EAST POINT COLLEGE OF ENGINEERING & TECHNOLOGY

An Autonomous Institution Affiliated to Visvesvaraya Technological University (VTU) Belagavi
Approved by All India Council for Technical Education (AICTE), New Delhi.
Recognized by Govt. of Karnataka
Accredited by NAAC with A Grade
UG programs Accredited by National Board of Accreditation (NBA): CSE, ECE & ISE

DEPARTMENT OF CSE (ARTIFICIAL INTELLIGENCE AND MACHINE LEARNING)

CURRICULUM

Academic Batch 2024 – 2028 (Autonomous)

Undergraduate Bachelor of Engineering Program - B.E.

Outcome Based Education (OBE)

V & VI SEMESTER

2024-2028

V SEMESTER

Artificial Intelligence Product Management			
Course Code	24CI51	**CIE Marks**	50
Teaching Hours/Week (L: T: P)	3:0:0	**SEE Marks**	50
Credits	03	**Total Marks**	100
Contact Hours	40	**Exam Hours**	03
Examination type (SEE)	Theory		

Prerequisites:

The students should have knowledge of

- Basic knowledge of artificial intelligence
- Understanding of software / product development process

Course Objectives:

- Introduce students to core concepts of Artificial Intelligence and Machine Learning and their application in real-world product development.
- Enable students to integrate product lifecycle management with AI-driven product design and development.
- Equip students with the ability to analyze data, define key performance metrics, and make informed product decisions.
- Help students understand user needs, create AI-based solutions, and evaluate user experience and product-market fit.

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 **08 Hours**

Introduction: Product Management, Product Management Lifecycle, Concept validation to Go to Market cycle.

Understanding the Infrastructure and Tools for Building AI Products: Order of Optimal Process Flow, Deployment Strategies, Model Development and Maintenance for AI Products.

Text Book 1: Chapters – 1 and 2

Module-2	08 Hours

Building an AI-Native Product: Stages of AI product development, AI/ML product dream team, Productizing AI-powered outputs, how AI product management is different, AI customization; Customization for Verticals, Customers, and Peer Groups, Benchmarking Performance, Growth Hacking, and Cost.

Text Book 1: Chapters – 6, 8 and 10

Module-3	08 Hours

Integrating AI into Existing Non-AI Products: The Rising Tide of AI, Trends in AI adoption-Embedded AI, Ethical AI, Creative AI, Autonomous AI, Evolving Products into AI Products.

Text Book 1: Chapters – 11, 12 and 13

Module-4	08 Hours

AI Product Strategy: Product Vision, Strategy, Roadmap, understanding customer needs, Product prioritization, Collaborators and Tools for Need Discovery, Translating Needs to Requirements, Requirement categorization, Case study.

https://doi.org/10.1007/978-1-4842-9502-1_5

Module-5	08 Hours

Human Centered AI Developer Experience Design: AI Products for Developers, AI as a Service, AI as an Engine, AI Platform as a Service, Principles of AI DX Design

Case Studies - Deep dives into Successful and Unsuccessful AI Product Launches, Lessons Learned and Best Practices.

https://doi.org/10.1007/978-1-4842-9502-1_7

Course outcomes (Course Skill Set):

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

CO1: Understand and realize the need of AI in Product Management. (PO – 1, 2, 6, 7, 11, PSO- 1, 2, 3)

CO2: Identify AI Product Management concepts for building AI products for various applications. (PO – 1, 2, 3, 4, 5, 6, 7, 11, PSO – 1, 2, 3)

CO3: Explain and apply Product Management concepts to address various requirements of real-world problems. (PO – 1, 2, 3, 5, 6, 7, PSO-1, 2, 3)

CO4: Analyse and summarize the concepts of Product Management as a member of team to manage projects in multidisciplinary environments. (PO – 1, 2, 3, 4, 5, 6, 7, 11, PSO – 1, 2)

CO5: Exhibit effective communication through writing effective reports and presentations. (PO – 1, 2, 6, 7, 11, PSO – 1, 2)

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:

- 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 regulations; 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 Institute 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 Book:

1. The AI Product Manager's Handbook, Irene Bratsis, Packt Publisher, 1st Edition, February 2023, ISBN 9781804612934.

Reference Books:

1. Product Management for AI, Justin Norman, Peter Skomoroch, Mike Louides,1st Edition, O Reilly Media, Inc, 2021, ISBN:9781098104191.

2. AI Product Management: A practical Guide for Building, Launching and Scaling AI Products,

Kumar Vishwesh,1st Edition, Notion Press, 2023, ISBN-:13- 979-8890022400.

3. Phill Akinwale, Artificial Intelligence for Product Managers,1st Edition, Praizion Media, 2023, ISBN-10: 1934579289.

Web links and Video Lectures (e-Resources):

- https://www.youtube.com/watch?v=zyb3yqwQcC0
- https://www.youtube.com/watch?v=CfAQ9u0FUaM

Theory of Computation			
Course Code	24CI52	**CIE Marks**	50
Teaching Hours/Week (L: T: P)	3:2:0	**SEE Marks**	50
Credits	04	**Total Marks**	100
Contact Hours	50	**Exam Hours**	03
Examination type (SEE)	Theory		

Prerequisites:

The students should have knowledge of

- Discrete Mathematics

Course Objectives:

- Understand the foundational concepts of Automata and Theory of Computation.
- Explore different classes of formal languages and their interrelationships.
- Gain knowledge of grammars and recognizers for various formal languages.
- Apply theoretical principles to prove or disprove theorems in automata theory.
- Assess the decidability and computational complexity of problems.

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) 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.

Text Book: Sections 3.1, 3.2 (Except 3.2.1), 3.3, 4.1, 4.2

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.

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.

Case Study: Transforming Context-Free Grammars into Chomsky Normal Form

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.

Case Study: Halting Problem, Real-World Implications of Turing Machines

Text Book: Sections 8.1, 8.2, 8.3, 8.4, 9.1, 9.2

Course outcomes (Course Skill Set):

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

CO1: Apply the fundamentals of automata theory to write DFA, NFA, Epsilon-NFA and conversion between them. (PO – 1,2,3,11, PSO – 1,2,3)

CO2: Prove the properties of regular languages using regular expressions. (PO – 1,2,3,11, PSO – 1,2,3)

CO3: Design context-free grammars (CFGs) and pushdown automata (PDAs) to represent various formal languages. (PO – 1,2,3,11, PSO – 1,2,3)

CO4: Design Turing machines to solve the computational problems effectively. (PO – 1,2,3,11, PSO – 1,2,3)

CO5: Explain the concepts of decidability and undecidability. (PO – 1,2,3,11, PSO – 1,2,3)

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:

- 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 regulations; 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 Institute 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 Book:

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

Reference Books:

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://nptel.ac.in/courses/106104148
- https://nptel.ac.in/courses/106106049
- https://onlinecourses.nptel.ac.in/noc21_cs83/preview
- https://www.coursera.org/learn/cs-algorithms-theory-machines

Computer Networks			
Course Code	24CI53	**CIE Marks**	50
Teaching Hours/Week (L: T: P)	3:0:2	**SEE Marks**	50
Credits	04	**Total Marks**	100
Contact Hours	40 T + 20 P	**Exam Hours**	03
Examination type (SEE)	Theory		

Prerequisites:

The students should have knowledge of

- Familiarity with how computers work, including basic hardware components (CPU, memory, storage) and operating systems
- Basic Programming Skills
- Networking Terms and Basic Concepts.

Course Objectives:

- 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 **08 Hours**

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.

Text Book: Ch. 1.1 - 1.3, 2.1 - 2.3, 7.1 – 7.3, 8.3.

Module-2 **08 Hours**

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.

Text Book: Ch. 10.1-10.4, 11.1 -11.4, 12.1 - 12.2

Module-3 **08 Hours**

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.

Text Book: Ch. 18.1, 18.2, 18.4, 22.2,20.1-20.3, 21.3.2

Module-4 **08 Hours**

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.

Text Book: Ch. 23.1- 23.2, 24.1-24.3.4, 24.3.6-24.3.9

Module-5 **10 Hours**

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).

Text Book: Ch. 25.1-25.2, 26.1-26.6

PRACTICAL COMPONENT OF IPCC

S. 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.

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.

Course outcomes (Course Skill Set):

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

CO1: Understand, analyze, and explain the fundamental principles to interpret basic networking scenarios and select appropriate communication technologies. (PO - 1,2,3,5,6,9,11, PSO - 1,2,3)

CO2: Apply data link layer principles and protocols to analyze framing, flow control, error control, and medium access mechanisms for reliable point-to-point and shared-channel communication. (PO - 1,2,3,5,6,9,11, PSO - 1,2,3)

CO3: Apply network layer principles and routing protocols to analyze IP addressing, packet forwarding, and routing mechanisms for efficient data communication across networks. (PO - 1,2,3,5,6,9,11, PSO - 1,2,3)

CO4: Apply transport layer principles and protocols to analyze process-to-process communication, and evaluate the services, features, and mechanisms of UDP and TCP for reliable end-to-end data transmission. (PO - 1,2,3,5,6,9,11, PSO - 1,2,3)

CO5: Analyze the working of common application layer protocols and implement basic client–server programming for network-based applications. (PO - 1,2,3,5,6,9,11, PSO - 1,2,3)

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

- 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 the regulation. 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.
   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:
Text Book:

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):

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

Machine Learning Lab			
Course Code	24CIL54	**CIE Marks**	50
Teaching Hours/Week (L: T: P)	0:0:2	**SEE Marks**	50
Credits	01	**Total Marks**	100
Contact Hours	24	**Exam Hours**	2
Examination type (SEE)	Practical		

Prerequisites:

The students should have knowledge of

- Python
- Data Structures and Algorithms
- Probability and Statistics
- Linear Algebra

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.

Teaching-Learning Process (General Instructions)

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

6. Demonstration based teaching
7. ICT based learning using Simulation and Tools
8. Problem Based Learning

S. No	Experiments
1.	Develop a program to create histograms for all numerical features and analyze the distribution of each feature. Generate box plots for all numerical features and identify any outliers. Use California Housing dataset.
2.	Develop a program to Compute the correlation matrix to understand the relationships between pairs of features. Visualize the correlation matrix using a heatmap to know which variables have strong positive/negative correlations. Create a pair plot to visualize pairwise relationships between features. Use California Housing dataset.
3.	Develop a program to implement Principal Component Analysis (PCA) for reducing

	the dimensionality of the Iris dataset from 4 features to 2.
4.	For a given set of training data examples stored in a .CSV file, implement and demonstrate to find-S algorithm to output a description of the set of all hypotheses consistent with the training examples.
5.	Develop a program to implement k-Nearest Neighbour algorithm to classify the randomly generated 100 values of x in the range of [0,1]. Perform the following based on dataset generated. 1. Label the first 50 points $\{x_1,\ldots\ldots,x_{50}\}$ as follows: if $(x_i \leq 0.5)$, then $x_i \in$ Class 1, else $x_i \in$ Class2 2. Classify the remaining points, $x_{51},\ldots\ldots,x_{100}$ using KNN. Perform this for $k=1,2,3,4,5,20,30$
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 demonstrate the working of the decision tree algorithm. Use Breast Cancer Data set for building the decision tree and apply this knowledge to classify a new sample.
9.	Develop a program to implement the Naive Bayesian classifier considering Olivetti Face Data set for training. Compute the accuracy of the classifier, considering a few test data sets.
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:

CO1: Illustrate the principles of multivariate data and apply dimensionality reduction techniques. (PO – 1,2,3,5,8,9,11, PSO – 1,2,3)

CO2: Demonstrate similarity-based learning methods and perform regression analysis. (PO – 1,2,3,5,8,9,11, PSO – 1,2,3)

CO3: Develop decision trees for classification and regression problems. (PO – 1,2,3,5,8,9,11, PSO – 1,2,3)

CO4: Develop Bayesian models for probabilistic learning. (PO – 1,2,3,5,8,9,11, PSO – 1,2,3)

CO5: Implement the clustering algorithms to share computing resources. (PO – 1,2,3,5,8,9,11, PSO – 1,2,3)

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 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 Examination:

- 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):

1. https://www.drssridhar.com/?page_id=1053
2. https://www.universitiespress.com/resources?id=9789393330697
3. https://onlinecourses.nptel.ac.in/noc23_cs18/preview

Advanced Machine Learning			
Course Code	24CI55A	**CIE Marks**	50
Teaching Hours/Week (L: T: P)	4:0:0	**SEE Marks**	50
Credits	04	**Total Marks**	100
Contact Hours	50	**Exam Hours**	03
Examination type (SEE)	Theory		

Prerequisites:

The students should have knowledge of

- Machine Learning Basics
- Linear Algebra
- Probability and Statistics

Course Objectives:

- To teach the theoretical foundations of various learning algorithms.
- To train the students better understand the context of supervised and unsupervised learning through real-life examples.
- Apply all learning algorithms over appropriate real-time dataset.
- Evaluate the algorithms based on corresponding metrics identified.

Teaching-Learning Process (General Instructions)

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

9. Chalk and Talk
10. Animated videos to demonstrate the applications
11. Collaborative Learning
12. Problem based Learning
13. Power point presentation

Module-1 **10 Hours**

Important Elements in Machine Learning: Data formats, Learnability, Statistical Learning Approaches.

Feature Selection: scikit-learn toy datasets, creating training and test sets, Managing Categorical data, Managing Missing Features.

