



MAHARAJA INSTITUTE OF TECHNOLOGY MYSORE

Autonomous Institution Affiliated to VTU

Competency Based Syllabus (CBS)

for

Computer Engineering

(Under Outcome Based Education (OBE) and

Choice-Based Credit System (CBCS))

Offered from 7th to 8th Semesters of Study

in

Partial Fulfillment for the Award of Bachelor's Degree in

Computer Engineering

2023 Scheme

Scheme Effective from the academic year 2023-24

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7 th Semester	MS MANAGEMENT AND ENTREPRENEURSHIP	M23BCS701
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1. Prerequisites

S/L	Proficiency	Prerequisites
1.	Development of management thought	How the classical way to approaches the management.
2.	Social responsibilities of business	New Management Challenges for the New Age towards different groups and performance of business.
3.	Decision making and business forecasting and operations research	The responsibility of making decisions on behalf of both the organization and the stakeholder's rationality, behavior of difficult decision making and forecasting of business, classification, methods, technics and operation.
4.	Source of finance and marketing channel	Entrepreneur looks at defeat as an opportunity for success. They are determined to make all of their endeavors succeed to source of development finance and project financing and setting quality standards.
5	Project management	Looks at identification, formulation, design and network analysis

2. Competencies

S/L	Competency	KSA Description
1	Management:	Knowledge: Management is how businesses organize and direct workflow, operations, and employees to meet company goals. Skills: The primary goal of management is to create an environment that empowers employees to work efficiently and productively Attitudes: Management is a dynamic function and evolves and adapts to changes in its environment, whether they are economic, socio-political or technological.
2	Administration	Knowledge: performance of supervising duties, management. Skills: Administration skills involve organization, communication, teamwork, customer service, responsibility and time management. Attitudes: It is a collaborative activity that involves writing, correspondence, and other administrative tasks. Administration is essential in both small, local organizations and large, complex enterprises.
3	Planning	Knowledge: Planning is essential for the establishment of goals, policies, and procedures for a social or economic unit Skills: Process used to develop objectives, develop tasks to meet objectives, determine needed resources, create a timeline, determine tracking and assessment, finalize the plan, and distribute the plan to the team. Attitudes: Planning is based on foresight, the fundamental capacity for mental time travel.
4	Organizing and staffing:	Knowledge: Arranging resources and tasks to implement the plan Skills: Staffing: Recruiting, selecting, evaluation and training individuals for specific roles within the organization Attitudes: Arrange and relate the work, so that it can be done efficiently by people – specifically.
5	Directing	Knowledge: Directing: Leading and motivating employees to work towards the organization's goals. Skills: The directing function of management is the process of motivating, communicating, instructing, leading, and supervising employees in order to ensure that they are working towards the accomplishment of organizational goals

		Attitudes: It is a continuous managerial process that goes on. Throughout the life of the organization.
6.	Entrepreneur:	Knowledge: Originates from a thirteenth-century French verb, entrepreneur, meaning “to do something” or “to undertake.” Skills: Include various skill sets such as leadership, business management, time management, creative thinking and problem-solving. Attitudes: Entrepreneurs are business people who find their success by taking risks. In their pursuits, they often become disruptors in established industries.
7	Small scale industries:	Knowledge: In which manufacturing, providing services, productions are done on a small scale or micro scale. Skills: Industries that manufacture produce and render services on a small or micro scale level. Attitudes: To play an active role in reducing the regional imbalances in the nation. To help in improving the standard of living for people in rural areas.
8	Institutional support	Knowledge: Refers to the assistance, frameworks, and resources provided by formal and informal institutions to individuals Skills: The organization is running various schemes to meet its objectives. Attitudes: Approved Colleges/Registered facilitators with objective for enhancing their Employment/ Self-Employment opportunities

3. Syllabus

Management and Entrepreneurship SEMESTER – VII			
Course Code	M23BCS701	CIE Marks	50
Number of Lecture Hours/Week(L: T: P: S)	(3:0:0:0)	SEE Marks	50
Total Number of Lecture Hours	40 hours Theory	Total Marks	100
Credits	03	Exam Hours	03
Course Objectives:			
1. Explain fundamentals management functions of a manager. Also explain planning and decision making processes			
2. Explain the organizational structure, staffing and leadership process and describe the understanding of motivation.			
3. Explain understanding of Entrepreneurships and Entrepreneurship development process.			
4. Illustrate Small Scale Industries, various types of supporting agencies and financing available for an entrepreneur.			
5. Summarize the preparation of project report, need significance of report. Also to explain about industrial ownership.			
Module -1			
Management: Introduction - Meaning - nature and characteristics of Management, Scope and Functional areas of management - Management as art or science, art or profession - Management & Administration - Roles of Management, Levels of Management,			
Planning: Nature, importance and purpose of planning process objectives - Types of plans (meaning only) - Decision making, Importance of planning - steps in planning & planning premises			
Module -2			
Organizing and staffing: Nature and purpose of organization, Principles of organization – Types of organization-Departmental Committees-Centralization Vs Decentralization of authority and responsibility - Span of control - MBO and MBE (Meaning only) Nature and importance of staffing--Process of Selection & Recruitment (in brief).			
Directing: Meaning and nature of directing Leadership styles, Motivation, Theories, Communication - Meaning and importance - coordination, meaning and importance and Techniques of coordination.			
Module -3			
Entrepreneur: Meaning of Entrepreneur; Evolution of the Concept; Functions of an Entrepreneur, Types of Entrepreneur, Entrepreneur an emerging class. Concept of Entrepreneurship - Evolution of Entrepreneurship, Development of Entrepreneurship; Stages in entrepreneurial process; Role of			

