BMS INSTITUTE OF TECHNOLOGY AND MANAGEMENT

(Autonomous Institute affiliated to VTU, Belagavi, Approved by AICTE, New Delhi)

Avalahalli, Yelahanka, Bengaluru 560064

Bachelor of Engineering

Department of Information Science and Engineering

V and VI Semester Scheme and Syllabus
2021 Scheme - Autonomous

Approved in the BoS meeting held on 25.05.2023

Vision:

Emerge as Centre of learning in the field of information science & engineering with technical competency to serve the society.

Mission:

To provide excellent learning environment through balanced curriculum, best teaching methods, innovation, mentoring and industry institute interaction.

Program Educational Objectives (PEOs)

PEO-1: Successful professional career in Information Science & Technology.

PEO-2: Pursue higher studies to persist knowledge in IT industry.

PEO-3: Exhibit professionalism and team work with social concern.

Program Specific Outcomes (PSOs)

PSO 1: Apply the Knowledge of Information technology to develop software solutions.

PSO 2: Design and develop hardware systems, manage and monitor resources in the product life cycle.

BMS INSTITUTE OF TECHNOLOGY & MANAGEMENT

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Yelahanka, Bengaluru-560064

Date: 14.06.2023

CIE and SEE Pattern for 2021 Scheme
(Applicable from the AY 2021-22 onwards)

Important Note:

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Examinations (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks out of 50) and for SEE minimum passing mark is 35% of the maximum marks (18 marks out of 50). 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.

4 CREDIT and 3 CREDIT COURSES

I. CONTINUOUS INTERNAL EVALUATION (CIE): 50 MARKS

- Internal Assessment (IA) Tests: 3 IAs to be conducted for 40 Marks (90 minutes each). Total of 3 tests will be 120 and the same can be scale down to **60 marks.**
- Alternate Assignment Tool (AAT): 2 AATs each of 10 marks, total **20 marks.**
- Assignments: 2 assignments of each 10 marks, total **20 marks**.
- CIE marks = 60 + 20 + 20 = 100 and same can be scale down to **50 marks.**
- Student has to score minimum of 20 marks (40%).

II. SEMESTER END EXAMINATIONS (SEE): 50 MARKS

SEE is conducted for 100 Marks (3 hours).

Question Paper Pattern:

Part - A: Comprises 20 objective type questions carrying 1 Mark each with a total 20 Marks.

Part - B: There will be **5 modules**. Each module will have **TWO questions carrying 16 marks** each. There will be a maximum of three sub section for each question. **Student has to answer any ONE full question from each module.**

SEE Marks = 20 + 80 = 100 marks and can be scale down to 50 marks.

2 CREDIT COURSES

I. **CONTINUOUS INTERNAL EVALUATION (CIE): 50 MARKS**

- Internal Assessment (IA) Tests: 3 IAs of MCQ type to be conducted for 40 Marks (60 minutes each). Total of 3 tests will be 120 and the same can be scale down to **60 marks.**
- Alternate Assignment Tool (AAT): 2 AATs each of 10 marks, total **20 marks.**
- Assignments: 2 assignments of each 10marks, total **20 marks.**
- CIE marks = 60 + 20 + 20 = 100 and same can be scale down to **50 marks.**
- Student has to score minimum of 20 marks (40%).

II. **SEMESTER END EXAMINATIONS (SEE): 50 MARKS**

SEE is conducted for 100 Marks (2 hours).

Question Paper Pattern:

- The pattern of the question paper is MCQ.
- SEE question paper will be set for 100 questions each of 01 marks. The same is scale down to 50 marks.

1 CREDIT COURSES

I. **CONTINUOUS INTERNAL EVALUATION (CIE): 50 MARKS**

- Internal Assessment (IA) Tests: 3 IAs of MCQ type to be conducted for 40 Marks (60 minutes each). Total of 3 tests will be 120 and the same can be scale down to **60 marks.**
- Alternate Assignment Tool (AAT): 2 AATs each of 10 marks, total **20 marks.**
- Assignments: 2 assignments of each 10marks, total **20 marks.**
- CIE marks = 60 + 20 + 20 = 100 and same can be scale down to **50 marks.**
- Student has to score minimum of 20 marks (40%).

II. **SEMESTER END EXAMINATIONS (SEE): 50 MARKS**

SEE is conducted for 50 Marks (1 hours).

Question Paper Pattern:

- The pattern of the question paper is MCQ.
- SEE question paper will be set for 50 questions each of 01marks. The same is scale down to 50 marks.

1 CREDIT LABORATORY COURSES

I. CONTINUOUS INTERNAL EVALUATION (CIE): 50 MARKS

- Cumulative Assessment (CA) of each experiment is 20 Marks (Conduction 10 marks + Records 5 marks +Viva 5marks). The average of all the experiments to be taken for **20 marks.**
- Open Ended Experiments (OE) **10 marks.**
- 2 IAs Test to be conducted for 100 marks. General rubrics suggested for SEE are: Writeup 20 marks, Conduction of the experiments, calculations, graphs, results, etc.,: 60 marks and Viva: 20 marks. The average of 2 IA marks is scale down to **20 marks**.
- CIE marks =20 (CA) +10 (OE) + 20 (IA test) = 50 marks.
- Student has to score minimum of 20 marks (40%).

II. SEMESTER END EXAMINATIONS (SEE): 50 MARKS

SEE is conducted for 100 Marks and scale down to 50 Marks.

Examinations to be conducted jointly by Two examiners. All the experiments are to be included for practical examination. General rubrics suggested for SEE are: Writeup 20 marks, Conduction of the experiments, calculations, graphs, results, etc.,: 60 marks and Viva: 20 marks.

CoE 16/06/2023 Dean AA 16/06/2023 Principal 19/6/23

BMS INSTITUTE OF TECHNOLOGY AND MANAGEMENT

(Autonomous Institute affiliated to VTU)

Scheme of Teaching and Examination: Effective from AY 2023– 24Choice Based Credit System (CBCS)

UG PROGRAM: Department of Information Science and Engineering (ISE) — **Semester: V**

Sl. No	Course Category	Course Code	Course Title	Teaching Dept.	Teaching Hours /Week				Credits	Examination			
					L	T	P	PW		Duration in Hours	CIE Marks	SEE Marks	Total Marks
1	HS	21HSS51	Management and Entrepreneurship	ISE	3	0	0	0	3	3	50	50	100
2	AEC	21AEC52	Cyber and Intellectual Property law	ISE	1	0	0	0	1	1	50	50	100
3	INT	21INT53	Innovation / Entrepreneurship / Societal Internship	ISE	0	0	0	6	3	-	100	-	100
4	PE	21IS54X	Professional Elective I	ISE	3	0	0	0	3	3	50	50	100
5	PC	21CS55	Data Base Management Systems	ISE	3	0	0	0	3	3	50	50	100
6	PC	21CS56	Operating Systems	ISE	2	1	0	0	3	3	50	50	100
7	PC	21CS57	Data Communication and Networks	ISE	3	0	0	0	3	3	50	50	100
8	PC	21CSL58A	Database Management Systems Laboratory	ISE	0	0	2	0	1	3	50	50	100
9	PC	21CSL58B	Operating Systems Laboratory	ISE	0	0	2	0	1	3	50	50	100
10	PC	21CSL58C	Data Communication and Networks Laboratory	ISE	0	0	2	0	1	3	50	50	100
TOTAL					15	1	6	6	22		550	450	1000

Professional Elective - Group I	
Course Code	**Course Title**
21IS541	Cryptography and Network Security
21IS542	Data Science
21IS543	Systems for IoT
21IS544	Human Computer Interface
21IS545	Computer Graphics and Visualization

BMS INSTITUTE OF TECHNOLOGY AND MANAGEMENT

(Autonomous Institute under VTU)

Scheme of Teaching and Examination: Effective from AY 2023 – 24

Choice Based Credit System (CBCS)

UG PROGRAM: INFORMATION SCIENCE AND ENGINEERING (ISE) — **Semester: VI**

Sl. No	Course category	Course Code	Course Title	Teaching Department	Teaching Hours/Week				Credits	Examination			
					L	T	P	PW		Duration (Hrs)	CIE Marks	SEE Marks	Total Marks
1.	HS	21HSS61	Project & Finance Management	ISE	2	0	0	0	2	1	50	50	100
2.	AEC	21AEC62	Bio Informatics	ISE	1	0	0	0	1	1	50	50	100
3.	AEC	21CS63	Green IT and Sustainability	ISE	1	0	0	0	1	1	50	50	100
4.	PE	21IS64X	Professional Elective-II	ISE	3	0	0	0	3	3	50	50	100
5.	OE	21IS65X	Open Elective-I	ISE	3	0	0	0	3	3	50	50	100
6.	PW	21IS66	Mini Project	ISE	0	0	0	4	2	3	50	50	100
7.	PC	21IS67	Machine Learning	ISE	3	0	0	0	3	3	50	50	100
8.	PC	21IS68	Cloud Computing	ISE	3	0	0	0	3	3	50	50	100
9.	PC	21IS69A	Mobile Application Development Laboratory	ISE	0	0	2	0	1	3	50	50	100
10.	PC	21IS69B	Cloud Computing Laboratory	ISE	0	0	2	0	1	3	50	50	100
11.	PC	21IS69C	Machine Learning Laboratory	ISE	0	0	2	0	1	3	50	50	100
TOTAL					**16**	**0**	**6**	**4**	**21**		**550**	**550**	**1100**

Open Elective - Group I	
Course Code	**Course Title**
21CS651	Introduction to Operating Systems
21CS652	OOPS With C++
21CS653	Web Technologies
21CS654	Python Programming
21CS655	Introduction to Data Structures

Professional Elective - Group II	
Course Code	**Course Title**
21IS641	Cyber Security and Digital Forensics
21IS642	Data Analytics
21IS643	Distributed Database System
21IS644	Advanced Java Programming
21IS645	Computer Vision

VI Semester Syllabus

B.E INFORMATION SCIENCE AND ENGINEERING
Choice Based Credit System (CBCS)
SEMESTER - VI

PROJECT & FINANCE MANAGEMENT (2:0:0) 2
(Effective from the academic year 2023-24)

Course Code	**21HSS61**	CIE Marks	50
Teaching Hours/Week (L:T:P)	2:0:0	SEE Marks	50
Total Number of Contact Hours	25	Exam Hours	01

Course Objectives:

This course will enable students to:

1. Define the fundamentals of Project Management.
2. Identify the strategies involved in selection, prioritization, planning & scheduling of a project.
3. Understand the time value of money & apply it for decision making.
4. Analyse project risk, progress & results.
5. Make awareness about various sources of finance.
6. Gain Knowledge on working capital & capital budgeting.

