol

**Textbook:** Ch. 10.1-10.4, 11.1 -11.4, 12.1 - 12.2

**MODULE-3**

Network Layer: Network layer Services, Packet Switching, IPv4 Address, IPv4 Datagram, IPv6 Datagram, Introduction to Routing Algorithms, Unicast Routing Protocols: DVR, LSR, PVR, Unicast Routing protocols: RIP, OSPF, BGP, Multicasting Routing-MOSPF

**Textbook:** Ch. 18.1, 18.2, 18.4, 22.2,20.1-20.3, 21.3.2

**MODULE-4**

Introduction to Transport Layer: Introduction, Transport-Layer Protocols: Introduction, User Datagram Protocol, Transmission Control Protocol: services, features, segments, TCP connections, flow control, Error control, Congestion control.

**Textbook:** Ch. 23.1- 23.2, 24.1-24.3.4, 24.3.6-24.3.9

**MODULE-5**

Introduction to Application Layer: Introduction, Client-Server Programming, Standard Client-Server Protocols: World Wide Web and HTTP, FTP, Electronic Mail, Domain Name System (DNS), TELNET, Secure Shell (SSH)

**Textbook:** Ch. 25.1-25.2, 26.1-26.6

**PRACTICAL COMPONENT OF IPCC**

| Sl.NO | Experiments |
|---|---|
| 1 | Implement three nodes point – to – point network with duplex links between them. Set the queue size, vary the bandwidth, and find the number of packets dropped. |
| 2 | Implement transmission of ping messages/trace route over a network topology consisting of 6 nodes and find the number of packets dropped due to congestion. |
| 3 | Implement an Ethernet LAN using n nodes and set multiple traffic nodes and plot congestion window for different source / destination. |
| 4 | Develop a program for error detecting code using CRC-CCITT (16- bits). |
| 5 | Develop a program to implement a sliding window protocol in the data link layer. |
| 6 | Develop a program to find the shortest path between vertices using the Bellman-Ford and path vector routing algorithm. |
| 7 | Using TCP/IP sockets, write a client – server program to make the client send the file name and to make the server send back the contents of the requested file if present. |
| 8 | Develop a program on a datagram socket for client/server to display the messages on client side, typed at the server side. |
| 9 | Develop a program for a simple RSA algorithm to encrypt and decrypt the data. |
| 10 | Develop a program for congestion control using a leaky bucket algorithm. |

**Course outcomes (Course Skill Set):**

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

- **Explain** the fundamentals of computer networks.
- **Apply** the concepts of computer networks to demonstrate the working of various layers and protocols in communication network.
- **Analyze** the principles of protocol layering in modern communication systems.
- **Demonstrate** various Routing protocols and their services using tools such as Cisco packet tracer.

**Note: For the Simulation experiments modify the topology and parameters set for the experiment and take multiple rounds of reading and analyze the results available in log files. Plot necessary graphs and conclude using NS2 or NS3. Installation procedure of the required software must be demonstrated, carried out in groups, and documented in the report. Non simulation programs can be implemented using Java.**

**Assessment Details (both CIE and SEE)**

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks out of 50) and for the SEE minimum passing mark is 35% of the maximum marks (18 out of 50 marks). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures a minimum of 40% (40 marks out of 100) in the sum total of the CIE

(Continuous Internal Evaluation) and SEE (Semester End Examination) taken together.

**CIE for the theory component of the IPCC (maximum marks 50)**

- IPCC means practical portion integrated with the theory of the course.
- CIE marks for the theory component are **25 marks** and that for the practical component is **25 marks**.
- 25 marks for the theory component are split into **15 marks** for two Internal Assessment Tests (Two Tests, each of 15 Marks with 01-hour duration, are to be conducted) and **10 marks** for other assessment methods mentioned in 22OB4.2. The first test at the end of 40-50% coverage of the syllabus and the second test after covering 85-90% of the syllabus.
- Scaled-down marks of the sum of two tests and other assessment methods will be CIE marks for the theory component of IPCC (that is for **25 marks)**.
- The student has to secure 40% of 25 marks to qualify in the CIE of the theory component of IPCC.

**CIE for the practical component of the IPCC**

- **15 marks** for the conduction of the experiment and preparation of laboratory record, and **10 marks** for the test to be conducted after the completion of all the laboratory sessions.
- On completion of every experiment/program in the laboratory, the students shall be evaluated including viva-voce and marks shall be awarded on the same day.
- The CIE marks awarded in the case of the Practical component shall be based on the continuous evaluation of the laboratory report. Each experiment report can be evaluated for 10 marks. Marks of all experiments' write-ups are added and scaled down to **15 marks**.
- The laboratory test **(duration 02/03 hours)** after completion of all the experiments shall be conducted for 50 marks and scaled down to **10 marks.**
- Scaled-down marks of write-up evaluations and tests added will be CIE marks for the laboratory component of IPCC for **25 marks**.
- The student has to secure 40% of 25 marks to qualify in the CIE of the practical component of the IPCC.

**SEE for IPCC**

Theory SEE will be conducted by University as per the scheduled timetable, with common question papers for the course (**duration 03 hours**)

1. The question paper will have ten questions. Each question is set for 20 marks.
2. There will be 2 questions from each module. Each of the two questions under a module (with a maximum of 3 sub-questions), **should have a mix of topics** under that module.
3. The students have to answer 5 full questions, selecting one full question from each module.
4. Marks scoredby the student shall be proportionally scaled down to 50 Marks

**The theory portion of the IPCC shall be for both CIE and SEE, whereas the practical portion will have a CIE component only. Questions mentioned in the SEE paper may include questions from the practical component**.

**Suggested Learning Resources:**

**Textbook:**

1. Behrouz A. Forouzan, Data Communications and Networking, 5th Edition, Tata McGraw-

Hill,2013.

**Reference Books:**

1. Larry L. Peterson and Bruce S. Davie: Computer Networks – A Systems Approach, 4th Edition, Elsevier, 2019.
2. Nader F. Mir: Computer and Communication Networks, 2nd Edition, Pearson Education, 2015.
3. William Stallings, Data and Computer Communication 10th Edition, Pearson Education, Inc., 2014.

**Web links and Video Lectures (e-Resources):**

1. https://www.digimat.in/nptel/courses/video/106105183/L01.html
2. http://www.digimat.in/nptel/courses/video/106105081/L25.html
3. https://nptel.ac.in/courses/10610

**Activity Based Learning (Suggested Activities in Class)/ Practical Based learning**

- Implementation of various protocols using open source simulation tools. (5 marks)
- Simulation of Personal area network, Home area network, achieve QoS etc. (5 marks)

| | | | | |
|---|---|---|---|---|
| | **THEORY OF COMPUTATION** | | Semester | V |
| | Course Code | **BCS503** | CIE Marks | 50 |
| | Teaching Hours/Week (L: T:P: S) | (3:2:0:0) | SEE Marks | 50 |
| | Total Hours of Pedagogy | 50 | Total Marks | 100 |
| | Credits | 04 | Exam Hours | 3 |
| | Examination type (SEE) | Theory | | |

**Course objectives:**

- Introduce core concepts in Automata and Theory of Computation.
- Identify different Formal Language Classes and their Relationships.
- Learn concepts of Grammars and Recognizers for different formal languages.
- Prove or disprove theorems in automata theory using their properties.
- Determine the decidability and intractability of Computational problems.

**Teaching-Learning Process (General Instructions)**

These are sample Strategies which teachers can use to accelerate the attainment of the various course outcomes.

1. Lecturer method (L) needs not to be only a traditional lecture method, but alternative effective teaching methods could be adopted to attain the outcomes.
2. Use of Video/Animation to explain functioning of various concepts.
3. Encourage collaborative (Group Learning) Learning in the class.
4. Ask at least three HOT (Higher order Thinking) questions in the class, which promotes critical thinking.
5. Adopt Problem Based Learning (PBL), which fosters students' Analytical skills, develop design thinking skills such as the ability to design, evaluate, generalize, and analyse information rather than simply recall it.
6. Introduce Topics in manifold representations.
7. Show the different ways to solve the same problem with different approaches and encourage the students to come up with their own creative ways to solve them.
8. Discuss how every concept can be applied to the real world - and when that's possible, it helps improve the students' understanding.

| **Module-1** | **10 Hours** |
|---|---|

Introduction to Finite Automata, Structural Representations, Automata and Complexity. The Central Concepts of Automata Theory. Deterministic Finite Automata, Nondeterministic Finite Automata, An Application: Text Search, Finite Automata with Epsilon-Transitions.

**TEXT BOOK: Sections 1.1, 1.5, 2.2,2.3,2.4,2.5**

| **Module-2** | **10 Hours** |
|---|---|

Regular Expressions, Finite Automata and Regular Expressions, Proving Languages not to be Regular. Closure Properties of Regular Languages, Equivalence and Minimization of Automata, Applications of Regular Expressions

**TEXT BOOK: Sections 3.1, 3.2 (Except 3.2.1), 3.3, 4.1, 4.2, 4.4**

| **Module-3** | **10 Hours** |
|---|---|

| | |
|---|---|
| | Context-Free Grammars, Parse Trees, Ambiguity in Grammars and Languages, Ambiguity in Grammars and Languages, Definition of the Pushdown Automaton, The Languages of a PDA, Equivalence of PDA's and CFG's, Deterministic Pushdown Automata.<br><br>**TEXT BOOK: Sections 5.1, 5.2, 5.4, 6.1,6.2,6.3.1,6.4** |
| | **Module-4** **10 Hours** |
| | Normal Forms for Context-Free Grammars, The Pumping Lemma for Context-Free Languages, Closure Properties of Context-Free Languages.<br><br>**TEXT BOOK: Sections 7.1, 7.2, 7.3** |
| | **Module-5** **10 Hours** |
| | Introduction to Turing Machines: Problems That Computers Cannot Solve, The Turing Machine, Programming Techniques for Turing Machines, Extensions to the Basic Turing Machine, Undecidability: A Language That Is Not Recursively Enumerable.<br>**TEXT BOOK: Sections 8.1,8.2, 8.3,8.4, 9.1, 9.2** |

**Course outcome (Course Skill Set)**

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

1. Apply the fundamentals of automata theory to write DFA, NFA, Epsilon-NFA and conversion between them.
2. Prove the properties of regular languages using regular expressions.
3. Design context-free grammars (CFGs) and pushdown automata (PDAs) for formal languages.
4. Design Turing machines to solve the computational problems.
5. Explain the concepts of decidability and undecidability.

## Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks out of 50) and for the SEE minimum passing mark is 35% of the maximum marks (18 out of 50 marks). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures a minimum of 40% (40 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together.

**Continuous Internal Evaluation:**

- For the Assignment component of the CIE, there are 25 marks and for the Internal Assessment Test component, there are 25 marks.
- The first test will be administered after 40-50% of the syllabus has been covered, and the second test will be administered after 85-90% of the syllabus has been covered
- Any two assignment methods mentioned in the 22OB2.4, if an assignment is project-based then only one assignment for the course shall be planned. The teacher should not conduct two assignments at the end of the semester if two assignments are planned.
- For the course, CIE marks will be based on a scaled-down sum of two tests and other methods of assessment.

**The Internal Assessment Test question paper is designed to attain the different levels of Bloom's taxonomy as per the outcome defined for the course.**

**Semester-End Examination:**

Theory SEE will be conducted by University as per the scheduled timetable, with common question papers for the course (**duration 03 hours).**

1. The question paper will have ten questions. Each question is set for 20 marks.
2. There will be 2 questions from each module. Each of the two questions under a module (with a maximum of 3 sub-questions), **should have a mix of topics** under that module.
3. The students have to answer 5 full questions, selecting one full question from each module.
4. Marks scored shall be proportionally reduced to 50 marks.

**Suggested Learning Resources:**

**Books**

1. John E Hopcroft, Rajeev Motwani, Jeffrey D. Ullman," Introduction to Automata Theory, Languages and Computation", Second Edition, Pearson.

**Reference:**

1. Elain Rich, "Automata,Computability and complexity", 1st Edition, Pearson Education,2018.
2. K.L.P Mishra, N Chandrashekaran , 3rd Edition , 'Theory of Computer Science",PHI,2012.
3. Peter Linz, "An introduction to Formal Languages and Automata ", 3rd Edition, Narosa Publishers,1998.
4. Michael Sipser : Introduction to the Theory of Computation, 3rd edition, Cengage learning,2013.
5. John C Martin, Introduction to Languages and The Theory of Computation, 3rd Edition, Tata McGraw –Hill Publishing Company Limited, 2013.

**Web links and Video Lectures (e-Resources):**

- https://archive.nptel.ac.in/courses/106/105/106105196/
- https://archive.nptel.ac.in/courses/106/106/106106049/
- https://nptelvideos.com/course.php?id=717

**Activity Based Learning (Suggested Activities in Class)/ Practical Based Learning**

- Open source tools (like JFLAP) to make teaching and learning more interactive [https://www.jflap.org/] (10 Marks)
- Assignments at RBTL-4 (15 marks)

| Web Technology Lab | | Semester | 5 |
|---|---|---|---|
| Course Code | **BCSL504** | CIE Marks | 50 |
| Teaching Hours/Week (L:T:P: S) | 0:0:2:0 | SEE Marks | 50 |
| Credits | 01 | Exam Hours | 100 |
| Examination type (SEE) | Practical | | |

**Course objectives:**

- Learn HTML 5 elements and their use.
- Use of CSS for enhanced user interface presentation.
- Gain knowledge of JavaScript, AJAX and jQuery for dynamic presentation.
- Use of PHP to build Web applications.
- Design and develop Websites and Web applications.

| Sl.NO | Experiments |
|---|---|
| 1 | Develop the HTML page named as "Myfirstwebpage.html". Add the following tags with relevant content.<br>1. Set the title of the page as "My First Web Page"<br>2. Within the body use the following tags:<br>a) Moving text = "Basic HTML Tags"<br>b) Different heading tags (h1 to h6)<br>c) Paragraph<br>d) Horizontal line<br>e) Line Break<br>f) Block Quote<br>g) Pre tag<br>h) Different Logical Style (<b>, <u>, <sub>, <sup> etc.) |
| 2 | Develop the HTML page named as "Table.html" to display your class time table.<br>a) Provide the title as Time Table with table header and table footer, row-span and col-span etc.<br>b) Provide various colour options to the cells (Highlight the lab hours and elective hours with different colours.)<br>c) Provide colour options for rows. |
| 3 | Develop an external style sheet named as "style.css" and provide different styles for h2, h3, hr, p, div, span, time, img & a tags. Apply different CSS selectors for tags and demonstrate the significance of each. |
| 4 | Develop HTML page named as "registration.html" having variety of HTML input elements with background colors, table for alignment & provide font colors & size using CSS styles. |
| 5 | Develop HTML page named as "newpaper.html" having variety of HTML semantic elements with background colors, text-colors & size for figure, table, aside, section, article, header, footer… etc. |
| 6 | Apply HTML, CSS and JavaScript to design a simple calculator to perform the following operations: sum, product, difference, remainder, quotient, power, square-root and square. |
| 7 | Develop JavaScript program (with HTML/CSS) for:<br>a) Converting JSON text to JavaScript Object<br>b) Convert JSON results into a date<br>c) Converting From JSON To CSV and CSV to JSON<br>d) Create hash from string using crypto.createHash() method |
| 8 | a. Develop a PHP program (with HTML/CSS) to keep track of the number of visitors visiting the web page and to display this count of visitors, with relevant headings.<br>b. Develop a PHP program (with HTML/CSS) to sort the student records which are stored in the database using selection sort. |

| | |
|---|---|
| 9 | Develop jQuery script (with HTML/CSS) for:<br>a. Appends the content at the end of the existing paragraph and list.<br>b. Change the state of the element with CSS style using animate() method<br>c. Change the color of any div that is animated. |
| 10 | Develop a JavaScript program with Ajax (with HTML/CSS) for:<br>a. Use ajax() method (without Jquery) to add the text content from the text file by sending ajax request.<br>b. Use ajax() method (with Jquery) to add the text content from the text file by sending ajax request.<br>c. Illustrate the use of getJSON() method in jQuery<br>d. Illustrate the use of parseJSON() method to display JSON values. |
| **Programming Assignment (5 marks):**<br>Construct a Website (multiple Web pages) containing 'Resume' and Bio -data by using relevant HTML elements and appropriate styling for presentation with CSS/jQuery/JavaScript. Host the Website on a cloud platform. | |
| **Programming Assignment (5 marks):** Build a Web application with HTML, CSS, JavaScript, jQuery and PHP for online application/registration form. Form should accept the information and print/display on a browser with formatting/styling upon submission (Button click) on success. Host the application on a cloud platform. | |
| **Course outcomes (Course Skill Set):**<br>At the end of the course, the student will be able to:<br>● Design the experiment for the given problem using HTML, Javascript and CSS.<br>● Develop the solution for the given real-world problem using jQuery, Ajax and PHP.<br>● Analyze the results and produce substantial written documentation. | |

**Assessment Details (both CIE and SEE)**

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks out of 50) and for the SEE minimum passing mark is 35% of the maximum marks (18 out of 50 marks). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures a minimum of 40% (40 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together

**Continuous Internal Evaluation (CIE):**

CIE marks for the practical course are **50 Marks**.

The split-up of CIE marks for record/ journal and test are in the ratio **60:40**.

- Each experiment is to be evaluated for conduction with an observation sheet and record write-up. Rubrics for the evaluation of the journal/write-up for hardware/software experiments are designed by the faculty who is handling the laboratory session and are made known to students at the beginning of the practical session.
- Record should contain all the specified experiments in the syllabus and each experiment write-up will be evaluated for 10 marks.
- Total marks scored by the students are scaled down to **30 marks** (60% of maximum marks).
- Weightage to be given for neatness and submission of record/write-up on time.
- Department shall conduct a test of 100 marks after the completion of all the experiments listed in the syllabus.
- In a test, test write-up, conduction of experiment, acceptable result, and procedural knowledge will carry a weightage of 60% and the rest 40% for viva-voce.
- The suitable rubrics can be designed to evaluate each student's performance and learning ability.
- The marks scored shall be scaled down to **20 marks** (40% of the maximum marks).

The Sum of scaled-down marks scored in the report write-up/journal and marks of a test is the total CIE marks scored by the student.

**Semester End Evaluation (SEE):**

- SEE marks for the practical course are 50 Marks.
- SEE shall be conducted jointly by the two examiners of the same institute, examiners are appointed by the Head of the Institute.
- The examination schedule and names of examiners are informed to the university before the conduction of the examination. These practical examinations are to be conducted between the schedule mentioned in the academic calendar of the University.

- All laboratory experiments are to be included for practical examination.
- (Rubrics) Breakup of marks and the instructions printed on the cover page of the answer script to be strictly adhered to by the examiners. **OR** based on the course requirement evaluation rubrics shall be decided jointly by examiners.
- Students can pick one question (experiment) from the questions lot prepared by the examiners jointly.
- Evaluation of test write-up/ conduction procedure and result/viva will be conducted jointly by examiners.

General rubrics suggested for SEE are mentioned here, writeup-20%, Conduction procedure and result in -60%, Viva-voce 20% of maximum marks. SEE for practical shall be evaluated for 100 marks and scored marks shall be scaled down to 50 marks (however, based on course type, rubrics shall be decided by the examiners)
Change of experiment is allowed only once and 15% of Marks allotted to the procedure part are to be made zero.
The minimum duration of SEE is 02 hours

**Suggested Learning Resources:**
**Books:**

1. Randy Connolly and Ricardo Hoar, Fundamentals of Web Development, 3rd edition, Pearson, 2021
2. Robert W Sebesta, Programming the World Wide Web, 8th Edition, Pearson Education, 2020.

**Web Links:**

- https://www.w3schools.com/html/default.asp
- https://www.w3schools.com/css/default.asp
- https://www.w3schools.com/js/js_examples.asp
- https://www.geeksforgeeks.org/javascript-examples/
- https://www.w3schools.com/php/default.asp
- https://www.w3schools.com/jquery/default.asp
- https://www.w3schools.com/js/js_ajax_intro.asp
- https://www.geeksforgeeks.org/jquery-tutorial/

| | | | | |
|---|---|---|---|---|
| | **COMPUTER GRAPHICS** | | Semester | 5 |
| | Course Code | **BAI515A** | CIE Marks | 50 |
| | Teaching Hours/Week (L: T:P: S) | 3:0:0:0 | SEE Marks | 50 |
| | Total Hours of Pedagogy | 3Hrs | Total Marks | 100 |
| | Credits | 03 | Exam Hours | |
| | Examination type (SEE) | Theory | | |

**Course objectives:**

- Understand the basic principles of Graphical Systems.
- Understand hardware, software and OpenGL Graphics Primitives.
- Illustrate interactive computer graphic using the OpenGL.
- Design and implementation of algorithms for 2D graphics Primitives and attributes.
- Demonstrate Geometric transformations, viewing on both 2D and 3D objects.
- Infer the representation of lines, surfaces, Color and Illumination models

**Teaching-Learning Process (General Instructions)**

These are sample Strategies, which teachers can use to accelerate the attainment of the various course outcomes.

1. Lecturer method (L) need not to be only traditional lecture method, but alternative effective teaching methods could be adopted to attain the outcomes.
2. Use of Video/Animation to explain functioning of various concepts.
3. Encourage collaborative (Group Learning) Learning in the class.
4. Ask at least three HOT (Higher order Thinking) questions in the class, which promotes critical thinking.
5. Adopt Problem Based Learning (PBL), which fosters students' Analytical skills, develop design thinking skills such as the ability to design, evaluate, generalize, and analyse information rather than simply recall it.
6. Introduce Topics in manifold representations.
7. Show the different ways to solve the same problem and encourage the students to come up with their own creative ways to solve them.
8. Demonstrate every concept by implementing an OpenGL program.

**Module-1**

**Graphics Systems and Models:** Applications of Computer Graphics, A Graphics System, Images: Physical and Synthetic, Imaging Systems, The Synthetic-Camera Model, The Programmer's Interface, Graphics Architectures, Programmable Pipelines, Performance Characteristics.

**Text book 1: Chapter 1**

**Module-2**

**Input and Interaction:** Interaction, Input devices, Clients and Servers, Display Lists, Display Lists and Modeling, Programming Event Driven Input, Menus.

**Text book 1: Chapter 3 – 3.1 to 3.7**

**Module-3**

**Geometric Objects and Transformations:** Frames in OpenGL, Modeling a Colored Cube, Affine Transformations, Rotation, Translation and Scaling, Transformation in Homogeneous Coordinates, Concatenation of Transformations.

**Text book 1: Chapter 4 – 4.4 to 4.9**

**Module-4**

| | |
|---|---|
| | **Viewing:** Classical and Computer Viewing, Viewing with a Computer.<br><br>**Lighting and Shading:** Light and Matter, Light Sources, The Phong Lighting Model, Polygonal Shading.<br><br>**Text book 1: Chapter 5 – 5.1, 5.2 and Chapter 6 – 6.1, 6.2, 6.3 and 6.5** |
| | **Module-5** |
| | **From Vertices to Fragments:** Basic Implementation Strategies, Four major tasks, Clipping, Line-segment clipping, Cohen-Sutherland Clipping, Liang-Barsky Clipping.<br><br>**Implementation Algorithms for Graphics Primitives and Attributes:** Line-Drawing Algorithms, DDA Algorithm, Bresenham's Line Algorithm, Parallel Line Algorithms, Setting Frame-Buffer Values, Circle-Generating Algorithms, Midpoint Circle Algorithm.<br><br>**Text book 1: Chapter 7 – 7.1 to 7.4**<br>**Text Book 2: Chapter 5 – 5.1 to 5.4** |

**Course outcome (Course Skill Set)**

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

1. Explain the fundamentals of computer graphics systems.
2. Develop event driven graphical applications by interfacing hardware devices.
3. Apply the Geometrical Transformations on geometrical objects.
4. Apply the concepts of viewing, lighting and shading on graphical objects.
5. Demonstrate algorithms for 2D graphical primitives.

## Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks out of 50) and for the SEE minimum passing mark is 35% of the maximum marks (18 out of 50 marks). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures a minimum of 40% (40 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together.

**Continuous Internal Evaluation:**

- For the Assignment component of the CIE, there are 25 marks and for the Internal Assessment Test component, there are 25 marks.
- The first test will be administered after 40-50% of the syllabus has been covered, and the second test will be administered after 85-90% of the syllabus has been covered
- Any two assignment methods mentioned in the 22OB2.4, if an assignment is project-based then only one assignment for the course shall be planned. The teacher should not conduct two assignments at the end of the semester if two assignments are planned.
- For the course, CIE marks will be based on a scaled-down sum of two tests and other methods of assessment.

**Internal Assessment Test question paper is designed to attain the different levels of Bloom's taxonomy as per the outcome defined for the course.**

**Semester-End Examination:**

Theory SEE will be conducted by University as per the scheduled timetable, with common question papers for the course (**duration 03 hours).**

1. The question paper will have ten questions. Each question is set for 20 marks.
2. There will be 2 questions from each module. Each of the two questions under a module (with a maximum of 3 sub-questions), **should have a mix of topics** under that module.
3. The students have to answer 5 full questions, selecting one full question from each module.
4. Marks scored shall be proportionally reduced to 50 marks

**Suggested Learning Resources:**

**TextBooks**

1. Edward Angel: Interactive Computer Graphics A Top-Down Approach with OpenGL, 5th Edition, Pearson Education, 2008.
2. Donald Hearn & Pauline Baker: Computer Graphics with OpenGL Version, 4th Edition, Pearson Education, 2011.

**Web links and Video Lectures (e-Resources):**

- https://nptel.ac.in/courses/106/106/106106090/
- https://nptel.ac.in/courses/106/102/106102063/
- https://nptel.ac.in/courses/106/103/106103224/
- https://nptel.ac.in/courses/106/102/106102065/

**Activity Based Learning (Suggested Activities in Class)/ Practical Based learning**

- Developed a project in OpenGL with C++ to implement the various concepts. (25 marks)

| ARTIFICIAL INTELLIGENCE | | Semester | V |
|---|---|---|---|
| Course Code | **BCS515B** | CIE Marks | 50 |
| Teaching Hours/Week (L: T:P: S) | 3:0:0:0 | SEE Marks | 50 |
| Total Hours of Pedagogy | 40 | Total Marks | 100 |
| Credits | 03 | Exam Hours | 3 |
| Examination type (SEE) | Theory | | |

**Course objectives:**

- Learn the basic principles and theories underlying artificial intelligence, including machine learning, neural networks, natural language processing, and robotics.
- Apply AI techniques to solve real-world problems, including search algorithms, optimization, and decision-making processes.
- Understand the ethical, legal, and societal implications of AI, including topics such as bias, fairness, accountability, and the impact of AI on the workforce and privacy.

**Teaching-Learning Process (General Instructions)**

These are sample Strategies, which teachers can use to accelerate the attainment of the various course outcomes.

1. Use of Video/Animation to explain functioning of various concepts.
2. Encourage collaborative (Group Learning) Learning in the class.
3. Discuss application of every concept to solve the real-world problems.
4. Demonstrate ways to solve the same problem and encourage the students to come up with their own creative solutions.

**Module-1**

**Introduction:** What Is AI? , The State of The Art.

**Intelligent Agents:** Agents and environment, Concept of Rationality, The nature of environment, The structure of agents.

**Chapter 1 - 1.1, 1.4**

**Chapter 2 - 2.1, 2.2, 2.3, 2.4**

**Module-2**

**Problem-solving:** Problem-solving agents, Example problems, Searching for Solutions Uninformed Search Strategies

**Chapter 3 - 3.1, 3.2, 3.3, 3.4**

**Module-3**

**Problem-solving:** Informed Search Strategies, Heuristic functions

**Logical Agents:** Knowledge–based agents, The Wumpus world, Logic, Propositional logic, Reasoning patterns in Propositional Logic

**Chapter 3 - 3.5, 7.6**

**Chapter 7 - 7.1, 7.2, 7.3, 7.4**

**Module-4**

**First Order Logic:** Representation Revisited, Syntax and Semantics of First Order logic, Using First Order logic, Knowledge Engineering In First-Order Logic

**Inference in First Order Logic:** Propositional Versus First Order Inference, Unification, Forward Chaining

**Chapter 8- 8.1, 8.2, 8.3, 8.4**

**Chapter 9- 9.1, 9.2, 9.3**

| Module-5 |
| --- |
| **Inference in First Order Logic:** Backward Chaining, Resolution<br>**Classical Planning:** Definition of Classical Planning, Algorithms for Planning as State-Space Search, Planning Graphs<br>**Chapter 9-9.4, 9.5**<br>**Chapter 10- 10.1,10.2,10.3** |
| **Course outcomes (Course Skill Set)**<br>At the end of the course, the student will be able to:<br>1. Explain the architecture and components of intelligent agents, including their interaction with the AI environment.<br>2. Apply problem-solving agents and various search strategies to solve a given problem.<br>3. Illustrate logical reasoning and knowledge representation using propositional and first-order logic.<br>4. Demonstrate proficiency in representing knowledge and solving problems using first-order logic.<br>5. Describe classical planning in the context of artificial intelligence, including its goals, constraints, and applications in problem-solving. |
| **Assessment Details (both CIE and SEE)**<br>The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks out of 50) and for the SEE minimum passing mark is 35% of the maximum marks (18 out of 50 marks). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures a minimum of 40% (40 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together.<br><br>**Continuous Internal Evaluation:**<br>• For the Assignment component of the CIE, there are 25 marks and for the Internal Assessment Test component, there are 25 marks.<br>• The first test will be administered after 40-50% of the syllabus has been covered, and the second test will be administered after 85-90% of the syllabus has been covered<br>• Any two assignment methods mentioned in the 22OB2.4, if an assignment is project-based then only one assignment for the course shall be planned. The teacher should not conduct two assignments at the end of the semester if two assignments are planned.<br>• For the course, CIE marks will be based on a scaled-down sum of two tests and other methods of assessment.<br>**Internal Assessment Test question paper is designed to attain the different levels of Bloom's taxonomy as per the outcome defined for the course.**<br><br>**Semester-End Examination:**<br>Theory SEE will be conducted by University as per the scheduled timetable, with common question papers for the course (**duration 03 hours).**<br>1. The question paper will have ten questions. Each question is set for 20 marks.<br>2. There will be 2 questions from each module. Each of the two questions under a module (with |

**Suggested Learning Resources:**

**Text Book**

Stuart J. Russell and Peter Norvig, Artificial Intelligence, 3rd Edition, Pearson, 2015

**Reference Books**

1. Elaine Rich, Kevin Knight, Artificial Intelligence, 3rd edition, Tata McGraw Hill, 2013
2. George F Lugar, Artificial Intelligence Structure and strategies for complex, Pearson Education, 5th Edition, 2011
3. Nils J. Nilsson, Principles of Artificial Intelligence, Elsevier, 1980
4. Saroj Kaushik, Artificial Intelligence, Cengage learning, 2014

**Web links and Video Lectures (e-Resources):**

1. https://www.kdnuggets.com/2019/11/10-free-must-read-books-ai.html
2. https://www.udacity.com/course/knowledge-based-ai-cognitive-systems--ud409
3. https://nptel.ac.in/courses/106/105/106105077/

**Activity Based Learning (Suggested Activities in Class)/ Practical Based learning**

1. Using OpenAI tool, develop a chatbot (25 marks)

| | | | | |
|---|---|---|---|---|
| | **UNIX SYSTEM PROGRAMMING** | | Semester | V |
| | Course Code | **BCS515C** | CIE Marks | 50 |
| | Teaching Hours/Week (L: T:P: S) | 3:0:0:0 | SEE Marks | 50 |
| | Total Hours of Pedagogy | 40 | Total Marks | 100 |
| | Credits | 03 | Exam Hours | 03 |
| | Examination type (SEE) | Theory | | |

**Course objectives:** This course will enable students to

- To help the students to understand effective use of Unix concepts, commands and terminology. Identify, access, and evaluate UNIX file system
- Explain the fundamental design of the unix operating system
- Familiarize with the systems calls provided in the unix environment
- Design and build an application/service over the unix operating system

**Teaching-Learning Process (General Instructions)**

These are sample Strategies; which teachers can use to accelerate the attainment of the various course outcomes.

1. Lecturer method (L) need not to be only a traditional lecture method, but alternative effective teaching methods could be adopted to attain the outcomes.
2. Use of Video/Animation to explain functioning of various concepts.
3. Encourage collaborative (Group Learning) Learning in the class.
4. Ask at least three HOT (Higher order Thinking) questions in the class, which promotes critical thinking.
5. Adopt Problem Based Learning (PBL), which fosters students' Analytical skills, develop design thinking skills such as the ability to design, evaluate, generalize, and analyze information rather than simply recall it.
6. Introduce Topics in manifold representations.
7. Show the different ways to solve the same problem with different circuits/logic and encourage the students to come up with their own creative ways to solve them.
8. Discuss how every concept can be applied to the real world - and when that's possible, it helps improve the students' understanding.

## Module-1

**Introduction:** Unix Components/Architecture. Features of Unix. The UNIX Environment and UNIX Structure, Posix and Single Unix specification. General features of Unix commands/ command structure. Command arguments and options. Basic Unix commands such as echo, printf, ls, who, date, passwd, cal, Combining commands. Meaning of Internal and external commands. The type command: knowing the type of a command and locating it. The root login. Becoming the super user: su command.

**Unix files:** Naming files. Basic file types/categories. Organization of files. Hidden files. Standard directories. Parent-child relationship. The home directory and the HOME variable. Reaching required files- the PATH variable, manipulating the PATH, Relative and absolute pathnames. Directory commands – pwd, cd, mkdir, rmdir commands. The dot (.) and double dots (..) notations to represent present and parent directories and their usage in relative path names. File related commands – cat, mv, rm, cp, wc and od commands.

| | |
|---|---|
| | **Text Book1: Chapter-1, 2, 3, 4, 5** |
| | **Module-2** |
| | **File attributes and permissions:** The ls command with options. Changing file permissions: the relative and absolute permissions changing methods. Recursively changing file permissions. Directory permissions.<br><br>**The shells interpretive cycle:** Wild cards. Removing the special meanings of wild cards. Three standard files and redirection.<br><br>**Connecting commands:** Pipe. Basic and Extended regular expressions. The grep, egrep. Typical examples involving different regular expressions.<br><br>**Shell programming:** Ordinary and environment variables. The. profile. Read and read-only commands. Command line arguments. exit and exit status of a command. Logical operators for conditional execution. The test command and its shortcut. The if, while, for and case control statements. The set and shift commands and handling positional parameters. The here (<<) document and trap command. Simple shell program examples.<br><br>**Text Book1: Chapter-6,8,13,14** |
| | **Module-3** |
| | **Unix Standardization and Implementations:** Introduction, Unix Standardization, UNIX System Implementation.<br><br>**File I/O:** Introduction, File Description, open, create, read, write, close, fcntl functions.<br><br>**Files and Dictionaries:** mkdir and rmdir functions, reading dictionaries, chdir, fchdir and getcwd functions. Device Special files.<br><br>**The Environment of a UNIX Process:** Introduction, main function, Process Termination, Command-Line Arguments, Environment List, Memory Layout of a C Program, Shared Libraries, Memory Allocation, Environment Variables, setjmp and longjmp Functions, getrlimit, setrlimit Functions.<br><br>**Text Book 2: 2,3,4,7.** |
| | **Module-4** |
| | **Process Control:** Introduction, Process Identifiers, fork, vfork, exit, wait, waitpid, wait3, wait4 Functions, Race Conditions, exec Functions.<br><br>**Overview of IPC Methods**, Pipes, popen, pclose Functions, Coprocesses, FIFOs, System V IPC, Message Queues, Semaphores.<br><br>**Shared Memory**, Client-Server Properties, Passing File Descriptors, An Open Server-Version 1.<br><br>**Text Book2: Chapter 8, 15,17** |
| | **Module-5** |

**Signals and Daemon Processes:** Introduction, Signal Concepts, Signal Functions, SIGCLD Semantics, Kill and Raise functions, Alarm and Pause Functions, Signal Sets, sigprocmask Function, sigpending function, sigaction function, sigsetjmp and siglongjmp functions, sigsuspend function, abort function, system function, sleep, nanosleep and clock_nanosleep functions, sigqueue functions, job-control signals, signal names and numbers.

**Daemon Processes:** Introduction, Daemon Characteristics, Coding Rules, Error Logging, Client-Server Model.

**Text Book 2: Chapter 10, 13**

**Course outcome (Course Skill Set)**

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

- Demonstrate the basics of Unix concepts and commands.
- Demonstrate the UNIX file system.
- Apply comands to reflect changes in file system.
- Demonstrate IPC and process management.
- Develop an application/service over a Unix system.

## Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks out of 50) and for the SEE minimum passing mark is 35% of the maximum marks (18 out of 50 marks). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures a minimum of 40% (40 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together.

**Continuous Internal Evaluation:**

- For the Assignment component of the CIE, there are 25 marks and for the Internal Assessment Test component, there are 25 marks.
- The first test will be administered after 40-50% of the syllabus has been covered, and the second test will be administered after 85-90% of the syllabus has been covered
- Any two assignment methods mentioned in the 22OB2.4, if an assignment is project-based then only one assignment for the course shall be planned. The teacher should not conduct two assignments at the end of the semester if two assignments are planned.
- For the course, CIE marks will be based on a scaled-down sum of two tests and other methods of assessment.

**Internal Assessment Test question paper is designed to attain the different levels of Bloom's taxonomy as per the outcome defined for the course.**

**Semester-End Examination:**

Theory SEE will be conducted by University as per the scheduled timetable, with common question papers for the course (**duration 03 hours).**

1. The question paper will have ten questions. Each question is set for 20 marks.
2. There will be 2 questions from each module. Each of the two questions under a module (with a maximum of 3 sub-questions), **should have a mix of topics** under that module.
3. The students have to answer 5 full questions, selecting one full question from each module.
4. Marks scored shall be proportionally reduced to 50 marks

**Suggested Learning Resources:**

**Text Books:**

1. Sumitabha Das., Unix Concepts and Applications., 4thEdition., Tata McGraw Hill
2. W. Richard Stevens: Advanced Programming in the UNIX Environment, 2nd Edition, Pearson Education, 2005

**Reference Books:**

1. Unix System Programming Using C++ - Terrence Chan, PHI, 1999.
2. M.G. Venkatesh Murthy: UNIX & Shell Programming, Pearson Education.
3. Richard Blum, Christine Brenham: Linux Command Line and Shell Scripting Bible, 2ndEdition, Wiley, 2014.

**Web links and Video Lectures (e-Resources):**

https://www.youtube.com/watch?v=ffYUfAqEamY
https://www.youtube.com/watch?v=Q05NZiYFcD0
https://www.youtube.com/watch?v=8GdT53KDIyY
https://www.youtube.com/watch?app=desktop&v=3Pga3y7rCgo

**Activity Based Learning (Suggested Activities in Class)/ Practical Based learning**

Programming assignment -1 (Shell level) - 10 marks
Programming assignment -2 (API level) - 15 marks

| | | | | |
|---|---|---|---|---|
| | **DISTRIBUTED SYSTEMS** | | Semester | 5 |
| | Course Code | **BCS515D** | CIE Marks | 50 |
| | Teaching Hours/Week (L: T:P: S) | 3:0:0:0 | SEE Marks | 50 |
| | Total Hours of Pedagogy | 3Hrs | Total Marks | 100 |
| | Credits | 03 | Exam Hours | |
| | Examination type (SEE) | Theory | | |

**Course objectives:**

- Understand the goals and challenges of distributed systems
- Describe the architecture of RPC/RMI, distributed file systems and name services
- Learn clock synchronization algorithms to monitor and order the events, mutual exclusion, election and consensus algorithms.
- Study the fundamental concepts and algorithms related to distributed transactions and replication.

**Teaching-Learning Process (General Instructions)**

These are sample strategies which teachers can use to accelerate the attainment of the various course outcomes.

1. Lecturer method (L) need not to be only traditional lecture method, but alternative effective teaching methods could be adopted to attain the outcomes.
2. Use of Video/Animation to explain functioning of various concepts.
3. Encourage collaborative (Group Learning) Learning in the class.
4. Ask at least three HOT (Higher order Thinking) questions in the class, which promotes critical thinking.
5. Adopt Problem Based Learning (PBL), which fosters students' Analytical skills, develop design thinking skills such as the ability to design, evaluate, generalize, and analyse information rather than simply recall it.
6. Introduce Topics in manifold representations.
7. Show the different ways to solve the same problem and encourage the students to come up with their own creative ways to solve them.
8. Demonstrate every concept by implementing an OpenGL program.

**Module-1**

**CHARACTERIZATION OF DISTRIBUTED SYSTEMS**: Introduction, Focus on resource sharing, Challenges.

**REMOTE INVOCATION:** Introduction, Request-reply protocols, Remote procedure call, Introduction to Remote Method Invocation.

**Textbook: Chapter- 1.1,1.4,1.5, 5.1-5.5**

**Module-2**

**DISTRIBUTED FILE SYSTEMS:** Introduction, File service architecture.

**NAME SERVICES:** Introduction, Name services and the Domain Name System, Directory services.

**Textbook: Chapter- 12.1,12.2, 13.1-13.3**

**Module-3**

**TIME AND GLOBAL STATES:** Introduction, Clocks, events and process states, Synchronizing Physical clocks, Logical time and logical clocks, Global states

| | |
|---|---|
| | **Textbook: Chapter- 14.1-14.5** |
| | **Module-4** |
| | **COORDINATION AND AGREEMENT:** Introduction, Distributed mutual exclusion, Elections, Coordination and agreement in group communication, Consensus and related problems.<br><br>**Textbook: Chapter -15.1-15.5** |
| | **Module-5** |
| | **DISTRIBUTED TRANSACTIONS:** Introduction, Flat and nested distributed transactions, Atomic commit protocols, Concurrency control in distributed transactions, Distributed deadlocks, Transaction recovery.<br><br>**REPLICATION:** Introduction.<br><br>**Textbook: Chapter -17.1-17.6, 18.1** |

**Course outcome (Course Skill Set)**

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

1. Identify the goals and challenges of distributed systems
2. Demonstrate the remote invocation techniques for communication
3. Describe the architecture of distributed file systems and name services
4. Apply clock synchronization algorithms to monitor and order the events.
5. Analyze the performance of mutual exclusion, election and consensus algorithms.
6. Illustrate the fundamental concepts and algorithms related to distributed transactions and replication

## Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks out of 50) and for the SEE minimum passing mark is 35% of the maximum marks (18 out of 50 marks). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures a minimum of 40% (40 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together.

**Continuous Internal Evaluation:**

- For the Assignment component of the CIE, there are 25 marks and for the Internal Assessment Test component, there are 25 marks.
- The first test will be administered after 40-50% of the syllabus has been covered, and the second test will be administered after 85-90% of the syllabus has been covered
- Any two assignment methods mentioned in the 22OB2.4, if an assignment is project-based then only one assignment for the course shall be planned. The teacher should not conduct two assignments at the end of the semester if two assignments are planned.
- For the course, CIE marks will be based on a scaled-down sum of two tests and other methods of assessment.

**Internal Assessment Test question paper is designed to attain the different levels of Bloom's taxonomy as per the outcome defined for the course.**

**Semester-End Examination:**

Theory SEE will be conducted by University as per the scheduled timetable, with common question papers for the course (**duration 03 hours).**

1. The question paper will have ten questions. Each question is set for 20 marks.
2. There will be 2 questions from each module. Each of the two questions under a module (with a maximum of 3 sub-questions), **should have a mix of topics** under that module.
3. The students have to answer 5 full questions, selecting one full question from each module.
4. Marks scored shall be proportionally reduced to 50 marks

**Suggested Learning Resources:**

**Textbook's:**

1. George Coulouris, Jean Dollimore and Tim Kindberg, "Distributed Systems Concepts and Design", Fifth Edition, Pearson Education, 2012.

**Web links and Video Lectures (e-Resources):**

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- https://www.youtube.com/watch?v=Azyizl9w2xo&list=PLrjkTql3jnm9FEOXHA_qjRTMODlaIk-W

**Activity Based Learning (Suggested Activities in Class)/ Practical Based learning**

- Programming Assignment (15 marks)
- Literature Review/ Case Studies (10 marks)

VISVESVARAYA TECHNOLOGICAL UNIVERSITY, BELAGAVI

**B.E. in Artificial Intelligence and Machine Learning**

**Scheme of Teaching and Examinations 2022**

Outcome Based Education (OBE) and Choice Based Credit System (CBCS)

(Effective from the academic year 2023-24)

**III SEMESTER**

| Sl. No | Course | Course Code | Course Title | Teaching Department (TD) and Question Paper Setting Board (PSB) | Teaching Hours /Week | | | | Examination | | | | Credits |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | Theory Lecture | Tutorial | Practical / Drawing | SDA | Duration in hours | CIE Marks | SEE Marks | Total Marks | |
| | | | | | L | T | P | S | | | | | |
| 1 | PCC/BSC | BCS301 | Mathematics for Computer Science | TD : Maths<br>PSB : Maths | 3 | 2 | 0 | | 03 | 50 | 50 | 100 | 4 |
| 2 | IPCC | BCS302 | Digital Design & Computer Organization | TD : AI<br>PSB : CS | 3 | 0 | 2 | | 03 | 50 | 50 | 100 | 4 |
| 3 | IPCC | BCS303 | Operating Systems | TD : AI<br>PSB : CS | 3 | 0 | 2 | | 03 | 50 | 50 | 100 | 4 |
| 4 | PCC | BCS304 | Data Structures and Applications | TD : AI<br>PSB : CS | 3 | 0 | 0 | | 03 | 50 | 50 | 100 | 3 |
| 5 | PCCL | BCSL305 | Data Structures Lab | TD : AI<br>PSB : CS | 0 | 0 | 2 | | 03 | 50 | 50 | 100 | 1 |
| 6 | ESC | BXX306x | ESC/ETC/PLC | TD : AI<br>PSB : CS | 2 | 0 | 2 | | 03 | 50 | 50 | 100 | 3 |
| 7 | UHV | BSCK307 | **Social Connect and Responsibility** | Any Department | 0 | 0 | 2 | | 01 | 100 | --- | 100 | 1 |
| 8 | AEC/ SEC | BXX358x | Ability Enhancement Course/Skill Enhancement Course – III | TD and PSB: Concerned department | If the course is a Theory<br>1 | 0 | 0 | | 01 | 50 | 50 | 100 | 1 |
| | | | | | If a course is a laboratory<br>0 | 0 | 2 | | 02 | | | | |
| 9 | MC | BNSK359 | National Service Scheme (NSS) | NSS coordinator | 0 | 0 | 2 | | | 100 | --- | 100 | 0 |
| | | BPEK359 | Physical Education (PE) (Sports and Athletics) | Physical Education Director | | | | | | | | | |
| | | BYOK359 | Yoga | Yoga Teacher | | | | | | | | | |
| | | | | | | | | | **Total** | **550** | **350** | **900** | **21** |

**PCC**: Professional Core Course, **PCCL**: Professional Core Course laboratory, **UHV**: Universal Human Value Course, **MC**: Mandatory Course (Non-credit), **AEC**: Ability Enhancement Course, **SEC**: Skill Enhancement Course, **L:** Lecture, **T**: Tutorial, **P**: Practical **S= SDA**: Skill Development Activity, **CIE**: Continuous Internal Evaluation, **SEE**: Semester End Evaluation.K :This letter in the course code indicates common to all the stream of engineering. ESC: Engineering Science Course, ETC: Emerging Technology Course, PLC: Programming Language Course

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| **Engineering Science Course (ESC/ETC/PLC) (Note- Student should opt for the course which should not be similar to the course opted in 1st Year)** | | | |
|---|---|---|---|
| BCS306A | Object Oriented Programming with Java | BDS306C | Data Analytics with R |
| BDS306B | Python Programming for Data Science | BAI306D | |
| **Ability Enhancement Course – III** | | | |
| BCS358A | Data Analytics with Excel | BCS358C | Project Management with Git |
| BAI358B | Ethics and Public Policy for AI | BAI358D | PHP Programming |

**Professional Core Course (IPCC):** Refers to Professional Core Course Theory Integrated with practicals of the same course. Credit for IPCC can be 04 and its Teaching–Learning hours (L : T : P) can be considered as (3 : 0 : 2) or (2 : 2 : 2). The theory part of the IPCC shall be evaluated both by CIE and SEE. The practical part shall be evaluated by only CIE (no SEE). However, questions from the practical part of IPCC shall be included in the SEE question paper. For more details, the regulation governing the Degree of Bachelor of Engineering /Technology (B.E./B.Tech.) 2022-23 may please be refered.

**National Service Scheme /Physical Education/Yoga:** All students have to register for any one of the courses namely National Service Scheme (NSS), Physical Education (PE)(Sports and Athletics), and Yoga(YOG) with the concerned coordinator of the course during the first week of III semesters. Activities shall be carried out between III semester to the VI semester (for 4 semesters). Successful completion of the registered course and requisite CIE score is mandatory for the award of the degree. The events shall be appropriately scheduled by the colleges and the same shall be reflected in the calendar prepared for the NSS, PE, and Yoga activities. These courses shall not be considered for vertical progression as well as for the calculation of SGPA and CGPA, but completion of the course is mandatory for the award of degree.

| | | | | |
|---|---|---|---|---|
| | **Mathematics for Computer Science** | | Semester | 3 |
| | Course Code | **BCS301** | CIE Marks | 50 |
| | Teaching Hours/Week (L: T:P: S) | 3:2:0:0 | SEE Marks | 50 |
| | Total Hours of Pedagogy | 40 hours Theory + 20 Hours Tutorial | Total Marks | 100 |
| | Credits | 04 | Exam Hours | 3 |
| | Examination type (SEE) | **Theory** | | |

**Course objectives:** This course will enable the students to:

1. To introduce the concept of random variables, probability distributions, specific discrete and continuous distributions with practical application in Computer Science Engineering and social life situations.
2. To Provide the principles of statistical inferences and the basics of hypothesis testing with emphasis on some commonly encountered hypotheses.
3. To Determine whether an input has a statistically significant effect on the system's response through ANOVA testing.

**Teaching-Learning Process**

**Pedagogy (General Instructions):**

Teachers can use the following strategies to accelerate the attainment of the various course outcomes.

1. In addition to the traditional lecture method, different types of innovative teaching methods may be adopted so that the delivered lessons shall develop students' theoretical and applied Mathematical skills.
2. State the need for Mathematics with Engineering Studies and Provide real-life examples.
3. Support and guide the students for self–study.
4. You will assign homework, grading assignments and quizzes, and documenting students' progress.
5. Encourage the students to group learning to improve their creative and analytical skills.
6. Show short related video lectures in the following ways:
   - As an introduction to new topics (pre-lecture activity).
   - As a revision of topics (post-lecture activity).
   - As additional examples (post-lecture activity).
   - As an additional material of challenging topics (pre-and post-lecture activity).
   - As a model solution of some exercises (post-lecture activity).

**Module-1: Probability Distributions**

**Probability Distributions**: Review of basic probability theory. Random variables (discrete and continuous), probability mass and density functions. Mathematical expectation, mean and variance. Binomial, Poisson and normal distributions- problems (derivations for mean and standard deviation for Binomial and Poisson distributions only)-Illustrative examples. Exponential distribution. **(12 Hours)**

**(RBT Levels: L1, L2 and L3)**

| | |
|---|---|
| **Pedagogy** | Chalk and Board, Problem-based learning |

**Module-2: Joint probability distribution & Markov Chain**

| | |
|---|---|
| | **Joint probability distribution**: Joint Probability distribution for two discrete random variables, expectation, covariance and correlation.<br>**Markov Chain:** Introduction to Stochastic Process, Probability Vectors, Stochastic matrices, Regular stochastic matrices, Markov chains, Higher transition probabilities, Stationary distribution of Regular Markov chains and absorbing states. **(12 Hours)**<br>**(RBT Levels: L1, L2 and L3)** |
| **Pedagogy** | Chalk and Board, Problem-based learning |
| | **Module-3: Statistical Inference 1** |
| | Introduction, sampling distribution, standard error, testing of hypothesis, levels of significance, test of significances, confidence limits, simple sampling of attributes, test of significance for large samples, comparison of large samples. **(12 Hours)**<br>**(RBT Levels: L1, L2 and L3)** |
| **Pedagogy** | Chalk and Board, Problem-based learning |
| | **Module-4: Statistical Inference 2** |
| | Sampling variables, central limit theorem and confidences limit for unknown mean. Test of Significance for means of two small samples, students 't' distribution, Chi-square distribution as a test of goodness of fit. F-Distribution. **(12 Hours)**<br>**(RBT Levels: L1, L2 and L3)** |
| **Pedagogy** | Chalk and Board, Problem-based learning |
| | **Module-5: Design of Experiments & ANOVA** |
| | Principles of experimentation in design, Analysis of completely randomized design, randomized block design. The ANOVA Technique, Basic Principle of ANOVA, One-way ANOVA, Two-way ANOVA, Latin-square Design, and Analysis of Co-Variance. **(12 Hours)**<br>**(RBT Levels: L1, L2 and L3)** |
| **Pedagogy** | Chalk and Board, Problem-based learning |

**Course outcome (Course Skill Set)**

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

1. Explain the basic concepts of probability, random variables, probability distribution
2. Apply suitable probability distribution models for the given scenario.
3. Apply the notion of a discrete-time Markov chain and n-step transition probabilities to solve the given problem
4. Use statistical methodology and tools in the engineering problem-solving process.
5. Compute the confidence intervals for the mean of the population.
6. Apply the ANOVA test related to engineering problems.

**Assessment Details (both CIE and SEE)**

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks out of 50) and for the SEE minimum passing mark is 35% of the maximum marks (18 out of 50 marks). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures a minimum of 40% (40 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together.

**Continuous Internal Evaluation:**

- For the Assignment component of the CIE, there are 25 marks and for the Internal Assessment

Test component, there are 25 marks.

- The first test will be administered after 40-50% of the syllabus has been covered, and the second test will be administered after 85-90% of the syllabus has been covered
- Any two assignment methods mentioned in the 22OB2.4, if an assignment is project-based then only one assignment for the course shall be planned. The teacher should not conduct two assignments at the end of the semester if two assignments are planned.
- For the course, CIE marks will be based on a scaled-down sum of two tests and other methods of assessment.

**Internal Assessment Test question paper is designed to attain the different levels of Bloom's taxonomy as per the outcome defined for the course.**

**Semester-End Examination:**

Theory SEE will be conducted by the University as per the scheduled timetable, with common question papers for the course (**duration 03 hours).**

1. The question paper will have ten questions. Each question is set for 20 marks.
2. There will be 2 questions from each module. Each of the two questions under a module (with a maximum of 3 sub-questions), **should have a mix of topics** under that module.
3. The students have to answer 5 full questions, selecting one full question from each module.

Marks scored shall be proportionally reduced to 50 marks

**Suggested Learning Resources:**

**Textbooks:**


1. **Ronald E. Walpole, Raymond H Myers, Sharon L Myers & Keying Ye** "Probability & Statistics for Engineers & Scientists", Pearson Education, 9th edition, 2017.
2. **Peter Bruce, Andrew Bruce & Peter Gedeck** "Practical Statistics for Data Scientists" O'Reilly Media, Inc., 2nd edition **2020**.


**Reference Books: (Name of the author/Title of the Book/ Name of the publisher/Edition and Year)**


1. **Erwin Kreyszig**, "Advanced Engineering Mathematics", John Wiley & Sons, 9th Edition, 2006.
2. **B. S. Grewal** "Higher Engineering Mathematics", Khanna publishers, 44th Ed., 2021.
3. **G Haribaskaran** "Probability, Queuing Theory & Reliability Engineering", Laxmi Publication, Latest Edition, 2006
4. **Irwin Miller & Marylees Miller,** John E. Freund's "Mathematical Statistics with Applications" Pearson. Dorling Kindersley Pvt. Ltd. India, 8th edition, 2014.
5. **S C Gupta and V K Kapoor**, "Fundamentals of Mathematical Statistics", S Chand and Company, Latest edition.
6. **Robert V. Hogg, Joseph W. McKean & Allen T. Craig**. "Introduction to Mathematical Statistics", Pearson Education 7th edition, 2013.
7. **Jim Pitman**. Probability, Springer-Verlag, 1993.
8. **Sheldon M. Ross,** "Introduction to Probability Models" 11th edition. Elsevier, 2014.
9. **A. M. Yaglom and I. M. Yaglom**, "Probability and Information". D. Reidel Publishing Company. Distributed by Hindustan Publishing Corporation (India) Delhi, 1983.
10. **P. G. Hoel, S. C. Port and C. J. Stone**, "Introduction to Probability Theory", Universal Book Stall, (Reprint), 2003.
11. **S. Ross**, "A First Course in Probability", Pearson Education India, 6th Ed., 2002.
12. **W. Feller**, "An Introduction to Probability Theory and its Applications", Vol. 1, Wiley, 3rd

Ed., 1968.
13. **N.P. Bali and Manish Goyal**, A Textbook of Engineering Mathematics, Laxmi Publications, Reprint, 2010.
14. **Veerarajan T**, Engineering Mathematics (for semester III), Tata McGraw-Hill, New Delhi, 2010

**Web links and Video Lectures (e-Resources):**

http://nptel.ac.in/courses.php?disciplineID=111
http://www.class-central.com/subject/math(MOOCs)
http://academicearth.org/
http://www.bookstreet.in.
VTU EDUSAT PROGRAMME – 20
VTU e-Shikshana Program

**Activity-Based Learning (Suggested Activities in Class)/Practical-Based Learning**

- Programming Assignment
- Seminars

| Digital Design and Computer Organization | | Semester | 3 |
|---|---|---|---|
| Course Code | BCS302 | CIE Marks | 50 |
| Teaching Hours/Week (L:T:P: S) | 3:0:2:0 | SEE Marks | 50 |
| Total Hours of Pedagogy | 40 hours Theory + 20 Hours of Practicals | Total Marks | 100 |
| Credits | 04 | Exam Hours | 3 |
| Examination nature (SEE) | Theory | | |

**Course objectives:**

- To demonstrate the functionalities of binary logic system
- To explain the working of combinational and sequential logic system
- To realize the basic structure of computer system
- To illustrate the working of I/O operations and processing unit

**Teaching-Learning Process (General Instructions)**
These are sample Strategies; that teachers can use to accelerate the attainment of the various course outcomes.