entrepreneurs in Economic Development;
Module -4
Small scale industries: Definition; Characteristics; Need and rationale; Objectives; Scope; Role of SSI in Economic Development. Advantages of SSI, Steps to Start and SSI - Government policy towards SSI; Different Policies of SSI; Government Support for SSI during 5year plans. Impact of Liberalization, Privatization, Globalization on SSI Effect of WTO/GA TT Supporting Agencies of Government for SSI, Meaning, Nature of support; Objectives; Functions; Types of Help; Ancillary Industry and Tiny Industry (Definition Only).
Institutional support: Different Schemes; TECKSOK; KIADB; KSSIDC;
Module -5
Preparation of project: Meaning of Project; Project Identification; Project Selection; Project Report; Need and Significance of Report; Contents; formulation; Guidelines by Planning Commission for Project report; Network Analysis; Errors of Project Report; Project Appraisal. Identification of. Business Opportunities: Market Feasibility Study; Technical Feasibility Study; Financial Feasibility Study & Social Feasibility Study.
Industrial ownership: Definition and meaning of Partnership, Characteristics of Partnership, Kinds of Partners, Partnership Agreement or Partnership Deed
TEXTBOOKS: 1. Principles of Management – P. C. Tripathi, P.N. Reddy – Tata McGraw Hill. 2. Dynamics of Entrepreneurial Development & Management-Vasant Desai,Himalaya PublishingHouse. 3. Entrepreneurship Development – Poornima. M. Charantimath, Small Business Enterprises – PearsonEducation - 2006 (2 & 4)
Reference Books 1. Management Fundamentals - Concepts, Application, Skill Development – RobersLusier, Thomson. 2. Entrepreneurship Development - S. S. Khanka, S. Chand & Co. New Delhi. 3. Management - Stephen Robbins, Pearson Education/PHI - 17thEdition, 2003.

4. Syllabus Timeline

S/L	Syllabus Timeline	Description
1	Week 1-3: Management and Planning	Competency: Understand the basic functions managements and planning Knowledge: Management is how businesses organize and direct workflow, operations, and employees to meet company goals. Skills: The primary goal of management is to create an environment that empowers employees to work efficiently and productively.
2	Week 4-6: Organizing and staffing: Directing:	Competency: Understand the basic functions managements, committee, centralised and decentralised authority and responsibility and directing. Knowledge: Arranging resources and tasks to implement the plan. Skills: Staffing: Recruiting, selecting, evaluation and training individuals for specific roles within the organization
3	Week 8-11: Entrepreneur:	Competency: Student will able to do, arrange and relate the work, so that it can be done efficiently and – specifically. Knowledge: Entrepreneurship usually starts as a small business but the long-term vision is much greater, to seek high profits and capture market share with an innovative new idea to reach students. Skills: Include various skill sets such as leadership, business management, time management, creative thinking and problem-solving.
4	Week 7-8: Small scale industries and Institutional support	Competency: Learn the scope and manufacturing development OF SSI and institution. Knowledge: In which manufacturing, providing services, productions are done on a small scale or micro scale. Skills: Industries that manufacture produce and render services on a small or micro scale level.

5	Week 9-12: Preparation of project and Industrial ownership	Competency: student able to understand the project identification, selection, preparation and report, and also knowledge about industrial ownership. Knowledge: Students able to analyse difference between single and partner ownership and Identification of. Business Opportunities. Skills: The primary goal of management is to create an environment that empowers employees to work efficiently and productively.
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5. Teaching-Learning Process Strategies

S/L	TLP Strategies:	Description
1	Lecture Method	Utilize various teaching methods within the lecture format to management and entrepreneurship.
2	Video/Animation	Incorporate visual aids like videos/animations to enhance understanding of management and entrepreneur activities.
3	Collaborative Learning	Encourage collaborative learning for improved competency application.
4	Higher Order Thinking (HOTS) Questions:	Pose HOTS questions to stimulate critical thinking related to each competency

1. Assessment Details (both CIE and SEE)

Continuous Internal Evaluation:

Components		Number	Weightage	Max. Marks	Min. Marks
(i)	Internal Assessment-Tests (A)	2	50%	25	10
(ii)	Assignments/Quiz/Activity (B)	2	50%	25	10
Total Marks				50	20

Final CIE Marks = (A) + (B)

Average internal assessment shall be the average of the 2 test marks conducted.

Semester End Examination:

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

- Question paper pattern will be ten questions. Each question is set for 20 marks. The medium of the question paper shall be English unless otherwise it is mentioned.
- There shall be 2 question from each module, each of the two questions under a module (with a maximum of 3 sub questions), may have mix of topics under that module if necessary.
- The students have to answer 5 full questions selecting one full question from each module.
- Marks scored will be proportionally scaled down to 50 marks

7. Learning Objectives

S/L	Learning Objectives	Description
1	Management and Planning	Understand the fundamentals management functions of a manager. Also explain planning and decision making processes, management, object and administration
2	Organizing and staffing: Directing	Explain the organizational structure, staffing and leadership process and describe the understanding of motivation about leadership style, communication, co-ordination and technic also learn the basic functions managements, committee, centralised and decentralised authority and responsibility and directing.
3	Entrepreneur:	Analyse the Entrepreneurships and Entrepreneurship development process and

		Student will able to do, arrange and related the work, so that it can be done efficiently and – specifically.
4	Small scale industries and Institutional support	Illustrate Small Scale Industries, various types of supporting agencies and financing available for an entrepreneur and learn the scope and manufacturing development OF SSI and institution.
5	Preparation of project and Industrial ownership	Summarize the preparation of project report, need significance of report. Also to explain about industrial ownership and student able to understand the project identification, selection, preparation and report, and also knowledge about industrial ownership.

8. Course Outcomes (COs) and Mapping with POs/ PSOs

Course Outcomes (COs)

COs	Description
M23BCS701.1	Understand the management functions of a manager and also explain planning and decision making processes.
M23BCS701.2	Explain the organizational structure, staffing and leadership processes and describe the understanding of motivation
M23BCS701.3	Analyse the entrepreneurship and development process.
M23BCS701.4	Illustrate Small Scale Industries, various types of supporting agencies and financing available for an entrepreneur.
M23BCS701.5	Summarize the preparation of project report, need significance of report.