Text Book 1: Chapter 2 & 3

Module-2 **10 Hours**

Feature Engineering: Data scaling and normalization, Feature selection and filtering, Principal

Component Analysis.

Linear Regression: Linear Models, Ridge, Lasso and ElasticNet, Polynomial Regression.

Text Book 1: Chapter 3 & 4

Module-3 **10 Hours**

Logistic Regression: Linear Classification, Logistic Regression, Implementation ad optimizations, Stochastic gradient descent algorithms, Finding the optimal hyperparameters through grid search, Classification metrics, ROC curve.

Text Book 1: Chapter 5

Module-4 **10 Hours**

Naïve Bayes: Bayes' theorem, Naïve Bayes classifiers, Naïve Bayes in scikit-learn.

Support Vector Machines: Linear support vector machines, scikit-learn implementation, Controlled support vector machines, Support vector regression.

Text Book 1: Chapter 6 & 7

Module-5 **10 Hours**

Decision Trees: Binary decision trees, Decision tree classification with scikit-learn.

Applications of Machine Learning: Introduction, Pattern Recognition, Video Processing, Medical Imaging, List of possible real-world applications.

Text Book 1: Chapter 8 and Text Book 2: Chapter 8 – 8.1 to 8.4, 8.6

Course outcomes (Course Skill Set):

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

CO1: Analyze fundamental machine learning concepts and data preparation techniques, including feature selection, handling missing data, and dataset preparation, to build learnable and statistically sound models. (PO – 1,2,3,5,11, PSO – 1,2,3)

CO2: Apply feature engineering and linear regression techniques, including regularization and dimensionality reduction, to improve model performance on real-world datasets. (PO – 1,2,3,5,11, PSO – 1,2,3)

CO3: Design and evaluate classification models using logistic regression and optimization techniques, and assess their performance using appropriate classification metrics. (PO – 1,2,3,5,11, PSO – 1,2,3)

CO4: Develop and implement probabilistic and margin-based learning models such as Naïve Bayes and Support Vector Machines for classification and regression problems. (PO – 1,2,3,5,11, PSO – 1,2,3)

CO5: Identify and analyze real-world applications of machine learning in domains such as pattern recognition, video processing, and medical imaging, and justify suitable algorithms for each application. (PO – 1,2,3,5,11, PSO – 1,2,3)

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:

- 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 regulations; 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 Institute 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. Giuseppe Bonaccorso, Machine Learning Algorithms, Packt Publishing Ltd, 2017.
2. Indranath Chatterjee, Machine Learning and its Application: A Quick Guide for Beginners, Bentham Science Publishers, 2021.

Reference Books:

1. Aurélien Géron, Hands-On Machine Learning with Scikit-Learn, Keras, and TensorFlow, 3rd Edition, O'Reilly Media, Inc., October 2022.

2. Christopher M. Bishop, Pattern Recognition and Machine Learning, Springer, 2006.

Web links and Video Lectures(e-Resources):

- https://ocw.mit.edu/courses/6-036-introduction-to-machine-learning-fall-2020/
- https://developers.google.com/machine-learning/crash-course
- https://www.youtube.com/watch?v=YLczBemZpaE
- https://nptel.ac.in/courses/106106139

Software Engineering with AI			
Course Code	24CI55B	**CIE Marks**	50
Teaching Hours/Week (L: T: P)	4:0:0	**SEE Marks**	50
Credits	04	**Total Marks**	100
Contact Hours	50	**Exam Hours**	03
Examination type (SEE)	Theory		

Prerequisites:

NIL

Course Objectives:

- 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.

Teaching-Learning Process (General Instructions)

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

1. Lecture method (L) need not be 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.

Module-1 **10 Hours**

Software Engineering: The nature of Software, The unique nature of WebApps, Software Engineering, The software Process, The software Engineering practice, The 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.

Text Book 1: Chapter 1: 1.1 to 1.6, Chapter 2: 2.1 to 2.5

Module-2 **10 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.

Text Book 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.

Text Book 1: Chapter 3: 3.1 to 3.6, Chapter 4: 4.1 to 4.3

Module-4 **10 Hours**

Using Artificial Intelligence for Auto-Generating Software for Cyber-Physical Applications: Introduction, Model-Based Methods, Learning-Based Methods, Fault Trees, Model-Based Software Engineering, Running Example, AI-Based Framework for MBSE Task, AI-based MBSE Model Construction Methods, MBSE Trade-Off Framework, Empirical Modelling Cost Comparison.

Text Book 2: Chapter 8: 8.1 to 8.6, 8.8, 8.9

Module-5 **10 Hours**

Application of Machine Learning in Software Testing: Introduction, Applications of Machine Learning in software testing-Machine Learning for software fault prediction, Machine Learning for test oracles automation, Machine learning for test cases generation, Machine learning for test suite reduction, prioritization and evaluation, other tasks.

Text Book 2: Chapter 9: 9.1, 9.3

Course outcomes (Course Skill Set):

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

CO1: Differentiate process models to judge which process model has to be adopted for the given scenarios. (PO – 1, 2, 3, 7, 8, 9, 10, PSO – 1, 3)

CO2: Derive both functional and nonfunctional requirements from the case study. (PO – 1, 2, 3, 7, 8, 9, 10, PSO – 1, 3)

CO3: Analyze the importance of various software testing methods and agile methodology. (PO – 1, 2, 3, 7, 8, 9, 10, PSO – 1, 3)

CO4: Apply AI techniques to automate software engineering tasks such as testing, debugging, and code analysis. (PO – 1, 2, 3, 7, 8, 9, 10, PSO – 1, 3)

CO5: Conduct case studies to appraise the benefits of integrating AI in software engineering. (PO – 1, 2, 3, 7, 8, 9, 10, PSO – 1, 3)

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:

- 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 regulations; 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 Institute 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. Roger S. Pressman: Software Engineering-A Practitioners approach, 7th Edition, Tata McGraw Hill.
2. Artificial Intelligence Methods for Software Engineering, Meir Kalech, Rui Abreu, Mark Last, World

Scientific Publishing Co. Pte. Ltd, 1st Edition, 2021.

Reference Books:

1. Pankaj Jalote, An Integrated Approach to Software Engineering, Wiley India.
2. "Software Engineering: Principles and Practice", Hans van Vliet, Wiley India, 3rd Edition, 2010.
3. Bob Hughes, Mike Cotterell, Rajib Mall: Software Project Management, 6th Edition, McGraw Hill Education, 2018.

Web links and Video Lectures(e-Resources):

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

Cyber Physical Systems			
Course Code	24CI55C	**CIE Marks**	50
Teaching Hours/Week (L: T: P)	4:0:0	**SEE Marks**	50
Credits	04	**Total Marks**	100
Contact Hours	50	**Exam Hours**	03
Examination type (SEE)	Theory		

Prerequisites:

NIL

Course Objectives:

- To provide the fundamental understanding of Cyber-Physical Systems and their applications in solving complex engineering problems.
- To introduce various Cyber-Physical System components, architectures, and technologies used in real-world applications.
- To facilitate students in designing and implementing data acquisition, monitoring, and processing techniques for CPS environments.
- To impart knowledge of modern tools and technologies for developing Cyber-Physical Systems through practical problem-solving and presentations.
- To encourage teamwork and collaborative development, evaluation, and deployment of Cyber-Physical System solutions.

Teaching-Learning Process (General Instructions)

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

1. Lecture method (L) need not be 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.

Module-1 **10 Hours**

Cyber-Physical Systems-Basics and Fundamentals: Introduction, CPS concept and requirements, CPS Architecture, CPS Applications: CPS for Vehicular Environments, CPS for Agriculture, CPS for Health and Medical Sciences, CPS for the Smart Grids, Future aspects of CPS.

Text Book 1: Chapter 2

Module-2	10 Hours

Basics of Computer and Embedded Architecture: Computer Architecture-Processors, Basic System Architecture, Interrupts, CISC and RISC, Digital Signal Processors, Memory-RAM and ROM, Input/ Output: Programmed I/O, Interrupt-driven I/O, Direct Memory Access (DMA)-Standard block transfer, Demand-mode transfers, Fly-by transfer, Data-chaining transfers. Parallel and Distributed Computers-Introduction to parallel architectures, SIMD computers, MIMD computers, Embedded Computer Architecture.

Text Book 2: Chapter 1

Module-3	10 Hours

Embedded System Components: Introduction, Hardware Components- Sensors, Actuators, IO Interfaces, Processor Complex or System on Chip (SoC), Processor and IO Interconnection, Bus Interconnection, High-Speed Serial Interconnection, Low-Speed Serial Interconnection, Firmware Components - Boot Code, Device Drivers, Operating System Services.

Text Book 3: Chapter 8

Module-4	10 Hours

Sensors: Sensor Definition, Use of Sensors, Sensor Network Definition and the Use of Sensor Networks, Traditional Sensor Networks vs. WSNs, Types of Sensors, Sensor Performance, Smart Sensors, Sensor Networks and Associated Technologies: Wireless Sensor Networks as Sensor Networks and Smart Sensor Networks.

Text Book 4: Chapter 5.1 to 5.6

Module-5	10 Hours

Actuators: Actuators, Actuator Types: Hydraulic actuators, Pneumatic actuators, Electric actuators, Thermal or magnetic actuators, Mechanical actuators, soft actuator, Shape memory polymers, Actuator Characteristics.

Robotic Application: Introduction, Robotic Arm, Sensing, Actuation, Automation and Autonomy.

Text Book 4: Chapter 5.7 to 5.9; Text Book 2: Chapter 17

Course outcomes (Course Skill Set):

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

CO1: Understand the concept of Cyber-Physical Systems and apply it to address complex engineering problems. (PO – 1, 2, 3, 5, 11, PSO – 1)

CO2: Analyze the various Cyber-Physical System Components used in solving the real-world problem. (PO – 1, 2, 3, 5, 11, PSO – 1)

CO3: Design and implement data acquisition and processing techniques to extract meaningful information from CPS. (PO – 1, 2, 3, 5, 11, PSO – 1, 2)

CO4: Demonstrate the use of modern tools in solving day-to-day problems by exhibiting teamwork through oral presentations and reports. (PO – 1, 2, 3, 5, 8, 9, 11, PSO – 1, 2)

CO5: Collaborate in a group to design, develop, and evaluate Cyber-Physical Systems. (PO – 3, 5, 7, 8, 9, 11, PSO – 1, 2)

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:

- 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 regulations; 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 Institute 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. Cyber-Physical System Design with Sensor networking Technologies, Control, Robotics and Sensor Series, Edited by Sherali Zeadally and Nafaa Jabeur ISBN 978-1-84919-825-7.
2. Designing Embedded Hardware, John Catsoulis, 2nd Edition, O'Reilly Media, 2005, ISBN: 0-596-00755-8.

3. Real-Time Embedded Components and Systems with LINUX and RTOS, S. Siewert and J. Pratt, 2016, ISBN: 978-1-942270-04-1.
4. Introduction to IoT, Sudip Misra, Anandarup Mukherjee and Arijit Roy, Cambridge University Press, 1 st Edition, 2020, ISBN 978-1-108-84295-2, ISBN 978-1-108-95974-2.

Web links and Video Lectures(e-Resources):

- https://nptel.ac.in/courses/106105241
- http://www.digimat.in/nptel/courses/video/106105241/L07.html

Cloud Computing			
Course Code	24CI55D	**CIE Marks**	50
Teaching Hours/Week (L: T: P)	4:0:0	**SEE Marks**	50
Credits	04	**Total Marks**	100
Contact Hours	50	**Exam Hours**	03
Examination type (SEE)	Theory		

Prerequisites:

NIL

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 that teachers can use to accelerate the attainment of the various course outcomes.

1. Lecture method (L) need not be 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 student's understanding.
6. Use any of these methods: Chalk and board, Active Learning, Case Studies.

Module-1 **10 Hours**

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.

Text Book 1: Chapter 1: 1.1 to 1.5

Module-2 **10 Hours**

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.

Text Book 1: Chapter 3: 3.1 to 3.5

Module-3 **10 Hours**

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.

Text Book 1: Chapter 4: 4.1 to 4.5

Module-4 **10 Hours**

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

Cloud Security and Trust Management: Cloud Security Defense Strategies, Distributed Intrusion/Anomaly Detection, Data and Software Protection Techniques, Reputation-Guided Protection of Data Centers.

Text Book 2: Chapter 11: 11.1 to 11.3, 11.5 to 11.8, 11.10 to 11.14
Text Book 1: Chapter 4: 4.6

Module-5 **10 Hours**

Cloud Programming and Software Environments: 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.

Text Book 1: Chapter 6: 6.1 to 6.5

Course outcomes (Course Skill Set):

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

CO1: Describe various cloud computing platforms and service providers. (PO – 1,2,3,5, PSO – 1,2,3)
CO2: Illustrate the significance of various types of virtualizations. (PO – 1,2,3,5, PSO – 1,2,3)
CO3: Identify the architecture, delivery models and industrial platforms for cloud computing-based applications. (PO – 1,2,3,5, PSO – 1,2,3)
CO4: Analyze the role of security aspects in cloud computing. (PO – 1,2,3,5, PSO – 1,2,3)
CO5: Demonstrate cloud applications in various fields using suitable cloud platforms. (PO – 1,2,3,5, PSO – 1,2,3)

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:

- 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 regulations; 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 Institute 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 McGraw Hill Education, 1st Edition, 2017.
2. Toby Velte, Anthony Velte, Cloud Computing: A Practical Approach, McGraw-Hill Education, 2017.
3. 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

Agentic AI			
Course Code	24CI56A	**CIE Marks**	50
Teaching Hours/Week (L: T: P)	4:0:0	**SEE Marks**	50
Credits	04	**Total Marks**	100
Contact Hours	50	**Exam Hours**	03
Examination type (SEE)	Theory		

Prerequisites:

The students should have knowledge of

- Basic understanding of Artificial Intelligence and Machine Learning Concepts.
- Familiarity with Data Structures, Algorithms and Problem-Solving Techniques.