1. Chalk and Talk
2. Live Demo with experiments
3. Power point presentation

**MODULE-1** **8 Hr**

**Introduction to Digital Design:** Binary Logic, Basic Theorems And Properties Of Boolean Algebra, Boolean Functions, Digital Logic Gates, Introduction, The Map Method, Four-Variable Map, Don't-Care Conditions, NAND and NOR Implementation, Other Hardware Description Language – Verilog Model of a simple circuit.

**Text book 1: 1.9, 2.4, 2.5, 2.8, 3.1, 3.2, 3.3, 3.5, 3.6, 3.9**

**MODULE-2** **8 Hr**

**Combinational Logic**: Introduction, Combinational Circuits, Design Procedure, Binary Adder- Subtractor, Decoders, Encoders, Multiplexers. HDL Models of Combinational Circuits – Adder, Multiplexer, Encoder. **Sequential Logic**: Introduction, Sequential Circuits, Storage Elements: Latches, Flip-Flops.

**Text book 1: 4.1, 4.2, 4.4, 4.5, 4.9, 4.10, 4.11, 4.12, 5.1, 5.2, 5.3, 5.4.**

**MODULE-3** **8 Hr**

**Basic Structure of Computers:** Functional Units, Basic Operational Concepts, Bus structure, Performance – Processor Clock, Basic Performance Equation, Clock Rate, Performance Measurement.**Machine Instructions and Programs:** Memory Location and Addresses, Memory Operations, Instruction and Instruction sequencing, Addressing Modes.

**Text book 2: 1.2, 1.3, 1.4, 1.6, 2.2, 2.3, 2.4, 2.5**

**MODULE-4** **8 Hr**

**Input/output Organization:** Accessing I/O Devices, Interrupts – Interrupt Hardware, Enabling and Disabling Interrupts, Handling Multiple Devices, Direct Memory Access: Bus Arbitration, Speed, size and Cost of memory systems. Cache Memories – Mapping Functions.

**Text book 2: 4.1, 4.2.1, 4.2.2, 4.2.3, 4.4, 5.4, 5.5.1**

**MODULE-5** **8 Hr**

| |
|---|
| **Basic Processing Unit:** Some Fundamental Concepts: Register Transfers, Performing ALU operations, fetching a word from Memory, Storing a word in memory. Execution of a Complete Instruction. **Pipelining:** Basic concepts, Role of Cache memory, Pipeline Performance.<br><br>**Text book 2: 7.1, 7.2, 8.1** |

**PRACTICAL COMPONENT OF IPCC**

| Sl.NO | Experiments<br>Simulation packages preferred: Multisim, Modelsim, PSpice or any other relevant |
|---|---|
| 1 | Given a 4-variable logic expression, simplify it using appropriate technique and simulate the same using basic gates. |
| 2 | Design a 4 bit full adder and subtractor and simulate the same using basic gates. |
| 3 | Design Verilog HDL to implement simple circuits using structural, Data flow and Behavioural model. |
| 4 | Design Verilog HDL to implement Binary Adder-Subtractor – Half and Full Adder, Half and Full Subtractor. |
| 5 | Design Verilog HDL to implement Decimal adder. |
| 6 | Design Verilog program to implement Different types of multiplexer like 2:1, 4:1 and 8:1. |
| 7 | Design Verilog program to implement types of De-Multiplexer. |
| 8 | Design Verilog program for implementing various types of Flip-Flops such as SR, JK and D. |

**Course outcomes (Course Skill Set):**

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

CO1: Apply the K–Map techniques to simplify various Boolean expressions.

CO2: Design different types of combinational and sequential circuits along with Verilog programs.

CO3: Describe the fundamentals of machine instructions, addressing modes and Processor performance.

CO4: Explain the approaches involved in achieving communication between processor and I/O devices.

CO5:Analyze internal Organization of Memory and Impact of cache/Pipelining on Processor Performance.

**Assessment Details (both CIE and SEE)**

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks out of 50) and for the SEE minimum passing mark is 35% of the maximum marks (18 out of 50 marks). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures a minimum of 40% (40 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together.

**CIE for the theory component of the IPCC (maximum marks 50)**

- IPCC means practical portion integrated with the theory of the course.
- CIE marks for the theory component are **25 marks** and that for the practical component is **25 marks**.
- 25 marks for the theory component are split into **15 marks** for two Internal Assessment Tests (Two Tests, each of 15 Marks with 01-hour duration, are to be conducted) and **10 marks** for other

assessment methods mentioned in 22OB4.2. The first test at the end of 40-50% coverage of the syllabus and the second test after covering 85-90% of the syllabus.

- Scaled-down marks of the sum of two tests and other assessment methods will be CIE marks for the theory component of IPCC (that is for **25 marks)**.
- The student has to secure 40% of 25 marks to qualify in the CIE of the theory component of IPCC.

**CIE for the practical component of the IPCC**

- **15 marks** for the conduction of the experiment and preparation of laboratory record, and **10 marks** for the test to be conducted after the completion of all the laboratory sessions.
- On completion of every experiment/program in the laboratory, the students shall be evaluated including viva-voce and marks shall be awarded on the same day.
- The CIE marks awarded in the case of the Practical component shall be based on the continuous evaluation of the laboratory report. Each experiment report can be evaluated for 10 marks. Marks of all experiments' write-ups are added and scaled down to **15 marks**.
- The laboratory test **(duration 02/03 hours)** after completion of all the experiments shall be conducted for 50 marks and scaled down to **10 marks.**
- Scaled-down marks of write-up evaluations and tests added will be CIE marks for the laboratory component of IPCC for **25 marks**.
- The student has to secure 40% of 25 marks to qualify in the CIE of the practical component of the IPCC.

**SEE for IPCC**

Theory SEE will be conducted by University as per the scheduled timetable, with common question papers for the course (**duration 03 hours**)

1. The question paper will have ten questions. Each question is set for 20 marks.
2. There will be 2 questions from each module. Each of the two questions under a module (with a maximum of 3 sub-questions), **should have a mix of topics** under that module.
3. The students have to answer 5 full questions, selecting one full question from each module.
4. Marks scored by the student shall be proportionally scaled down to 50 Marks

**The theory portion of the IPCC shall be for both CIE and SEE, whereas the practical portion will have a CIE component only. Questions mentioned in the SEE paper may include questions from the practical component**.

**Suggested Learning Resources:**

**Books**

1. M. Morris Mano & Michael D. Ciletti, Digital Design With an Introduction to Verilog Design, 5e, Pearson Education.

2. Carl Hamacher, ZvonkoVranesic, SafwatZaky, Computer Organization, 5th Edition, Tata McGraw Hill.

**Web links and Video Lectures (e-Resources):**

https://cse11-iiith.vlabs.ac.in/

**Activity Based Learning (Suggested Activities in Class)/ Practical Based learning**

Assign the group task to Design the various types of counters and display the output accordingly

Assessment Methods

- Lab Assessment (25 Marks)
- GATE Based Aptitude Test

| OPERATING SYSTEMS | | Semester | 3 |
|---|---|---|---|
| Course Code | BCS303 | CIE Marks | 50 |
| Teaching Hours/Week (L:T:P: S) | 3:0:2:0 | SEE Marks | 50 |
| Total Hours of Pedagogy | 40 hours Theory + 20 hours practicals | Total Marks | 100 |
| Credits | 04 | Exam Hours | 3 |
| Examination nature (SEE) | **Theory** | | |

**Course objectives:**

- To Demonstrate the need for OS and different types of OS
- To discuss suitable techniques for management of different resources
- To demonstrate different APIs/Commands related to processor, memory, storage and file system management.

**Teaching-Learning Process (General Instructions)**

Teachers can use the following strategies to accelerate the attainment of the various course outcomes.

1. Lecturer methods (L) need not to be only traditional lecture method, but alternative effective teaching methods could be adopted to attain the outcomes.
2. Use of Video/Animation to explain functioning of various concepts.
3. Encourage collaborative (Group Learning) Learning in the class.
4. Adopt Problem Based Learning (PBL), which fosters students' Analytical skills, develop design thinking skills such as the ability to design, evaluate, generalize, and analyze information rather than simply recall it.
5. Role play for process scheduling.
6. Demonstrate the installation of any one Linux OS on VMware/Virtual Box

**MODULE-1** **8 Hours**

**Introduction to operating systems, System structures:** What operating systems do; Computer System organization; Computer System architecture; Operating System structure; Operating System operations; Process management; Memory management; Storage management; Protection and Security; Distributed system; Special-purpose systems; Computing environments.

**Operating System Services:** User - Operating System interface; System calls; Types of system calls; System programs; Operating system design and implementation; Operating System structure; Virtual machines; Operating System debugging, Operating System generation; System boot.

**Textbook 1: Chapter – 1 (1.1-1.12), 2 (2.2-2.11)**

**MODULE-2** **8 Hours**

**Process Management:** Process concept; Process scheduling; Operations on processes; Inter process communication

**Multi-threaded Programming:** Overview; Multithreading models; Thread Libraries; Threading issues.

**Process Scheduling**: Basic concepts; Scheduling Criteria; Scheduling Algorithms; Thread scheduling; Multiple-processor scheduling,

**Textbook 1: Chapter – 3 (3.1-3.4), 4 (4.1-4.4), 5 (5.1 -5.5)**

**MODULE-3** **8 Hours**

**Process Synchronization:** Synchronization: The critical section problem; Peterson's solution; Synchronization hardware; Semaphores; Classical problems of synchronization;

**Deadlocks:** System model; Deadlock characterization; Methods for handling deadlocks; Deadlock prevention; Deadlock avoidance; Deadlock detection and recovery from deadlock.

**Textbook 1: Chapter – 6 (6.1-6.6), 7 (7.1 -7.7)**

**MODULE-4** **8 Hours**

**Memory Management:** Memory management strategies: Background; Swapping; Contiguous memory allocation; Paging; Structure of page table; Segmentation.

**Virtual Memory Management:** Background; Demand paging; Copy-on-write; Page replacement; Allocation of frames; Thrashing.

**Textbook 1: Chapter -8 (8.1-8.6), 9 (9.1-9.6)**

**MODULE-5** **8 Hours**

**File System, Implementation of File System:** File system: File concept; Access methods; Directory and Disk structure; File system mounting; File sharing; **Implementing File system:** File system structure; File system implementation; Directory implementation; Allocation methods; Free space management.

**Secondary Storage Structure, Protection:** Mass storage structures; Disk structure; Disk attachment; Disk scheduling; Disk management; **Protection**: Goals of protection, Principles of protection, Domain of protection, Access matrix.

**Textbook 1: Chapter – 10 (10.1-10.5) ,11 (11.1-11.5),12 (12.1-12.5), 14 (14.1-14.4)**

**PRACTICAL COMPONENT OF IPCC***(May cover all / major modules)*

| Sl.NO | Experiments |
|---|---|
| 1 | Develop a c program to implement the Process system calls (fork (), exec(), wait(), create process, terminate process) |
| 2 | Simulate the following CPU scheduling algorithms to find turnaround time and waiting time a) FCFS b) SJF c) Round Robin d) Priority. |
| 3 | Develop a C program to simulate producer-consumer problem using semaphores. |
| 4 | Develop a C program which demonstrates interprocess communication between a reader process and a writer process. Use mkfifo, open, read, write and close APIs in your program. |
| 5 | Develop a C program to simulate Bankers Algorithm for DeadLock Avoidance. |
| 6 | Develop a C program to simulate the following contiguous memory allocation Techniques:<br>a) Worst fit b) Best fit c) First fit. |
| 7 | Develop a C program to simulate page replacement algorithms:<br>a) FIFO b) LRU |
| 8 | Simulate following File Organization Techniques<br>a) Single level directory b) Two level directory |
| 9 | Develop a C program to simulate the Linked file allocation strategies. |
| 10 | Develop a C program to simulate SCAN disk scheduling algorithm. |

**Course outcomes (Course Skill Set):**

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

CO 1. Explain the structure and functionality of operating system
CO 2. Apply appropriate CPU scheduling algorithms for the given problem.
CO 3. Analyse the various techniques for process synchronization and deadlock handling.
CO 4. Apply the various techniques for memory management
CO 5. Explain file and secondary storage management strategies.
CO 6. Describe the need for information protection mechanisms

**Assessment Details (both CIE and SEE)**

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks out of 50) and for the SEE minimum passing mark is 35% of the maximum marks (18 out of 50 marks). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures a minimum of 40% (40 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together.

**CIE for the theory component of the IPCC (maximum marks 50)**

- IPCC means practical portion integrated with the theory of the course.
- CIE marks for the theory component are **25 marks** and that for the practical component is **25 marks**.
- 25 marks for the theory component are split into **15 marks** for two Internal Assessment Tests (Two Tests, each of 15 Marks with 01-hour duration, are to be conducted) and **10 marks** for other assessment methods

mentioned in 22OB4.2. The first test at the end of 40-50% coverage of the syllabus and the second test after covering 85-90% of the syllabus.

- Scaled-down marks of the sum of two tests and other assessment methods will be CIE marks for the theory component of IPCC (that is for **25 marks)**.
- The student has to secure 40% of 25 marks to qualify in the CIE of the theory component of IPCC.

**CIE for the practical component of the IPCC**

- **15 marks** for the conduction of the experiment and preparation of laboratory record, and **10 marks** for the test to be conducted after the completion of all the laboratory sessions.
- On completion of every experiment/program in the laboratory, the students shall be evaluated including viva-voce and marks shall be awarded on the same day.
- The CIE marks awarded in the case of the Practical component shall be based on the continuous evaluation of the laboratory report. Each experiment report can be evaluated for 10 marks. Marks of all experiments' write-ups are added and scaled down to **15 marks**.
- The laboratory test **(duration 02/03 hours)** after completion of all the experiments shall be conducted for 50 marks and scaled down to **10 marks.**
- Scaled-down marks of write-up evaluations and tests added will be CIE marks for the laboratory component of IPCC for **25 marks**.
- The student has to secure 40% of 25 marks to qualify in the CIE of the practical component of the IPCC.

**SEE for IPCC**

Theory SEE will be conducted by University as per the scheduled timetable, with common question papers for the course (**duration 03 hours**)

1. The question paper will have ten questions. Each question is set for 20 marks.
2. There will be 2 questions from each module. Each of the two questions under a module (with a maximum of 3 sub-questions), **should have a mix of topics** under that module.
3. The students have to answer 5 full questions, selecting one full question from each module.
4. Marks scoredby the student shall be proportionally scaled down to 50 Marks

**The theory portion of the IPCC shall be for both CIE and SEE, whereas the practical portion will have a CIE component only. Questions mentioned in the SEE paper may include questions from the practical component**.

**Suggested Learning Resources:**

**Textbooks**

1. Abraham Silberschatz, Peter Baer Galvin, Greg Gagne, Operating System Principles 8th edition, Wiley-India, 2015

**Reference Books**

1. Ann McHoes Ida M Fylnn, Understanding Operating System, Cengage Learning, 6th Edition
2. D.M Dhamdhere, Operating Systems: A Concept Based Approach 3rd Ed, McGraw- Hill, 2013.
3. P.C.P. Bhatt, An Introduction to Operating Systems: Concepts and Practice 4th Edition, PHI(EEE), 2014.
4. William Stallings Operating Systems: Internals and Design Principles, 6th Edition, Pearson.

**Web links and Video Lectures (e-Resources):**

1. https://youtu.be/mXw9ruZaxzQ

2. https://youtu.be/vBURTt97EkA
3. https://www.youtube.com/watch?v=783KAB-tuE4&list=PLIemF3uozcAKTgsCIj82voMK3TMR0YE_f
4. https://www.youtube.com/watch?v=3-ITLMMeeXY&list=PL3pGy4HtqwD0n7bQfHjPnsWzkeRn6mkO

**Activity Based Learning (Suggested Activities in Class)/ Practical Based learning**

- Assessment Methods
  - Case Study on Unix Based Systems (10 Marks)
  - Lab Assessment (25 Marks)

| | | | | |
|---|---|---|---|---|
| | **DATA STRUCTURES AND APPLICATIONS** | | Semester | 3 |
| | Course Code | BCS304 | CIE Marks | 50 |
| | Teaching Hours/Week (L: T:P: S) | 3:0:0:0 | SEE Marks | 50 |
| | Total Hours of Pedagogy | 40 | Total Marks | 100 |
| | Credits | 03 | Exam Hours | 3 |
| | Examination type (SEE) | **Theory** | | |

**Course objectives:**

CLO 1. To explain fundamentals of data structures and their applications.
CLO 2. To illustrate representation of Different data structures such as Stack, Queues, Linked Lists, Trees and Graphs.
CLO 3. To Design and Develop Solutions to problems using Linear Data Structures
CLO 4. To discuss applications of Nonlinear Data Structures in problem solving.
CLO 5. To introduce advanced Data structure concepts such as Hashing and Optimal Binary Search Trees

**Teaching-Learning Process (General Instructions)**

Teachers can use following strategies to accelerate the attainment of the various course outcomes.

1. Chalk and Talk with Black Board
2. ICT based Teaching
3. Demonstration based Teaching

**Module-1** **8Hours**

**INTRODUCTION TO DATA STRUCTURES:** Data Structures, Classifications (Primitive & Non-Primitive), Data structure Operations
**Review of** pointers and dynamic Memory Allocation,
**ARRAYS and STRUCTURES:** Arrays, Dynamic Allocated Arrays, Structures and Unions, Polynomials, Sparse Matrices, representation of Multidimensional Arrays, Strings
**STACKS:** Stacks, Stacks Using Dynamic Arrays, Evaluation and conversion of Expressions
Text Book: Chapter-1:1.2 Chapter-2: 2.1 to 2.7 Chapter-3: 3.1,3.2,3.6
Reference Book 1: 1.1 to 1.4

**Module-2** **8Hours**

**QUEUES:** Queues, Circular Queues, Using Dynamic Arrays, Multiple Stacks and queues.
**LINKED LISTS :** Singly Linked, Lists and Chains, Representing Chains in C, Linked Stacks and Queues, Polynomials
Text Book: Chapter-3: 3.3, 3.4, 3.7 Chapter-4: 4.1 to 4.4

**Module-3** **8Hours**

**LINKED LISTS :** Additional List Operations, Sparse Matrices, Doubly Linked List.
**TREES:** Introduction, Binary Trees, Binary Tree Traversals, Threaded Binary Trees.
Text Book: Chapter-4: 4.5,4.7,4.8 Chapter-5: 5.1 to 5.3, 5.5

**Module-4** **8Hours**

**TREES(Cont..):** Binary Search trees, Selection Trees, Forests, Representation of Disjoint sets, Counting Binary Trees,
**GRAPHS:** The Graph Abstract Data Types, Elementary Graph Operations
Text Book: Chapter-5: 5.7 to 5.11 Chapter-6: 6.1, 6.2

**Module-5** **8Hours**

| | |
|---|---|
| | **HASHING:** Introduction, Static Hashing, Dynamic Hashing<br>**PRIORITY QUEUES:** Single and double ended Priority Queues, Leftist Trees<br>**INTRODUCTION TO EFFICIENT BINARY SEARCH TREES:** Optimal Binary Search Trees<br>Text Book: Chapter 8: 8.1 to 8.3 Chapter 9: 9.1, 9.2 Chapter 10: 10.1 |

**Course outcome (Course Skill Set)**

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

CO 1. Explain different data structures and their applications.

CO 2. Apply Arrays, Stacks and Queue data structures to solve the given problems.

CO 3. Use the concept of linked list in problem solving.

CO 4. Develop solutions using trees and graphs to model the real-world problem.

CO 5. Explain the advanced Data Structures concepts such as Hashing Techniques and Optimal Binary Search Trees.

## Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks out of 50) and for the SEE minimum passing mark is 35% of the maximum marks (18 out of 50 marks). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures a minimum of 40% (40 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together.

**Continuous Internal Evaluation:**

- For the Assignment component of the CIE, there are 25 marks and for the Internal Assessment Test component, there are 25 marks.
- The first test will be administered after 40-50% of the syllabus has been covered, and the second test will be administered after 85-90% of the syllabus has been covered
- Any two assignment methods mentioned in the 22OB2.4, if an assignment is project-based then only one assignment for the course shall be planned. The teacher should not conduct two assignments at the end of the semester if two assignments are planned.
- For the course, CIE marks will be based on a scaled-down sum of two tests and other methods of assessment.

**Internal Assessment Test question paper is designed to attain the different levels of Bloom's taxonomy as per the outcome defined for the course.**

**Semester-End Examination:**

Theory SEE will be conducted by University as per the scheduled timetable, with common question papers for the course (**duration 03 hours).**

1. The question paper will have ten questions. Each question is set for 20 marks.
2. There will be 2 questions from each module. Each of the two questions under a module (with a maximum of 3 sub-questions), **should have a mix of topics** under that module.
3. The students have to answer 5 full questions, selecting one full question from each module.
4. Marks scored shall be proportionally reduced to 50 marks

**Suggested Learning Resources:**

### Textbook:

1. Ellis Horowitz, Sartaj Sahni and Susan Anderson-Freed, Fundamentals of Data Structures in C, 2nd Ed, Universities Press, 2014

**Reference Books:**


1. Seymour Lipschutz, Data Structures Schaum's Outlines, Revised 1st Ed, McGraw Hill, 2014.
2. Gilberg & Forouzan, Data Structures: A Pseudo-code approach with C, 2nd Ed, Cengage Learning,2014.
3. Reema Thareja, Data Structures using C, 3rd Ed, Oxford press, 2012.
4. Jean-Paul Tremblay & Paul G. Sorenson, An Introduction to Data Structures with Applications, 2nd Ed, McGraw Hill, 2013
5. A M Tenenbaum, Data Structures using C, PHI, 1989
6. Robert Kruse, Data Structures and Program Design in C, 2nd Ed, PHI, 1996.


**Web links and Video Lectures (e-Resources):**

- http://elearning.vtu.ac.in/econtent/courses/video/CSE/06CS35.html
- https://nptel.ac.in/courses/106/105/106105171/
- http://www.nptelvideos.in/2012/11/data-structures-and-algorithms.html
- https://www.youtube.com/watch?v=3Xo6P_V-qns&t=201s
- https://ds2-iiith.vlabs.ac.in/exp/selection-sort/index.html
- https://nptel.ac.in/courses/106/102/106102064/
- https://ds1-iiith.vlabs.ac.in/exp/stacks-queues/index.html
- https://ds1-iiith.vlabs.ac.in/exp/linked-list/basics/overview.html
- https://ds1-iiith.vlabs.ac.in/List%20of%20experiments.html
- https://ds1-iiith.vlabs.ac.in/exp/tree-traversal/index.html
- https://ds1-iiith.vlabs.ac.in/exp/tree-traversal/depth-first-traversal/dft-practice.html
- https://infyspringboard.onwingspan.com/web/en/app/toc/lex_auth_013501595428077568125 59/overview

**Activity Based Learning (Suggested Activities in Class)/ Practical Based learning**

- Role Play
- Flipped classroom
- Assessment Methods for 25 Marks (opt two Learning Activities)
    - Case Study
    - Programming Assignment
    - Gate Based Aptitude Test
    - MOOC Assignment for selected Module

**DATA STRUCTURES LABORATORY**
**SEMESTER – III**

| | | | |
|---|---|---|---|
| **Course Code** | **BCSL305** | **CIE Marks** | 50 |
| **Number of Contact Hours/Week** | 0:0:2 | **SEE Marks** | 50 |
| **Total Number of Lab Contact Hours** | 28 | **Exam Hours** | 03 |

**Credits – 1**

**Course Learning Objectives:**

This laboratory course enables students to get practical experience in design, develop, implement, analyze and evaluation/testing of

- Dynamic memory management
- Linear data structures and their applications such as stacks, queues and lists
- Non-Linear data structures and their applications such as trees and graphs

**Descriptions (if any):**

- Implement all the programs in "C " Programming Language and Linux OS.

**Programs List:**

| | |
|---|---|
| 1. | Develop a Program in C for the following:<br>a) Declare a calendar as an array of 7 elements (A dynamically Created array) to represent 7 days of a week. Each Element of the array is a structure having three fields. The first field is the name of the Day (A dynamically allocated String), The second field is the date of the Day (A integer), the third field is the description of the activity for a particular day (A dynamically allocated String).<br>b) Write functions create(), read() and display(); to create the calendar, to read the data from the keyboard and to print weeks activity details report on screen. |
| 2. | Develop a Program in C for the following operations on Strings.<br>a. Read a main String (STR), a Pattern String (PAT) and a Replace String (REP)<br>b. Perform Pattern Matching Operation: Find and Replace all occurrences of PAT in STR with REP if PAT exists in STR. Report suitable messages in case PAT does not exist in STR<br>Support the program with functions for each of the above operations. Don't use Built-in functions. |
| 3. | Develop a menu driven Program in C for the following operations on STACK of Integers (Array Implementation of Stack with maximum size MAX)<br>a. Push an Element on to Stack<br>b. Pop an Element from Stack<br>c. Demonstrate how Stack can be used to check Palindrome<br>d. Demonstrate Overflow and Underflow situations on Stack<br>e. Display the status of Stack<br>f. Exit<br>Support the program with appropriate functions for each of the above operations |

| | |
|---|---|
| 4. | Develop a Program in C for converting an Infix Expression to Postfix Expression. Program should support for both parenthesized and free parenthesized expressions with the operators: +, -, *, /, % (Remainder), ^ (Power) and alphanumeric operands. |
| 5. | Develop a Program in C for the following Stack Applications<br>a. Evaluation of Suffix expression with single digit operands and operators: +, -, *, /, %, ^<br>b. Solving Tower of Hanoi problem with n disks |

| | |
|---|---|
| 6. | Develop a menu driven Program in C for the following operations on Circular QUEUE of Characters (Array Implementation of Queue with maximum size MAX)<br>a. Insert an Element on to Circular QUEUE<br>b. Delete an Element from Circular QUEUE<br>c. Demonstrate Overflow and Underflow situations on Circular QUEUE<br>d. Display the status of Circular QUEUE<br>e. Exit<br>Support the program with appropriate functions for each of the above operations |
| 7. | Develop a menu driven Program in C for the following operations on Singly Linked List (SLL) of Student Data with the fields: *USN, Name, Programme, Sem, PhNo*<br>a. Create a SLL of N Students Data by using *front insertion*.<br>b. Display the status of SLL and count the number of nodes in it<br>c. Perform Insertion / Deletion at End of SLL<br>d. Perform Insertion / Deletion at Front of SLL(Demonstration of stack)<br>e. Exit |
| 8. | Develop a menu driven Program in C for the following operations on Doubly Linked List (DLL) of Employee Data with the fields: *SSN, Name, Dept, Designation, Sal, PhNo*<br>a. Create a DLL of N Employees Data by using *end insertion*.<br>b. Display the status of DLL and count the number of nodes in it<br>c. Perform Insertion and Deletion at End of DLL<br>d. Perform Insertion and Deletion at Front of DLL<br>e. Demonstrate how this DLL can be used as Double Ended Queue.<br>f. Exit |
| 9. | Develop a Program in C for the following operationson Singly Circular Linked List (SCLL) with header nodes<br>a. Represent and Evaluate a Polynomial $P(x,y,z) = 6x^2y^2z-4yz^5+3x^3yz+2xy^5z-2xyz^3$<br>b. Find the sum of two polynomials POLY1(x,y,z) and POLY2(x,y,z) and store the result in POLYSUM(x,y,z)<br>Support the program with appropriate functions for each of the above operations |
| 10. | Develop a menu driven Program in C for the following operations on Binary Search Tree (BST) of Integers .<br>a. Create a BST of N Integers: 6, 9, 5, 2, 8, 15, 24, 14, 7, 8, 5, 2<br>b. Traverse the BST in Inorder, Preorder and Post Order<br>c. Search the BST for a given element (KEY) and report the appropriate message<br>d. Exit |
| 11. | Develop a Program in C for the following operations on Graph(G) of Cities<br>a. Create a Graph of N cities using Adjacency Matrix.<br>b. Print all the nodes reachable from a given starting node in a digraph using DFS/BFS method |

| | |
|---|---|
| 12. | Given a File of N employee records with a set K of Keys (4-digit) which uniquely determine the records in file F. Assume that file F is maintained in memory by a Hash Table (HT) of m memory locations with L as the set of memory addresses (2-digit) of locations in HT. Let the keys in K and addresses in L are Integers. Develop a Program in C that uses Hash function H: K →L as H(K)=K mod m (remainder method), and implement hashing technique to map a given key K to the address space L. Resolve the collision (if any) using linear probing. |

**Laboratory Outcomes**: The student should be able to:

- Analyze various linear and non-linear data structures
- Demonstrate the working nature of different types of data structures and their applications
- Use appropriate searching and sorting algorithms for the give scenario.
- Apply the appropriate data structure for solving real world problems

**Conduct of Practical Examination:**

- Experiment distribution
  - For laboratories having only one part: Students are allowed to pick one experiment from the lot with equal opportunity.
  - For laboratories having PART A and PART B: Students are allowed to pick one experiment from PART A and one experiment from PART B, with equal opportunity.
- Change of experiment is allowed only once and marks allotted for procedure to be made zero of the changed part only.
- Marks Distribution *(Need to change in accordance with university regulations)*
  c) For laboratories having only one part – Procedure + Execution + Viva-Voce: 15+70+15 = 100 Marks
  d) For laboratories having PART A and PART B
    i. Part A – Procedure + Execution + Viva = 6 + 28 + 6 = 40 Marks
    ii. Part B – Procedure + Execution + Viva = 9 + 42 + 9 = 60 Marks

| | | | | |
|---|---|---|---|---|
| | **Object Oriented Programming with JAVA** | | Semester | 3 |
| | Course Code | BCS306A | CIE Marks | 50 |
| | Teaching Hours/Week (L: T:P: S) | 2:0:2 | SEE Marks | 50 |
| | Total Hours of Pedagogy | 28 Hours of Theory + 20 Hours of Practical | Total Marks | 100 |
| | Credits | 03 | Exam Hours | 03 |
| | Examination type (SEE) | Theory | | |

**Note - Students who have undergone " Basics of Java Programming- BPLCK105C/205C" in first year are not eligible to opt this course**

**Course objectives:**

- To learn primitive constructs JAVA programming language.
- To understand Object Oriented Programming Features of JAVA.
- To gain knowledge on: packages, multithreaded programing and exceptions.

**Teaching-Learning Process (General Instructions)**
These are sample Strategies, which teachers can use to accelerate the attainment of the various course outcomes and make Teaching –Learning more effective

1. Use Online Java Compiler IDE: https://www.jdoodle.com/online-java-compiler/ or any other.
2. Demonstration of programing examples.
3. Chalk and board, power point presentations
4. Online material (Tutorials) and video lectures.

**Module-1**

**An Overview of Java:** Object-Oriented Programming (Two Paradigms, Abstraction, The Three OOP Principles), Using Blocks of Code, Lexical Issues (Whitespace, Identifiers, Literals, Comments, Separators, The Java Keywords).
**Data Types, Variables, and Arrays:** The Primitive Types (Integers, Floating-Point Types, Characters, Booleans), Variables, Type Conversion and Casting, Automatic Type Promotion in Expressions, Arrays, Introducing Type Inference with Local Variables.
**Operators:** Arithmetic Operators, Relational Operators, Boolean Logical Operators, The Assignment Operator, The ? Operator, Operator Precedence, Using Parentheses.
**Control Statements:** Java's Selection Statements (if, The Traditional switch), Iteration Statements (while, do-while, for, The For-Each Version of the for Loop, Local Variable Type Inference in a for Loop, Nested Loops), Jump Statements (Using break, Using continue, return).
**Chapter 2, 3, 4, 5**

**Module-2**

**Introducing Classes:** Class Fundamentals**,** Declaring Objects**,** Assigning Object Reference Variables**,** Introducing Methods**,** Constructors**,** The this Keyword**,** Garbage Collection.
**Methods and Classes:** Overloading Methods, Objects as Parameters, Argument Passing, Returning Objects, Recursion, Access Control, Understanding static, Introducing final, Introducing Nested and Inner Classes.
**Chapter 6, 7**

**Module-3**

**Inheritance:** Inheritance Basics, Using super, Creating a Multilevel Hierarchy, When Constructors Are Executed, Method Overriding, Dynamic Method Dispatch, Using Abstract Classes, Using final with Inheritance, Local Variable Type Inference and Inheritance, The Object Class.
**Interfaces:** Interfaces, Default Interface Methods, Use static Methods in an Interface, Private Interface Methods.
**Chapter 8, 9**

| | |
|---|---|
| | **Module-4** |
| | **Packages:** Packages, Packages and Member Access, Importing Packages.<br>**Exceptions:** Exception-Handling Fundamentals**,** Exception Types**,** Uncaught Exceptions**,** Using try and catch, Multiple catch Clauses, Nested try Statements, throw, throws, finally, Java's Built-in Exceptions, Creating Your Own Exception Subclasses, Chained Exceptions.<br>**Chapter 9, 10** |
| | **Module-5** |
| | **Multithreaded Programming:** The Java Thread Model, The Main Thread, Creating a Thread, Creating Multiple Threads, Using isAlive() and join(), Thread Priorities, Synchronization, Interthread Communication, Suspending, Resuming, and Stopping Threads, Obtaining a Thread's State.<br>**Enumerations, Type Wrappers and Autoboxing:** Enumerations (Enumeration Fundamentals**,** The values() and valueOf() Methods), Type Wrappers (Character, Boolean, The Numeric Type Wrappers), Autoboxing (Autoboxing and Methods, Autoboxing/Unboxing Occurs in Expressions, Autoboxing/Unboxing Boolean and Character Values).<br>**Chapter 11, 12** |

**Course outcome (Course Skill Set)**

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

1. Demonstrate proficiency in writing simple programs involving branching and looping structures.
2. Design a class involving data members and methods for the given scenario.
3. Apply the concepts of inheritance and interfaces in solving real world problems.
4. Use the concept of packages and exception handling in solving complex problem
5. Apply concepts of multithreading, autoboxing and enumerations in program development

**Programming Experiments (Suggested and are not limited to)**

1. Develop a JAVA program to add TWO matrices of suitable order N (The value of N should be read from command line arguments).
2. Develop a stack class to hold a maximum of 10 integers with suitable methods. Develop a JAVA main method to illustrate Stack operations.
3. A class called Employee, which models an employee with an ID, name and salary, is designed as shown in the following class diagram. The method raiseSalary (percent) increases the salary by the given percentage. Develop the Employee class and suitable main method for demonstration.
4. A class called MyPoint, which models a 2D point with x and y coordinates, is designed as follows:
   - Two instance variables x (int) and y (int).
   - A default (or "no-arg") constructor that construct a point at the default location of (0, 0).
   - A overloaded constructor that constructs a point with the given x and y coordinates.
   - A method setXY() to set both x and y.
   - A method getXY() which returns the x and y in a 2-element int array.
   - A toString() method that returns a string description of the instance in the format "(x, y)".
   - A method called distance(int x, int y) that returns the distance from this point to another point at the given (x, y) coordinates
   - An overloaded distance(MyPoint another) that returns the distance from this point to the given MyPoint instance (called another)
   - Another overloaded distance() method that returns the distance from this point to the origin (0,0)

   Develop the code for the class MyPoint. Also develop a JAVA program (called TestMyPoint) to test all the methods defined in the class.
5. Develop a JAVA program to create a class named shape. Create three sub classes namely: circle, triangle and square, each class has two member functions named draw () and erase (). Demonstrate

polymorphism concepts by developing suitable methods, defining member data and main program.

6. Develop a JAVA program to create an abstract class Shape with abstract methods calculateArea() and calculatePerimeter(). Create subclasses Circle and Triangle that extend the Shape class and implement the respective methods to calculate the area and perimeter of each shape.
7. Develop a JAVA program to create an interface Resizable with methods resizeWidth(int width) and resizeHeight(int height) that allow an object to be resized. Create a class Rectangle that implements the Resizable interface and implements the resize methods
8. Develop a JAVA program to create an outer class with a function display. Create another class inside the outer class named inner with a function called display and call the two functions in the main class.
9. Develop a JAVA program to raise a custom exception (user defined exception) for DivisionByZero using try, catch, throw and finally.
10. Develop a JAVA program to create a package named mypack and import & implement it in a suitable class.
11. Write a program to illustrate creation of threads using runnable class. (start method start each of the newly created thread. Inside the run method there is sleep() for suspend the thread for 500 milliseconds).
12. Develop a program to create a class MyThread in this class a constructor, call the base class constructor, using super and start the thread. The run method of the class starts after this. It can be observed that both main thread and created child thread are executed concurrently.

**Assessment Details (both CIE and SEE)**

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks out of 50) and for the SEE minimum passing mark is 35% of the maximum marks (18 out of 50 marks). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures a minimum of 40% (40 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together.

**CIE for the theory component of the IPCC (maximum marks 50)**

- IPCC means practical portion integrated with the theory of the course.
- CIE marks for the theory component are **25 marks** and that for the practical component is **25 marks**.
- 25 marks for the theory component are split into **15 marks** for two Internal Assessment Tests (Two Tests, each of 15 Marks with 01-hour duration, are to be conducted) and **10 marks** for other assessment methods mentioned in 22OB4.2. The first test at the end of 40-50% coverage of the syllabus and the second test after covering 85-90% of the syllabus.
- Scaled-down marks of the sum of two tests and other assessment methods will be CIE marks for the theory component of IPCC (that is for **25 marks)**.
- The student has to secure 40% of 25 marks to qualify in the CIE of the theory component of IPCC.

**CIE for the practical component of the IPCC**

- **15 marks** for the conduction of the experiment and preparation of laboratory record, and **10 marks** for the test to be conducted after the completion of all the laboratory sessions.
- On completion of every experiment/program in the laboratory, the students shall be evaluated including viva-voce and marks shall be awarded on the same day.
- The CIE marks awarded in the case of the Practical component shall be based on the continuous evaluation of the laboratory report. Each experiment report can be evaluated for 10 marks. Marks of all experiments' write-ups are added and scaled down to **15 marks**.
- The laboratory test **(duration 02/03 hours)** after completion of all the experiments shall be conducted for 50 marks and scaled down to **10 marks.**
- Scaled-down marks of write-up evaluations and tests added will be CIE marks for the laboratory component of IPCC for **25 marks**.
- The student has to secure 40% of 25 marks to qualify in the CIE of the practical component of the IPCC.

**SEE for IPCC**

Theory SEE will be conducted by University as per the scheduled timetable, with common question papers for the course (**duration 03 hours**)

1. The question paper will have ten questions. Each question is set for 20 marks.
2. There will be 2 questions from each module. Each of the two questions under a module (with a maximum of 3 sub-questions), **should have a mix of topics** under that module.
3. The students have to answer 5 full questions, selecting one full question from each module.
4. Marks scored by the student shall be proportionally scaled down to 50 Marks

**The theory portion of the IPCC shall be for both CIE and SEE, whereas the practical portion will have a CIE component only. Questions mentioned in the SEE paper may include questions from the practical component**.

**Suggested Learning Resources:**

**Textbook**

1. Java: The Complete Reference, Twelfth Edition, by Herbert Schildt, November 2021, McGraw-Hill, ISBN: 9781260463422

**Reference Books**

1. Programming with Java, 6th Edition, by E Balagurusamy, Mar-2019, McGraw Hill Education, ISBN: 9789353162337.
2. Thinking in Java, Fourth Edition, by Bruce Eckel, Prentice Hall, 2006 (https://sd.blackball.lv/library/thinking_in_java_4th_edition.pdf)

**Web links and Video Lectures (e-Resources):**

- Java Tutorial: https://www.geeksforgeeks.org/java/
- Introduction To Programming In Java (by Evan Jones, Adam Marcus and Eugene Wu): https://ocw.mit.edu/courses/6-092-introduction-to-programming-in-java-january-iap-2010/
- Java Tutorial: https://www.w3schools.com/java/
- Java Tutorial: https://www.javatpoint.com/java-tutorial

**Activity Based Learning (Suggested Activities)/ Practical Based learning**

1. Installation of Java (Refer: https://www.java.com/en/download/help/index_installing.html)
2. Demonstration of online IDEs like geeksforgeeks, jdoodle or any other Tools
3. Demonstration of class diagrams for the class abstraction, type visibility, composition and inheritance

Assessment Method

- Programming Assignment / Course Project

| | | | | |
|---|---|---|---|---|
| | **Python Programming for Data Science** | | Semester | 3 |
| | Course Code | **BDS306B** | CIE Marks | 50 |
| | Teaching Hours/Week (L: T:P: S) | 2:0:2:0 | SEE Marks | 50 |
| | Total Hours of Pedagogy | 28 Hours Theory + 20 Hours Practical | Total Marks | 100 |
| | Credits | 03 | Exam Hours | 03 |
| | Examination type (SEE) | Theory | | |

**Note - Students who have undergone " Introduction to Python Programming- BPLCK105B/205B" in first year are not eligible to opt this course**

**Course Learning objectives:**

CLO 1:To understand Python constructs and use them to build the programs.
CLO 2: To analyse different conditional statements and their applications in programs.
CLO 3: To learn and use basic data structures in python language.
CLO 4: To learn and demonstrate array manipulations by reading data from files
CLO 5: To understand and use different data in a data analytics context.

**Teaching-Learning Process (General Instructions)**

These are sample Strategies, which teachers can use to accelerate the attainment of the various course outcomes.

1. Chalk and board, power point presentations
2. Online material (Tutorials) and video lectures.
3. Demonstration of programing examples.

**Module-1** **6 hr**

Introduction to python: Elements of python language, python block structure, variables and assignment statement, data types in python, operations, simple input/output print statements, formatting print statement.

**Text Book 1: Chapter 3 ( 3.2, 3.3, 3.4, 3.6, 3.7, 3.9 and 3.10)**

**Module-2** **5 hr**

Decision structure: forming conditions, if statement, the if-else and nested if-else, looping statements: introduction to looping, python built in functions for looping, loop statements, jump statement.

**Text Book 1: Chapter 4 (4.2 to 4.6) , Chapter 5 (5.1 to 5.4)**

**Module-3** **5 hr**

Lists: lists, operation on list, Tuples: introduction, creating,indexing and slicing, operations on tuples. sets: creating, operation in sets, introduction dictionaries, creating, operations, nested dictionary, looping over dictionary.

**Text Book 1: Chapter 7 ( 7.2 to 7.3) , Chapter 8 (8.1 to 8.4) and Chapter 9( 9.1 to 9.3, 9.7 to 9.12)**

**Module-4** **6 hr**

**The NumPy Library:** Ndarray: the heart of the library, Basic operations, indexing, slicing and iterating, conditions and boolean arrays, array manipulation, general concepts, reading and writing array data on files. **The pandas Library:** an introduction to Data structure, other functionalities on indexes, operations between data structures, function application and mapping.

| | |
|---|---|
| | **Text Book 2: Chapter 3 and Chapter 4.** |
| | **Module-5** **6 hr** |
| | **The pandas : Reading and Writing data:** i/o API tools, CSV and textual files, Reading data in CSV or text files, reading and writing HTML files, reading data from XML files, Microsoft excel files, JSON data, Pickle python object serialization. **Pandas in Depth : data manipulation:** data preparation, concatenating data transformation discretization binning, permutation, string manipulation, data aggregation group iteration.<br>**Text Book 2: Chapter 5 and Chapter 6** |

**Course outcome (Course Skill Set)**

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

CO1: Describe the constructs of python programming

CO2: Use looping and conditional constructs to build programs.

CO3: Apply the concept of data structure to solve the real world problem.

CO4: Use the NumPy constructs for matrix manipulations

CO5: Apply the Panda constructs for data analytics.

## Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks out of 50) and for the SEE minimum passing mark is 35% of the maximum marks (18 out of 50 marks). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures a minimum of 40% (40 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together.

**Continuous Internal Evaluation:**

- For the Assignment component of the CIE, there are 25 marks and for the Internal Assessment Test component, there are 25 marks.
- The first test will be administered after 40-50% of the syllabus has been covered, and the second test will be administered after 85-90% of the syllabus has been covered
- Any two assignment methods mentioned in the 22OB2.4, if an assignment is project-based then only one assignment for the course shall be planned. The teacher should not conduct two assignments at the end of the semester if two assignments are planned.
- For the course, CIE marks will be based on a scaled-down sum of two tests and other methods of assessment.

**Internal Assessment Test question paper is designed to attain the different levels of Bloom's taxonomy as per the outcome defined for the course.**

**Semester-End Examination:**

Theory SEE will be conducted by University as per the scheduled timetable, with common question papers for the course (**duration 03 hours).**

1. The question paper will have ten questions. Each question is set for 20 marks.
2. There will be 2 questions from each module. Each of the two questions under a module (with a maximum of 3 sub-questions), **should have a mix of topics** under that module.
3. The students have to answer 5 full questions, selecting one full question from each module.
4. Marks scored shall be proportionally reduced to 50 marks

**Suggested Learning Resources:**

**Text Books:**

1. S. Sridhar, J. Indumathi, V.M. Hariharan "Python Programming" Pearson publishers, 1st edition 2023.
2. Fabio Nelli, "**Python Data Analytics**", Apress, Publishing, 1st Edition, 2015.

Reference Book:

1. Paul Deitel and Harvey deitel,"**Intro to Python for Computer Science and Data science**", 1st edition Pearson Publisher 2020.

**Web links and Video Lectures (e-Resources):**

- Nptel: Introduction to Python for Data Sciencehttps://www.youtube.com/watch?v=tA42nHmmEKw&list=PLh2mXjKcTPSACrQxPM2_1Ojus5HX88ht7

**Activity Based Learning (Suggested Activities in Class)/ Practical Based learning**

- Assessment Methods
  - Programming Assignment (10 Marks)

## Practical Component

| Sl.NO | Experiments |
|---|---|
| 1 | Develop a python program to read **n** digit integer number, and separate the integer number and display each digit. [Hint: input:5678 output: 5 6 7 8, use: floor and mod operators) |
| 2 | Develop a python program to accept 4 numbers and display them in sorted order using a minimum number of **if else** statements. |
| 3 | Develop python scripts to Calculate the mean, median, mode, variance and standard deviation of **n** integer numbers. |
| 4 | Develop a program for checking if a given **n** digit number is palindrome or not.<br>[hint: input 1221 output: palindrome, use //and % operator with loop statement] |
| 5 | Develop a python script to display a multiplication table for given integer **n**. |
| 6 | Develop a python script to rotate right about a given position in that list and display them.<br>[hint: input [1,4,5,-10] position: 2, output: [-10,5,4,1]] |
| 7 | DevelopWrite a python script to interchange the digits of a given integer number.<br>[hint: input: 23456, interchange: 3 and 5 output: 25436] |

| | |
|---|---|
| 8 | Develop a python program to capitalize a given list of strings.<br>[hint: [hello, good, how, simple] output: [Hello, Good, How, Simple] |
| 9 | Using a dictionary, Develop a python program to determine and print the number of duplicate words in a sentence. |
| 10 | Develop python program to read Numpy array and print row (sum,mean std) and column (sum,mean,std) |
| 11 | Develop a python program to read and print in the console CSV file. |
| 12 | Develop a python program to read a HTML file with basic tags, and construct a dictionary and display the same in the console. |

**Assessment Details (both CIE and SEE)**

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks out of 50) and for the SEE minimum passing mark is 35% of the maximum marks (18 out of 50 marks). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures a minimum of 40% (40 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together.

**CIE for the theory component of the IPCC (maximum marks 50)**

- IPCC means practical portion integrated with the theory of the course.
- CIE marks for the theory component are **25 marks** and that for the practical component is **25 marks**.
- 25 marks for the theory component are split into **15 marks** for two Internal Assessment Tests (Two Tests, each of 15 Marks with 01-hour duration, are to be conducted) and **10 marks** for other assessment methods mentioned in 22OB4.2. The first test at the end of 40-50% coverage of the syllabus and the second test after covering 85-90% of the syllabus.
- Scaled-down marks of the sum of two tests and other assessment methods will be CIE marks for the theory component of IPCC (that is for **25 marks)**.
- The student has to secure 40% of 25 marks to qualify in the CIE of the theory component of IPCC.

**CIE for the practical component of the IPCC**

- **15 marks** for the conduction of the experiment and preparation of laboratory record, and **10 marks** for the test to be conducted after the completion of all the laboratory sessions.
- On completion of every experiment/program in the laboratory, the students shall be evaluated including viva-voce and marks shall be awarded on the same day.
- The CIE marks awarded in the case of the Practical component shall be based on the continuous evaluation of the laboratory report. Each experiment report can be evaluated for 10 marks. Marks of all experiments' write-ups are added and scaled down to **15 marks**.
- The laboratory test **(duration 02/03 hours)** after completion of all the experiments shall be conducted for 50 marks and scaled down to **10 marks.**
- Scaled-down marks of write-up evaluations and tests added will be CIE marks for the laboratory component of IPCC for **25 marks**.
- The student has to secure 40% of 25 marks to qualify in the CIE of the practical component of the IPCC.

**SEE for IPCC**

Theory SEE will be conducted by University as per the scheduled timetable, with common question papers for the course (**duration 03 hours**)

1. The question paper will have ten questions. Each question is set for 20 marks.
2. There will be 2 questions from each module. Each of the two questions under a module (with a maximum of 3 sub-questions), **should have a mix of topics** under that module.
3. The students have to answer 5 full questions, selecting one full question from each module.
4. Marks scored by the student shall be proportionally scaled down to 50 Marks

**The theory portion of the IPCC shall be for both CIE and SEE, whereas the practical portion will have a CIE component only. Questions mentioned in the SEE paper may include questions from the practical component**.

| | | | | |
|---|---|---|---|---|
| | **Data Analytics with R** | | Semester | 3 |
| | Course Code | **BDS306C** | CIE Marks | 50 |
| | Teaching Hours/Week (L: T:P: S) | 2;0;2;0 | SEE Marks | 50 |
| | Total Hours of Pedagogy | 28 Hours Theory + 20 Hours Practical | Total Marks | 100 |
| | Credits | 03 | Exam Hours | 03 |
| | Examination type (SEE) | Theory | | |

**Course Learning objectives:**

CLO 1: To Gain the knowledge of R Programming Concepts

CLO 2: To Explain the concepts of Data Visualization

CLO 3: To Explain the concept of Statistics in R.

CLO 4: To Work with R charts and Graphs

**Teaching-Learning Process (General Instructions)**

1. Chalk and board, power point presentations
2. Online material (Tutorials) and video lectures.
3. Demonstration of programing examples.

**Module-1** **5 hours**

## Basics of R

Introducing R, Initiating R, Packages in R, Environments and Functions, Flow Controls, Loops, Basic Data Types in R, Vectors

Chapter 1: 1.1 to 1.7 Chapter 2: 2.1,2.2

**Module-2** **5 hours**

## Basics of R Continued

Matrices and Arrays, Lists, Data Frames, Factors, Strings, Dates and Times

Chapter 2: 2.3,2.4,2.5,2.6,2.7.2.8.1,2.8.2

**Module-3** **6 Hours**

## Data Preparation

Datasets, Importing and Exporting files, Accessing Databases, Data Cleaning and Transformation

Chapter 3: 3.1,3.2,3.3,3.4

**Module-4** **6 Hours**

## Graphics using R

Exploratory Data Analysis, Main Graphical Packages, Pie Charts, Scatter Plots, Line Plots, Histograms, Box Plots, Bar Plots, Other Graphical packages

Chapter 4: 4.1 to 4.9

**Module-5** **6 Hours**

## Statistical Analysis using R

Basic Statistical Measures, Normal distribution, Binomial distribution, Correlation Analysis, Regression Analysis-Linear Regression Analysis of Variance

Chapter 5: 5.1, 5.3, 5.4, 5.5, 5.6.1, 5.7

**Course outcome (Course Skill Set)**

At the end of the course, the student will be able to :
CO1: Describe the structures of R Programming.
CO2: Illustrate the basics of Data Preparation with real world examples.
CO3: Apply the Graphical Packages of R for visualization.
CO4: Apply various Statistical Analysis methods for data analytics.

## Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks out of 50) and for the SEE minimum passing mark is 35% of the maximum marks (18 out of 50 marks). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures a minimum of 40% (40 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together.

**Continuous Internal Evaluation:**

- For the Assignment component of the CIE, there are 25 marks and for the Internal Assessment Test component, there are 25 marks.
- The first test will be administered after 40-50% of the syllabus has been covered, and the second test will be administered after 85-90% of the syllabus has been covered
- Any two assignment methods mentioned in the 22OB2.4, if an assignment is project-based then only one assignment for the course shall be planned. The teacher should not conduct two assignments at the end of the semester if two assignments are planned.
- For the course, CIE marks will be based on a scaled-down sum of two tests and other methods of assessment.

**Internal Assessment Test question paper is designed to attain the different levels of Bloom's taxonomy as per the outcome defined for the course.**

**Semester-End Examination:**

Theory SEE will be conducted by University as per the scheduled timetable, with common question papers for the course (**duration 03 hours).**

1. The question paper will have ten questions. Each question is set for 20 marks.
2. There will be 2 questions from each module. Each of the two questions under a module (with a maximum of 3 sub-questions), **should have a mix of topics** under that module.
3. The students have to answer 5 full questions, selecting one full question from each module.
4. Marks scored shall be proportionally reduced to 50 marks

**Suggested Learning Resources:**

**Text Books:**

R Programming: An Approach to Data Analytics, G. Sudhamathy and C. Jothi Venkateswaran, MJP Publishers, 2019

Reference Books:

1..An Introduction to R, Notes on R: A Programming Environment for Data Analysis and Graphics. W. N. Venables, D.M. Smith and the R Development Core Team. Version 3.0.1 (2013-05-16)

2. Cotton, R. (2013). Learning R: A Step by Step Function Guide to Data Analysis. 1st ed. O'Reilly Media Inc

**Web links and Video Lectures (e-Resources):**

1. URL: https://cran.r-project.org/doc/manuals/r-release/R-intro.pdf
2. http://www.tutorialspoint.com/r/r_tutorial.pdf
3. https://users.phhp.ufl.edu/rlp176/Courses/PHC6089/R_notes/intro.html
4. https://cran.r-project.org/web/packages/explore/vignettes/explore_mtcars.html
5. https://www.w3schools.com/r/r_stat_data_set.asp
6. https://rpubs.com/BillB/217355

**Activity Based Learning (Suggested Activities in Class)/ Practical Based learning**

- Programming Assignment (10 Marks)

## Practical Component

| Sl.NO | Experiments |
|---|---|
| 1 | Demonstrate the steps for installation of R and R Studio. Perform the following:<br>a) Assign different type of values to variables and display the type of variable. Assign different types such as Double, Integer, Logical, Complex and Character and understand the difference between each data type.<br>b) Demonstrate Arithmetic and Logical Operations with simple examples.<br>c) Demonstrate generation of sequences and creation of vectors.<br>d) Demonstrate Creation of Matrices<br>e) Demonstrate the Creation of Matrices from Vectors using Binding Function.<br>f) Demonstrate element extraction from vectors, matrices and arrays |
| 2 | Assess the Financial Statement of an Organization being supplied with 2 vectors of data: Monthly Revenue and Monthly Expenses for the Financial Year. You can create your own sample data vector for this experiment) Calculate the following financial metrics:<br>a. Profit for each month.<br>b. Profit after tax for each month (Tax Rate is 30%).<br>c. Profit margin for each month equals to profit after tax divided by revenue.<br>d. Good Months – where the profit after tax was greater than the mean for the year.<br>e. Bad Months – where the profit after tax was less than the mean for the year.<br>f. The best month – where the profit after tax was max for the year.<br>g. The worst month – where the profit after tax was min for the year.<br>**Note:**<br>a. All Results need to be presented as vectors<br>b. Results for Dollar values need to be calculated with $0.01 precision, but need to be presented in Units of $1000 (i.e 1k) with no decimal points<br>c. Results for the profit margin ratio need to be presented in units of % with no decimal point.<br>d. It is okay for tax to be negative for any given month (deferred tax asset)<br>e. Generate CSV file for the data. |
| 3 | Develop a program to create two 3 X 3 matrices A and B and perform the following operations a) Transpose of the matrix b) addition c) subtraction d) multiplication |
| 4 | Develop a program to find the factorial of given number using recursive function calls. |

<table>
<tr><td>5</td><td>Develop an R Program using functions to find all the prime numbers up to a specified number by the method of Sieve of Eratosthenes.</td></tr>
<tr><td>6</td><td>The built-in data set mammals contain data on body weight versus brain weight. Develop R commands to:<br>a) Find the Pearson and Spearman correlation coefficients. Are they similar?<br>b) Plot the data using the plot command.<br>c) Plot the logarithm (log) of each variable and see if that makes a difference.</td></tr>
<tr><td>7</td><td>Develop R program to create a Data Frame with following details and do the following operations.
<table>
<tr><th>itemCode</th><th>itemCategory</th><th>itemPrice</th></tr>
<tr><td>1001</td><td>Electronics</td><td>700</td></tr>
<tr><td>1002</td><td>Desktop Supplies</td><td>300</td></tr>
<tr><td>1003</td><td>Office Supplies</td><td>350</td></tr>
<tr><td>1004</td><td>USB</td><td>400</td></tr>
<tr><td>1005</td><td>CD Drive</td><td>800</td></tr>
</table>
a) Subset the Data frame and display the details of only those items whose price is greater than or equal to 350.<br>b) Subset the Data frame and display only the items where the category is either “Office Supplies” or “Desktop Supplies”<br>c) Create another Data Frame called “item-details” with three different fields itemCode, ItemQtyonHand and ItemReorderLvl and merge the two frames</td></tr>
<tr><td>8</td><td>Let us use the built-in dataset air quality which has Daily air quality measurements in New York, May to September 1973. Develop R program to generate histogram by using appropriate arguments for the following statements.<br>a) Assigning names, using the air quality data set.<br>b) Change colors of the Histogram<br>c) Remove Axis and Add labels to Histogram<br>d) Change Axis limits of a Histogram<br>e) Add Density curve to the histogram</td></tr>
<tr><td>9</td><td>Design a data frame in R for storing about 20 employee details. Create a CSV file named “input.csv” that defines all the required information about the employee such as id, name, salary, start_date, dept. Import into R and do the following analysis.<br>a) Find the total number rows & columns<br>b) Find the maximum salary<br>c) Retrieve the details of the employee with maximum salary<br>d) Retrieve all the employees working in the IT Department.<br>e) Retrieve the employees in the IT Department whose salary is greater than 20000 and write these details into another file “output.csv”</td></tr>
<tr><td>10</td><td>Using the built in dataset mtcars which is a popular dataset consisting of the design and fuel consumption patterns of 32 different automobiles. The data was extracted from the 1974 Motor Trend US magazine, and comprises fuel consumption and 10 aspects of automobile design and performance for 32 automobiles (1973-74 models). Format A data frame with 32 observations on 11 variables : [1] mpg Miles/(US) gallon, [2] cyl Number of cylinders [3] disp Displacement (cu.in.), [4] hp Gross horsepower [5] drat Rear axle ratio,[6] wt Weight (lb/1000) [7] qsec 1/4 mile time, [8] vs V/S, [9] am Transmission (0 = automatic, 1 = manual), [10] gear Number of forward gears, [11] carb Number of carburetors<br><br>Develop R program, to solve the following:<br>a) What is the total number of observations and variables in the dataset?<br>b) Find the car with the largest hp and the least hp using suitable functions<br>c) Plot histogram / density for each variable and determine whether continuous variables are normally distributed or not. If not, what is their skewness?<br>d) What is the average difference of gross horse power(hp) between automobiles with 3 and 4 number of cylinders(cyl)? Also determine the difference in their standard deviations.<br>e) Which pair of variables has the highest Pearson correlation?</td></tr>
</table>

| | |
|---|---|
| 11 | Demonstrate the progression of salary with years of experience using a suitable data set (You can create your own dataset). Plot the graph visualizing the best fit line on the plot of the given data points. Plot a curve of Actual Values vs. Predicted values to show their correlation and performance of the model. Interpret the meaning of the slope and y-intercept of the line with respect to the given data. Implement using lm function. Save the graphs and coefficients in files. Attach the predicted values of salaries as a new column to the original data set and save the data as a new CSV file. |

**Assessment Details (both CIE and SEE)**

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks out of 50) and for the SEE minimum passing mark is 35% of the maximum marks (18 out of 50 marks). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures a minimum of 40% (40 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together.