CO-PO-PSO Mapping

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
M23BCS701.1	3	-	-	-	-	-	-	-	-	-	3	-	3	-
M23BCS701.2	-	3	-	-	-	-	-	-	-	-	-	-	3	-
M23BCS701.3	-	-	-	-	-	-	-	-	-	-	-	-	3	-
M23BCS701.4	-	-	3	3	3	-	-	-	3	-	-	-	3	-
M23BCS701.5	-	-	3	3	-	-	-	-	3	-	-	-	3	-
M23BCS701	3	3	3	3	3	-	-	-	3	-	3	-	3	-

9. Assessment Plan

Continuous Internal Evaluation (CIE)

	CO1	CO2	CO3	CO4	CO5	Total
Module 1	10					10
Module 2		10				10
Module 3			10			10
Module 4				10		10
Module 5					10	10
Total	10	10	10	10	10	50

Semester End Examination (SEE)

	CO1	CO2	CO3	CO4	CO5	Total
Module 1	20					20
Module 2		20				20
Module 3			20			20
Module 4				20		20
Module 5					20	20
Total	20	20	20	20	20	100

10. Future with this Subject:

- ❖ **Management:** With the new start-ups and ongoing businesses, the business management field in India has witnessed a steady rise in demand for skilled managers. A business management degree can open the doors to many industries and you can climb up the hierarchy if you have the necessary skill
- ❖ **Planning:** Career planning is a lifelong process that can help you manage important life and work decisions. Consider your priorities, options, and strengths to build a plan that gets you where you want to go
- ❖ **Organizing and staffing:** The scope of a management system may include the whole of the organization, specific and identified functions of the organization, specific and identified sections of the organization, or one or more functions across a group of organizations. By embracing emerging technologies, leveraging data-driven insights, and adopting ethical recruiting practices, recruiters can navigate the ever-changing landscape of staffing with confidence and drive better outcomes for both employers
- ❖ **Directing:** Directing is thus concerned with instructing, guiding and inspiring people in the organisation to achieve its objectives. It's important components are communication, supervision, motivation and leadership. Supervision involves seeing that subordinates perform the work as per instructions given.
- ❖ **Entrepreneur:** Entrepreneurs in the future will need to navigate the potential job displacement and automation resulting from technological advancements. This means being adaptable and continuously learning new skills to stay relevant in the changing landscape.
- ❖ **Small scale industries:** The advantages of smallscale industry development are many. From economic growth to fostering regional development, SMEs play a pivotal role in shaping the future. They create livelihood opportunities, cater to niche markets and products, drive innovation and empower rural communities.
- ❖ **Institutional support:** Institutional planning is a part of educational planning. It is confined to a particular institution and functions keeping the goals of that particular institution. It is one of the grass roots level planning. It ensures better and more fruitful use of the resources which the institution has or can have.
- ❖ **Preparation of project:** Project scope is a part of the project planning process that documents specific goals, deliverables, features, and budgets. The scope document details the list of activities for the successful completion of the project. The scope is defined by understanding the project requirements and the client's expectations.
- ❖ **Industrial ownership:** Industrial Management deals with industrial design, construction, management, and application of science and engineering principles to improve the entire industrial infrastructure and

7 th Semester	Integrated Professional Course (IPC) NATURAL LANGUAGE PROCESSING	M23BCE702
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1. Prerequisites

S/L	Proficiency	Prerequisites
1	Mathematics	Linear Algebra: Understanding of vectors, matrices, eigenvalues, and eigenvectors. Probability and Statistics: Basic concepts such as probability distributions, Bayes' theorem, expectation, variance, and hypothesis testing. Calculus: Differentiation and integration, especially in the context of optimization and gradient descent.
2	Machine Learning Basics	Understanding of supervised and unsupervised learning. Familiarity with key algorithms such as linear regression, logistic regression, decision trees, and clustering. Basics of neural networks and deep learning.
3	Data Structures and Algorithms	Knowledge of common data structures like arrays, linked lists, stacks, queues, trees, and graphs. Understanding of algorithmic concepts like sorting, searching, and dynamic programming.
4	Text Processing:	Familiarity with regular expressions and basic text processing techniques. Basic understanding of tokenization, stemming, lemmatization, and stop-word removal
5	Basic of NLP Concepts	Awareness of what NLP is and its applications. Familiarity with terms like tokenization, parsing, language models, etc.
6	Linguistics	Basic understanding of syntax, semantics, and morphology. Awareness of linguistic structures like parts of speech, grammar, and sentence structure.

2. Competencies

S/L	Competency	KSADescription
1	Application of NLP Foundations	Knowledge: Understand the origins, challenges, and applications of NLP, particularly in language and grammar processing, including Indian languages. Skills: Analyze key challenges in NLP, apply grammar-based and statistical language models, and develop basic NLP applications. Attitude: Demonstrate curiosity about linguistic diversity, particularly Indian languages, and a commitment to addressing challenges in NLP applications.
2	Proficiency in Text Preprocessing and Analysis	Knowledge: Grasp essential text preprocessing techniques like tokenization, stemming, lemmatization, and regular expressions. Skills: Implement text preprocessing pipelines, perform word-level morphological parsing, and correct spelling errors using advanced techniques. Attitude: Exhibit attention to detail and perseverance in solving complex preprocessing challenges. Maintain adaptability when exploring new techniques or tools.