Module – 1

Preamble: Project Management: Need for project management, management practices to meet the challenges of new economic environment, globalization process, rapid technological advancement, and quality concerns of the stakeholders.

Project Management: Definition of project, characteristics of projects, types of projects, project roles.

Project Selection & Prioritization: Strategic planning process, strategic objectives, identifying potential projects, feasibility study (environment, society), methods of selecting projects, prioritizing projects, securing and negotiating projects.

(5 Hours**)**

Module – 2

Project planning & scheduling: Project scope & check list, work break down structure, project schedule, uncertainty in project schedules.

Project resourcing & risk planning: Abilities needed when resourcing projects, estimate resource needs, cost planning & estimating, risk management planning, risk identification, risk analysis, project quality planning and project kick-off.

(5 Hours**)**

Module – 3
Project performing, progress & results: Project supply chain management, project balanced score card approach, terminate project early, finish project, customer feedback & approval. (5 Hours**)**
Module – 4
Financial Management: Evolution of financial management, key activities of finance manager, key decision areas in financial management, financial statement with balance sheet. Efficient utilization and generation of monetary resources and funds, a comparative study of finance and economics, Costs and revenue evaluation for various engineering operations. **Capital Budgeting**: Types of capital budgeting decisions, capital budgeting proposals, estimating cash flows for project appraisal, green capital budgeting. (5 Hou**rs)**
Module – 5
Working capital management: Factors affecting working capital requirement, operating cycle analysis, negative working capital, cash planning & managing cash flows. **Cost of capital and leverage Analysis**: Concept, significance, assumptions, factors affecting cost of capital, Leverage Analysis: operating leverage, financial leverage. **Recap:** All the 5 modules. (5 Hours)
Course outcomes: The students will be able to: CO1: Understand the selection, prioritization & initiation of individual projects. CO2: Understand WBS, scheduling, uncertainty & risks associated in project. CO3: Identify & Evaluate the progress and results of the project. CO4: Understand time value of money & use it for decision making. CO5: Outline capital requirements for starting a business & management of working capital.
Textbooks
1. Timothy J Kloppenborg, Project Management, Cengage Learning, 2nd Edition, 2009. 2. John J Hampton, Financial Management, PHI Publication, 4th edition.
References

1. Pennington Lawrence, Project Management, McGraw-Hill, 1st edition.
2. Joseph A Moder, Philips New Yark, Project Management with CPM & PRT, McGraw-Hill, 2nd edition, 1983.
3. Harold Kerzner, Project Management A system approach to Planning, Scheduling & Controlling, CBS Publication, 2nd Edition,2006.
4. S.D. Sharma, Operations Research, Kedar Nath Ramnath, Meerut, New Edition,2015.
5 M.Y. Khan, Financial Management, Tata Mc-Graw Hill, Fifth Edition,2007.
6 O.P. Khanna, Industrial Engineering & Management, Dhanpat Rai Publications, Second Edition, 1999.

B.E INFORMATION SCIENCE and ENGINEERING

Choice Based Credit System (CBCS)

SEMESTER VI

Bioinformatics (1:0:0) 1

(Effective from the academic year 2023-24)

Course Code	21AEC62	CIE Marks	50
Teaching Hours/Week (L:T:P)	1:0:0	SEE Marks	50
Total Number of Contact Hours	15	Exam. Hours	3

Course Objectives:

1. Better understanding of dynamic biological processes and their understanding at molecular level enabled through and correlated using internet and Bioinformatics.
2. To relate the basic knowledge in Genetics & Molecular Biology and see how it can be applied through Bioinformatics perspective.
3. To utilize bioinformatics tools and databases for retrieving, analyzing, understanding and managing biological data.

Module – 1

Preamble: Bioinformatics is an interdisciplinary field mainly involving molecular biology and genetics, computer science, mathematics, and statistics. Data intensive, large-scale biological problems are addressed from a computational point of view.

Biological Data Acquisition

The form of biological information. Retrieval methods for DNA sequence, protein sequence and protein structure information

(3 Hours)

Module – 2

DATABASES

Format and Annotation: Conventions for database indexing and specification of search terms, Common sequence file formats. Annotated sequence databases – primary sequence databases, protein sequence and structure databases, Organism specific databases.

(3 Hours)

Module – 3

DATA PROCESSING

Data – Access, Retrieval and Submission: Standard search engines; Data retrieval tools – Entrez, DBGET and SRS; Submission of (new and revised) data; Sequence Similarity Searches: Local versus global. Distance metrics. Similarity and homology. Scoring matrices.

(3 Hours)

Module – 4

METHODS OF ANALYSIS

Dynamic programming algorithms, Needleman-wunsch and Smith-waterman. Heuristic Methods of sequence alignment, FASTA, and PSI BLAST.

(3 Hours)

Module – 5

APPLICATIONS

Genome Annotation and Gene Prediction; ORF finding; Phylogenetic Analysis: Comparative genomics, orthologs, paralogs.

(3 Hours)

Course Outcomes: The students will be able to:

CO1: Apply the basic methodology in Bioinformatics to retrieve data.

CO2: Analyse bioinformatics tools and databases for understanding and managing biological data.

CO3: Examine the applications of bioinformatics in allied areas.

ASSESSMENT METHODS:

CIE Components (50 Marks)

Three Internal Assessments Tests (MCQ based) each of 40 Marks (duration 01 hour)

Two Assignment: 20 Marks

Two AATs: 20 Marks

Sum of the Assignment and AATs will be out of 40 Marks and scaled down to 20 Marks.

Sum of the three Internal Assessments Tests Marks will be out of 120 Marks and scaled down to 30 Marks.

Internal Assessments from Tests: 30 Marks

Assignment and AAT: 20 Marks

Total CIE Marks: 50 Marks

Semester-End Examination (50 Marks)

- SEE question paper will be set for 50 questions of each of 01 mark.
- The pattern of the question paper is MCQ.

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).
- The minimum passing mark for the SEE is 35% of the maximum marks (18 marks out of 50).

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.

Textbooks:

1. Introduction to Bioinformatics by Arthur K. Lesk , Oxford University Press.
2. Algorithms on Strings, Trees and Sequences by Dan Gusfield, Cambridge University Press.
3. Biological Sequence Analysis Probabilistic Models of proteins and nucleic acids by Durbin, S.Eddy, A.Krogh, G.Mitchison.
4. Bioinformatics Sequence and Genome Analysis by David W. Mount, Cold Spring Harbor Laboratory Press.
5. Beginning Perl for Bioinformatics: An introduction to Perl for Biologists by James Tindall, O"Reilley Media.

References:

1. Bioinformatics The Machine Learning Approach by Pierre Baldi and Soren Brunak.

B.E INFORMATION SCIENCE AND ENGINEERING

Choice Based Credit System (CBCS)

SEMESTER – VI

Green IT and Sustainability (1:0:0) 1

(Effective from the academic year 2023-24)

Course Code	**21CS63**	CIE Marks	**50**
Teaching Hours/Week (L:T:P)	1:0:0	SEE Marks	**50**
Total Hours of Pedagogy	14	Total Marks	**100**
Credits	01	Exam Hours	**1**
Examination type (SEE)	Theory		

Course Objectives:

- Understand challenges for Green ICT and the environmental impact.
- Learn different aspects of ICT metrics and Sustainable Cloud Computing.
- Explore effects of software design on the sustainability.

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 Case study Based Learning (CBL), which fosters students' analytical skills, develop thinking skills such as the ability to evaluate, generalize, and analyse information rather than simply recall it.
6. Discuss how every concept can be applied to the real world - and when that's possible, it helps improve the students' understanding.

Module – 1

Green ICT -History, Agenda, and Challenges Ahead: Introduction, Industrial Revolution, The Emergence of Information and Communication Technologies, The Agenda and Challenges Ahead.

Module – 2

Emerging Technologies and Their Environmental Impact: Introduction, Number of Connected Devices, Increased, Functionality, Increased Number of Separate Functions, Increased Demand for Speed and Reliability, Obsolescence—The Problem of Backward Compatibility, The Other Side of the Balance Sheet, Videoconference as an Alternative to Business Travel, Dematerialization of Product Chain, Travel Advice/Road Traffic Control, Intelligent Energy Metering, Building Management Systems, Saving IT.

Module – 3

Measurements and Sustainability: Introduction, ICT Technical Measures, Ecological Measures and Ethical Consideration, Systems Engineering for Designing Sustainable ICT-Based Architectures.

Module – 4

Sustainable Cloud Computing: Introduction, Challenges in the Use of Cloud Computing As Green Technology, Cloud Computing and Sustainability, Sustainable Applications of Cloud Computing, Technologies Associated With Sustainable Cloud Computing, Future Prospects of Sustainable Cloud Computing, Reflections on Sustainable Cloud Computing Applications.