**CIE for the theory component of the IPCC (maximum marks 50)**

- IPCC means practical portion integrated with the theory of the course.
- CIE marks for the theory component are **25 marks** and that for the practical component is **25 marks**.
- 25 marks for the theory component are split into **15 marks** for two Internal Assessment Tests (Two Tests, each of 15 Marks with 01-hour duration, are to be conducted) and **10 marks** for other assessment methods mentioned in 22OB4.2. The first test at the end of 40-50% coverage of the syllabus and the second test after covering 85-90% of the syllabus.
- Scaled-down marks of the sum of two tests and other assessment methods will be CIE marks for the theory component of IPCC (that is for **25 marks)**.
- The student has to secure 40% of 25 marks to qualify in the CIE of the theory component of IPCC.

**CIE for the practical component of the IPCC**

- **15 marks** for the conduction of the experiment and preparation of laboratory record, and **10 marks** for the test to be conducted after the completion of all the laboratory sessions.
- On completion of every experiment/program in the laboratory, the students shall be evaluated including viva-voce and marks shall be awarded on the same day.
- The CIE marks awarded in the case of the Practical component shall be based on the continuous evaluation of the laboratory report. Each experiment report can be evaluated for 10 marks. Marks of all experiments' write-ups are added and scaled down to **15 marks**.
- The laboratory test **(duration 02/03 hours)** after completion of all the experiments shall be conducted for 50 marks and scaled down to **10 marks.**
- Scaled-down marks of write-up evaluations and tests added will be CIE marks for the laboratory component of IPCC for **25 marks**.
- The student has to secure 40% of 25 marks to qualify in the CIE of the practical component of the IPCC.

**SEE for IPCC**

Theory SEE will be conducted by University as per the scheduled timetable, with common question papers for the course (**duration 03 hours**)

1. The question paper will have ten questions. Each question is set for 20 marks.
2. There will be 2 questions from each module. Each of the two questions under a module (with a maximum of 3 sub-questions), **should have a mix of topics** under that module.
3. The students have to answer 5 full questions, selecting one full question from each module.
4. Marks scored by the student shall be proportionally scaled down to 50 Marks

**The theory portion of the IPCC shall be for both CIE and SEE, whereas the practical portion will have a CIE component only. Questions mentioned in the SEE paper may include questions from the practical component**.

| BSCK307 – Social Connect & Responsibility 2022 Scheme & syllabus for 3rd sem | | Semester | 3rd |
|---|---|---|---|
| Course Code | BSCK307 | CIE Marks | 100 |
| Teaching Hours/Week (L:T:P: S) | 0:0:3:1 | SEE Marks | ------ |
| Total Hours of Pedagogy | 40 hour Practical Session +15 hour Planning | Total Marks | 100 |
| Examination nature (No SEE – Only CIE) | For CIE Assessment - Activities Report Evaluation by College NSS Officer / HOD / Sports Dept / Any Dept. | | |
| Credits | 01 - Credit | | |

## Course objectives: The course will enable the students to:

1. Provide a formal platform for students to communicate and connect to the surrounding.
2. create a responsible connection with the society.
3. Understand the community in general in which they work.
4. Identify the needs and problems of the community and involve them in problem –solving.
5. Develop among themselves a sense of social & civic responsibility & utilize their knowledge in finding practical solutions to individual and community problems.
6. Develop competence required for group-living and sharing of responsibilities & gain skills in mobilizing community participation to acquire leadership qualities and democratic attitudes.

## General Instructions - Pedagogy :

These are sample Strategies, which teachers can use to accelerate the attainment of the various course outcomes.

1. In addition to the traditional lecture method, different types of innovative teaching methods may be adopted so that the activities will develop students' theoretical and applied social and cultural skills.
2. State the need for activities and its present relevance in the society and Provide real-life examples.
3. Support and guide the students for self-planned activities.
4. You will also be responsible for assigning homework, grading assignments and quizzes, and documenting students' progress in real activities in the field.
5. Encourage the students for group work to improve their creative and analytical skills.

## Contents :

The course is mainly activity-based that will offer a set of activities for the student that enables them to connect with fellow human beings, nature, society, and the world at large.

The course will engage students for interactive sessions, open mic, reading group, storytelling sessions, and semester-long activities conducted by faculty mentors.

In the following a set of activities planned for the course have been listed:

# Social Connect & Responsibility - Contents

## Part I:

## Plantation and adoption of a tree:

Plantation of a tree that will be adopted for four years by a group of BE / B.Tech students. (ONE STUDENT ONE TREE)

They will also make an excerpt either as a documentary or a photo blog describing the plant's origin, its usage in daily life, its appearance in folklore and literature - – Objectives, Visit, case study, report, outcomes.

## Part II :

## Heritage walk and crafts corner:

Heritage tour, knowing the history and culture of the city, connecting to people around through their history, knowing the city and its craftsman, photo blog and documentary on evolution and practice of various craft forms - – Objectives,Visit, case study, report, outcomes.

## Part III :

## Organic farming and waste management:

Usefulness of organic farming, wet waste management in neighboring villages, and implementation in the campus –

Objectives,Visit, case study, report, outcomes.

**Part IV:**

**Water conservation:**

Knowing the present practices in the surrounding villages and implementation in the campus, documentary or photoblog presenting the current practices – Objectives, Visit, case study, report, outcomes.

**Part V :**

**Food walk:**

City's culinary practices, food lore, and indigenous materials of the region used in cooking – Objectives, Visit, case study, report, outcomes.

**Course outcomes (Course Skill Set):**

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

CO1: Communicate and connect to the surrounding.

CO2: Create a responsible connection with the society.

CO3: Involve in the community in general in which they work.

CO4: Notice the needs and problems of the community and involve them in problem –solving.

CO5: Develop among themselves a sense of social & civic responsibility & utilize their knowledge in finding practical solutions to individual and community problems.

CO6: Develop competence required for group-living and sharing of responsibilities & gain skills in mobilizing community participation to acquire leadership qualities and democratic attitudes.

## Activities:

Jamming session, open mic, and poetry: Platform to connect to others. Share the stories with others. Share the experience of Social Connect. Exhibit the talent like playing instruments, singing, one-act play, art-painting, and fine art.

**PEDAGOGY:**

The pedagogy will include interactive lectures, inspiring guest talks, field visits, social immersion, and a course project. Applying and synthesizing information from these sources to define the social problem to address and take up the solution as the course project, with your group. Social immersionwith NGOs/social sections will be a key part of the course. Will all lead to the course project that will address the needs of the social sector?

**COURSE TOPICS:**

The course will introduce social context and various players in the social space, and present approaches to discovering and understanding social needs. Social immersion and inspiring conversional will culminate in developing an actual, idea for problem-based intervention, based on an in-depth understanding of a key social problem.

## Duration :

A total of 40 - 50 hrs engagement per semester is required for the 3rd semester of the B.E. /B.Tech. program. The students will be divided into groups. Each group will be handled by faculty mentor. Faculty mentor will design the activities (particularly Jamming sessions open mic ,and poetry) Faculty mentors has to design the evaluation system as per VTU guidelines of scheme & syllabus.

## Guideline for Assessment Process:

## Continuous Internal Evaluation (CIE):

After completion of the course, the student shall prepare, with daily diary as reference, a comprehensive report in consultation with the mentor/s to indicate what he has observed and learned in the social connect period. The report should be signed by the mentor. The report shall

be evaluated on the basis of the following criteria and/or other relevant criteria pertaining to the activity completed. Marks allotted for the diary are out of 50. Planning and scheduling the social connect Information/Data collected during the social connect Analysis of the information/data and report writing Considering all above points allotting the marks as mentioned below

**Excellent : 80 to 100**
**Good : 60 to 79**
**Satisfactory : 40 to 59**
**Unsatisfactory and fail : <39**

## Special Note :

**NO SEE – Semester End Exam – Completely Practical and activities based evaluation**

# Pedagogy – Guidelines :

**It may differ depending on local resources available for the study as well as environment and climatic differences, location and time of execution.**

| Sl No | Topic | Group size | Location | Activity execution | Reporting | Evaluation Of the Topic |
|---|---|---|---|---|---|---|
| 1. | **Plantation and adoption of a tree:** | May be individual or team | Farmers land/ parks / Villages / roadside/ community area / College campus etc….. | Site selection /proper consultation/Continuous monitoring/ Information board | Report should be submitted by individual to the concerned evaluation authority | Evaluation as per the rubrics Of scheme and syllabus by Faculty |
| 2. | **Heritage walk and crafts corner:** | May be individual or team | Temples / monumental places / Villages/ City Areas / Grama panchayat/ public associations/Government Schemes officers/ campus etc….. | Site selection /proper consultation/Continuous monitoring/ Information board | Report should be submitted by individual to the concerned evaluation authority | Evaluation as per the rubrics Of scheme and syllabus by Faculty |
| 3. | **Organic farming and waste management:** | May be individual or team | Farmers land / parks / Villages visits / roadside/ community area / College campus etc….. | Group selection / proper consultation / Continuous monitoring / Information board | Report should be submitted by individual to the concerned evaluation authority | Evaluation as per the rubrics Of scheme and syllabus by Faculty |
| 4. | **Water conservation:** & conservation techniques | May be individual or team | Villages/ City Areas / Grama panchayat/ public associations/Government Schemes officers / campus etc….. | site selection / proper consultation/Continuous monitoring/ Information board | Report should be submitted by individual to the concerned evaluation authority | Evaluation as per the rubrics Of scheme and syllabus by Faculty |
| 5. | **Food walk: Practices in society** | May be individual or team | Villages/ City Areas / Grama panchayat/ public associations/Government Schemes officers/ campus etc….. | Group selection / proper consultation / Continuous monitoring / Information board | Report should be submitted by individual to the concerned evaluation authority | Evaluation as per the rubrics Of scheme and syllabus by Faculty |

# Plan of Action (Execution of Activities )

| Sl.NO | Practice Session Description |
|---|---|
| 1 | **Lecture session in field to start activities** |
| 2 | **Students Presentation on Ideas** |
| 3 | **Commencement of activity and its progress** |
| 4 | **Execution of Activity** |
| 5 | **Execution of Activity** |
| 6 | **Execution of Activity** |
| 7 | **Execution of Activity** |
| 8 | **Case study based Assessment, Individual performance** |
| 9 | **Sector/ Team wise study and its consolidation** |
| 10 | **Video based seminar for 10 minutes by each student At the end of semester with Report.** |

- Each student should do activities according to the scheme and syllabus.
- At the end of semester student performance has to be evaluated by the faculty for the assigned activity progress and its completion.
- At last consolidated report of all activities from 1st to 5th, compiled report should be submitted as per the instructions and scheme.

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**Assessment Details for CIE (both CIE and SEE)**

| **Weightage** | **CIE – 100%** | • Implementation strategies of the project ( NSS work).<br>• The last report should be signed by NSS Officer, the HOD and principal.<br>• At last report should be evaluated by the NSS officer of the institute.<br>• Finally the consolidated marks sheet should be sent to the university and also to be made available at LIC visit. |
|---|---|---|
| Field Visit, Plan, Discussion | 10 Marks | |
| Commencement of activities and its progress | 20 Marks | |
| Case study based Assessment<br>Individual performance with report | 20 Marks | |
| Sector wise study & its consolidation 5*5 = 25 | 25 Marks | |
| Video based seminar for 10 minutes by each student At the end of semester with Report.<br>**Activities 1 to 5, 5*5 = 25** | 25 Marks | |
| **Total marks for the course in each semester** | **100 Marks** | |
| **For each activity, 20 marks CIE will be evaluated for IA marks at the end of semester, Report and assessment copy should be made available in the department.** | | |
| Students should present the progress of the activities as per the schedule in the prescribed practical session in the field. There should be positive progress in the vertical order for the benefit of society in general through activities. | | |

| Data Analytics with Excel | | Semester | 3 |
|---|---|---|---|
| Course Code | **BCS358A** | CIE Marks | 50 |
| Teaching Hours/Week (L:T:P: S) | 0:0:2:0 | SEE Marks | 50 |
| Credits | 01 | Exam Hours | 100 |
| Examination type (SEE) | Practical | | |

Course objectives:

- To Apply analysis techniques to datasets in Excel
- Learn how to use Pivot Tables and Pivot Charts to streamline your workflow in Excel
- Understand and Identify the principles of data analysis
- Become adept at using Excel functions and techniques for analysis
- Build presentation ready dashboards in Excel

| Sl.NO | Experiments |
|---|---|
| 1 | **Getting Started with Excel**: Creation of spread sheets, Insertion of rows and columns, Drag & Fill, use of Aggregate functions. |
| 2 | **Working with Data** : Importing data, Data Entry & Manipulation, Sorting & Filtering. |
| 3 | **Working with Data:** Data Validation, Pivot Tables & Pivot Charts. |
| 4 | **Data Analysis Process**: Conditional Formatting, What-If Analysis, Data Tables, Charts & Graphs. |
| 5 | **Cleaning Data with Text Functions**: use of UPPER and LOWER, TRIM function, Concatenate. |
| 6 | **Cleaning Data Containing Date and Time Values:** use of DATEVALUE function, DATEADD and DATEDIF, TIMEVALUE functions. |
| 7 | **Conditional Formatting**: formatting, parsing, and highlighting data in spreadsheets during data analysis. |
| 8 | **Working with Multiple Sheets**: work with multiple sheets within a workbook is crucial for organizing and managing data, perform complex calculations and create comprehensive reports. |
| 9 | Create worksheet with following fields: Empno, Ename, Basic Pay(BP), Travelling Allowance(TA), Dearness Allowance(DA), House Rent Allowance(HRA), Income Tax(IT), Provident Fund(PF), Net Pay(NP). Use appropriate formulas to calculate the above scenario. Analyse the data using appropriate chart and report the data. |
| 10 | Create worksheet on Inventory Management: Sheet should contain Product code, Product name, Product type, MRP, Cost after % of discount, Date of purchase. Use appropriate formulas to calculate the above scenario. Analyse the data using appropriate chart and report the data. |

| | |
|---|---|
| 11 | Create worksheet on Sales analysis of Merchandise Store: data consisting of Order ID, Customer ID, Gender, age, date of order, month, online platform, Category of product, size, quantity, amount, shipping city and other details. Use of formula to segregate different categories and perform a comparative study using pivot tables and different sort of charts. |
| 12 | Generation of report & presentation using Autofilter &macro. |

**Course outcomes (Course Skill Set):**

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

- Use advanced functions and productivity tools to assist in developing worksheets.
- Manipulate data lists using Outline and PivotTables.
- Use Consolidation to summarise and report results from multiple worksheets.
- Apply Macros and Autofilter to solve the given real world scenario.

**Assessment Details (both CIE and SEE)**

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks out of 50) and for the SEE minimum passing mark is 35% of the maximum marks (18 out of 50 marks). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures a minimum of 40% (40 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together

**Continuous Internal Evaluation (CIE):**

CIE marks for the practical course are **50 Marks**.

The split-up of CIE marks for record/ journal and test are in the ratio **60:40**.

- Each experiment is to be evaluated for conduction with an observation sheet and record write-up. Rubrics for the evaluation of the journal/write-up for hardware/software experiments are designed by the faculty who is handling the laboratory session and are made known to students at the beginning of the practical session.
- Record should contain all the specified experiments in the syllabus and each experiment write-up will be evaluated for 10 marks.
- Total marks scored by the students are scaled down to **30 marks** (60% of maximum marks).
- Weightage to be given for neatness and submission of record/write-up on time.
- Department shall conduct a test of 100 marks after the completion of all the experiments listed in the syllabus.
- In a test, test write-up, conduction of experiment, acceptable result, and procedural knowledge will carry a weightage of 60% and the rest 40% for viva-voce.
- The suitable rubrics can be designed to evaluate each student's performance and learning ability.
- The marks scored shall be scaled down to **20 marks** (40% of the maximum marks).

The Sum of scaled-down marks scored in the report write-up/journal and marks of a test is the total CIE marks scored by the student.

**Semester End Evaluation (SEE):**

- SEE marks for the practical course are 50 Marks.
- SEE shall be conducted jointly by the two examiners of the same institute, examiners are appointed by the Head of the Institute.
- The examination schedule and names of examiners are informed to the university before the conduction of the examination. These practical examinations are to be conducted between the schedule mentioned in the academic calendar of the University.

- All laboratory experiments are to be included for practical examination.
- (Rubrics) Breakup of marks and the instructions printed on the cover page of the answer script to be strictly adhered to by the examiners. **OR** based on the course requirement evaluation rubrics shall be decided jointly by examiners.
- Students can pick one question (experiment) from the questions lot prepared by the examiners jointly.
- Evaluation of test write-up/ conduction procedure and result/viva will be conducted jointly by examiners.

- General rubrics suggested for SEE are mentioned here, writeup-20%, Conduction procedure and result in -60%, Viva-voce 20% of maximum marks. SEE for practical shall be evaluated for 100 marks and scored marks shall be scaled down to 50 marks (however, based on course type, rubrics shall be decided by the examiners)
- Change of experiment is allowed only once and 15% of Marks allotted to the procedure part are to be made zero.

The minimum duration of SEE is 02 hours

**Suggested Learning Resources:**


- **Berk & Carey** - Data Analysis with Microsoft® Excel: Updated for Offi ce 2007®, Third Edition, © 2010 Brooks/Cole, Cengage Learning, ISBN-13: 978-0-495-39178-4
- **Wayne L. Winston** - Microsoft Excel 2019: Data Analysis And Business Modeling, PHI, ISBN: 9789389347180
- **Aryan Gupta** - Data Analysis in Excel: The Best Guide. (https://www.simplilearn.com/tutorials/excel-tutorial/data-analysis-excel)

| | | | | |
|---|---|---|---|---|
| | **Ethics and Public Policy for AI** | | Semester | |
| | Course Code | **BAI358B** | CIE Marks | 50 |
| | Teaching Hours/Week (L:T:P: S) | **1:0:0** | SEE Marks | 50 |
| | Total Hours of Pedagogy | 14 | Total Marks | 100 |
| | Credits | 03 | Exam Hours | 2 |
| | Examination type (SEE) | Theory | | |

**Course objectives:**

- ***To understand Ethical Framework for a Good AI Society, establishing Rules for trustworthy AI***
- ***To Designing ethics for good society***
- ***To familiar with Tools, methods and practices for designing AI for social good***
- ***To familiar with Innovation and future AI***
- ***To understand the Case Study: Ai in health care, knowing Regulation and Governance of AI ethics***

**Teaching-Learning Process (General Instructions)**
These are sample Strategies, which teachers can use to accelerate the attainment of the various course outcomes.

1. **Chalk and Talk**
2. **Real time Examples**
3. **Natural Approaches**

**Module-1**

**An Ethical Framework for a Good AI Society:** opportunities, Risks, principles and Recommendations.
**Establishing the rules for building trustworthy AI**

Textbook1: Chapter 3, chapter 4

**Module-2**

**Translating principles into practices of digital ethics:** five risks of being Unethical
**The Ethics of Algorithms: Key problems and Solution**
**How to Design AI for Social Good:** Seven Essential Factors

Textbook1: Chapter 6, Chapter 8, Chapter 9

**Module-3**

**How to design AI for social good: seven essential factors**
**From What to How:** An Initial Review of publicly available AI Ethics tools, Methods and Research to Translate principles into Practices

Textbook1: Chapter 9, Chapter 10

**Module-4**

**Innovating with Confidence**: Embedding AI Governance and fairness in financial Services Risk management framework,
**What the near future of AI could be.**

Textbook1: Chapter 20, chapter 22

**Module-5**

**Human-AI Relationship**, AI and Workforce, Autonomous Machines and Moral Decisions,
**AI in HealthCare**: balancing Progress and Ethics,

**Regulation and Governance of AI Ethics**

Textbook2 : Chapter 5,Chapter 8, Chapter 9

**Course outcome (Course Skill Set)**

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

1. ***Describe Ethical Framework for a Good AI Society, establishing Rules for trustworthy AI***
2. ***Explain ethics for good society***
3. ***Illustrate various Tools, methods and practices for designing AI for social good***
4. ***Describe the Innovation and future AI***
5. ***Illustrate Regulation and Governance of AI ethics in Healthcare domain.***

## Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks out of 50) and for the SEE minimum passing mark is 35% of the maximum marks (18 out of 50 marks). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures a minimum of 40% (40 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together.

**Continuous Internal Evaluation:**

- For the Assignment component of the CIE, there are 25 marks and for the Internal Assessment Test component, there are 25 marks.
- The first test will be administered after 40-50% of the syllabus has been covered, and the second test will be administered after 85-90% of the syllabus has been covered
- Any two assignment methods mentioned in the 22OB2.4, if an assignment is project-based then only one assignment for the course shall be planned. The teacher should not conduct two assignments at the end of the semester if two assignments are planned.
- For the course, CIE marks will be based on a scaled-down sum of two tests and other methods of assessment.

**Internal Assessment Test question paper is designed to attain the different levels of Bloom's taxonomy as per the outcome defined for the course.**

**Semester-End Examination:**

Theory SEE will be conducted by University as per the scheduled timetable, with common question papers for the course (**duration 03 hours).**

1. The question paper will have ten questions. Each question is set for 20 marks.
2. There will be 2 questions from each module. Each of the two questions under a module (with a maximum of 3 sub-questions), **should have a mix of topics** under that module.
3. The students have to answer 5 full questions, selecting one full question from each module.
4. Marks scored shall be proportionally reduced to 50 marks

**Suggested Learning Resources:**

**Books**

1. "Ethics, governance and Policies in Artificial Intelligence", Author-Editor : Luciano Floridi, Springer, 1st Edition 2021, vol 144, Oxford Internet Institute, University of ixford, UK, ISSN 0921-8599, e-ISSN 2542-8349 Philosophical Studies series, ISBN 978-3-030-81906-4 e-ISBN 978-3-030-81907-1, ://doi.orghttps/10.1007/978-3-030-81907-1, 2021.
2. "Ethics and AI: Navigating the Moral Landscape of Digital Age", Author: Aaron Aboagye,

| Project Management with Git | | Semester | 3 |
|---|---|---|---|
| Course Code | BCS358C | CIE Marks | 50 |
| Teaching Hours/Week (L:T:P: S) | 0: 0 : 2: 0 | SEE Marks | 50 |
| Credits | 01 | Exam Marks | 100 |
| Examination type (SEE) | Practical | | |

**Course objectives:**

- .To familiar with basic command of Git
- To create and manage branches
- To understand how to collaborate and work with Remote Repositories
- To familiar with virion controlling commands

| Sl.NO | Experiments |
|---|---|
| 1 | **Setting Up and Basic Commands**<br>Initialize a new Git repository in a directory. Create a new file and add it to the staging area and commit the changes with an appropriate commit message. |
| 2 | **Creating and Managing Branches**<br>Create a new branch named "feature-branch." Switch to the "master" branch. Merge the "feature-branch" into "master." |
| 3 | **Creating and Managing Branches**<br>Write the commands to stash your changes, switch branches, and then apply the stashed changes. |
| 4 | **Collaboration and Remote Repositories**<br>Clone a remote Git repository to your local machine. |
| 5 | **Collaboration and Remote Repositories**<br>Fetch the latest changes from a remote repository and rebase your local branch onto the updated remote branch. |
| 6 | **Collaboration and Remote Repositories**<br>Write the command to merge "feature-branch" into "master" while providing a custom commit message for the merge. |
| 7 | **Git Tags and Releases**<br>Write the command to create a lightweight Git tag named "v1.0" for a commit in your local repository. |
| 8 | **Advanced Git Operations** |

| | |
|---|---|
| | Write the command to cherry-pick a range of commits from "source-branch" to the current branch. |
| 9 | **Analysing and Changing Git History**<br><br>Given a commit ID, how would you use Git to view the details of that specific commit, including the author, date, and commit message? |
| 10 | **Analysing and Changing Git History**<br><br>Write the command to list all commits made by the author "JohnDoe" between "2023-01-01" and "2023-12-31." |
| 11 | **Analysing and Changing Git History**<br><br>Write the command to display the last five commits in the repository's history. |
| 12 | **Analysing and Changing Git History**<br><br>Write the command to undo the changes introduced by the commit with the ID "abc123". |

**Course outcomes (Course Skill Set):**

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

- Use the basics commands related to git repository
- Create and manage the branches
- Apply commands related to Collaboration and Remote Repositories
- Use the commands related to Git Tags, Releases and advanced git operations
- Analyse and change the git history

**Assessment Details (both CIE and SEE)**

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks out of 50) and for the SEE minimum passing mark is 35% of the maximum marks (18 out of 50 marks). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures a minimum of 40% (40 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together

**Continuous Internal Evaluation (CIE):**

CIE marks for the practical course are **50 Marks**.

The split-up of CIE marks for record/ journal and test are in the ratio **60:40**.

- Each experiment is to be evaluated for conduction with an observation sheet and record write-up. Rubrics for the evaluation of the journal/write-up for hardware/software experiments are designed by the faculty who is handling the laboratory session and are made known to students at the beginning of the practical session.
- Record should contain all the specified experiments in the syllabus and each experiment write-up will be evaluated for 10 marks.
- Total marks scored by the students are scaled down to **30 marks** (60% of maximum marks).
- Weightage to be given for neatness and submission of record/write-up on time.
- Department shall conduct a test of 100 marks after the completion of all the experiments listed in the syllabus.
- In a test, test write-up, conduction of experiment, acceptable result, and procedural knowledge will carry a weightage of 60% and the rest 40% for viva-voce.
- The suitable rubrics can be designed to evaluate each student's performance and learning ability.
- The marks scored shall be scaled down to **20 marks** (40% of the maximum marks).

The Sum of scaled-down marks scored in the report write-up/journal and marks of a test is the total CIE marks scored by the student.

**Semester End Evaluation (SEE):**

- SEE marks for the practical course are 50 Marks.
- SEE shall be conducted jointly by the two examiners of the same institute, examiners are appointed by the Head of the Institute.
- The examination schedule and names of examiners are informed to the university before the conduction of the examination. These practical examinations are to be conducted between the schedule mentioned in the academic calendar of the University.

- All laboratory experiments are to be included for practical examination.
- (Rubrics) Breakup of marks and the instructions printed on the cover page of the answer script to be strictly adhered to by the examiners. **OR** based on the course requirement evaluation rubrics shall be decided jointly by examiners.
- Students can pick one question (experiment) from the questions lot prepared by the examiners jointly.
- Evaluation of test write-up/ conduction procedure and result/viva will be conducted jointly by examiners.

- General rubrics suggested for SEE are mentioned here, writeup-20%, Conduction procedure and result in -60%, Viva-voce 20% of maximum marks. SEE for practical shall be evaluated for 100 marks and scored marks shall be scaled down to 50 marks (however, based on course type, rubrics shall be decided by the examiners)
- Change of experiment is allowed only once and 15% of Marks allotted to the procedure part are to be made zero.

The minimum duration of SEE is 02 hours

**Suggested Learning Resources:**


- Version Control with Git, 3rd Edition, by Prem Kumar Ponuthorai, Jon Loeliger Released October 2022, Publisher(s): O'Reilly Media, Inc.
- Pro Git book, written by Scott Chacon and Ben Straub and published by Apress, https://git-scm.com/book/en/v2
- https://infyspringboard.onwingspan.com/web/en/app/toc/lex_auth_013094443347369984278 2_shared/overview
- https://infyspringboard.onwingspan.com/web/en/app/toc/lex_auth_013301347121774592119 26_shared/overview

| PHP Programming | | Semester | 3 |
|---|---|---|---|
| Course Code | BAI358D | CIE Marks | 50 |
| Teaching Hours/Week (L:T:P: S) | 0:0:2:0 | SEE Marks | 50 |
| Credits | 01 | Exam Hours | 02 |
| Examination type (SEE) | Practical | | |

**Course objectives:**

- To introduce the PHP syntax, elements, and control structures
- To make use of PHP Functions and File handling
- To illustrate the concept of PHP arrays and OOPs

| Sl.NO | Experiments |
|---|---|
| **AIM:** Introduction to HTML/PHP environment, PHP Data Types, Variables, Literals, and operators | |
| 1 | a. Develop a PHP program to calculate areas of Triangle and Rectangle.<br>b. Develop a PHP program to calculate Compound Interest. |
| 2 | Demonstrating the various forms to concatenate multiple strings<br>Develop program(s) to demonstrate concatenation of strings:<br>(i) Strings represented with literals (single quote or double quote)<br>(ii) Strings as variables<br>(iii) Multiple strings represented with literals (single quote or double quote) and variables<br>(iv) Strings and string variables containing single quotes as part string contents<br>(v) Strings containing HTML segments having elements with attributes |
| 3 | a. Develop a PHP Program(s) to check given number is:<br>(i) Odd or even<br>(ii) Divisible by a given number (N)<br>(iii) Square of a another number<br>b. Develop a PHP Program to compute the roots of a quadratic equation by accepting the coefficients. Print the appropriate messages. |
| 4 | a. Develop a PHP program to find the square root of a number by using the newton's algorithm.<br>b. Develop a PHP program to generate Floyd's triangle. |
| 5 | a. Develop a PHP application that reads a list of numbers and calculates mean and standard deviation.<br>b. Develop a PHP application that reads scores between 0 and 100 (possibly including both 0 and 100) and creates a histogram array whose elements contain the number of scores between 0 and 9, 10 and 19, etc. The last "box" in the histogram should include scores between 90 and 100. Use a function to generate the histogram. |
| 6 | a. Develop PHP program to demonstrate the date() with different parameter options.<br>b. Develop a PHP program to generate the Fibonacci series using a recursive function. |
| 7 | Develop a PHP program to accept the file and perform the following<br>(i) Print the first N lines of a file<br>(ii) Update/Add the content of a file |
| 8 | Develop a PHP program to read the content of the file and print the frequency of occurrence of the word accepted by the user in the file |
| 9 | Develop a PHP program to filter the elements of an array with key names.<br>Sample Input Data:<br>1st array: ('c1' => 'Red', 'c2' => 'Green', 'c3' => 'White', c4 => 'Black')<br>2nd array: ('c2', 'c4') |

| | |
|---|---|
| | Output:<br>Array<br>(<br>[c1] => Red<br>[c3] => White<br>) |
| 10 | Develop a PHP program that illustrates the concept of classes and objects by reading and printing employee data, including Emp_Name, Emp_ID, Emp_Dept, Emp_Salary, and Emp_DOJ. |
| 11 | a. Develop a PHP program to count the occurrences of Aadhaar numbers present in a text.<br>b. Develop a PHP program to find the occurrences of a given pattern and replace them with a text. |
| 12 | Develop a PHP program to read the contents of a HTML form and display the contents on a browser. |

**NOTE: Necessary HTML elements (and CSS) can be used for designing the experiments.**

**Course outcomes (Course Skill Set):**

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

- Apply basic concepts of PHP to develop web program
- Develop programs in PHP involving control structures
- Develop programs to handle structured data (object) and data items (array)
- Develop programs to access and manipulate contents of files
- Use super-global arrays and regular expressions to solve real world problems.

**Assessment Details (both CIE and SEE)**

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks out of 50) and for the SEE minimum passing mark is 35% of the maximum marks (18 out of 50 marks). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures a minimum of 40% (40 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together

**Continuous Internal Evaluation (CIE):**

CIE marks for the practical course are **50 Marks**.

The split-up of CIE marks for record/ journal and test are in the ratio **60:40**.

- Each experiment is to be evaluated for conduction with an observation sheet and record write-up. Rubrics for the evaluation of the journal/write-up for hardware/software experiments are designed by the faculty who is handling the laboratory session and are made known to students at the beginning of the practical session.
- Record should contain all the specified experiments in the syllabus and each experiment write-up will be evaluated for 10 marks.
- Total marks scored by the students are scaled down to **30 marks** (60% of maximum marks).
- Weightage to be given for neatness and submission of record/write-up on time.
- Department shall conduct a test of 100 marks after the completion of all the experiments listed in the syllabus.
- In a test, test write-up, conduction of experiment, acceptable result, and procedural knowledge will carry a weightage of 60% and the rest 40% for viva-voce.
- The suitable rubrics can be designed to evaluate each student's performance and learning ability.
- The marks scored shall be scaled down to **20 marks** (40% of the maximum marks).

The Sum of scaled-down marks scored in the report write-up/journal and marks of a test is the total CIE marks scored by the student.

**Semester End Evaluation (SEE):**

- SEE marks for the practical course are 50 Marks.
- SEE shall be conducted jointly by the two examiners of the same institute, examiners are appointed by the Head of the Institute.
- The examination schedule and names of examiners are informed to the university before the conduction of the examination. These practical examinations are to be conducted between the schedule mentioned in the academic calendar of the University.
- All laboratory experiments are to be included for practical examination.
- (Rubrics) Breakup of marks and the instructions printed on the cover page of the answer script to be strictly adhered to by the examiners. **OR** based on the course requirement evaluation rubrics shall be decided jointly by examiners.

- Students can pick one question (experiment) from the questions lot prepared by the examiners jointly.
- Evaluation of test write-up/ conduction procedure and result/viva will be conducted jointly by examiners.

General rubrics suggested for SEE are mentioned here, writeup-20%, Conduction procedure and result in -60%, Viva-voce 20% of maximum marks. SEE for practical shall be evaluated for 100 marks and scored marks shall be scaled down to 50 marks (however, based on course type, rubrics shall be decided by the examiners)

Change of experiment is allowed only once and 15% of Marks allotted to the procedure part are to be made zero.

The minimum duration of SEE is 02 hours

**Suggested Learning Resources:**

- BOOK: Programming in HTML and PHP (Coding for Scientists and Engineers, BY DEVID R BROOKS, Springer International Publishing AG 2017
- PHP TUTORIALS: [https://www.w3schools.com/php/}
- PHP TUTORIALS: [ https://www.tutorialspoint.com/php/index.htm]
- HTML TUTORIALS: [https://www.w3schools.com/html/]

**VISVESVARAYA TECHNOLOGICAL UNIVERSITY, BELAGAVI**

**B.E. in Artificial Intelligence and Machine Learning**

**Scheme of Teaching and Examinations 2021**

**Outcome-Based Education (OBE) and Choice Based Credit System (CBCS)**

**(Effective from the academic year 2021 - 22)**

**Swappable VII and VIII SEMESTER**

**VII SEMESTER**

| Sl. No | Course and Course Code | Course Title | Teaching Department (TD) and Question Paper Setting Board (PSB) | Teaching Hours /Week | | | | Examination | | | | Credits |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | Theory Lecture | Tutorial | Practical/ Drawing | Self -Study | Duration in hours | CIE Marks | SEE Marks | Total Marks | |
| | | | | L | T | P | S | | | | | |
| 1 | PCC 21AI71 | Advanced AI and ML | Any CS Board Department | 3 | 0 | 0 | | 3 | 50 | 50 | 100 | 3 |
| 2 | PCC 21CS72 | Cloud Computing | | 2 | 0 | 0 | | 3 | 50 | 50 | 100 | 2 |
| 3 | PEC 21XX73X | Professional elective Course-II | | 3 | 0 | 0 | | 3 | 50 | 50 | 100 | 3 |
| 4 | PEC 21XX74X | Professional elective Course-III | | 3 | 0 | 0 | | 3 | 50 | 50 | 100 | 3 |
| 5 | OEC 21XX75X | Open elective Course-II | Concerned Department | 3 | 0 | 0 | | 3 | 50 | 50 | 100 | 3 |
| 6 | Project 21AIP76 | Project work | | Two contact hours /week for interaction between the faculty and students. | | | | 3 | 100 | 100 | 200 | 10 |
| | | | | | | | | **Total** | **350** | **350** | **700** | **24** |

**VIII SEMESTER**

| Sl. No | Course and Course Code | | Course Title | Teaching Department | Teaching Hours /Week | | | | Examination | | | | Credits |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | Theory Lecture | Tutorial | Practical/ Drawing | Self -Study | Duration in hours | CIE Marks | SEE Marks | Total Marks | |
| | | | | | L | T | P | S | | | | | |
| 1 | Seminar 21AI81 | | Technical Seminar | | One contact hour /week for interaction between the faculty and students. | | | | -- | 100 | -- | 100 | 01 |
| 2 | INT 21INT82 | | Research Internship/ Industry Internship | | Two contact hours /week for interaction between the faculty and students. | | | | 03 (Batch wise ) | 100 | 100 | 200 | 15 |
| 3 | NCMC | 21NS83 | National Service Scheme (NSS) | NSS | Completed during the intervening period of III semester to VIII semester. | | | | -- | 50 | 50 | 100 | 0 |
| | | 21PE83 | Physical Education (PE) (Sports and Athletics) | PE | | | | | | | | | |
| | | 21YO83 | Yoga | Yoga | | | | | | | | | |
| | | | | | | | | | **Total** | **250** | **150** | **400** | **16** |

**Professional Elective - II**

| | | | |
|---|---|---|---|
| 21AI731 | Social Network Analysis | 21CS734 | Blockchain Technology |
| 21CS732 | Digital Image Processing | 21CS735 | Internet of Things |
| 21AI733 | Fullstack Development | | |

**Professional Elective - III**

| | | | |
|---|---|---|---|
| 21AI741 | Augmented Reality | 21CS744 | Robotic Process Automation Design and Development |
| 21CS742 | Multiagent Systems | 21CS745 | NoSQL Data Base |
| 21AI743 | Predictive Analytics | | |

| Open Electives - II offered by the Department to other Department students | | | |
|---|---|---|---|
| 21CS751 | Programming in Python | 21CS754 | Introduction to Data Science |
| 21CS752 | Introduction to AI and ML | 21CS755 | |
| 21CS753 | Introduction to Big Data | | |

**Note: PCC:** Professional Core Course, **PEC:** Professional Elective Courses, **OEC**–Open Elective Course, **AEC** –Ability Enhancement Courses.
L –Lecture, T – Tutorial, P- Practical / Drawing, S – Self Study Component, CIE: Continuous Internal Evaluation, SEE: Semester End Examination.

**Note: VII and VIII semesters of IV year of the programme**

**(1)** Institutions can swap VII and VIII Semester Scheme of Teaching and Examinations to accommodate research internship/ industry internship after the VI semester**.**

**(2)** Credits earned for the courses of VII and VIII Semester Scheme of Teaching and Examinations shall be counted against the corresponding semesters whether VII or VIII semester is completed during the beginning of IV year or later part of IV year of the programme.

**PROJECT WORK (21XXP76):** The objective of the Project work is

**(i)** To encourage independent learning and the innovative attitude of the students.
**(ii)** To develop interactive attitude, communication skills, organization, time management, and presentation skills.
**(iii)** To impart flexibility and adaptability.
**(iv)** To inspire team working.
**(v)** To expand intellectual capacity, credibility, judgment and intuition.
**(vi)** To adhere to punctuality, setting and meeting deadlines.
**(vii)** To instil responsibilities to oneself and others.
**(viii)**To train students to present the topic of project work in a seminar without any fear, face the audience confidently, enhance communication skills, involve in group discussion to present and exchange ideas.

**CIE procedure for Project Work:**

**(1) Single discipline:** The CIE marks shall be awarded by a committee consisting of the Head of the concerned Department and two senior faculty members of the Department, one of whom shall be the Guide.

The CIE marks awarded for the project work, shall be based on the evaluation of project work Report, project presentation skill, and question and answer session in the ratio 50:25:25. The marks awarded for the project report shall be the same for all the batch mates.

**(2) Interdisciplinary:** Continuous Internal Evaluation shall be group-wise at the college level with the participation of all guides of the college. Participation of external guide/s, if any, is desirable. The CIE marks awarded for the project work, shall be based on the evaluation of project work Report, project presentation skill, and question and answer session in the ratio 50:25:25. The marks awarded for the project report shall be the same for all the batch mates.

**SEE procedure for Project Work:** SEE for project work will be conducted by the two examiners appointed by the University. The SEE marks awarded for the project work, shall be based on the evaluation of project work Report, project presentation skill, and question and answer session in the ratio 50:25:25.

**TECHNICAL SEMINAR (21XXS81):** The objective of the seminar is to inculcate self-learning, present the seminar topic confidently, enhance communication skill, involve in group discussion for exchange of ideas. Each student, under the guidance of a Faculty, shall choose, preferably, a recent topic of his/her interest relevant to the programme of Specialization.

**(i)** Carry out literature survey, systematically organize the content.
**(ii)** Prepare the report with own sentences, avoiding a cut and paste act.
**(iii)**Type the matter to acquaint with the use of Micro-soft equation and drawing tools or any such facilities.
**(iv)** Present the seminar topic orally and/or through PowerPoint slides.
**(v)** Answer the queries and involve in debate/discussion.
(**vi)** Submit a typed report with a list of references.

The participants shall take part in the discussion to foster a friendly and stimulating environment in which the students are motivated to reach high standards and become self-confident.

**Evaluation Procedure:**

The CIE marks for the seminar shall be awarded (based on the relevance of the topic, presentation skill, participation in the question and answer session, and quality of report) by the committee constituted for the purpose by the Head of the Department. The committee shall consist of three teachers from the department with the senior-most acting as the Chairman.

**Marks distribution for CIE of the course:**

Seminar Report:50 marks
Presentation skill:25 marks
Question and Answer: 25 marks. ■ No SEE component for Technical Seminar

**Non – credit mandatory courses (NCMC):**

**National Service Scheme/Physical Education (Sport and Athletics)/ Yoga:**

**(1)** Securing 40 % or more in CIE,35 % or more marks in SEE and 40 % or more in the sum total of CIE + SEE leads to successful completion of the registered course.

**(2)** In case, students fail to secure 35 % marks in SEE, they has to appear for SEE during the subsequent examinations conducted by the University.

**(3)**In case, any student fails to register for NSS, PE or Yoga/fails to secure the minimum 40 % of the prescribed CIE marks, he/she shall be deemed to have not completed the requirements of the course. In such a case, the student has to fulfill the course requirements during subsequently to earn the qualifying CIE marks subject to the maximum programme period.

**(4)** Successful completion of the course shall be indicated as satisfactory in the grade card. Non-completion of the course shall be indicated as Unsatisfactory.

**(5)** These courses shall not be considered for vertical progression as well as for the calculation of SGPA and CGPA, but completion of the courses shall be mandatory for the award of degree.

**VII Semester**

| ADVANCED AI AND ML | | | |
|---|---|---|---|
| Course Code | 21AI71 | CIE Marks | 50 |
| Teaching Hours/Week (L:T:P: S) | 3:0:0:0 | SEE Marks | 50 |
| Total Hours of Pedagogy | 40 | Total Marks | 100 |
| Credits | 03 | Exam Hours | 03 |

**Course Learning Objectives**

CLO 1. Demonstrate the fundamentals of Intelligent Agents
CLO 2. Illustrate the reasoning on Uncertain Knowledge
CLO 3. Explore the explanation-based learning in solving AI problems
CLO 4. Illustrate the use of KNN
CLO 5. Explore the Text feature Engineering concepts with Applications

**Teaching-Learning Process (General Instructions)**

These are sample Strategies, which teacher can use to accelerate the attainment of the various course outcomes.

1. Lecturer method (L) needs not to be only traditional lecture method, but alternative effective teaching methods could be adopted to attain the outcomes.
2. Use of Video/Animation to explain functioning of various concepts.
3. Encourage collaborative (Group Learning) Learning in the class.
4. Ask at least three HOT (Higher order Thinking) questions in the class, which promotes critical thinking.
5. Adopt Problem Based Learning (PBL), which fosters students' Analytical skills, develop design thinking skills such as the ability to design, evaluate, generalize, and analyse information rather than simply recall it.
6. Introduce Topics in manifold representations.
7. Show the different ways to solve the same problem with different circuits/logic and encourage the students to come up with their own creative ways to solve them.
8. Discuss how every concept can be applied to the real world - and when that's possible, it helps improve the students' understanding.

**Module-1**

**Intelligent Agents**: Agents and Environments, Good Behaviour: The Concept of Rationality, The Nature of Environments, The Structure of Agents

**Problem Solving :** Game Paying

**Text book 1: Chapter 2, Chapter 5 (2.1 to 2.4, 5.1 to 5.6)**

| | |
|---|---|
| **Teaching-Learning Process** | Chalk and board, Active Learning, Problem based learning |

**Module-2**

**Uncertain knowledge and Reasoning:** Quantifying Uncertainty**,** Acting under Uncertainty , Basic Probability Notation, Inference Using Full Joint Distributions, Independence , Bayes' Rule and Its Use The WumpusWorld Revisited,

**Text book 1: Chapter 13**

| | |
|---|---|
| **Teaching-Learning Process** | Chalk and board, Active Learning, Demonstration |

**Module-3**

Neural Network Representation – Problems – Perceptrons – Multilayer Networks and Back Propagation Algorithms – Genetic Algorithms – Hypothesis Space Search – Genetic Programming – Models of Evolution

and Learning.

**Text book 2: chapter 4.1-4.6 & 9.1-9.5**

**Neural networks and genetic algorithms:**
Brief history and Evolution of Neural network, Biological neuron, Basics of ANN, Activation function, MP model.

**Text book 3: chapter 6**

| | |
|---|---|
| **Teaching-Learning Process** | Chalk and board, Problem based learning, Demonstration |

**Module-4**

**Recommender System:**
Datasets, Association rules, Collaborative filtering, User-based similarity, item-based similarity, using surprise library, Matrix factorization

**Text Analytics:**
Overview, Sentiment Classification, Naïve Bayes model for sentiment classification, using TF-IDF vectorizer, Challenges of text analytics

**Text book 4: Chapter 9 and 10**

| | |
|---|---|
| **Teaching-Learning Process** | Chalk& board, Problem based learning |

**Module-5**

**Clustering**
**Introduction,** Types of clustering, Partitioning methods of clustering (k-means, k-medoids), hierarchical methods

**Text book 3: Chapter 13**

Instance Based Learning: Introduction, k-nearest neighbour learning(review), locally weighted regression, radial basis function, cased-based reasoning,

**Text book 2: Chapter 8.1-8.5**

| | |
|---|---|
| **Teaching-Learning Process** | Chalk and board, MOOC |

**Course Outcomes**
At the end of the course the student will be able to:

CO 1. Demonstrate the fundamentals of Intelligent Agents
CO 2. Illustrate the reasoning on Uncertain Knowledge
CO 3. Explore the explanation-based learning in solving AI problems
CO 4. Apply effectively ML algorithms to solve real world problems.
CO 5. Apply Instant based techniques and derive effectively learning rules to real world problems.

**Assessment Details (both CIE and SEE)**

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures not less than 35% (18 Marks out of 50) in the semester-end examination (SEE), and a minimum of 40% (40 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE

(Semester End Examination) taken together

**Continuous Internal Evaluation:**

Three Unit Tests each of **20 Marks (duration 01 hour**)

1. First test at the end of 5th week of the semester
2. Second test at the end of the 10th week of the semester
3. Third test at the end of the 15th week of the semester

Two assignments each of **10 Marks**

4. First assignment at the end of 4th week of the semester
5. Second assignment at the end of 9th week of the semester

Group discussion/Seminar/quiz any one of three suitably planned to attain the COs and POs for **20 Marks** (**duration 01 hours**)

6. At the end of the 13th week of the semester

The sum of three tests, two assignments, and quiz/seminar/group discussion will be out of 100 marks and will be **scaled down to 50 marks**

(to have less stressed CIE, the portion of the syllabus should not be common /repeated for any of the methods of the CIE. Each method of CIE should have a different syllabus portion of the course).

**CIE methods /question paper has to be designed to attain the different levels of Bloom's taxonomy as per the outcome defined for the course.**

**Semester End Examination:**

Theory SEE will be conducted by University as per the scheduled timetable, with common question papers for the subject (**duration 03 hours)**

1. The question paper will have ten questions. Each question is set for 20 marks.
2. There will be 2 questions from each module. Each of the two questions under a module (with a maximum of 3 sub-questions), **should have a mix of topics** under that module.
3. The students have to answer 5 full questions, selecting one full question from each module. Marks scored shall be proportionally reduced to 50 marks

**Suggested Learning Resources:**

**Textbooks:**

1. Artificial Intelligence, A Modern Approach, Stuart J. Russell and Peter Norvig, Third Edition, Pearson, 2010
2. Tom M. Mitchell, Machine Learning, McGraw-Hill Education, 2013
3. Machine Learning, Anuradha Srinivasaraghavan, VincyJoeph, Wiley 2019
4. Machine Learning using Python ,Manaranjan Pradhan, U Dinesh Kumar, Wiley 2019

**Reference:**

1. An Introduction to Multi Agent Systems, Michael Wooldridge, Second Edition, John Wiley & Sons

**Web links and Video Lectures (e-Resources):**

1. https://www.youtube.com/playlist?list=PLwdnzlV3ogoXaceHrrFVZCJKbm_laSHcH
2. https://nptel.ac.in/courses/106/102/106102220/
3. https://www.youtube.com/playlist?list=PL1xHD4vteKYVpaIiy295pg6_SY5qznc77
4. https://nptel.ac.in/courses/106/106/106106139/

**Activity Based Learning (Suggested Activities in Class)/ Practical Based learning**

**VII Semester**

| CLOUD COMPUTING | | | |
|---|---|---|---|
| Course Code | 21CS72 | CIE Marks | 50 |
| Teaching Hours/Week (L:T:P: S) | 2:0:0:0 | SEE Marks | 50 |
| Total Hours of Pedagogy | 24 | Total Marks | 100 |
| Credits | 02 | Exam Hours | 03 |

**Course Learning Objectives:**

CLO 1. Introduce the rationale behind the cloud computing revolution and the business drivers
CLO 2. Introduce various models of cloud computing
CLO 3. Introduction on how to design cloud native applications, the necessary tools and the design tradeoffs.
CLO 4. Realize the importance of Cloud Virtualization, Abstraction`s and Enabling Technologies and cloud security

**Teaching-Learning Process (General Instructions)**

These are sample Strategies, which teachers can use to accelerate the attainment of the various course outcomes.

1. Lecturer method (L) does not mean only traditional lecture method, but different type of teaching methods may be adopted to develop the outcomes.
2. Show Video/animation films to explain functioning of various concepts.
3. Encourage collaborative (Group Learning) Learning in the class.
4. Ask at least three HOT (Higher order Thinking) questions in the class, which promotes critical thinking.
5. Adopt Problem Based Learning (PBL), which fosters students' Analytical skills, develop thinking skills such as the ability to evaluate, generalize, and analyze information rather than simply recall it.
6. Topics will be introduced in a multiple representation.
7. Show the different ways to solve the same problem and encourage the students to come up with their own creative ways to solve them.
8. Discuss how every concept can be applied to the real world - and when that's possible, it helps improve the students' understanding.

**Module-1**

**Introduction**:
Introduction ,Cloud Computing at a Glance, Historical Developments, Building Cloud Computing Environments, Amazon Web Services (AWS), Google AppEngine, Microsoft Azure, Hadoop, Force.com and Salesforce.com, Manjrasoft Aneka

**Textbook 1: Chapter 1: 1.1,1.2 and 1.3**

| **Teaching-Learning Process** | Chalk and board, Active Learning |
|---|---|

**Module-2**

**Virtualization:** Introduction, Characteristics of Virtualized, Environments Taxonomy of Virtualization Techniques, Execution Virtualization, Other Types of Virtualization, Virtualization and Cloud Computing, Pros and Cons of Virtualization, Technology Examples

**Textbook 1 : Chapter 3: 3.1 to 3.6**

| **Teaching-Learning Process** | Chalk and board, Active Learning |
|---|---|

**Module-3**

**Cloud Computing Architecture:** Introduction, Cloud Reference Model, Types of Clouds, Economics of the Cloud, Open Challenges

**Textbook 1: Chapter 4: 4.1 to 4.5**

| | |
|---|---|
| **Teaching-Learning Process** | Chalk and board, Demonstration |

**Module-4**

**Cloud Security**: Risks, Top concern for cloud users, privacy impact assessment, trust, OS security, VM Security, Security Risks posed by shared images and management OS.

**Textbook 2: Chapter 9: 9.1 to 9.6, 9.8, 9.9**

| | |
|---|---|
| **Teaching-Learning Process** | Chalk and board |

**Module-5**

**Cloud Platforms in Industry**
Amazon web services: - Compute services, Storage services, Communication services, Additional services. Google AppEngine: - Architecture and core concepts, Application life cycle, Cost model, Observations.

**Textbook 1: Chapter 9: 9.1 to 9.2**

**Cloud Applications:**
Scientific applications: - HealthCare: ECG analysis in the cloud, Biology: gene expression data analysis for cancer diagnosis, Geoscience: satellite image processing. Business and consumer applications: CRM and ERP, Social networking, media applications.

**Textbook 1: Chapter 10: 10.1 to 10.2**

| | |
|---|---|
| **Teaching-Learning Process** | Chalk and board |

**Course outcome (Course Skill Set)**
At the end of the course the student will be able to:

CO 1. Understand and analyze various cloud computing platforms and service provider.
CO 2. Illustrate various virtualization concepts.
CO 3. Identify the architecture, infrastructure and delivery models of cloud computing.
CO 4. Understand the Security aspects of CLOUD.
CO 5. Define platforms for development of cloud applications

**Assessment Details (both CIE and SEE)**

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures not less than 35% (18 Marks out of 50) in the semester-end examination (SEE), and a minimum of 40% (40 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together

**Continuous Internal Evaluation:**

Three Unit Tests each of **20 Marks (duration 01 hour**)

1. First test at the end of 5th week of the semester
2. Second test at the end of the 10th week of the semester
3. Third test at the end of the 15th week of the semester

Two assignments each of **10 Marks**

4. First assignment at the end of 4th week of the semester
5. Second assignment at the end of 9th week of the semester

Group discussion/Seminar/quiz any one of three suitably planned to attain the COs and POs for **20**

**Marks** (**duration 01 hours**)

6. At the end of the 13th week of the semester

The sum of three tests, two assignments, and quiz/seminar/group discussion will be out of 100 marks and will be **scaled down to 50 marks**

(to have less stressed CIE, the portion of the syllabus should not be common /repeated for any of the methods of the CIE. Each method of CIE should have a different syllabus portion of the course).

**CIE methods /question paper has to be designed to attain the different levels of Bloom's taxonomy as per the outcome defined for the course.**

**Semester End Examination:**

Theory SEE will be conducted by University as per the scheduled timetable, with common question papers for the subject (**duration 03 hours)**

1. The question paper will have ten questions. Each question is set for 20 marks.
2. There will be 2 questions from each module. Each of the two questions under a module (with a maximum of 2 sub-questions), **should have a mix of topics** under that module.
3. The students have to answer 5 full questions, selecting one full question from each module
4. Marks scored shall be proportionally reduced to 50 marks

**Suggested Learning Resources:**

**Textbooks**

1. Rajkumar Buyya, Christian Vecchiola, and Thamrai Selvi Mastering Cloud Computing McGraw Hill Education.
2. Dan C. Marinescu, Cloud Compting Theory and Practice, Morgan Kaufmann, Elsevier 2013

**Reference Books**

1. Toby Velte, Anthony Velte, Cloud Computing: A Practical Approach, McGraw-Hill Osborne Media.
2. George Reese, Cloud Application Architectures: Building Applications and Infrastructure in the Cloud, O'Reilly Publication.
3. John Rhoton, Cloud Computing Explained: Implementation Handbook for Enterprises, Recursive Press.