3	Language Modeling Techniques	<p>Knowledge: Understand various grammar-based and statistical language models, including modern models like Transformers.</p> <p>Skills: Develop and evaluate language models for different NLP tasks, implement n-gram models, and apply modern models like BERT or GPT.</p> <p>Attitude: Show enthusiasm for innovation and continuous learning in rapidly evolving NLP technologies. Maintain a critical perspective when evaluating models.</p>
4	Ability to Conduct Syntactic and Semantic Analysis	<p>Knowledge: Understand syntactic structures, context-free grammars, and probabilistic parsing methods; comprehend semantic role labeling and frame semantics.</p> <p>Skills: Perform syntactic parsing using context-free grammar, constituency parsing, and dependency parsing, and execute semantic analysis through role labeling.</p> <p>Attitude: Demonstrate analytical rigor and an appreciation for linguistic nuances. Foster a problem-solving mindset when tackling syntactic and semantic challenges.</p>

3. Syllabus

Natural Language Preprocessing			
Course Code	M23BCE702	CIE Marks	50
Number of Lecture Hours/Week(L: T: P: S)	(3:0:2:0)	SEE Marks	50
Total Number of Lecture Hours	40 T+20 P	Total Marks	100
Credits	04	Exam Hours	03
Course objectives: This course will enable students to CO 1. Analyze the natural language text. CO 2. Define the importance of natural language. CO 3. Understand the concepts Text mining. CO 4. Illustrate information retrieval techniques.			
Module -1			
Overview and language modeling: Overview: Origins and challenges of NLP-Language and Grammar-Processing Indian Languages- NLP Applications-Information Retrieval. Language Modeling: Various Grammar- based Language Models- Statistical Language Model. Text Book 1: Chapter 1,2			
Module -2			
Word level and syntactic analysis: Word Level Analysis: Regular Expressions-Finite State Automata-Morphological Parsing-Spelling Error Detection and correction-Words and Word classes-Part-of Speech Tagging. Syntactic Analysis: Context-free Grammar Constituency- Parsing-Probabilistic Parsing. Text Book 1: Chapter 3,4			
Module -3			
Extracting Relations from Text: From Word Sequences to Dependency Paths: Introduction, Subsequence Kernels for Relation Extraction, A Dependency-Path Kernel for Relation Extraction and Experimental Evaluation. Mining Diagnostic Text Reports by Learning to Annotate Knowledge Roles:			

Introduction, Domain Knowledge and Knowledge Roles, Frame Semantics and Semantic Role Labeling, Learning to Annotate Cases with Knowledge Roles and Evaluations.

A Case Study in Natural Language Based Web Search:

In Fact System Overview, The Global Security.org Experience.

Text Book 2: Chapter 3, 4 and Chapter 5

Module -4

Evaluating Self-Explanations in iSTART:

Word Matching, Latent Semantic Analysis, and Topic Models: Introduction, iSTART: Feedback Systems, iSTART: Evaluation of Feedback Systems,

Textual Signatures: Identifying Text-Types Using Latent Semantic Analysis to Measure the Cohesion of Text Structures:

Introduction, Cohesion, Coh-Metrix, Approaches to Analyzing Texts, Latent Semantic Analysis, Predictions, Results of Experiments.

Automatic Document Separation: A Combination of Probabilistic Classification and Finite-State Sequence Modeling:

Introduction, Related Work, Data Preparation, Document Separation as a Sequence Mapping Problem, Results.

Evolving Explanatory Novel Patterns for Semantically-Based Text Mining:

Related Work, A Semantically Guided Model for Effective Text Mining.

Text Book 12 Chapter 6, 7, 8, 9

Module -5

INFORMATION RETRIEVAL AND LEXICAL RESOURCES:

Information Retrieval: Design features of Information Retrieval Systems-Classical, Non classical, Alternative Models of Information Retrieval – valuation Lexical Resources: World Net-Frame Net Stemmers-POS Tagger- Research Corpora.

Textbook 1: Ch. 9,12

Text Books:

1. Tanveer Siddiqui, U.S. Tiwary, "Natural Language Processing and Information Retrieval", Oxford University Press, 2008.
2. Anne Kao and Stephen R. Poteet (Eds), "Natural Language Processing and Text Mining", Springer-Verlag London Limited 2007.

Reference Books:

1. Daniel Jurafsky and James H Martin, "Speech and Language Processing: An introduction to Natural Language Processing, Computational Linguistics and SpeechRecognition", 2nd Edition, Prentice Hall, 2008.
2. James Allen, "Natural Language Understanding", 2nd edition, Benjamin/Cummings publishing company, 1995.
3. Gerald J. Kowalski and Mark.T. Maybury, "Information Storage and Retrieval systems", Kluwer academic Publishers, 2000.

Programs

1	Introduction to Python for NLP: Basic string manipulation, regular expressions, and text processing.
2	Write a program to preprocess a given text document by performing tokenization, stop word removal, and stemming/lemmatization using the NLTK or SpaCy library
3	Implementing Tokenization and POS Tagging: Use NLTK or spaCy to perform tokenization and part-of-speech tagging on sample texts.
4	Define a small Context-Free grammar (CFG) for a subset of the English language. Write a parser that checks if a given sentence belongs to the language defined by your CFG.
5	Implement a basic POS tagger using the NLTK library. Compare its performance with SpaCy's pre-trained POS tagger on the same text.
6	Implement a simple Named Entity Recognition (NER) model using the NLTK library. Train it on a small custom dataset and evaluate its performance.

7	Implement Latent Semantic Analysis (LSA) to find similarity between documents in a corpus. Use the cosine similarity measure to find the most similar document to a given query document.
8	Write a program to extract subject-object-verb triplets from a given text using dependency parsing.
9	Implement a simple inverted index for a set of documents. Allow users to query the index and return ranked results based on TF-IDF.
10	Evaluation of IR Systems: Design and conduct experiments to evaluate the effectiveness of an information retrieval system using precision, recall, and F1-score.

4. Syllabus Timeline

S/L	Syllabus Timeline	Description
1	Week 1-2: Overview and Language Modeling	<p>Competency: Understand the fundamental concepts and challenges of Natural Language Processing (NLP). Develop a foundational understanding of language models and their application in NLP.</p> <p>Knowledge: Origins and evolution of NLP. Language and grammar essentials. Challenges in processing Indian languages. Key applications of NLP, such as information retrieval. Different types of grammar-based and statistical language models.</p> <p>Skills: Analyze and differentiate between various NLP challenges and applications. Apply knowledge of language models to develop basic NLP solutions.</p>
2	Week 3-4: Word Level and Syntactic Analysis	<p>Competency: Analyze text at the word level and perform syntactic parsing for NLP tasks. Understand and apply techniques for part-of-speech tagging and syntactic parsing.</p> <p>Knowledge: Basics of word-level analysis, including regular expressions and finite-state automata. Techniques for morphological parsing, spelling error detection, and correction. Understanding words and word classes. Concepts of part-of-speech tagging. Syntactic analysis using context-free grammar and constituency parsing. Introduction to probabilistic parsing techniques.</p> <p>Skills: Implement regular expressions and finite-state automata for text analysis. Perform morphological parsing and correct spelling errors in text. Develop and apply part-of-speech tagging algorithms. Parse sentences using context-free grammar and probabilistic models.</p>