Course Objectives:

- To understand the fundamentals of AI agents, Large Language Models (LLMs), and prompt engineering concepts.
- To identify prompt engineering techniques to improve interaction and communication with AI systems.
- To design the architecture and workflow of multi-agent systems using frameworks such as AutoGen and CrewAI.
- To apply Retrieval-Augmented Generation (RAG) applications using semantic search, embeddings, and vector databases.
- To develop autonomous AI assistants capable of reasoning, decision-making, and task execution.

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. Animated videos to demonstrate the applications
3. Collaborative Learning
4. Problem based Learning
5. Power point presentation

Module-1 **10 Hours**

Introduction to Agents and Their World: Defining agents, understanding the component systems of an agent, examining the rise of the agent. Harnessing the Power of LLMs: Mastering the OpenAI API (Chat Completions, request/response), Exploring and serving open-source LLMs locally (LM Studio). Prompting LLMs with Prompt Engineering: Creating detailed queries, adopting personas, using delimiters, specifying steps, providing examples. Engaging GPT Assistants: Exploring GPT assistants, building custom GPTs (e.g., for data science), adding custom actions, extending knowledge with file uploads.

Text Book 1: Chapter 1, 2 & 3

Module-2 **10 Hours**

Foundations of Prompt Engineering: Introduction to Prompt Engineering, types of prompts. Prompt Engineering techniques: Instructions Prompt, Zero/One/Few-Shot Prompting**.**

Text Book 2: Chapter 1 & 3

Module-3 **10 Hours**

Exploring Multi-Agent Systems (AutoGen): Introducing multi-agent systems with AutoGen Studio, adding skills, exploring AutoGen, group chat with agents.

Multi-Agent Orchestration (CrewAI): Building an agent crew with CrewAI, creating a jokester crew, observing agents, revisiting coding agents with CrewAI. Defining Agent Actions: Empowering agents with actions, executing OpenAI functions, actioning function calls.

Text Book 1: Chapter 4, 5.1 & 5.2

Module-4 **10 Hours**

Retrieval-Augmented Generation (RAG): Understanding retrieval in AI applications, the basics of Retrieval Augmented Generation (RAG). Semantic Search and Document Indexing: Delving into semantic search, applying vector similarity search, vector databases (e.g., Chroma), demystifying document embeddings.

Constructing RAG: Constructing RAG with LangChain, splitting and loading documents (by token), applying RAG to build agent knowledge.

Text Book 1: Chapter 8.1 to 8.5

Module-5 **10 Hours**

Building Autonomous Assistants: Introducing behavior trees (BTs), understanding BT execution, introducing agentic behavior trees (ABTs), building conversational autonomous multi-agents.

Text Book 1: Chapter 5

Course outcomes (Course Skill Set):

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

CO1: Explain the architecture and working principles of AI agents, GPT assistants, and OpenAI APIs. (PO - 1, 5, 10, PSO – 1, 2, 3)

CO2: Describe the fundamentals and significance of Prompt Engineering in AI applications. (PO – 1, 5, 10, PSO – 1, 2, 3)

CO3: Apply CrewAI frameworks to build and coordinate agent crews for task-oriented applications. (PO – 1, 2, 5, 10, PSO – 1, 2, 3)

CO4: Apply Retrieval-Augmented Generation (RAG) techniques to enhance AI-based information retrieval systems. (PO – 1, 2, 5, 10, PSO – 1, 2, 3)

CO5: Develop conversational autonomous multi-agent systems for real-world applications. (PO – 1, 2,

5, 10, 11, PSO – 1, 2, 3)

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:

- 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 regulations; 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 Institute 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. Micheal Lanham, AI Agents in Action — Manning Publications (2024).

2. Ajantha Devi Vairamani and Anand Nayyar, Prompt Engineering: Empowering Communication, 1st Edition, CRC Press, Taylor & Francis Group, 2024. (DOI: https://doi.org/10.1201/9781032692319).

Web links and Video Lectures(e-Resources):

- https://blogs.nvidia.com/blog/what-is-agentic-ai/
- https://www.forbes.com/sites/bernardmarr/2025/02/03/generative-ai-vs-agentic-ai-the-key-differences-everyone-needs-to-know/
- https://www.ibm.com/think/topics/agentic-architecture
- https://blog.equinix.com/blog/2024/11/20/what-are-agentic-ai-workflows/

Quantum Computing			
Course Code	24CI56B	**CIE Marks**	50
Teaching Hours/Week (L: T: P)	4:0:0	**SEE Marks**	50
Credits	04	**Total Marks**	100
Contact Hours	50	**Exam Hours**	03
Examination type (SEE)	Theory		

Prerequisites:

The students should have knowledge of

- Basic Physics – Fundamentals of quantum mechanics (superposition, wave–particle duality, uncertainty principle)
- Engineering Mathematics – Linear Algebra (vectors, matrices, eigenvalues, tensor products), Complex Numbers, Probability Theory
- Classical Computing Fundamentals – Logic gates, Boolean algebra, digital circuits.

Course Objectives:

- To know the background of classical computing and quantum computing.
- To learn the fundamental concepts behind quantum computation.
- To study the details of quantum mechanics and the relation to Computer Science.
- To gain knowledge about the basic hardware and mathematical models of quantum computation
- To learn the basics of quantum information and the theory behind it.

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. Animated videos to demonstrate the applications
3. Collaborative Learning
4. Problem based Learning
5. Power point presentation

Module-1 **10 Hours**

Fundamental Concepts: Global Perspectives – Quantum Bits – Quantum Computation – Quantum Algorithms – Experimental Quantum Information Processing – Quantum Information.

Text Book 1: Chapter 1 (1.1 to 1.6)

Module-2 **10 Hours**

Quantum Mechanics and Overview of Computational Models: Quantum Mechanics: Linear Algebra – Postulates of Quantum Mechanics – Application: Super dense Coding – Density Operator – The

Schmidt Decomposition and Purifications – EPR and the Bell Inequality.

Text Book 1: Chapter 2 (2.1 to 2.6)

Module-3 **10 Hours**

Quantum Computation: Quantum Circuits: Quantum Algorithms – Single qubit operations – Controlled operations – Measurement - Universal Quantum Gates – Quantum Circuit Model of Computation – Simulation of quantum systems.

Text Book 1: Chapter 4 (4.1 to 4.7)

Module-4 **10 Hours**

Quantum Search Algorithms: The quantum search algorithm, Quantum search as a quantum simulation, Quantum counting, Speeding up the solution of NP-complete problems, Quantum search of an unstructured database, Optimality of the search algorithm, Black box algorithm limits.

Text Book 1: Chapter 6 (6.1 to 6.7)

Module-5 **10 Hours**

Quantum Information: Quantum noise and quantum operations: Quantum operations, Examples of quantum noise and quantum operations, Applications of quantum operations, Limitations of the quantum operations formalism.

Distance measures for quantum information: How close are two quantum states.

Text Book 1: Chapter 8 (8.2 to 8.5) and Chapter 9 (9.2)

Course outcomes (Course Skill Set):

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

CO1: Understand and explain the various essentials of quantum computation. (PO – 1, 2, 3, PSO – 1, 2, 3)

CO2: Analyze the working of quantum transformations and quantum gates. (PO – 1, 2, 3, PSO – 1, 2, 3)

CO3: Describe the principle of working of some of the quantum algorithms and conduct simulations using open-source quantum simulators. (PO – 1, 2, 3, 5, PSO – 1, 2, 3)

CO4: Investigate the applications of quantum computing algorithms in real-world applications. (PO – 1, 2, 3, PSO – 1, 2, 3)

CO5: Appraise the knowledge and potential in quantum computing to build a successful career, work in teams, and communicate their ideas effectively. (PO – 5, 6, 7, 8, 9, 11, PSO – 1, 2, 3)

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:

- 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 regulations; 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 Institute 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 Book:

1. Michael A. Nielsen, Issac L. Chuang, "Quantum Computation and Quantum Information", Tenth Edition, Cambridge University Press, 2010.

Reference Books:

1. Scott Aaronson, "Quantum Computing Since Democritus", Cambridge University Press, 2013.
2. N. David Mermin, "Quantum Computer Science: An Introduction", Cambridge University Press, 2007.

Web links and Video Lectures(e-Resources):

- https://nptel.ac.in/courses/106106232
- https://onlinecourses.nptel.ac.in/noc21_cs103/preview

Big Data Systems			
Course Code	24CI56C	**CIE Marks**	50
Teaching Hours/Week (L: T: P)	4:0:0	**SEE Marks**	50
Credits	04	**Total Marks**	100
Contact Hours	50	**Exam Hours**	03
Examination type (SEE)	Theory		

Prerequisites:

The students should have knowledge of

- Programming Concepts
- Database Management Systems
- Data Structures.

Course Objectives:

- To provide the basic understanding of big data concepts and their applications.
- To introduce the processes involved in collecting, storing, and managing large-scale data.
- To facilitate students in understanding distributed computing frameworks for big data processing.
- To impart knowledge of data processing techniques using tools like Hadoop and Spark.
- To provide the basic understanding of data storage technologies such as HDFS databases.

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. Animated videos to demonstrate the applications
3. Collaborative Learning
4. Problem based Learning
5. Power point presentation

Module-1 **10 Hours**

Introduction to Big Data: Characteristics, Evolution, Definition, Challenges, what is Big Data, Other Characteristics, Why Big data, Traditional BI versus Big Data, Data warehouse environment versus Hadoop Environment.

Big Data Analytics: Introduction to Big Data Analytics, Classification of Analytics, Importance of Big Data Analytics, Technologies for Big data, Data Science, Data Scientist, Terminologies Used.

Text Book 1: Chapter 2: 2.1 to 2.7, 2.9 to 2.11; Chapter 3: 3.2 to 3.5 to 3.12

Module-2 **10 Hours**

Hadoop / Spark /HDFS Overview: Hadoop Overview: Features, Key advantages, Versions, Overview

of Hadoop Ecosystem, Distributions.

Why Hadoop, why not RDBMS, HDFS: Hadoop Distributed File System (HDFS), HDFS Daemons, File Read, File Write, Replica Placement Strategy, HDFS commands, Special features of HDFS and its limitations, MapReduce, YARN.

Text Book 1: Chapter 4: 4.2.1 to 4.2.5; Chapter 5: 5.2 to 5.3, 5.10 to 5.12

Module-3 **10 Hours**

Spark Core: Spark Overview: Spark Ecosystems, Advantages of Spark, Spark Standalone application, Running on Cluster, Programming with RDD's: Basics, RDD operations, Lineage Graphs, Lazy evaluation, Persistence, Immutability, Fault Tolerance, Performance (Pipelining, Shuffle). Pair RDD's: Transformations and Actions, Partitioning, Accumulators, Broadcast Variables.

Text Book 2: Chapter 1 and 2

Module-4 **10 Hours**

Spark SQL: Rows, Data frames, Tables and SQL operations on Tables. Spark Session, Creating Data Frame, Parquet files, working with Hive. Spark Streaming: Introduction to Stream Processing, Architecture of Spark Streaming, Caching and Persistence, Check pointing, Fault tolerance, Structured Streaming-Output Modes, Output sinks, Failure recovery and check pointing.

Text Book 2: Chapter 4 and 5

Module-5 **10 Hours**

Machine Learning with Spark: Introduction to spark ML Lib, need for pipeline API, working of pipeline API, Scala syntax for building pipeline, Predictions on test documents, Feature engineering, Feature extraction algorithms, Feature transformation algorithms, Feature selection algorithms, classification and regression, clustering, Collaborative filtering, ML-tuning - model selection and hyperparameter tuning.

Text Book 2: Chapter 6

Course outcomes (Course Skill Set):

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

CO1: Understand the Big Data concepts and differentiate Big Data environments from traditional BI systems. (PO - 1, 2, 3, PSO - 1, 2)

CO2: Demonstrate Hadoop ecosystem tools including HDFS, MapReduce, and YARN for large-scale data processing. (PO - 1, 2, 3, 5, 10, PSO - 1, 2)

CO3: Explain the various components of Spark architecture and their key features. (PO - 1, 2, 3, PSO - 1, 2)

CO4: Implement RDD operations, data processing with Spark SQL and Spark Streaming for batch and real-time analytics. (PO - 1, 2, 3, 5, 10, PSO - 1, 2)

CO5: Apply Spark MLlib for machine learning tasks. (PO - 1, 2, 3, 5, 10, PSO - 1, 2)

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:

- 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 regulations; 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 Institute 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. Seema Acharya and Subhashini C, Big Data and Analytics, Wiley India, 2019.
2. Muhammad Asif Abbasi, Learning Apache Spark 2, Packt Publishing, 2017.

Reference Books:

1. Cay S. Horstmann, Scala for the Impatient 2nd Edition.
2. Andy Konwinski, Holden Karau, Matei Zaharia, Patrick Wendell, Learning Spark Lightning Fast, Big Data Analysis, O'Reilly, 2015.