**Weblinks and Video Lectures (e-Resources):**

- https://www.youtube.com/watch?v=1N3oqYhzHv4
- https://www.youtube.com/watch?v=RWgW-CgdIk0

**Activity Based Learning (Suggested Activities in Class)/ Practical Based learning**

**VII Semester**

| SOCIAL NETWORK ANALYSIS | | | |
|---|---|---|---|
| Course Code | 21AI731 | CIE Marks | 50 |
| Teaching Hours/Week (L:T:P: S) | 3:0:0:0 | SEE Marks | 50 |
| Total Hours of Pedagogy | 40 | Total Marks | 100 |
| Credits | 03 | Exam Hours | 03 |

**Course Learning Objectives**

CLO 1. Understand Semantic Web for social network analysis.
CLO 2. Learn the Representation, Modelling and Aggregating social network data.
CLO 3. Learn the basic algorithms and techniques for detection and decentralization of social network.
CLO 4. Study Human behaviour in social networks and its management.
CLO 5. Visual representation of social network data in different applications.

**Teaching-Learning Process (General Instructions)**

These are sample Strategies, which teachers can use to accelerate the attainment of the various course outcomes.

1. Lecturer method (L) needs not to be only a traditional lecture method, but alternative effective teaching methods could be adopted to attain the outcomes.
2. Use of Video/Animation to explain functioning of various concepts.
3. Encourage collaborative (Group Learning) Learning in the class.
4. Ask at least three HOT (Higher order Thinking) questions in the class, which promotes critical thinking.
5. Adopt Problem Based Learning (PBL), which fosters students' Analytical skills, develop design thinking skills such as the ability to design, evaluate, generalize, and analyse information rather than simply recall it.
6. Introduce Topics in manifold representations.
7. Show the different ways to solve the same problem with different circuits/logic and encourage the students to come up with their own creative ways to solve them.
8. Discuss how every concept can be applied to the real world - and when that's possible, it helps improve the students' understanding.

**Module-1**

**Introduction to Semantic Web:** Limitations of current Web - Development of Semantic Web - Emergence of the Social Web.

**Social Network analysis:** Development of Social Network Analysis - Key concepts and measures in network analysis.

**Electronic sources for network analysis:** Electronic discussion networks, Blogs and online communities - Web-based networks.

**Text book 1: Chapter1 – 1.1, 1.3, 1.4, Chapter2 – 2.2 , 2.3, Chapter3 – 3.1 to 3.3**

| | |
|---|---|
| **Teaching-Learning Process** | Chalk and board, Active Learning, |

**Module-2**

**Knowledge Representation on the Semantic Web:** Ontology and their role in the Semantic Web – Ontology based knowledge Representation - Ontology languages for the Semantic Web - Resource Description Framework and schema - Web Ontology Language.

**Modelling and aggregating social network data:** State-of-the-art in network data representation - Ontological representation of social individuals - Ontological representation of social relationships -

Aggregating and reasoning with social network data.

**Text book 1: Chapter4 – 4.1(4.1.1), 4.2(4.2.1,4.2.2), Chapter5 – 5.1 to 5.4**

| | |
|---|---|
| **Teaching-Learning Process** | Chalk and board, Active Learning, Demonstration |

**Module-3**

**Detecting communities in social networks** - Definition of community - Evaluating communities - Methods for community detection - Tools for detecting communities

**Decentralized online social networks** - Introduction - Challenges for DOSN - The Case for Decentralizing OSNs - General Purpose DOSNs - Specialized Application Centric DOSNs - Social Distributed Systems - Delay-Tolerant DOSN.

**Text book 2: Chapter 12 – 12.2 to 12.5, Chapter 17**

| | |
|---|---|
| **Teaching-Learning Process** | Chalk and board, Problem based learning, Demonstration |

**Module-4**

**Understanding and predicting human behaviour for social communities:** User data management - Inference and Distribution - Enabling new human experiences – The Technologies.

**Managing Trust in Online Social Networks:** Trust in online environment - Trust models based on subjective logic - Trust network analysis - Trust transitivity analysis - Combining trust and reputation - Trust derivation based on trust comparisons.

**Text book 2: Chapter20 - 20.2, 20.3(20.3.1), Chapter22 – 22.3, 22.5, 22.6, 22.7, 22.9, 22.10**

| | |
|---|---|
| **Teaching-Learning Process** | Chalk & board, Problem based learning, MOOC |

**Module-5**

**Visualization of Social Networks**: Social Network Analysis - Visualization - Visualizing online social networks,

**Novel Visualizations and Interactions for Social Networks Exploration:** Visualizing social networks with matrix-based representations - Matrix and Node-Link Diagrams - Hybrid representations.

**Applications of Social Network Analysis**: Applications of Social Network Analysis - Covert networks - Community welfare - Collaboration networks - Co-Citation networks.

**Text Book 2: Chapter 27 – 27.2, 27.3, 27.4, Chapter 28 – 28.5, Chapter 29 – 29.3.3, 29.3.5 to 29.3.7**

| | |
|---|---|
| **Teaching-Learning Process** | Chalk and board, MOOC |

**Course Outcomes**

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

CO 1. Understand the Semantic Web and Electronic sources for social network analysis.
CO 2. Understand the **Representation,** Modelling and Aggregating social network data.
CO 3. Analyse the human behaviour in social network.
CO 4. Apply techniques for detection and decentralization of social network.
CO 5. Illustrate the visual representation of social network data.

**Assessment Details (both CIE and SEE)**

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The

minimum passing mark for the CIE is 40% of the maximum marks (20 marks). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures not less than 35% ( 18 Marks out of 50)in the semester-end examination(SEE), and a minimum of 40% (40 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together

**Continuous Internal Evaluation:**

Three Unit Tests each of **20 Marks (duration 01 hour**)

1. First test at the end of 5th week of the semester
2. Second test at the end of the 10th week of the semester
3. Third test at the end of the 15th week of the semester

Two assignments each of **10 Marks**

4. First assignment at the end of 4th week of the semester
5. Second assignment at the end of 9th week of the semester
6. At the end of the 13th week of the semester -Group discussion/Seminar/quiz any one of three suitably planned to attain the COs and POs for **20 Marks** (**duration 01 hours**)

The sum of three tests, two assignments, and quiz/seminar/group discussion will be out of 100 marks and will be **scaled down to 50 marks**

(to have less stressed CIE, the portion of the syllabus should not be common /repeated for any of the methods of the CIE. Each method of CIE should have a different syllabus portion of the course).

**CIE methods /question paper is designed to attain the different levels of Bloom's taxonomy as per the outcome defined for the course.**

**Semester End Examination:**

Theory SEE will be conducted by University as per the scheduled timetable, with common question papers for the subject (**duration 03 hours)**

1. The question paper will have ten questions. Each question is set for 20 marks.
2. There will be 2 questions from each module. Each of the two questions under a module (with a maximum of 3 sub-questions), **should have a mix of topics** under that module.
3. The students have to answer 5 full questions, selecting one full question from each module Marks scored shall be proportionally reduced to 50 marks

**Suggested Learning Resources:**

**Text Books**


1. Peter Mika, "Social Networks and the Semantic Web", First Edition, Springer 2007.
2. Borko Furht, "Handbook of Social Network Technologies and Applications", 1st Edition, Springer, 2010.


**Reference:**


1. Guandong Xu ,Yanchun Zhang and Lin Li, "Web Mining and Social Networking – Techniques and applications", First Edition Springer, 2011.
2. Dion Goh and Schubert Foo, "Social information Retrieval Systems: Emerging Technologies and Applications for Searching the Web Effectively", IGI Global Snippet, 2008.
3. Max Chevalier, Christine Julien and Chantal Soulé-Dupuy, "Collaborative and Social Information Retrieval and Access: Techniques for Improved user Modelling", IGI Global Snippet, 2009.
4. John G. Breslin, Alexander Passant and Stefan Decker, "The Social Semantic Web", Springer, 2009


**Web links and Video Lectures (e-Resources):**

1. https://www.youtube.com/watch?v=IiUDKDxScxI
2. http://www.nitttrc.edu.in/nptel/courses/video/106106146/L21.html
3. https://www.youtube.com/watch?v=DTxE9KV3YrE
4. https://www.youtube.com/watch?v=MQsTxRMy3Xg
5. https://www.youtube.com/watch?v=BQWoMRS5CGA
6. https://onlinecourses.nptel.ac.in/noc20_cs78/preview

**Activity Based Learning (Suggested Activities in Class)/ Practical Based learning**

**VII Semester**

| DIGITAL IMAGE PROCESSING | | | |
|---|---|---|---|
| Course Code | 21CS732 | CIE Marks | 50 |
| Teaching Hours/Week (L:T:P: S) | 3:0:0:0 | SEE Marks | 50 |
| Total Hours of Pedagogy | 40 | Total Marks | 100 |
| Credits | 03 | Exam Hours | 03 |

**Course Learning Objectives**

CLO 1. Understand the fundamentals of digital image processing
CLO 2. Explain the image transform techniques used in digital image processing
CLO 3. Apply different image enhancement techniques on digital images
CLO 4. Evaluate image restoration techniques and methods used in digital imageprocessing
CLO 5. Understand the Morphological Operations and Segmentation used in digital imageprocessing

**Teaching-Learning Process (General Instructions)**

These are sample Strategies, which teachers can use to accelerate the attainment of the various course outcomes.

1. Lecturer method (L) need not to be only a traditional lecture method, but alternative effective teaching methods could be adopted to attain the outcomes.
2. Use of Video/Animation to explain functioning of various concepts.
3. Encourage collaborative (Group Learning) Learning in the class.
4. Ask at least three HOT (Higher order Thinking) questions in the class, which promotes critical thinking.
5. Adopt Problem Based Learning (PBL), which fosters students' Analytical skills, develop design thinking skills such as the ability to design, evaluate, generalize, and analyze information rather than simply recall it.
6. Introduce Topics in manifold representations.
7. Show the different ways to solve the same problem with different circuits/logic and encourage the students to come up with their own creative ways to solve them.
8. Discuss how every concept can be applied to the real world - and when that's possible, it helps improve the students' understanding.

**Module-1**

**Digital Image Fundamentals**: What is Digital Image Processing? Originsof Digital Image Processing, Examples of fields that use DIP, FundamentalSteps in Digital Image Processing, Components of an Image ProcessingSystem, Elements of Visual Perception, Image Sensing and Acquisition, Image Sampling and Quantization, Some Basic Relationships BetweenPixels, Linear and Nonlinear Operations.

**Textbook 1: Chapter 1 and Chapter 2: Sections 2.1 to 2.5, 2.6.2**

| | |
|---|---|
| **Teaching-Learning Process** | Chalk and board, Active Learning, Problem based learning |

**Module-2**

**Spatial Domain:** Some Basic Intensity Transformation Functions, Histogram Processing, Fundamentals of Spatial Filtering, SmoothingSpatial Filters, Sharpening Spatial Filters

**Frequency Domain**: Preliminary Concepts, The Discrete FourierTransform (DFT) of Two Variables, Properties of the 2-D DFT, Filtering inthe Frequency Domain, Image Smoothing and Image Sharpening UsingFrequency Domain Filters, Selective Filtering.

**Textbook 1: Chapter 3: Sections 3.2 to 3.6 and Chapter 4: Sections 4.2, 4.5 to 4.10**

| | |
|---|---|
| **Teaching-Learning Process** | 1. Chalk and board, Active Learning, Demonstration<br>2. Laboratory Demonstration |

| Module-3 | |
|---|---|
| **Restoration:** Noise models, Restoration in the Presence of Noise Onlyusing Spatial Filtering and Frequency Domain Filtering, Linear, Position-Invariant Degradations, Estimating the Degradation Function, InverseFiltering, Minimum Mean Square Error (Wiener) Filtering, ConstrainedLeast Squares Filtering.<br><br>**Textbook 1: Chapter 5: Sections 5.2, to 5.9** | |
| **Teaching-Learning Process** | 1. Chalk and board |
| **Module-4** | |
| **Color Image Processing**: Color Fundamentals, Color Models, Pseudo color Image Processing. Wavelets: Background, Multiresolution Expansions.<br><br>**Morphological Image Processing**: Preliminaries, Erosion and Dilation, Opening and Closing, The Hit-or-Miss Transforms, Some Basic Morphological Algorithms.<br><br>**Text: Chapter 6: Sections 6.1 to 6.3, Chapter 7: Sections 7.1 and 7.2, Chapter 9: Sections 9.1 to 9.5** | |
| **Teaching-Learning Process** | 1.Chalk& board<br>2.Demonstartion of Case study /Application for wavelet transfer method |
| **Module-5** | |
| **Segmentation**: Introduction, classification of image segmentation algorithms, Detection of Discontinuities, Edge Detection, Hough Transforms and Shape Detection, Corner Detection, Principles of Thresholding.<br><br>**Representation and Description:** Representation, Boundary descriptors.<br><br>**Text2: Chapter 9: Sections 9.1, to 9.7 and Text 1: Chapter 11: Sections 11.1and 11.2** | |
| **Teaching-Learning Process** | 1.Chalk and board, MOOC.<br>2. Poster making activity for various image segmentation algorithms |

**Course Outcomes**

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

CO 1. Understand the fundamentals of Digital Image Processing.
CO 2. Apply different Image transformation techniques
CO 3. Analyze various image restoration techniques
CO 4. Understand colour image and morphological processing
CO 5. Design image analysis and segmentation techniques

**Assessment Details (both CIE and SEE)**

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures not less than 35% (18 Marks out of 50) in the semester-end examination (SEE), and a minimum of 40% (40 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together

**Continuous Internal Evaluation:**

Three Unit Tests each of **20 Marks (duration 01 hour**)

1. First test at the end of 5$^{th}$ week of the semester
2. Second test at the end of the 10$^{th}$ week of the semester
3. Third test at the end of the 15$^{th}$ week of the semester

Two assignments each of **10 Marks**

4. First assignment at the end of 4$^{th}$ week of the semester

5. Second assignment at the end of 9th week of the semester

Group discussion/Seminar/quiz any one of three suitably planned to attain the COs and POs for **20 Marks** (**duration 01 hours**)

6. At the end of the 13th week of the semester

The sum of three tests, two assignments, and quiz/seminar/group discussion will be out of 100 marks and will be **scaled down to 50 marks**

(to have less stressed CIE, the portion of the syllabus should not be common /repeated for any of the methods of the CIE. Each method of CIE should have a different syllabus portion of the course).

**CIE methods /question paper has to be designed to attain the different levels of Bloom's taxonomy as per the outcome defined for the course.**

**Semester End Examination:**

Theory SEE will be conducted by University as per the scheduled timetable, with common question papers for the subject (**duration 03 hours)**

1. The question paper will have ten questions. Each question is set for 20 marks.
2. There will be 2 questions from each module. Each of the two questions under a module (with a maximum of 3 sub-questions), **should have a mix of topics** under that module.
3. The students have to answer 5 full questions, selecting one full question from each module Marks scored shall be proportionally reduced to 50 marks

**Textbooks**

1. Rafael C. Gonzalez and Richard E. Woods, Digital Image Processing, Third Ed., Prentice Hall, 2008.
2. S. Sridhar, Digital Image Processing, Oxford University Press, 2nd Edition, 2016

**Reference:**

1. Digital Image Processing- S.Jayaraman, S.Esakkirajan, T.Veerakumar, TataMcGraw Hill 2014.
2. Fundamentals of Digital Image Processing-A. K. Jain, Pearson 2004

**Weblinks and Video Lectures (e-Resources):**

1. https://https://nptel.ac.in/courses/106/105/106105032/
2. https://github.com/PrajwalPrabhuiisc/Image-processing-assignments

**Activity Based Learning (Suggested Activities in Class)/ Practical Based learning**

Demonstration of finding the histogram from grayscale image, to check the low pass filter properties, filtering the images using Gaussian low pass filter, etc… using Python programming

Practical Based Assignment like following or any topic which is in-line with the course requirement. Students shall present and demonstrate their work at the end of semester.

- Program to show rotation, scaling, and translation of an image.
- Read an image and extract and display low-level features such as edges, textures using filtering techniques
- Demonstrate enhancing and segmenting low contrast 2D images.
- To Read an image, first apply erosion to the image and then subtract the result from the original.

**VII Semester**

| FULLSTACK DEVELOPMENT | | | |
|---|---|---|---|
| Course Code | 21AI733 | CIE Marks | 50 |
| Teaching Hours/Week (L:T:P: S) | 3:0:0:0 | SEE Marks | 50 |
| Total Hours of Pedagogy | 40 T | Total Marks | 100 |
| Credits | 03 | Exam Hours | 03 |

**Course Learning Objectives:**

CLO 1. Explain the use of learning full stack web development.
CLO 2. Make use of rapid application development in the design of responsive web pages.
CLO 3. Illustrate Models, Views and Templates with their connectivity in Django for full stack web development.
CLO 4. Demonstrate the use of state management and admin interfaces automation in Django.
CLO 5. Design and implement Django apps containing dynamic pages with SQL databases.

**Teaching-Learning Process (General Instructions)**

These are sample Strategies, which teachers can use to accelerate the attainment of the various course outcomes.

1. Lecturer method (L) does not mean only traditional lecture method, but different type of teaching methods may be adopted to develop the outcomes.
2. Show Video/animation films to explain functioning of various concepts.
3. Encourage collaborative (Group Learning) Learning in the class.
4. Ask at least three HOT (Higher order Thinking) questions in the class, which promotes critical thinking.
5. Adopt Problem Based Learning (PBL), which fosters students' Analytical skills, develop thinking skills such as the ability to evaluate, generalize, and analyze information rather than simply recall it.
6. Topics will be introduced in a multiple representation.
7. Show the different ways to solve the same problem and encourage the students to come up with their own creative ways to solve them.
8. Discuss how every concept can be applied to the real world - and when that's possible, it helps improve the students' understanding.

**Module-1: MVC based Web Designing**

Web framework, MVC Design Pattern, Django Evolution, Views, Mapping URL to Views, Working of Django URL Confs and Loose Coupling, Errors in Django, Wild Card patterns in URLS.

**Textbook 1: Chapter 1 and Chapter 3**

| | |
|---|---|
| **Teaching-Learning Process** | 1. Demonstration using Visual Studio Code<br>2. PPT/Prezi Presentation for Architecture and Design Patterns<br>3. Live coding of all concepts with simple examples |

**Module-2: Django Templates and Models**

Template System Basics, Using Django Template System, Basic Template Tags and Filters, MVT Development Pattern, Template Loading, Template Inheritance, MVT Development Pattern.

Configuring Databases, Defining and Implementing Models, Basic Data Access, Adding Model String Representations, Inserting/Updating data, Selecting and deleting objects, Schema Evolution

**Textbook 1: Chapter 4 and Chapter 5**

| | |
|---|---|
| **Teaching-Learning Process** | 1. Demonstration using Visual Studio Code<br>2. PPT/Prezi Presentation for Architecture and Design Patterns<br>3. Live coding of all concepts with simple examples |

| | |
|---|---|
| | 4. Case Study: Apply concepts learnt for an Online Ticket Booking System |

**Module-3: Django Admin Interfaces and Model Forms**

Activating Admin Interfaces, Using Admin Interfaces, Customizing Admin Interfaces, Reasons to use Admin Interfaces.

Form Processing, Creating Feedback forms, Form submissions, custom validation, creating Model Forms, URLConf Ticks, Including Other URLConfs.

**Textbook 1: Chapters 6, 7 and 8**

| | |
|---|---|
| **Teaching-Learning Process** | 1. Demonstration using Visual Studio Code<br>2. PPT/Prezi Presentation for Architecture and Design Patterns<br>3. Live coding of all concepts with simple examples |

**Module-4: Generic Views and Django State Persistence**

Using Generic Views, Generic Views of Objects, Extending Generic Views of objects, Extending Generic Views.

MIME Types, Generating Non-HTML contents like CSV and PDF, Syndication Feed Framework, Sitemap framework, Cookies, Sessions, Users and Authentication.

**Textbook 1: Chapters 9, 11 and 12**

| | |
|---|---|
| **Teaching-Learning Process** | 1. Demonstration using Visual Studio Code<br>2. PPT/Prezi Presentation for Architecture and Design Patterns<br>3. Live coding of all concepts with simple examples<br>4. Project Work: Implement all concepts learnt for Student Admission Management. |

**Module-5: jQuery and AJAX Integration in Django**

Ajax Solution, Java Script, XHTMLHttpRequest and Response, HTML, CSS, JSON, iFrames, Settings of Java Script in Django, jQuery and Basic AJAX, jQuery AJAX Facilities, Using jQuery UI Autocomplete in Django

**Textbook 2: Chapters 1, 2 and 7.**

| | |
|---|---|
| **Teaching-Learning Process** | 1. Demonstration using Visual Studio Code<br>2. PPT/Prezi Presentation for Architecture and Design Patterns<br>3. Live coding of all concepts with simple examples<br>4. Case Study: Apply the use of AJAX and jQuery for development of EMI calculator. |

**Course outcome (Course Skill Set)**

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

CO 1. Understand the working of MVT based full stack web development with Django.
CO 2. Designing of Models and Forms for rapid development of web pages.
CO 3. Analyze the role of Template Inheritance and Generic views for developing full stack web applications.
CO 4. Apply the Django framework libraries to render nonHTML contents like CSV and PDF.
CO 5. Perform jQuery based AJAX integration to Django Apps to build responsive full stack web applications,

**Assessment Details (both CIE and SEE)**

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is

50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures not less than 35% (18 Marks out of 50) in the semester-end examination (SEE), and a minimum of 40% (40 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together

**Continuous Internal Evaluation:**

Three Unit Tests each of **20 Marks (duration 01 hour**)

1. First test at the end of 5th week of the semester
2. Second test at the end of the 10th week of the semester
3. Third test at the end of the 15th week of the semester

Two assignments each of **10 Marks**

4. First assignment at the end of 4th week of the semester
5. Second assignment at the end of 9th week of the semester

Group discussion/Seminar/quiz any one of three suitably planned to attain the COs and POs for **20 Marks** (**duration 01 hours**)

6. At the end of the 13th week of the semester

The sum of three tests, two assignments, and quiz/seminar/group discussion will be out of 100 marks and will be **scaled down to 50 marks**

(to have less stressed CIE, the portion of the syllabus should not be common /repeated for any of the methods of the CIE. Each method of CIE should have a different syllabus portion of the course).

**CIE methods /question paper has to be designed to attain the different levels of Bloom's taxonomy as per the outcome defined for the course.**

**Semester End Examination:**

Theory SEE will be conducted by University as per the scheduled timetable, with common question papers for the subject (**duration 03 hours)**

1. The question paper will have ten questions. Each question is set for 20 marks.
2. There will be 2 questions from each module. Each of the two questions under a module (with a maximum of 3 sub-questions), **should have a mix of topics** under that module.
3. The students have to answer 5 full questions, selecting one full question from each module Marks scored shall be proportionally reduced to 50 marks

**Suggested Learning Resources:**

**Textbooks**

1. Adrian Holovaty, Jacob Kaplan Moss, The Definitive Guide to Django: Web Development Done Right, Second Edition, Springer-Verlag Berlin and Heidelberg GmbH & Co. KG Publishers, 2009
2. Jonathan Hayward, Django Java Script Integration: AJAX and jQuery, First Edition, Pack Publishing, 2011

**Reference Books**

1. Aidas Bendroraitis, Jake Kronika, Django 3 Web Development Cookbook, Fourth Edition, Packt Publishing, 2020
2. William Vincent, Django for Beginners: Build websites with Python and Django, First Edition, Amazon Digital Services, 2018
3. Antonio Mele, Django3 by Example, 3rd Edition, Pack Publishers, 2020
4. Arun Ravindran, Django Design Patterns and Best Practices, 2nd Edition, Pack Publishers, 2020.

5. Julia Elman, Mark Lavin, Light weight Django, David A. Bell, 1st Edition, Oreily Publications, 2014

**Weblinks and Video Lectures (e-Resources):**

1. MVT architecture with Django: https://freevideolectures.com/course/3700/django-tutorials
2. Using Python in Django: https://www.youtube.com/watch?v=2BqoLiMT3Ao
3. Model Forms with Django: https://www.youtube.com/watch?v=gMM1rtTwKxE
4. Real time Interactions in Django: https://www.youtube.com/watch?v=3gHmfoeZ45k
5. AJAX with Django for beginners: https://www.youtube.com/watch?v=3VaKNyjlxAU

**Activity Based Learning (Suggested Activities in Class)/ Practical Based learning**

1. Real world problem solving - applying the Django framework concepts and its integration with AJAX to develop any shopping website with admin and user dashboards.

**VII Semester**

| BLOCKCHAIN TECHNOLOGY | | | |
|---|---|---|---|
| Course Code | 21CS734 | CIE Marks | 50 |
| Teaching Hours/Week (L:T:P: S) | 3:0:0:0 | SEE Marks | 50 |
| Total Hours of Pedagogy | 40 | Total Marks | 100 |
| Credits | 03 | Exam Hours | 03 |

**Course Learning Objectives**

CLO 1. Explain the fundamentals of distributed computing and blockchain
CLO 2. Discuss the concepts in bitcoin
CLO 3. Demonstrate Ethereum platform

**Teaching-Learning Process (General Instructions)**

These are sample Strategies, which teachers can use to accelerate the attainment of the various course outcomes.

1. Lecturer method (L) need not to be only a traditional lecture method, but alternative effective teaching methods could be adopted to attain the outcomes.
2. Use of Video/Animation to explain functioning of various concepts.
3. Encourage collaborative (Group Learning) Learning in the class.
4. Ask at least three HOT (Higher order Thinking) questions in the class, which promotes critical thinking.
5. Adopt Problem Based Learning (PBL), which fosters students' Analytical skills, develop design thinking skills such as the ability to design, evaluate, generalize, and analyze information rather than simply recall it.
6. Introduce Topics in manifold representations.
7. Show the different ways to solve the same problem with different circuits/logic and encourage the students to come up with their own creative ways to solve them.
8. Discuss how every concept can be applied to the real world - and when that's possible, it helps improve the students' understanding.

**Module-1**

**Blockchain 101:** Distributed systems, History of blockchain, Introduction to blockchain, Types of blockchain, CAP theorem and blockchain, Benefits and limitations of blockchain.

**Decentralization and Cryptography:** Decentralization using blockchain, Methods of decentralization, Routes to decentralization, Decentralized organizations.

**Textbook 1: Chapter 1, 2**

| **Teaching-Learning Process** | Chalk and board, Active Learning – Oral presentations. |
|---|---|

**Module-2**

**Introduction to Cryptography & Cryptocurrencies:** Cryptographic Hash Functions, Hash Pointers and Data Structures, Digital Signatures, Public Keys as Identities, A Simple Cryptocurrency,

**How Bitcoin Achieves Decentralization:** Distributed consensus, Consensus without identity using a block chain, Incentives and proof of work, Putting it all together,

**Textbook 2: Chapter 1, 2**

| **Teaching-Learning Process** | Chalk and board, Demonstration |
|---|---|

**Module-3**

**Mechanics of Bitcoin:** Bitcoin transactions, Bitcoin Scripts, Applications of Bitcoin scripts, Bitcoin blocks, The Bitcoin network, Limitations and improvements

**How to Store and Use Bitcoins:** Simple Local Storage, Hot and Cold Storage, Splitting and Sharing Keys,

Online Wallets and Exchanges, Payment Services, Transaction Fees, Currency Exchange Markets

**Textbook2: Chapter 3,4**

| **Teaching-Learning Process** | Chalk and board, Problem based learning, Demonstration, MOOC |
|---|---|

**Module-4**

**Bitcoin Mining:** The task of Bitcoin miners, Mining Hardware, Energy consumption and ecology, Mining pools, Mining incentives and strategies,

**Bitcoin and Anonymity:** Anonymity Basics, How to De-anonymize Bitcoin, Mixing, Decentralized Mixing, Zerocoin and Zerocash,

**Textbook2: Chapter 5,6**

| **Teaching-Learning Process** | Chalk& board, Problem based learning, MOOC |
|---|---|

**Module-5**

**Smart Contracts and Ethereum 101:**
Smart Contracts: Definition, Ricardian contracts.

**Ethereum 101:** Introduction, Ethereum blockchain, Elements of the Ethereum blockchain, Precompiled contracts.

**Textbook 1: Chapter 10**

| **Teaching-Learning Process** | Chalk and board, MOOC, Practical Demonstration |
|---|---|

**Course Outcomes**

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

CO 1. Describe the concepts of Distrbuted computing and its role in Blockchain
CO 2. Describe the concepts of Cryptography and its role in Blockchain
CO 3. List the benefits, drawbacks and applications of Blockchain
CO 4. Appreciate the technologies involved in Bitcoin
CO 5. Appreciate and demonstrate the Ethereum platform to develop blockchain application.

**Assessment Details (both CIE and SEE)**

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures not less than 35% (18 Marks out of 50) in the semester-end examination (SEE), and a minimum of 40% (40 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together

**Continuous Internal Evaluation:**

Three Unit Tests each of **20 Marks (duration 01 hour**)

1. First test at the end of 5th week of the semester
2. Second test at the end of the 10th week of the semester
3. Third test at the end of the 15th week of the semester

Two assignments each of **10 Marks**

4. First assignment at the end of 4th week of the semester
5. Second assignment at the end of 9th week of the semester

Group discussion/Seminar/quiz any one of three suitably planned to attain the COs and POs for **20 Marks** (**duration 01 hours**)

6. At the end of the 13th week of the semester

The sum of three tests, two assignments, and quiz/seminar/group discussion will be out of 100 marks and will be **scaled down to 50 marks**

(to have less stressed CIE, the portion of the syllabus should not be common /repeated for any of the methods of the CIE. Each method of CIE should have a different syllabus portion of the course).

**CIE methods /question paper has to be designed to attain the different levels of Bloom's taxonomy**

**as per the outcome defined for the course.**

**Semester End Examination:**

Theory SEE will be conducted by University as per the scheduled timetable, with common question papers for the subject (**duration 03 hours)**

1. The question paper will have ten questions. Each question is set for 20 marks.
2. There will be 2 questions from each module. Each of the two questions under a module (with a maximum of 3 sub-questions), **should have a mix of topics** under that module.
3. The students have to answer 5 full questions, selecting one full question from each module Marks scored shall be proportionally reduced to 50 marks

**Suggested Learning Resources:**

**Textbooks**

1. Mastering Blockchain - Distributed ledgers, decentralization and smart contracts explained, Imran Bashir, Packt Publishing Ltd, Second Edition, ISBN 978-1-78712-544-5, 2017.
2. Arvind Narayanan, Joseph Bonneau, Edward W. Felten, Andrew Miller, Steven Goldfeder and Jeremy Clark., Bitcoin and Cryptocurrency Technologies: A Comprehensive Introduction. Princeton University Press, 2016.

**Reference:**

1. Mastering Bitcoins: Unlocking Digital Cryptocurrencies by Andreas Antonopoulos. O'Reilly Media, Inc, 2013.

**Weblinks and Video Lectures (e-Resources):**

1. http://bitcoinbook.cs.princeton.edu/?_ga=2.8302578.1344744326.1642688462-86383721.1642688462
2. https://nptel.ac.in/courses/106/105/106105184/
3. https://ethereum.org/en/developers/
4. https://developer.ibm.com/components/hyperledger-fabric/tutorials/

**Activity Based Learning (Suggested Activities in Class)/ Practical Based learning**

**VII Semester**

| INTERNET OF THINGS | | | |
|---|---|---|---|
| Course Code | 21CS735 | CIE Marks | 50 |
| Teaching Hours/Week (L:T:P: S) | 3:0:0:0 | SEE Marks | 50 |
| Total Hours of Pedagogy | 40 | Total Marks | 100 |
| Credits | 03 | Exam Hours | 03 |

**Course Learning Objectives**

CLO 1. Understand about the fundamentals of Internet of Things and its building blocks along with their characteristics.
CLO 2. Understand the recent application domains of IoT in everyday life.
CLO 3. Understand the protocols and standards designed for IoT and the current research on it.
CLO 4. Understand the other associated technologies like cloud and fog computing in the domain of IoT.
CLO 5. Improve their knowledge about the various cutting-edge technologies in the field IoT and machine learning applications.
CLO 6. Gain insights about the current trends of machine learning and AI techniques used in IoT to orient towards the present industrial scenario.

**Teaching-Learning Process (General Instructions)**

These are sample Strategies, which teachers can use to accelerate the attainment of the various course outcomes.

1. Lecturer method (L) need not to be only a traditional lecture method, but alternative effective teaching methods could be adopted to attain the outcomes.
2. Use of Video/Animation to explain functioning of various concepts.
3. Encourage collaborative (Group Learning) Learning in the class.
4. Ask at least three HOT (Higher order Thinking) questions in the class, which promotes critical thinking.
5. Adopt Problem Based Learning (PBL), which fosters students' Analytical skills, develop design thinking skills such as the ability to design, evaluate, generalize, and analyze information rather than simply recall it.
6. Introduce Topics in manifold representations.
7. Show the different ways to solve the same problem with different circuits/logic and encourage the students to come up with their own creative ways to solve them.
8. Discuss how every concept can be applied to the real world - and when that's possible, it helps improve the students' understanding.

**Module-1**

**Emergence of IoT:** Introduction, Evolution of IoT, Enabling IoT and the Complex Interdependence of Technologies, IoT Networking Components, Addressing Strategies in IoT.

**Textbook 1: Chapter 4 – 4.1 to 4.5**

| **Teaching-Learning Process** | Chalk and board, Active Learning, Problem based learning |
|---|---|

**Module-2**

**IoT Sensing and Actuation:** Introduction, Sensors, Sensor Characteristics, Sensorial Deviations, Sensing Types, Sensing Considerations, Actuators, Actuator Types, Actuator Characteristics.

**Textbook 1: Chapter 5 – 5.1 to 5.9**

| **Teaching-Learning Process** | Chalk and board, Active Learning, Demonstration |
|---|---|

**Module-3**

**IoT Processing Topologies and Types:** Data Format, Importance of Processing in IoT, Processing Topologies, IoT Device Design and Selection Considerations, Processing Offloading.

**Textbook 1: Chapter 6 – 6.1 to 6.5**

| **Teaching-Learning Process** | Chalk and board, Problem based learning, Demonstration |
|---|---|

**Module-4**

**IoT Connectivity Technologies:** Introduction, IEEE 802.15.4, Zigbee, Thread, ISA100.11A, WirelessHART, RFID, NFC, DASH7, Z-Wave, Weightless, Sigfox, LoRa, NB-IoT, Wi-Fi, Bluetooth

**Textbook 1: Chapter 7 – 7.1 to 7.16**

| **Teaching-Learning Process** | Chalk & board, Problem based learning |
|---|---|

**Module-5**

**IoT Communication Technologies:** Introduction, Infrastructure Protocols, Discovery Protocols, Data Protocols, Identification Protocols, Device Management, Semantic Protocols

**IoT Interoperability:** Introduction, Taxonomy of interoperability, Standards, Frameworks

**Textbook 1: Chapter 8 – 8.1, 6.2, 8.3, 8.4, 8.5, 8.6, .7**
**Textbook 1: Chapter 9 – 9.1, 9.2, 9.3**

| **Teaching-Learning Process** | Chalk and board, MOOC |
|---|---|

**Course Outcomes**

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

CO 1. Understand the evolution of IoT, IoT networking components, and addressing strategies in IoT.
CO 2. Analyze various sensing devices and actuator types.
CO 3. Demonstrate the processing in IoT.
CO 4. Apply different connectivity technologies.
CO 5. Understand the communication technologies , protocols and interoperability in IoT.

**Assessment Details (both CIE and SEE)**

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures not less than 35% (18 Marks out of 50) in the semester-end examination (SEE), and a minimum of 40% (40 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together

**Continuous Internal Evaluation:**

Three Unit Tests each of **20 Marks (duration 01 hour**)

1. First test at the end of 5th week of the semester
2. Second test at the end of the 10th week of the semester
3. Third test at the end of the 15th week of the semester

Two assignments each of **10 Marks**

4. First assignment at the end of 4th week of the semester
5. Second assignment at the end of 9th week of the semester
6. At the end of the 13th week of the semester- Group discussion/Seminar/quiz any one of three suitably planned to attain the COs and POs for **20 Marks** (**duration 01 hours**)

The sum of three tests, two assignments, and quiz/seminar/group discussion will be out of 100 marks and will be **scaled down to 50 marks**

(to have less stressed CIE, the portion of the syllabus should not be common /repeated for any of the methods of the CIE. Each method of CIE should have a different syllabus portion of the course).

**CIE methods /question paper has to be designed to attain the different levels of Bloom's taxonomy as per the outcome defined for the course.**

**Semester End Examination:**

Theory SEE will be conducted by University as per the scheduled timetable, with common question papers for the subject (**duration 03 hours)**

1. The question paper will have ten questions. Each question is set for 20 marks.

2. There will be 2 questions from each module. Each of the two questions under a module (with a maximum of 3 sub-questions), **should have a mix of topics** under that module.
3. The students have to answer 5 full questions, selecting one full question from each module Marks scored shall be proportionally reduced to 50 marks

**Suggested Learning Resources:**

**Textbooks**

1. Sudip Misra, Anandarup Mukherjee, Arijit Roy, "Introduction to IoT", Cambridge University Press 2021.

**Reference:**

1. S. Misra, C. Roy, and A. Mukherjee, 2020. Introduction to Industrial Internet of Things and Industry 4.0. CRC Press.
2. Vijay Madisetti and Arshdeep Bahga, "Internet of Things (A Hands-on-Approach)",1st Edition, VPT, 2014.
3. Francis daCosta, "Rethinking the Internet of Things: A Scalable Approach to Connecting Everything", 1st Edition, Apress Publications, 2013.

**Weblinks and Video Lectures (e-Resources):**

1. https://nptel.ac.in/noc/courses/noc19/SEM1/noc19-cs31/

**Activity Based Learning (Suggested Activities in Class)/ Practical Based learning**

**VII Semester**

| AUGMENTED REALITY | | | |
|---|---|---|---|
| Course Code | 21AI741 | CIE Marks | 50 |
| Teaching Hours/Week (L:T:P: S) | 3:0:0:0 | SEE Marks | 50 |
| Total Hours of Pedagogy | 40 | Total Marks | 100 |
| Credits | 03 | Exam Hours | 03 |

**Course Learning Objectives**

CLO 1. Understand the importance of Augmented reality
CLO 2. Understand and analyse the importance of Tracking system.
CLO 3. Compare and contrast the computer vision for Augmented reality and its applications
CLO 4. Analyse and understand Registration and camera simulation of visual coherence.
CLO 5. Acquire knowledge of Situated Visualization

**Teaching-Learning Process (General Instructions)**

These are sample Strategies, which teachers can use to accelerate the attainment of the various course outcomes.

1. Lecturer method (L) needs not to be only the traditional lecture method, but alternative effective teaching methods could be adopted to attain the outcomes.
2. Use of Video/Animation to explain the functioning of various concepts.
3. Encourage collaborative (Group Learning) Learning in the class.
4. Ask at least three HOT (Higher order Thinking) questions in the class, which promotes critical thinking.
5. Adopt Problem Based Learning (PBL), which fosters students' Analytical skills, develop design thinking skills such as the ability to design, evaluate, generalize, and analyse information rather than simply recall it.
6. Introduce Topics in manifold representations.
7. Show the different ways to solve the same problem with different circuits/logic and encourage the students to come up with their own creative ways to solve them.
8. Discuss how every concept can be applied to the real world - and when that's possible, it helps improve the students' understanding.

**Module-1**

**Introduction to Augmented Reality**
What Is Augmented Reality - Defining augmented reality, history of augmented reality, Examples, Displays-Multimodal Displays, Visual Perception, Requirements and Characteristics, Spatial Display Model

**Text book 1: Chapter 1,2**

| | |
|---|---|
| **Teaching-Learning Process** | Chalk and board, Active Learning, Problem based learning |

**Module-2**

**Tracking:** Tracking, Calibration, and Registration, Characteristics of Tracking Technology, Stationary Tracking Systems, Mobile Sensors, Optical Tracking, Sensor Fusion

**Text book 1: Chapter 3**

| | |
|---|---|
| **Teaching-Learning Process** | Chalk and board, Active Learning, Demonstration |

**Module-3**

**Computer Vision for Augmented Reality**-Marker Tracking, Multiple-Camera Infrared Tracking, Natural Feature Tracking by Detection, Incremental Tracking, Simultaneous Localization and Mapping, Outdoor Tracking

Calibration and Registration-Camera Calibration, Display Calibration, Registration

**Text book 1: Chapter 4,5**

| | |
|---|---|
| **Teaching-Learning Process** | Chalk and board, Problem based learning, Demonstration |

**Module-4**

**Visual Coherence:** Registration, Photometric Registration, Common Illumination, Diminished Reality, Camera Simulation, Stylized Augmented Reality

**Text book 1: Chapter 6**

| | |
|---|---|
| **Teaching-Learning Process** | Chalk& board, Problem based learning |

**Module-5**

**Situated Visualization:** Challenges, Visualization Registration, Annotations and Labeling, X-Ray Visualization, Spatial Manipulation, Information Filtering
Interaction-Output Modalities, Input Modalities, Tangible Interfaces

**Text Book 1: Chapter 7,8**

| | |
|---|---|
| **Teaching-Learning Process** | Chalk and board, MOOC |

**Course Outcomes**

At the end of the course the student will be able to:
CO1:Understand the importance of Augmented reality
CO2: Comprehend and analyse the Tracking system.
CO3: Compare and Contrast the computer vision for Augmented reality
CO4: Analyse and understand Registration and camera simulation of visual coherence.
CO5: Acquire knowledge of Situated Visualization

**Assessment Details (both CIE and SEE)**

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures not less than 35% ( 18 Marks out of 50)in the semester-end examination(SEE), and a minimum of 40% (40 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together

**Continuous Internal Evaluation:**

Three Unit Tests each of **20 Marks (duration 01 hour**)

1. First test at the end of 5th week of the semester
2. Second test at the end of the 10th week of the semester
3. Third test at the end of the 15th week of the semester

Two assignments each of **10 Marks**

4. First assignment at the end of 4th week of the semester
5. Second assignment at the end of 9th week of the semester

Group discussion/Seminar/quiz any one of three suitably planned to attain the COs and POs for **20 Marks** (**duration 01 hours**)

6. At the end of the 13th week of the semester

The sum of three tests, two assignments, and quiz/seminar/group discussion will be out of 100 marks and

will be **scaled down to 50 marks**

(to have less stressed CIE, the portion of the syllabus should not be common /repeated for any of the methods of the CIE. Each method of CIE should have a different syllabus portion of the course).

**CIE methods /question papers are designed to attain the different levels of Bloom's taxonomy as per the outcome defined for the course.**

**Semester End Examination:**

Theory SEE will be conducted by University as per the scheduled timetable, with common question papers for the subject (**duration 03 hours)**

1. The question paper will have ten questions. Each question is set for 20 marks.
2. There will be 2 questions from each module. Each of the two questions under a module (with a maximum of 3 sub-questions), **should have a mix of topics** under that module.
3. The students have to answer 5 full questions, selecting one full question from each module Marks scored shall be proportionally reduced to 50 marks

**Suggested Learning Resources:**

**Text Books**

1. Augmented Reality: Principles and Practice by Dieter SCHMALSTIEG,Tobias HOLLERER

**Reference:**

1. Augmented Reality: Principles & Practice by Schmalstieg / Hollerer, Pearson Education India; First edition (12 October 2016),ISBN-10: 9332578494
2. Sanni Siltanen- Theory and applications of marker-based augmented reality. Julkaisija – Utgivare Publisher. 2012. ISBN 978-951-38-7449-0
3. Allan Fowler-AR Game Development‖, 1st Edition, A press Publications, 2018, ISBN 978-1484236178

**Web links and Video Lectures (e-Resources):**

e-Books:

1. https://www.vttresearch.com/sites/default/files/pdf/science/2012/S3.pdf
2. https://docs.microsoft.com/en-us/windows/mixed-reality/
3. https://docs.microsoft.com/enus/archive/msdnmagazine/2016/november/hololensintroduction-to-the-hololens

**Activity Based Learning (Suggested Activities in Class)/ Practical Based learning**

**VII Semester**

| MULTIAGENT SYSTEMS | | | |
|---|---|---|---|
| Course Code | 21CS742 | CIE Marks | 50 |
| Teaching Hours/Week (L:T:P: S) | 3:0:0:0 | SEE Marks | 50 |
| Total Hours of Pedagogy | 40 | Total Marks | 100 |
| Credits | 03 | Exam Hours | 03 |

**Course Learning Objectives**

CLO 1. To introduce the concept of a multi agent systems and Distributed Constraints
CLO 2. Explore the main issues surrounding the computer and extended form games.
CLO 3. Develop cooperative learning, stochastic games
CLO 4. Exhibit the awareness about protocols about multi agent resource allocation and auctions
CLO 5. Construct voting mechanism design.

**Teaching-Learning Process (General Instructions)**

These are sample Strategies, which teachers can use to accelerate the attainment of the various course outcomes.

1. Lecturer method (L) need not to be only a traditional lecture method, but alternative effective teaching methods could be adopted to attain the outcomes.
2. Use of Video/Animation to explain functioning of various concepts.
3. Encourage collaborative (Group Learning) Learning in the class.
4. Ask at least three HOT (Higher order Thinking) questions in the class, which promotes critical thinking.
5. Adopt Problem Based Learning (PBL), which fosters students' Analytical skills, develop design thinking skills such as the ability to design, evaluate, generalize, and analyze information rather than simply recall it.
6. Introduce Topics in manifold representations.
7. Show the different ways to solve the same problem with different circuits/logic and encourage the students to come up with their own creative ways to solve them.
8. Discuss how every concept can be applied to the real world - and when that's possible, it helps improve the students' understanding.

**Module-1: Multiagent Problem Formulation**

Utility, Markov Decision Processes, Planning
**Distributed Constraints**: Distributed Constraint Satisfaction, Distributed Constraint Optimization

**Textbook 1: Chapters 1 &2, Textbook 2: Chapter 1**

| | |
|---|---|
| **Teaching-Learning Process** | 1. PPT – Decision Processes, Planning<br>2. Demonstration of constraints and their optimization |

**Module-2: Standard and Extended Form Games**

Games in Normal Form, Games in Extended Form, Self-interested agents, Characteristic Form Games, Coalition Formation

**Textbook 1: Chapters 3 & 4, Textbook 2: Chapter 3**

| | |
|---|---|
| **Teaching-Learning Process** | 1. PPT – Games in different forms<br>2. Demonstration of coalition formation |

**Module-3: Learning in Multiagent Systems**

The Machine Learning Problem, Cooperative Learning, Repeated Games, Stochastic Games, General Theories for Learning Agents, Collective Intelligence

**Textbook 1: Chapters 5**

| | |
|---|---|
| **Teaching-Learning Process** | 1. PPT – Cooperative learning, Collective intelligence<br>2. Demonstration of stochastic games |

**Module-4: Negotiation**

The Bargaining Problem, Monotonic Concession Protocol, Negotiation as Distributed Search, Ad-hoc Negotiation Strategies, The Task Allocation Problem.
**Protocols for Multiagent Resource Allocation: Auctions:** Simple Auctions, Combinatorial Auctions

**Textbook 1: Chapters 6&7,**
**Textbook 2: Chapter 11**

| | |
|---|---|
| **Teaching-Learning Process** | 1. PPT – Bargaining problems<br>2. Demonstration of different auctions for resource allocation |

**Module-5: Voting and Mechanism Design**

The Voting Problem, Mechanism Design. **Nature-Inspired Approaches:** Ants and Termites, Immune System

**Textbook 1: Chapters 8&10,**
**Textbook 2: Chapter 10**

| | |
|---|---|
| **Teaching-Learning Process** | 1. PPT – Voting Problem<br>2. Demonstration of nature inspired Approaches |

**Course Outcomes**

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

CO 1. Demonstrate the decision process with different constraints
CO 2. Analyze games in different forms
CO 3. Apply the cooperative learning in developing games
CO 4. Analyze different negotiation strategies of Multi-Agent System
CO 5. Design and develop solutions for voting problems

**Assessment Details (both CIE and SEE)**

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures not less than 35% (18 Marks out of 50) in the semester-end examination (SEE), and a minimum of 40% (40 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together

**Continuous Internal Evaluation:**

Three Unit Tests each of **20 Marks (duration 01 hour**)

1. First test at the end of 5th week of the semester
2. Second test at the end of the 10th week of the semester
3. Third test at the end of the 15th week of the semester

Two assignments each of **10 Marks**

4. First assignment at the end of 4th week of the semester
5. Second assignment at the end of 9th week of the semester

Group discussion/Seminar/quiz any one of three suitably planned to attain the COs and POs for **20 Marks** (**duration 01 hours**)

6. At the end of the 13th week of the semester

The sum of three tests, two assignments, and quiz/seminar/group discussion will be out of 100 marks and will be **scaled down to 50 marks**

(to have less stressed CIE, the portion of the syllabus should not be common /repeated for any of the methods of the CIE. Each method of CIE should have a different syllabus portion of the course).

**CIE methods /question papers are designed to attain the different levels of Bloom's taxonomy as per the outcome defined for the course.**

**Semester End Examination:**

Theory SEE will be conducted by University as per the scheduled timetable, with common question papers for the subject (**duration 03 hours)**

1. The question paper will have ten questions. Each question is set for 20 marks.
2. There will be 2 questions from each module. Each of the two questions under a module (with a maximum of 3 sub-questions), **should have a mix of topics** under that module.
3. The students have to answer 5 full questions, selecting one full question from each module Marks scored shall be proportionally reduced to 50 marks

**Suggested Learning Resources:**

**Textbooks**

1. Fundamentals of Multiagent Systems by Jos´e M. Vidal, 2006, available online http://jmvidal.cse.sc.edu/papers/mas.pdf.
2. Multiagent Systems: Algorithmic, Game-Theoretic, and Logical Foundations, By YoavShoham, Kevin Leyton-Brown, Cambridge University Press, 2008, 2nded http://www.masfoundations.org/mas.pdf

**Reference:**

1. Multiagent Systems : A Modern Approach to Distributed Artificial Intelligence Gerhard Weiss The MIT Press 2000

**Weblinks and Video Lectures (e-Resources):**

1. https://nptel.ac.in/courses/106/105/106105077/
2. https://www.youtube.com/watch?v=O2su1u2AXG0.
3. https://www.coursera.org/lecture/modeling-simulation-natural-processes/multi-agent-systems-kAKyC

**Activity Based Learning (Suggested Activities in Class)/ Practical Based learning**

**VII Semester**

| PREDICTIVE ANALYTICS | | | |
|---|---|---|---|
| Course Code | 21AI743 | CIE Marks | 50 |
| Teaching Hours/Week (L:T:P: S) | 3:0:0:0 | SEE Marks | 50 |
| Total Hours of Pedagogy | 40 | Total Marks | 100 |
| Credits | 03 | Exam Hours | 03 |

**Course Learning Objectives**

CLO 1. Comprehend the fundamental principles of analytics for business
CLO 2. Explore various techniques for predictive modelling
CLO 3. Analyse the data transformation of different predictors
CLO 4. Examine how predictive analytics can be used in decision making
CLO 5. Apply predictive models to generate predictions for new data

**Teaching-Learning Process (General Instructions)**

These are sample Strategies, which teachers can use to accelerate the attainment of the various course outcomes.

1. Lecturer method (L) needs not to be only a traditional lecture method, but alternative effective teaching methods could be adopted to attain the outcomes.
2. Use of Video/Animation to explain functioning of various concepts.
3. Encourage collaborative (Group Learning) Learning in the class.
4. Ask at least three HOT (Higher order Thinking) questions in the class, which promotes critical thinking.
5. Adopt Problem Based Learning (PBL), which fosters students' Analytical skills, develop design thinking skills such as the ability to design, evaluate, generalize, and analyse information rather than simply recall it.
6. Introduce Topics in manifold representations.
7. Show the different ways to solve the same problem with different circuits/logic and encourage the students to come up with their own creative ways to solve them.
8. Discuss how every concept can be applied to the real world - and when that's possible, it helps improve the students' understanding.

**Module-1**

**Introduction to Predictive analytics –** Business analytics: types, applications, Analytical Techniques, Tools

**Predictive Modelling:** Propensity Models, Cluster Models,Applications.

**Text book 1: Chapter 1, 2.**

| | |
|---|---|
| **Teaching-Learning Process** | Chalk and board, Active Learning |

**Module-2**

**Modelling Techniques**: Statistical Modelling, Machine Learning, Empirical Bayes Method,Point Estimation.

**Text book 1: Chapter 3,4**

| | |
|---|---|
| **Teaching-Learning Process** | Chalk and board, Active Learning |

**Module-3**

**Data Pre-processing:** Data Transformations for Individual Predictors, Data Transformation for Multiple Predictors, Dealing with Missing Values, Removing Predictors,Adding Predictors, Binning Predictors. Over-Fitting and Model Tuning.

**Text book 2: 3, 4**

| | |
|---|---|
| **Teaching-Learning Process** | Chalk and board, Active Learning |

**Module-4**

**Regression Models:** Measuring Performance in Regression Models - Linear Regression and Its Cousins - Non-Linear Regression Models - Regression Trees and Rule-Based Models Case Study: Compressive Strength of Concrete Mixtures.

**Text book 2: Chapter 5,6,7,8**

| | |
|---|---|
| **Teaching-Learning Process** | Chalk& board, Active Learning, MOOC |

**Module-5**

**Classification Models:** Measuring Performance in Classification Models - Discriminant Analysis and Other Linear Classification Models - Non-Linear Classification Models - Classification Trees and Rule-Based Models – Model Evaluation Techniques**.**

**Text Book 2: Chapter 11,12,13,14**

| | |
|---|---|
| **Teaching-Learning Process** | Chalk and board, MOOC |

**Course Outcomes**

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

CO 1. Understand the importance of predictive analytics, able to prepare and process data for the models
CO 2. Apply the statistical techniques for predictive models
CO 3. Comprehend the transformation of data in the predictors.
CO 4. Apply regression and classification models for decision making and evaluate the performance
CO 5. Apply and build the time series forecasting models in a variety of business contexts

**Assessment Details (both CIE and SEE)**

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures not less than 35% ( 18 Marks out of 50)in the semester-end examination(SEE), and a minimum of 40% (40 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together

**Continuous Internal Evaluation:**

Three Unit Tests each of **20 Marks (duration 01 hour**)

1. First test at the end of 5th week of the semester
2. Second test at the end of the 10th week of the semester
3. Third test at the end of the 15th week of the semester

Two assignments each of **10 Marks**

4. First assignment at the end of 4th week of the semester
5. Second assignment at the end of 9th week of the semester

Group discussion/Seminar/quiz any one of three suitably planned to attain the COs and POs for **20 Marks** (**duration 01 hours**)

6. At the end of the 13th week of the semester

The sum of three tests, two assignments, and quiz/seminar/group discussion will be out of 100 marks and will be **scaled down to 50 marks**

(to have less stressed CIE, the portion of the syllabus should not be common /repeated for any of the methods of the CIE. Each method of CIE should have a different syllabus portion of the course).

**CIE methods /question paper is designed to attain the different levels of Bloom's taxonomy as per the outcome defined for the course.**

**Semester End Examination:**

Theory SEE will be conducted by University as per the scheduled timetable, with common question papers for the subject (**duration 03 hours)**

1. The question paper will have ten questions. Each question is set for 20 marks.
2. There will be 2 questions from each module. Each of the two questions under a module (with a maximum of 3 sub-questions), **should have a mix of topics** under that module.
3. The students have to answer 5 full questions, selecting one full question from each module. Marks scored shall be proportionally reduced to 50 marks

**Suggested Learning Resources:**

**Text Books**

1. Jeffrey S. Strickland, Predictive Analytics using R,2014
2. Max Kuhn and Kjell Johnson, Applied Predictive Modeling, 1st edition Springer, 2013.

**Reference:**

1. Dean Abbott, Applied Predictive Analytics: Principles and Techniques for the Professional Data Analyst, 1st Edition Wiley, 2014.

**Web links and Video Lectures (e-Resources):**

1. https://www.coursera.org/lecture/fundamentals-of-data-analysis/introduction-to-predictive-analytics-u4H61

**Activity Based Learning (Suggested Activities in Class)/ Practical Based learning**

**VII Semester**

| ROBOTIC PROCESS AUTOMATION DESIGN AND DEVELOPMENT | | | |
|---|---|---|---|
| Course Code | 21CS744 | CIE Marks | 50 |
| Teaching Hours/Week (L:T:P: S) | 3:0:0:0 | SEE Marks | 50 |
| Total Hours of Pedagogy | 40 | Total Marks | 100 |
| Credits | 3 | Exam Hours | 3 |

**Course Learning Objectives**

CLO 1. To understand basic concepts of RPA
CLO 2. To Describe RPA, where it can be applied and how its implemented
CLO 3. To Describe the different types of variables, Control Flow and data manipulation techniques
CLO 4. To Understand Image, Text and Data Tables Automation
CLO 5. To Describe various types of Exceptions and strategies to handle

**Teaching-Learning Process (General Instructions)**

These are sample Strategies, which teachers can use to accelerate the attainment of the various course outcomes.

1. Lecturer method (L) need not to be only a traditional lecture method, but alternative effective teaching methods could be adopted to attain the outcomes.
2. Use of Video/Animation to explain functioning of various concepts.
3. Encourage collaborative (Group Learning) Learning in the class.
4. Ask at least three HOT (Higher order Thinking) questions in the class, which promotes critical thinking.
5. Adopt Problem Based Learning (PBL), which fosters students' Analytical skills, develop design thinking skills such as the ability to design, evaluate, generalize, and analyze information rather than simply recall it.
6. Introduce Topics in manifold representations.
7. Show the different ways to solve the same problem with different circuits/logic and encourage the students to come up with their own creative ways to solve them.
8. Discuss how every concept can be applied to the real world - and when that's possible, it helps improve the students' understanding.