3	<p>Week 5-6: Extracting Relations from Text and Case Studies</p>	<p>Competency: Extract and analyze relations from text using advanced NLP techniques. Understand and apply knowledge roles and semantic role labeling in specific domains.</p> <p>Knowledge: Techniques for extracting relations from word sequences and dependency paths. Subsequence kernels and dependency-path kernels for relation extraction. Domain knowledge and knowledge roles in text mining. Frame semantics and semantic role labeling. Case studies involving natural language-based web search.</p> <p>Skills: Apply relation extraction techniques to analyze text. Implement dependency-path kernels for improved relation extraction. Annotate text with knowledge roles using semantic role labeling. Analyze real-world case studies and apply NLP techniques for web search.</p>
4	<p>Week 7-8: Evaluating Self-Explanations and Textual Signatures</p>	<p>Competency: Evaluate and enhance textual explanations using advanced NLP techniques. Identify and classify text types based on cohesion and structure.</p> <p>Knowledge: Techniques for evaluating self-explanations using word matching, latent semantic analysis (LSA), and topic models. Introduction to iSTART feedback systems and their evaluation. Understanding textual cohesion and the use of Coh-Metrix. Analyzing texts using LSA to identify textual signatures and measure cohesion. Combining probabilistic classification and finite-state sequence modeling for document separation. Evolving novel patterns for semantically-based text mining.</p> <p>Skills: Implement word matching, LSA, and topic models to evaluate self-explanations. Use Coh-Metrix to analyze the cohesion of text structures. Apply probabilistic classification and sequence modeling for document separation. Develop and test novel approaches for semantically-based text mining.</p>
5	<p>Week 9-10: Information Retrieval and Lexical Resources</p>	<p>Competency: Design and evaluate information retrieval systems using various models. Utilize lexical resources effectively in NLP applications.</p> <p>Knowledge: Key design features of information retrieval systems. Classical, non-classical, and alternative models of information retrieval. Methods for evaluating information retrieval systems. Overview of lexical resources, including WordNet, FrameNet, stemmers, POS taggers, and research corpora.</p> <p>Skills: Design and implement information retrieval systems using different models. Evaluate the performance and effectiveness of information retrieval systems. Apply lexical resources like WordNet and FrameNet in NLP tasks.</p>

		Develop custom stemmers and POS taggers for specific applications.
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5. Teaching-Learning Process Strategies

S/L	TLP Strategies:	Description
1	Lecture Method	Utilize various teaching methods within the lecture format to reinforce competencies.
2	Video/Animation	Incorporate visual aids like videos/animation to enhance understanding of concepts.
3	Collaborative Learning	Encourage collaborative learning for improved competency application.
4	Higher Order Thinking (HOTS) Questions:	Pose HOTS questions to stimulate critical thinking related to each competency.
5	Problem-Based Learning (PBL)	Implement PBL to enhance analytical skills and practical application of competencies.
6	Pair Programming	Incorporate pair programming sessions where students collaborate in pairs to solve coding tasks or work on projects together.
7	Practical Application and Projects	To reinforce the competencies in an NLP course, practical applications and projects are essential. These hands-on activities allow students to apply the theoretical knowledge and skills they've gained in real-world scenarios.
8	Problem-Solving Sessions	Organize problem-solving sessions where students can work together to solve coding challenges and overcome programming obstacles.

6. Assessment Details (both CIE and SEE)

Theory Course with 4 credits: Integrated Professional Core Course (IPC)

Components		Number	Weightage	Max. Marks	Min. Marks
Theory (A)	Internal Assessment-Tests (A)	2	60%	15	06
	Assignments/Quiz/Activity (B)	2	40%	10	04
	Total Marks		100%	25	10
Components		Number	Weightage	Max. Marks	Min. Marks
Laboratory (B)	Record Writing	Continuous	60%	15	06
	Test at the end of the semester	1	40%	10	04
	Total Marks		100%	25	10

Final CIE Marks = (A) + (B)

Semester End Examination pattern:

1. Question paper pattern will be ten questions. Each question is set for 20 marks. The medium of the question paper shall be English unless otherwise it is mentioned.
2. There shall be 2 question from each module, each of the two questions under a module (with a maximum of 3 sub questions), may have mix of topics under that module if necessary.
3. The students have to answer 5 full questions selecting one full question from each module.
4. The question paper may include at least one question from the laboratory component.
5. Marks scored will be proportionally scaled down to 50 mark

7. Learning Objectives

S/L	Learning Objectives	Description
1	Analyze Natural Language Text	Demonstrate the ability to preprocess text data by applying techniques such as tokenization, stemming, and lemmatization to prepare text for further analysis. Implement part-of-speech tagging and syntactic parsing

		to identify grammatical structures and relationships within text.
2	Define the Importance of Natural Language Processing	Explain the role of NLP in enhancing human-computer interaction through applications like virtual assistants, chatbots, and automated translation services. Discuss how NLP technologies improve information retrieval systems, enabling better search results and data retrieval.
3	Understand the Concepts of Text Mining	Apply text preprocessing techniques to clean and prepare text data for analysis, including handling noise and normalization. Use feature extraction methods to transform text data into numerical representations suitable for analysis, such as term frequency-inverse document frequency (TF-IDF) and word embeddings
4	Illustrate Information Retrieval Techniques	Design and build a basic search engine using information retrieval models, including vector space models and Boolean retrieval. Implement and evaluate advanced retrieval techniques, such as probabilistic models and relevance feedback, to enhance search accuracy.

8. Course Outcomes (COs) and Mapping with POs/PSOs

Course Outcomes (COs)

COs	Description
M23BCE702.1	Analyze the natural language text.
M23BCE702.2	Define the importance of natural language.
M23BCE702.3	Implement and evaluate different NLP Text mining techniques.
M23BCE702.4	Illustrate information retrieval techniques.