Module – 5

Sustainable Software Design: Overview and Scope, Evaluating Sustainability Effects , Sustainability and the Product Life Cycle , Direct Effects: Sustainability During Use, Runtime Energy Consumption Basics , Analyzing the Energy Consumption of an Application , Energy Consumption Reduction Using Physical Properties of Semiconductors, Optimizing the Energy Consumption of an Application: Compiler Techniques, Optimizing the Energy Consumption of an Application: Runtime Approaches.

Course outcome (Course Skill Set)

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

1. Classify the challenges for Green ICT.
2. Relate the environmental impact due to emerging technologies.
3. Demonstrate different aspects of ICT metrics.
4. Compare the various parameters related to Sustainable Cloud Computing.
5. Interpret the effects of software design on the sustainability.

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. Green Information Technology – A Sustainable Approach, Mohammad Dastbaz Colin Pattinson, Babak Akhgar, Elsevier, 2015 Inc.
2. San Murugesan, G.R. Gangadharan, Harnessing Green IT: Principles and Practices, Wiley-IEEE Press

Web links and Video Lectures (e-Resources):
• https://www.youtube.com/watch?v=kvn_-mJ2tSo • https://www.youtube.com/watch?v=kxngsYn5N3Y • https://www.youtube.com/watch?v=EgdFi3sCgzU • https://www.brightest.io/sustainability-measurement • https://www.youtube.com/watch?v=S2m49Op25Zw
Activity Based Learning (Suggested Activities in Class)/ Practical Based learning Literature survey/review

B.E INFORMATION SCIENCE AND ENGINEERING

Choice Based Credit System (CBCS)

SEMESTER – VI

MACHINE LEARNING (3:0:0) 3

(Effective from the academic year 2023-24)

Course Code	**21IS67**	CIE Marks	**50**
Teaching Hours/Week (L:T:P)	3:0:0	SEE Marks	**50**
Total Number of Contact Hours	40	Exam Hours	**3**

Course Objectives:

1. To familiarize students with the fundamental concepts, theories and applications of Artificial Intelligence and Machine Learning.
2. To demonstrate the characteristics of Decision Trees, Neural Networks, Bayesian Techniques for solving real world problems.
3. Evaluate hypothesis and investigate Instance Based Learning and Reinforcement Learning.

(8 Hours)

Module – 1

What is artificial intelligence?, Problems, problem spaces and search,
Well posed learning problems, Designing a Learning system, Perspective and Issues in Machine Learning.

Textbook 1: Chapter 1, 2

Textbook 2: Chapter 1 (8 Hours)

Module – 2

Concept Learning: Concept learning task, Concept learning as search, Find-S algorithm,Candidate Elimination Algorithm, Inductive bias of Candidate Elimination Algorithm.

Texbook2: Chapter 2 (2.1-2.5, 2.7) (8 Hours)

Module – 3

Decision Tree Learning: Introduction, Decision tree representation, Appropriate problems, ID3 algorithm. Artificial Neural Network: Introduction, NN representation, Appropriate problems, Perceptrons, Multilayer Networks and Backpropagation algorithm.

Texbook2: Chapter 3 (3.1-3.4), Chapter 4 (4.1-4.5) (8 Hours)

Module – 4

Bayesian Learning: Introduction, Bayes theorem, Bayes theorem and concept learning, ML and LS error hypothesis, ML for predicting, MDL principle, Naive Bayes classifier, EM Algorithm.

Texbook2: Chapter 6(6.1-6.6,6.9,6.12). (8 Hours)

Module – 5

Instance-Base Learning: Introduction, k-Nearest Neighbor Learning, Locally weightedregression, Radial basis function. Reinforcement Learning: Introduction, The learning task, Q-Learning.

Textbook 1: Chapter 8 (8.1-8.4), Chapter 13 (13.1 – 13.3) (8 Hours)

Course Outcomes: The students will be able to:

CO1: Understand fundamentals of AI and ML techniques to address the learning problem.

CO2: Apply AI and ML strategies for decision-making.

CO3: Analyze various AI and ML approaches to address real-time problems.

CO4: Evaluate the performance of AI and ML algorithms on an appropriate dataset.

Textbooks:

1. Elaine Rich, Kevin K and S B Nair, **"Artificial Intelligence",** 3rd Edition, McGraw HillEducation, 2017.
2. Tom M Mitchell, **"Machine Lerning",**1st Edition, McGraw Hill Education, 2017.

References:

1. Saroj Kaushik, Artificial Intelligence, Cengage learning
2. Stuart Rusell, Peter Norving , Artificial Intelligence: A Modern Approach, Pearson Education 2nd Edition
3. AurÈlienGÈron,"Hands-On Machine Learning with Scikit-Learn and Tensor Flow: Concepts, Tools, and Techniques to Build Intelligent Systems", 1st Edition, Shroff/O'Reilly Media, 2017.
4. Trevor Hastie, Robert Tibshirani, Jerome Friedman, h The Elements of Statistical Learning, 2nd edition, springer series in statistics.
5. Ethem Alpaydın, Introduction to machine learning, second edition, MIT press
6. Srinvivasa K G and Shreedhar, " Artificial Intelligence and Machine Learning", Cengage.

B.E INFORMATION SCIENCE AND ENGINEERING

Choice Based Credit System (CBCS)

SEMESTER – VI

Cloud Computing (3:0:0) 3

(Effective from the academic year 2023-24)

Course Code	**21IS68**	CIE Marks	50
Teaching Hours/Week (L:T:P)	3:0:0	SEE Marks	50
Total Number of Contact Hours	40	Exam Hours	3

Course Objectives: This course will enable the students to:

1. Explain the technology and principals involved in building a cloud environment.
2. Contrast various programming models used in cloud computing.
3. Choose appropriate cloud model for a given application

Module – 1

Introduction ,Cloud Computing at a Glance, The Vision of Cloud Computing, Defining a Cloud, A Closer Look, Cloud Computing Reference Model, Characteristics and Benefits, Challenges Ahead, Historical Developments, Distributed Systems, Virtualization, Web 2.0, Service-Oriented Computing, Utility-Oriented Computing, Building Cloud Computing Environments, Application Development, Infrastructure and System Development, Computing Platforms and Technologies, Amazon Web Services (AWS), Google AppEngine,

Microsoft Azure, Hadoop, Force.com and Salesforce.com, Manjra soft Aneka

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.

(8 Hours)

Module – 2

Cloud Computing Architecture: Introduction, Cloud Reference Model, Architecture, Infrastructure / Hardware as a Service, Platform as a Service, Software as a Service, Types of Clouds, Public Clouds, Private Clouds, Hybrid Clouds, Community Clouds, Economics of the Cloud, Open Challenges, Cloud Definition, Cloud Interoperability and Standards Scalability and Fault Tolerance Security, Trust, and Privacy Organizational Aspects

Aneka: Cloud Application Platform, Framework Overview, Anatomy of the Aneka Container, From the Ground Up: Platform Abstraction Layer, Fabric Services, foundation Services, Application Services, Building Aneka Clouds, Infrastructure Organization, Logical Organization, Private Cloud Deployment Mode, Public Cloud Deployment Mode, Hybrid Cloud Deployment Mode, Cloud Programming and Management, Aneka SDK, Management Tools. (8 Hours)

Module – 3

Concurrent Computing: Thread Programming, Introducing Parallelism for Single Machine Computation, Programming Applications with Threads, What is a Thread?, Thread APIs, Techniques for Parallel Computation with Threads, Multithreading with Aneka, Introducing the Thread Programming Model, Aneka Thread vs. Common Threads, Programming Applications with Aneka Threads, Aneka Threads Application Model, Domain Decomposition: Matrix Multiplication, Functional Decomposition: Sine, Cosine, and Tangent.

High-Throughput Computing: Task Programming, Task Computing, Characterizing a Task, Computing Categories, Frameworks for Task Computing, Task-based Application Models, Embarrassingly Parallel Applications, Parameter Sweep Applications, MPI Applications, Workflow Applications with Task Dependencies, Aneka Task-Based Programming, Task Programming Model, Developing Applications with the Task Model, Developing Parameter Sweep Application, Managing Workflows. (8 Hours)

Module – 4

Data Intensive Computing: Map-Reduce Programming, What is Data-Intensive Computing?, Characterizing Data-Intensive Computations, Challenges Ahead, Historical Perspective, Technologies for Data-Intensive Computing, Storage Systems, Programming Platforms, Aneka MapReduce Programming, Introducing the MapReduce Programming Model, Example Application. (8 Hours)

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, Microsoft Azure, Azure Core Concepts, SQL Azure, Windows Azure Platform Appliance.

Cloud Applications Scientific Applications: Healthcare: ECG Analysis in the Cloud, , Social

Networking, Media Applications, Multiplayer Online Gaming. (8 Hours)
Course Outcomes: The students will be able to:
CO1: Understand the basic concepts and terminologies of cloud computing. CO2: Apply the concept of cloud computing to different real word examples. CO3: Analysis the cloud frameworks and technologies for different IT Industry. CO4: Design real word cloud applications. CO5: Study the framework of Aneka cloud for data intensive Application
Textbooks: 1. Rajkumar Buyya, Christian Vecchiola, and Thamarai Selvi Mastering Cloud. Computing McGraw Hill Education**.** ISBN (10 digits): 1-25-902995-6.
References:
1. Dan C. Marinescu, Cloud Computing Theory and Practice, Morgan Kaufmann, Elsevier 2013.