**Module-1**

**RPA Foundations**- What is RPA – Flavors of RPA- History of RPA- The Benefits of RPA- The downsides of RPA- RPA Compared to BPO, BPM and BPA – Consumer Willingness for Automation- The Workforce of the Future- RPA Skills-On-Premise Vs. the Cloud- Web Technology- Programming Languages and Low Code- OCR-Databases-APIs- AI-Cognitive Automation-Agile, Scrum, Kanban and Waterfall0 DevOps-Flowcharts.

**Textbook 1: Ch 1, Ch 2**

| **Teaching-Learning Process** | Chalk and board, Active Learning, Problem based learning |
|---|---|

**Module-2**

**RPA Platforms**- Components of RPA- RPA Platforms-About Ui Path- About UiPath - The future of automation - Record and Play - Downloading and installing UiPath Studio -Learning Ui Path Studio- - Task recorder - Step-by-step examples using the recorder.

**Textbook 2: Ch 1, Ch 2**

| **Teaching-Learning Process** | Chalk and board, Active Learning, Demonstration |
|---|---|

**Module-3**

**Sequence, Flowchart, and Control Flow**-Sequencing the workflow-Activities-Control flow, various types of loops, and decision making-Step-by-step example using Sequence and Flowchart-Step-by-step

example using Sequence and Control flow-Data Manipulation-Variables and Scope-Collections-Arguments – Purpose and use-Data table usage with examples-Clipboard management-File operation with step-by-step example-CSV/Excel to data table and vice versa (with a step-by-step example).

**Textbook 2: Ch 3, Ch 4**

| **Teaching-Learning Process** | Chalk and board, Problem based learning, Demonstration |
|---|---|

**Module-4**

**Taking Control of the Controls**- Finding and attaching windows- Finding the control- Techniques for waiting for a control- Act on controls – mouse and keyboard activities- Working with UiExplorer- Handling events- Revisit recorder- Screen Scraping- When to use OCR- Types of OCR available- How to use OCR- Avoiding typical failure points.

**Textbook 2: Ch 5**

| **Teaching-Learning Process** | Chalk& board, Problem based learning |
|---|---|

**Module-5**

Exception Handling, Debugging, and Logging- Exception handling- Common exceptions and ways to handle them- Logging and taking screensHOT- Debugging techniques- Collecting crash dumps- Error reporting- Future of RPA

**Textbook 2: Ch 8**
**Textbook 1: Ch 13**

| **Teaching-Learning Process** | Chalk and board, MOOC |
|---|---|

**Course Outcomes**

CO 1. To Understand the basic concepts of RPA
CO 2. To Describe various components and platforms of RPA
CO 3. To Describe the different types of variables, control flow and data manipulation techniques
CO 4. To Understand various control techniques and OCR in RPA
CO 5. To Describe various types and strategies to handle exceptions

**Assessment Details (both CIE and SEE)**

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures not less than 35% (18 Marks out of 50) in the semester-end examination (SEE), and a minimum of 40% (40 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together

**Continuous Internal Evaluation:**

Three Unit Tests each of **20 Marks (duration 01 hour**)

1. First test at the end of 5th week of the semester
2. Second test at the end of the 10th week of the semester
3. Third test at the end of the 15th week of the semester

Two assignments each of **10 Marks**

4. First assignment at the end of 4th week of the semester
5. Second assignment at the end of 9th week of the semester

Group discussion/Seminar/quiz any one of three suitably planned to attain the COs and POs for **20 Marks** (**duration 01 hours**)

6. At the end of the 13th week of the semester

The sum of three tests, two assignments, and quiz/seminar/group discussion will be out of 100 marks and will be **scaled down to 50 marks**

(to have less stressed CIE, the portion of the syllabus should not be common /repeated for any of the

methods of the CIE. Each method of CIE should have a different syllabus portion of the course).

**CIE methods /question paper has to be designed to attain the different levels of Bloom's taxonomy as per the outcome defined for the course.**

**Semester End Examination:**

Theory SEE will be conducted by University as per the scheduled timetable, with common question papers for the subject (**duration 03 hours)**

1. The question paper will have ten questions. Each question is set for 20 marks.
2. There will be 2 questions from each module. Each of the two questions under a module (with a maximum of 3 sub-questions), **should have a mix of topics** under that module.
3. The students have to answer 5 full questions, selecting one full question from each module. Marks scored shall be proportionally reduced to 50 marks

**Suggested Learning Resources:**

**Textbooks**

1. Tom Taulli , The Robotic Process Automation Handbook : A Guide to Implementing RPA Systems, 2020, ISBN-13 (electronic): 978-1-4842-5729-6, Publisher : Apress
2. Alok Mani Tripathi, Learning Robotic Process Automation, Publisher: Packt Publishing Release Date: March 2018 ISBN: 9781788470940

**Reference:**

1. Frank Casale, Rebecca Dilla, Heidi Jaynes, Lauren Livingston, "Introduction to Robotic Process Automation: a Primer", Institute of Robotic Process Automation.
2. Richard Murdoch, Robotic Process Automation: Guide To Building Software Robots, Automate Repetitive Tasks & Become An RPA Consultant
3. Srikanth Merianda,Robotic Process Automation Tools, Process Automation and their benefits: Understanding RPA and Intelligent Automation

**Weblinks and Video Lectures (e-Resources):**

- https://www.uipath.com/rpa/robotic-process-automation

**Activity Based Learning (Suggested Activities in Class)/ Practical Based learning**

**VII Semester**

| NOSQL DATABASE | | | |
|---|---|---|---|
| Course Code: | 21CS745 | CIE Marks | 50 |
| Teaching Hours/Week (L:T:P:S) | 3:0:0:0 | SEE Marks | 50 |
| Total Hours of Pedagogy | 40 | Total Marks | 100 |
| Credits | 03 | Exam Hours | 03 |

**Course Objectives:**

CLO 1. Recognize and Describe the four types of NoSQL Databases, the Document-oriented, KeyValue
CLO 2. Pairs, Column-oriented and Graph databases useful for diverse applications.
CLO 3. Apply performance tuning on Column-oriented NoSQL databases and Document-oriented NoSQL Databases.
CLO 4. Differentiate the detailed architecture of column oriented NoSQL database, Document database and Graph Database and relate usage of processor, memory, storage and file system commands.
CLO 5. Evaluate several applications for location based service and recommendation services. Devise an application using the components of NoSQL.

**Teaching-Learning Process (General Instructions)**

These are sample Strategies, which teachers can use to accelerate the attainment of the various course outcomes.

1. Lecturer methods (L) need not to be only traditional lecture methods, but alternative effective teaching methods could be adopted to attain the outcomes.
2. Use of Video/Animation to explain functioning of various concepts.
3. Encourage collaborative (Group Learning) Learning in the class.
4. Ask at least three HOT (Higher order Thinking) questions in the class, which promotes critical thinking.
5. Adopt Problem Based Learning (PBL), which fosters students' Analytical skills, develop design thinking skills such as the ability to design, evaluate, generalize, and analyze information rather than simply recall it.
6. Introduce Topics in manifold representations.
7. Show the different ways to solve the same problem and encourage the students to come up with their own creative ways to solve them.
8. Discuss how every concept can be applied to the real world - and when that's possible, it helps improve the students' understanding.

**Module-1**

Why NoSQL? The Value of Relational Databases, Getting at Persistent Data, Concurrency, Integration, A (Mostly) Standard Model, Impedance Mismatch, Application and Integration Databases, Attack of the Clusters, The Emergence of NoSQL,

Aggregate Data Models; Aggregates, Example of Relations and Aggregates, Consequences of Aggregate Orientation, Key-Value and Document Data Models, Column-Family Stores, Summarizing Aggregate-Oriented Databases.

More Details on Data Models; Relationships, Graph Databases, Schemaless Databases, Materialized Views, Modeling for Data Access,

**Textbook1: Chapter 1,2,3**

| **Teaching-Learning Process** | Active learning |
|---|---|

**Module-2**

Distribution Models; Single Server, Sharding, Master-Slave Replication, Peer-to-Peer Replication, Combining Sharding and Replication.

Consistency, Update Consistency, Read Consistency, Relaxing Consistency, The CAP Theorem, Relaxing Durability, Quorums.

Version Stamps, Business and System Transactions, Version Stamps on Multiple Nodes

**Textbook1: Chapter 4,5,6**

| **Teaching-Learning Process** | Active Learning and Demonstrations |
|---|---|

**Module-3**

Map-Reduce, Basic Map-Reduce, Partitioning and Combining, Composing Map-Reduce Calculations, A Two Stage Map-Reduce Example, Incremental Map-Reduce

Key-Value Databases, What Is a Key-Value Store, Key-Value Store Features, Consistency, Transactions, Query Features, Structure of Data, Scaling, Suitable Use Cases, Storing Session Information, User Profiles, Preference, Shopping Cart Data, When Not to Use, Relationships among Data, Multioperation Transactions, Query by Data, Operations by Sets

**Textbook1: Chapter 7,8**

| **Teaching-Learning Process** | Active Learning, Problem solving based |
|---|---|

**Module-4**

Document Databases, What Is a Document Database?, Features, Consistency, Transactions, Availability, Query Features, Scaling, Suitable Use Cases, Event Logging, Content Management Systems, Blogging Platforms, Web Analytics or Real-Time Analytics, E- Commerce Applications, When Not to Use, Complex Transactions Spanning Dif erent Operations, Queries against Varying Aggregate Structure

**Textbook1: Chapter 9**

| **Teaching-Learning Process** | Active learning |
|---|---|

**Module-5**

Graph Databases, What Is a Graph Database?, Features, Consistency, Transactions, Availability, Query Features, Scaling, Suitable Use Cases, Connected Data, Routing, Dispatch, and Location-Based Services, Recommendation Engines, When Not to Use.

**Textbook1: Chapter 11**

| **Teaching-Learning Process** | Active learning |
|---|---|

**Course Outcomes (Course Skill Set)**

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

CO1. Demonstrate an understanding of the detailed architecture of Column Oriented NoSQL databases, Document databases, Graph databases.

CO2. Use the concepts pertaining to all the types of databases.

CO3. Analyze the structural Models of NoSQL.

CO4. Develop various applications using NoSQL databases.

**Assessment Details (both CIE and SEE)**

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures not less than 35% (18 Marks out of 50) in the semester-end examination (SEE), and a minimum of 40% (40 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together

**Continuous Internal Evaluation:**

Three Unit Tests each of **20 Marks (duration 01 hour**)

1. First test at the end of 5$^{th}$ week of the semester
2. Second test at the end of the 10$^{th}$ week of the semester
3. Third test at the end of the 15$^{th}$ week of the semester

Two assignments each of **10 Marks**

4. First assignment at the end of 4th week of the semester
5. Second assignment at the end of 9th week of the semester

Group discussion/Seminar/quiz any one of three suitably planned to attain the COs and POs for **20 Marks** (**duration 01 hours**)

6. At the end of the 13th week of the semester

The sum of three tests, two assignments, and quiz/seminar/group discussion will be out of 100 marks and will be **scaled down to 50 marks**

(to have less stressed CIE, the portion of the syllabus should not be common /repeated for any of the methods of the CIE. Each method of CIE should have a different syllabus portion of the course).

**CIE methods /question paper has to be designed to attain the different levels of Bloom's taxonomy as per the outcome defined for the course.**

**Semester End Examination:**

Theory SEE will be conducted by University as per the scheduled timetable, with common question papers for the subject (**duration 03 hours)**

1. The question paper will have ten questions. Each question is set for 20 marks.
2. There will be 2 questions from each module. Each of the two questions under a module (with a maximum of 3 sub-questions), **should have a mix of topics** under that module.
3. The students have to answer 5 full questions, selecting one full question from each module Marks scored shall be proportionally reduced to 50 marks

**Suggested Learning Resources:**

**Textbooks**

1. Sadalage, P. & Fowler, NoSQL Distilled: A Brief Guide to the Emerging World of Polyglot Persistence, Pearson Addision Wesley, 2012

**Reference Books**

1. Dan Sullivan, "NoSQL For Mere Mortals", 1st Edition, Pearson Education India, 2015. (ISBN- 13: 978-9332557338)
2. Dan McCreary and Ann Kelly, "Making Sense of NoSQL: A guide for Managers and the Rest of us", 1st Edition, Manning Publication/Dreamtech Press, 2013. (ISBN-13: 978-9351192022)
3. Kristina Chodorow, "Mongodb: The Definitive Guide- Powerful and Scalable Data Storage", 2nd Edition, O'Reilly Publications, 2013. (ISBN-13: 978-9351102694)

**Weblinks and Video Lectures (e-Resources):**

1. https://www.geeksforgeeks.org/introduction-to-nosql/ ( and related links in the page)
2. https://www.youtube.com/watch?v=0buKQHokLK8 (How do NoSQL databases work? Simply explained)
3. https://www.techtarget.com/searchdatamanagement/definition/NoSQL-Not-Only-SQL (What is NoSQL and How do NoSQL databases work)
4. https://www.mongodb.com/nosql-explained (What is NoSQL)
5. https://onlinecourses.nptel.ac.in/noc20-cs92/preview (preview of Bigdata course contains NoSQL)

**Activity Based Learning (Suggested Activities in Class)/ Practical Based learning**

- Real world problem solving using group discussion.

**VII Semester**

| PROGRAMMING IN PYTHON | | | |
|---|---|---|---|
| Course Code | 21CS751 | CIE Marks | 50 |
| Teaching Hours/Week (L:T:P: S) | 3:0:0:0 | SEE Marks | 50 |
| Total Hours of Pedagogy | 40 | Total Marks | 100 |
| Credits | 03 | Exam Hours | 03 |

**Course Learning Objectives**

CLO 1. To understand why Python is a useful scripting language for developers
CLO 2. To read and write simple Python programs
CLO 3. To learn how to identify Python object types.
CLO 4. To learn how to write functions and pass arguments in Python.
CLO 5. To use Python data structures –- lists, tuples, dictionaries.

**Teaching-Learning Process (General Instructions)**

These are sample Strategies, which teachers can use to accelerate the attainment of the various course outcomes.

1. Lecturer method (L) need not to be only a traditional lecture method, but alternative effective teaching methods could be adopted to attain the outcomes.
2. Use of Video/Animation to explain functioning of various concepts.
3. Encourage collaborative (Group Learning) Learning in the class.
4. Ask at least three HOT (Higher order Thinking) questions in the class, which promotes critical thinking.
5. Adopt Problem Based Learning (PBL), which fosters students' Analytical skills, develop design thinking skills such as the ability to design, evaluate, generalize, and analyze information rather than simply recall it.
6. Introduce Topics in manifold representations.
7. Show the different ways to solve the same problem with different circuits/logic and encourage the students to come up with their own creative ways to solve them.
8. Discuss how every concept can be applied to the real world - and when that's possible, it helps improve the students' understanding.

**Module-1**

**INTRODUCTION DATA, EXPRESSIONS, STATEMENTS:08 Hours**
Introduction: Creativity and motivation, understanding programming, Terminology: Interpreter and compiler, Running Python, The First Program; Data types: Int, float, Boolean, string, and list, variables, expressions, statements, Operators and operands.

**Textbook 1: Chapter 1.1,1.2,1.3,1.6, Chapter 2.1-2.6**
**Textbook 2: Chapter 1**

| **Teaching-Learning Process** | Chalk and board, Active Learning |
|---|---|

**Module-2**

**CONTROL FLOW, LOOPS:**
Conditionals: Boolean values and operators, conditional (if), alternative (if-else), chained conditional (if-elif-else); Iteration: while, for, break, continue, pass statement.

**Textbook 1: Chapter 3.1-3.6, chapter 5**

| **Teaching-Learning Process** | Chalk and board, Active Learning, Demonstration |
|---|---|

**Module-3**

**FUNCTIONS AND STRINGS:**
Functions: Function calls, adding new functions, definition and uses, local and global scope, return values. Strings: strings, length of string, string slices, immutability, multiline comments, string functions and methods;

**Textbook 1: Chapter 6**
**Textbook 2: Chapter 3**

| **Teaching-Learning Process** | Chalk and board, Active Learning, Demonstration |
|---|---|

**Module-4**

**LISTS, TUPLES, DICTIONARIES:08 Hours**
**Lists:**List operations, list slices, list methods, list loop, mutability, aliasing, cloning lists, listparameters, list comprehension;

**Tuples:** tuple assignment, tuple as return value, tuple comprehension;

**Dictionaries:** operations and methods, comprehension;

**Textbook 2: Chapter 10,11,12**

| **Teaching-Learning Process** | Chalk& board, Active Learning |
|---|---|

**Module-5**

**REGULAR EXPRESSIONS,FILES AND EXCEPTION:**
**Regular expressions:**Character matching in regular expressions, extracting data using regular expressions, Escape character

**Files and exception**: Text files, reading and writing files, command line arguments, errors andexceptions, handling exceptions, modules.

**Textbook 1: Chapter 11.1,11.2,11.4**
**Textbook 2: Chapter 14**

| **Teaching-Learning Process** | Chalk and board, MOOC |
|---|---|

**Suggested Course Outcomes**

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

CO 1. Understand Python syntax and semantics and be fluent in the use of Python flow control and functions.
CO 2. Demonstrate proficiency in handling Strings and File Systems.
CO 3. Represent compound data using Python lists, tuples, Strings, dictionaries.
CO 4. Read and write data from/to files in Python Programs

**Assessment Details (both CIE and SEE)**

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures not less than 35% (18 Marks out of 50) in the semester-end examination (SEE), and a minimum of 40% (40 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together

**Continuous Internal Evaluation:**

Three Unit Tests each of **20 Marks (duration 01 hour**)

1. First test at the end of 5th week of the semester
2. Second test at the end of the 10th week of the semester
3. Third test at the end of the 15th week of the semester

Two assignments each of **10 Marks**

4. First assignment at the end of 4th week of the semester
5. Second assignment at the end of 9th week of the semester

Group discussion/Seminar/quiz any one of three suitably planned to attain the COs and POs for **20 Marks** (**duration 01 hours**)

6. At the end of the 13th week of the semester

The sum of three tests, two assignments, and quiz/seminar/group discussion will be out of 100 marks and will be **scaled down to 50 marks**

(to have less stressed CIE, the portion of the syllabus should not be common /repeated for any of the

methods of the CIE. Each method of CIE should have a different syllabus portion of the course).

**CIE methods /question paper has to be designed to attain the different levels of Bloom's taxonomy as per the outcome defined for the course.**

**Semester End Examination:**

Theory SEE will be conducted by University as per the scheduled timetable, with common question papers for the subject (**duration 03 hours)**

1. The question paper will have ten questions. Each question is set for 20 marks.
2. There will be 2 questions from each module. Each of the two questions under a module (with a maximum of 3 sub-questions), **should have a mix of topics** under that module.
3. The students have to answer 5 full questions, selecting one full question from each module Marks scored shall be proportionally reduced to 50 marks

**Textbooks**

1. Charles R. Severance, "Python for Everybody: Exploring Data Using Python 3", 1st Edition, CreateSpace Independent Publishing Platform, 2016. http://do1.dr-chuck.com/pythonlearn/EN_us/pythonlearn.pdf
2. Allen B. Downey, "Think Python: How to Think Like a Computer Scientist", 2ndEdition, Green Tea Press, 2015. (Chapters 15, 16, 17) http://greenteapress.com/thinkpython2/thinkpython2.pdf

**REFERENCE BOOKS:**

1. R. Nageswara Rao, "Core Python Programming", dreamtech
2. Python Programming: A Modern Approach, Vamsi Kurama, Pearson
3. Python Programming , Reema theraja, OXFORD publication

**Weblinks and Video Lectures (e-Resources):**

1. https://www.w3resource.com/python/python-tutorial.php
2. https://data-flair.training/blogs/python-tutorials-home/
3. https://www.youtube.com/watch?v=c235EsGFcZs
4. https://www.youtube.com/watch?v=v4e6oMRS2QA
5. https://www.youtube.com/watch?v=Uh2ebFW8OYM
6. https://www.youtube.com/watch?v=oSPMmeaiQ68
7. https://www.youtube.com/watch?v=_uQrJ0TkZlc
8. https://www.youtube.com/watch?v=K8L6KVGG-7o

**Activity Based Learning (Suggested Activities in Class)/ Practical Based learning**

Real world problem solving: Demonstration of projects developed using python language

**VII Semester**

| INTRODUCTION TO AI AND ML | | | |
|---|---|---|---|
| Course Code | 21CS752 | CIE Marks | 50 |
| Teaching Hours/Week (L:T:P: S) | 3:0:0:0 | SEE Marks | 50 |
| Total Hours of Pedagogy | 40 | Total Marks | 100 |
| Credits | 03 | Exam Hours | 03 |

**Course Learning Objectives**

CLO1. Understands the basics of AI, history of AI and its foundations, basic principles of AI for problem solving

CLO2. Explore the basics of Machine Learning & Machine Learning process, understanding data

CLO3. Understand the Working of Artificial Neural Networks

**Teaching-Learning Process (General Instructions)**

These are sample Strategies, which teachers can use to accelerate the attainment of the various course outcomes.

1. Lecturer method (L) need not to be only a traditional lecture method, but alternative effective teaching methods could be adopted to attain the outcomes.
2. Use of Video/Animation to explain functioning of various concepts.
3. Encourage collaborative (Group Learning) Learning in the class.
4. Ask at least three HOT (Higher order Thinking) questions in the class, which promotes critical thinking.
5. Adopt Problem Based Learning (PBL), which fosters students' Analytical skills, develop design thinking skills such as the ability to design, evaluate, generalize, and analyze information rather than simply recall it.
6. Introduce Topics in manifold representations.
7. Show the different ways to solve the same problem with different circuits/logic and encourage the students to come up with their own creative ways to solve them.
8. Discuss how every concept can be applied to the real world - and when that's possible, it helps improve the students' understanding.

**Module-1**

**Introduction:** What is AI, The foundation of Artificial Intelligence, The history of Artificial Intelligence**,** Intelligent Agents: Agents and Environments, Good Behaviour: The concept of rationality, the nature of Environments, the structure of Agents.

**Textbook 1: Chapter: 1 and 2**

| **Teaching-Learning Process** | Chalk and board, Active Learning, Problem based learning |
|---|---|

**Module-2**

**Problem solving by searching:** Problem solving agents, Example problems, Searching for solutions, Uniformed search strategies, Informed search strategies, Heuristic functions

**Textbook 1: Chapter: 3**

| **Teaching-Learning Process** | Chalk and board, Active Learning, Demonstration |
|---|---|

**Module-3**

**Introduction to machine learning:** Need for Machine Learning, Machine Learning Explained, and Machine Learning in relation to other fields, Types of Machine Learning. Challenges of Machine Learning, Machine Learning process, Machine Learning applications.

**Understanding Data:** What is data, types of data, Big data analytics and types of analytics, Big data analytics framework, Descriptive statistics, univariate data analysis and visualization

**Textbook 2: Chapter: 1 and 2.1 to 2.5**

| **Teaching-Learning Process** | Chalk and board, Problem based learning, Demonstration |
|---|---|

**Module-4**

**Understanding Data**
Bivariate and Multivariate data, Multivariate statistics **,** Essential mathematics for Multivariate data, Overview hypothesis, Feature engineering and dimensionality reduction techniques,

**Basics of Learning Theory:** Introduction to learning and its types**,** Introduction computation learning theory, Design of learning system, Introduction concept learning.

**Similarity-based learning**: Introduction to Similarity or instance based learning, Nearest-neighbour learning**,** weighted k- Nearest **-** Neighbour algorithm**.**

**Textbook 2: Chapter: 2.6 to 2.10, 3.1 to 3.4, 4.1 to 4.3**

| **Teaching-Learning Process** | Chalk& board, Problem based learning |
|---|---|

**Module-5**

**Artificial Neural Network:** Introduction, Biological neurons, Artificial neurons, Perceptron and learning theory, types of Artificial neural Network**,** learning in multilayer Perceptron, Radial basis function neural network, self-organizing feature map,

**Textbook 2: Chapter: 10**

| **Teaching-Learning Process** | Chalk and board, MOOC |
|---|---|

**Course Outcomes**
At the end of the course the student will be able to:

CO 1. Design intelligent agents for solving simple gaming problems.
CO 2. Have a good understanding of machine leaning in relation to other fields and fundamental issues and
Challenges of machine learning
CO 3. Understand data and applying machine learning algorithms to predict the outputs.
CO 4. Model the neuron and Neural Network, and to analyze ANN learning and its applications.

**Assessment Details (both CIE and SEE)**
The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures not less than 35% (18 Marks out of 50) in the semester-end examination (SEE), and a minimum of 40% (40 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together

**Continuous Internal Evaluation:**
Three Unit Tests each of **20 Marks (duration 01 hour**)

1. First test at the end of 5th week of the semester
2. Second test at the end of the 10th week of the semester
3. Third test at the end of the 15th week of the semester

Two assignments each of **10 Marks**

4. First assignment at the end of 4th week of the semester
5. Second assignment at the end of 9th week of the semester

Group discussion/Seminar/quiz any one of three suitably planned to attain the COs and POs for **20 Marks** (**duration 01 hours**)

6. At the end of the 13th week of the semester

The sum of three tests, two assignments, and quiz/seminar/group discussion will be out of 100 marks and will be **scaled down to 50 marks**
(to have less stressed CIE, the portion of the syllabus should not be common /repeated for any of the methods of the CIE. Each method of CIE should have a different syllabus portion of the course).
**CIE methods /question paper has to be designed to attain the different levels of Bloom's taxonomy as per the outcome defined for the course.**

**Semester End Examination:**
Theory SEE will be conducted by University as per the scheduled timetable, with common question

papers for the subject (**duration 03 hours)**

1. The question paper will have ten questions. Each question is set for 20 marks.
2. There will be 2 questions from each module. Each of the two questions under a module (with a maximum of 3 sub-questions), **should have a mix of topics** under that module.
3. The students have to answer 5 full questions, selecting one full question from each module. Marks scored shall be proportionally reduced to 50 marks

**Textbooks**

1. Stuart Russel, Peter Norvig: "Artificial Intelligence A Modern Approach", 3rd Edition, Pearson Education, 2015.
2. S. Sridhar, M Vijayalakshmi "Machine Learning". Oxford ,2021

**REFERENCE BOOKS:**

1. Elaine Rich, Kevin Knight: "Artificial Intelligence", 3rd Edition, Tata McGraw Hill, 2009, ISBN-10: 0070087709
2. Nils J. Nilsson: "Principles of Artificial Intelligence", Elsevier, 1980, ISBN: 978-3-540-11340-9.

**Weblinks and Video Lectures (e-Resources):**

http://stpk.cs.rtu.lv/sites/all/files/stpk/materiali/MI/Artificial%20Intelligence%20A%20Modern%20Approach.pdf.

1. http://www.getfreeebooks.com/16-sites-with-free-artificial-intelligence-e books/https://www.tutorialspoint.com/artificial_intelligence/artificial_intelligence_overview.htm
2. Problem solving agent:https://www.youtube.com/watch?v=KTPmo-KsOis.
3. https://www.youtube.com/watch?v=X_Qt0U66aH0&list=PLwdnzlV3ogoXaceHrrFVZCJKbm_laSHcH
4. https://www.javatpoint.com/history-of-artificial-intelligence
5. https://www.tutorialandexample.com/problem-solving-in-artificial-intelligence
6. https://techvidvan.com/tutorials/ai-heuristic-search/
7. https://www.analyticsvidhya.com/machine-learning/
8. https://www.hackerearth.com/practice/machine-learning/machine-learning-algorithms/ml-decision-tree/tutorial/
9. https://www.javatpoint.com/unsupervised-artificial-neural-networks

**Activity Based Learning (Suggested Activities in Class)/ Practical Based learning**

Real world problem solving: Demonstration of projects related to AI and ML.

**VII Semester**

| INTRODUCTION TO BIG DATA | | | |
|---|---|---|---|
| Course Code | 21CS753 | CIE Marks | 50 |
| Teaching Hours/Week (L:T:P: S) | 3:0:0:0 | SEE Marks | 50 |
| Total Hours of Pedagogy | 40 | Total Marks | 100 |
| Credits | 03 | Exam Hours | 03 |

**Course Learning Objectives**

CLO 1. Understand Hadoop Distributed File system and examine MapReduce Programming
CLO 2. Explore Hadoop tools and manage Hadoop with Sqoop
CLO 3. Appraise the role of data mining and its applications across industries
CLO 4. Identify various Text Mining techniques

**Teaching-Learning Process (General Instructions)**

These are sample Strategies, which teachers can use to accelerate the attainment of the various course outcomes.

1. Lecturer method (L) need not to be only a traditional lecture method, but alternative effective teaching methods could be adopted to attain the outcomes.
2. Use of Video/Animation to explain functioning of various concepts.
3. Encourage collaborative (Group Learning) Learning in the class.
4. Ask at least three HOT (Higher order Thinking) questions in the class, which promotes critical thinking.
5. Adopt Problem Based Learning (PBL), which fosters students' Analytical skills, develop design thinking skills such as the ability to design, evaluate, generalize, and analyze information rather than simply recall it.
6. Introduce Topics in manifold representations.
7. Show the different ways to solve the same problem with different circuits/logic and encourage the students to come up with their own creative ways to solve them.
8. Discuss how every concept can be applied to the real world - and when that's possible, it helps improve the students' understanding.

**Module-1**

**Hadoop Distributed file system**:HDFS Design, Features, HDFS Components, HDFS user commands Hadoop MapReduce Framework**:** The MapReduce Model, Map-reduce Parallel Data Flow,Map Reduce Programming

**Textbook 1: Chapter 3,5,68hr**

| **Teaching-Learning Process** | Chalk and board, Active Learning, Problem based learning |
|---|---|

**Module-2**

**Essential Hadoop Tools:**Using apache Pig, Using Apache Hive, Using Apache Sqoop, Using Apache Apache Flume, Apache H Base

**Textbook 1: Chapter 78hr**

| **Teaching-Learning Process** | Chalk and board, Active Learning, Demonstration |
|---|---|

**Module-3**

**Data Warehousing:** Introduction, Design Consideration, DW Development Approaches, DW Architectures

**Data Mining:** Introduction, Gathering, and Selection, data cleaning and preparation, outputs ofData Mining, Data Mining Techniques

**Textbook 2: Chapter 4,5**

| **Teaching-Learning Process** | Chalk and board, Problem based learning, Demonstration |
|---|---|

**Module-4**

**Decision Trees:** Introduction, Decision Tree Problem, Decision Tree Constructions, Lessons from Construction Trees. Decision Tree Algorithm

**Regressions:** Introduction, Correlations and Relationships, Non-Linear Regression, Logistic Regression, Advantages and disadvantages.

**Textbook 2: Chapter 6,7**

| **Teaching-Learning Process** | Chalk& board, Problem based learning |
|---|---|

**Module-5**

**Text Mining**: Introduction, Text Mining Applications, Text Mining Process, Term Document Matrix, Mining the TDM, Comparison, Best Practices

**Web Mining:** Introduction, Web Content Mining, Web Structured Mining, Web Usage Mining, Web Mining Algorithms.

**Textbook 2: Chapter 11,14**

| **Teaching-Learning Process** | Chalk and board, MOOC |
|---|---|

**Suggested Course Outcomes**

At the end of the course the students will be able to:

CO 1. Master the concepts of HDFS and MapReduce framework.
CO 2. Investigate Hadoop related tools for Big Data Analytics and perform basic
CO 3. Infer the importance of core data mining techniques for data analytics
CO 4. Use Machine Learning algorithms for real world big data.

**Assessment Details (both CIE and SEE)**

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures not less than 35% (18 Marks out of 50) in the semester-end examination (SEE), and a minimum of 40% (40 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together

**Continuous Internal Evaluation:**

Three Unit Tests each of **20 Marks (duration 01 hour**)

1. First test at the end of 5$^{th}$ week of the semester
2. Second test at the end of the 10$^{th}$ week of the semester
3. Third test at the end of the 15$^{th}$ week of the semester

Two assignments each of **10 Marks**

4. First assignment at the end of 4$^{th}$ week of the semester
5. Second assignment at the end of 9$^{th}$ week of the semester

Group discussion/Seminar/quiz any one of three suitably planned to attain the COs and POs for **20 Marks** (**duration 01 hours**)

6. At the end of the 13$^{th}$ week of the semester

The sum of three tests, two assignments, and quiz/seminar/group discussion will be out of 100 marks and will be **scaled down to 50 marks**

(to have less stressed CIE, the portion of the syllabus should not be common /repeated for any of the methods of the CIE. Each method of CIE should have a different syllabus portion of the course).

**CIE methods /question paper has to be designed to attain the different levels of Bloom's taxonomy as per the outcome defined for the course.**

**Semester End Examination:**

Theory SEE will be conducted by University as per the scheduled timetable, with common question papers for the subject (**duration 03 hours)**

1. The question paper will have ten questions. Each question is set for 20 marks.
2. There will be 2 questions from each module. Each of the two questions under a module (with a

maximum of 3 sub-questions), **should have a mix of topics** under that module.

3. The students have to answer 5 full questions, selecting one full question from each module Marks scored shall be proportionally reduced to 50 marks

**Textbooks**

1. Douglas Eadline,"Hadoop 2 Quick-Start Guide: Learn the Essentials of Big DataComputing in the Apache Hadoop 2 Ecosystem", 1st Edition, Pearson Education,2016.
2. Anil Maheshwari, "Data Analytics", 1st Edition, McGraw Hill Education,2017

**Weblinks and Video Lectures (e-Resources):**

1. https://nptel.ac.in/courses/106/104/106104189/
2. https://www.youtube.com/watch?v=mNP44rZYiAU
3. https://www.youtube.com/watch?v=qr_awo5vz0g
4. https://www.youtube.com/watch?v=rr17cbPGWGA
5. https://www.youtube.com/watch?v=G4NYQox4n2g
6. https://www.youtube.com/watch?v=owI7zxCqNY0
7. https://www.youtube.com/watch?v=FuJVLsZYkuE

**Activity Based Learning (Suggested Activities in Class)/ Practical Based learning**

Real world problem solving: Demonstration of Big Data related projects

Exploring the applications which involves big data.

**VII Semester**

| INTRODUCTION TO DATA SCIENCE | | | |
|---|---|---|---|
| Course Code | 21CS754 | CIE Marks | 50 |
| Teaching Hours/Week (L:T:P: S) | 3:0:0:0 | SEE Marks | 50 |
| Total Hours of Pedagogy | 40 | Total Marks | 100 |
| Credits | 03 | Exam Hours | 03 |

**Course Learning Objectives**

CLO 1. To provide a foundation in data Science terminologies
CLO 2. To familiarize data science process and steps
CLO 3. To Demonstrate the data visualization tools
CLO 4. To analyze the data science applicability in real time applications.

**Teaching-Learning Process (General Instructions)**

These are sample Strategies, which teachers can use to accelerate the attainment of the various course outcomes.

1. Lecturer method (L) need not to be only a traditional lecture method, but alternative effective teaching methods could be adopted to attain the outcomes.
2. Use of Video/Animation to explain functioning of various concepts.
3. Encourage collaborative (Group Learning) Learning in the class.
4. Ask at least three HOT (Higher order Thinking) questions in the class, which promotes critical thinking.
5. Adopt Problem Based Learning (PBL), which fosters students' Analytical skills, develop design thinking skills such as the ability to design, evaluate, generalize, and analyze information rather than simply recall it.
6. Introduce Topics in manifold representations.
7. Show the different ways to solve the same problem with different circuits/logic and encourage the students to come up with their own creative ways to solve them.
8. Discuss how every concept can be applied to the real world - and when that's possible, it helps improve the students' understanding.

**Module-1**

**PREPARING AND GATHERING DATA AND KNOWLEDGE**
Philosophies of data science - Data science in a big data world - Benefits and uses of data science and big data - facts of data: Structured data, Unstructured data, Natural Language, Machine generated data, Audio, Image and video streaming data - The Big data Eco system: Distributed file system, Distributed Programming framework, Data Integration frame work, Machine learning Framework, NoSQL Databases, Scheduling tools, Benchmarking Tools, System Deployment, Service programming and Security.

**Textbook 1: Ch 1.1 to 1.4**

| **Teaching-Learning Process** | Chalk and board, Active Learning, PPT Based presentation |
|---|---|

**Module-2**

**THE DATA SCIENCE PROCESS-**Overview of the data science process- defining research goals and creating project charter, retrieving data, cleansing, integrating and transforming data, exploratory data analysis, Build the models, presenting findings and building application on top of them.

**Textbook 1:,Ch 2**

| **Teaching-Learning Process** | Chalk and board, Active Learning, PPT Based presentation |
|---|---|

**Module-3**

**MACHINE LEARNING:** Application for machine learning in data science- Tools used in machine learning- Modeling Process – Training model – Validating model – Predicting new observations –Types of machine learning Algorithm : Supervised learning algorithms, Unsupervised learning algorithms.

**Textbook 1: Ch 3.1 to 3.3**

| | |
|---|---|
| **Teaching-Learning Process** | Chalk and board, Active Learning, PPT Based presentation, Video |

**Module-4**

**VISUALIZATION–**Introduction to data visualization – Data visualization options – Filters – MapReduce – Dashboard development tools.

**Textbook 1: Ch 9**

| | |
|---|---|
| **Teaching-Learning Process** | Chalk and board, Active Learning, PPT Based presentation, MOOC |

**Module-5**

**CASE STUDIES** Distributing data storage and processing with frameworks - Case study: e.g, Assessing risk when lending money.

**Textbook 1: Ch 5.1, 5.2**

| | |
|---|---|
| **Teaching-Learning Process** | Chalk and board, Active Learning, PPT Based presentation, Video |

**Course Outcomes**

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

CO 1. Describe the data science terminologies
CO 2. Apply the Data Science process on real time scenario.
CO 3. Analyze data visualization tools
CO 4. Apply Data storage and processing with frameworks

**Assessment Details (both CIE and SEE)**

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures not less than 35% (18 Marks out of 50) in the semester-end examination (SEE), and a minimum of 40% (40 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together

**Continuous Internal Evaluation:**

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2. Second test at the end of the 10th week of the semester
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Two assignments each of **10 Marks**

4. First assignment at the end of 4th week of the semester
5. Second assignment at the end of 9th week of the semester

Group discussion/Seminar/quiz any one of three suitably planned to attain the COs and POs for **20 Marks** (**duration 01 hours**)

6. At the end of the 13th week of the semester

The sum of three tests, two assignments, and quiz/seminar/group discussion will be out of 100 marks and will be **scaled down to 50 marks**

(to have less stressed CIE, the portion of the syllabus should not be common /repeated for any of the methods of the CIE. Each method of CIE should have a different syllabus portion of the course).

**CIE methods /question paper has to be designed to attain the different levels of Bloom's taxonomy as per the outcome defined for the course.**

**Semester End Examination:**

Theory SEE will be conducted by University as per the scheduled timetable, with common question papers for the subject (**duration 03 hours)**

1. The question paper will have ten questions. Each question is set for 20 marks.
2. There will be 2 questions from each module. Each of the two questions under a module (with a maximum of 3 sub-questions), **should have a mix of topics** under that module.
3. The students have to answer 5 full questions, selecting one full question from each module Marks scored shall be proportionally reduced to 50 marks

**Textbooks**

1. Introducing Data Science, Davy Cielen, Arno D. B. Meysman and Mohamed Ali,Manning Publications, 2016.

**Reference Books**

1. Doing Data Science, Straight Talk from the Frontline, Cathy O'Neil, Rachel Schutt, O' Reilly, 1st edition, 2013.
2. Mining of Massive Datasets, Jure Leskovec, Anand Rajaraman, Jeffrey David Ullman, Cambridge University Press, 2nd edition, 2014
3. An Introduction to Statistical Learning: with Applications in R, Gareth James, Daniela Witten, Trevor Hastie, Robert Tibshirani, Springer, 1st edition, 2013
4. Think Like a Data Scientist, Brian Godsey, Manning Publications, 2017.

**Weblinks and Video Lectures (e-Resources):**

1. https://www.simplilearn.com/tutorials/data-science-tutorial/what-is-data-science
2. https://www.youtube.com/watch?v=N6BghzuFLIg
3. https://www.coursera.org/lecture/what-is-datascience/fundamentals-of-data-science-tPgFU
4. https://www.youtube.com/watch?v=ua-CiDNNj30

**Activity Based Learning (Suggested Activities in Class)/ Practical Based learning**

Real world problem solving using Data science techniques and demonstration of data visualization methods with the help of suitable project.

VISVESVARAYA TECHNOLOGICAL UNIVERSITY, BELAGAVI

**B.E. in Artificial Intelligence and Machine Learning**

**Scheme of Teaching and Examinations 2022**

Outcome Based Education (OBE) and Choice Based Credit System (CBCS)

(Effective from the academic year 2023-24)

**VI SEMESTER**

| Sl. No | Course and Course Code | | Course Title | Teaching Department (TD) and Question Paper Setting Board (PSB) | Teaching Hours /Week | | | | Examination | | | | Credits |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | Theory Lecture | Tutorial | Practical / Drawing | SDA | Duration in hours | CIE Marks | SEE Marks | Total Marks | |
| | | | | | L | T | P | S | | | | | |
| 1 | IPCC | BAI601 | Natural Language Processing | TD : AI<br>PSB : AI | 3 | 0 | 2 | | 03 | 50 | 50 | 100 | 4 |
| 2 | PCC | BAI602 | Machine Learning -I | TD : AI<br>PSB : AI | 4 | 0 | 0 | | 03 | 50 | 50 | 100 | 4 |
| 3 | PEC | BXX613x | Professional Elective Course | TD : AI<br>PSB : AI | 3 | 0 | 0 | | 03 | 50 | 50 | 100 | 3 |
| 4 | OEC | BXX654x | Open Elective Course | TD : AI<br>PSB : AI | 3 | 0 | 0 | | 03 | 50 | 50 | 100 | 3 |
| 5 | PROJ | BAI685 | Project Phase I | TD : AI<br>PSB : AI | 0 | 0 | 4 | | 03 | 100 | -- | 100 | 2 |
| 6 | PCCL | BAIL606 | Machine Learning lab | TD : AI<br>PSB : AI | 0 | 0 | 2 | | 03 | 50 | 50 | 100 | 1 |
| 7 | AEC/SDC | BXX657x | Ability Enhancement Course/Skill Development Course V | TD and PSB: Concerned department | If the course is offered as a Theory: 1 | 0 | 0 | | 01 | 50 | 50 | 100 | 1 |
| | | | | | If course is offered as a practical: 0 | 0 | 2 | | | | | | |
| 8 | MC | BNSK658 | National Service Scheme (NSS) | NSS coordinator | 0 | 0 | 2 | | | 100 | --- | 100 | 0 |
| | | BPEK658 | Physical Education (PE) (Sports and Athletics) | Physical Education Director | | | | | | | | | |
| | | BYOK658 | Yoga | Yoga Teacher | | | | | | | | | |
| 9 | MC | BIKS609 | Indian Knowledge System | | 1 | 0 | 0 | | 01 | 100 | --- | 100 | 0 |
| | | | | | | | | | **Total** | **500** | **300** | **800** | **18** |

**Professional Elective Course**

| | | | |
|---|---|---|---|
| BAI613A | Human-Centred AI | BCS613A | Blockchain Technology |

| | | | |
|---|---|---|---|
| BIS613D | Cloud Computing and Security | BAI613D | Time Series Analysis |
| **Open Elective Course** | | | |
| BCS654A | Introduction to Data Structures | BIS654C | Mobile Application Development |
| BCS654B | Fundamentals of Operating Systems | BAI654D | Introduction to Artificial Intelligence |
| **Ability Enhancement Course / Skill Enhancement Course-V** | | | |
| BCGL657A | Mobile Application Development with Flutter | BAIL657C | Generative AI |
| BADL657B | UI/UX | BCSL657D | Devops |

**PCC**: Professional Core Course, **PCCL**: Professional Core Course laboratory, **UHV**: Universal Human Value Course, **MC**: Mandatory Course (Non-credit), **AEC**: Ability Enhancement Course, **SEC**: Skill Enhancement Course, **L:** Lecture, **T**: Tutorial, **P**: Practical **S= SDA**: Skill Development Activity, **CIE**: Continuous Internal Evaluation, **SEE**: Semester End Evaluation. **K :** The letter in the course code indicates common to al the stream of engineering. **PROJ**: Project /Mini Project. **PEC**: Professional Elective Course. **PROJ**: Project Phase -I, **OEC**: Open Elective Course

**Professional Core Course (IPCC):** Refers to Professional Core Course Theory Integrated with practicals of the same course. Credit for IPCC can be 04 and its Teaching–Learning hours (L : T : P) can be considered as (3 : 0 : 2) or (2 : 2 : 2). The theory part of the IPCC shall be evaluated both by CIE and SEE. The practical part shall be evaluated by only CIE (no SEE). However, questions from the practical part of IPCC shall be included in the SEE question paper. For more details, the regulation governing the Degree of Bachelor of Engineering /Technology (B.E./B.Tech.) 2022-23

**National Service Scheme /Physical Education/Yoga:** All students have to register for any one of the courses namely National Service Scheme (NSS), Physical Education (PE)(Sports and Athletics), and Yoga(YOG) with the concerned coordinator of the course during the first week of III semesters. Activities shall be carried out between III semester to the VI semester (for 4 semesters). Successful completion of the registered course and requisite CIE score is mandatory for the award of the degree. The events shall be appropriately scheduled by the colleges and the same shall be reflected in the calendar prepared for the NSS, PE, and Yoga activities. These courses shall not be considered for vertical progression as well as for the calculation of SGPA and CGPA, but completion of the course is mandatory for the award of degree.

**Professional Elective Courses (PEC):** A professional elective (PEC) course is intended to enhance the depth and breadth of educational experience in the Engineering and Technology curriculum. Multidisciplinary courses that are added supplement the latest trend and advanced technology in the selected stream of engineering. Each group will provide an option to select one course. The minimum number of students' strengths for offering professional electives is 10. However, this conditional shall not be applicable to cases where the admission to the program is less than 10.

**Open Elective Courses:**

Students belonging to a particular stream of Engineering and Technology are not entitled to the open electives offered by their parent Department. However, they can opt for an elective offered by other Departments, provided they satisfy the prerequisite condition if any. Registration to open electives shall be documented under the guidance of the Program Coordinator/ Advisor/Mentor. The minimum numbers of students' strength for offering Open Elective Course is 10. However, this condition shall not be applicable to class where the admission to the program is less than 10.

**Project Phase-I :** Students have to discuss with the mentor /guide and with their helphe/she has to complete the literature survey and prepare the report and finally

| define the problem statement for the project work. |
| --- |
| |

| NATURAL LANGUAGE PROCESSING | | Semester | 6 |
|---|---|---|---|
| Course Code | **BAI601** | CIE Marks | 50 |
| Teaching Hours/Week (L:T:P: S) | 3:0:2:0 | SEE Marks | 50 |
| Total Hours of Pedagogy | 40 hours Theory + 8-10 Lab slots | Total Marks | 100 |
| Credits | 04 | Exam Hours | 03 |
| Examination nature (SEE) | Theory | | |

**Course objectives:**

This course will enable students to,

- Learn the importance of natural language modelling
- Understand the Applications of natural language processing
- Study spelling, error detection and correction methods and parsing techniques in NLP
- Illustrate the information retrieval models in natural language processing

**Teaching-Learning Process (General Instructions)**

These are sample Strategies that teachers can use to accelerate the attainment of the various course outcomes.

1. Lecturer method (L) need not to be only traditional lecture methods, but alternative effective teaching methods could be adopted to attain the outcomes.
2. Use of Video/Animation to explain functioning of various concepts.
3. Encourage collaborative (Group Learning) Learning in the class.
4. Ask at least three HOT (Higher order Thinking) questions in the class, which promotes critical thinking.
5. Adopt Problem Based Learning (PBL), which fosters student's Analytical skills, develop design thinking skills such as the ability to design, evaluate, generalize, and analyze information rather than simply recall it.

## MODULE-1

**Introduction**: What is Natural Language Processing? Origins of NLP, Language and Knowledge, The Challenges of NLP, Language and Grammar, Processing Indian Languages, NLP Applications.

**Language Modeling**: Statistical Language Model - N-gram model (unigram, bigram), Paninion Framework, Karaka theory.

**Textbook 1:** Ch. 1, Ch. 2.

## MODULE-2

**Word Level Analysis**: Regular Expressions, Finite-State Automata, Morphological Parsing, Spelling Error Detection and Correction, Words and Word Classes, Part-of Speech Tagging.

**Syntactic Analysis:** Context-Free Grammar, Constituency, Top-down and Bottom-up Parsing, CYK Parsing.

**Textbook 1:** Ch. 3, Ch. 4.

## MODULE-3

**Naive Bayes, Text Classification and Sentiment**: Naive Bayes Classifiers, Training the Naive Bayes Classifier, Worked Example, Optimizing for Sentiment Analysis, Naive Bayes for Other Text Classification Tasks, Naive Bayes as a Language Model.

**Textbook 2:** Ch. 4.

## MODULE-4

| |
|---|
| **Information Retrieval**: Design Features of Information Retrieval Systems, Information Retrieval Models - Classical, Non-classical, Alternative Models of Information Retrieval - Custer model, Fuzzy model, LSTM model**,** Major Issues in Information Retrieval.<br><br>**Lexical Resources**: WordNet, FrameNet, Stemmers, Parts-of-Speech Tagger, Research Corpora.<br><br>**Textbook 1:** Ch. 9, Ch. 12. |
| **MODULE-5** |
| **Machine Translation**: Language Divergences and Typology, Machine Translation using Encoder-Decoder, Details of the Encoder-Decoder Model, Translating in Low-Resource Situations, MT Evaluation, Bias and Ethical Issues.<br><br>**Textbook 2:** Ch. 13. |

**PRACTICAL COMPONENT OF IPCC**

| Sl.NO | Experiments |
|---|---|
| 1 | Write a Python program for the following preprocessing of text in NLP:<br>● Tokenization<br>● Filtration<br>● Script Validation<br>● Stop Word Removal<br>● Stemming |
| 2 | Demonstrate the N-gram modeling to analyze and establish the probability distribution across sentences and explore the utilization of unigrams, bigrams, and trigrams in diverse English sentences to illustrate the impact of varying n-gram orders on the calculated probabilities. |
| 3 | Investigate the Minimum Edit Distance (MED) algorithm and its application in string comparison and the goal is to understand how the algorithm efficiently computes the minimum number of edit operations required to transform one string into another.<br>● Test the algorithm on strings with different type of variations (e.g., typos, substitutions, insertions, deletions)<br>● Evaluate its adaptability to different types of input variations |
| 4 | Write a program to implement top-down and bottom-up parser using appropriate context free grammar. |
| 5 | Given the following short movie reviews, each labeled with a genre, either comedy or action:<br>● fun, couple, love, love comedy<br>● fast, furious, shoot action<br>● couple, fly, fast, fun, fun comedy<br>● furious, shoot, shoot, fun action<br>● fly, fast, shoot, love action and<br><br>A new document D: fast, couple, shoot, fly<br><br>Compute the most likely class for D. Assume a Naive Bayes classifier and use add-1 smoothing for the likelihoods. |
| 6 | Demonstrate the following using appropriate programming tool which illustrates the use of information retrieval in NLP:<br>● Study the various Corpus – Brown, Inaugural, Reuters, udhr with various methods like filelds, raw, words, sents, categories |

| | |
|---|---|
| | ● Create and use your own corpora (plaintext, categorical)<br>● Study Conditional frequency distributions<br>● Study of tagged corpora with methods like tagged_sents, tagged_words<br>● Write a program to find the most frequent noun tags<br>● Map Words to Properties Using Python Dictionaries<br>● Study Rule based tagger, Unigram Tagger<br><br>Find different words from a given plain text without any space by comparing this text with a given corpus of words. Also find the score of words. |
| 7 | Write a Python program to find synonyms and antonyms of the word "active" using WordNet. |
| 8 | Implement the machine translation application of NLP where it needs to train a machine translation model for a language with limited parallel corpora. Investigate and incorporate techniques to improve performance in low-resource scenarios. |

**Course outcomes (Course Skill Set):**

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

- Apply the fundamental concept of NLP, grammar-based language model and statistical-based language model.
- Model morphological analysis using Finite State Transducers and parsing using context-free grammar and different parsing approaches.
- Develop the Naïve Bayes classifier and sentiment analysis for Natural language problems and text classifications.
- Apply the concepts of information retrieval, lexical semantics, lexical dictionaries such as WordNet, lexical computational semantics, distributional word similarity.
- Identify the Machine Translation applications of NLP using Encode and Decoder.

**Assessment Details (both CIE and SEE)**

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks out of 50) and for the SEE minimum passing mark is 35% of the maximum marks (18 out of 50 marks). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures a minimum of 40% (40 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together.

**CIE for the theory component of the IPCC (maximum marks 50)**

- IPCC means practical portion integrated with the theory of the course.
- CIE marks for the theory component are **25 marks** and that for the practical component is **25 marks**.
- 25 marks for the theory component are split into **15 marks** for two Internal Assessment Tests (Two Tests, each of 15 Marks with 01-hour duration, are to be conducted) and **10 marks** for other assessment methods mentioned in 22OB4.2. The first test at the end of 40-50% coverage of the syllabus and the second test after covering 85-90% of the syllabus.
- Scaled-down marks of the sum of two tests and other assessment methods will be CIE marks for the theory component of IPCC (that is for **25 marks)**.
- The student has to secure 40% of 25 marks to qualify in the CIE of the theory component of IPCC.

**CIE for the practical component of the IPCC**

- **15 marks** for the conduction of the experiment and preparation of laboratory record, and **10 marks** for the test to be conducted after the completion of all the laboratory sessions.

- On completion of every experiment/program in the laboratory, the students shall be evaluated including viva-voce and marks shall be awarded on the same day.
- The CIE marks awarded in the case of the Practical component shall be based on the continuous evaluation of the laboratory report. Each experiment report can be evaluated for 10 marks. Marks of all experiments' write-ups are added and scaled down to **15 marks**.
- The laboratory test **(duration 02/03 hours)** after completion of all the experiments shall be conducted for 50 marks and scaled down to **10 marks.**
- Scaled-down marks of write-up evaluations and tests added will be CIE marks for the laboratory component of IPCC for **25 marks**.
- The student has to secure 40% of 25 marks to qualify in the CIE of the practical component of the IPCC.

**SEE for IPCC**

Theory SEE will be conducted by University as per the scheduled timetable, with common question papers for the course (**duration 03 hours**)

1. The question paper will have ten questions. Each question is set for 20 marks.
2. There will be 2 questions from each module. Each of the two questions under a module (with a maximum of 3 sub-questions), **should have a mix of topics** under that module.
3. The students have to answer 5 full questions, selecting one full question from each module.
4. Marks scored by the student shall be proportionally scaled down to 50 Marks

**The theory portion of the IPCC shall be for both CIE and SEE, whereas the practical portion will have a CIE component only. Questions mentioned in the SEE paper may include questions from the practical component**.

**Suggested Learning Resources:**

**Textbook:**


1. Tanveer Siddiqui, U.S. Tiwary, "Natural Language Processing and Information Retrieval", Oxford University Press.
2. Daniel Jurafsky, James H. Martin, "Speech and Language Processing, An Introduction to Natural Language Processing, Computational Linguistics, and Speech Recognition", Pearson Education, 2023.


**Reference Books:**


1. Akshay Kulkarni, Adarsha Shivananda, "Natural Language Processing Recipes - Unlocking Text Data with Machine Learning and Deep Learning using Python", Apress, 2019.
2. T V Geetha, "Understanding Natural Language Processing – Machine Learning and Deep Learning Perspectives", Pearson, 2024.
3. Gerald J. Kowalski and Mark.T. Maybury, "Information Storage and Retrieval systems", Kluwer Academic Publishers.


**Web links and Video Lectures (e-Resources):**

1. https://www.youtube.com/watch?v=M7SWr5xObkA
2. https://youtu.be/02QWRAhGc7g
3. https://www.youtube.com/watch?v=CMrHM8a3hqw
4. **https://onlinecourses.nptel.ac.in/noc23_cs45/preview**
5. **https://archive.nptel.ac.in/courses/106/106/106106211/**

**Activity Based Learning (Suggested Activities in Class)/ Practical Based learning**

**Text Classification Game (5 Marks)**

- **Objective:** Learn supervised learning and text classification.
- **Activity:** Provide students with a set of documents (e.g., movie reviews) labeled as positive or negative. Divide them into groups and have them create a simple classification model using keywords or phrases. They can then test their model on new reviews.

**Grammar Check and Correction (5 Marks)**

- **Objective:** Learn about language structure and NLP tools.
- **Activity:** Provide sentences with grammatical errors. Students can use grammar checking tools (like Grammarly or LanguageTool) to identify errors and suggest corrections, discussing why each suggestion is made.

| | | | | |
|---|---|---|---|---|
| | **MACHINE LEARNING** | | Semester | 6 |
| | Course Code | **BAI602** | CIE Marks | 50 |
| | Teaching Hours/Week (L: T:P: S) | 4:0:0:0 | SEE Marks | 50 |
| | Total Hours of Pedagogy | 50 | Total Marks | 100 |
| | Credits | 04 | Exam Hours | 03 |
| | Examination type (SEE) | Theory | | |

**Course objectives:**

- To introduce the fundamental concepts and techniques of machine learning.
- To understanding of various types of machine learning and the challenges faced in real-world applications.
- To enable students to evaluate machine learning models for different types of problems.
- To familiarize the machine learning algorithms such as regression, decision trees, Bayesian models, clustering, and neural networks.

**Teaching-Learning Process (General Instructions)**

These are sample Strategies, which teachers can use to accelerate the attainment of the various course outcomes.