COPO-PSO Mapping

COs/ POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO 1	PSO 2
M23BCE702.1	3										3			
M23BCE702.2		3									3			
M23BCE702.3			3									3	3	3
M23BCE702.4				3								3	3	3

9. Assessment Plan

Continuous Internal Evaluation (CIE)

	CO1	CO2	CO3	CO4	CO5	Total
Module 1	10					10
Module 2		10				10
Module 3			10			10
Module 4				10		10
Module 5					10	10
Total	10	10	10	10	10	50

Semester End Examination (SEE)

	CO1	CO2	CO3	CO4	CO5	Total
Module 1	20					20
Module 2		20				20
Module 3			20			20
Module 4				20		20
Module 5					20	20
Total	20	20	20	20	20	50

Conditions for SEE Paper Setting:

Each module of SEE question paper should be allocated with questions for 20% of the total SEE marks

10. Future with this Subject

The future of advanced Java development is poised to evolve with advancements in technology and shifts in software development practices.

1. Continued Evolution of Java: Facilitates better interoperability between Java and native code, such as C and C++, which could expand Java's usability in systems programming.

2. Adoption of Modern Frameworks and Libraries: Continued evolution of these tools to simplify the development of microservices and cloud-native applications. Integration with new cloud technologies and services.

3. Enhanced Performance and Scalability: Evolution of garbage collection algorithms to improve latency and throughput for Java applications. Increased use of reactive programming to build scalable and resilient systems that can handle high loads and real-time data.

4. Integration with Emerging Technologies: Expanded support for integrating AI and ML capabilities into Java applications with libraries like DeepLearning4J and others. Use of AI-driven tools to enhance development practices, such as automated code analysis and debugging.

5. Development Practices and Tools: Improved tools and practices for monitoring and managing the performance and health of Java applications in production environments. Advanced Integrated Development Environments (IDEs) and tools providing enhanced code assistance, debugging, and profiling capabilities.

7 th Semester	Professional Course (PC) BIG DATA ANALYTICS	M23BCE703
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1. Prerequisites

S/L	Proficiency	Prerequisites
1	Basic Programming Skills	Familiarity with programming languages such as Python, Java, or Scala, as they are commonly used in Big Data tools and frameworks.
2	Understanding of Data Structures and Algorithms	Knowledge of fundamental data structures (e.g., arrays, lists, trees) and algorithms, which is essential for effective data manipulation and processing.
3	Mathematics and Statistics	A solid foundation in mathematics, particularly in statistics and probability, to understand data analysis concepts and machine learning algorithms.
4	Database Management Knowledge	Basic understanding of database concepts, including relational databases, SQL, and data modelling, to grasp how data is stored and managed.
5	Familiarity with Operating Systems	Basic knowledge of operating system concepts, particularly Linux/Unix commands, as many Big Data tools run in a Linux environment.
6	Fundamentals of Data Analysis	Exposure to basic data analysis concepts and techniques, including data visualization and exploratory data analysis.
7	Understanding of Cloud Computing (Optional)	Familiarity with cloud computing concepts may be beneficial, as many Big Data solutions are hosted on cloud platforms.

2. Competencies

S/L	Competency	KSA Description
1	Understanding Big Data Concepts	Knowledge: Encompasses knowledge of Big Data definitions and technologies. Skills: Skills in data analysis and visualization Attitudes: To critically evaluate data sources and communicate insights effectively.
2	Data Architecture Design	Knowledge: Concepts of architectural frameworks and best practices. Skills: Designing scalable and efficient data storage solutions. Attitudes: The ability to integrate various data sources and ensure data accessibility and quality.
3	Proficiency in Hadoop Ecosystem	Knowledge: Understanding of Hadoop architecture and its components. Skills: Implementing and managing Hadoop-based solutions. Attitudes: To optimize data processing workflows using tools like HDFS, MapReduce, and YARN.
4	Hadoop Tool Utilization	Knowledge: Understanding of the functions, features, and best practices associated with key Hadoop ecosystem tools such as Apache Pig, Hive, Sqoop, Flume, Oozie, and HBase for efficient data processing and analysis. Skills:

		<p>To effectively implement and use Hadoop tools like Pig, Hive, and Sqoop to process, analyze, and manage large datasets in a Hadoop environment.</p> <p>Attitudes:</p> <p>Reflects a proactive and open-minded approach to learning and adapting to new Hadoop tools and technologies, demonstrating a commitment to continuous improvement and innovation in data processing practices.</p>
5	NoSQL Database Management	<p>Knowledge:</p> <p>Understanding of NoSQL database types, architecture patterns, and key principles of data modeling, storage, and retrieval specific to systems like MongoDB and Cassandra for handling unstructured and semi-structured data.</p> <p>Skills:</p> <p>Design, implement, and optimize NoSQL databases like MongoDB and Cassandra for efficient data storage, retrieval, and scalability in handling large and complex datasets.</p> <p>Attitudes:</p> <p>To explore and embrace diverse database technologies, along with a proactive mindset toward solving complex data challenges using NoSQL systems.</p>
6	MapReduce Programming	<p>Knowledge:</p> <p>Understanding of the MapReduce framework, its core concepts, and the principles behind parallel data processing and distributed computing in Big Data environments.</p> <p>Skills:</p> <p>To design, write, and optimize MapReduce programs to efficiently process and analyze large datasets across distributed systems.</p> <p>Attitudes:</p> <p>A problem-solving mindset and a proactive approach to tackling complex data processing tasks, with a willingness to experiment and optimize for performance in distributed environments.</p>
7	Data Preprocessing and Quality Assurance	<p>Knowledge:</p> <p>Understanding data cleaning techniques, data transformation methods, and best practices for ensuring data accuracy, consistency, and reliability before analysis.</p> <p>Skills:</p> <p>Ability to effectively clean, transform, and validate datasets to ensure they meet quality standards and are suitable for accurate analysis.</p> <p>Attitudes:</p> <p>Reflects a meticulous and detail-oriented approach, with a strong commitment to ensuring data integrity and accuracy throughout the preprocessing phase.</p>
8	Application of Machine Learning	<p>Knowledge:</p> <p>Understanding of key machine learning algorithms, techniques, and their practical applications in analyzing and making predictions from large datasets.</p> <p>Skills:</p> <p>Involves the ability to implement, train, and fine-tune machine learning models to extract insights and make predictions from Big Data.</p> <p>Attitudes:</p> <p>Reflects a curiosity-driven mindset and a willingness to explore, experiment, and adapt to new machine learning techniques and tools to solve complex data problems.</p>