DEPARTMENT OF INFORMATION SCIENCE AND ENGINEERING
Choice Based Credit System (CBCS)
SEMESTER – VI

Mobile Applications Development Laboratory(0:0:2)
(Effective from the academic year 2023-24)

Course Code	**21IS69A**	CIE Marks	50
Teaching Hours/Week (L:T:P)	0:0:2	SEE Marks	50
Total Number of Contact Hours	26	Exam Hours	3

Course Objectives:

This course will enable students to:

1. Build an application using Android development environment
2. Experiment with the method of storing, sharing and retrieving the data in Android Applications
3. Analyze the responsive user interface across wide range of devices.
4. Create a mobile Application by using various components of android app development.

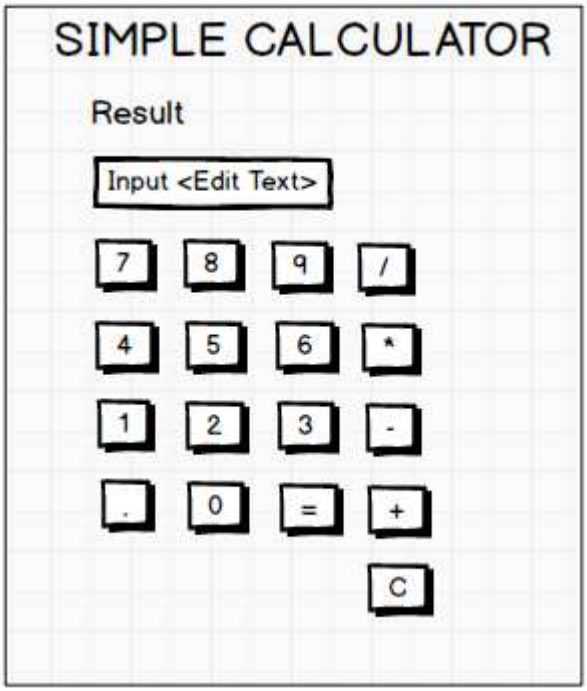
Laboratory Exercises:

1A. Installation of Android studio

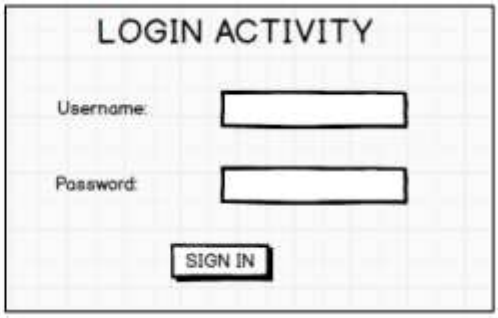
B. Development Of Hello World Application

2. Create an application to design a Visiting Card. The Visiting card should have a company logo at the top right corner. The company name should be displayed in Capital letters, aligned to the center. Information like the name of the employee, job title, phone number, address, email, fax and the website address is to be displayed. Insert a horizontal line between the job title and the phone number.

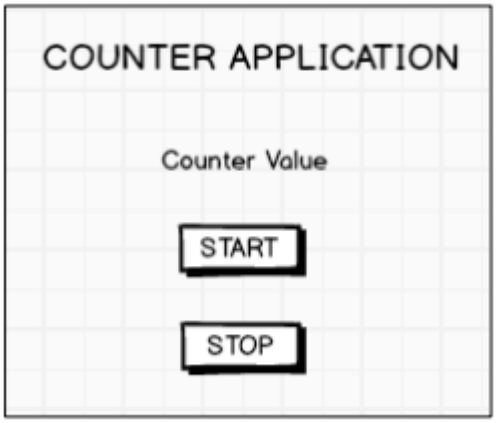
1. Develop an Android application using controls like Button, TextView, EditText for designing a Calculator having basic functionality like Addition, Subtraction, Multiplication, and Division.



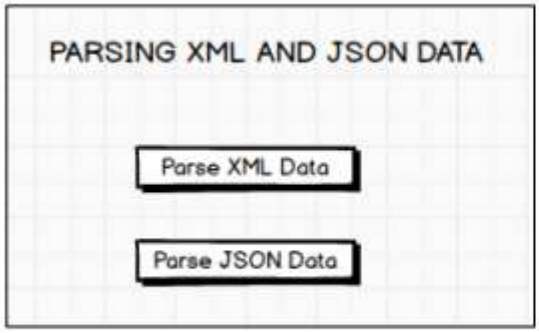
2. Create a SIGN Up activity with Username and Password. Validation of password should happen based on the following rules: • Password should contain uppercase and lowercase letters. • Password should contain letters and numbers. • Password should contain special characters. • Minimum length of the password (the default value is 8). On successful SIGN UP proceed to the next Login activity. Here the user should SIGN IN using the Username and Password created during signup activity. If the Username and Password are matched then navigate to the next activity which displays a message saying "Successful Login" or else display a toast message saying "Login Failed". The user is given only two attempts and after that display a toast message saying "Failed Login Attempts" and disable the SIGN IN button. Use Bundle to transfer information from one activity to another.

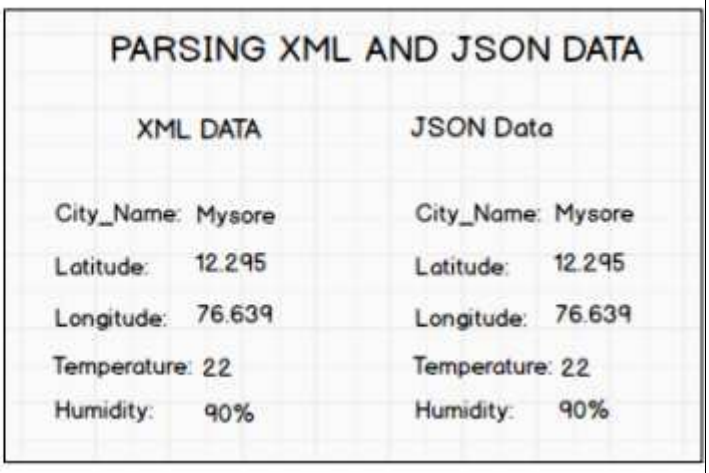


3. Write a program to create an activity with two buttons START and STOP. On Pressing of the START button, the activity must start the counter by displaying the numbers from One and the counter must keep on counting until the STOP button is pressed. Display the counter value in a TextView control.



4. Create two files of XML and JSON type with values for City_Name, Latitude, Longitude, Temperature, and Humidity. Develop an application to create an activity with two buttons to parse the XML and JSON files which when clicked should display the data in their respective layouts side by side.

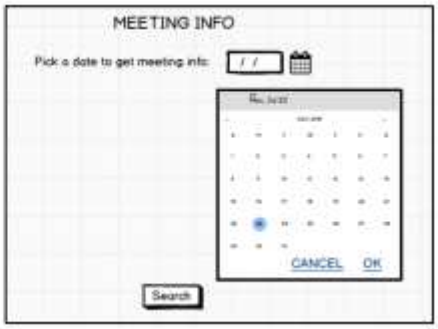




5. Create an activity like a phone dialer with CALL and SAVE buttons. On pressing the CALL button, it must call the phone number and on pressing the SAVE button it must save the number to the phone contacts.

6. Write a program to enter Medicine Name, Date and Time of the Day as input from the user and store it in the SQLite database. Input for Time of the Day should be either Morning or Afternoon or Evening or Night. Trigger an alarm based on the Date and Time of the Day and display the Medicine Name.

7. Develop a content provider application with an activity called “Meeting Schedule” which takes Date, Time and Meeting Agenda as input from the user and store this information into the SQLite database. Create another application with an activity called “Meeting Info” having DatePicker control, which on the selection of a date should display the Meeting Agenda information for that particular date, else it should display a toast message saying “No Meeting on this Date”.



Part B

Mini project

Course Outcomes:

The students will be able to:

CO1: Build an application using Android development environment

CO2: Experiment with the method of storing, sharing and retrieving the data in Android Applications

CO3: Analyze the responsive user interface across wide range of devices.

CO4: Create a mobile Application by using various components of android app development.

Textbooks:

1.Reto Meier, Professional Android 4 Application Development, Wrox Publication,2012,
2.Google Developer Training, "Android Developer Fundamentals Course – Concept Reference", Google Developer Training Team, 2017. https://www.gitbook.com/book/google-developer-training/android-developerfundamentals-course-concepts/details (Download pdf file from the above link)
3.Baijian Yang, Pei Zheng, Lionel M. Ni, Professional Microsoft Smartphone Programming, Wrox Publication,2007.

References:

1.Shane Conder, Lauren Darcey, Android Wireless Application Development,3rd Edition, Addison Wesley,2009.
2.Zigurd Mednieks, Laird Dornin, G. Blake Meike, Masumi Nakamura, Programming Android,2nd Edition ,O'Reilly Publication ,2012.
3.Satya Komatineni , Dave MacLean , Sayed Hashimi, Pro Android 3, Apress publication, 2011.
4.Erik Hellman, "Android Programming – Pushing the Limits", 1st Edition, Wiley India Pvt Ltd, 2014.
5.Dawn Griffiths and David Griffiths, "Head First Android Development", 1st Edition, O'Reilly SPD Publishers, 2015.
6.J F DiMarzio, "Beginning Android Programming with Android Studio", 4th Edition, Wiley India Pvt Ltd, 2016. ISBN-13: 978-8126565580.
7.Anubhav Pradhan, Anil V Deshpande, " Composing Mobile Apps" using Android, Wiley 2014, ISBN: 978-81-265-4660-2

DEPARTMENT OF INFORMATION SCIENCE AND ENGINEERING

Choice Based Credit System (CBCS)

SEMESTER – VI

Cloud Computing Laboratory (0:0:2) 1

(Effective from the academic year 2023-2024)

Course Code	**21IS69B**	CIE Marks	50
Teaching Hours/Week (L:T:P)	0:0:2	SEE Marks	50
Total Number of Contact Hours	26	Exam Hours	3

Course Objectives:

This laboratory course enable students to get practical experience in design, develop, implement, analyze and evaluation/testing of

1. To develop web applications in cloud
2. To learn the design and development process involved in creating a cloud based application
3. To learn to implement and use parallel programming using Hadoop.