1. Lecturer method (L) needs not to be only a traditional lecture method, but alternative effective teaching methods could be adopted to attain the outcomes.
2. Use of Video/Animation/Demonstration to explain functioning of various concepts.
3. Encourage collaborative (Group Learning) Learning in the class.
4. Ask at least three HOT (Higher order Thinking) questions in the class, which promotes critical thinking.
5. Adopt Problem/Practical Based Learning (PBL), which fosters students' Analytical skills, develop design thinking skills, and practical skill such as the ability to design, evaluate, generalize, and analyze information rather than simply recall it.
6. Use animations/videos to help the students to understand the concepts.
7. Demonstrate the concepts using PYTHON and its libraries wherever possible

**Module-1**

**Introduction:** Need for Machine Learning, Machine Learning Explained, Machine Learning in Relation to other Fields, Types of Machine Learning, Challenges of Machine Learning, Machine Learning Process, Machine Learning Applications.

**Understanding Data – 1:** Introduction, Big Data Analysis Framework, Descriptive Statistics, Univariate Data Analysis and Visualization.

**Chapter-1, 2 (2.1-2.5)**

**Module-2**

**Understanding Data – 2:** Bivariate Data and Multivariate Data, Multivariate Statistics, Essential Mathematics for Multivariate Data, Feature Engineering and Dimensionality Reduction Techniques.

**Testing Machine Learning Algorithms:** Overfitting , Training, Testing, and Validation Sets ,The Confusion Matrix , Accuracy Metrics , The Receiver Operator Characteristic (ROC) Curve , Unbalanced Datasets , Measurement Precision

**Textbook-1: Chapter -2 (2.6-2.8, 2.10), Text book-2 (2.2)**

**Module-3**

**Similarity-based Learning:** Nearest-Neighbor Learning, Weighted K-Nearest-Neighbor Algorithm, Nearest Centroid Classifier, Locally Weighted Regression (LWR).

| | |
|---|---|
| | **Regression Analysis:** Introduction to Regression, Introduction to Linear Regression, Multiple Linear Regression, Polynomial Regression, Logistic Regression.<br><br>**Chapter-4 (4.2-4.5), Chapter-5 (5.1-5.3, 5.5-5.7)** |
| | **Module-4** |
| | **Decision Tree Learning:** Introduction to Decision Tree Learning Model, Decision Tree Induction Algorithms. Validating and pruning of Decision trees.<br><br>**Bayesian Learning:** Introduction to Probability-based Learning, Fundamentals of Bayes Theorem, Classification Using Bayes Model, Naïve Bayes Algorithm for Continuous Attributes.<br><br>**Chapter-6 (6.1, 6.3), Chapter-8 (8.1-8.4)** |
| | **Module-5** |
| | **Artificial Neural Networks:** Introduction, Biological Neurons, Artificial Neurons, Perceptron and Learning Theory, Types of Artificial Neural Networks, Popular Applications of Artificial Neural Networks, Advantages and Disadvantages of ANN, Challenges of ANN.<br><br>**Clustering Algorithms:** Introduction to Clustering Approaches, Proximity Measures, Hierarchical Clustering Algorithms, Partitional Clustering Algorithm, Density-based Methods, Grid-based Approach.<br><br>**Chapter-10 (10.1-10.5, 10.9-10.11), Chapter -13 (13.1-13.6)** |

**Course outcome (Course Skill Set)**

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

1. Explain the machine learning techniques, their types and data analysis framework.
2. Apply mathematical concepts for feature engineering and perform dimensionality reduction to enhance model performance.
3. Develop similarity-based learning models and regression models for solving classification and prediction tasks.
4. Develop probabilistic learning models and neural network models using perceptrons and multilayer architectures.
5. Utilize clustering algorithms to identify patterns in data .

## Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks out of 50) and for the SEE minimum passing mark is 35% of the maximum marks (18 out of 50 marks). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures a minimum of 40% (40 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together.

**Continuous Internal Evaluation:**

- For the Assignment component of the CIE, there are 25 marks and for the Internal Assessment Test component, there are 25 marks.
- The first test will be administered after 40-50% of the syllabus has been covered, and the second test will be administered after 85-90% of the syllabus has been covered
- Any two assignment methods mentioned in the 22OB2.4, if an assignment is project-based then only one assignment for the course shall be planned. The teacher should not conduct two assignments at the end of the semester if two assignments are planned.
- For the course, CIE marks will be based on a scaled-down sum of two tests and other methods of assessment.

**Internal Assessment Test question paper is designed to attain the different levels of Bloom's taxonomy as per the outcome defined for the course.**

**Semester-End Examination:**

Theory SEE will be conducted by University as per the scheduled timetable, with common question papers for the course (**duration 03 hours).**

1. The question paper will have ten questions. Each question is set for 20 marks.
2. There will be 2 questions from each module. Each of the two questions under a module (with a maximum of 3 sub-questions), **should have a mix of topics** under that module.
3. The students have to answer 5 full questions, selecting one full question from each module.
4. Marks scored shall be proportionally reduced to 50 marks

**Suggested Learning Resources:**

**Books**

1. S Sridhar, M Vijayalakshmi, "Machine Learning", OXFORD University Press 2021, First Edition.

2. Stephen Marsland, "Machine Learning - An Algorithmic Perspective", Second Edition, CRC Press - Taylor and Francis Group, 2015 .

**Reference Books**

1. T. M. Mitchell, "Machine Learning", McGraw Hill, 1997.
2. Murty, M. N., and V. S. Ananthanarayana. Machine Learning: Theory and Practice, Universities Press, 2024.
3. Burkov, Andriy. *The hundred-page machine learning book*. Vol. 1. Quebec City, QC, Canada: Andriy Burkov, 2019.

**Web links and Video Lectures (e-Resources):**

- **https://www.universitiespress.com/resources?id=9789393330697**
- https://www.drssridhar.com/?page_id=1053
- Machine Learning Tutorials: https://www.geeksforgeeks.org/machine-learning/
- Machine Learning Tutorials: https://www.tutorialspoint.com/machine_learning/index.htm
- Python for Machine Learning: https://www.w3schools.com/python/python_ml_getting_started.asp
- Introduction to Machine Learning: https://onlinecourses.nptel.ac.in/noc22_cs29/preview

**Activity Based Learning (Suggested Activities in Class)/ Practical Based learning**

**Activities (10 marks)**

1. Identify real-world applications in ML and Discuss the type of ML (supervised, unsupervised, or semi-supervised) used in each case.
2. Consider a messy dataset and use data preprocessing approaches to clean up this data (for activity 1).
3. Use Data Analysis approaches to visualize trends, correlations, and distributions (for activity 2).

**Course project(15 marks):**
Implement suitable machine learning-based real-world application problems**.**

| | | | | |
|---|---|---|---|---|
| | **Human-Centred AI** | | Semester | 6 |
| | Course Code | **BAI613A** | CIE Marks | 50 |
| | Teaching Hours/Week (L: T:P: S) | 3:0:0:0 | SEE Marks | 50 |
| | Total Hours of Pedagogy | 40 | Total Marks | 100 |
| | Credits | 03 | Exam Hours | 03 |
| | Examination type (SEE) | Theory | | |

**Course objectives:**

- To understanding of the foundational principles of Human-Centered AI
- To learn and evaluate reliable, safe, and trustworthy AI systems using the HCAI framework
- To understand governance strategies that bridge the gap between ethical principles and practical steps
- To learn how to create and assess safety cultures in organizations through management strategies, incident reporting, and trustworthy certification practices
- To understand how AI can amplify human-to-human communication and cooperation

**Teaching-Learning Process (General Instructions)**

These are sample Strategies, which teachers can use to accelerate the attainment of the various course outcomes.

1. Lecturer method (L) needs not to be only a traditional lecture method, but alternative effective teaching methods could be adopted to attain the outcomes.
2. Use of Video/Animation/Demonstration to explain functioning of various concepts.
3. Encourage collaborative (Group Learning) Learning in the class.
4. Ask at least three HOT (Higher order Thinking) questions in the class, which promotes critical thinking.
5. Adopt Problem Based Learning (PBL), which fosters students' Analytical skills, develop design thinking skills such as the ability to design, evaluate, generalize, and analyze information rather than simply recall it.
6. Use animations/videos to help the students to understand the concepts.

**Module-1**

**WHAT IS HUMAN-CENTERED ARTIFICIAL INTELLIGENCE:** Introduction, Are People and Computers in the Same Category?, Will Automation, AI, and Robots Lead to Widespread Unemployment?

**Textbook: Chapter 1, Chapter 3, Chapter 4**

**Module-2**

**HUMAN-CENTERED AI FRAMEWORK:** Introduction, Defining Reliable, Safe, and Trustworthy Systems, Two-Dimensional HCAI Framework, Design Guidelines and Examples

**Textbook: Chapter 6, Chapter 7, Chapter 8, Chapter 9**

**Module-3**

**DESIGN METAPHORS:** Introduction, Science and Innovation Goals, Intelligent Agents and Supertools, Teammates and Tele-bots, Social Robots and Active Appliances

**Textbook: Chapter 11, Chapter 12, Chapter 13, Chapter 14, Chapter 16**

**Module-4**

**GOVERNANCE STRUCTURES – 1:** Introduction, Reliable Systems Based on Sound Software Engineering Practice, Safety Culture through Business Management Strategies, Trustworthy Certification by Independent Oversight

| | |
|---|---|
| | **Textbook: Chapter 18, Chapter 19, Chapter 20, Chapter 21** |
| | **Module-5** |
| | **GOVERNANCE STRUCTURES – 2:** Government Interventions and Regulations, Introduction: Driving HCAI<br>Forward, Assessing Trustworthiness, Caring for and Learning from Older Adults<br><br>**Textbook: Chapter 22, Chapter 24, Chapter 25, Chapter 26,** |

**Course outcome (Course Skill Set)**

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

1. Demonstrate a foundational of Human-Centered AI with human values such as rights, dignity, and justice.
2. Apply the Human-Centered AI framework to design AI systems that achieve high levels of both human control and automation
3. Utilize design metaphors (supertools and tele-bots) to innovate and develop AI applications that enhance human creativity
4. Develop governance structures and ethical strategies to ensure the safe and responsible deployment of AI systems
5. Identify emerging trends and challenges in Human-Centered AI and Design strategies for enhancing trustworthiness and societal benefits

## Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks out of 50) and for the SEE minimum passing mark is 35% of the maximum marks (18 out of 50 marks). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures a minimum of 40% (40 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together.

**Continuous Internal Evaluation:**

- For the Assignment component of the CIE, there are 25 marks and for the Internal Assessment Test component, there are 25 marks.
- The first test will be administered after 40-50% of the syllabus has been covered, and the second test will be administered after 85-90% of the syllabus has been covered
- Any two assignment methods mentioned in the 22OB2.4, if an assignment is project-based then only one assignment for the course shall be planned. The teacher should not conduct two assignments at the end of the semester if two assignments are planned.
- For the course, CIE marks will be based on a scaled-down sum of two tests and other methods of assessment.

**Internal Assessment Test question paper is designed to attain the different levels of Bloom's taxonomy as per the outcome defined for the course.**

**Semester-End Examination:**

Theory SEE will be conducted by University as per the scheduled timetable, with common question papers for the course (**duration 03 hours).**

1. The question paper will have ten questions. Each question is set for 20 marks.
2. There will be 2 questions from each module. Each of the two questions under a module (with a maximum of 3 sub-questions), **should have a mix of topics** under that module.
3. The students have to answer 5 full questions, selecting one full question from each module.
4. Marks scored shall be proportionally reduced to 50 marks

**Suggested Learning Resources:**

**Books**

1. Shneiderman, Ben. Human-centered AI. Oxford University Press, 2022.

**Reference Book**

1. Nam, Chang S., Jae-Yoon Jung, and Sangwon Lee, eds. Human-Centered Artificial Intelligence: Research and Applications. Academic Press, 2022.
2. Chetouani, Mohamed, et al., eds. Human-centered artificial intelligence: Advanced lectures. Vol. 13500. Springer Nature, 2023.

**Web links and Video Lectures (e-Resources):**

- https://www.youtube.com/playlist?app=desktop&list=PL2ovtN0KdWZiBkaQsHXMGFTEzok7YQkvt
- https://www.youtube.com/watch?v=HcCZSw-Rm-w

**Activity Based Learning (Suggested Activities in Class)/ Practical Based learning**

- Course Project: Covers the demonstration of the concepts outlined in the syllabus– 25 Marks

| | | | | |
|---|---|---|---|---|
| | **Cloud Computing & Security** | | Semester | VI |
| | Course Code | **BIS613D** | CIE Marks | 50 |
| | Teaching Hours/Week (L: T:P: S) | 3:0:0:0 | SEE Marks | 50 |
| | Total Hours of Pedagogy | 40 | Total Marks | 100 |
| | Credits | 03 | Exam Hours | 3 |
| | Examination type (SEE) | Theory | | |

**Course objectives:**

- Introduce the rationale behind the cloud computing revolution and the business drivers
- Understand various models, types and challenges of cloud computing
- Understand the design of cloud native applications, the necessary tools and the design tradeoffs.
- Realize the importance of Cloud Virtualization, Abstraction`s, Enabling Technologies and cloud security

**Teaching-Learning Process (General Instructions)**

These are sample Strategies; which teachers can use to accelerate the attainment of the various course outcomes.

1. Lecturer method (L) needs not to be only a traditional lecture method, but alternative effective teaching methods could be adopted to attain the outcomes.
2. Use of Video/Animation to explain functioning of various concepts.
3. Encourage collaborative (Group Learning) Learning in the class.
4. Ask at least three HOT (Higher order Thinking) questions in the class, which promotes critical thinking.
5. Discuss how every concept can be applied to the real world - and when that's possible, it
   helps improve the students' understanding.
6. Use any of these methods: Chalk and board, Active Learning, Case Studies.

## Module-1

**Distributed System Models and Enabling Technologies:** Scalable Computing Over the Internet, Technologies for Network Based Systems, System Models for Distributed and Cloud Computing, Software Environments for Distributed Systems and Clouds, Performance, Security and Energy Efficiency.

**Textbook 1: Chapter 1: 1.1 to 1.5**

## Module-2

**Virtual Machines and Virtualization of Clusters and Data Centers:** Implementation Levels of Virtualization, Virtualization Structure/Tools and Mechanisms, Virtualization of CPU/Memory and I/O devices, Virtual Clusters and Resource Management, Virtualization for Data Center Automation.

**Textbook 1: Chapter 3: 3.1 to 3.5**

## Module-3

**Cloud Platform Architecture over Virtualized Datacenters:** Cloud Computing and Service Models, Data Center Design and Interconnection Networks, Architectural Design of

| | |
|---|---|
| | Compute and Storage Clouds, Public Cloud Platforms: GAE, AWS and Azure, Inter-Cloud Resource Management.<br>**Textbook 1: Chapter 4: 4.1 to 4.5** |
| | **Module-4** |
| | **Cloud Security:** Top concern for cloud users, Risks, Privacy Impact Assessment, Cloud Data Encryption, Security of Database Services, OS security, VM Security, Security Risks Posed by Shared Images and Management OS, XOAR, A Trusted Hypervisor, Mobile Devices and Cloud Security.<br>**Cloud Security and Trust Management:** Cloud Security Defense Strategies, Distributed Intrusion/Anomaly Detection, Data and Software Protection Techniques, Reputation-Guided Protection of Data Centers.<br>**Textbook 2: Chapter 11: 11.1 to 11.3, 11.5 to 11.8, 11.10 to 11.14**<br>**Textbook 1: Chapter 4: 4.6** |
| | **Module-5** |
| | **Cloud Programming and Software Environments:**<br>Features of Cloud and Grid Platforms, Parallel and Distributed Computing Paradigms, Programming Support for Google App Engine, Programming on Amazon AWS and Microsoft, Emerging Cloud Software Environments.<br>**Textbook 1: Chapter 6: 6.1 to 6.5** |

**Course outcome (Course Skill Set)**

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

1. Describe various cloud computing platforms and service providers.
2. Illustrate the significance of various types of virtualization.
3. Identify the architecture, delivery models and industrial platforms for cloud computing based applications.
4. Analyze the role of security aspects in cloud computing.
5. Demonstrate cloud applications in various fields using suitable cloud platforms.

## Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks out of 50) and for the SEE minimum passing mark is 35% of the maximum marks (18 out of 50 marks). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures a minimum of 40% (40 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together.

**Continuous Internal Evaluation:**

- For the Assignment component of the CIE, there are 25 marks and for the Internal Assessment Test component, there are 25 marks.
- The first test will be administered after 40-50% of the syllabus has been covered, and the second test will be administered after 85-90% of the syllabus has been covered
- Any two assignment methods mentioned in the 22OB2.4, if an assignment is project-based then only one assignment for the course shall be planned. The teacher should not conduct two assignments at the end of the semester if two assignments are planned.
- For the course, CIE marks will be based on a scaled-down sum of two tests and other methods of assessment.

**Internal Assessment Test question paper is designed to attain the different levels of Bloom's taxonomy as per the outcome defined for the course.**

**Semester-End Examination:**

Theory SEE will be conducted by University as per the scheduled timetable, with common question papers for the course (**duration 03 hours).**

1. The question paper will have ten questions. Each question is set for 20 marks.
2. There will be 2 questions from each module. Each of the two questions under a module (with a maximum of 3 sub-questions), **should have a mix of topics** under that module.
3. The students have to answer 5 full questions, selecting one full question from each module.
4. Marks scored shall be proportionally reduced to 50 marks

**Suggested Learning Resources:**

**Text Books:**

1. Kai Hwang, Geoffrey C Fox, and Jack J Dongarra, Distributed and Cloud Computing, Morgan Kaufmann, Elsevier 2012
2. Dan C. Marinescu, Cloud Computing Theory and Practice, Morgan Kaufmann, 2nd Edition, Elsevier 2018

**Reference Books:**

1. Rajkumar Buyya, Christian Vecchiola, and Thamrai Selvi, Mastering Cloud Computing McGrawHill Education, 1st Edition, 2017
2. Toby Velte, Anthony Velte, Cloud Computing: A Practical Approach, McGraw-Hill Education, 2017.
3. George Reese, Cloud Application Architectures: Building Applications and Infrastructure in the Cloud, O'Reilly Publication, 1st Edition, 2009
4. John Rhoton, Cloud Computing Explained: Implementation Handbook for Enterprises, Recursive Press, 2nd Edition, 2009.

**Web links and Video Lectures (e-Resources):**

- https://freevideolectures.com/course/4639/nptel-cloud-computing/1.
- https://www.youtube.com/playlist?list=PLShJJCRzJWxhz7SfG4hpaBD5bKOloWx9J
- https://www.youtube.com/watch?v=EN4fEbcFZ_E
- https://www.youtube.com/watch?v=RWgW-CgdIk0
- https://www.geeksforgeeks.org/virtualization-cloud-computing-types/
- https://www.javatpoint.com/cloud-service-provider-companies

**Activity Based Learning (Suggested Activities in Class)/ Practical Based learning**

- Installation of virtualization software (Virtual box, Xen etc..) and run applications with different OS. - 10 Marks
- Implement cloud applications using GAE, AWS, Azure/simulate cloud applications using Cloudsim/ Greencloud/ Cloud Analyst etc… - 15 Marks

| | | | | |
|---|---|---|---|---|
| | **Blockchain Technology** | | Semester | 6 |
| | Course Code | **BCS613A** | CIE Marks | 50 |
| | Teaching Hours/Week (L: T:P: S) | 3:0:0:0 | SEE Marks | 50 |
| | Total Hours of Pedagogy | 40 | Total Marks | 100 |
| | Credits | 03 | Exam Hours | 03 |
| | Examination type (SEE) | Theory | | |

**Course objectives:**

- To Understand Blockchain terminologies with its applications. design
- To learn working principles of Blockchain and methodologies used in Bitcoin
- To gain knowledge on Ethereum Network, Wallets, Nodes, Smart contract & DApps
- To learn blockchain Based Application Architecture using Hyperledger and the Smart Contract Lifecycle

**Teaching-Learning Process (General Instructions)**

These are sample Strategies, which teachers can use to accelerate the attainment of the various course outcomes.

1. Lecturer method (L) needs not to be only a traditional lecture method, but alternative effective teaching methods could be adopted to attain the outcomes.
2. Use of Video/Animation/Demonstration to explain functioning of various concepts.
3. Encourage collaborative (Group Learning) Learning in the class.
4. Ask at least three HOT (Higher order Thinking) questions in the class, which promotes critical thinking.
5. Adopt Problem Based Learning (PBL), which fosters students' Analytical skills, develop design thinking skills such as the ability to design, evaluate, generalize, and analyze information rather than simply recall it.
6. Use animations/videos to help the students to understand the concepts.

**Module-1**

Distributed systems, CAP theorem, Byzantine Generals problem, Consensus. The history of blockchain, Introduction to blockchain, Various technical definitions of blockchains, Generic elements of a blockchain, Features of a blockchain, Applications of blockchain technology, Tiers of blockchain technology, Consensus in blockchain, CAP theorem and blockchain, Benefits and limitations of blockchain.

**Chapter 1**

**Module-2**

Decentralization using blockchain, Methods of decentralization, Blockchain and full ecosystem decentralization, Smart contract, Decentralized organizations, Decentralized autonomous organizations, Decentralized autonomous corporations, Decentralized autonomous societies Decentralized applications, Platforms for decentralization.

Cryptographic primitives: Symmetric cryptography, Asymmetric cryptography, Public and private keys, Hash functions: Compression of arbitrary messages into fixed length digest, Easy to compute, Pre-image resistance, Second pre-image resistance, Collision resistance, Message Digest (MD),Secure Hash Algorithms (SHAs), Merkle trees, Patricia trees, Distributed hash tables (DHTs), Digital signatures, Elliptic Curve Digital signature algorithm (ECDSA).

**Chapter 2, Chapter 3: pg:56-105**

**Module-3**

| | |
|---|---|
| | Bitcoin, Bitcoin definition, Transactions, The transaction life cycle, The transaction structure, Types of transaction, The structure of a block , The structure of a block header, The genesis block, The bitcoin network, Wallets, Smart Contracts-History, Definition, Ricardian contracts, Smart contract templates, Oracles, Smart Oracles, Deploying smart contracts on a blockchain, The DAO.<br><br>**Chapter 4:pg:111-148, Chapter 6** |
| | **Module-4** |
| | Ethereum 101, Introduction, Ethereum clients and releases, The Ethereum stack, Ethereum blockchain, Currency (ETH and ETC), Forks, Gas, The consensus mechanism, The world state, Transactions, Contract creation transaction, Message call transaction, Elements of the Ethereum blockchain , Ethereum virtual machine (EVM), Accounts, Block, Ether, Messages, Mining, The Ethereum network.<br>Hands-on: Clients and wallets –Geth.<br><br>**Chapter 7: pg: 210-227, 235-269** |
| | **Module-5** |
| | Hyperledger, Hyperledger as a protocol, Fabric, Hyperledger Fabric, Sawtooth lake, Corda.<br><br>**Chapter 9** |

**Course outcomes (Course Skill Set)**

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

1. Explain the Blockchain terminologies with its applications. design
2. Illustrate the working principles of Blockchain and the Smart Contract Lifecycle
3. Demonstrate the principles and methodologies used in Bitcoin
4. Develop Ethereum Network, Wallets, Nodes, Smart contract and DApps.
5. Make use of Hyperledger in Blockchain Based Application Architecture.

## Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks out of 50) and for the SEE minimum passing mark is 35% of the maximum marks (18 out of 50 marks). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures a minimum of 40% (40 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together.

**Continuous Internal Evaluation:**

- For the Assignment component of the CIE, there are 25 marks and for the Internal Assessment Test component, there are 25 marks.
- The first test will be administered after 40-50% of the syllabus has been covered, and the second test will be administered after 85-90% of the syllabus has been covered
- Any two assignment methods mentioned in the 22OB2.4, if an assignment is project-based then only one assignment for the course shall be planned. The teacher should not conduct two assignments at the end of the semester if two assignments are planned.
- For the course, CIE marks will be based on a scaled-down sum of two tests and other methods of assessment.

**Internal Assessment Test question paper is designed to attain the different levels of Bloom's taxonomy as per the outcome defined for the course.**

**Semester-End Examination:**

Theory SEE will be conducted by University as per the scheduled timetable, with common question papers for the course (**duration 03 hours).**

1. The question paper will have ten questions. Each question is set for 20 marks.
2. There will be 2 questions from each module. Each of the two questions under a module (with a maximum of 3 sub-questions), **should have a mix of topics** under that module.
3. The students have to answer 5 full questions, selecting one full question from each module.
4. Marks scored shall be proportionally reduced to 50 marks

**Suggested Learning Resources:**

**Books**

1. Imran Bashir. "Mastring BlockChain", Third Edition, Packt – 2020.

**Reference Book**

1. Andreas M. , Mastering Bitcoin: Programming the Open Blockchain – O'rielly – 2017.

**Web links and Video Lectures (e-Resources):**

- https://nptel.ac.in/courses/106104220
- https://www.geeksforgeeks.org/blockchain/
- https://www.tutorialspoint.com/blockchain/index.htm

**Activity Based Learning (Suggested Activities in Class)/ Practical Based learning**

- Course Project: Covers the implementation of the major concepts outlined in the syllabus– 25 Marks

| | | | | |
|---|---|---|---|---|
| | **TIME SERIES ANALYSIS** | | Semester | 6 |
| | Course Code | **BAI613D** | CIE Marks | 50 |
| | Teaching Hours/Week (L: T:P: S) | 3:0:0:0 | SEE Marks | 50 |
| | Total Hours of Pedagogy | 40 | Total Marks | 100 |
| | Credits | 03 | Exam Hours | 03 |
| | Examination type (SEE) | Theory | | |

**Course objectives:**

- Learn the importance of time series analysis on the data.
- Identify approaches to handle linear stationary and non stationary models.
- Analyse ways of model building and parameter estimation.
- Recognize methods to handle multivariate time series data.

**Teaching-Learning Process (General Instructions)**

These are sample strategies; which teachers can use to accelerate the attainment of the various course outcomes.

1. Lecturer method (L) does not mean only the traditional lecture method, but different types of teaching methods may be adopted to achieve the outcomes.
2. Utilize video/animation films to illustrate the functioning of various concepts.
3. Promote collaborative learning (Group Learning) in the class.
4. Pose at least three HOT (Higher Order Thinking) questions in the class to stimulate critical thinking.
5. Incorporate Problem-Based Learning (PBL) to foster students' analytical skills and develop their ability to evaluate, generalize, and analyze information rather than merely recalling it.
6. Introduce topics through multiple representations.
7. Demonstrate various ways to solve the same problem and encourage students to devise their own creative solutions.
8. Discuss the real-world applications of every concept to enhance students' comprehension.
9. Use any of these methods: Chalk and board, Active Learning, Case Studies.

**Module-1**

Introduction, Five Important Practical Problems, **Autocorrelation Function and Spectrum of Stationary Processes:** Autocorrelation Properties of Stationary Models, Spectral Properties of Stationary Models, **Linear Stationary Models:** General Linear Process, Autoregressive Processes, Moving Average Processes, Mixed Autoregressive--Moving Average Processes.

**Ch. 1.1, Ch. 2.1,2.2 Ch. 3.1,3.2,3.3,3.4**

**Module-2**

**Linear Nonstationary Models:** Autoregressive Integrated Moving Average Processes, Three Explicit Forms for the ARIMA Model, Integrated Moving Average Processes.

**Forecasting :** Minimum Mean Square Error Forecasts and Their Properties, Calculating Forecasts and Probability Limits, Examples of Forecast Functions and Their Updating, Use of State-Space Model Formulation for Exact Forecasting

**Ch. 4.1,4.2,4.3, Ch. 5.1,5.2,5.3,5.4,5.5.**

| | |
|---|---|
| | **Module-3** |
| | **Model Identification:** Objectives of Identification, Identification Techniques, Initial Estimates for the Parameters, Model Multiplicity.<br><br>**Parameter Estimation:** Study of the Likelihood and Sum-of-Squares Functions, Nonlinear Estimation, Some Estimation Results for Specific Models, Likelihood Function Based on the State-Space Model, Estimation Using Bayes' Theorem<br><br>**Ch. 6.1,6.2,6.3,6.4 Ch. 7.1,7.2,7.3,7.4,7.5.** |
| | **Module-4** |
| | **Model Diagnostic Checking**: Checking the Stochastic Model, Overfitting, Diagnostic Checks Applied to Residuals, Use of Residuals to Modify the Model,<br><br>**Analysis of Seasonal Time Series**: Parsimonious Models for Seasonal Time Series, Some Aspects of More General Seasonal ARIMA Models, Structural Component Models and Deterministic Seasonal Components, Regression Models with Time Series Error Terms.<br><br>**Ch. 8.1,8.2,8.3 Ch. 9.1,9.2,9.3,9.4,9.5** |
| | **Module-5** |
| | **Multivariate Time Series Analysis:** Stationary Multivariate Time Series, Vector Autoregressive Models, Vector Moving Average Models, Vector Autoregressive--Moving Average Models, Forecasting for Vector Autoregressive--Moving Average Processes, State-Space Form of the VARMA Model, Nonstationary and Cointegration<br><br>**Ch. 14.1,14.2,14.3,14.4,14.5,14.6,14.8** |

## Course outcome (Course Skill Set)

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

1. Apply the fundamental concept of Time series analysis for Autocorrelation Function and spectrum on linear stationary models.
2. Develop non-linear stationary models and perform forecasting.
3. Identify models and estimate the various parameters .
4. Recognize ways to perform model diagnostic checking and analyze the seasonal time series .
5. Analyze multivariate time series data.

**Assessment Details (both CIE and SEE)**

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks out of 50) and for the SEE minimum passing mark is 35% of the maximum marks (18 out of 50 marks). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures a minimum of 40% (40 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together.

**Continuous Internal Evaluation:**

- For the Assignment component of the CIE, there are 25 marks and for the Internal Assessment Test component, there are 25 marks.
- The first test will be administered after 40-50% of the syllabus has been covered, and the second test will be administered after 85-90% of the syllabus has been covered
- Any two assignment methods mentioned in the 22OB2.4, if an assignment is project-based then only one assignment for the course shall be planned. The teacher should not conduct two assignments at the end of the semester if two assignments are planned.
- For the course, CIE marks will be based on a scaled-down sum of two tests and other methods of assessment.

**Internal Assessment Test question paper is designed to attain the different levels of Bloom's taxonomy as per the outcome defined for the course.**

**Semester-End Examination:**

Theory SEE will be conducted by University as per the scheduled timetable, with common question papers for the course (**duration 03 hours).**

1. The question paper will have ten questions. Each question is set for 20 marks.
2. There will be 2 questions from each module. Each of the two questions under a module (with a maximum of 3 sub-questions), **should have a mix of topics** under that module.
3. The students have to answer 5 full questions, selecting one full question from each module.
4. Marks scored shall be proportionally reduced to 50 marks

**Suggested Learning Resources:**

**Text Books:**

1. George E. P. Box, Gwilym M. Jenkins, Gregory C. Reinsel, Greta M. Ljung, "Time Series Analysis – Forecasting and Control", Wiley Publications , 2016.

**Reference Books:**

1. Paul S.P. Cowpertwait and Andrew V. Metcalfe, Introductory Time Series with R, Springer Verlag, New York, 2009.
2. Rob J. Hyndman and George Athanasopoulos, Forecasting: Principles and Practice, One line, Open Access Textbooks.

**Web links and Video Lectures (e-Resources):**

- https://nptel.ac.in/courses/103106123
- https://www.youtube.com/watch?v=GE3JOFwTWVM
- https://www.youtube.com/watch?v=tepxdcepTbY
- https://www.youtube.com/watch?v=rDwczdWBlTA

**Activity Based Learning (Suggested Activities in Class)/ Practical Based learning**

- Course project ( 25 marks)

Load a raw time series dataset (e.g., stock prices, weather data, or energy consumption). Identify trends, seasonality, and noise using visualization tools.
Handle missing values, outliers, and perform data transformation (e.g., log transformation or differencing). Decompose the series into trend, seasonal, and residual components using decomposition techniques.

Refer to monthly sales data or airline passenger data and Fit simple models like Moving Average (MA) and Exponential Smoothing (SES). Evaluate performance using metrics such as RMSE, MAE, and MAPE. Experiment with different smoothing parameters to improve forecasts.

| Mobile Application Development with Flutter | | Semester | 6 |
|---|---|---|---|
| Course Code | **BCGL657A** | CIE Marks | 50 |
| Teaching Hours/Week (L:T:P: S) | 0:0:2:0 | SEE Marks | 50 |
| Credits | 01 | Exam Hours | 100 |
| Examination type (SEE) | Practical | | |

**Course objectives:**

- To introduce basics of Flutter platform for progressive app development
- To gain knowledge on user interface support in Flutter.
- To learn various programming elements reuired for app development.
- To develop progressive applications with flutter.

| Sl.NO | Experiments |
|---|---|
| 1 | Develop an application using Flutter to print “Hello world and Hello Flutter”. |
| 2 | Develop an application using Flutter to Increment and Decrement Numbers (Counter App). |
| 3 | Develop Login Screen Application. |
| 4 | Develop a “To-do List” Application. |
| 5 | Develop Calculator Application. |
| 6 | Develop an application to Check the Weather in Countries Across the world (Weather app). |
| 7 | Develop a “Stopwatch” application using Flutter. |
| 8 | Develop an application that Navigate from one Screen to another (Seamless navigation). |
| 9 | Develop Basic E-commerce UI Application. |
| 10 | Develop an application to implement Animates Logo. |
| 11 | Develop an application that tracks our daily Expenses and get a report chart. |
| 12 | Develop an application to Play Quiz and get the Score Board. |

**Course outcomes (Course Skill Set):**

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

- Demonstrate basics elements Flutter platform for progressive app development.
- Develop user interface designs for applications.
- Experiment with different programming elements of app development.
- Develop progressive applications for real-world problems.

**Assessment Details (both CIE and SEE)**

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks out of 50) and for the SEE minimum passing mark is 35% of the maximum marks (18 out of 50 marks). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures a minimum of 40% (40 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together

**Continuous Internal Evaluation (CIE):**

CIE marks for the practical course are **50 Marks**.

The split-up of CIE marks for record/ journal and test are in the ratio **60:40**.

- Each experiment is to be evaluated for conduction with an observation sheet and record write-up. Rubrics for the evaluation of the journal/write-up for hardware/software experiments are designed by the faculty who is handling the laboratory session and are made known to students at the beginning of the practical session.
- Record should contain all the specified experiments in the syllabus and each experiment write-up will be evaluated for 10 marks.
- Total marks scored by the students are scaled down to **30 marks** (60% of maximum marks).
- Weightage to be given for neatness and submission of record/write-up on time.
- Department shall conduct a test of 100 marks after the completion of all the experiments listed in the syllabus.
- In a test, test write-up, conduction of experiment, acceptable result, and procedural knowledge will carry a weightage of 60% and the rest 40% for viva-voce.
- The suitable rubrics can be designed to evaluate each student's performance and learning ability.
- The marks scored shall be scaled down to **20 marks** (40% of the maximum marks).

The Sum of scaled-down marks scored in the report write-up/journal and marks of a test is the total CIE marks scored by the student.

**Semester End Evaluation (SEE):**

- SEE marks for the practical course are 50 Marks.
- SEE shall be conducted jointly by the two examiners of the same institute, examiners are appointed by the Head of the Institute.
- The examination schedule and names of examiners are informed to the university before the conduction of the examination. These practical examinations are to be conducted between the schedule mentioned in the academic calendar of the University.
- All laboratory experiments are to be included for practical examination.
- (Rubrics) Breakup of marks and the instructions printed on the cover page of the answer script to be strictly adhered to by the examiners. **OR** based on the course requirement evaluation rubrics shall be decided jointly by examiners.

- Students can pick one question (experiment) from the questions lot prepared by the examiners jointly.
- Evaluation of test write-up/ conduction procedure and result/viva will be conducted jointly by examiners.

General rubrics suggested for SEE are mentioned here, writeup-20%, Conduction procedure and result in -60%, Viva-voce 20% of maximum marks. SEE for practical shall be evaluated for 100 marks and scored marks shall be scaled down to 50 marks (however, based on course type, rubrics shall be decided by the examiners)

Change of experiment is allowed only once and 15% of Marks allotted to the procedure part are to be made zero.

The minimum duration of SEE is 02 hours

**Suggested Learning Resources:**

- https://flutter.dev/
- https://developers.google.com/learn/pathways/intro-to-flutter
- https://github.com/flutter/flutter
- https://www.geeksforgeeks.org/flutter-tutorial/
- https://www.tutorialspoint.com/flutter/index.htm

| UI/UX | | Semester | 6 |
|---|---|---|---|
| Course Code | **BADL657B** | CIE Marks | 50 |
| Teaching Hours/Week (L:T:P: S) | 0:0:2:0 | SEE Marks | 50 |
| Credits | 01 | Exam Hours | 02 |
| Examination type (SEE) | Practical | | |

**Course objectives:**

- To explore and understand the nuances of User Experience and User Interface.
- To gain mastery over the usage of Figma for designing and prototyping UI/UX.
- To understand user requirement and translate it into UI/UX protype.
- To analyse apps and websites and understand how they can be continually improved.
- To understand the UI components and interactions being used in different apps and websites.

| Sl.NO | Experiments (Designing and Prototyping using Figma) |
|---|---|
| NOTE: Wire frames can be hand-drawn and recorded by the students. Designing and Prototyping can be done using Figma. | |
| 1 | Chat App Redesign: Create a Wireframe and redesign any popular chat app. |
| 2 | Food App: Create a wireframe, Design and Prototype the UI Pages for the food application. |
| 3 | Social Media App: Create a wireframe, Design and Prototype social media photo sharing app. |
| 4 | Product Website: Design and prototype a product website page. Create web pages and rollovers for the web pages |
| 5 | Travel Agency Website: Create a wireframe, Design and prototype the UI for the website including design for Home Page with search bar, Activities page, Client Testimonial Page, Image Gallery |
| 6 | UI/UX Designer Portfolio Design: Create a wireframe, Design and prototype a UI for a portfolio including design for About page, Work showcase page, Blog page, contact page |
| 7 | Dashboard Design: Create a wireframe, Design and Prototype Dashboard UI page, add some Dashboard details, statistics and graphs, Add dropdown options for some dashboard details |
| 8 | E-Commerce Website: Create a wireframe, Design and prototype Web pages including product category pages (example: mobiles, gaming consoles, Speakers), product pages in each category, buynow page, add to cart page |
| 9 | Educational Website: Create a wireframe, Design and Prototype the UI for an educational website – Include a Homepage with footer, About Us Page, Programs page, Instructors page, Pricing page, Payments page with radial buttons. Design dropdowns for programs button |
| 10 | Music Player App: Create a wireframe, Design and prototype the pages with a background and a Rollover button, and Song selection Page with a Home Rollover button. The third page may include animated play and pause button, play music animation, timer animation. |

**Course outcomes (Course Skill Set):**

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

- Apply the basics of wireframing in designing apps and Websites.
- Make use of Figma for designing and prototyping UI/UX for different types of apps and Websites.
- Analyse user requirements and translate the requirements to design prototypes.
- Demonstrate the UI/UX concepts applied when designing the prototype of apps and Websites.
- Develop (redesign) the existing apps & Websites with customized design.

**Assessment Details (both CIE and SEE)**

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks out of 50) and for the SEE minimum passing mark is 35% of the maximum marks (18 out of 50 marks). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures a minimum of 40% (40 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together

**Continuous Internal Evaluation (CIE):**

CIE marks for the practical course are **50 Marks**.

The split-up of CIE marks for record/ journal and test are in the ratio **60:40**.

- Each experiment is to be evaluated for conduction with an observation sheet and record write-up. Rubrics for the evaluation of the journal/write-up for hardware/software experiments are designed by the faculty who is handling the laboratory session and are made known to students at the beginning of the practical session.
- Record should contain all the specified experiments in the syllabus and each experiment write-up will be evaluated for 10 marks.
- Total marks scored by the students are scaled down to **30 marks** (60% of maximum marks).
- Weightage to be given for neatness and submission of record/write-up on time.
- Department shall conduct a test of 100 marks after the completion of all the experiments listed in the syllabus.
- In a test, test write-up, conduction of experiment, acceptable result, and procedural knowledge will carry a weightage of 60% and the rest 40% for viva-voce.
- The suitable rubrics can be designed to evaluate each student's performance and learning ability.
- The marks scored shall be scaled down to **20 marks** (40% of the maximum marks).

The Sum of scaled-down marks scored in the report write-up/journal and marks of a test is the total CIE marks scored by the student.

**Semester End Evaluation (SEE):**

- SEE marks for the practical course are 50 Marks.
- SEE shall be conducted jointly by the two examiners of the same institute, examiners are appointed by the Head of the Institute.
- The examination schedule and names of examiners are informed to the university before the conduction of the examination. These practical examinations are to be conducted between the schedule mentioned in the academic calendar of the University.
- All laboratory experiments are to be included for practical examination.
- (Rubrics) Breakup of marks and the instructions printed on the cover page of the answer script to be strictly adhered to by the examiners. **OR** based on the course requirement evaluation rubrics shall be decided jointly by examiners.

- Students can pick one question (experiment) from the questions lot prepared by the examiners jointly.
- Evaluation of test write-up/ conduction procedure and result/viva will be conducted jointly by examiners.

General rubrics suggested for SEE are mentioned here, writeup-20%, Conduction procedure and result in -60%, Viva-voce 20% of maximum marks. SEE for practical shall be evaluated for 100 marks and scored marks shall be scaled down to 50 marks (however, based on course type, rubrics shall be decided by the examiners)

Change of experiment is allowed only once and 15% of Marks allotted to the procedure part are to be made zero.

The minimum duration of SEE is 02 hours

**Suggested Learning Resources:**

- https://www.figma.com/
- UX Programming for Beginners, August, 2022
- https://www.udemy.com/course/learn-figma-web-design
- https://www.udemy.com/course/figma-2023-master-class-realtime-uiux-web-projects

| Generative AI | | Semester | 6 |
|---|---|---|---|
| Course Code | **BAIL657C** | CIE Marks | 50 |
| Teaching Hours/Week (L:T:P: S) | 0:0:1:0 | SEE Marks | 50 |
| Credits | 01 | Exam Hours | 100 |
| Examination type (SEE) | Practical | | |

**Course objectives:**

- Understand the principles and concepts behind generative AI models
- Explain the knowledge gained to implement generative models using Prompt design frameworks.
- Apply various Generative AI applications for increasing productivity.
- Develop Large Language Model-based Apps.

| Sl.NO | Experiments |
|---|---|
| 1. | Explore pre-trained word vectors. Explore word relationships using vector arithmetic. Perform arithmetic operations and analyze results. |
| 2. | Use dimensionality reduction (e.g., PCA or t-SNE) to visualize word embeddings for Q 1. Select 10 words from a specific domain (e.g., sports, technology) and visualize their embeddings. Analyze clusters and relationships. Generate contextually rich outputs using embeddings. Write a program to generate 5 semantically similar words for a given input. |
| 3. | Train a custom Word2Vec model on a small dataset. Train embeddings on a domain-specific corpus (e.g., legal, medical) and analyze how embeddings capture domain-specific semantics. |
| 4. | Use word embeddings to improve prompts for Generative AI model. Retrieve similar words using word embeddings. Use the similar words to enrich a GenAI prompt. Use the AI model to generate responses for the original and enriched prompts. Compare the outputs in terms of detail and relevance. |
| 5. | Use word embeddings to create meaningful sentences for creative tasks. Retrieve similar words for a seed word. Create a sentence or story using these words as a starting point. Write a program that: Takes a seed word. Generates similar words. Constructs a short paragraph using these words. |
| 6. | Use a pre-trained Hugging Face model to analyze sentiment in text. Assume a real-world application, Load the sentiment analysis pipeline. Analyze the sentiment by giving sentences to input. |
| 7. | Summarize long texts using a pre-trained summarization model using Hugging face model. Load the summarization pipeline. Take a passage as input and obtain the summarized text. |
| 8. | Install langchain, cohere (for key), langchain-community. Get the api key( By logging into Cohere and obtaining the cohere key). Load a text document from your google drive . Create a prompt template to display the output in a particular manner. |
| 9. | Take the Institution name as input. Use Pydantic to define the schema for the desired output and create a custom output parser. Invoke the Chain and Fetch Results. Extract the below Institution related details from Wikipedia: **The founder of the Institution. When it was founded. The current branches in the institution . How many employees are working in it. A brief 4-line summary of the institution.** |
| 10 | Build a chatbot for the Indian Penal Code. We'll start by downloading the official Indian Penal Code document, and then we'll create a chatbot that can interact with it. Users will be able to ask questions about the Indian Penal Code and have a conversation with it. |

**Course outcomes (Course Skill Set):**

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

- Develop the ability to explore and analyze word embeddings, perform vector arithmetic to investigate word relationships, visualize embeddings using dimensionality reduction techniques
- Apply prompt engineering skills to real-world scenarios, such as information retrieval, text generation.
- Utilize pre-trained Hugging Face models for real-world applications, including sentiment analysis and text summarization.
- Apply different architectures used in large language models, such as transformers, and understand their advantages and limitations.

## Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks out of 50) and for the SEE minimum passing mark is 35% of the maximum marks (18 out of 50 marks). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures a minimum of 40% (40 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together

### Continuous Internal Evaluation (CIE):

CIE marks for the practical course are **50 Marks**.

The split-up of CIE marks for record/ journal and test are in the ratio **60:40**.

- Each experiment is to be evaluated for conduction with an observation sheet and record write-up. Rubrics for the evaluation of the journal/write-up for hardware/software experiments are designed by the faculty who is handling the laboratory session and are made known to students at the beginning of the practical session.
- Record should contain all the specified experiments in the syllabus and each experiment write-up will be evaluated for 10 marks.
- Total marks scored by the students are scaled down to **30 marks** (60% of maximum marks).
- Weightage to be given for neatness and submission of record/write-up on time.
- Department shall conduct a test of 100 marks after the completion of all the experiments listed in the syllabus.
- In a test, test write-up, conduction of experiment, acceptable result, and procedural knowledge will carry a weightage of 60% and the rest 40% for viva-voce.
- The suitable rubrics can be designed to evaluate each student's performance and learning ability.
- The marks scored shall be scaled down to **20 marks** (40% of the maximum marks).

The Sum of scaled-down marks scored in the report write-up/journal and marks of a test is the total CIE marks scored by the student.

### Semester End Evaluation (SEE):

- SEE marks for the practical course are 50 Marks.
- SEE shall be conducted jointly by the two examiners of the same institute, examiners are appointed by the Head of the Institute.

- The examination schedule and names of examiners are informed to the university before the conduction of the examination. These practical examinations are to be conducted between the schedule mentioned in the academic calendar of the University.
- All laboratory experiments are to be included for practical examination.
- (Rubrics) Breakup of marks and the instructions printed on the cover page of the answer script to be strictly adhered to by the examiners. **OR** based on the course requirement evaluation rubrics shall be decided jointly by examiners.
- Students can pick one question (experiment) from the questions lot prepared by the examiners jointly.
- Evaluation of test write-up/ conduction procedure and result/viva will be conducted jointly by examiners.

General rubrics suggested for SEE are mentioned here, writeup-20%, Conduction procedure and result in -60%, Viva-voce 20% of maximum marks. SEE for practical shall be evaluated for 100 marks and scored marks shall be scaled down to 50 marks (however, based on course type, rubrics shall be decided by the examiners)

Change of experiment is allowed only once and 15% of Marks allotted to the procedure part are to be made zero.

The minimum duration of SEE is 02 hours

**Suggested Learning Resources:**

**Books:**

1. Modern Generative AI with ChatGPT and OpenAI Models: Leverage the Capabilities of OpenAI's LLM for Productivity and Innovation with GPT3 and GPT4, by Valentina Alto, Packt Publishing Ltd, 2023.
2. Generative AI for Cloud Solutions: Architect modern AI LLMs in secure, scalable, and ethical cloud environments, by Paul Singh, Anurag Karuparti ,Packt Publishing Ltd, 2024.

**Web links and Video Lectures (e-Resources):**

- https://www.w3schools.com/gen_ai/index.php
- https://youtu.be/eTPiL3DF27U
- https://youtu.be/je6AlVeGOV0
- https://youtu.be/RLVqsA8ns6k
- https://youtu.be/0SAKM7wiC-A
- https://youtu.be/28_9xMyrdjg
- https://youtu.be/8iuiz-c-EBw
- https://youtu.be/7oQ8VtEKcgE
- https://youtu.be/seXp0VWWZV0

| INTRODUCTION TO ARTIFICIAL INTELLIGENCE | | Semester | 6 |
|---|---|---|---|
| Course Code | **BAI654D** | CIE Marks | 50 |
| Teaching Hours/Week (L: T:P: S) | 3:0:0:0 | SEE Marks | 50 |
| Total Hours of Pedagogy | 40 | Total Marks | 100 |
| Credits | 03 | Exam Hours | 03 |
| Examination type (SEE) | Theory | | |

**Course objectives:**

- To understand the primitives of AI
- To familiarize Knowledge Representation Issues
- To understand fundamentals of Statistical Reasoning, Natural Language Processing.

**Teaching-Learning Process (General Instructions)**

These are sample strategies; which teachers can use to accelerate the attainment of the various course outcomes.

1. Lecturer method (L) does not mean only the traditional lecture method, but different types of teaching methods may be adopted to achieve the outcomes.
2. Utilize video/animation films to illustrate the functioning of various concepts.
3. Promote collaborative learning (Group Learning) in the class.
4. Pose at least three HOT (Higher Order Thinking) questions in the class to stimulate critical thinking.
5. Incorporate Problem-Based Learning (PBL) to foster students' analytical skills and develop their ability to evaluate, generalize, and analyze information rather than merely recalling it.
6. Introduce topics through multiple representations.
7. Demonstrate various ways to solve the same problem and encourage students to devise their own creative solutions.
8. Discuss the real-world applications of every concept to enhance students' comprehension.
9. Use any of these methods: Chalk and board, Active Learning, Case Studies

**Module-1**

What **is** artificial intelligence? Problems, Problem Spaces, and search

**Text Book 1: Ch 1, 2**

**Module-2**

Knowledge Representation Issues, Using Predicate Logic, representing knowledge using Rules.

**Text Book 1: Ch 4, 5 and 6.**

**Module-3**

Symbolic Reasoning under Uncertainty, Statistical reasoning

**Text Book 1: Ch 7, 8**

**Module-4**

Game Playing, Natural Language Processing

**Text Book 1: Ch 12 and 15**

**Module-5**

Learning, Expert Systems.

**Text Book 1: Ch 17 and 20**

**Course outcomes (Course Skill Set)**

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

1. Identify the problems where the adaptation of AI has significant impact.
2. Analyse the different approaches of Knowledge Representation.
3. Explain Symbolic Reasoning under Uncertainty and Statistical reasoning.
4. Derive the importance of different types of Learning Techniques.
5. Explain Natural Language Processing and Expert System.

**Assessment Details (both CIE and SEE)**

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks out of 50) and for the SEE minimum passing mark is 35% of the maximum marks (18 out of 50 marks). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures a minimum of 40% (40 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together.

**Continuous Internal Evaluation:**

- For the Assignment component of the CIE, there are 25 marks and for the Internal Assessment Test component, there are 25 marks.
- The first test will be administered after 40-50% of the syllabus has been covered, and the second test will be administered after 85-90% of the syllabus has been covered
- Any two assignment methods mentioned in the 22OB2.4, if an assignment is project-based then only one assignment for the course shall be planned. The teacher should not conduct two assignments at the end of the semester if two assignments are planned.
- For the course, CIE marks will be based on a scaled-down sum of two tests and other methods of assessment.

**Internal Assessment Test question paper is designed to attain the different levels of Bloom's taxonomy as per the outcome defined for the course.**

**Semester-End Examination:**

Theory SEE will be conducted by University as per the scheduled timetable, with common question papers for the course (**duration 03 hours).**

1. The question paper will have ten questions. Each question is set for 20 marks.
2. There will be 2 questions from each module. Each of the two questions under a module (with a maximum of 3 sub-questions), **should have a mix of topics** under that module.
3. The students have to answer 5 full questions, selecting one full question from each module.
4. Marks scored shall be proportionally reduced to 50 marks

**Suggested Learning Resources:**

**Text Books:**

**1.** E. Rich, K. Knight & S. B. Nair, Artificial Intelligence, 3rd Edition, McGraw Hill.,2009

**Reference Books**

**2.** Stuart Rusell, Peter Norving, Artificial Intelligence: A Modern Approach, 2nd Edition, Pearson Education

3. Dan W. Patterson, Introduction to Artificial Intelligence and Expert Systems, 1st Edition,Prentice Hal of India, 2015
4. G. Luger, Artificial Intelligence: Structures and Strategies for complex problem Solving, 4th Edition, Pearson Education, 2002.
5. N.P. Padhy "Artificial Intelligence and Intelligent Systems", Oxford University Press, 2015

**Web links and Video Lectures (e-Resources):**

1. https://nptel.ac.in/courses/106102220
2. https://nptel.ac.in/courses/106105077
3. https://archive.nptel.ac.in/courses/106/105/106105158/
4. https://archive.nptel.ac.in/courses/106/106/106106140/

**Activity Based Learning (Suggested Activities in Class)/ Practical Based learning**

- Apply NLP steps for any given real time scenario. Students are expected to document different NLP steps and their output for the given scenario. Students can use python or any programming language of their choice. **(10 Marks)**
- Students are expected to identify different case studies/scenarios where expert systems can be adopted. Students need to prepare a report on any one case study. **(15 marks)**

| **Machine Learning lab** | | Semester | **6** |
|---|---|---|---|
| Course Code | BAIL606 | CIE Marks | 50 |
| Teaching Hours/Week (L:T:P: S) | 0:0:2:0 | SEE Marks | 50 |
| Credits | 01 | Exam Hours | 100 |
| Examination type (SEE) | Practical | | |

**Course objectives:**

- To become familiar with data and visualize univariate, bivariate, and multivariate data using statistical techniques and dimensionality reduction.
- To understand various machine learning algorithms such as similarity-based learning, regression, decision trees, and clustering.
- To familiarize with learning theories, probability-based models and developing the skills required for decision-making in dynamic environments.

| **Sl.NO** | **Experiments** |
|---|---|
| 1 | Develop a program to Load a dataset and select one numerical column. Compute mean, median, mode, standard deviation, variance, and range for a given numerical column in a dataset. Generate a histogram and boxplot to understand the distribution of the data. Identify any outliers in the data using IQR. Select a categorical variable from a dataset. Compute the frequency of each category and display it as a bar chart or pie chart. |
| 2 | Develop a program to Load a dataset with at least two numerical columns (e.g., Iris, Titanic). Plot a scatter plot of two variables and calculate their Pearson correlation coefficient. Write a program to compute the covariance and correlation matrix for a dataset. Visualize the correlation matrix using a heatmap to know which variables have strong positive/negative correlations. |
| 3 | Develop a program to implement Principal Component Analysis (PCA) for reducing the dimensionality of the Iris dataset from 4 features to 2. |
| 4 | Develop a program to load the Iris dataset. Implement the k-Nearest Neighbors (k-NN) algorithm for classifying flowers based on their features. Split the dataset into training and testing sets and evaluate the model using metrics like accuracy and F1-score. Test it for different values of $k$ (e.g., k=1,3,5) and evaluate the accuracy. Extend the k-NN algorithm to assign weights based on the distance of neighbors (e.g., $weight=1/d^2$ ). Compare the performance of weighted k-NN and regular k-NN on a synthetic or real-world dataset. |
| 6 | Implement the non-parametric Locally Weighted Regression algorithm in order to fit data points. Select appropriate data set for your experiment and draw graphs. |
| 7 | Develop a program to demonstrate the working of Linear Regression and Polynomial Regression. Use Boston Housing Dataset for Linear Regression and Auto MPG Dataset (for vehicle fuel efficiency prediction) for Polynomial Regression. |
| 8 | Develop a program to load the Titanic dataset. Split the data into training and test sets. Train a decision tree classifier. Visualize the tree structure. Evaluate accuracy, precision, recall, and F1-score. |
| 9 | Develop a program to implement the Naive Bayesian classifier considering Iris dataset for training. Compute the accuracy of the classifier, considering the test data. |
| 10 | Develop a program to implement k-means clustering using Wisconsin Breast Cancer data set and visualize the clustering result. |

**Course outcomes (Course Skill Set):**

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

- Illustrate the principles of multivariate data and apply dimensionality reduction techniques.
- Demonstrate similarity-based learning methods and perform regression analysis.
- Develop decision trees for classification and regression problems, and Bayesian models for probabilistic learning.
- Implement the clustering algorithms to share computing resources.

## Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks out of 50) and for the SEE minimum passing mark is 35% of the maximum marks (18 out of 50 marks). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures a minimum of 40% (40 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together

### Continuous Internal Evaluation (CIE):

CIE marks for the practical course are **50 Marks**.

The split-up of CIE marks for record/ journal and test are in the ratio **60:40**.

- Each experiment is to be evaluated for conduction with an observation sheet and record write-up. Rubrics for the evaluation of the journal/write-up for hardware/software experiments are designed by the faculty who is handling the laboratory session and are made known to students at the beginning of the practical session.
- Record should contain all the specified experiments in the syllabus and each experiment write-up will be evaluated for 10 marks.
- Total marks scored by the students are scaled down to **30 marks** (60% of maximum marks).
- Weightage to be given for neatness and submission of record/write-up on time.
- Department shall conduct a test of 100 marks after the completion of all the experiments listed in the syllabus.
- In a test, test write-up, conduction of experiment, acceptable result, and procedural knowledge will carry a weightage of 60% and the rest 40% for viva-voce.
- The suitable rubrics can be designed to evaluate each student's performance and learning ability.
- The marks scored shall be scaled down to **20 marks** (40% of the maximum marks).