3. Tom White, Hadoop: The Definitive Guide, O'Reilly, 2015.

Web links and Video Lectures(e-Resources):

- https://www.youtube.com/watch?v=bAyrObl7TYE&list=PLEiEAq2VkUUJqp1k-5W1mo37urJQOdCZ
- https://www.youtube.com/watch?v=VmO0QgPCbZY&list=PLEiEAq2VkUUJqp1kg5W1mo37urJQOdCZ&in dex=4
- https://www.youtube.com/watch?v=GG-VRm6XnNk
- https://www.youtube.com/watch?v=JglO2Nv_92A

Full Stack Development			
Course Code	24CI56D	**CIE Marks**	50
Teaching Hours/Week (L: T: P)	4:0:0	**SEE Marks**	50
Credits	04	**Total Marks**	100
Contact Hours	50	**Exam Hours**	03
Examination type (SEE)	Theory		

Prerequisites:

The students should have knowledge of

- Programming Fundamentals
- Database Concepts

Course Objectives:

- To design and develop responsive front-end user interfaces.
- Helps to build dynamic web applications using modern frameworks and technologies.
- Develop back-end services and integrate them with databases.
- Connecting front-end and back-end components to create complete full stack applications.
- Equip students with skills for deployment, version control, and real-world application development.

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 **08 Hours**

Front-End Web Development: JavaScript syntax, Types of Data and Variables, Operations and calculations, The Document Object, Using Events. JavaScript Advanced: Scopes and Closures, understanding "this" and prototypes, OOP concepts as applied to JavaScript and prototypal inheritance, asynchronous programming, event loops and Promises, hoisting in java script, Local and session storage.

Link: https://www.coursera.org/learn/

Module-2 **08 Hours**

ReactJS: Building blocks of React, create-react-app, creating first React application using CLI, JSX and component creation, functional components, loading and applying CSS, props for component reusability, React Hooks (useState, useEffect).

Link: https://www.coursera.org/

Module-3	08 Hours

Back-End Web Development: Node.js introduction, architecture and features, installation and setup, creating web servers using HTTP request and response, npm and package.json, file system APIs, event handling, GET and POST implementation using Express.js. Express JS Routing and controllers, Middleware concepts.

Link: https://www.coursera.org/

Module-4	08 Hours

Database Integration: Overview of NoSQL and SQL databases, document-oriented data model, key features of MongoDB, MongoDB Compass cloud setup, schema design and data modeling, core MongoDB CRUD operations, Connecting MongoDB with Node.Js [File system].

Link: https://www.coursera.org/

Module-5	08 Hours

MERN Stack Deployment: Development and deployment of a full-featured MERN stack application including authentication, authorization and CRUD operations. Version Control Systems (VCSs) and Git: Distributed Git: Distributed Workflows, contributing to a Project. Scripting GitHub: Services and hooks, GitHub API: Basic Usage, commenting on an Issue, Changing the Status of a Pull Request. Static code quality analysis using SonarQube and real-time code feedback using SonarLint. GitHub Actions: CI/CD Concepts using GitHub Actions.

Link: https://www.coursera.org/

Course outcomes (Course Skill Set):

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

CO1: Apply fundamental concepts of JavaScript and web technologies to solve basic and intermediate problems in front-end web application development. (PO - 1, 2, 5, PSO - 1)

CO2: Analyze client-side and server-side requirements and develop logical solutions using advanced JavaScript concepts such as asynchronous programming, scopes, closures, and event handling. (PO - 1, 2, 3, PSO - 1, 2)

CO3: Design and develop scalable and reusable front-end applications using ReactJS, following component-based architecture and modern UI development practices. (PO - 3, 5, 9, 10, PSO - 2)

CO4: Design and implement secure and efficient back-end services using Node.js and Express.js with RESTful APIs for real-world web applications. (PO - 3, 4, 5, 11, PSO - 2)

CO5: Implement a full-stack MERN application using Git-based version control, GitHub collaboration, code quality tools, and CI/CD automation. (PO - 1, 2, 3, 4, 5, 6, 8, 11, 12, PSO - 2, 3)

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:

- 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 regulations; 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 Institute 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:

Reference Books:

1. Pro Mern Stack: Full Stack Web App Development with Mongo, Express, React, and Node by Subramanian, Vasan.
2. Ethan Brown, Web Development with Node and Express: Leveraging the JavaScript Stack, Publisher: O'Reilly Media Latest Edition: 2nd Edition.
3. Scott Chacon, Ben Straub by "ProGit" Version 2.1.447, 2025-04-10.

Web links and Video Lectures(e-Resources):

- https://react.dev/
- https://nodejs.org/en/docs/
- https://www.mongodb.com/docs/manual

Environmental Studies and E-Waste Management			
Course Code	24ES57	**CIE Marks**	100
Teaching Hours/Week (L: T: P)	1:0:0	**SEE Marks**	-
Credits	-	**Total Marks**	100
Contact Hours	14	**Exam Hours**	-
Examination type (SEE)	Theory		

Prerequisites:

The students should have knowledge of:

- Understanding of Ecosystems and Sustainability
- Awareness of Environmental Issues
- Familiarity with Environmental Legislation
- Basic Scientific Principles
- Knowledge of E-waste Lifecycle
- Familiarity with E-waste Recycling Methods
- Awareness of Environmental Policies.

Course Objectives:

- Identify the major challenges of environmental issues
- Develop skills, critical thinking and demonstrate socio-economic skills for Environmental protection
- Analyze the impact of issues w. r. t. waste management.

Teaching-Learning Process (General Instructions)

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

1. Lecture method (L) need not be 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 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.

Module-1 **03 Hours**

Ecosystem and Sustainability: Ecosystem: Structure of Ecosystem, Types: Forest, Desert, Wetlands, Riverine, Oceanic ecosystems. Sustainability: 17SDG targets and possible actions.

Self-Study Component (SSC): Components of the environment.

Text Book 1: CH- 3, e-resource: 1

Module-2	03 Hours

Natural resources and Energy: Natural Resources: Water resources – Availability & Quality aspects, Water borne diseases & water induced diseases, Fluoride problem in drinking water. Energy: Different types of energy, Conventional sources & Non - Conventional sources of Energy, Solar energy, Wind Energy, Hydrogen as an alternative energy.

Self-Study Component (SSC): Alternative Energy sources**.**

Text Book 1: CH- 2

Module-3	03 Hours

Environmental Pollution: Environmental Pollution: Water Pollution, Noise pollution, Air pollution (Sources, Impacts, Preventive measures and Public Health Aspects).

Self-Study Component (SSC): Case studies of air pollution episodes.

Text Book 1: CH- 5

Module-4	03 Hours

Waste Management: Waste management: Solid Waste Management, types and sources, functional elements of SWM, Biomedical Waste Management - Sources, Characteristics. Environmental Legislation: Solid Waste Management Rules, 2016, Biomedical Waste Management Rules, 2016.

Self-Study Component (SSC): Case studies on waste management options.

Text Book 1: CH- 6, e-resource:2

Module-5	02 Hours

E - Waste Management: E- waste; composition and generation. Global context in e- waste; E-waste pollutants, E waste hazardous properties, Effects of pollutant (E- waste) on human health and surrounding environment, domestic e-waste disposal, Basic principles of E waste management, Component of E waste management. E-waste (Management and Handling) Rules, 2011; and E-Waste (Management) Rules, 2022 - Salient Features and its implications.

Self-Study Component (SSC): E-Waste (Management) Amendment Rules, 2023, 2024**.**

Text Book 1: CH- 6, Text Book 2: CH-2, e-resource:3

Course outcomes (Course Skill Set):

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

CO1: Comprehend the principles of ecology and environmental issues pertaining to air, land, and water on a global scale. (PO – 1, 2, 3, 4, 6, 7)

CO2: Acquire observation skills for solving problems related to the environment. (PO – 1, 2, 3, 4, 6, 7)
CO3: Conduct survey to describe the realities of waste management system. (PO – 1, 2, 3, 4, 5, 6, 7)
CO4: Apply their ecological knowledge to illustrate and graph a problem and describe the realities that managers face when dealing with complex issues (PO – 1, 2, 3, 4, 5, 6, 7)
CO5: Understand the sources, types, and composition of electronic waste and its impact on the environment and human health. (PO – 1, 2, 3, 4, 5, 6, 7)

Assessment Details CIE:

The weightage of Continuous Internal Evaluation (CIE) is 100% and the minimum passing mark for the CIE is 40% of the maximum marks (40 marks out of 100). 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 CIE (Continuous Internal Evaluation).

Continuous Internal Evaluation:

- There are 50 marks for the CIE's Assignment component and 50 for the Internal Assessment Test component.
- Each test shall be conducted for 50 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 50 marks.
- Any two assignment methods mentioned in the regulations; 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.
- The final CIE marks of the course out of 100 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.

Suggested Learning Resources:

Text Books:

1. S M Prakash, "Environmental Studies" 3rd Edition, Elite Publishing House, Mangalore, 2018.
2. Hester R.E., and Harrison R.M, Electronic Waste Management. Science, 2009.

Reference Books:

1. Earch Barucha, "Environmental Studies for UG students", 2004.
2. Benny Joseph (2005), "Environmental Studies", Tata McGraw – Hill Publishing Company Limited.
3. R. Rajagopalan, "Environmental Studies- From Crisis to Cure", 2nd Edition, Oxford university press, New Delhi, 2013.

Web links and Video Lectures(e-Resources):

- https://www.youtube.com/watch?v=VYVriv2vWxE
- https://www.youtube.com/watch?v=yxA6ilJp5fk

- https://www.youtube.com/watch?v=Ccu_wQqT1kA
- https://www.youtube.com/watch?v=hqq4waDUrnk
- https://www.youtube.com/watch?v=RQSM4Z-hgUo
- https://www.youtube.com/watch?v=oepriQ_TOLo
- https://www.youtube.com/watch?v=qS8mfAX1tAk
- NPTEL materials.

VI SEMESTER

Deep Learning			
Course Code	24CI61	**CIE Marks**	50
Teaching Hours/Week (L: T: P)	3:0:0	**SEE Marks**	50
Credits	03	**Total Marks**	100
Contact Hours	40	**Exam Hours**	03
Examination type (SEE)	Theory		

Prerequisites:

The students should have knowledge of

- Engineering Mathematics (Linear Algebra – matrices, eigenvalues, vector spaces)
- Probability and Statistics (random variables, distributions, Bayes theorem)
- Basic Machine Learning concepts (supervised & unsupervised learning)

Course Objectives:

- Understand the fundamentals of artificial neural networks and deep learning.
- Understanding the working of Convolutional Neural Networks and RNN in decision making.
- Illustrate the strength and weaknesses of many popular deep learning approaches.
- Introduce major deep learning algorithms, the problem settings, and their applications to solve real world problems.

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 **08 Hours**

Introduction: What is a Neural Network? The Human Brain, Models of a Neuron, Neural Networks Viewed as Directed Graphs, Feedback, Network Architectures.

Rosenblatt's Perceptron: Introduction, Perceptron, The Perceptron Convergence Theorem, Relation Between the Perceptron and Bayes Classifier for a Gaussian Environment.

Text Book 1: Introduction (1 to 6), Chapter 1 (1.1 to 1.4)

Module-2 **08 Hours**

Multilayer Perceptrons: Introduction, Batch Learning and On-Line Learning, The Back-Propagation Algorithm, XOR Problem, Heuristics for Making the Back- Propagation Algorithm Perform Better, Back Propagation and Differentiation.

Text Book 1: Chapter 4 (4.1, 4.3 to 4.6, 4.8)

Module-3	08 Hours

Regularization for Deep Learning: Parameter Norm Penalties - L^2 Parameter Regularization, Dataset Augmentation, Semi-Supervised Learning.

Optimization for Training Deep Models: Challenges in Neural Network Optimization – Ill Conditioning, Local Minima, Plateaus, Saddle Points and Other Flat Regions.

Text Book 2: Chapter 7 - 7.1 (7.1.1), 7.4, 7.6; Chapter 8 – 8.2 (8.2.1, 8.2.2, 8.2.3)

Module-4	08 Hours

Convolutional Networks: The Convolution Operation, Motivation, Pooling, Convolution and Pooling as an Infinitely Strong Prior, Variants of the Basic Convolution Function, Structured Outputs, Data Types, Efficient Convolution Algorithms, Convolutional Networks and the History of Deep Learning.

Text Book 2: Chapter 9 (9.1 to 9.8, 9.11)

Module-5	08 Hours

Sequence Modeling: Recurrent and Recursive Nets: Unfolding Computational Graphs, Recurrent Neural Networks, Bidirectional RNNs, Encoder-Decoder Sequence-to- Sequence Architectures, Deep Recurrent Networks, Recursive Neural Networks, The Long Short-Term Memory and Other Gated RNNs.

Text Book 2: Chapter 10 (10.1 to 10.6, 10.10)

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:

- 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 regulations; 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 Institute 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. Simon Haykin, Neural networks and Learning Machines, Third Edition, Pearson, 2016.
2. Ian Goodfellow, Yoshua Bengio and Aaron Courville, Deep Learning, MIT Press, 2016.