Lab Experiments: Part-A

Implement all the programs in 'C / Python Programming Language using Linux OS

Preamble: This course is intended to teach the basics involved cloud computing ie. Virtualization concepts. This includes the fundamentals of how the use virtual machines, cloudsim, trystack on linux based machines.

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

Mini Project: Part -B

1. Find a procedure to launch virtual machine using trystack (Online Open stack Demo Version)
2. Install Hadoop single node cluster and run simple applications like word count

Course Outcomes: The students will be able to:

CO1: Configure various virtualization tools such as Virtual Box, VMware workstation.

CO2: Design and deploy a web application in a PaaS environment.

CO3: Learn how to simulate a cloud environment to implement new schedulers. CO4: Install and use a generic cloud environment that can be used as a private cloud CO5: Manipulate large data sets in a parallel environment
Lab Exam Pattern 1. All laboratory experiments from part A are to be included for practical Examination. 2. Students are allowed to pick one experiment from the lot. 3. Strictly follow the instructions as printed on the cover page of answer script. 4. Marks distribution: a) Part A: Procedure + Conduction + Viva: **09 + 42 +09 =60 Marks** b) Part B: Demonstration + Report + Viva voce: **20+14+06 = 40 Marks** **Change of experiment is allowed only once and marks allotted to the procedure part to be made zero**.

B.E INFORMATION SCIENCE AND ENGINEERING Choice Based Credit System (CBCS) **SEMESTER – VI**			
Machine Learning Laboratory (0:0:2) 1 (Effective from the academic year 2023-24)			
Course Code	**21IS69C**	CIE Marks	**50**
Teaching Hours/Week (L:T:P)	0:0:2	SEE Marks	**50**
Total Number of Contact Hours	40	Exam Hours	**3 H**

Course Objectives:

1. Make use of Data sets in implementing the machine learning algorithms
2. Implement the machine learning concepts and algorithms in any suitable language of choice

Experiments

1. Implement A* Search algorithm.

2. Implement AO* Search algorithm.

3. For a given set of training data examples stored in a .CSV file, implement and demonstrate the Candidate-Elimination algorithmto output a description of the set of all hypotheses consistent with the training examples.

4. Write a program to demonstrate the working of the decision tree based ID3 algorithm. Use an appropriate data set for building the decision tree and apply this knowledge toclassify a

new sample.

5. Build an Artificial Neural Network by implementing the Backpropagation algorithm and test the same using appropriate data sets.

6. Write a program to implement the naïve Bayesian classifier for a sample training data set stored as a .CSV file. Compute the accuracy of the classifier, considering few test data sets.

7. Apply EM algorithm to cluster a set of data stored in a .CSV file. Use the same data set for clustering using k-Means algorithm. Compare the results of these two algorithms and comment on the quality of clustering. You can add Java/Python ML library classes/API in the program.

8. Write a program to implement k-Nearest Neighbour algorithm to classify the iris data set. Print both correct and wrong predictions. Java/Python ML library classes can be used for this problem.

9. Implement the non-parametric Locally Weighted Regression algorithm in order to fit data points. Select appropriate data set for your experiment and draw graphs

Course Outcomes: The students will be able to:

Co1: Apply various pre-processing techniques on different datasets.

CO2 Construct Machine learning programs for Supervised, Unsupervised and Semi supervised learning models.

CO3 Develop Deep learning programs for Supervised & Unsupervised learning models.

CO4 Identify and Apply Artificial Intelligence concepts to solve real world problems.

Question paper pattern:

- **SEE** will be conducted for 100 marks.
- **Part A:** First question with 20 MCQs carrying 1 mark each.
- **Part B:** Each full question is for 16 marks. (Answer five full questions out of 10 questions with intra modular choice). In every question, there will be a maximum of three sub-questions.
- **CIE** will be announced prior to the commencement of the course.
- 25 marks for test. Average of three tests will be taken.
- 25 marks for Alternate Assessment Method.

Textbooks:

1. S. Russell and P. Norvig, Artificial Intelligence: A Modern Approach, Prentice Hall, 3rd Edition, 2009

2. Bratko, I., Prolog Programming for Artificial Intelligence (International Computer Science Series), Addison-Wesley Educational Publishers Inc; 4th edition, 2011.

References:

1. David L. Poole, Alan K. Mackworth, Artificial Intelligence: Foundations of Computational Agents, Cambridge University Press, 2010.

2. Ethem Alpaydin, Introduction to Machine Learning (Adaptive Computation and Machine Learning series), The MIT Press; second edition, 2009

B.E INFORMATION SCIENCE AND ENGINEERING
Choice Based Credit System (CBCS)
SEMESTER – VI

Cyber Security and Digital Forensics (3:0:0) 3
(Effective from the academic year 2023 -2024)

Course Code	**21IS641**	CIE Marks	**50**
Teaching Hours/Week (L:T:P)	**3:0:0**	SEE Marks	**50**
Total Number of Contact Hours	**40**	Exam Hours	**03**

Course Objectives:

This course will enable the students to:

1. Build awareness on cyber security and its evolution.
2. Analyze investigations and forensics applied on social media and mobile devices.
3. Study and apply tools for digital forensics.

Module – 1

Introduction: Significance and Scope of the course, Importance of the security on protecting the national data and information assets for building secured nation, Impact of the course on Societal and Ethical Problems/ Sustainable Solutions/ National Economy, Career Perspective, Innovations (Current), Research status/trends.
Introduction to Cyber Security.
Importance of Cyber Security: History of data breaches, Scenario for security, Understanding the attack surface, Threat Landscape, Importance of the securing network and applications, History of breaches, how security helps to build trust.

[T1: Ch 1] (08 Hours)

Module – 2

Security Evolution: Legacy security systems, Transformation in cyber security, Advancements in Securing technologies, Cognitive Security (AL&ML in Cyber Security),
Learning Cyber security technologies: Mobile Security, Advanced Data security, Cloud Security, Modern Day regulations, Incident response and forensics, Enterprise security at scale, Penetration testing, DevSecOps, IoT Security, User behavior analysis (UBA), End-Point Detection and response (EDR).

[T1: Ch2, Ch3] (08 Hours)

Module – 3

Data Acquisition: Understanding Storage Formats for Digital Evidence, Determining the Best Acquisition Method, Contingency Planning for Image Acquisitions, Contingency Planning for Image Acquisitions, Using Acquisition Tool, Validating Data Acquisitions, Performing RAID Data Acquisitions, Using Remote Network Acquisition Tools, Using Other Forensics Acquisition Tools.
Digital Forensics Analysis and Validation: Determining What Data to Collect and Analyze, Validating Forensic Data, Addressing Data-Hiding Techniques.

[T2: Ch3, Ch9] (08 Hours)

Module – 4

Current Digital Forensics Tools: Evaluating Digital Forensics Tool Needs, Digital Forensics Software Tools, Digital Forensics Hardware Tools, Validating and Testing Forensics Software.
Virtual Machine Forensics, Live Acquisitions, and Network Forensics: An Overview of Virtual Machine Forensics, Performing Live Acquisitions, Network Forensics Overview.

(08 Hours)

[T2: Ch6, Ch10]

Module – 5

E-mail and Social Media Investigations: Exploring the Role of E-mail in Investigations, Exploring the Roles of the Client and Server in E-mail, Investigating E-mail Crimes and Violations, Understanding E-mail Servers, Using Specialized E-mail Forensics Tools, Applying Digital Forensics Methods to Social Media Communications

Mobile Device Forensics and the Internet of Anything: Understanding Mobile Device Forensics, Understanding Acquisition Procedures for Mobile Devices, Understanding Forensics in the Internet of Anything

[T2: Ch11, Ch12]

Summary: The student will be able to explore the importance and evolution of various security techniques, testing methods, importance of security in mundane activities with inclusive focus on digital forensics in corporate and government enterprises.

(08 Hours)

Course Outcomes:

The students will be able to:

1. Summarize the use of security technologies and policies to protect computers and digital information.
2. Apply techniques to solve cyber security threats and risks and mitigate problems of individual or nation.
3. Analyze different domain specific tools of digital forensics.
4. Compare the tools for solving real time problems in current industrial context.

Text Books

1. Dr. Erdal Ozkaya, Cybersecurity: The Beginner's Guide: A comprehensive guide to getting started in cybersecurity, Packt, 2019.
2. Bill Nelson, Amelia Phillips, Christopher Steuart, Guide to Computer Forensics and Investigations, Cengage Learning, 4th Edition, 2010.

References

1. Marjie T. Britz, Computer Forensics and Cyber Crime: An Introduction, Pearson, 3rd Edition, 2004.
2. Cory Altheide and Harlan Carvey, Digital Forensics with Open-Source Tools, Elsevier publication, 2011, ISBN: 978-1-59749- 586-8

DEPARTMENT OF INFORMATION SCIENCE AND ENGINEERING

Choice Based Credit System (CBCS)

SEMESTER – VI

Data Analytics (3:0:0) 3

(Effective from the academic year 2023-24)

Subject Code	**21IS642**	CIE Marks	50
Teaching Hours/Week (L:T:P)	3:0:0	SEE Marks	50
Total Number of Contact Hours	40	Exam Hours	3

Course Objectives:

This course will enable the students to:

1. Understand fundamentals of Big Data analytics
2. Explore the Hadoop framework and Hadoop Distributed File system
3. Illustrate the concepts of NoSQL using MongoDB and Cassandra for Big Data
4. Employ MapReduce programming model to process the big data
5. Understand various machine learning algorithms for Big Data Analytics, Web Mining and Social Network Analysis.