9	Text and Web Analytics	<p>Knowledge: Understanding of techniques for text mining, web content analysis, and algorithms like PageRank, as well as methods for analyzing and extracting insights from textual and web-based data.</p> <p>Skills: The ability to apply text mining techniques, analyzes web data, and use algorithms to extract meaningful patterns and insights from textual and web-based content.</p> <p>Attitudes: An inquisitive and analytical mindset, with a keen interest in exploring and deriving actionable insights from vast amounts of textual and web data.</p>
10	Problem-Solving and Critical Thinking	<p>Knowledge: Understanding of analytical frameworks and strategies for identifying, assessing, and addressing complex problems effectively.</p> <p>Skills: The ability to analyze situations, identify root causes, and develop effective solutions through logical reasoning and creative thinking.</p> <p>Attitudes: A proactive and open-minded approach to challenges, with a willingness to embrace diverse perspectives and explore innovative solutions.</p>

3. Syllabus

Big Data Analytics SEMESTER – VII			
Course Code	M23BCE703	CIE Marks	50
Number of Lecture Hours/Week(L: T: P: S)	4:0:0:0	SEE Marks	50
Total Number of Lecture Hours	50 hours Theory	Total Marks	100
Credits	3	Exam Hours	03
<p>Course Objectives:</p> <ol style="list-style-type: none"> 1. Study the fundamentals and applications of Big Data analytics. 2. Explore the Hadoop framework and Hadoop Distributed File system and essential Hadoop Tools 3. Illustrate the concepts of NoSQL using MongoDB and Cassandra for Big Data. 4. Employ the MapReduce programming model to process the big data. 5. Study various machine learning algorithms for Big Data Analytics, Web Mining and Social Network Analysis. 			
Module -1			
Introduction to Big Data Analytics: Big Data, Scalability and Parallel Processing, Designing Data Architecture, Data Sources, Quality, Pre-Processing, and Storing, Data Storage and Analysis, Big Data Analytics Applications and Case Studies.			
Module -2			
<p>Introduction to Hadoop (T1): Introduction, Hadoop and its Ecosystem, Hadoop Distributed File System, MapReduce Framework and Programming Model, Hadoop Yarn, Hadoop Ecosystem Tools.</p> <p>Hadoop Distributed File System Basics (T2): HDFS Design Features, Components, HDFS User Commands.</p> <p>Essential Hadoop Tools (T2): Using Apache Pig, Hive, Sqoop, Flume, Oozie, HBase.</p>			
Module -3			
<p>NoSQL Big Data Management, MongoDB and Cassandra: Introduction, NoSQL Data Store, NoSQL Data Architecture Patterns, NoSQL to Manage Big Data, Shared-Nothing Architecture for Big Data Tasks, MongoDB, Databases, Cassandra Databases.</p>			
Module -4			
Introduction, MapReduce Map Tasks, Reduce Tasks and MapReduce Execution, Composing MapReduce for Calculations and Algorithms, Hive, HiveQL, Pig.			
Module -5			

Machine Learning Algorithms for Big Data Analytics: Introduction, Estimating the relationships, Outliers, Variances, Probability Distributions, and Correlations, Regression analysis, Finding Similar Items, Similarity of Sets and Collaborative Filtering, Frequent Itemsets, and Association Rule Mining.

Text, Web Content, Link, and Social Network Analytics: Introduction, Text mining, Web Mining, Web Content and Web Usage Analytics, Page Rank, Structure of Web and analyzing a Web Graph, Social Network as Graphs and Social Network Analytics:

TEXTBOOKS:

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

REFERENCE BOOKS:

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

VIDEO LINKS:

https://www.youtube.com/watch?v=n_Krer6YWY4

https://onlinecourses.nptel.ac.in/noc20_cs92/preview

<https://www.digimat.in/nptel/courses/video/106104189/L01.html>

4. Syllabus Timeline

S/L	Syllabus Timeline	Description
1	Week 1-2: Introduction to Big Data Analytics	Overview of Big Data concepts, emphasizing scalability, parallel processing, data architecture design, data quality management, preprocessing techniques, storage solutions, analysis methods, and practical applications through case studies.
2	Week 3-5: Hadoop Distributed File System and tools	Understanding the fundamentals of Hadoop and its ecosystem, including the Hadoop Distributed File System (HDFS), the Map Reduce programming model, resource management with YARN, and practical applications of essential Hadoop tools like Pig, Hive, Sqoop, Flume, Oozie, and HBase.
3	Week 6-8: NoSQL, MongoDB and Cassandra	Explores NoSQL data management, focusing on the principles of NoSQL databases, architecture patterns, and the implementation of MongoDB and Cassandra for efficient handling of Big Data within a shared-nothing architecture.
4	Week 9-11: MapReduce, Hive, HiveQL, Pig	Introduction to Map Reduce programming model, detailing map and reduce tasks, execution processes, and the use of Hive and Pig for efficient data processing and analysis in Big Data environments.
5	Week 12-14: Machine Learning Algorithms	Introduction to machine learning algorithms for Big Data Analytics, including regression analysis, collaborative filtering, and association rule mining, as well as techniques for text mining, web content analysis, and social network analytics, emphasizing their applications in deriving insights from complex data.

5. Teaching-Learning Process Strategies

S/L	TLP Strategies:	Description
1	Lecture Method	Focus on clearly explaining complex concepts through real-world examples, visual aids, and interactive discussions.