Web links and Video Lectures(e-Resources):

- https://www.youtube.com/watch?v=VyWAvY2CF9c
- https://www.youtube.com/watch?v=7sB052Pz0sQ
- https://www.youtube.com/watch?v=Mubj_fqiAv8
- https://www.coursera.org/learn/neural-networks-deep-learning
- https://onlinecourses.nptel.ac.in/noc20_cs62/preview

Natural Language Processing			
Course Code	24CI62	**CIE Marks**	50
Teaching Hours/Week (L: T: P)	3:0:2	**SEE Marks**	50
Credits	04	**Total Marks**	100
Contact Hours	40 T + 20 P	**Exam Hours**	03
Examination type (SEE)	Theory		

Prerequisites:

The students should have knowledge of

- Engineering Mathematics - Linear Algebra, Statistics.
- Programming Languages such as Python.
- Data Structures, Algorithms and Probability Concepts

Course Objectives:

- To provide the fundamental understanding of Natural Language Processing concepts, architectures, and frameworks for solving engineering problems.
- To introduce popular NLP libraries and tools for developing real-world applications in domains such as Healthcare, Smart Cities, and Agriculture.
- To facilitate students in designing and developing intelligent agents using Transformer-based models for natural language understanding and generation.
- To impart knowledge of modern NLP tools and techniques through practical problem-solving, presentations, and technical reports.
- To encourage teamwork and collaborative development of NLP-based solutions for societal benefit.

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 **08 Hours**

Introduction to NLP: NLP in the Real-world, NLP Tasks, what is Language: Building Blocks of Language, Why NLP is Challenging, Machine Learning, Deep Learning, and NLP: An Overview, Approaches to NLP: Heuristic-based NLP, Machine Learning for NLP, Deep Learning for NLP, Why

Deep Learning is not Yet the Silver Bullet for NLP, An NLP Walkthrough: Conversational Agents.

Text Book 1: Chapter 1

Module-2	**08 Hours**

NLP Pipeline: Data Acquisition, Text Extraction and Cleanup: HTML Parsing and Cleanup, Unicode Normalization, Spelling Correction, System-Specific Error Correction, Pre-Processing: Preliminaries, Frequent Steps, Other Pre-Processing Steps, Advanced Processing. Feature Engineering, Modeling.

Text Book 1: Chapter 2

Module-3	**08 Hours**

Text Representation: Vector Space Models, Basic Vectorization Approaches, Distributed Representations, Distributed Representations Beyond Words and Characters, Universal Text Representations, Visualizing Embeddings, Handcrafted Feature Representations,

Text Book 1: Chapter 3

Module-4	**08 Hours**

Transformers Basics: The Encoder-Decoder Framework, Attention Mechanisms, Transfer Learning in NLP, Hugging Face Transformers: Bridging the Gap, A Tour of Transformer Applications: Text Classification, Named Entity Recognition, Question Answering, Summarization, Translation, Text Generation, The Hugging Face Ecosystem: The Hugging Face Hub, Hugging Face Tokenizers, Hugging Face Datasets, Hugging Face Accelerate, Main Challenges with Transformers.

Text Classification: The Dataset: A First Look at Hugging Face Datasets, From Datasets to Data Frames, looking at the Class Distribution, How Long Are Our Tweets? From Text to Tokens: Character Tokenization, Word Tokenization, Sub-word Tokenization, Tokenizing the Whole Dataset, Training a Text Classifier: Transformers as Feature Extractors, Fine-Tuning Transformers.

Text Book 2: Chapter 1 & 2

Module-5	**08 Hours**

Transformer Anatomy: The Transformer Architecture, The Encoder: Self-Attention, The Feed-Forward Layer, Adding Layer Normalization, Positional Embeddings, Adding a Classification Head, The Decoder, Meet the Transformers: The Transformer Tree of Life, The Encoder Branch, The Decoder Branch, The Encoder-Decoder Branch.

Text Generation: The Challenge with Generating Coherent Text, Greedy Search Decoding, Beam Search Decoding, Sampling Methods, Top-k and Nucleus Sampling.

Text Book 2: Chapter 3 & 5

PRACTICAL COMPONENT OF IPCC

S. No	Experiments
1	a) Write a python program to perform tokenization by word and sentence using nltk. b) Write a python program to eliminate stopwords using nltk. c) Write a python program to perform stemming using nltk.
2	a) Write a python program to perform Parts of Speech tagging using nltk. b) Write a python program to perform lemmatization using nltk.
3	a) Write a python program for chunking using nltk. b) Write a python program to perform Named Entity Recognition using nltk.
4	a) Write a python program to find Term Frequency and Inverse Document Frequency (TF-IDF). b) Write a python program for CYK parsing (CockeYounger-Kasami Parsing) or Chart Parsing.
5	a) Write a python program to find all unigrams, bigrams and trigrams present in the given corpus. b) Write a python program to find the probability of the given statement "This is my cat" by taking an example corpus into consideration.
6	Use the Stanford named Entity recognizer to extract entities from the documents. Use it programmatically and output for each document which named entities it contains and of which type.
7	Choose any corpus available on the internet freely. For the corpus, for each document, count how many times each stop word occurs and find out which are the most frequently occurring stop words. Further, calculate the term frequency and inverse document frequency as the motivation behind this is basically to find out how important a document is to a given query. For e.g.: If the query is say: "The brown crow". "The" is less important. "Brown" and "crow" are relatively more important. Since "the" is a more common word, its tf will be high. Hence, we multiply it by idf, by knowing how common it is to reduce its weight.
8	Write the python code to perform sentiment analysis using NLP.
9	Write the python code to develop Spam Filter using NLP.
10	Write the python code to detect Fake News using NLP.

Course outcomes (Course Skill Set):

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

CO1: Apply various concepts, architectures, and frameworks of NLP to engineering problems. (PO - 1, 2, 3, 5, 11, PSO - 1, 2, 3)

CO2: Demonstrate proficiency in utilizing the core and popular NLP libraries to provide solutions to real-world applications in Healthcare, Smart Cities, Agriculture, etc. (PO -1, 2, 3, 5, 6, 11, PSO - 1, 2, 3)

CO3: Design and Develop agents that use Transformers for natural language understanding and generation. (PO - 1, 2, 3, 5, 11, PSO - 1, 2, 3)

CO4: Demonstrate the use of modern tools in solving day-to-day problems by exhibiting teamwork through oral presentations and reports. (PO - 1, 2, 3, 5, 7, 8, 9, 11, PSO - 1, 2, 3)

CO5: Collaborate in a group to build NLP solutions for the benefit of society. (PO - 3, 5, 6, 7, 8, 9, 11, PSO - 1, 2, 3)

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

- 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 the regulation. 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. 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:
Text Books:

1. Practical Natural Language Processing: A Comprehensive Guide to Building Real-World NLP Systems, Sowmya Vajjala, Bodhisattwa Majumder, Anuj Gupta & Harshit Surana ,1st Edition, 2020, O'Reilly, ISBN: 978-1-492-05405-4.
2. Natural Language Processing with Transformers: Building Language Applications with Hugging Fac, Lewis Tunstall, Leandro von Werra, and Thomas Wolf, 2022, 1st Edition, O'Reilly Media, ISBN: 978-1-098-10324-8

Reference Books:

1. Python 3 Text Processing with NLTK 3 Cookbook, Jacob Perkins 2014, 1st Edition, Packt Publishing, ISBN 978-1-78216-785-3.
2. Jurafsky, Dan., Martin, James H. Speech and Language Processing, 2nd Edition. United Kingdom: Pearson Prentice Hall, 2008.
3. Natural language processing, Eisenstein, Jacob, Online verfügbar unter https://princeton-nlp. github. io/cos484/readings/eisenstein-nlp-notes. pdf, zuletzt geprüft am 14 (2018): 2022.

Web links and Video Lectures(e-Resources):

- https://nptel.ac.in/courses/106105158
- http://www.digimat.in/nptel/courses/video/106101007/106101007.html

DevOps Lab			
Course Code	24CIL63	**CIE Marks**	50
Teaching Hours/Week (L: T: P)	0:0:2	**SEE Marks**	50
Credits	01	**Total Marks**	100
Contact Hours	24	**Exam Hours**	2
Examination type (SEE)	Practical		

Prerequisites:

The students should have knowledge of

- Programming fundamentals
- Cloud and Virtualization basics
- Networking Basics

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

Teaching-Learning Process (General Instructions)

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

1. Demonstration based teaching
2. ICT based learning using Simulation and Tools
3. Problem Based Learning

S. 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:

CO1: Demonstrate different actions performed through Version control tools like Git. (PO – 1, 2, 3, 5, 8, 9, 11, PSO – 1, 2, 3)

CO2: Perform Continuous Integration and Continuous Testing and Continuous Deployment using Jenkins by building. (PO – 1, 2, 3, 5, 8, 9, 11, PSO – 1, 2, 3)

CO3: Automating test cases using Maven & Gradle. (PO – 1, 2, 3, 5, 8, 9, 11, PSO – 1, 2, 3)

CO4: Experiment with configuration management using Ansible. (PO – 1, 2, 3, 5, 8, 9, 11, PSO – 1, 2, 3)

CO5: Demonstrate Cloud-based DevOps tools using Azure DevOps. (PO – 1, 2, 3, 5, 8, 9, 11, PSO – 1, 2, 3)

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 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 Examination:

- 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.

Web links and Video Lectures (e-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

Cryptography and Network Security			
Course Code	24CI64A	**CIE Marks**	50
Teaching Hours/Week (L: T: P)	3:2:0	**SEE Marks**	50
Credits	04	**Total Marks**	100
Contact Hours	50	**Exam Hours**	03
Examination type (SEE)	Theory		

Prerequisites:

The students should have knowledge of

- Operating Systems – Process management and basic system concepts
- Computer Networks – OSI and TCP/IP models, protocols, routing, switching
- Discrete Mathematics – Number theory (modular arithmetic, prime numbers, GCD), permutations and combinations, logic.

Course Objectives:

- Understand the basics of Cryptography concepts, Security and its principle
- To analyse different Cryptographic Algorithms
- To illustrate public and private key cryptography
- To understand the key distribution scenario and certification
- To understand approaches and techniques to build protection mechanism in order to secure computer networks.

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) 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	10 Hours

A model for Network Security.

Classical encryption techniques: Symmetric cipher model, Substitution ciphers-Caesar Cipher, Monoalphabetic Cipher, Playfair Cipher, Hill Cipher, Polyalphabetic Ciphers, One time pad, Steganography.

Block Ciphers and Data Encryption Standards: Traditional Block Cipher structures, data Encryption Standard (DES), A DES Example, The strength of DES, Block cipher design principles.

Text Book 1: Chapter 1: 1.8; Chapter 3: 3.1, 3.2, 3.5; Chapter 4: 4.1, 4.2, 4.3, 4.4, 4.5

Module-2	10 Hours

Pseudorandom number Generators: Linear Congruential Generators, Blum Blum Shub Generator.

Public key cryptography and RSA: Principles of public key cryptosystems-Public key cryptosystems, Applications for public key cryptosystems, Requirements for public key cryptography, public key Cryptanalysis, The RSA algorithm: Description of the Algorithm, Computational aspects, The Security of RSA.

Diffie-Hellman key exchange: The Algorithm, Key exchange Protocols, Man-in-the-middle Attack, Elliptic Curve Cryptography: Analog of Diffie-Hellman key Exchange, Elliptic Curve Encryption/Decryption, Security of Elliptic Curve Cryptography.

Text Book 1: Chapter 8: 8.2; Chapter 9: 9.1, 9.2; Chapter 10: 10.1, 10.4

Module-3	10 Hours

Applications of Cryptographic Hash functions, two simple Hash functions,

Key management and distribution: Symmetric key distribution using symmetric encryption, Symmetric key distribution using asymmetric encryption, Distribution of public keys, X.509 Certificates, Public Key Infrastructures.

Text Book 1: Chapter 11: 11.1, 11.2; Chapter 14: 14.1, 14.2, 14.3, 14.4, 14.5

Module-4	10 Hours

User Authentication: Remote user authentication principles, Kerberos, Remote user authentication using asymmetric encryption.

Web security consideration, Transport layer security.

Email Threats and comprehensive email security, S/MIME, Pretty Good Privacy.

Text Book 1: Chapter 15: 15.1, 15.3, 15.4; Chapter 17: 17.1, 17.2; Chapter 19: 19.3, 19.4, 19.5

Module-5	10 Hours

Domain keys Identified Mail.

IP Security: IP Security overview, IP Security Policy, Encapsulating Security Payload, Combining security associations, Internet key exchange.

Text Book 1: Chapter 19: 19.9; Chapter 20: 20.1, 20.2, 20.3, 20.4, 20.5

Course outcomes (Course Skill Set):

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

CO1: Explain the basic concepts of Cryptography and Security aspects. (PO – 1, 2, PSO – 1, 2, 3)
CO2: Apply different Cryptographic Algorithms for different applications. (PO – 1, 2, 3, PSO – 1, 2, 3)
CO3: Analyze different methods for authentication and access control. (PO – 1, 2, 3, 5, PSO – 1, 2, 3)
CO4: Describe key management, key distribution and Certificates. (PO – 1, 2, 3, PSO – 1, 2, 3)
CO5: Explain about Electronic mail and IP Security. (PO – 1, 2, 5, 11, PSO – 1, 2, 3)

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:

- 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 regulations; 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 Institute 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 Book:

1. William Stallings, "Cryptography and Network Security", Pearson Publication, Seventh Edition.

Reference Books:

1. Keith M Martin, "Everyday Cryptography", Oxford University Press.
2. V.K Pachghare, "Cryptography and Network Security", PHI, 2nd Edition.