Module – 1

Introduction to Big Data Analytics: Big Data, Scalability and Parallel Processing, Designing Data Architecture, Data Sources, Quality, Pre-Processing and Storing, Data Storage and Analysis, Big Data Analytics Applications and Case Studies.

Text book 1: Chapter 1: 1.2 -1.7

RBT: L1, L2, L3

(8 Hours)

Module – 2

Introduction to Hadoop (T1): Introduction, Hadoop and its Ecosystem, Hadoop Distributed

File System, MapReduce Framework and Programming Model, Hadoop Yarn, Hadoop Ecosystem Tools.

Hadoop Distributed File System Basics (T2): HDFS Design Features, Components, HDFS User Commands.

Essential Hadoop Tools (T2): Using Apache Pig, Hive, Sqoop, Flume, Oozie, HBase.

Text book 1: Chapter 2 :2.1-2.6

Text Book 2: Chapter 3

Text Book 2: Chapter 7 (except walk throughs)

Module – 3

NoSQL Big Data Management, MongoDB and Cassandra: Introduction, NoSQL Data Store, NoSQL Data Architecture Patterns, NoSQL to Manage Big Data, Shared-Nothing Architecture for Big Data Tasks, MongoDB, Databases, Cassandra Databases.

Text book 1: Chapter 3: 3.1-3.7
RBT: L1, L2, L3 (8 Hours)

Module – 4

MapReduce, Hive and Pig: Introduction, MapReduce Map Tasks, Reduce Tasks and MapReduce Execution, Composing MapReduce for Calculations and Algorithms, Hive, HiveQL, Pig.

Text book 1: Chapter 4: 4.1-4.6

RBT: L1, L2, L3 (8 Hours)

Module – 5

Machine Learning Algorithms for Big Data Analytics: Introduction, Estimating therelationships, Outliers, Variances, Probability Distributions, and Correlations, Regression analysis, Finding Similar Items, Similarity of Sets and Collaborative Filtering, Frequent Item sets and Association Rule Mining.
Text, Web Content, Link, and Social Network Analytics: Introduction, Text mining, Web Mining, Web Content and Web Usage Analytics, Page Rank, Structure of Web and analyzing a Web Graph, Social Network as Graphs and Social Network Analytics:
Text book 1: Chapter 6: 6.1 to 6.5
Text book 1: Chapter 9: 9.1 to 9.5

(8 Hours)

Course outcomes:
The students will be able to:
Understand fundamentals of Big Data analytics.
1. Investigate Hadoop framework and Hadoop Distributed File system.
2. Illustrate the concepts of NoSQL using MongoDB and Cassandra for Big Data.
3. Demonstrate the MapReduce programming model to process the big data along with Hadoop tools.
4. Use Machine Learning algorithms for real world big data.
5. Analyze web contents and Social Networks to provide analytics with relevant visualization tools

Text Books:

1. Raj Kamal and Preeti Saxena, “Big Data Analytics Introduction to Hadoop, Spark, and Machine-Learning”, McGraw Hill Education, 2018 ISBN: 9789353164966, 9353164966
2. Douglas Eadline, "Hadoop 2 Quick-Start Guide: Learn the Essentials of Big Data Computing in the Apache Hadoop 2 Ecosystem", 1stEdition, Pearson Education, 2016. ISBN13: 978-9332570351

References:

1. Tom White, “Hadoop: The Definitive Guide”, 4th Edition, O‟Reilly Media, 2015.ISBN-13: 978-9352130672
2. Boris Lublinsky, Kevin T Smith, Alexey Yakubovich, "Professional Hadoop Solutions", 1stEdition, Wrox Press, 2014ISBN-13: 978-8126551071
3. Eric Sammer, "Hadoop Operations: A Guide for Developers and Administrators",1 stEdition, O'Reilly Media, 2012.ISBN-13: 978-9350239261
4. Arshdeep Bahga, Vijay Madisetti, "Big Data Analytics: A Hands-On Approach", 1st Edition, VPT Publications, 2018. ISBN-13: 978-0996025577

B.E INFORMATION SCIENCE AND ENGINEERING

Choice Based Credit System (CBCS)

SEMESTER – VI

Distributed Database Systems (3:0:0) 3

(Effective from the academic year 2023-24)

Course Code	**21IS643**	**CIE Marks**	50
Number of Contact Hours/Week	3:0:0	**SEE Marks**	50
Total Number of Contact Hours	40	**Exam Hours**	03

Course Learning Objectives: This course (18CS823) will enable students to:

- Define, compare and use the four types of NoSQL Databases (Document-oriented, KeyValue Pairs, Column-oriented and Graph).
- Demonstrate an understanding of the detailed architecture, define objects, load data, query data and performance tune Column-oriented NoSQL databases.
- Explain the detailed architecture, define objects, load data, query data and performance tune Document-oriented NoSQL databases.

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 RBT: L1, L2, L3 (8 Hours)

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 RBT: L1, L2, L3 (8 Hours)

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 RBT: L1, L2, L3 (8 Hours)

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 (8 Hours)

Textbook1: Chapter 9 RBT: L1, L2, L3

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 RBT: L1, L2, L3 (8 Hours)

Course Outcomes: The student will be able to :

- Define, compare and use the four types of NoSQL Databases (Document-oriented, KeyValue Pairs, Column-oriented and Graph).
- Demonstrate an understanding of the detailed architecture, define objects, load data, query data and performance tune Column-oriented NoSQL databases.
- Explain the detailed architecture, define objects, load data, query data and performance tune Document-oriented NoSQL databases.

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)

B.E INFORMATION SCIENCE AND ENGINEERING

Choice Based Credit System (CBCS)

SEMESTER – VI

Advanced Java Programming (21IS644) (3:0.0) 3

(Effective from the academic year 2023-24)

Course Code	**21IS644**	CIE Marks	50
Teaching Hours/Week (L:T:P)	3:0:0	SEE Marks	50
Total Number of Contact Hours	40	Exam Hours	3

Course Objectives:

1. Identify the need for advanced Java concepts like Enumerations and Collections
2. Construct client-server applications using Java socket API
3. Make use of JDBC to access database through Java Programs
4. Adapt servlets to build server side programs
5. Demonstrate the use of JavaBeans to develop component-based Java software

Module – 1 **8- Hours**

Enumerations, Autoboxing and Annotations(metadata): Enumerations, Enumeration fundamentals, the values() and valueOf() Methods, java enumerations are class types, enumerations Inherits Enum, example, type wrappers, Autoboxing, Autoboxing and Methods, Autoboxing/Unboxing occurs in Expressions, Autoboxing/Unboxing, Boolean and character values, Autoboxing/Unboxing helps prevent errors, A word of Warning. Annotations, Annotation basics, specifying retention policy, Obtaining Annotations at run time by use of reflection, Annotated element Interface, Using Default values, Marker Annotations, Single Member annotations, Built-In annotations.

Module – 2 **8- Hours**

The collections and Framework: Collections Overview, Recent Changes to Collections, The Collection Interfaces, The Collection Classes, Accessing a collection Via an Iterator, Storing User Defined Classes in Collections, The Random Access Interface, Working With Maps, Comparators, The Collection Algorithms, Why Generic Collections?, The legacy Classes and Interfaces, Parting Thoughts on Collections.

Module – 3 **8- Hours**

String Handling : The String Constructors, String Length, Special String Operations, String Literals, String Concatenation, String Concatenation with Other Data Types, String Conversion and toString( ) Character Extraction, charAt( ), getChars( ), getBytes( ) toCharArray(), String Comparison, equals( ) and equalsIgnoreCase( ), regionMatches( ) startsWith( ) and endsWith( ), equals( ) Versus == , compareTo( ) Searching Strings, Modifying a String, substring( ), concat( ), replace( ), trim( ), Data Conversion Using valueOf( ), Changing the Case of Characters Within a String, Additional String Methods, StringBuffer , StringBuffer Constructors, length( ) and capacity( ), ensureCapacity( ), setLength( ), charAt( ) and setCharAt( ), getChars( ),append( ), insert( ), reverse( ), delete( ) and deleteCharAt( ), replace( ), substring( ), Additional StringBuffer Methods, StringBuilder.

Module – 4 **8- Hours**

Servlet : Background; The Life Cycle of a Servlet; Using Tomcat for Servlet Development; A simple

Servlet; The Servlet API; The Javax.servlet Package; Reading Servlet Parameter; The 08 Javax.servlet.http package; Handling HTTP Requests and Responses; Using Cookies; Session Tracking. Java Server Pages (JSP): JSP, JSP Tags, Tomcat, Request String, User Sessions, Cookies, Session Objects.

Module – 5 **8- Hours**

JDBC : The Concept of JDBC; JDBC Driver Types; JDBC Packages; A Brief Overview of the JDBC process; Database Connection; Associating the JDBC/ODBC Bridge with the Database; Statement Objects; ResultSet; Transaction Processing; Metadata, Data types; Exceptions.

Course Outcomes(CO): The students will be able to:

1. Interpret the need for advanced Java concepts for developing modular and efficient programs
2. Build client-server applications and TCP/IP socket programs
3. Illustrate database access and details for managing information using the JDBC API
4. Describe how servlets fit into Java-based web application architecture
5. Develop reusable software components using Java Beans

Textbooks:

1. Herbert Schildt: JAVA the Complete Reference, 12th Edition, Tata McGraw Hill, 2021
2. Jim Keogh: J2EE-TheCompleteReference, McGraw Hill, 2007.