The Sum of scaled-down marks scored in the report write-up/journal and marks of a test is the total CIE marks scored by the student.

### Semester End Evaluation (SEE):

- SEE marks for the practical course are 50 Marks.
- SEE shall be conducted jointly by the two examiners of the same institute, examiners are appointed by the Head of the Institute.

- The examination schedule and names of examiners are informed to the university before the conduction of the examination. These practical examinations are to be conducted between the schedule mentioned in the academic calendar of the University.
- All laboratory experiments are to be included for practical examination.
- (Rubrics) Breakup of marks and the instructions printed on the cover page of the answer script to be strictly adhered to by the examiners. **OR** based on the course requirement evaluation rubrics shall be decided jointly by examiners.
- Students can pick one question (experiment) from the questions lot prepared by the examiners jointly.
- Evaluation of test write-up/ conduction procedure and result/viva will be conducted jointly by examiners.

General rubrics suggested for SEE are mentioned here, writeup-20%, Conduction procedure and result in -60%, Viva-voce 20% of maximum marks. SEE for practical shall be evaluated for 100 marks and scored marks shall be scaled down to 50 marks (however, based on course type, rubrics shall be decided by the examiners)

Change of experiment is allowed only once and 15% of Marks allotted to the procedure part are to be made zero.

The minimum duration of SEE is 02 hours

**Suggested Learning Resources:**

**Books:**

1. S Sridhar and M Vijayalakshmi, “Machine Learning”, Oxford University Press, 2021.
2. M N Murty and Ananthanarayana V S, “Machine Learning: Theory and Practice”, Universities Press (India) Pvt. Limited, 2024.

**Web links and Video Lectures (e-Resources):**

- https://www.drssridhar.com/?page_id=1053
- https://www.universitiespress.com/resources?id=9789393330697
- https://onlinecourses.nptel.ac.in/noc23_cs18/preview

| | | | | |
|---|---|---|---|---|
| | **INTRODUCTION TO DATA STRUCTURES** | | Semester | 6 |
| | Course Code | **BCS654A** | CIE Marks | 50 |
| | Teaching Hours/Week (L: T:P: S) | 3:0:0:0 | SEE Marks | 50 |
| | Total Hours of Pedagogy | 40 | Total Marks | 100 |
| | Credits | 03 | Exam Hours | 03 |
| | Examination type (SEE) | Theory | | |

**Course Objectives:**

- Introduce primitive and non-primitive data structures
- Understand the various types of data structure along their operations
- Study various searching and sorting algorithms
- Assess appropriate data structures during program development / problem solving

**Teaching-Learning Process (General Instructions)**

These are sample strategies; which teachers can use to accelerate the attainment of the various course outcomes.

1. Lecturer method (L) does not mean only the traditional lecture method, but different types of teaching methods may be adopted to achieve the outcomes.
2. Utilize video/animation films to illustrate the functioning of various concepts.
3. Promote collaborative learning (Group Learning) in the class.
4. Pose at least three HOT (Higher Order Thinking) questions in the class to stimulate critical thinking.
5. Incorporate Problem-Based Learning (PBL) to foster students' analytical skills and develop their ability to evaluate, generalize, and analyze information rather than merely recalling it.
6. Introduce topics through multiple representations.
7. Demonstrate various ways to solve the same problem and encourage students to devise their own creative solutions.
8. Discuss the real-world applications of every concept to enhance students' comprehension.
9. Use any of these methods: Chalk and board, Active Learning, Case Studies.

**Module-1**

**Arrays:** Introduction, One-Dimensional Arrays, Two-Dimensional Arrays, Initializing Two-Dimensional Arrays, Multidimensional arrays.

**Pointers:** Introduction, Pointer Concepts, Accessing Variables through Pointers, Pointer Applications, Dynamic Memory Allocation Functions.

**Structures and Unions:** Introduction, Declaring Structures, Giving Values to Members, Structure Initialization, Comparison of Structure Variables, Arrays of Structures, Arrays within Structures, Nested Structures, Unions, Size of Structures.

**Textbook 1:** Ch. 8.1 to 8.5, Ch. 12.1 to 12.8, 12.10, 12.11.
**Textbook 2:** Ch. 2.1 to 2.3, 2.5, 2.9.

**Module-2**

| | |
|---|---|
| | **Stacks:** Introduction, Stack Operations, Stack Implementation using Arrays, Applications of Stacks.<br><br>**Queues:** Introduction, Queue Operations, Queue Implementation using Arrays, Different Types of Queues: Circular Queues, Double-Ended Queues, Priority Queues, Applications of Queues.<br><br>**Textbook 2:** Ch. 6.1 to 6.3, Ch. 8.1 to 8.2. |
| | **Module-3** |
| | **Linked Lists:** Introduction, Singly Linked List, Self-Referential Structures, Operations on Singly Linked Lists: Insert-Delete-Display, Implementation of Stacks and Queues using Linked List, Concatenate two Lists, Reverse a List without Creating a New Node, Static Allocation Vs Linked Allocation.<br><br>**Circular Singly Linked List:** Introduction, Operations: Insert-Delete-Display.<br><br>**Textbook 2:** Ch. 9.1 to 9.2, 9.3 (Only 9.3.1 to 9.3.5, 9.3.11 to 9.3.12), 9.4 to 9.5. |
| | **Module-4** |
| | **Trees:** Introduction, Basic Concepts, Representation of Binary Trees, Operations on Binary Trees: Insertion-Traversals-Searching-Copying a Tree, Binary Search Trees, Operations on Binary Search Trees: Insertion-Searching-Find Maximum and Minimum Value-Count Nodes, Expression Trees.<br><br>**Textbook 2:** Ch. 10.1 to 10.4, 10.5 (Only 10.5.1, 10.5.2, 10.5.3.1, 10.5.3.2, 10.5.3.4), 10.6.3. |
| | **Module-5** |
| | **Sorting:** Introduction, Bubble Sort, Selection Sort, Insertion Sort.<br><br>**Searching:** Introduction, Linear Search, Binary Search.<br><br>**Textbook 1:** Ch. 17.1, 17.2.6, 17.3.2.<br>**Textbook 2:** Ch. 11.1 to 11.3, 11.10.1. |

**Course outcome (Course Skill Set)**

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

1. Develop C programs utilizing fundamental concepts such as arrays, pointers and structures.
2. Apply data structures like stacks and queues to solve problems.
3. Develop C programs using linked lists and their various types.
4. Explain the fundamental concepts of trees and their practical applications.
5. Demonstrate different sorting and searching algorithms and determine their algorithmic complexities.

**Assessment Details (both CIE and SEE)**

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks out of 50) and for the SEE minimum passing mark is 35% of the maximum marks (18 out of 50 marks). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures a minimum of 40% (40 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together.

**Continuous Internal Evaluation:**

- For the Assignment component of the CIE, there are 25 marks and for the Internal Assessment Test component, there are 25 marks.
- The first test will be administered after 40-50% of the syllabus has been covered, and the second test will be administered after 85-90% of the syllabus has been covered
- Any two assignment methods mentioned in the 22OB2.4, if an assignment is project-based then only one assignment for the course shall be planned. The teacher should not conduct two assignments at the end of the semester if two assignments are planned.
- For the course, CIE marks will be based on a scaled-down sum of two tests and other methods of assessment.

**Internal Assessment Test question paper is designed to attain the different levels of Bloom's taxonomy as per the outcome defined for the course.**

**Semester-End Examination:**

Theory SEE will be conducted by University as per the scheduled timetable, with common question papers for the course (**duration 03 hours).**

1. The question paper will have ten questions. Each question is set for 20 marks.
2. There will be 2 questions from each module. Each of the two questions under a module (with a maximum of 3 sub-questions), **should have a mix of topics** under that module.
3. The students have to answer 5 full questions, selecting one full question from each module.
4. Marks scored shall be proportionally reduced to 50 marks

**Suggested Learning Resources:**

**Text Books:**


1. E Balagurusamy, "C Programming and Data Structures", 4th Edition, McGraw-Hill, 2007.
2. A M Padma Reddy, "Systematic Approach to Data Structures using C", 9th Revised Edition, Sri Nandi Publications, 2009.


**Reference Books:**


1. Ellis Horowitz and Sartaj Sahni, "Fundamentals of Data Structures in C", 2nd Edition, Universities Press, 2014.
2. Seymour Lipschutz, "Data Structures Schaum's Outlines", Revised 1st Edition, McGraw-Hill, 2014.


**Web links and Video Lectures (e-Resources):**

- https://www.youtube.com/watch?v=DFpWCl_49i0
- https://www.youtube.com/watch?v=x7t_-ULoAZM
- https://www.youtube.com/watch?v=I37kGX-nZEI
- https://www.youtube.com/watch?v=XuCbpw6Bj1U
- https://www.youtube.com/watch?v=R9PTBwOzceo

- https://www.youtube.com/watch?v=qH6yxkw0u78
- https://archive.nptel.ac.in/courses/106/105/106105085/
- https://onlinecourses.swayam2.ac.in/cec19_cs04/preview

**Activity Based Learning (Suggested Activities in Class)/ Practical Based learning**

Develop C programs that focus on Data Structure concepts such as arrays, pointers, structures, stacks, queues, linked lists, trees as well as, sorting and searching algorithms (25 Marks).

| | | | | |
|---|---|---|---|---|
| | **FUNDAMENTALS OF OPERATING SYSTEMS** | | Semester | 6 |
| | Course Code | **BCS654B** | CIE Marks | 50 |
| | Teaching Hours/Week (L: T:P: S) | 3:0:0:0 | SEE Marks | 50 |
| | Total Hours of Pedagogy | 40 | Total Marks | 100 |
| | Credits | 03 | Exam Hours | 03 |
| | Examination type (SEE) | Theory | | |

**Course objectives:**

- To demonstrate the need and different types of OS
- To discuss suitable techniques for management of different resources
- To analyse different memory, storage, and file system management strategies.

**Teaching-Learning Process (General Instructions)**

These are sample strategies; which teachers can use to accelerate the attainment of the various course outcomes.

1. Lecturer method (L) does not mean only the traditional lecture method, but different types of teaching methods may be adopted to achieve the outcomes.
2. Utilize video/animation films to illustrate the functioning of various concepts.
3. Promote collaborative learning (Group Learning) in the class.
4. Pose at least three HOT (Higher Order Thinking) questions in the class to stimulate critical thinking.
5. Incorporate Problem-Based Learning (PBL) to foster students' analytical skills and develop their ability to evaluate, generalize, and analyze information rather than merely recalling it.
6. Introduce topics through multiple representations.
7. Demonstrate various ways to solve the same problem and encourage students to devise their own creative solutions.
8. Discuss the real-world applications of every concept to enhance students' comprehension.
9. Use any of these methods: Chalk and board, Active Learning, Case Studies.

**Module-1**

**Introduction:** What operating systems do; Computer System organization; Computer System Organization, Computer System architecture; Operating System operations; Resource Management

**Operating System Structures:** Operating System Servies, User and Operating System interface; System calls, Application Program Interface, Types of system calls;

**Textbook 1: Chapter 1: 1.1, 1.2, 1.3,1.4, 1.5 Chapter 2: 2.1, 2.2 (2.2.1, 2.2.2), 2.3 (2.3.2, 2.3.3)**

**Module-2**

**Process Management**: Process concept; Process scheduling; Operations on processes; Interprocess Communication

**Multi-threaded Programming:** Overview; Multithreading models, Thread Libraries

**Textbook 1: Chapter 3: 3.1-3.4, Chapter 4: 4.1, 4.3 5, 4.4**

**Module-3**

| | |
|---|---|
| | **CPU Scheduling:** Basic Concepts, Scheduling criteria, Scheduling algorithms, Thread Scheduling**,**<br><br>**Process Synchronization:** Synchronization: The critical section problem; Peterson's solution; Semaphores; Classical problems of synchronization;<br><br>**Textbook 1: Chapter 5: 5.1, 5.2,5.3.1, 5.3.2, 5.3.3, 5.3.4, 5.4 Chapter 6: 6.1, 6.2.,6.3, 6.6** |
| | **Module-4** |
| | **Deadlocks:** System model; Deadlock characterization; Methods for handling deadlocks; Deadlock prevention; Deadlock avoidance; Deadlock detection and recovery from deadlock.<br><br>**Memory Management:** Background; Contiguous memory allocation; Paging; Structure of page table<br><br>**Textbook 1: Chapter 8: 8.1-8.8 Textbook 1: Chapter 9: 9.1-9.4 (9.4.1, 9.4.2)** |
| | **Module-5** |
| | **Virtual Memory Management:** Background; Demand paging; Copy-on-write; Page replacement;<br><br>**File System Interface:** File concept; Access methods; Directory Structure, Protection, File System Implementation: File System Structure, File System Operations,<br><br>**File System Internals**: File Systems, File System Mounting; Partition and Mounting, File sharing;<br><br>**Textbook 1: Chapter 10: 10.1-10.3, 10.4 (10.4.1, 10.4.2, 10.4.4.) Chapter 13: 13.1, 13.2, 13.3 (13.3.1, 13.3.2, 13.3.3), 13.4 (13.4.1, 13.4.2) Chapter 15: 15.1-15.4** |

**Course outcomes (Course Skill Set)**

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

1. Explain the fundamentals of operating systems.
2. Apply appropriate CPU scheduling algorithm for the given scenarios.
3. Analyse the various techniques for process synchronization and deadlock handling.
4. Apply the various techniques for memory management
5. Analyse the importance of File System Mounting and File Sharing

**Assessment Details (both CIE and SEE)**

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks out of 50) and for the SEE minimum passing mark is 35% of the maximum marks (18 out of 50 marks). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures a minimum of 40% (40 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together.

**Continuous Internal Evaluation:**

- For the Assignment component of the CIE, there are 25 marks and for the Internal Assessment Test component, there are 25 marks.
- The first test will be administered after 40-50% of the syllabus has been covered, and the second test will be administered after 85-90% of the syllabus has been covered
- Any two assignment methods mentioned in the 22OB2.4, if an assignment is project-based then only one assignment for the course shall be planned. The teacher should not conduct two assignments at the end of the semester if two assignments are planned.
- For the course, CIE marks will be based on a scaled-down sum of two tests and other methods of assessment.

**Internal Assessment Test question paper is designed to attain the different levels of Bloom's taxonomy as per the outcome defined for the course.**

**Semester-End Examination:**

Theory SEE will be conducted by University as per the scheduled timetable, with common question papers for the course (**duration 03 hours).**

1. The question paper will have ten questions. Each question is set for 20 marks.
2. There will be 2 questions from each module. Each of the two questions under a module (with a maximum of 3 sub-questions), **should have a mix of topics** under that module.
3. The students have to answer 5 full questions, selecting one full question from each module.
4. Marks scored shall be proportionally reduced to 50 marks

**Suggested Learning Resources:**

**Text Books:**


**1.** Abraham Silberschatz, Peter Baer Galvin, Greg Gagne, Operating System Principles 10th edition, Wiley-India, 2015


**Reference Books**


**2.** Ann McHoes Ida M Fylnn, Understanding Operating System, Cengage Learning, 6th Edition, 2010

**3.** D.M Dhamdhere, Operating Systems: A Concept Based Approach 3rd Ed, McGraw-Hill, 2013, P.C.P. Bhatt, An Introduction to Operating Systems: Concepts and Practice 4th Edition, PHI(EEE), 2014.

**4.** William Stallings Operating Systems: Internals and Design Principles, 6th Edition, Pearson, 2008


**Reference Books:**


**1.** Akshay Kulkarni, Adarsha Shivananda, "Natural Language Processing Recipes - Unlocking Text Data with Machine Learning and Deep Learning using Python", Apress, 2019.

**2.** T V Geetha, "Understanding Natural Language Processing – Machine Learning and Deep Learning Perspectives", Pearson, 2024.

**3.** Gerald J. Kowalski and Mark.T. Maybury, "Information Storage and Retrieval systems", Kluwer Academic Publishers.

**Web links and Video Lectures (e-Resources):**

1.https://archive.nptel.ac.in/courses/106/105/106105214/
2.https://archive.nptel.ac.in/courses/106/102/106102132/

**Activity Based Learning (Suggested Activities in Class)/ Practical Based learning**

- Students are expected to prepare animated PPT to illustrate the different types of Process Scheduling and Paging. **(10 Marks)**
- Students are required to prepare detailed case study report on Deadlocks **OR** Students can illustrate deadlock using any programming language **(15 Marks)**

| | MOBILE APPLICATION DEVELOPMENT | | Semester | 6 |
|---|---|---|---|---|
| | Course Code | BIS654C | CIE Marks | 50 |
| | Teaching Hours/Week (L:T:P: S) | 3:0:0 | SEE Marks | 50 |
| | Total Hours of Pedagogy | 40 | Total Marks | 100 |
| | Credits | 03 | Exam Hours | 3 |
| | Examination type (SEE) | Theory | | |

**Course objectives:**

Create, test and debug Android application by setting up Android development environment.

Implement adaptive, responsive user interfaces that work across a wide range of devices.

Infer long running tasks and background work in Android applications

Demonstrate methods in storing, sharing and retrieving data in Android applications

Analyze performance of android applications

Describe the steps involved in publishing Android application to share with the world.

**Teaching-Learning Process (General Instructions)**

These are sample Strategies, which teachers can use to accelerate the attainment of the various course outcomes.

1. Chalk and board, power point presentations
2. Online material (Tutorials) and video lectures.
3. Demonstration of setup Android application development environment & programing examples.
4. Illustrate user interfaces for interacting with apps and triggering actions

**Module-1**

Introduction to Android OS: Android Description – Open Handset Alliance – Android. Ecosystem – Android versions – Android Activity – Features of Android – Android Architecture Stack Linux Kernel. Configuration of Android Environment: Operating System – Java JDK Android SDK – Android Development Tools (ADT) – Android Virtual Devices (AVDs) – Emulators Dalvik Virtual Machine – Differences between JVM and DVM – Steps to Install and Configure Eclipse and SDK.

(Chapters 1 & 2)

**Module-2**

Create the first android application: Directory Structure. Android User Interface: Understanding the Components of a screen– Linear Layout – Absolute Layout – Frame. Layout Relative Layout – Table Layout.

(Chapters 3 & 4)

**Module-3**

| |
|---|
| Designing User Interface with View – Text View – Button – Image Button – Edit Text Check Box – Toggle Button – Radio Button and Radio Group – Progress Bar – Auto complete Text View – Spinner – List View – Grid View – Image View - Scroll View – Custom Toast – Alert – Time and Date Picker.<br><br>(Chapter 5) |
| **Module-4** |
| Activity: Introduction – Intent – Intent filter – Activity life cycle – Broadcast life cycle Service. Multimedia: Android System Architecture – Play Audio and Video – Text to Speech.<br><br>(Chapters 6 & 7) |
| **Module-5** |
| SQLite Database in Android: SQLite Database – Creation and Connection of the database – Transactions. Case Study: SMS Telephony and Location Based Services.<br><br>(Chapters 8, 9, & 10) |
| **Course outcome (Course Skill Set)**<br>At the end of the course the student will be able to:<br><br>1. Explain Mobile Application Ecosystem like concepts, architecture, and lifecycle of mobile applications on Android<br>2. Identify the key components of mobile application frameworks and development tools.<br>3. Apply design principles to create intuitive and responsive user interfaces using appropriate UI/UX tools.<br>4. Develop Functional Mobile Applications -Integrate core functionalities such as layouts, event handling, navigation, and multimedia support into applications.<br>5. Implement local data storage mechanisms (SQLite, Shared Preferences) and external databases (Firebase, APIs) for mobile applications. |

**Assessment Details (both CIE and SEE)**

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks out of 50) and for the SEE minimum passing mark is 35% of the maximum marks (18 out of 50 marks). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures a minimum of 40% (40 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together.

**Continuous internal Examination (CIE)**

- For the Assignment component of the CIE, there are 25 marks and for the Internal Assessment Test component, there are 25 marks.
- The first test will be administered after 40-50% of the syllabus has been covered, and the second test will be administered after 85-90% of the syllabus has been covered
- Any two assignment methods mentioned in the 22OB2.4, if an assignment is project-based then only one assignment for the course shall be planned. The teacher should not conduct two assignments at the end of the semester if two assignments are planned.
- For the course, CIE marks will be based on a scaled-down sum of two tests and other methods of assessment.

**Internal Assessment Test question paper is designed to attain the different levels of Bloom's taxonomy as per the outcome defined for the course.**

**Semester End Examinations (SEE)**

SEE paper shall be set for 50 questions, each of the 01 marks. The pattern of the question paper is MCQ (multiple choice questions). The time allotted for SEE is **01 hour.** The student has to secure a minimum of 35% of the maximum marks meant for SEE.

OR

MCQ (Multiple Choice Questions) are preferred for 01 credit courses, however, if course content demands the general question paper pattern that followed for 03 credit course, then

1. The question paper will have ten questions. Each question is set for 10 marks.
2. There will be 2 questions from each module. Each of the two questions under a module may or may not have the sub-questions (with maximum sub-questions of 02, with marks distributions 5+5, 4+6, 3+7).
3. The students have to answer 5 full questions, selecting one full question from each module.

**Suggested Learning Resources:**

**Books**

1. TEXT BOOK 1. Prasanna Kumar Dixit, "Android", Vikas Publishing House Private Ltd., Noida, 2014.
2. REFERENCE BOOKS
   1. Reto Meier and Wrox Wiley, "Professional Android 4 Application Development", 2012.
   2. ZiguradMednieks, LaridDornin, G.BlakeMeike, Masumi Nakamura, "Programming Andriod", O'Reilly,2013.
   3. Robert Green, Mario Zechner, "Beginning Android 4 Games Development", Apress Media LLC, New York, 2011

**Web links and Video Lectures (e-Resources):**

| | |
|---|---|
| | • .https://www.geeksforgeeks.org/android-tutorial/<br>• https://developer.android.com/<br>• https://www.tutorialspoint.com/android<br>• https://www.w3schools.blog/android-tutorial |
| | **Activity Based Learning (Suggested Activities in Class)/Practical-Based Learning:**<br>1. Programming exercises, fostering the practical application of theoretical concepts. [ 25 marks] |

| DEVOPS | | Semester | 6 |
|---|---|---|---|
| Course Code | **BCSL657D** | CIE Marks | 50 |
| Teaching Hours/Week (L:T:P: S) | 0:0:2:0 | SEE Marks | 50 |
| Credits | 01 | Exam Hours | 100 |
| Examination type (SEE) | Practical | | |

**Course objectives:**

- To introduce DevOps terminology, definition & concepts
- To understand the different Version control tools like Git, Mercurial
- To understand the concepts of Continuous Integration/ Continuous Testing/ Continuous Deployment)
- To understand Configuration management using Ansible
- Illustrate the benefits and drive the adoption of cloud-based Devops tools to solve real world problems

| Sl.NO | Experiments |
|---|---|
| 1 | **Introduction to Maven and Gradle:** Overview of Build Automation Tools, Key Differences Between Maven and Gradle, Installation and Setup |
| 2 | **Working with Maven:** Creating a Maven Project, Understanding the POM File, Dependency Management and Plugins |
| 3 | **Working with Gradle:** Setting Up a Gradle Project, Understanding Build Scripts (Groovy and Kotlin DSL), Dependency Management and Task Automation |
| 4 | **Practical Exercise:** Build and Run a Java Application with Maven**,** Migrate the Same Application to Gradle |
| 5 | **Introduction to Jenkins:** What is Jenkins?, Installing Jenkins on Local or Cloud Environment, Configuring Jenkins for First Use |
| 6 | **Continuous Integration with Jenkins:** Setting Up a CI Pipeline**,** Integrating Jenkins with Maven/Gradle**,** Running Automated Builds and Tests |
| 7 | **Configuration Management with Ansible:** Basics of Ansible: Inventory, Playbooks, and Modules, Automating Server Configurations with Playbooks, Hands-On: Writing and Running a Basic Playbook |
| 8 | **Practical Exercise:** Set Up a Jenkins CI Pipeline for a Maven Project, Use Ansible to Deploy Artifacts Generated by Jenkins |
| 9 | **Introduction to Azure DevOps:** Overview of Azure DevOps Services, Setting Up an Azure DevOps Account and Project |
| 10 | **Creating Build Pipelines:** Building a Maven/Gradle Project with Azure Pipelines, Integrating Code Repositories (e.g., GitHub, Azure Repos), Running Unit Tests and Generating Reports |
| 11 | **Creating Release Pipelines:** Deploying Applications to Azure App Services, Managing Secrets and Configuration with Azure Key Vault, Hands-On: Continuous Deployment with Azure Pipelines |
| 12 | **Practical Exercise and Wrap-Up:** Build and Deploy a Complete DevOps Pipeline, Discussion on Best Practices and Q&A |

**Course outcomes (Course Skill Set):**

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

- Demonstrate different actions performed through Version control tools like Git.
- Perform Continuous Integration and Continuous Testing and Continuous Deployment using Jenkins by building and automating test cases using Maven & Gradle.
- Experiment with configuration management using Ansible.
- Demonstrate Cloud-based DevOps tools using Azure DevOps.

**Assessment Details (both CIE and SEE)**

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks out of 50) and for the SEE minimum passing mark is 35% of the maximum marks (18 out of 50 marks). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures a minimum of 40% (40 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together

**Continuous Internal Evaluation (CIE):**

CIE marks for the practical course are **50 Marks**.

The split-up of CIE marks for record/ journal and test are in the ratio **60:40**.

- Each experiment is to be evaluated for conduction with an observation sheet and record write-up. Rubrics for the evaluation of the journal/write-up for hardware/software experiments are designed by the faculty who is handling the laboratory session and are made known to students at the beginning of the practical session.
- Record should contain all the specified experiments in the syllabus and each experiment write-up will be evaluated for 10 marks.
- Total marks scored by the students are scaled down to **30 marks** (60% of maximum marks).
- Weightage to be given for neatness and submission of record/write-up on time.
- Department shall conduct a test of 100 marks after the completion of all the experiments listed in the syllabus.
- In a test, test write-up, conduction of experiment, acceptable result, and procedural knowledge will carry a weightage of 60% and the rest 40% for viva-voce.
- The suitable rubrics can be designed to evaluate each student's performance and learning ability.
- The marks scored shall be scaled down to **20 marks** (40% of the maximum marks).

The Sum of scaled-down marks scored in the report write-up/journal and marks of a test is the total CIE marks scored by the student.

**Semester End Evaluation (SEE):**

- SEE marks for the practical course are 50 Marks.
- SEE shall be conducted jointly by the two examiners of the same institute, examiners are appointed by the Head of the Institute.
- The examination schedule and names of examiners are informed to the university before the conduction of the examination. These practical examinations are to be conducted between the schedule mentioned in the academic calendar of the University.
- All laboratory experiments are to be included for practical examination.
- (Rubrics) Breakup of marks and the instructions printed on the cover page of the answer script to be strictly adhered to by the examiners. **OR** based on the course requirement evaluation rubrics shall be decided jointly by examiners.

- Students can pick one question (experiment) from the questions lot prepared by the examiners jointly.
- Evaluation of test write-up/ conduction procedure and result/viva will be conducted jointly by examiners.

General rubrics suggested for SEE are mentioned here, writeup-20%, Conduction procedure and result in -60%, Viva-voce 20% of maximum marks. SEE for practical shall be evaluated for 100 marks and scored marks shall be scaled down to 50 marks (however, based on course type, rubrics shall be decided by the examiners)

Change of experiment is allowed only once and 15% of Marks allotted to the procedure part are to be made zero.

The minimum duration of SEE is 02 hours

**Suggested Learning Resources:**

- https://www.geeksforgeeks.org/devops-tutorial/
- https://www.javatpoint.com/devops
- https://www.youtube.com/watch?v=2N-59wUIPVI
- https://www.youtube.com/watch?v=87ZqwoFeO88

VARAYA TECHNOLOGICAL UNIVERSITY, BELAGAVI

**B.E. in Artificial Intelligence and Machine Learning**

**Scheme of Teaching and Examinations2022**

Outcome Based Education (OBE) and Choice Based Credit System (CBCS)

(Effective from the academic year 2023-24)

**IV SEMESTER**

| Sl. No | Course and Course Code | | Course Title | Teaching Department (TD) and Question Paper Setting Board (PSB) | Teaching Hours /Week | | | | Examination | | | | Credits |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | Theory Lecture | Tutorial | Practical / Drawing | Self - Study | Duration in hours | CIE Marks | SEE Marks | Total Marks | |
| | | | | | L | T | P | S | | | | | |
| 1 | PCC/BSC | BCS401 | Analysis & Design of Algorithms | TD : AI<br>PSB : CS | 3 | 0 | 0 | | 03 | 50 | 50 | 100 | 3 |
| 2 | IPCC | BAD402 | Artificial Intelligence | TD : AI<br>PSB : CS | 3 | 0 | 2 | | 03 | 50 | 50 | 100 | 4 |
| 3 | IPCC | BCS403 | Database Management Systems | TD : AI<br>PSB : CS | 3 | 0 | 2 | | 03 | 50 | 50 | 100 | 4 |
| 4 | PCCL | BCSL404 | Analysis & Design of Algorithms Lab | TD : AI<br>PSB : CS | 0 | 0 | 2 | | 03 | 50 | 50 | 100 | 1 |
| 5 | ESC | BXX405x | ESC/ETC/PLC | TD: AI/Maths<br>PSB : CS/Maths | 2 | 2 | 0 | | 03 | 50 | 50 | 100 | 3 |
| 6 | AEC/ SEC | BDS456x | Ability Enhancement Course/Skill Enhancement Course- IV | TD : AI<br>PSB : CS | If the course is Theory<br>1 | 0 | 0 | | 01 | 50 | 50 | 100 | 1 |
| | | | | | If the course is a lab<br>0 | 0 | 2 | | 02 | | | | |
| 4 | BSC | BBOC407 | Biology For Computer Engineers | TD / PSB: BT, CHE, | 2 | 0 | 0 | | 03 | 50 | 50 | 100 | 2 |
| 7 | UHV | BUHK408 | Universal human values course | Any Department | 1 | 0 | 0 | | 01 | 50 | 50 | 100 | 1 |
| 9 | MC | BNSK459 | National Service Scheme (NSS) | NSS coordinator | 0 | 0 | 2 | | | 100 | --- | 100 | 0 |
| | | BPEK459 | Physical Education (PE) (Sports and Athletics) | Physical Education Director | | | | | | | | | |
| | | BYOK459 | Yoga | Yoga Teacher | | | | | | | | | |
| | | | | | | | | | **Total** | **500** | **400** | **900** | **19** |

**PCC**: Professional Core Course, **PCCL**: Professional Core Course laboratory, **UHV**: Universal Human Value Course, **MC**: Mandatory Course (Non-credit), **AEC**: Ability Enhancement Course, **SEC**: Skill Enhancement Course, **L:** Lecture, **T**: Tutorial, **P**: Practical **S= SDA**: Skill Development Activity, **CIE**: Continuous Internal Evaluation, **SEE**: Semester End Evaluation. K :This letter in the course code indicates common to all the stream of engineering.

**Ability Enhancement Course / Skill Enhancement Course – IV**

| | | | |
|---|---|---|---|
| BDSL456A | Scala (0:0:2) | BDSL456C | MERN (0:0:2) |
| BDSL456B | MangoDB (0:0:2) | BDSL456D | Julia (0:0:2) |

**Engineering Science Course (ESC/ETC/PLC)**

| | | | |
|---|---|---|---|
| BCS405A | Discrete Mathematical Structures | BCS405C | Optimization Technique |
| BAI405B | Metric Spaces | BAI405D | Algorithmic Game Theory |

**Professional Core Course (IPCC):** Refers to Professional Core Course Theory Integrated with practical of the same course. Credit for IPCC can be 04 and its Teaching–Learning hours (L : T : P) can be considered as (3 : 0 : 2) or (2 : 2 : 2). The theory part of the IPCC shall be evaluated both by CIE and SEE. The practical part shall be evaluated by only CIE (no SEE). However, questions from the practical part of IPCC shall be included in the SEE question paper. For more details, the regulation governing the Degree of Bachelor of Engineering /Technology (B.E./B.Tech.) 2022-23

**National Service Scheme /Physical Education/Yoga:** All students have to register for any one of the courses namely National Service Scheme (NSS), Physical Education (PE)(Sports and Athletics), and Yoga(YOG) with the concerned coordinator of the course during the first week of III semesters. Activities shall be carried out between III semester to the VI semester (for 4 semesters). Successful completion of the registered course and requisite CIE score is mandatory for the award of the degree. The events shall be appropriately scheduled by the colleges and the same shall be reflected in the calendar prepared for the NSS, PE, and Yoga activities. These courses shall not be considered for vertical progression as well as for the calculation of SGPA and CGPA, but completion of the courses is mandatory for the award of degree.

| Analysis & Design of Algorithms | | Semester | 4 |
|---|---|---|---|
| Course Code | **BCS401** | CIE Marks | 50 |
| Teaching Hours/Week (L: T:P: S) | 3:0:0:0 | SEE Marks | 50 |
| Total Hours of Pedagogy | 40 | Total Marks | 100 |
| Credits | 03 | Exam Hours | 03 |
| Examination type (SEE) | Theory | | |

**Course objectives:**

- To learn the methods for analyzing algorithms and evaluating their performance.
- To demonstrate the efficiency of algorithms using asymptotic notations.
- To solve problems using various algorithm design methods, including brute force, greedy, divide and conquer, decrease and conquer, transform and conquer, dynamic programming, backtracking, and branch and bound.
- To learn the concepts of P and NP complexity classes.

**Teaching-Learning Process (General Instructions)**

These are sample Strategies, which teachers can use to accelerate the attainment of the various course outcomes.

1. Lecturer method (L) does not mean only the traditional lecture method, but different types of teaching methods may be adopted to achieve the outcomes.
2. Utilize video/animation films to illustrate the functioning of various concepts.
3. Promote collaborative learning (Group Learning) in the class.
4. Pose at least three HOT (Higher Order Thinking) questions in the class to stimulate critical thinking.
5. Incorporate Problem-Based Learning (PBL) to foster students' analytical skills and develop their ability to evaluate, generalize, and analyze information rather than merely recalling it.
6. Introduce topics through multiple representations.
7. Demonstrate various ways to solve the same problem and encourage students to devise their own creative solutions.
8. Discuss the real-world applications of every concept to enhance students' comprehension.

**Module-1**

**INTRODUCTION:** What is an Algorithm?, Fundamentals of Algorithmic Problem Solving.

**FUNDAMENTALS OF THE ANALYSIS OF ALGORITHM EFFICIENCY:** Analysis Framework, Asymptotic Notations and Basic Efficiency Classes, Mathematical Analysis of Non recursive Algorithms, Mathematical Analysis of Recursive Algorithms.

**BRUTE FORCE APPROACHES:** Selection Sort and Bubble Sort, Sequential Search and Brute Force String Matching.

**Chapter 1 (Sections 1.1,1.2), Chapter 2(Sections 2.1,2.2,2.3,2.4), Chapter 3(Section 3.1,3.2)**

**Module-2**

**BRUTE FORCE APPROACHES (contd..):** Exhaustive Search (Travelling Salesman probem and Knapsack Problem).

**DECREASE-AND-CONQUER:** Insertion Sort, Topological Sorting.

**DIVIDE AND CONQUER:** Merge Sort, Quick Sort, Binary Tree Traversals, Multiplication of Large Integers and Strassen's Matrix Multiplication.

| **Chapter 3(Section 3.4), Chapter 4 (Sections 4.1,4.2), Chapter 5 (Section 5.1,5.2,5.3, 5.4)** |
|---|
| **Module-3** |
| **TRANSFORM-AND-CONQUER:** Balanced Search Trees, Heaps and Heapsort.<br>**SPACE-TIME TRADEOFFS:** Sorting by Counting: Comparison counting sort, Input Enhancement in String Matching: Horspool's Algorithm.<br>**Chapter 6 (Sections 6.3,6.4), Chapter 7 (Sections 7.1,7.2)** |
| **Module-4** |
| **DYNAMIC PROGRAMMING:** Three basic examples, The Knapsack Problem and Memory Functions, Warshall's and Floyd's Algorithms.<br>**THE GREEDY METHOD:** Prim's Algorithm, Kruskal's Algorithm, Dijkstra's Algorithm, Huffman Trees and Codes.<br>**Chapter 8 (Sections 8.1,8.2,8.4), Chapter 9 (Sections 9.1,9.2,9.3,9.4)** |
| **Module-5** |
| **LIMITATIONS OF ALGORITHMIC POWER:** Decision Trees, P, NP, and NP-Complete Problems.<br>**COPING WITH LIMITATIONS OF ALGORITHMIC POWER**: Backtracking (n-Queens problem, Subset-sum problem), Branch-and-Bound (Knapsack problem), Approximation algorithms for NP-Hard problems (Knapsack problem).<br>**Chapter 11 (Section 11.2, 11.3), Chapter 12 (Sections 12.1,12.2,12.3)** |

**Course outcome (Course Skill Set)**

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

1. Apply asymptotic notational method to analyze the performance of the algorithms in terms of time complexity.
2. Demonstrate divide & conquer approaches and decrease & conquer approaches to solve computational problems.
3. Make use of transform & conquer and dynamic programming design approaches to solve the given real world or complex computational problems.
4. Apply greedy and input enhancement methods to solve graph & string based computational problems.
5. Analyse various classes (P,NP and NP Complete) of problems
6. Illustrate backtracking, branch & bound and approximation methods.

**Assessment Details (both CIE and SEE)**

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks out of 50) and for the SEE minimum passing mark is 35% of the maximum marks (18 out of 50 marks). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures a minimum of 40% (40 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together.

**Continuous Internal Evaluation:**

- For the Assignment component of the CIE, there are 25 marks and for the Internal Assessment Test component, there are 25 marks.
- The first test will be administered after 40-50% of the syllabus has been covered, and the second test will be administered after 85-90% of the syllabus has been covered
- Any two assignment methods mentioned in the 22OB2.4, if an assignment is project-based then only one assignment for the course shall be planned. The teacher should not conduct two assignments at the end of the semester if two assignments are planned.
- For the course, CIE marks will be based on a scaled-down sum of two tests and other methods of assessment.

**Internal Assessment Test question paper is designed to attain the different levels of Bloom's taxonomy as per the outcome defined for the course.**

**Semester-End Examination:**

Theory SEE will be conducted by the University as per the scheduled timetable, with common question papers for the course (**duration 03 hours).**

1. The question paper will have ten questions. Each question is set for 20 marks.
2. There will be 2 questions from each module. Each of the two questions under a module (with a maximum of 3 sub-questions), **should have a mix of topics** under that module.
3. The students have to answer 5 full questions, selecting one full question from each module.
4. Marks scored shall be proportionally **reduced to 50 marks**

**Suggested Learning Resources:**

**Textbooks**

1. Introduction to the Design and Analysis of Algorithms, By Anany Levitin, 3rd Edition (Indian), 2017, Pearson.

**Reference books**

1. Computer Algorithms/C++, Ellis Horowitz, SatrajSahni and Rajasekaran, 2nd Edition, 2014, Universities Press.
2. Introduction to Algorithms, Thomas H. Cormen, Charles E. Leiserson, Ronal L. Rivest, Clifford Stein, 3rd Edition, PHI.
3. Design and Analysis of Algorithms, S. Sridhar, Oxford (Higher Education)

**Web links and Video Lectures (e-Resources):**

- Design and Analysis of Algorithms: https://nptel.ac.in/courses/106/101/106101060/

**Activity Based Learning (Suggested Activities in Class)/ Practical Based learning**

- Promote real-world problem-solving and competitive problem solving through group discussions to engage students actively in the learning process.
- Encourage students to enhance their problem-solving skills by implementing algorithms and solutions through programming exercises, fostering practical application of theoretical concepts.

Assessment Methods -

1. Problem Solving Assignments (Hacker Rank/ Hacker Earth / Leadcode)
2. Gate Based Aptitude Test

| ARTIFICIAL INTELLIGENCE | | Semester | IV |
|---|---|---|---|
| Course Code | BAD402 | CIE Marks | 50 |
| Teaching Hours/Week (L:T:P: S) | 3:0:2:0 | SEE Marks | 50 |
| Total Hours of Pedagogy | 40 hours Theory + 8-10 Lab slots | Total Marks | 100 |
| Credits | 04 | Exam Hours | |
| Examination nature (SEE) | Theory/ | | |

**Course objectives:**

- Gain a historical perspective of AI and its foundations.
- Become familiar with basic principles of AI toward problem solving
- Get to know approaches of inference, perception, knowledge representation, and learning

**Teaching-Learning Process (General Instructions)**

These are sample Strategies, which teachers can use to accelerate the attainment of the various course outcomes.

1. Lecturer methods (L) need not to be only traditional lecture method, but alternative effective teaching methods could be adopted to attain the outcomes.
2. Use of Video/Animation to explain functioning of various concepts.
3. Encourage collaborative (Group Learning) Learning in the class.
4. Ask at least three HOT (Higher order Thinking) questions in the class, which promotes critical thinking.
5. Adopt Problem Based Learning (PBL), which fosters students' Analytical skills, develop design thinking skills such as the ability to design, evaluate, generalize, and analyze information rather than simply recall it.
6. Introduce Topics in manifold representations.
7. Demonstrate ways to solve the same problem and encourage the students to come up with their own creative solutions.
8. Discuss application of every concept to solve the real world problems.

**MODULE-1**

**Introduction:** What is AI? Foundations and History of AI **Intelligent Agents:** Agents and environment, Concept of Rationality, The nature of environment, The structure of agents**.**

**Text book 1**: Chapter 1- 1.1, 1.2, 1.3 Chapter 2- 2.1, 2.2, 2.3, 2.4

**MODULE-2**

**Problem-solving**: Problem-solving agents, Example problems, Searching for Solutions Uninformed Search Strategies: Breadth First search, Depth First Search, Iterative deepening depth first search;

**Text book 1**: Chapter 3- 3.1, 3.2, 3.3, 3.4

**MODULE-3**

| |
|---|
| **Informed Search Strategies**: Heuristic functions, Greedy best first search, A*search. Heuristic Functions **Logical Agents**: Knowledge–based agents, The Wumpus world, Logic, Propositional logic, Reasoning patterns in Propositional Logic<br><br>**Text book 1**: Chapter 3-3.5,3.6<br>Chapter 4 – 4.1, 4.2 Chapter 7- 7.1, 7.2, 7.3, 7.4, 7.5 |
| **MODULE-4** |
| **First Order Logic**: Representation Revisited, Syntax and Semantics of First Order logic, Using First Order logic. **Inference in First Order Logic** :Propositional Versus First Order Inference, Unification, Forward Chaining, Backward Chaining, Resolution<br><br>Text book 1: Chapter 8- 8.1, 8.2, 8.3 Chapter 9- 9.1, 9.2, 9.3, 9.4, 9.5 |
| **MODULE-5** |
| **Uncertain Knowledge and Reasoning: Quantifying Uncertainty**: Acting under Uncertainty, Basic Probability Notation, Inference using Full Joint Distributions, Independence, Baye's Rule and its use. Wumpus World Revisited<br>**Expert Systems:** Representing and using domain knowledge, ES shells. Explanation, knowledge acquisition<br>Text Book 1: Chapter 13-13.1, 13.2, 13.3, 13.4, 13.5, 13.6<br>Text Book 2: Chapter 20 |

**PRACTICAL COMPONENT OF IPCC***(May cover all / major modules)*

*NOTE: Programs need to be implemented in python*

| Sl.NO | Experiments |
|---|---|
| 1 | Implement and Demonstrate Depth First Search Algorithm on Water Jug Problem |
| 2 | Implement and Demonstrate Best First Search Algorithm on Missionaries-Cannibals Problems using Python |
| 3 | Implement A* Search algorithm |
| 4 | Implement AO* Search algorithm |
| 5 | Solve 8-Queens Problem with suitable assumptions |
| 6 | Implementation of TSP using heuristic approach |
| 7 | Implementation of the problem solving strategies: either using Forward Chaining or Backward Chaining |
| 8 | Implement resolution principle on FOPL related problems |
| 9 | Implement Tic-Tac-Toe game using Python |

| | |
|---|---|
| 10 | Build a bot which provides all the information related to text in search box |
| 11 | Implement any Game and demonstrate the Game playing strategies |

**Course outcomes (Course Skill Set):**

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

CO1: Apply knowledge of agent architecture, searching and reasoning techniques for different applications.
CO 2. Compare various Searching and Inferencing Techniques.
CO 3. Develop knowledge base sentences using propositional logic and first order logic
CO 4. Describe the concepts of quantifying uncertainty.
CO5: Use the concepts of Expert Systems to build applications.

**Assessment Details (both CIE and SEE)**

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks out of 50) and for the SEE minimum passing mark is 35% of the maximum marks (18 out of 50 marks). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures a minimum of 40% (40 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together.

**CIE for the theory component of the IPCC (maximum marks 50)**

- IPCC means practical portion integrated with the theory of the course.
- CIE marks for the theory component are **25 marks** and that for the practical component is **25 marks**.
- 25 marks for the theory component are split into **15 marks** for two Internal Assessment Tests (Two Tests, each of 15 Marks with 01-hour duration, are to be conducted) and **10 marks** for other assessment methods mentioned in 22OB4.2. The first test at the end of 40-50% coverage of the syllabus and the second test after covering 85-90% of the syllabus.
- Scaled-down marks of the sum of two tests and other assessment methods will be CIE marks for the theory component of IPCC (that is for **25 marks)**.
- The student has to secure 40% of 25 marks to qualify in the CIE of the theory component of IPCC.

**CIE for the practical component of the IPCC**

- **15 marks** for the conduction of the experiment and preparation of laboratory record, and **10 marks** for the test to be conducted after the completion of all the laboratory sessions.
- On completion of every experiment/program in the laboratory, the students shall be evaluated including viva-voce and marks shall be awarded on the same day.
- The CIE marks awarded in the case of the Practical component shall be based on the continuous evaluation of the laboratory report. Each experiment report can be evaluated for 10 marks. Marks of all experiments' write-ups are added and scaled down to **15 marks**.
- The laboratory test **(duration 02/03 hours)** after completion of all the experiments shall be conducted for 50 marks and scaled down to **10 marks.**
- Scaled-down marks of write-up evaluations and tests added will be CIE marks for the laboratory component of IPCC for **25 marks**.

- The student has to secure 40% of 25 marks to qualify in the CIE of the practical component of the IPCC.

**SEE for IPCC**

Theory SEE will be conducted by University as per the scheduled timetable, with common question papers for the course (**duration 03 hours**)

1. The question paper will have ten questions. Each question is set for 20 marks.
2. There will be 2 questions from each module. Each of the two questions under a module (with a maximum of 3 sub-questions), **should have a mix of topics** under that module.
3. The students have to answer 5 full questions, selecting one full question from each module.
4. Marks scoredby the student shall be proportionally scaled down to 50 Marks

**The theory portion of the IPCC shall be for both CIE and SEE, whereas the practical portion will have a CIE component only. Questions mentioned in the SEE paper may include questions from the practical component**.

**Suggested Learning Resources:**

**Text Books**

1. Stuart J. Russell and Peter Norvig , Artificial Intelligence, 3rd Edition, Pearson,2015
2. Elaine Rich, Kevin Knight, Artificial Intelligence, 3rd edition,Tata McGraw Hill,2013

**Reference:**

1. George F Lugar, Artificial Intelligence Structure and strategies for complex, Pearson Education, 5th Edition, 2011
2. Nils J. Nilsson, Principles of Artificial Intelligence, Elsevier, 1980
3. Saroj Kaushik, Artificial Intelligence, Cengage learning, 2014

**Web links and Video Lectures (e-Resources)**

**1**. https://www.kdnuggets.com/2019/11/10-free-must-read-books-ai.html
2. https://www.udacity.com/course/knowledge-based-ai-cognitive-systems--ud409
3. https://nptel.ac.in/courses/106/105/106105077/

**Activity Based Learning (Suggested Activities in Class)/ Practical Based learning**

1. Group discussion on Real world examples
2. Project based learning
3. Simple strategies on gaming, reasoning and uncertainty etc

| DATABASE MANAGEMENT SYSTEM | | Semester | 4 |
|---|---|---|---|
| Course Code | **BCS403** | CIE Marks | 50 |
| Teaching Hours/Week (L:T:P: S) | 3:0:2:0 | SEE Marks | 50 |
| Total Hours of Pedagogy | 40 hours Theory + 8-10 Lab slots | Total Marks | 100 |
| Credits | 04 | Exam Hours | |
| Examination nature (SEE) | Theory | | |

**Course objectives:**

- To Provide a strong foundation in database concepts, technology, and practice.
- To Practice SQL programming through a variety of database problems.
- To Understand the relational database design principles.
- To Demonstrate the use of concurrency and transactions in database.
- To Design and build database applications for real world problems.
- To become familiar with database storage structures and access techniques.

**Teaching-Learning Process**

These are sample Strategies, which teachers can use to accelerate the attainment of the various course outcomes.

1. Lecturer method (L) needs not to be only a traditional lecture method, but alternative effective teaching methods could be adopted to attain the outcomes.
2. Use of Video/Animation to explain functioning of various concepts.
3. Encourage collaborative (Group Learning) Learning in the class.
4. Ask at least three HOT (Higher order Thinking) questions in the class, which promotes critical thinking.
5. Adopt Problem Based Learning (PBL), which fosters students' Analytical skills, develop design thinking skills such as the ability to design, evaluate, generalize, and analyze information rather than simply recall it.
6. Introduce Topics in manifold representations.
7. Show the different ways to solve the same problem with different circuits/logic and encourage the students to come up with their own creative ways to solve them.
8. Discuss how every concept can be applied to the real world - and when that's possible, it helps improve the students' understanding
9. Use any of these methods: Chalk and board, Active Learning, Case Studies

| **MODULE-1** | **No. of Hours: 8** |
|---|---|

**Introduction to Databases:** Introduction, Characteristics of database approach, Advantages of using the DBMS approach, History of database applications.
**Overview of Database Languages and Architectures:** Data Models, Schemas, and Instances. Three schema architecture and data independence, database languages, and interfaces, The Database System environment.
**Conceptual Data Modelling using Entities and Relationships:** Entity types, Entity sets and structural constraints, Weak entity types, ER diagrams,Specialization and Generalization.

**Textbook 1:Ch 1.1 to 1.8, 2.1 to 2.6, 3.1 to 3.10**
**RBT: L1, L2, L3**

| **MODULE-2** | **No. of Hours: 8** |
|---|---|

**Relational Model**: Relational Model Concepts, Relational Model Constraints and relational database schemas, Update operations, transactions, and dealing with constraint violations.
**Relational Algebra:** Unary and Binary relational operations, additional relational operations (aggregate, grouping, etc.) Examples of Queries in relational algebra.
**Mapping Conceptual Design into a Logical Design:** Relational Database Design using ER-to-Relational mapping.

**Textbook 1: Ch 5.1 to 5.3, Ch 8.1 to 8.5; Ch 9.1 to 9.2 Textbook 2: 3.5**
**RBT: L1, L2, L3**

| **MODULE-3** | **No. of Hours:8** |
|---|---|

**Normalization: Database Design Theory** – Introduction to Normalization using Functional and Multivalued Dependencies: Informal design guidelines for relation schema, Functional Dependencies, Normal Forms based on Primary Keys, Second and Third Normal Forms, Boyce-Codd Normal Form, Multivalued Dependency and Fourth Normal Form, Join Dependencies and Fifth Normal Form.
**SQL:** SQL data definition and data types, Schema change statements in SQL, specifying constraints in SQL, retrieval queries in SQL, INSERT, DELETE, and UPDATE statements in SQL, Additional features of SQL
**Textbook 1: Ch 14.1 to 14.7, Ch 6.1 to 6.5**
**RBT: L1, L2, L3**

| **MODULE-4** | **No. of Hours:8** |
|---|---|

**SQL: Advanced Queries:** More complex SQL retrieval queries, Specifying constraints as assertions and action triggers, Views in SQL.

**Transaction Processing:** Introduction to Transaction Processing, Transaction and System concepts, Desirable properties of Transactions, Characterizing schedules based on recoverability, Characterizing schedules based on Serializability, Transaction support in SQL.

**Textbook 1: Ch 7.1 to 7.3, Ch 20.1 to 20.6**
**RBT: L1, L2, L3**

| **MODULE-5** | **No. of Hours:08** |
|---|---|

**Concurrency Control in Databases:** Two-phase locking techniques for Concurrency control, Concurrency control based on Timestamp ordering, Multiversion Concurrency control techniques, Validation Concurrency control techniques, Granularity of Data items and Multiple Granularity Locking.
**NOSQL Databases and Big Data Storage Systems:** Introduction to NOSQL Systems, The CAP Theorem, Document-Based NOSQL Systems and MongoDB, NOSQL Key-Value Stores, Column-Based or Wide Column NOSQL Systems, NOSQL Graph Databases and Neo4j

**Textbook 1:Chapter 21.1 to 21.5, Chapter 24.1 to 24.6**
**RBT: L1, L2, L3**

**PRACTICAL COMPONENT OF IPCC** *(May cover all / major modules)*

| Sl.NO | Experiments |
|---|---|
| 1 | Create a table called Employee & execute the following.<br>**Employee(EMPNO,ENAME,JOB, MANAGER_NO, SAL, COMMISSION)**<br>1. Create a user and grant all permissions to theuser.<br>2. Insert the any three records in the employee table contains attributes EMPNO,ENAME JOB, MANAGER_NO, SAL, COMMISSION and use rollback. Check the result.<br>3. Add primary key constraint and not null constraint to the employee table.<br>4. Insert null values to the employee table and verify the result. |
| 2 | Create a table called Employee that contain attributes EMPNO,ENAME,JOB, MGR,SAL & execute the following.<br>1. Add a column commission with domain to the Employeetable.<br>2. Insert any five records into the table.<br>3. Update the column details of job<br>4. Rename the column of Employ table using alter command.<br>5. Delete the employee whose Empno is 105. |
| 3 | Queries using aggregate functions(COUNT,AVG,MIN,MAX,SUM),Group by,Orderby.<br>**Employee(E_id, E_name, Age, Salary)**<br>1. Create Employee table containing all Records E_id, E_name, Age, Salary.<br>2. Count number of employee names from employeetable<br>3. Find the Maximum age from employee table.<br>4. Find the Minimum age from employeetable.<br>5. Find salaries of employee in Ascending Order.<br>6. Find grouped salaries of employees. |
| 4 | Create a row level trigger for the customers table that would fire for INSERT or UPDATE or DELETE operations performed on the CUSTOMERS table. This trigger will display the salary difference between the old & new Salary.<br>**CUSTOMERS(ID,NAME,AGE,ADDRESS,SALARY)** |
| 5 | Create cursor for Employee table & extract the values from the table. Declare the variables ,Open the cursor & extrct the values from the cursor. Close the cursor.<br>**Employee(E_id, E_name, Age, Salary)** |
| 6 | Write a PL/SQL block of code using parameterized Cursor, that will merge the data available in the newly created table N_RollCall with the data available in the table O_RollCall. If the data in the first table already exist in the second table then that data should be skipped. |
| 7 | Install an Open Source NoSQL Data base MangoDB & perform basic CRUD(Create, Read, Update & Delete) operations. Execute MangoDB basic Queries using CRUD operations. |

**Course outcomes (Course Skill Set):**

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

- Describe the basic elements of a relational database management system
- Design entity relationship for the given scenario.
- Apply various Structured Query Language (SQL) statements for database manipulation.
- Analyse various normalization forms for the given application.
- Develop database applications for the given real world problem.
- Understand the concepts related to NoSQL databases.

**Assessment Details (both CIE and SEE)**

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum

passing mark for the CIE is 40% of the maximum marks (20 marks out of 50) and for the SEE minimum passing mark is 35% of the maximum marks (18 out of 50 marks). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures a minimum of 40% (40 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together.

**CIE for the theory component of the IPCC (maximum marks 50)**

- IPCC means practical portion integrated with the theory of the course.
- CIE marks for the theory component are **25 marks** and that for the practical component is **25 marks**.
- 25 marks for the theory component are split into **15 marks** for two Internal Assessment Tests (Two Tests, each of 15 Marks with 01-hour duration, are to be conducted) and **10 marks** for other assessment methods mentioned in 22OB4.2. The first test at the end of 40-50% coverage of the syllabus and the second test after covering 85-90% of the syllabus.
- Scaled-down marks of the sum of two tests and other assessment methods will be CIE marks for the theory component of IPCC (that is for **25 marks)**.
- The student has to secure 40% of 25 marks to qualify in the CIE of the theory component of IPCC.

**CIE for the practical component of the IPCC**

- **15 marks** for the conduction of the experiment and preparation of laboratory record, and **10 marks** for the test to be conducted after the completion of all the laboratory sessions.
- On completion of every experiment/program in the laboratory, the students shall be evaluated including viva-voce and marks shall be awarded on the same day.
- The CIE marks awarded in the case of the Practical component shall be based on the continuous evaluation of the laboratory report. Each experiment report can be evaluated for 10 marks. Marks of all experiments' write-ups are added and scaled down to **15 marks**.
- The laboratory test **(duration 02/03 hours)** after completion of all the experiments shall be conducted for 50 marks and scaled down to **10 marks.**
- Scaled-down marks of write-up evaluations and tests added will be CIE marks for the laboratory component of IPCC for **25 marks**.
- The student has to secure 40% of 25 marks to qualify in the CIE of the practical component of the IPCC.

**SEE for IPCC**

Theory SEE will be conducted by University as per the scheduled timetable, with common question papers for the course (**duration 03 hours**)

1. The question paper will have ten questions. Each question is set for 20 marks.
2. There will be 2 questions from each module. Each of the two questions under a module (with a maximum of 3 sub-questions), **should have a mix of topics** under that module.
3. The students have to answer 5 full questions, selecting one full question from each module.
4. Marks scoredby the student shall be proportionally scaled down to 50 Marks

**The theory portion of the IPCC shall be for both CIE and SEE, whereas the practical portion will have a CIE component only. Questions mentioned in the SEE paper may include questions from the practical component**.