Web links and Video Lectures(e-Resources):

- https://nptel.ac.in/courses/106105162
- https://onlinecourses.nptel.ac.in/noc22_cs90/preview

Information Retrieval			
Course Code	24CI64B	**CIE Marks**	50
Teaching Hours/Week (L: T: P)	3:2:0	**SEE Marks**	50
Credits	04	**Total Marks**	100
Contact Hours	50	**Exam Hours**	03
Examination type (SEE)	Theory		

Prerequisites:

The students should have knowledge of

- Data Structures – Arrays, Linked Lists, Trees, Hashing, Graphs
- Design and Analysis of Algorithms – Searching, sorting, complexity analysis
- Discrete Mathematics – Sets, relations, logic, combinatorics.

Course Objectives:

- Understand the need of an information retrieval system.
- Understand various retrieval models and the factors of evaluation.
- Explore on text, query and indexed based processing for information retrieval.
- Realize the importance of user interfaces for visualization and the web-based search.

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) 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 **10 Hours**

Introduction: Information retrieval, IR problem, IR System, The web. User interfaces for search: Introduction, how people search, Search interfaces today, Visualization on search interfaces, Design and evaluation of search interfaces.

Text Book 1: Chapter 1: 1.1 to 1.4, Chapter 2: 2.1 to 2.5

Module-2 **10 Hours**

Modeling: IR models, Classic information retrieval, Alternative set theoretic models, Alternative

algebraic models, Alternative probabilistic models, other models.

Text Book 1: Chapter 3: 3.1 to 3.6

Module-3 **10 Hours**

Retrieval Evaluation: Retrieval metrics, Reference Collections, User-based evaluation Relevance feedback and Query expansion: A framework for feedback methods, Explicit relevance feedback, Explicit feedback through clicks, Implicit feedback through local analysis, Implicit feedback through global analysis Documents - Languages and Properties: Metadata, Document formats, Text properties, Document preprocessing, Organizing documents, Text compression**.**

Text Book 1: Chapter 4: 4.3 to 4.5, Chapter 5: 5.2 to 5.6, Chapter 6: 6.2 to 6.3, 6.5 to 6.8

Module-4 **10 Hours**

Indexing and Searching: Inverted indexes, Signature files, Suffix trees and suffix arrays, Sequential searching, multi-dimensional indexing.

Text Book 1: Chapter 9: 9.2 to 9.6

Module-5 **10 Hours**

Web retrieval: The web, Search engine architectures, Search engine ranking, Managing web data, Search engine user interaction. Structured Text Retrieval: Structuring Power, Early text retrieval models, XML retrieval, XML retrieval evaluation.

Text Book 1: Chapter 11: 11.2 to 11.7, Chapter 13: 13.2 to 13.5

Course outcomes (Course Skill Set):

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

CO1: Identify the models and the tools for building an Information Retrieval system. (PO – 1, 2, 3, PSO – 1, 2, 3)

CO2: Apply query-based operations for information retrieval. (PO – 1, 2, 3, PSO – 1, 2, 3)

CO3: Use of text-based operations for information retrieval from the documents. (PO – 1, 2, 3, 5, PSO – 1, 2, 3)

CO4: Apply indexing and searching techniques for information retrieval. (PO – 1, 2, 3, PSO – 1, 2, 3)

CO5: Design user interface for search and retrieval of information from the web/documents. (PO – 1, 2, 5, 11, PSO – 1, 2, 3)

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:

- 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 regulations; 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 Institute 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 Book:

1. Ricardo Baeza Yates and Berthier Ribeiro Neto, Modern Information Retrieval, 2nd Edition, Pearson 2011.

Reference Books:

1. Stefan Buettcher, Charles L. A. Clarke and Gordon V. Cormack, ―Information Retrieval: Implementing and Evaluating Search Engines, The MIT Press, 2010.
2. Information Storage and Retrieval Systems: Theory and Implementation, Kowalski, Gerald, Mark T Maybury, Springer, 2nd Edition, 2002.
3. Modern Information Retrieval, Ricardo Baeza-Yates, Pearson Education, 2007.

Web links and Video Lectures(e-Resources):

- https://www.youtube.com/watch?v=cv7ztWiIaAM
- https://www.youtube.com/watch?v=ecRMy60oBrA
- https://www.youtube.com/watch?v=dXHxPvAIwcI
- https://www.youtube.com/playlist?list=PLpwnR8mPhhf8m7L_b9cSRLdjPW2soerAd

- https://www.youtube.com/watch?v=m0oiAOgSQFw
- https://www.youtube.com/watch?v=yluvahNq3wk

AI Hardware Architectures			
Course Code	24CI64C	**CIE Marks**	50
Teaching Hours/Week (L: T: P)	3:2:0	**SEE Marks**	50
Credits	04	**Total Marks**	100
Contact Hours	50	**Exam Hours**	03
Examination type (SEE)	Theory		

Prerequisites:

The students should have knowledge of

- Computer Organization and Architecture Concepts.
- Artificial Intelligence and Machine Learning Fundamentals.
- Programming languages such as Python or C/C++.

Course Objectives:

- To provide the fundamental understanding of AI hardware architectures used for developing intelligent applications.
- To introduce hardware accelerators and platforms for designing and implementing AI-based solutions to real-world problems.
- To facilitate students in understanding next-generation hardware architectures for accelerating deep learning applications.
- To impart knowledge of analyzing and evaluating AI hardware architectures across various application domains.
- To encourage teamwork and collaborative learning through case studies and practical exploration of AI hardware systems.

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) 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	10 Hours

AI Accelerators for Standalone Computer: Introduction, Hardware Accelerators for Standalone Compute: Inference and Training of DNNs, Accelerating DNN Computation, Considerations in Hardware Design, Deep Learning Frameworks, Hardware Accelerators in GPU: History and Overview, GPU Architecture, GPU Acceleration Techniques, Hardware Accelerators in NPU: History and Overview, Standalone Accelerating System Characteristics, Architectures of Hardware Accelerator in NPU, SOTA Architectures**.**

Text Book 1: Chapter 2

Module-2	10 Hours

Introduction to Hardware Accelerator Systems for Artificial Intelligence and Machine Learning – I: Introduction, Deep learning, and neural network acceleration, HW accelerators for artificial neural networks and machine learning, SW framework for deep neural networks, Comparison of FPGA, CPU and GPU**.**

Introduction to Hardware Accelerator Systems for Artificial Intelligence and Machine Learning – II: Hardware inference accelerators for deep neural networks: Architectures of hardware accelerators, Eyeriss: hardware accelerator using a spatial architecture, UNPU and BIT FUSION: hardware accelerators using shiftbased multiplier, Digital neuron: a multiplier-less massive parallel processor, Power saving strategies for hardware accelerators, Hardware inference accelerators using digital neurons, System architecture, Implementation, and experimental results.

Text Book 2: Chapter 1 & 3

Module-3	10 Hours

Hardware Accelerator Systems for Embedded Systems: Introduction, Neural network computing in embedded systems: Driving neural network computing into embedded systems, Considerations for choosing embedded processing solutions, Hardware acceleration in embedded systems: Hardware acceleration options, Commercial options for neural network acceleration, Software frameworks for neural networks.

Text Book 2: Chapter 2

Module-4	10 Hours

FPGA-based Neural Network Accelerators: Introduction.

Background: Field programmable gate array, FPGA-based acceleration systems, Challenges of FPGA-based neural network acceleration.

Accelerator architecture: Processing element, Vector architecture, Array architecture, multi-FPGA architecture, Narrow bit-precision architecture.

Design methodology: Hardware/software co-design, High-level synthesis, OpenCL, Design automation framework.

Applications: Image recognition, Speech recognition, Autonomous vehicle, Cloud computing**.**

Evaluation: Matrix-vector multiplication, Deep neural networks, Vision kernels.

Text Book 2: Chapter 5

Module-5 **10 Hours**

Deep learning with GPUs: Deep learning applications using GPU as an accelerator.

Overview of graphics processing unit: History and overview of GPU architecture, Structure of GPGPU applications, GPU microarchitecture, Evolution of GPUs.

Deep learning acceleration in GPU hardware perspective: NVIDIA tensor core, Deep learning application specific core, High-bandwidth memory, multi-GPU system, Multiple-instance GPU, GPU software for accelerating deep learning: Deep learning framework for GPU, Software support specialized for deep learning, Software to optimize data communications on multi-node GPU, Cons and pros of GPU accelerators.

Architecture of Neural Processing Unit for Deep Neural Networks: Considerations in hardware design, NPU architectures: NPU architectures for primitive neural networks, NPU architectures for DNN.

Text Book 2: Chapter 6

Course outcomes (Course Skill Set):

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

CO1: Explain the fundamental principles of popular hardware architectures available for building AI applications. (PO – 1, 2, 5, PSO – 1, 2, 3)

CO2: Design and implement AI applications over Hardware Accelerators to address the requirements of real-world problems. (PO – 1, 2, 3, 5, PSO – 1, 2, 3)

CO3: Explore the need for new-generation hardware architectures to accelerate deep learning applications. (PO – 1, 2, 3, 5, PSO – 1, 2, 3)

CO4: Analyze and review the different AI Hardware Architectures applications in various domains. (PO – 1, 2, 3, PSO – 1, 2, 3)

CO5: Collaborate in a group to study various case studies based on AI hardware architectures. (PO – 3, 5, 8, 11, PSO – 1, 2, 3)

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:

- 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 regulations; 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 Institute 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. Artificial Intelligence and Hardware Accelerators, Ashutosh Mishra, Jaekwang Cha, Hyunbin Park, Shiho Kim, Springer, ISBN 978-3-031-22170-5 (eBook), 2023.
2. Advances in Computers: Hardware Accelerator Systems for Artificial Intelligence and Machine Learning, Shiho Kim, Ganesh Chandra Deka, Elsevier, ISBN: 978-0-12-823123-4, 2021.

Reference Books:

1. General-Purpose Graphics Processor Architecture, Tor M. Aamodt, Wilson Wai Lun Fung, and Timothy G. Rogers, Morgan & Claypool Publishers, ISSN-1935-3235 (Print), 1935-3243 (Electronic), 2018.
2. Artificial Intelligence Hardware Design: Challenges and Solutions, Albert Chun Chen Liu and Oscar Ming Kin Law, IEEE Press, ISBN: 9781119810452, 2021.

Web links and Video Lectures(e-Resources):

- https://onlinecourses.nptel.ac.in/e-learning/preview/noc22_cs83
- https://www.youtube.com/watch?v=-BFuQi6ff7Y

Edge AI			
Course Code	24CI64D	**CIE Marks**	50
Teaching Hours/Week (L: T: P)	3:2:0	**SEE Marks**	50
Credits	04	**Total Marks**	100
Contact Hours	50	**Exam Hours**	03
Examination type (SEE)	Theory		

Prerequisites:

The students should have knowledge of

- Artificial Intelligence and Machine Learning concepts.
- Programming languages such as Python or C/C++.

Course Objectives:

- To provide the fundamental understanding of Edge AI concepts and their applications in engineering domains.
- To introduce hardware architectures, embedded platforms, and resource-constrained computing for Edge AI systems.
- To facilitate students in designing and implementing machine learning models and AI algorithms for edge devices.
- To impart knowledge of developing real-time Edge AI applications using modern tools and frameworks.
- To encourage teamwork, ethical practices, and responsible deployment of Edge AI solutions for societal benefit.

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) 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	10 Hours

Edge AI: Introduction to Edge AI, Defining Key terms, Why Edge AI? Differences between Edge AI and Cloud AI, Embedded Machine Learning and Tiny Machine Learning, Digital Signal Processing, Benefits of Edge AI.

Edge AI in the Real-World: Types of Applications, Building Applications Responsibly.

Text Book 1: Chapter 1 & 2

Module-2	10 Hours

Edge AI Hardware and Platforms: Sensors, Signals, and Sources of Data, Types of Sensors and Signals, Acoustic and Vibration, Visual and Scene, Motion and Position, Force and Tactile, Optical, Electromagnetic, and Radiation, Environmental, Biological, and Chemical.

Processors for Edge AI: Hardware Architecture, Microcontrollers and Digital Signal Processors, System-on-Chip, Deep Learning Accelerators, FPGAs and ASICs, Edge Servers Multi-Device Architectures, Devices and Workloads.

Text Book 1: Chapter 3

Module-3	10 Hours

Machine Learning Models for Edge AI: Feature Engineering, Working with Data Streams, Digital Signal Processing Algorithms, Combining Features and Sensors, Artificial Intelligence Algorithms, Algorithm Types by Functionality, Algorithm Types by Implementation, Optimization for Edge Devices On-Device Training.

Edge AI Workflow: Responsible AI in the Edge AI Workflow, Need of Edge AI, Determining Feasibility, Moral Feasibility, Business Feasibility, Dataset Feasibility, Technological Feasibility.

Text Book 1: Chapter 4 & 6

Module-4	10 Hours

Designing Edge AI Applications: Product and Experience Design, Design Principles, Scoping a Solution, Setting Design Goals, Architectural Design - Hardware, Software, and Services, Basic Application Architectures, Complex Application Architectures and Design Patterns. Working with Design Patterns. Accounting for choices in Design, Design Deliverables.