References:

1. Giulio Zambon : Beginning JSP, JSF and Tomcat: Java Web Development, Publisher(s): Apress, 2012
2. M.T. Savaliya : Advanced Java, Revised ed Kindle Edition,

B.E INFORMATION SCIENCE AND ENGINEERING

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SEMESTER – VI

Computer Vision (3:0:0) 3

(Effective from the academic year 2023-24)

Course Code	**21IS645**	CIE Marks	50
Teaching Hours/Week (L:T:P)	3:0:0	SEE Marks	50
Total Number of Contact Hours	40	Exam Hours	3

Course Objectives:

1. To learn and understand the fundamentals of digital Computer vision,
2. To learn various image Transforms, Image Enhancement Techniques.
3. To learn Image restoration Techniques and methods
4. To learn image Segmentation used in digital Computer vision.
5. To learn image Compression in digital Computer vision.

Module – 1

Introduction

Fundamental Steps in Digital Image Processing, Components of an Image Processing System, Sampling and Quantization, Representing Digital Images (Data structure), Some Basic Relationships Between Pixels- Neighbors and Connectivity of pixels in image, Applications of Image Processing: Medical imaging, Robot, Character recognition, Remote Sensing.

(8 Hours)

Module – 2

Image Enhancement In The Spatial Domain:

Some Basic Gray Level Transformations, Histogram Processing, Enhancement Using Arithmetic/Logic Operations, Basics of Spatial Filtering, Smoothing Spatial Filters, Combining Spatial Enhancement Methods. (8 Hours)

Module – 3

Image Enhancement In Frequency Domain:

Introduction, Fourier Transform, Discrete Fourier Transform (DFT), properties of DFT, Image filtering in frequency domain. (8 Hours)

Module – 4

Image Segmentation:

Introduction, Detection of isolated points, line detection, Edge detection, Edge linking, Region based segmentation- Region growing, split and merge technique, regional processing, Hough transform, Segmentation using Threshold. (8 Hours)

Module – 5

Image Compression:

Introduction, coding Redundancy , Inter-pixel redundancy, image compression model, Lossy and Lossless compression, Huffman Coding, Arithmetic Coding, LZW coding, Transform

Coding, Sub-image size selection, blocking, DCT implementation using FFT, Run length coding. (8 Hours)

Course Outcomes: The students will be able to:

CO1: Describe the fundamentals of digital Computer vision

CO2: Understand image formation and the role human Visual system plays in perception of gray and color image data.

CO3: Apply Computer vision techniques in both the spatial and frequency (Fourier) domain

CO4: Design and evaluate image analysis techniques

CO5: Conduct independent study and analysis of Image Enhancement and restoration techniques.

Textbooks:

1.Rafael C G., Woods R E. and Eddins S L, Digital Image Processing, Prentice Hall, 3rd edition, 2008.

References:

1. Milan Sonka,"Image Processing, analysis and Machine Vision", Thomson Press India Ltd, Fourth Edition.

2. Fundamentals of Digital Image Processing- Anil K. Jain, 2nd Edition, Prentice Hall of India.

3. S. Sridhar, Digital Image Processing, Oxford University Press, 2nd Ed, 2016.

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SEMESTER – VI

Introduction to Operating Systems (3:0:0) 3
(Effective from the academic year 2023-24)

Subject Code	21CS651	CIE Marks	50
Teaching Hours/Week (L:T:P)	3:0:0	SEE Marks	50
Total Number of Contact Hours	40	Exam Hours	3

Course Objectives:
This course will enable students to:

- Explain the fundamentals of operating system
- Comprehend multithreaded programming, process management, memory management and storage management.
- Familiar with various types of operating systems

Module – 1

Introduction: What OS do, Computer system organization, architecture, structure, Operations, Process, memory and storage management, Protection and security, Distributed systems, Special purpose systems, computing environments. System Structure: OS Services, User - Operating System interface, System calls, Types of system calls, System programs, OS design and implementation, OS structure, Virtual machines, OS generation, system boot. **Chapter 1,2**

(8 Hours)

Module – 2

Process Concept: Overview, Process scheduling, Operations on process, IPC, Examples in IPC, Communication in client-server systems. Multithreaded Programming: Overview, Models, Issues, Process Scheduling: Basic concept, Scheduling criteria, Algorithm, Algorithm Evaluation.

Chapter 3,4,5 (8 Hours)

Module – 3

Synchronization: Background, the critical section problem, Petersons solution, Synchronization hardware, Semaphores, Classic problems of synchronization, Deadlocks: System model, Deadlock characterization, Method of handling deadlock, Deadlock prevention, Avoidance, Detection, Recovery from deadlock **Chapter 6**

(8 Hours)

Module – 4

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. **Chapter 7,8**

(8 Hours)

Module – 5

File system: File concept, Access methods, Directory structure, File system mounting, File sharing, protection, Mass Storage Management: Disk Structure, Disk scheduling algorithms. **Chapter 9,11**

(8 Hours)

Course outcomes: The students will be able to CO1: Demonstrate the need of OS and different types of OS CO2: Apply suitable techniques for management of different resources. CO3: Realize the different concepts of OS in the platform of usage.	
Textbooks:	
1.	Silberschatz, P B Galvin, G Gagne, Operating systems, 9th edition, John Wiley and sons,.
Reference Book:	
1.	William Stalling, "Operating Systems: Internals and Design Principles", Pearson Education, 1st Edition, 2018.
2.	Andrew S Tanenbaum, Herbert BOS, "Modern Operating Systems", Pearson Education, 4th Edition, 2016

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SEMESTER – VI

OOPS with C++ (3:0:0) 3
(Effective from the academic year 2023-24)

Course Code	21CS652	CIE Marks	50
Teaching Hours/Week (L:T:P)	3:0:0	SEE Marks	50
Total Number of Contact Hours	40	Exam Hours	3 Hours

Course Learning Objectives: This course will enable students to:

- Understanding about object oriented programming and Gain knowledge about the capability to store information together in an object.
- Understand the capability of a class to rely upon another class and functions.
- Understand about constructors which are special type of functions.
- Create and process data in files using file I/O functions
- Use the generic programming features of C++ including Exception handling

Module – I

Introduction to Object Oriented Programming: Computer programming background- C++ overview. First C++ Program -Basic C++ syntax, Object Oriented Programming: What is an object, Classes, methods and messages, abstraction and encapsulation, inheritance, abstract classes, polymorphism.
Textbook 1: Chapter 1(1.1 to 1.8)

8 Hours

Module – II

Functions in C++: Tokens – Keywords – Identifiers and constants – Operators in C++ – Scope resolution operator – Expressions and their types – Special assignment expressions – Function prototyping – Call by reference – Return by reference – Inline functions -Default arguments – Function overloading.
Textbook 2: Chapter 3(3.2,3.3,3.4,3.13,3.14,3.19, 3.20) , chapter 4(4.3,4.4,4.5,4.6,4.7,4.9)

8 Hours

Module – III

Inheritance & Polymorphism: Derived class Constructors, destructors-Types of InheritanceDefining Derived classes, Single Inheritance, Multiple, Hierarchical Inheritance, Hybrid Inheritance.
Textbook 2: Chapter 6 (6.2,6.11) chapter 8 (8.1 to,8.8)

8 Hours

Module – IV

I/O Streams: C++ Class Hierarchy- File Stream-Text File Handling- Binary File Handling during file operations.
Textbook 1: Chapter 12(12.5) , Chapter 13 (13.6,13.7) 8 Hours

Module – V	
Course outcomes: After studying this course, students will be able to: CO1: Illustrate the basic concepts of object-oriented programming. CO2: Design appropriate classes for the given real world scenario. CO3: Apply the knowledge of compile-time / run-time polymorphism to solve the given problem CO4: Use the knowledge of inheritance for developing optimized solutions	
Text books	
1.	Bhushan Trivedi, "Programming with ANSI C++", Oxford Press, Second Edition, 2012.
2	Balagurusamy E, Object Oriented Programming with C++, Tata McGraw Hill Education Pvt.Ltd , Fourth Edition 2010.
Weblinks and Video Lectures (e-Resources)	
1.	Basics of C++ - https://www.youtube.com/watch?v=BClS40yzssA
2	Functions of C++ - https://www.youtube.com/watch?v=p8ehAjZWjPw
Tutorial Link:	
1	https://www.w3schools.com/cpp/cpp_intro.asp
2	https://www.edx.org/course/introduction-to-c-3

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SEMESTER – VI

WEB TECHNOLOGIES (3:0:0) 3
(Effective from the academic year 2023-24)

Course Code	21CS653	CIE Marks	50
Teaching Hours/Week (L:T:P)	3:0:0	SEE Marks	50
Total Number of Contact Hours	40	Exam Hours	3 Hours

Course Learning Objectives: This course will enable students to:

1. Illustrate the Semantic Structure of HTML and CSS
2. Compose forms and tables using HTML and CSS
3. Design Client-Side programs using JavaScript and Server-Side programs using PHP
4. Infer Object Oriented Programming capabilities of PHP
5. Examine JavaScript frameworks such as jQuery and Backbone

Module – I

Introduction to HTML, What is HTML and Where did it come from?, HTML Syntax, Semantic Markup, Structure of HTML Documents, Quick Tour of HTML Elements, HTML5 Semantic Structure Elements, Introduction to CSS, What is CSS, CSS Syntax, Location of Styles, Selectors, The Cascade: How Styles Interact, The Box Model, CSS Text Styling.
Textbook 1: Ch. 2, 3

(8 hours)