**Suggested Learning Resources:**

**Text Books:**

1. Fundamentals of Database Systems, Ramez Elmasri and Shamkant B. Navathe, 7th Edition, 2017, Pearson.
2. Database management systems, Ramakrishnan, and Gehrke, 3rd Edition, 2014, McGraw Hill

**Activity Based Learning (Suggested Activities in Class)/ Practical Based learning**

**Mini Project:**

- Project Based Learning

| Analysis & Design of Algorithms Lab | | Semester | 4 |
|---|---|---|---|
| Course Code | **BCSL404** | CIE Marks | 50 |
| Teaching Hours/Week (L:T:P: S) | 0:0:2:0 | SEE Marks | 50 |
| Credits | 01 | Exam Hours | 2 |
| Examination type (SEE) | Practical | | |

**Course objectives:**

- To design and implement various algorithms in C/C++ programming using suitable development tools to address different computational challenges.
- To apply diverse design strategies for effective problem-solving.
- To Measure and compare the performance of different algorithms to determine their efficiency and suitability for specific tasks.

| Sl.No | Experiments |
|---|---|
| 1 | Design and implement C/C++ Program to find Minimum Cost Spanning Tree of a given connected undirected graph using Kruskal's algorithm. |
| 2 | Design and implement C/C++ Program to find Minimum Cost Spanning Tree of a given connected undirected graph using Prim's algorithm. |
| 3 | a. Design and implement C/C++ Program to solve All-Pairs Shortest Paths problem using Floyd's algorithm.<br>b. Design and implement C/C++ Program to find the transitive closure using Warshal's algorithm. |
| 4 | Design and implement C/C++ Program to find shortest paths from a given vertex in a weighted connected graph to other vertices using Dijkstra's algorithm. |
| 5 | Design and implement C/C++ Program to obtain the Topological ordering of vertices in a given digraph. |
| 6 | Design and implement C/C++ Program to solve 0/1 Knapsack problem using Dynamic Programming method. |
| 7 | Design and implement C/C++ Program to solve discrete Knapsack and continuous Knapsack problems using greedy approximation method. |
| 8 | Design and implement C/C++ Program to find a subset of a given set S = {sl , s2,.....,sn} of n positive integers whose sum is equal to a given positive integer d. |
| 9 | Design and implement C/C++ Program to sort a given set of n integer elements using Selection Sort method and compute its time complexity. Run the program for varied values of n> 5000 and record the time taken to sort. Plot a graph of the time taken versus n. The elements can be read from a file or can be generated using the random number generator. |
| 10 | Design and implement C/C++ Program to sort a given set of n integer elements using Quick Sort method and compute its time complexity. Run the program for varied values of n> 5000 and record the time taken to sort. Plot a graph of the time taken versus n. The elements can be read from a file or can be generated using the random number generator. |
| 11 | Design and implement C/C++ Program to sort a given set of n integer elements using Merge Sort method and compute its time complexity. Run the program for varied values of n> 5000, and record the time taken to sort. Plot a graph of the time taken versus n. The elements can be read from a file or can be generated using the random number generator. |
| 12 | Design and implement C/C++ Program for N Queen's problem using Backtracking. |

**Course outcomes (Course Skill Set):**

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

1. Develop programs to solve computational problems using suitable algorithm design strategy.
2. Compare algorithm design strategies by developing equivalent programs and observing running times for analysis (Empirical).
3. Make use of suitable integrated development tools to develop programs
4. Choose appropriate algorithm design techniques to develop solution to the computational and complex problems.
5. Demonstrate and present the development of program, its execution and running time(s) and record the results/inferences.

**Assessment Details (both CIE and SEE)**

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks out of 50) and for the SEE minimum passing mark is 35% of the maximum marks (18 out of 50 marks). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures a minimum of 40% (40 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together

**Continuous Internal Evaluation (CIE):**

CIE marks for the practical course are **50 Marks**.

The split-up of CIE marks for record/ journal and test are in the ratio **60:40**.

- Each experiment is to be evaluated for conduction with an observation sheet and record write-up. Rubrics for the evaluation of the journal/write-up for hardware/software experiments are designed by the faculty who is handling the laboratory session and are made known to students at the beginning of the practical session.
- Record should contain all the specified experiments in the syllabus and each experiment write-up will be evaluated for 10 marks.
- Total marks scored by the students are scaled down to **30 marks** (60% of maximum marks).
- Weightage to be given for neatness and submission of record/write-up on time.
- Department shall conduct a test of 100 marks after the completion of all the experiments listed in the syllabus.
- In a test, test write-up, conduction of experiment, acceptable result, and procedural knowledge will carry a weightage of 60% and the rest 40% for viva-voce.
- The suitable rubrics can be designed to evaluate each student's performance and learning ability.
- The marks scored shall be scaled down to **20 marks** (40% of the maximum marks).

The Sum of scaled-down marks scored in the report write-up/journal and marks of a test is the total CIE marks scored by the student.

**Semester End Evaluation (SEE):**

- SEE marks for the practical course are 50 Marks.

- SEE shall be conducted jointly by the two examiners of the same institute, examiners are appointed by the Head of the Institute.
- The examination schedule and names of examiners are informed to the university before the conduction of the examination. These practical examinations are to be conducted between the schedule mentioned in the academic calendar of the University.
- All laboratory experiments are to be included for practical examination.
- (Rubrics) Breakup of marks and the instructions printed on the cover page of the answer script to be strictly adhered to by the examiners. **OR** based on the course requirement evaluation rubrics shall be decided jointly by examiners.
- Students can pick one question (experiment) from the questions lot prepared by the examiners jointly.
- Evaluation of test write-up/ conduction procedure and result/viva will be conducted jointly by examiners.

General rubrics suggested for SEE are mentioned here, writeup-20%, Conduction procedure and result in -60%, Viva-voce 20% of maximum marks. SEE for practical shall be evaluated for 100 marks and scored marks shall be scaled down to 50 marks (however, based on course type, rubrics shall be decided by the examiners)

Change of experiment is allowed only once and 15% of Marks allotted to the procedure part are to be made zero.

The minimum duration of SEE is 02 hours

**Suggested Learning Resources:**

- Virtual Labs (CSE): http://cse01-iiith.vlabs.ac.in/

| DISCRETE MATHEMATICAL STRUCTURES | | Semester | IV |
|---|---|---|---|
| Course Code | **BCS405A** | CIE Marks | 50 |
| Teaching Hours/Week (L:T:P:S) | 2:2:0:0 | SEE Marks | 50 |
| Total Hours of Pedagogy | 40 | Total Marks | 100 |
| Credits | 03 | Exam Hours | 03 |
| Examination type (SEE) | Theory | | |

**Course objectives:**

1. To help students to understand discrete and continuous mathematical structures.
2. To impart basics of relations and functions.
3. To facilitate students in applying principles of Recurrence Relations to find the generating functions and solve the Recurrence relations.
4. To have the knowledge of groups and their properties to understand the importance of algebraic properties relative to various number systems.

**Teaching-Learning Process**

**Pedagogy (General Instructions):**

These are sample Strategies, teachers can use to accelerate the attainment of the various course outcomes.

1. In addition to the traditional lecture method, different types of innovative teaching methods may be adopted so that the delivered lessons shall develop students' theoretical and applied Mathematical skills.
2. State the need for Mathematics with Engineering Studies and Provide real-life examples.
3. Support and guide the students for self–study.
4. You will assign homework, grading assignments and quizzes, and documenting students' progress.
5. Encourage the students to group learning to improve their creative and analytical skills.
6. Show short related video lectures in the following ways:
   - As an introduction to new topics (pre-lecture activity).
   - As a revision of topics (post-lecture activity).
   - As additional examples (post-lecture activity).
   - As an additional material of challenging topics (pre-and post-lecture activity).
   - As a model solution for some exercises (post-lecture activity).

**Module-1: Fundamentals of Logic**

Basic Connectives and Truth Tables, Logic Equivalence – The Laws of Logic, Logical Implication – Rules of Inference. The Use of Quantifiers, Quantifiers, Definitions and the Proofs of Theorems. **(8 hours)**

**(RBT Levels: L1, L2 and L3)**

**Module-2: Properties of the Integers**

Mathematical Induction, The Well Ordering Principle – Mathematical Induction, Recursive Definitions.

**Fundamental Principles of Counting:** The Rules of Sum and Product, Permutations, Combinations – The Binomial Theorem, Combinations with Repetition. **(8 Hours)**

**(RBT Levels: L1, L2 and L3)**

**Module-3: Relations and Functions**

Cartesian Products and Relations, Functions – Plain and One-to-One, Onto Functions. The Pigeon-hole Principle, Function Composition and Inverse Functions.

**Properties of Relations**, Computer Recognition – Zero-One Matrices and Directed Graphs, Partial Orders – Hasse Diagrams, Equivalence Relations and Partitions. **(8 hours)**

**(RBT Levels: L1, L2 and L3)**

**Module-4: The Principle of Inclusion and Exclusion**

The Principle of Inclusion and Exclusion, Generalizations of the Principle, Derangements – Nothing is in its Right Place, Rook Polynomials.

**Recurrence Relations:** First Order Linear Recurrence Relation, The Second Order Linear Homogeneous Recurrence Relation with Constant Coefficients. **(8 Hours)**

**(RBT Levels: L1, L2 and L3)**

**Module-5: Introduction to Groups Theory**

Definitions and Examples of Particular Groups Klein 4-group, Additive group of Integers modulo n, Multiplicative group of Integers modulo-p and permutation groups, Properties of groups, Subgroups, cyclic groups, Cosets, Lagrange's Theorem. **(8 Hours)**

**(RBT Levels: L1, L2 and L3)**

**Course outcome (Course Skill Set)**

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

1. Apply concepts of logical reasoning and mathematical proof techniques in proving theorems and statements.
2. Demonstrate the application of discrete structures in different fields of computer science.
3. Apply the basic concepts of relations, functions and partially ordered sets for computer representations.
4. Solve problems involving recurrence relations and generating functions.
5. Illustrate the fundamental principles of Algebraic structures with the problems related to computer science & engineering.

**Assessment Details (both CIE and SEE)**

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks out of 50) and for the SEE, the minimum passing mark is 35% of the maximum marks (18 out of 50 marks). The student is declared as a pass in the course if he/she secures a minimum of 40% (40 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together.

**Continuous Internal Evaluation:**

- There are 25 marks for the CIE's Assignment component and 25 for the Internal Assessment Test component.
- Each test shall be conducted for 25 marks. The first test will be administered after 40-50% of the coverage of the syllabus, and the second test will be administered after 85-90% of the coverage of the syllabus. The average of the two tests shall be scaled down to 25 marks
- Any two assignment methods mentioned in the 22OB2.4, if an assignment is project-based then only one assignment for the course shall be planned. The schedule for assignments shall be planned properly by the course teacher. The teacher should not conduct two assignments at the end of the semester if two assignments are planned. Each assignment shall be conducted for 25 marks. (If two assignments are conducted then the sum of the two assignments shall be scaled down to 25 marks)

The final CIE marks of the course out of 50 will be the sum of the scale-down marks of tests and assignment/s marks.

**The Internal Assessment Test question paper is designed to attain the different levels of Bloom's taxonomy as per the outcome defined for the course.**

**Semester-End Examination:**

Theory SEE will be conducted by the University as per the scheduled timetable, with common question papers for the course (**duration 03 hours).**

1. The question paper will have ten questions. Each question is set for 20 marks.
2. There will be 2 questions from each module. Each of the two questions under a module (with a maximum of 3 sub-questions), **should have a mix of topics** under that module.
3. The students have to answer 5 full questions, selecting one full question from each module.

Marks scored shall be proportionally reduced to 50 marks

**Suggested Learning Resources:**

**Books (Name of the author/Title of the Book/Name of the publisher/Edition and Year)**

**Text Books:**

1. **Ralph P. Grimaldi, B V Ramana: "Discrete Mathematical Structures an Applied Introduction",** 5th Edition, Pearson Education, 2004.
2. **Ralph P. Grimaldi: "Discrete and Combinatorial Mathematics"**, 5th Edition, Pearson Education. 2004.

**Reference Books:**

1. **Basavaraj S Anami and Venakanna S Madalli: "Discrete Mathematics – A Concept-based approach"**, Universities Press, 2016
2. **Kenneth H. Rosen: "Discrete Mathematics and its Applications"**, 6th Edition, McGraw Hill, 2007.
3. **Jayant Ganguly: "A Treatise on Discrete Mathematical Structures",** Sanguine-Pearson, 2010.
4. **D.S. Malik and M.K. Sen: "Discrete Mathematical Structures Theory and Applications,** Latest Edition, Thomson, 2004.
5. **Thomas Koshy: "Discrete Mathematics with Applications"**, Elsevier, 2005, Reprint 2008.

**Web links and Video Lectures (e-Resources):**

- http://nptel.ac.in/courses.php?disciplineID=111
- http://www.class-central.com/subject/math(MOOCs)
- http://academicearth.org/
- VTU e-Shikshana Program
- VTU EDUSAT Program.
- **http://www.themathpage.com/**
- **http://www.abstractmath.org/**
- **http://www.ocw.mit.edu/courses/mathematics/**

**Activity-Based Learning (Suggested Activities in Class)/Practical-Based Learning**

- Quizzes
- Assignments
- Seminar

| METRIC SPACES | | Semester | IV |
|---|---|---|---|
| Course Code | **BAI405B** | CIE Marks | 50 |
| Teaching Hours/Week (L:T:P: S) | 2:2:0:0 | SEE Marks | 50 |
| Total Hours of Pedagogy | 40 | Total Marks | 100 |
| Credits | 03 | Exam Hours | 03 |
| Examination type (SEE) | Theory | | |

**Course objectives:**

- Provide insight into the theory of sets
- Learn basic concepts of metric spaces
- Understand the concepts of connected sets and compact spaces

**Teaching-Learning Process**

**Pedagogy (General Instructions):**

These are sample Strategies, teachers can use to accelerate the attainment of the various course outcomes.

1. In addition to the traditional lecture method, different types of innovative teaching methods may be adopted so that the delivered lessons shall develop students' theoretical and applied Mathematical skills.
2. State the need for Mathematics with Engineering Studies and Provide real-life examples.
3. Support and guide the students for self–study.
4. You will assign homework, grading assignments and quizzes, and documenting students' progress.
5. Encourage the students to group learning to improve their creative and analytical skills.
6. Show short related video lectures in the following ways:
   - As an introduction to new topics (pre-lecture activity).
   - As a revision of topics (post-lecture activity).
   - As additional examples (post-lecture activity).
   - As an additional material of challenging topics (pre-and post-lecture activity).
   - As a model solution for some exercises (post-lecture activity).

## Module-1: Theory of Sets

Finite and infinite sets, countable and uncountable sets, cardinality of sets, Schroder-Bernstein theorem, cantor's theorem, Order relation in cardinal numbers, Arithmetic of cardinal numbers, Partially ordered set, Zorn's lemma and axioms of choice, various set-theoretic paradoxes.

**(8 hours)**

**(RBT Levels: L1, L2 and L3)**

| **Teaching-Learning Process** | Chalk and talk method / PowerPoint Presentation |
|---|---|

## Module-2: Concepts in Metric Spaces

Definition and examples of metric spaces, Open spheres and Closed spheres, Neighborhoods, Open sets, Interior, Exterior and boundary points, Closed sets, Limit points and isolated points, Interior and closure of a set, Boundary of a set, Bounded sets, Distance between two sets, Diameter of a set. **(8 hours)**

**(RBT Levels: L1, L2 and L3)**

| **Teaching-Learning Process** | Chalk and talk method / PowerPoint Presentation |
|---|---|

## Module-3: Complete Metric Spaces and Continuous Functions

Cauchy and Convergent sequences, Completeness of metric spaces, Cantor's intersection theorem, Dense sets and separable spaces, Nowhere dense sets and Baire's category theorem, continuous and uniformly continuous functions, Homeomorphism. Banach contraction principle. **(8 hours)**

**(RBT Levels: L1, L2 and L3)**

| **Teaching-Learning Process** | Chalk and talk method / PowerPoint Presentation |
|---|---|

**Module-4: Compactness**

Compact spaces, Sequential compactness, Bolzano-Weierstrass property, Compactness and finite intersection property, Heine-Borel theorem, Totally bounded set, equivalence of compactness and sequential compactness. **(8 hours)**

**(RBT Levels: L1, L2 and L3)**

**Module-5: Connectedness**

Separated sets, Disconnected and connected sets, components, connected subsets of R, Continuous functions on connected sets. Local connectedness and arc-wise connectedness. **(8 hours)**

**(RBT Levels: L1, L2 and L3)**

| **Teaching-Learning Process** | Chalk and talk method / PowerPoint Presentation |
|---|---|

**Course outcome (Course Skill Set)**

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

1. Explain basic facts about the cardinality of a set and various set-theoretic paradoxes.
2. Apply the concepts of open and closed spheres and bounded sets to solve problems.
3. Demonstrate standard concepts of metric spaces and their properties.
4. Identify the continuity of a function defined on metric spaces and homomorphism.

**Assessment Details (both CIE and SEE)**

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks out of 50) and for the SEE, the minimum passing mark is 35% of the maximum marks (18 out of 50 marks). The student is declared as a pass in the course if he/she secures a minimum of 40% (40 marks out of 100) in the total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together.

**Continuous Internal Evaluation:**

- There are 25 marks for the CIE's Assignment component and 25 for the Internal Assessment Test component.
- Each test shall be conducted for 25 marks. The first test will be administered after 40-50% of the coverage of the syllabus, and the second test will be administered after 85-90% of the coverage of the syllabus. The average of the two tests shall be scaled down to 25 marks
- Any two assignment methods mentioned in the 22OB2.4, if an assignment is project-based then only one assignment for the course shall be planned. The schedule for assignments shall be planned properly by the course teacher. The teacher should not conduct two assignments at the end of the semester if two assignments are planned. Each assignment shall be conducted for 25 marks. (If two assignments are conducted then the sum of the two assignments shall be scaled down to 25 marks)

- The final CIE marks of the course out of 50 will be the sum of the scale-down marks of tests and assignment/s marks.

**Internal Assessment Test question paper is designed to attain the different levels of Bloom's taxonomy as per the outcome defined for the course.**

**Semester-End Examination:**

Theory SEE will be conducted by the University as per the scheduled timetable, with common question papers for the course (**duration 03 hours).**

1. The question paper will have ten questions. Each question is set for 20 marks.
2. There will be 2 questions from each module. Each of the two questions under a module (with a maximum of 3 sub-questions), **should have a mix of topics** under that module.
3. The students have to answer 5 full questions, selecting one full question from each module.

Marks scored shall be proportionally reduced to 50 marks

**Suggested Learning Resources:**

**Books (Name of the author/Title of the Book/Name of the publisher/Edition and Year)**

**Text Books**


1. P.K. Jain & Khalil Ahamad, "*Metric Spaces"*. Narosa, 2019.
2. Micheal O; Searcoid, "Metric spaces". Springer-Verlag, 2009.


**Reference Books:**


1. Satish Shirali & Harikishan L. Vasudeva, "*Metric Spaces"*, Springer-Verlag, 2006.
2. E.T. Copson, "*Metric spaces"*, Cambridge University Press, 1988.
3. P.R. Halmos, "*Naive Set Theor*y". Springer, 1974.
4. S. Kumaresan, "*Topology of Metric spaces",* 2nd edition, Narosa, 2011.
5. G.F. Simmons, "Introduction to Topology and Modern Analysis". McGraw-Hill, 2004.


**Web links and Video Lectures (e-Resources):**

- http://nptel.ac.in/courses.php?disciplineID=111
- http://www.class-central.com/subject/math(MOOCs)
- http://academicearth.org/
- VTU e-Shikshana Program
- VTU EDUSAT Program.

**Activity-Based Learning (Suggested Activities in Class)/Practical-Based Learning**

- Quizzes
- Assignments
- Seminar

| OPTIMIZATION TECHNIQUE | | Semester | IV |
|---|---|---|---|
| Course Code | **BCS405C** | CIE Marks | 50 |
| Teaching Hours/Week (L:T:P: S) | 2:2:0:0 | SEE Marks | 50 |
| Total Hours of Pedagogy | 40 | Total Marks | 100 |
| Credits | 03 | Exam Hours | 03 |
| Examination type (SEE) | Theory | | |

**Course objectives:** The objectives of the course are to fecilitate the learners to:

- Appreciate the importance of linear algebra in computer science and allied engineering science.
- Gain the knowledge of linear algebra tools and concepts to implememt them in their core domain.
- Improve their mathematical thinking and acquire skills required for sustained lifelong learning.

**Teaching-Learning Process**

**Pedagogy (General Instructions):**

These are sample Strategies, teachers can use to accelerate the attainment of the various course outcomes.

1. In addition to the traditional lecture method, different types of innovative teaching methods may be adopted so that the delivered lessons shall develop students' theoretical and applied Mathematical skills.
2. State the need for Mathematics with Engineering Studies and Provide real-life examples.
3. Support and guide the students for self–study.
4. You will assign homework, grading assignments and quizzes, and documenting students' progress.
5. Encourage the students to group learning to improve their creative and analytical skills.
6. Show short related video lectures in the following ways:
   - As an introduction to new topics (pre-lecture activity).
   - As a revision of topics (post-lecture activity).
   - As additional examples (post-lecture activity).
   - As an additional material of challenging topics (pre-and post-lecture activity).
   - As a model solution of some exercises (post-lecture activity).

**Module-1: VECTOR CALCULUS**

Functions of several variables, Differentiation and partial differentials, gradients of vector-valued functions, gradients of matrices, useful identities for computing gradients, linearization and multivariate Taylor series. **(8 hours)**

**(RBT Levels: L1, L2 and L3)**

**Module-2: APPLICATIONS OF VECTOR CALCULUS**

Backpropagation and automatic differentiation, gradients in a deep network, The Gradient of Quadratic Cost, Descending the Gradient of Cost, The Gradient of Mean Squared Error.

**(8 hours)**

**(RBT Levels: L1, L2 and L3)**

**Module-3: Convex Optimization-1**

Local and global optima, convex sets and functions separating hyperplanes, application of Hessian matrix in optimization, Optimization using gradient descent, Sequential search 3-point search and Fibonacci search. **(8 hours)**
**(RBT Levels: L1, L2 and L3)**

**Module-4: Convex Optimization-2**

Unconstrained optimization -Method of steepest ascent/descent, NR method, Gradient descent, Mini batch gradient descent, Stochastic gradient descent. **(8 hours)**
**(RBT Levels: L1, L2 and L3)**

**Module-5: Advanced Optimization**

Momentum-based gradient descent methods: Adagrad, RMSprop and Adam.
Non-Convex Optimization: Convergence to Critical Points, Saddle-Point methods. **(8 hours)**
**(RBT Levels: L1, L2 and L3)**

**Course outcome (Course Skill Set)**
At the end of the course, the student will be able to:

1. Apply the concepts of vector calculus to solve the given problem.
2. Apply the concepts of partial differentiation in machine learning and deep neural networks.
3. Analyze the convex optimization algorithms and their importance in computer science & engineering.
4. Apply the optimization algorithms to solve the problem.
5. Analyze the advanced optimization algorithms for machine learning .

**Assessment Details (both CIE and SEE)**

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks out of 50) and for the SEE, the minimum passing mark is 35% of the maximum marks (18 out of 50 marks). The student is declared as a pass in the course if he/she secures a minimum of 40% (40 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together.

**Continuous Internal Evaluation:**

- There are 25 marks for the CIE's Assignment component and 25 for the Internal Assessment Test component.
- Each test shall be conducted for 25 marks. The first test will be administered after 40-50% of the coverage of the syllabus, and the second test will be administered after 85-90% of the coverage of the syllabus. The average of the two tests shall be scaled down to 25 marks
- Any two assignment methods mentioned in the 22OB2.4, if an assignment is project-based then only one assignment for the course shall be planned. The schedule for assignments shall be planned properly by the course teacher. The teacher should not conduct two assignments at the end of the semester if two assignments are planned. Each assignment shall be conducted for 25 marks. (If two assignments are conducted then the sum of the two assignments shall be scaled down to 25 marks)
- The final CIE marks of the course out of 50 will be the sum of the scale-down marks of tests and assignment/s marks.

**Internal Assessment Test question paper is designed to attain the different levels of Bloom's taxonomy as per the outcome defined for the course.**

**Semester-End Examination:**

Theory SEE will be conducted by University as per the scheduled timetable, with common question papers for the course (**duration 03 hours).**

1. The question paper will have ten questions. Each question is set for 20 marks.
2. There will be 2 questions from each module. Each of the two questions under a module (with a maximum of 3 sub-questions), **should have a mix of topics** under that module.
3. The students have to answer 5 full questions, selecting one full question from each module.

Marks scored shall be proportionally reduced to 50 marks.

**Suggested Learning Resources:**

**Books (Name of the author/Title of the Book/Name of the publisher/Edition and Year)**

**Text Books:**


1. Mathematics for Machine learning, Marc Peter Deisennroth, A. Aldo Faisal, Cheng Soon Ong, 2020, Cambridge University Press.
2. S. Bubeck, Convex Optimization: Algorithms and Complexity, Foundations and Trends in Optimization, 2015.
3. S. Boyd, N. Parikh, and E. Chu," Distributed optimization and statistical learning via the alternating direction method of multipliers", Foundations and Trends in Machine Learning, Now Publishers Inc.


**Reference Books:**


1. Linear Algebra and Optimization for Machine Learning, Charu C. Aggarwal, Springer, 2020.
2. A. Beck, First-Order Methods in Optimization, MOS-SIAM Series on Optimization, 2017.
3. F. Bach, "Learning with Submodular Functions: A Convex Optimization Perspective", Foundations and Trends in Machine Learning, Now Publishers Inc.

| **Web links and Video Lectures (e-Resources):** |
| --- |
| • https://ocw.mit.edu/courses/mathematics/18-06sc-linear-algebra-fall-2011/index.htm<br>• https://www.math.ucdavis.edu/~linear/linear.pdf<br>• https://www.coursera.org/learn/linear-algebra-machine-learning<br>• https://nptel.ac.in/syllabus/111106051/<br>• https://github.com/epfml/OptML_course<br>• https://www.youtube.com/playlist?list=PL4O4bXkI-fAeYrsBqTUYn2xMjJAqlFQzX |
| **Activity-Based Learning (Suggested Activities in Class)/Practical-Based Learning**<br>• Quizzes<br>• Assignments<br>• Seminar |

| ALGORITHMIC GAME THEORY | | Semester | IV |
|---|---|---|---|
| Course Code | **BAI405D** | CIE Marks | 50 |
| Teaching Hours/Week (L:T:P: S) | 2:2:0:0 | SEE Marks | 50 |
| Total Hours of Pedagogy | 40 | Total Marks | 100 |
| Credits | 03 | Exam Hours | 03 |
| Examination type (SEE) | Theory | | |

**Course objectives:**

- Comprehend the basics of strategic gaming and mixed strategic equilibrium.
- Enable students to develop skills on extensive gaming strategies.
- Analyze and discuss various gaming models.
- Illustrate some real-time situations.

**Teaching-Learning Process**

**Pedagogy (General Instructions):**

These are sample Strategies, teachers can use to accelerate the attainment of the various course outcomes.

1. In addition to the traditional lecture method, different types of innovative teaching methods may be adopted so that the delivered lessons shall develop students' theoretical and applied Mathematical skills.
2. State the need for Mathematics with Engineering Studies and Provide real-life examples.
3. Support and guide the students for self–study.
4. You will assign homework, grading assignments and quizzes, and documenting students' progress.
5. Encourage the students to group learning to improve their creative and analytical skills.
6. Show short related video lectures in the following ways:
   - As an introduction to new topics (pre-lecture activity).
   - As a revision of topics (post-lecture activity).
   - As additional examples (post-lecture activity).
   - As an additional material of challenging topics (pre-and post-lecture activity).
   - As a model solution for some exercises (post-lecture activity).

**Module-1**

**Introduction to Strategic Games:** What is game theory? The theory of rational choice, Strategic games; Examples: The prisoner's dilemma, Bach or Stravinsky, Matching pennies; Nash equilibrium; Examples of Nash equilibrium; Best response functions; Dominated actions.

**(8 hours)**

**(RBT Levels: L1, L2 and L3)**

| **Teaching-Learning Process** | Chalk and talk method / PowerPoint Presentation |
|---|---|

**Module-2**

Introduction; Strategic games in which players may randomize; Mixed strategy Nash equilibrium; Dominated actions; Pure equilibrium when randomization is allowed.
Illustration: Expert Diagnosis; Equilibrium in a single population. **(8 hours)**
**(RBT Levels: L1, L2 and L3)**

| **Teaching-Learning Process** | Chalk and talk method / PowerPoint Presentation |
|---|---|

**Module-3**

Extensive games with perfect information; Strategies and outcomes; Nash equilibrium; Sub-game perfect equilibrium; Finding sub-game perfect equilibria of finite horizon games: Backward induction; Illustrations: The ultimatum game, Stackelberg's model of duopoly. **(8 hours)**
**(RBT Levels: L1, L2 and L3)**

| **Teaching-Learning Process** | Chalk and talk method / PowerPoint Presentation |
|---|---|

**Module-4**

Bayesian Games**,** Motivational examples; General definitions; Two examples concerning information; Illustrations: Cournot's duopoly game with imperfect information, Providing a public good; Auctions: Auctions with an arbitrary distribution of valuations. **(8 hours)**
**(RBT Levels: L1, L2 and L3)**

| **Teaching-Learning Process** | Chalk and talk method / PowerPoint Presentation |
|---|---|

**Module-5**

**Competative Games:** Strictly competitive games and maximization.
**Repeated games:** The main idea; Preferences; Repeated games; Finitely and infinitely repeated Prisoner's dilemma; Strategies in an infinitely repeated Prisoner's dilemma; Nash equilibrium of an infinitely repeated Prisoner's dilemma, Nash equilibrium payoffs of an infinitely repeated Prisoner's dilemma. **(8 hours)**
**(RBT Levels: L1, L2 and L3)**

| **Teaching-Learning Process** | Chalk and talk method / PowerPoint Presentation |
|---|---|

**Course outcome (Course Skill Set)**
At the end of the course, the student will be able to:

1. Interpret the basics of strategic gaming and extensive games.
2. Analyze gaming strategies on real-time incidence.
3. Develop the models of gaming on real-time incidence.
4. Apply game theory in the real world problems.

**Assessment Details (both CIE and SEE)**
The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks out of 50) and for the SEE, the minimum passing mark is 35% of the maximum marks (18 out of 50 marks). The student is declared as a pass in the course if he/she secures a minimum of 40% (40 marks out of 100) in the total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together.

**Continuous Internal Evaluation:**

- There are 25 marks for the CIE's Assignment component and 25 for the Internal Assessment Test component.
- Each test shall be conducted for 25 marks. The first test will be administered after 40-50% of the coverage of the syllabus, and the second test will be administered after 85-90% of the coverage of the syllabus. The average of the two tests shall be scaled down to 25 marks

- Any two assignment methods mentioned in the 22OB2.4, if an assignment is project-based then only one assignment for the course shall be planned. The schedule for assignments shall be planned properly by the course teacher. The teacher should not conduct two assignments at the end of the semester if two assignments are planned. Each assignment shall be conducted for 25 marks. (If two assignments are conducted then the sum of the two assignments shall be scaled down to 25 marks)
- The final CIE marks of the course out of 50 will be the sum of the scale-down marks of tests and assignment/s marks.

**Internal Assessment Test question paper is designed to attain the different levels of Bloom's taxonomy as per the outcome defined for the course.**

**Semester-End Examination:**

Theory SEE will be conducted by the University as per the scheduled timetable, with common question papers for the course (**duration 03 hours).**

1. The question paper will have ten questions. Each question is set for 20 marks.
2. There will be 2 questions from each module. Each of the two questions under a module (with a maximum of 3 sub-questions), **should have a mix of topics** under that module.
3. The students have to answer 5 full questions, selecting one full question from each module.

Marks scored shall be proportionally reduced to 50 marks

**Suggested Learning Resources:**

**Books (Name of the author/Title of the Book/Name of the publisher/Edition and Year)**

**Text Books:**

1. **Martin Osborne: "An Introduction to Game Theory",** Oxford University Press, First Indian Edition, 2009, 7th impression, ISBN – 0195128958.

**Reference Books:**

1. **Roger B. Myerson: "Analysis of Conflict Game Theory",** Re-print Edition, Harvard University Press, 2008, ISBN – 978-0674341166.
2. **Frederick S. Hillier and Gerald J. Lieberman: "Introduction to Operations Research, Concepts and Cases",** 9th Edition; Tata McGraw Hill, 2010, ISBN – 0073376299.
3. **Joel Watson: "An Introduction to Game Theory"** Strategy, 2nd Edition, W.W. Norton &Company, 2007, ISBN – 9780393929348.

**Web links and Video Lectures (e-Resources):**

- http://nptel.ac.in/courses.php?disciplineID=111
- http://www.class-central.com/subject/math(MOOCs)
- http://academicearth.org/
- VTU e-Shikshana Program
- VTU EDUSAT Program.

**Activity-Based Learning (Suggested Activities in Class)/Practical-Based Learning**

- Quizzes
- Assignments
- Seminar

| Scala | | Semester | 4 |
|---|---|---|---|
| Course Code | **BDSL456A** | CIE Marks | 50 |
| Teaching Hours/Week (L:T:P: S) | 0:0:2:0 | SEE Marks | 50 |
| Credits | 01 | Exam Hours | 02 |
| Examination type (SEE) | Practical | | |

**Course objectives:**

- Model data using algebraic data types, represented in Scala as families of sealed traits and case classes.
- Use structural recursion and pattern matching to traverse and transform data.
- Learn programming with the common data structures of Scala
- Learn object-oriented programming in Scala

| Sl.NO | Experiments |
|---|---|
| 1 | a. Write a Scala program to compute the sum of the two given integer values. If the two values are the same, then return triples their sum.<br>b. Write a Scala program to check two given integers, and return true if one of them is 22 or if their sum is 32. |
| 2 | a. Write a Scala program to remove the character in a given position of a given string. The given position will be in the range 0...string length -1 inclusive.<br>b. Write a Scala program to create a new string taking the first 5 characters of a given string and return the string with the 5 characters added at both the front and back. |
| 3 | a. Write a Scala program to print the multiplication table of a given number using a for loop.<br>b. Write a Scala program to find the largest element in an array using pattern matching |
| 4 | a. Write a Scala function to calculate the product of digits in a given number<br>b. Write a Scala function to check if a given number is a perfect square |
| 5 | a. Write a Scala program that creates a subclass Student that extends the Person class. Add a property called grade and implement methods to get and set it.<br>b. Write a Scala program that creates a class Triangle with properties side1, side2, and side3. Implement a method isEquilateral to check if the triangle is equilateral. |
| 6 | a. Write a Scala program that creates an enum class Color with values for different colors. Use the enum class to represent an object's color.<br>b. Write a Scala program that creates a class ContactInfo with properties name, email, and address. Create a class Customer that includes a ContactInfo object. |
| 7 | a. Write a Scala program to create a set and find the difference and intersection between two sets.<br>b. Write a Scala program to create a set and find the second largest element in the set. |
| 8 | a. Write a Scala program to create a list in different ways. Note: Use Lisp style, Java style, Range list, Uniform list, Tabulate list<br>b. Write a Scala program to flatten a given List of Lists, nested list structure. |
| 9 | a. Write a Scala program to add each element n times to a given list of integers.<br>b. Write a Scala program to split a given list into two lists. |
| 10 | a. Write a Scala program to swap the elements of a tuple Further print no swapping required if elements are same.<br>b. Write a Scala program to find non-unique elements in a tuple |

**Course outcomes (Course Skill Set):**

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

- Get familiar with the Scala syntax and object-oriented principles
- Learn advanced concepts - loops, expressions, inheritance, pattern matching
- Learn to write clean and functional Scala codes and test it
- Learn functional programming using Scala

**Assessment Details (both CIE and SEE)**

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks out of 50) and for the SEE minimum passing mark is 35% of the maximum marks (18 out of 50 marks). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures a minimum of 40% (40 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together

**Continuous Internal Evaluation (CIE):**

CIE marks for the practical course are **50 Marks**.

The split-up of CIE marks for record/ journal and test are in the ratio **60:40**.

- Each experiment is to be evaluated for conduction with an observation sheet and record write-up. Rubrics for the evaluation of the journal/write-up for hardware/software experiments are designed by the faculty who is handling the laboratory session and are made known to students at the beginning of the practical session.
- Record should contain all the specified experiments in the syllabus and each experiment write-up will be evaluated for 10 marks.
- Total marks scored by the students are scaled down to **30 marks** (60% of maximum marks).
- Weightage to be given for neatness and submission of record/write-up on time.
- Department shall conduct a test of 100 marks after the completion of all the experiments listed in the syllabus.
- In a test, test write-up, conduction of experiment, acceptable result, and procedural knowledge will carry a weightage of 60% and the rest 40% for viva-voce.
- The suitable rubrics can be designed to evaluate each student's performance and learning ability.
- The marks scored shall be scaled down to **20 marks** (40% of the maximum marks).

The Sum of scaled-down marks scored in the report write-up/journal and marks of a test is the total CIE marks scored by the student.

**Semester End Evaluation (SEE):**

- SEE marks for the practical course are 50 Marks.
- SEE shall be conducted jointly by the two examiners of the same institute, examiners are appointed by the Head of the Institute.
- The examination schedule and names of examiners are informed to the university before the conduction of the examination. These practical examinations are to be conducted between the schedule mentioned in the academic calendar of the University.
- All laboratory experiments are to be included for practical examination.
- (Rubrics) Breakup of marks and the instructions printed on the cover page of the answer script to be strictly adhered to by the examiners. **OR** based on the course requirement evaluation rubrics shall be decided jointly by examiners.
- Students can pick one question (experiment) from the questions lot prepared by the examiners

jointly.

- Evaluation of test write-up/ conduction procedure and result/viva will be conducted jointly by examiners.

- General rubrics suggested for SEE are mentioned here, writeup-20%, Conduction procedure and result in -60%, Viva-voce 20% of maximum marks. SEE for practical shall be evaluated for 100 marks and scored marks shall be scaled down to 50 marks (however, based on course type, rubrics shall be decided by the examiners)
- Change of experiment is allowed only once and 15% of Marks allotted to the procedure part are to be made zero.

The minimum duration of SEE is 02 hours

**Suggested Learning Resources:**

- Programming Scala, Third Edition, O'Reilly Media.
- Paul Chiusano, Rúnar Bjarnason, Functional Programming in Scala 1st Edition, Manning Publications
- https://docs.scala-lang.org/tutorials/scala-for-java-programmers.html
- https://www.javatpoint.com/scala-tutorial

| MongoDB | | Semester | 4 |
|---|---|---|---|
| Course Code | **BDSL456B** | CIE Marks | 50 |
| Teaching Hours/Week (L: T:P: S) | 0:0:2:0 | SEE Marks | 50 |
| Total Hours of Pedagogy | 24 | Total Marks | 100 |
| Credits | 01 | | |

**Course objectives:**

- Understand basic MongoDB functions, operators and types of operations in MongoDB.
- Demonstrate the use of Indexing, Advanced Indexing in MongoDB.
- Apply the aggregation and Map Reduction in MongoDB.
- Demonstrate text searching on collections in MongoDB.

| Sl.NO | Experiments |
|---|---|
| 1 | a. Illustration of Where Clause, AND,OR operations in MongoDB.<br>b. Execute the Commands of MongoDB and operations in MongoDB : Insert, Query, Update, Delete and Projection. (Note: use any collection)<br>[Refer: Book 1 chapter 4]. |
| 2 | a. Develop a MongoDB query to select certain fields and ignore some fields of the documents from any collection.<br>b. Develop a MongoDB query to display the first 5 documents from the results obtained in a.<br>[use of limit and find]<br>[Refe: Book1 Chapter 4, book 2: chapter 5] |
| 3 | a. Execute query selectors (comparison selectors, logical selectors ) and list out the results on any collection<br>b. Execute query selectors (Geospatial selectors, Bitwise selectors ) and list out the results on any collection<br>[Refer: Book 3 Chapter 13] |
| 4 | Create and demonstrate how projection operators ($, $elematch and $slice) would be used in the MondoDB.<br>[Refer: Book 3 Chapter 14] |
| 5 | Execute Aggregation operations ($avg, $min,$max, $push, $addToSet etc.). students encourage to execute several queries to demonstrate various aggregation operators)<br>[Refer: Book 3 Chapter 15] |
| 6 | Execute Aggregation Pipeline and its operations (pipeline must contain $match, $group, $sort, $project, $skip etc. students encourage to execute several queries to demonstrate various aggregation operators)<br>[refer book 2: chapter 6 ] |
| 7 | a. Find all listings with listing_url, name, address, host_picture_url in the listings And Reviews collection that have a host with a picture url<br>b. Using E-commerce collection write a query to display reviews summary.<br>[refer Book2: chapter 6] |
| 8 | a. Demonstrate creation of different types of indexes on collection (unique, sparse, compound and multikey indexes)<br>b. Demonstrate optimization of queries using indexes.<br>Refer: Book 2: Chapter 8 and Book 3: Chapter 12] |
| 9 | a. Develop a query to demonstrate Text search using catalog data collection for a given word<br>b. Develop queries to illustrate excluding documents with certain words and phrases<br>Refer: Book 2: Chapter 9] |

| | |
|---|---|
| 10 | Develop an aggregation pipeline to illustrate Text search on Catalog data collection.<br><br>Refer: Book 2 :Chapter 9] |

**Course outcomes (Course Skill Set):**

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

1. Make use of MangoDB commands and queries.
2. Illustrate the role of aggregate pipelines to extract data.
3. Demonstrate optimization of queries by creating indexes.
4. Develop aggregate pipelines for text search in collections.

## Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks out of 50) and for the SEE minimum passing mark is 35% of the maximum marks (18 out of 50 marks). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures a minimum of 40% (40 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together

**Continuous Internal Evaluation (CIE):**

CIE marks for the practical course are **50 Marks**.

The split-up of CIE marks for record/ journal and test are in the ratio **60:40**.

- Each experiment is to be evaluated for conduction with an observation sheet and record write-up. Rubrics for the evaluation of the journal/write-up for hardware/software experiments are designed by the faculty who is handling the laboratory session and are made known to students at the beginning of the practical session.
- Record should contain all the specified experiments in the syllabus and each experiment write-up will be evaluated for 10 marks.
- Total marks scored by the students are scaled down to **30 marks** (60% of maximum marks).
- Weightage to be given for neatness and submission of record/write-up on time.
- Department shall conduct a test of 100 marks after the completion of all the experiments listed in the syllabus.
- In a test, test write-up, conduction of experiment, acceptable result, and procedural knowledge will carry a weightage of 60% and the rest 40% for viva-voce.
- The suitable rubrics can be designed to evaluate each student's performance and learning ability.
- The marks scored shall be scaled down to **20 marks** (40% of the maximum marks).

The Sum of scaled-down marks scored in the report write-up/journal and marks of a test is the total CIE marks scored by the student.

**Semester End Evaluation (SEE):**

- SEE marks for the practical course are 50 Marks.
- SEE shall be conducted jointly by the two examiners of the same institute, examiners are appointed by the Head of the Institute.
- The examination schedule and names of examiners are informed to the university before the conduction of the examination. These practical examinations are to be conducted between the schedule mentioned in the academic calendar of the University.

- All laboratory experiments are to be included for practical examination.
- (Rubrics) Breakup of marks and the instructions printed on the cover page of the answer script to be strictly adhered to by the examiners. **OR** based on the course requirement evaluation rubrics shall be decided jointly by examiners.
- Students can pick one question (experiment) from the questions lot prepared by the examiners jointly.
- Evaluation of test write-up/ conduction procedure and result/viva will be conducted jointly by examiners.

General rubrics suggested for SEE are mentioned here, writeup-20%, Conduction procedure and result in -60%, Viva-voce 20% of maximum marks. SEE for practical shall be evaluated for 100 marks and scored marks shall be scaled down to 50 marks (however, based on course type, rubrics shall be decided by the examiners)

Change of experiment is allowed only once and 15% of Marks allotted to the procedure part are to be made zero.

The minimum duration of SEE is 02 hours

**Suggested Learning Resources:**

- **BOOK 1: "**MongoDB: The Definitive Guide", Kristina chodorow, 2nd ed O'REILLY, 2013.
- **BOOK 2: "***MongoDB in Action*" by KYLE BANKER et. al. 2nd ed, Manning publication, 2016
- **BOOK 3:** "MongoDB Complete Guide" by Manu Sharma 1st ed, bpb publication, 2023.
- **installation of MongoDB Video:** https://www.youtube.com/watch?v=dEm2AS5amyA
- **video on Aggregation:** https://www.youtube.com/watch?v=vx1C8EyTa7Y
- **MongoDB in action book Code download URL: h**ttps://www.manning.com/downloads/529
- **MongoDB Exercise URL:** https://www.w3resource.com/mongodb-exercises/

| MERN | | Semester | 4 |
|---|---|---|---|
| Course Code | **BDSL456C** | CIE Marks | 50 |
| Teaching Hours/Week (L:T:P: S) | 0:0:2:0 | SEE Marks | 50 |
| Credits | 01 | Exam Hours | 02 |
| Examination type (SEE) | Practical | | |

**Course objectives:**

- Understand and apply critical web development languages and tools to create dynamic and responsive web applications.
- To build server-side applications using Node.js and Express
- Develop user interfaces with React.js,
- Manage data using MongoDB, and integrate these technologies to create full stack apps
- Understanding APIs and routing.

| Sl.NO | Experiments |
|---|---|
| 1 | Using MongoDB, create a collection called transactions in database usermanaged (drop if it already exists) and bulk load the data from a json file, transactions.json<br>Upsert the record from the new file called transactions_upsert.json in Mongodb. |
| 2 | Query MongoDB with Conditions: [Create appropriate collection with necessary documents to answer the query]<br>a. Find any record where Name is Somu<br>b. Find any record where total payment amount (Payment.Total) is 600.<br>c. Find any record where price (Transaction.price) is between 300 to 500.<br>d. Calculate the total transaction amount by adding up Payment.Total in all records. |
| 3 | a. Write a program to check request header for cookies.<br>b. write node.js program to print the a car object properties, delete the second property and get length of the object. |
| 4 | a. Read the data of a student containing usn, name, sem, year_of_admission from node js and store it in the mongodb<br>b. For a partial name given in node js, search all the names from mongodb student documents created in Question(a) |
| 5 | Implement all CRUD operations on a File System using Node JS |
| 6 | Develop the application that sends fruit name and price data from client side to Node.js server using Ajax |
| 7 | Develop an authentication mechanism with email_id and password using HTML and Express JS (POST method) |
| 8 | Develop two routes: find_prime_100 and find_cube_100 which prints prime numbers less than 100 and cubes less than 100 using Express JS routing mechanism |
| 9 | Develop a React code to build a simple search filter functionality to display a filtered list based on the search query entered by the user. |
| 10 | Develop a React code to collect data from rest API. |

**Course outcomes (Course Skill Set):**

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

- Apply the fundamentals of MongoDB, such as data modelling, CRUD operations, and basic queries to solve given problem.
- Use constructs of Express.js, including routing, software and constructing RESTful APIs to solve real world problems.
- Develop scalable and efficient RESTful APIs using NodeJS.
- Develop applications using React, including components, state, props, and JSX syntax.

**Assessment Details (both CIE and SEE)**

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks out of 50) and for the SEE minimum passing mark is 35% of the maximum marks (18 out of 50 marks). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures a minimum of 40% (40 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together

**Continuous Internal Evaluation (CIE):**

CIE marks for the practical course are **50 Marks**.

The split-up of CIE marks for record/ journal and test are in the ratio **60:40**.

- Each experiment is to be evaluated for conduction with an observation sheet and record write-up. Rubrics for the evaluation of the journal/write-up for hardware/software experiments are designed by the faculty who is handling the laboratory session and are made known to students at the beginning of the practical session.
- Record should contain all the specified experiments in the syllabus and each experiment write-up will be evaluated for 10 marks.
- Total marks scored by the students are scaled down to **30 marks** (60% of maximum marks).
- Weightage to be given for neatness and submission of record/write-up on time.
- Department shall conduct a test of 100 marks after the completion of all the experiments listed in the syllabus.
- In a test, test write-up, conduction of experiment, acceptable result, and procedural knowledge will carry a weightage of 60% and the rest 40% for viva-voce.
- The suitable rubrics can be designed to evaluate each student's performance and learning ability.
- The marks scored shall be scaled down to **20 marks** (40% of the maximum marks).

The Sum of scaled-down marks scored in the report write-up/journal and marks of a test is the total CIE marks scored by the student.

**Semester End Evaluation (SEE):**

- SEE marks for the practical course are 50 Marks.
- SEE shall be conducted jointly by the two examiners of the same institute, examiners are appointed by the Head of the Institute.
- The examination schedule and names of examiners are informed to the university before the conduction of the examination. These practical examinations are to be conducted between the schedule mentioned in the academic calendar of the University.
- All laboratory experiments are to be included for practical examination.
- (Rubrics) Breakup of marks and the instructions printed on the cover page of the answer script to be strictly adhered to by the examiners. **OR** based on the course requirement evaluation rubrics shall be decided jointly by examiners.
- Students can pick one question (experiment) from the questions lot prepared by the examiners

jointly.

- Evaluation of test write-up/ conduction procedure and result/viva will be conducted jointly by examiners.

- General rubrics suggested for SEE are mentioned here, writeup-20%, Conduction procedure and result in -60%, Viva-voce 20% of maximum marks. SEE for practical shall be evaluated for 100 marks and scored marks shall be scaled down to 50 marks (however, based on course type, rubrics shall be decided by the examiners)
- Change of experiment is allowed only once and 15% of Marks allotted to the procedure part are to be made zero.

The minimum duration of SEE is 02 hours

**Suggested Learning Resources:**


- Vasan SubramanianPro MERN Stack: Full Stack Web App Development with Mongo, Express, React, and Node, Apress; 1st ed. edition (1 April 2017)
- . Eddy Wilson Iriarte Koroliova,MERN Quick Start Guide, Packt Publishing (31 May 2018),
- https://www.geeksforgeeks.org/mern-stack/
- https://blog.logrocket.com/mern-stack-tutorial/

| Julia | | Semester | 4 |
|---|---|---|---|
| Course Code | BDSL456D | CIE Marks | 50 |
| Teaching Hours/Week (L: T:P: S) | 0:0:2:0 | SEE Marks | 50 |
| Total Hours of Pedagogy | 24 | Total Marks | 100 |
| Credits | 01 | | |

**Course objectives:**

- To introduce the basics of Julia programming language
- To illustrate the data structures of Julia programming language
- To make use of built-in functions and packages

| Sl.NO | Experiments |
|---|---|
| 1 | a. Develop a Julia program to simulate a calculator (for integer and real numbers).<br>b. Develop a Julia program to add, subtract, multiply and divide complex numbers.<br>c. Develop a Julia program to evaluate expressions having mixed data types (integer, real, floating-point number and complex).<br>[Refer Book 2: Chapter 3, 4] |
| 2 | a. Develop a Julia program for the following problem: A computer repair shop charges $100 per hour for labour plus the cost of any parts used in the repair. However, the minimum charge for any job is $150. Prompt for the number of hours worked and the cost of parts (which could be $0) and print the charge for the job.<br>b. Develop a Julia program to calculate a person's regular pay, overtime pay and gross pay based on the following: If hours worked is less than or equal to 40, regular pay is calculated by multiplying hours worked by rate of pay, and overtime pay is 0. If hours worked is greater than 40, regular pay is calculated by multiplying 40 by the rate of pay, and overtime pay is calculated by multiplying the hours in excess of 40 by the rate of pay by 1.5. Gross pay is calculated by adding regular pay and overtime pay.<br>[Refer Book 1: Chapter 3] |
| 3 | a. An amount of money P (for principal) is put into an account which earns interest at r% per annum. So, at the end of one year, the amount becomes P + P×r/100. This becomes the principal for the next year. Develop a Julia program to print the amount at the end of each year for the next 10 years. However, if the amount ever exceeds 2P, stop any further printing. Your program should prompt for the values of P and r.<br>b. Develop a Julia program which reads numbers from a file (input.txt) and finds the largest number, smallest number, count, sum and average of numbers.<br>[Refer Book 1: Chapter 4] |
| 4 | a. Develop a Julia program and two separate functions to calculate GCD and LCM.<br>b. Develop a Julia program and a recursive function to calculate factorial of a number.<br>c. Develop a Julia program and a recursive function to generate Fibonacci series.<br>[Refer Book 1: Chapter 5] |
| 5 | a. Develop a Julia program which reads a string (word) and prints whether the word is palindrome.<br>b. Develop a Julia program which reads and prints the words present in a file (input.txt) having Random Data in which words are dispersed randomly (Assumption: a word is a contiguous sequence of letters. A word is delimited by any non-letter character or end-of-line).<br>[Refer Book 1: Chapter 6] |
| 6 | a. Develop a Julia program to determine and print the frequency with which each letter of the alphabet is used in a given line of text.<br>b. A survey of 10 pop artists is made. Each person votes for an artist by specifying the number of the artist (a value from 1 to 10). Develop a Julia program to read the names of the artists, followed by the votes, and find out which artist is the most popular.<br>[Refer Book 1: Chapter 7] |

| | |
|---|---|
| 7 | a. Given a line of text as input, develop a Julia program to determine the frequency with which each letter of the alphabet is used (make use of dictionary)<br>b. Develop a Julia program to fetch words from a file with arbitrary punctuation and keep track of all the different words found (make use of set and ignore the case of the letters: e.g. to and To are treated as the same word).<br>[Refer Book 1: Chapter 10] |
| 8 | a. Develop a Julia program to evaluate expressions consisting of rational, irrational number and floating-point numbers)<br>b. Develop a Julia program to determine the following properties of a matrix: determinant, inverse, rank, upper & lower triangular matrix, diagonal elements, Euclidean norm and Square Root of a Matrix.<br>[Refer Book 2: Chapter 5, 8] |
| 9 | a. Develop a Julia program to determine addition and subtraction of two matrices (element -wise).<br>b. Develop a Julia program to perform multiplication operation on matrices: scalar multiplication, element-wise multiplication, dot product, cross product.<br>[Refer Book 2: Chapter 8] |
| 10 | a. Develop a Julia program to generate a plot of (solid & dotted) a function: $y=x^2$ (use suitable data points for x).<br>b. Develop a Julia program to generate a plot of mathematical equation: y = sin(x) + sin(2x).<br>c. Develop a Julia program to generate multiple plots of mathematical equations: y = sin(x) + sin(2x) and y = sin(2x) + sin(3x).<br>[Refer Book 2: Chapter 13] |

**Course outcomes (Course Skill Set):**

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

- Apply concepts of data-types, selection and looping constructs of Julia programming language.
- Demonstrate the use of strings, functions, arrays and matrix operations in solving problems.
- Develop programs involving data structures to handle multi-valued data items.
- Make use of packages to generate plots of mathematical functions and equations.

**Assessment Details (both CIE and SEE)**

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks out of 50) and for the SEE minimum passing mark is 35% of the maximum marks (18 out of 50 marks). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures a minimum of 40% (40 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together

**Continuous Internal Evaluation (CIE):**

CIE marks for the practical course are **50 Marks**.

The split-up of CIE marks for record/ journal and test are in the ratio **60:40**.

- Each experiment is to be evaluated for conduction with an observation sheet and record write-up. Rubrics for the evaluation of the journal/write-up for hardware/software experiments are designed by the faculty who is handling the laboratory session and are made known to students at the beginning of the practical session.
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- Weightage to be given for neatness and submission of record/write-up on time.
- Department shall conduct a test of 100 marks after the completion of all the experiments listed in the syllabus.
- In a test, test write-up, conduction of experiment, acceptable result, and procedural knowledge will carry a weightage of 60% and the rest 40% for viva-voce.
- The suitable rubrics can be designed to evaluate each student's performance and learning ability.
- The marks scored shall be scaled down to **20 marks** (40% of the maximum marks).

The Sum of scaled-down marks scored in the report write-up/journal and marks of a test is the total CIE marks scored by the student.

**Semester End Evaluation (SEE):**

- SEE marks for the practical course are 50 Marks.
- SEE shall be conducted jointly by the two examiners of the same institute, examiners are appointed by the Head of the Institute.
- The examination schedule and names of examiners are informed to the university before the conduction of the examination. These practical examinations are to be conducted between the schedule mentioned in the academic calendar of the University.
- All laboratory experiments are to be included for practical examination.
- (Rubrics) Breakup of marks and the instructions printed on the cover page of the answer script to be strictly adhered to by the examiners. **OR** based on the course requirement evaluation rubrics shall be decided jointly by examiners.
- Students can pick one question (experiment) from the questions lot prepared by the examiners jointly.
- Evaluation of test write-up/ conduction procedure and result/viva will be conducted jointly by examiners.

General rubrics suggested for SEE are mentioned here, writeup-20%, Conduction procedure and

result in -60%, Viva-voce 20% of maximum marks. SEE for practical shall be evaluated for 100 marks and scored marks shall be scaled down to 50 marks (however, based on course type, rubrics shall be decided by the examiners)

Change of experiment is allowed only once and 15% of Marks allotted to the procedure part are to be made zero.

The minimum duration of SEE is 02 hours

**Suggested Learning Resources:**

- **BOOK 1:** Julia – Bit by Bit (Programming for Beginners), by Noel Kalicharan, Springer: ISBN 978-3-030-73935-5, doi: https://doi.org/10.1007/978-3-030-73936-2, 2021.
- **BOOK 2:** Beginning Julia Programming (For Engineers and Scientists), by Sandeep Nagar, Apress-Springer: ISBN 978-1-4842-3170-8, doi: https://doi.org/10.1007/978-1-4842-3171-5, 2017.