Text Book 1: Chapter 8

Module-5	10 Hours

Developing Edge AI Applications: An Iterative Workflow for Edge AI Development, Exploration, Goal Setting, Bootstrapping, Test and Iterate, Deployment and Support.

Evaluating Edge AI Systems: Ways to Evaluate a System, Useful Metrics, Techniques for Evaluation, Evaluation and Responsible AI.

Text Book 1: 9 & 10

Course outcomes (Course Skill Set):

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

CO1: Understand and apply the fundamentals and key concepts of Edge AI for developing engineering applications. (PO – 1, 2, 5, PSO – 1, 2, 3)

CO2: Analyze and select appropriate hardware architectures and platforms to build Edge AI-based engineering applications. (PO – 1, 2, 3, 5, PSO – 1, 2, 3)

CO3: Design machine learning models and AI algorithms for Edge AI devices based on basic principles. (PO – 1, 2, 3, 5, PSO – 1, 2, 3)

CO4: Develop Edge AI applications using modern tools to benefit various engineering domains and society. (PO – 1, 2, 3, PSO – 1, 2, 3)

CO5: Demonstrate teamwork while developing the Edge AI systems using appropriate metrics and techniques, ensuring ethical and responsible AI practices. (PO – 3, 5, 8, 11, PSO – 1, 2, 3)

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:

- 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 regulations; 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 Institute 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 Book:

1. Daniel Situnayake, "AI at the Edge", O'Reilly, 2023, Publisher(s): O'Reilly Media, Inc. ISBN: 9781098120207.

Reference Books:

1. Edge AI Convergence of Edge Computing and Artificial Intelligence Xiaofei Wang · Yiwen Han Victor C. M. Leung · Dusit Niyato Xueqiang Yan · Xu Chen, Springer Nature, ISBN 978-981-15-6185-6.
2. TinyML: Machine Learning with TensorFlow Lite on Arduino and Ultra-Low-Power Microcontrollers by Pete Warden, Daniel Situnayake December 2019 Publisher(s): O'Reilly Media, Inc. ISBN: 9781492051992.

Web links and Video Lectures(e-Resources):

- https://www.youtube.com/watch?v=_X6p-p6VOb4
- https://www.youtube.com/watch?v=ON_ndZNDjok

Research Methodology and IPR			
Course Code	24RM65	**CIE Marks**	50
Teaching Hours/Week (L: T: P)	3:0:0	**SEE Marks**	50
Credits	03	**Total Marks**	100
Contact Hours	40	**Exam Hours**	03
Examination type (SEE)	Theory		

Prerequisites:

NIL

Course Objectives:

- To Understand the knowledge on basics of research and its types.
- To Learn the concept of Literature Review, Technical Reading, Attributions and Citations.
- To learn Ethics in Engineering Research.
- To Discuss the concepts of Intellectual Property Rights in engineering.

Teaching-Learning Process (General Instructions)

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

1. Lecturer methods (L) need not be only the traditional lecture methods, but alternative effective teaching methods could be adopted to attain the outcomes.
2. Use of Video to explain various concepts on IPR.
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. Introduce Topics in manifold representations.
6. Show the different ways to analyze the research problem and encourage the students to come up with their own creative ways to solve them.
7. Discuss how every concept can be applied to the real world - and when that's possible, it helps Improve the students' understanding.

Module-1 **08 Hours**

Introduction: Meaning of Research, Objectives of Engineering Research, and Motivation in Engineering Research, Types of Engineering Research, Finding and Solving a Worthwhile Problem. Ethics in Engineering Research, Ethics in Engineering Research Practice, Types of Research Misconduct, Ethical Issues Related to Authorship.

Text Book 1: Chapter 1

Module-2 **08 Hours**

Literature Review and Technical Reading: New and Existing Knowledge, Analysis and Synthesis of Prior Art Bibliographic Databases, Web of Science, Google and Google Scholar, Effective Search: The

Way Forward Introduction to Technical Reading Conceptualizing Research, Critical and Creative Reading, Taking Notes While Reading, Reading Mathematics and Algorithms, Reading a Datasheet.

Attributions and Citations: Giving Credit Wherever Due, Citations: Functions and Attributes, Impact of Title and Keywords on Citations, Knowledge Flow through Citation, Citing Datasets, Styles for Citations, Acknowledgments and Attributions, What Should Be Acknowledged, Acknowledgments in, Books Dissertations, Dedication or Acknowledgments.

Text Book 1: **Chapter 2 & 3**

Module-3 **08 Hours**

Introduction To Intellectual Property: Role of IP in the Economic and Cultural Development of the Society, IP Governance, IP as a Global Indicator of Innovation, Origin of IP, History of IP in India. Major Amendments in IP Laws and Acts in India.

Patents: Conditions for Obtaining a Patent Protection, To Patent or Not to Patent an Invention. Rights Associated with Patents. Enforcement of Patent Rights. Inventions Eligible for Patenting. Non-Patentable Matters. Patent Infringements. Avoid Public Disclosure of an Invention before Patenting.

Process of Patenting: Prior Art Search. Choice of Application to be Filed. Patent Application Forms. Jurisdiction of Filing Patent Application. Publication. Pre-grant Opposition. Examination. Grant of a Patent. Validity of Patent Protection. Post-grant Opposition. Commercialization of a Patent. Need for a Patent Attorney/Agent. Can a Worldwide Patent be Obtained? Do I Need First to File a Patent in India? Patent Related Forms. Fee Structure. Types of Patent Applications. Commonly Used Terms in Patenting. National Bodies Dealing with Patent Affairs. Utility Models.

Text Book 1: Chapter 4, 5 & 6

Module-4 **08 Hours**

Copyrights and Related Rights: Classes of Copyrights. Criteria for Copyright. Ownership of Copyright. Copyrights of the Author. Copyright Infringements. Copyright Infringement is a Criminal Offence. Copyright Infringement is a Cognizable Offence. Fair Use Doctrine. Copyrights and Internet. Non-Copyright Work. Copyright Registration. Judicial Powers of the Registrar of Copyrights. Fee Structure. Copyright Symbol. Validity of Copyright. Copyright Profile of India. Copyright and the word 'Publish'. Transfer of Copyrights to a Publisher. Copyrights and the Word 'Adaptation'. Copyrights and the Word 'Indian Work'. Joint Authorship. Copyright Society. Copyright Board. Copyright Enforcement Advisory Council (CEAC). International Copyright Agreements, Conventions and Treaties. Interesting Copyrights Cases.

Trademarks: Eligibility Criteria. Who Can Apply for a Trademark. Acts and Laws. Designation of Trademark Symbols. Classification of Trademarks. Registration of a Trademark is Not Compulsory. Validity of Trademark. Types of Trademarks Registered in India. Trademark Registry. Process for Trademarks Registration. Prior Art Search. Famous Case Law: Coca-Cola Company vs. Bisleri International Pvt. Ltd.

Text Book 1: Chapter 7 & 8

Module-5 **08 Hours**

Industrial Designs: Eligibility Criteria. Acts and Laws to Govern Industrial Designs. Design Rights. Enforcement of Design Rights. Non-Protectable Industrial Designs India. Protection Term. Procedure for Registration of Industrial Designs. Prior Art Search. Application for Registration. Duration of the Registration of a Design. Importance of Design Registration. Cancellation of the Registered Design. Application Forms. Classification of Industrial Designs. Designs Registration Trend in India. International Treaties. Famous Case Law: Apple Inc. vs. Samsung Electronics Co.

Geographical Indications: Acts, Laws and Rules Pertaining to GI. Ownership of GI. Rights Granted to the Holders. Registered GI in India. Identification of Registered GI. Classes of GI. Non-Registerable GI. Protection of GI. Collective or Certification Marks. Enforcement of GI Rights. Procedure for GI Registration, Documents Required for GI Registration. GI Ecosystem in India.

Case Studies on Patents: Case study of Curcuma (Turmeric) Patent, Case study of Neem Patent, Case study of Basmati patent. IP Organizations in India. Schemes and Programmes.

Text Book 1: Chapter 9, 10 & 11

Course outcomes (Course Skill Set):

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

CO1: To know the meaning of engineering research. (PO – 1, 2, 4, PSO – 1, 2, 3)

CO2: To know the procedure of the literature Review and Technical Reading. (PO – 1, 2, 4, 5, 7, 9, 11, PSO – 1, 2, 3)

CO3: To understand the fundamentals of the patent laws and drafting procedure. (PO – 1, 2, 3, 6, 7, 9, 10, 11, PSO – 1, 2, 3)

CO4: Understanding the copyright laws and subject matters of copyrights and designs. (PO – 1, 3, 6, 7, 9, 10, 11, PSO – 1, 2, 3)

CO5: Understanding the basic principles of design rights. (PO – 1, 2, 3, 6, 7, 9, 10, 11, PSO – 1, 2, 3)

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:

- 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 regulations; 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 Institute 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 Book:

1. Dr. Santosh M Nejakar, Dr. Harish Bendigeri, "Research Methodology and Intellectual Property Rights", ISBN 978-93-5987-928-4, Edition: 2023-24.

Reference Books:

1. David V. Thiel "Research Methods for Engineers" Cambridge University Press, 978-1-107-03488-4.
2. Intellectual Property Rights by N. K. Acharya, Asia Law House 6th Edition. ISBN: 978-93-81849-30-9.

Web links and Video Lectures(e-Resources):

- https://www.udemy.com/courses/search/?q=research+methodology
- https://academicearth.org/
- https://alison.com/course/essentials-of-research-methodology?utm_

Introduction to Data Structures			
Course Code	24CI66A	**CIE Marks**	50
Teaching Hours/Week (L: T: P)	3:0:0	**SEE Marks**	50
Credits	03	**Total Marks**	100
Contact Hours	40	**Exam Hours**	03
Examination type (SEE)	Theory		

Prerequisites:

The students should have knowledge of

- Programming Concepts
- Concepts of Arrays and Strings
- Logical Thinking and Problem-Solving Skills.

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 that 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 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	**8 Hours**

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.

Text Book 1: Ch. 8.1 to 8.5, Ch. 12.1 to 12.8, 12.10, 12.11.
Text Book 2: Ch. 2.1 to 2.3, 2.5, 2.9.

Module-2 **8 Hours**

Stacks: Introduction, Stack Operations, Stack Implementation using Arrays, Applications of Stacks.

Queues: Introduction, Queue Operations, Queue Implementation using Arrays, Different Types of Queues: Circular Queues, Double-Ended Queues, Priority Queues, Applications of Queues.

Text Book 2: Ch. 6.1 to 6.3, Ch. 8.1 to 8.2.

Module-3 **8 Hours**

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.

Circular Singly Linked List: Introduction, Operations: Insert-Delete-Display.

Text Book 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 **8 Hours**

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.

Text Book 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 **8 Hours**

Sorting: Introduction, Bubble Sort, Selection Sort, Insertion Sort.

Searching: Introduction, Linear Search, Binary Search.

Text Book 1: Ch. 17.1, 17.2.6, 17.3.2.
Text Book 2: Ch. 11.1 to 11.3, 11.10.1.

Course outcomes (Course Skill Set):

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

CO1: Develop C programs utilizing fundamental concepts such as arrays, pointers and structures. (PO – 1,2,3,11, PSO – 1,2,3)

CO2: Apply data structures like stacks and queues to solve problems. (PO – 1,2,3,11, PSO – 1,2,3)

CO3: Develop C programs using linked lists and their various types. (PO – 1,2,3,11, PSO – 1,2,3)

CO4: Explain the fundamental concepts of trees and their practical applications. (PO – 1,2,3,11, PSO – 1,2,3)

CO5: Demonstrate different sorting and searching algorithms and determine their algorithmic complexities. (PO – 1,2,3,11, PSO – 1,2,3)

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 regulation, 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 Institute 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

Fundamentals of Operating Systems			
Course Code	24CI66B	**CIE Marks**	50
Teaching Hours/Week (L: T: P)	3:0:0	**SEE Marks**	50
Credits	03	**Total Marks**	100
Contact Hours	40	**Exam Hours**	03
Examination type (SEE)	Theory		

Prerequisites:

The students should have knowledge of

- Programming Concepts
- Concepts of Arrays and Stacks
- Logical Reasoning and Problem-Solving Skills.

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 that 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 **8 Hours**

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;

Text Book 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 **8 Hours**

Process Management: Process concept; Process scheduling; Operations on processes; Inter-process Communication

Multi-threaded Programming: Overview; Multithreading models, Thread Libraries

Text Book 1: Chapter 3: 3.1-3.4; Chapter 4: 4.1, 4.3 5, 4.4

Module-3 **8 Hours**

CPU Scheduling: Basic Concepts, Scheduling criteria, Scheduling algorithms, Thread Scheduling,

Process Synchronization: Synchronization: The critical section problem; Peterson's solution; Semaphores; Classical problems of synchronization;

Text Book 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 **8 Hours**

Deadlocks: System model; Deadlock characterization; Methods for handling deadlocks; Deadlock prevention; Deadlock avoidance; Deadlock detection and recovery from deadlock.