Module – II

HTML Tables and Forms, Introducing Tables, Styling Tables, Introducing Forms, Form Control Elements, Advanced CSS: Layout, Normal Flow, Positioning Elements, Floating Elements, Constructing Multicolumn Layouts, Approaches to CSS Layout, Responsive Design, CSS Frameworks.
Textbook 1: Ch. 4,5

(8 hours)

Module – III

JavaScript: Client-Side Scripting, What is JavaScript and What can it do?, JavaScript Design Principles, Where does JavaScript Go?, Syntax, JavaScript Objects, The Document Object Model (DOM), JavaScript Events, Forms, Introduction to Server-Side Development with PHP, What is Server-side Development, A web server's Responsibilities, Quick tour of PHP, Program Control, Functions.
Textbook 1: Ch. 6, 8

(8 hours)

Module – IV

PHP Arrays and Superglobals, Arrays, $_GET and $_POST Superglobal Arrays, $_SERVER Array, $_Files Array, Reading/Writing Files, PHP Classes and Objects, Object-Oriented Overview, Classes and Objects in PHP, Object Oriented Design, Error Handling and Validation, What are Errors and Exceptions?, PHP Error Reporting.
Textbook 1: Ch. 9, 10

(8 hours)

Module – V
Managing State, The Problem of State in Web Applications, Passing Information via Query Strings, Passing Information via the URL Path, Cookies, Serialization, Session State, HTML5 Web Storage, Caching, Advanced JavaScript and jQuery, JavaScript Pseudo-Classes. **Textbook 1: Ch. 13, 15,17** **(8 hours)**
Course outcomes: After studying this course, students will be able to: CO1: Adapt HTML and CSS syntax and semantics to build web pages. CO2: Construct and visually format tables and forms using HTML and CSS. CO3: Develop Client-Side Scripts using JavaScript and Server-Side Scripts using PHP to generate and display the contents dynamically. CO4: Appraise the principles of object oriented development using PHP. CO5:Inspect JavaScript frameworks like jQuery and Backbone which facilitates developer to focus on core features.

Text books	
1.	Randy Connolly, Ricardo Hoar, "Fundamentals of Wed Development", 1stEdition, Pearson Education India. (ISBN:978-9332575271)
References	
1.	Robin Nixon, "Learning PHP, MySQL & JavaScript with JQuery, CSS and HTML5", 4th Edition, O'Reilly Publications, 2015. (ISBN:978-9352130153)
2.	Luke Welling, Laura Thomson, "PHP and MySQL Web Development", 5th Edition, Pearson Education, 2016. (ISBN:978-9332582736)
3.	Nicholas C Zakas, "Professional JavaScript for Wen Developers", 3rd Edition, Wrox/Wiley India, 2012. (ISBN:978-8126535088)
4.	David Sawyer Mcfarland, "JavaScript & jQuery: The Missing Manual", 1st Edition, O'Reilly/Shroff Publishers & Distributors Pvt Lts, 2014.

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SEMESTER - VI

Python Programming (3:0:0) 3
(Effective from the academic year 2023-24)

Course Code	21CS654	CIE Marks	50
Teaching Hours/Week (L:T:P)	3:0:0	SEE Marks	50
Total Number of Contact Hours	40	Exam Hours	3 Hours

Course Objectives:
This course will enable students to:

1. Learn the syntax and semantics of Python programming language.
2. Illustrate the process of structuring the data using lists, tuples and dictionaries.
3. Demonstrate the use of functions
4. Implement the Object-Oriented Programming concepts in Python.

Module – I

Introduction: **Python Basics**, Entering Expressions into the Interactive Shell, The Integer, Floating-Point, and String Data Types, String Concatenation and Replication, Storing Values in Variables, Your First Program, Dissecting Your Program, **Flow control**, Boolean Values, Comparison Operators, Boolean Operators,Mixing Boolean and Comparison Operators, Elements of Flow Control, Program Execution, Flow Control Statements, Importing Modules, Ending a Program Early with sys.exit()
TextBook 1: Chapter 1,2 **(8 hours)**

Module – II

Introduction to functions: Functions, def Statements with Parameters, Return Values and return Statements, The None Value, Keyword Arguments and print(), Local and Global Scope, The global Statement, A Short Program: Guess the Number.

Lists: The List Data Type, Working with Lists, Augmented Assignment Operators, Methods,List-like Types: Strings and Tuples
TextBook 1: Chapter 3,4 **(8 hours)**

Module – III

Dictionaries and Structuring Data, The Dictionary Data Type, Pretty Printing, Using Data Structures to Model Real-World Things
Manipulating Strings: Working with Strings, Useful String Methods, Project: Password Locker
TextBook 1: Chapter 5,6 **(8 hours)**

Module – IV

Files and exceptions :Text files, Writing variables, Directories, Pickling,Exceptions
Debugging,Raising Exceptions, Getting the Traceback as a String, Assertions, Logging, IDLE'sDebugger
TextBook 2: Chapter 11
TextBook 1: Chapter 10 **(8 hours)**

Module – V
Classes and objects, Programmer-defined types, Attributes, Rectangles, Instances as return values, Objects are mutable, Copying, **Classes and functions,** Time, Pure functions, Modifiers, Prototyping versus planning, **Classes and methods,** Object-oriented features, Printing objects, Another example, A more complicated example,The init method, The __str__ method, Operator overloading, Type-based dispatch, Polymorphism, Interface and implementation. **TextBook 2: Chapter 12,13,14** **(8 hours)**
Course outcomes: The students will be able to: CO1: Understand syntax and semantics of python programming CO2: Apply knowledge of python programming for different applications. CO3: Develop python programs to realize various computational applications CO4: Interpret the concepts of Object-Oriented Programming as used in Python.

Text books	
1.	Al Sweigart,**"Automate the Boring Stuff with Python",**1stEdition, No Starch Press, 2015. (Available under CC-BY-NC-SA license at https://automatetheboringstuff.com/)
2.	Allen B. Downey, "Think Python: How to Think Like a Computer Scientist, 2ndEdition, Green Tea Press, 2015. (http://greenteapress.com/thinkpython2/thinkpython2.pdf) (Download pdf files from the above links)
References	
1.	David Beazley, Brian K. Jones,Python Cookbook: Recipes for Mastering Python 3, 3rd Edition, Kindle Edition, O'Reilly Media; 3rd edition (10 May 2013)
2.	Charles R. Severance, Python for Everybody: Exploring Data Using Python 3, 1st Edition, CreateSpace Independent Publishing Platform, 2016. (http://do1.dr-chuck.com/pythonlearn/ENus/pythonlearn.pdf)

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SEMESTER -VI

Introduction to Data Structures (3:0:0) 3
(Effective from the academic year 2023-24)

Course Code	21CS655	CIE Marks	50
Teaching Hours/Week (L:T:P)	3:0:0	SEE Marks	50
Total Number of Contact Hours	40	Exam Hours	3 Hours

Course Objectives:

This course will enable students to:

1. Learn and identify different data structures in C programming language.
2. Assess the use of suitable data structures in problem-solving.
3. Implement the usage of data structures using C programming language.
4. Develop solutions for practical problems.

Module – I

C Recap: Pointers.

Data Structures: Introduction, Classification, Operations.

Arrays: Declarations, Accessing/Storing of Elements, Operations, Passing arrays to Functions, Pointers and Arrays, Arrays of Pointers. Sorting (selection, insertion, bubble), and searching (Linear, Binary), Programming Examples. **Dynamic memory allocation**.

Text book 1: 1.11, 2.1-2.3, 3.1-3.8, 14.1-14.3, 14.7-14.9. **Text Book 2:** 1.2.2.

(8 hours)

Module – II

Structures: Introductions, Nested Structures, Arrays of Structures, Structures and Functions, Self-referential Structures.

Linked Lists: Definition, Representation of linked lists in Memory, Singly Linked List, **Linked list operations**: Traversing, Searching, Insertion, and Deletion. Doubly Linked lists, Circular linked lists, Circular Doubly Linked List—programming Examples.

Text Book 1: 5.1-5.5, 6.1-6.5.

(8 hours)

Module – III

Stacks: Definition, Stack Operations, Array Representation of Stacks, Linked representation of Stacks, Operations on Linked Stack, Programming Examples.

Recursion: Factorial, GCD, Fibonacci Sequence, Tower of Hanoi.

Text Book 1: 7.1-7.5, 7.7.4.

(8 hours)

Module – IV
Queues: Introduction, Array representation of Queues, Linked representation of Queues, Types of Queues, Applications of Queues (Excluding Josephus Problem), Programming Examples. **Text Book 1:** 8.1-8.5. (8 hours)
Module – V
Trees: Introduction, Types of Trees, Creating a Binary Tree, Binary Tree Traversals - Inorder, postorder, preorder, Level Order. **Binary Search Trees:** BST create, Insert, and search -, Programming Examples. **Graphs:** Introduction, Terminologies, Directed graphs, Matrix and Adjacency List Representation of Graphs, Breadth First Search, Depth First Search - Programming Examples. **Text Book 1:** 9.1-9.4, 10.1, 10.2.1, 10.2.2, 10.2.3, 13.1-13.3, 13.5, 13.6. (8 hours)
Course outcomes: CO1: Understand the concepts of data structures. CO2: Implement data structures using C Programming language. CO3: Apply various data structures in problem-solving using C language. CO4: Design and develop solutions using Data Structures for practical problems.

Text books	
1.	Reema Thareja, Data structures using C, 2nd Ed, Oxford University Press.
2.	Ellis Horowitz and Sartaj Sahni, Fundamentals of Data Structures in C, 2nd Ed, Universities Press, 2014.
References	
1.	Seymour Lipschutz, Data Structures Schaum's Outlines, Revised 1st Ed, McGraw Hill, 2014