Memory Management: Background; Contiguous memory allocation; Paging; Structure of page table

Text Book 1: Chapter 8: 8.1-8.8; Chapter 9: 9.1-9.4 (9.4.1, 9.4.2)

Module-5 **8 Hours**

Virtual Memory Management: Background; Demand paging; Copy-on-write; Page replacement;

File System Interface: File concept; Access methods; Directory Structure, Protection, File System Implementation: File System Structure, File System Operations,

File System Internals: File Systems, File System Mounting; Partition and Mounting, File sharing;

Text Book 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:

CO1: Explain the fundamentals of operating systems. (PO – 1,2,3,11, PSO – 1,2,3)

CO2: Apply appropriate CPU scheduling algorithm for the given scenarios. (PO – 1,2,3,11, PSO – 1,2,3)

CO3: Analyse the various techniques for process synchronization and deadlock handling. (PO – 1,2,3,11, PSO – 1,2,3)

CO4: Apply the various techniques for memory management. (PO – 1,2,3,11, PSO – 1,2,3)

CO5: Analyse the importance of File System Mounting and File Sharing. (PO – 1,2,3,11, PSO – 1,2,3)

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 regulation, 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 Institute 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 Book:

1. Abraham Silberschatz, Peter Baer Galvin, Greg Gagne, Operating System Principles, 10th edition, Wiley-India, 2015.

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.
4. Ann McHoes Ida M Fylnn, Understanding Operating System, Cengage Learning, 6th Edition, 2010.
5. D.M Dhamdhere, Operating Systems: A Concept Based Approach 3rd Ed, McGraw- Hill, 2013.
6. P.C.P. Bhatt, An Introduction to Operating Systems: Concepts and Practice 4th Edition, PHI (EEE), 2014.
7. William Stallings Operating Systems: Internals and Design Principles, 6th Edition, Pearson, 2008.

Web links and Video Lectures(e-Resources):

- https://archive.nptel.ac.in/courses/106/105/106105214/
- https://archive.nptel.ac.in/courses/106/102/106102132/

Mobile Application Development			
Course Code	24CI66C	**CIE Marks**	50
Teaching Hours/Week (L: T: P)	3:0:0	**SEE Marks**	50
Credits	03	**Total Marks**	100
Contact Hours	40	**Exam Hours**	03
Examination type (SEE)	Theory		

Prerequisites:

The students should have knowledge of

- Programming Concepts
- Object-Oriented Programming Concepts
- Databases and SQL Concepts.

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 that 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 **8 Hours**

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.

Text Book 1: Chapters 1 & 2

Module-2 **8 Hours**

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.

Text Book 1: Chapters 3 & 4

Module-3	**8 Hours**

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.

Text Book 1: Chapter 5

Module-4	**8 Hours**

Activity: Introduction - Intent - Intent filter - Activity life cycle - Broadcast life cycle Service. Multimedia: Android System Architecture - Play Audio and Video - Text to Speech.

Text Book 1: Chapters 6 & 7

Module-5	**8 Hours**

SQLite Database in Android: SQLite Database – Creation and Connection of the database – Transactions. Case Study: SMS Telephony and Location Based Services.

Text Book 1: Chapters 8, 9, & 10

Course outcomes (Course Skill Set):

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

CO1: Explain Mobile Application Ecosystem like concepts, architecture, and lifecycle of mobile applications on Android (PO – 1,2,3,11, PSO – 1,2,3)

CO2: Identify the key components of mobile application frameworks and development tools. (PO – 1,2,3,11, PSO – 1,2,3)

CO3: Apply design principles to create intuitive and responsive user interfaces using appropriate UI/UX tools. (PO – 1,2,3,11, PSO – 1,2,3)

CO4: Develop Functional Mobile Applications -Integrate core functionalities such as layouts, event handling, navigation, and multimedia support into applications. (PO – 1,2,3,11, PSO – 1,2,3)

CO5: Implement local data storage mechanisms (SQLite, Shared Preferences) and external databases (Firebase, APIs) for mobile applications. (PO – 1,2,3,11, PSO – 1,2,3)

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 regulation, 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 Institute 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 Book:

1. Prasanna Kumar Dixit, "Android", Vikas Publishing House Private Ltd., Noida, 2014.

Reference Books:

1. Reto Meier and Wrox Wiley, "Professional Android 4 Application Development", 2012.
2. Zigurad Mednieks, Larid Dornin, G.Blake Meike, Masumi Nakamura, "Programming Android" , 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/
- https://developer.android.com/
- https://www.tutorialspoint.com/android
- https://www.w3schools.blog/android-tutorial

Introduction to Artificial Intelligence			
Course Code	24CI66D	**CIE Marks**	50
Teaching Hours/Week (L: T: P)	3:0:0	**SEE Marks**	50
Credits	03	**Total Marks**	100
Contact Hours	40	**Exam Hours**	03
Examination type (SEE)	Theory		

Prerequisites:

The students should have knowledge of

- Programming Concepts on Python
- Mathematical Fundamentals
- Logical Reasoning and Problem-Solving Skills.

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 that 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 **8 Hours**

What is artificial intelligence? Problems, Problem Spaces, and search.

Text Book 1: Chapters 1 & 2

Module-2 **8 Hours**

Knowledge Representation Issues, Using Predicate Logic, representing knowledge using Rules.

Text Book 1: Chapters 4, 5 & 6.

Module-3	8 Hours

Symbolic Reasoning under Uncertainty, Statistical reasoning.

Text Book 1: Chapters 7 & 8

Module-4	8 Hours

Game Playing, Natural Language Processing.

Text Book 1: Chapters 12 & 15

Module-5	8 Hours

Learning, Expert Systems.

Text Book 1: Chapters 17 & 20

Course outcomes (Course Skill Set):

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

CO1: Identify the problems where the adaptation of AI has significant impact. (PO – 1,2,3,11, PSO – 1,2,3)

CO2: Analyse the different approaches of Knowledge Representation. (PO – 1,2,3,11, PSO – 1,2,3)

CO3: Explain Symbolic Reasoning under Uncertainty and Statistical reasoning. (PO – 1,2,3,11, PSO – 1,2,3)

CO4: Derive the importance of different types of Learning Techniques. (PO – 1,2,3,11, PSO – 1,2,3)

CO5: Explain Natural Language Processing and Expert System. (PO – 1,2,3,11, PSO – 1,2,3)

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 regulation, 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 Institute 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 Book:

1. E. Rich, K. Knight & S. B. Nair, Artificial Intelligence, 3rd Edition, McGraw Hill, 2009.

Reference Books:

1. Stuart Rusell, Peter Norving, Artificial Intelligence: A Modern Approach, 2nd Edition, Pearson Education.
2. Dan W. Patterson, Introduction to Artificial Intelligence and Expert Systems, 1st Edition, Prentice Hal of India, 2015.
3. G. Luger, Artificial Intelligence: Structures and Strategies for complex problem Solving, 4th Edition, Pearson Education, 2002.
4. N.P. Padhy, "Artificial Intelligence and Intelligent Systems", Oxford University Press, 2015.

Web links and Video Lectures(e-Resources):

- https://nptel.ac.in/courses/106102220
- https://nptel.ac.in/courses/106105077
- https://archive.nptel.ac.in/courses/106/105/106105158/
- https://archive.nptel.ac.in/courses/106/106/106106140/

Mini Project			
Course Code	24CIP67	**CIE Marks**	100
Teaching Hours/Week (L: T: P)	0:0:4	**SEE Marks**	-
Credits	02	**Total Marks**	100
Contact Hours	-	**Exam Hours**	-
Examination type (SEE)	-		

Prerequisites:

Nil

Course Contents

Guidelines:

In order to address challenges within the realm of cutting-edge technologies, students are required to collaborate in groups of three or four. Each group focuses on solving a problem within a specific domain. To provide guidance and oversight of project advancement, an Internal Guide is assigned to each batch. These guides possess expertise in the relevant domain. Should the need arise, the Internal Guide is capable of organizing clarification sessions to address any uncertainties raised by the students working on the project. These interactions are duly documented for future reference.

Relevance of Project:

Students are expected to articulate the significance of their project within the current IT landscape and broader society.

Literature Survey:

Students must conduct a thorough review of research articles and existing projects to pinpoint gaps within the identified problem statement.

Design:

Students are required to formulate a comprehensive design document encompassing class, use case, component diagrams, state models, sequence models, activity diagrams, and interaction models.

Implementation:

Students should execute the designed model using appropriate techniques.

Presentation:

Regularly, students are to present their progress to the evaluation committee. The committee evaluates based on the quality of the presentation, depth of content coverage, adeptness in addressing raised questions, and the evident division of teamwork. Scores are determined within this criterion for individual

students.

Report:

Each group must compose a project report and submit it to the department. Reports are expected to adhere to the standardized format set by the department.

Course outcomes (Course Skill Set):

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

CO1: Conduct a systematic literature review to synthesize current knowledge, identify gaps, and justify a focused problem statement in the chosen AIML area. (PO - 1,11, PSO - 1, 2, 3)

CO2: Formulate specific objectives and select appropriate methods/tools (e.g., theoretical analysis, simulations, model development, hardware/edge deployment) aligned to the problem context. (PO – 8,9,10,11, PSO – 1,2,3)

CO3: Design and implement a working solution (code/simulation/prototype), following sound engineering practices, reproducible workflows, and version control. (PO – 1,2,3,4,5,6,7,8,9,10,11, PSO – 1,2,3)

CO4: Plan tasks and milestones; maintain a professional journal/progress reports that evidence work completed, decisions taken, and a schedule for remaining tasks within the allotted timeline. (PO – 1,2,3,4,5,6,7,8,9,10,11, PSO – 1,2,3)

CO5: Deliver a structured technical presentation demonstrating individual contributions, and produce a formal report that clearly documents methodology, results, and conclusions. (PO – 1,2,4,8,9,10,11, PSO – 1,2,3)

Assessment Details (CIE):

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.

Indian Knowledge System			
Course Code	24IKS69	**CIE Marks**	100
Teaching Hours/Week (L: T: P)	1:0:0	**SEE Marks**	-
Credits	NCMC – Non Credit Mandatory Course (Completion of the course shall be mandatory for the award of degree)	**Total Marks**	100
Contact Hours	15	**Exam Hours**	-
Examination type (SEE)	NA		

Course objectives:

- To facilitate the students with the concepts of Indian traditional knowledge and to make them understand the Importance of roots of knowledge system.
- To make the students understand the traditional knowledge and analyse it and apply it to their day-to-day life.

Module-1 **5 Hours**

Introduction to Indian Knowledge Systems (IKS): Overview, Vedic Corpus, Philosophy, Character scope and importance, traditional knowledge vis-a-vis indigenous knowledge, traditional knowledge vs. western knowledge.

Module-2 **5 Hours**

Traditional Knowledge in Humanities and Sciences: Lingistics, Number and measurements-Mathematics, Chemistry, Physics, Art, Astronomy, Astrology, Crafts and Trade in India and Engineering and Technology.

Module-3 **5 Hours**

Traditional Knowledge in Professional domain: Town planning and architecture- Construction, Health, wellness and Psychology-Medicine, Agriculture, Governance and public administration, United Nations Sustainable development goals.

Course outcomes (Course Skill Set)

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

CO1: Provide an overview of the concept of the Indian Knowledge System and its importance. (PO - 1,7,11)

CO2: Appreciate the need and importance of protecting traditional knowledge. (PO - 6)

CO3: Recognize the relevance of Traditional knowledge in different domains. (PO - 3,4)

CO4: Establish the significance of Indian Knowledge systems in the contemporary world. (PO – 6)

Reference Books

1	**Introduction to Indian Knowledge System- concepts and applications**, B Mahadevan, Vinayak Rajat Bhat, Nagendra Pavana R N, 2022, PHI Learning Private Ltd, ISBN-978-93-91818-21-0
2	**Traditional Knowledge System in India**, Amit Jha, 2009, Atlantic Publishers and Distributors (P) Ltd., ISBN-13: 978-8126912230,
3	**Knowledge Traditions and Practices of India**, Kapil Kapoor, Avadesh Kumar Singh, Vol. 1, 2005, DK Print World (P) Ltd., ISBN 81-246-0334,
Suggested Web Links:	
1.	https://www.youtube.com/watch?v=LZP1StpYEPM
2.	http://nptel.ac.in/courses/121106003/
3.	http://www.iitkgp.ac.in/department/KS;jsessionid=C5042785F727F6EB46CBF432D7683B63 (Centre of Excellence for Indian Knowledge System, IIT Kharagpur)
4.	https://www.wipo.int/pressroom/en/briefs/tk_ip.html
5.	https://unctad.org/system/files/official-document/ditcted10_en.pdf
6.	http://nbaindia.org/uploaded/docs/traditionalknowledge_190707.pdf
7.	https://unfoundation.org/what-we-do/issues/sustainable-development goals/?gclid=EAIaIQobChMInp-Jtb_p8gIVTeN3Ch27LAmPEAAYASAAEgIm1vD_BwE

ASSESSMENT AND EVALUATION PATTERN	
WEIGHTAGE	**100% (CIE)**
QUIZZES	
Quiz-I	Each quiz is evaluated for 10 marks adding up to **20 Marks**
Quiz-II	
THEORY COURSE - (Bloom's Taxonomy Levels: Remembering, Understanding, Applying, Analyzing, Evaluating, and Creating)	
Test – I	Each test will be conducted for 25 Marks adding upto 50 marks. Final test marks will be reduced to **40 Marks**
Test – II	
EXPERIENTIAL LEARNING	**40**
Case Study-based Teaching-Learning	--
Sector wise study & consolidation (viz., Engg. Semiconductor Design, Healthcare & Pharmaceutical, FMCG, Automobile, Aerospace and IT/ ITeS)	--
Video based seminar (4-5 minutes per student)	--
Maximum Marks for the Theory	--
Practical	--
Total Marks for the Course	**100**