2	Video/Animation	Helps visualize abstract concepts, complex data flows, and processing techniques, making the material more accessible and easier to understand.
3	Collaborative Learning	Work together on data projects, share insights, and solve complex problems, fostering deeper understanding and practical skills through peer interaction.
4	Real-World Application	Connect theoretical concepts to practical scenarios, enhancing their ability to apply data analysis techniques to solve industry-specific challenges.
5	Flipped Class Technique	Explore foundational concepts independently before class, enabling more in-depth, hands-on data analysis and problem-solving during in-person sessions.
6	Laboratory Learning	Experience with data tools and technologies, enabling to apply theoretical knowledge to real datasets and develop practical data processing and analysis skills.

6. Assessment Details (both CIE and SEE)**Continuous Internal Evaluation:**

The minimum CIE marks requirement is 40% of maximum marks in each component.

CIE Split up

	Components	Number	Weightage	Max. Marks	Min. Marks
(i)	Internal Assessment-Tests (A)	2	50%	25	10
(ii)	Assignments/Quiz/Activity (B)	2	50%	25	10
	TotalMarks			50	20

FinalCIE Marks =(A) + (B)

Average internal assessment shall be the average of the 2 test marks conducted.

Semester End Examination:

1. Question paper pattern will be ten questions. Each question is set for 20marks. The medium of the question paper shall be English unless otherwise it is mentioned.
2. There shall be 2 question from each module, each of the two questions under a module (with a maximum of 3 sub questions), may have mix of topics under that module if necessary.
3. The students have to answer 5 full questions selecting one full question from each module.
4. Marks scored will be proportionally scaled down to 50 marks

7. Learning Objectives

S/L	Learning Objectives	Description
1	Grasp Scalability and Parallel Processing Concepts	Explain the importance of scalability in Big Data environments. Understand parallel processing techniques and how they contribute to Big Data processing efficiency.
2	Ensure Data Quality, Pre-Processing, and Storage	Understand the importance of data quality and learn techniques to ensure it. Apply data pre processing techniques to prepare data for analysis. Explore various data storage solutions and their applications in Big Data.
3	Explore the Hadoop Distributed File System (HDFS)	Understand the design features of HDFS and its components. Learn to use basic HDFS commands for data storage and retrieval.
4	Master the MapReduce Framework	Explain the Map Reduce programming model and its application in processing large datasets. Understand the role of Hadoop Yarn in resource management and job scheduling.
5	Implement NoSQL Solutions for Big Data	Learn how to apply NoSQL databases to manage and process large volumes of unstructured data. Understand the Shared-Nothing Architecture and its relevance in Big Data tasks.
6	Work with MongoDB and Cassandra	Gain hands-on experience with MongoDB and Cassandra databases, including their setup, configuration, and data management.

7	Work with Hive and Pig	Gain practical knowledge in using Hive and HiveQL for querying and managing Big Data. Learn to use Pig for large-scale data processing and analysis.
8	Apply Machine Learning Algorithms	Understand and implement regression analysis, collaborative filtering, and association rule mining on Big Data. Explore methods for finding similar items and analyzing frequent itemsets.
9	Analyze Text, Web Content, and Social Networks	Learn techniques for text mining, web mining, and web content analysis. Understand and apply Page Rank algorithms and analyze the structure of web graphs. Explore social network analytics using graph-based approaches.

8. Course Outcomes (COs) and Mapping with POs/ PSOs

Course Outcomes (COs)

COs	Description
M23BCE703.1	Understand and Apply fundamentals and applications of Big Data analytics.
M23BCE703.2	Analyze Hadoop framework, Hadoop Distributed File system and essential Hadoop tools.
M23BCE703.3	Develop the concepts of NoSQL using MongoDB and Cassandra for Big Data.
M23BCE703.4	Evaluate the Map Reduce programming model to process the big data along with Hadoop tools.
M23BCE703.5	Create Machine Learning algorithms for real world big data, web contents and Social Networks to provide analytics with relevant visualization tools

CO-PO-PSO Mapping

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
M23BCE703.1	3	-	-	-	-	-	-	-	-	-	-	-	3	3
M23BCE703.2	-	3	-	-	-	-	-	-	-	-	-	-	3	3
M23BCE703.3	-	-	3	3	-	-	-	-	-	-	-	-	3	3
M23BCE703.4	-	-	-	3	-	-	-	-	-	-	-	-	3	3
M23BCE703.5	-	-	3	-	3	-	-	-	-	-	-	-	3	3
M23BCE703	3	3	3	3	3	-	-	-	-	-	-	-	3	3

9. Assessment Plan

Continuous Internal Evaluation (CIE)

	CO1	CO2	CO3	CO4	CO5	Total
Module 1	10					10
Module 2		10				10
Module 3			10			10
Module 4				10		10
Module 5					10	10
Total	10	10	10	10	10	50

Semester End Examination (SEE)

	CO1	CO2	CO3	CO4	CO5	Total
Module 1	20					20
Module 2		20				20
Module 3			20			20
Module 4				20		20
Module 5					20	20
Total	20	20	20	20	20	100

10. Future with this Subject:

- **AI-Driven Analytics:** Big Data Analytics will increasingly integrate with AI and machine learning, enabling more sophisticated and automated data analysis. This will allow organizations to uncover deeper insights, predict future trends, and make more informed decisions.

- **Automated Data Processing:** The use of AI will streamline data preprocessing, feature selection, and model training, reducing the need for manual intervention and allowing analysts to focus on more strategic tasks.
- **Real-Time Analytics:** The demand for real-time data processing will grow, driven by the need for immediate insights in areas like financial markets, supply chain management, and customer interactions. Technologies like Apache Kafka and real-time stream processing frameworks will become more prevalent.
- **Predictive and Prescriptive Analytics:** Big Data Analytics will increasingly move beyond descriptive analytics to predictive and prescriptive analytics, where data is used not just to understand what has happened, but to forecast future events and recommend actions.
- **Edge Analytics:** With the proliferation of IoT devices, there will be a shift towards edge computing, where data is processed closer to its source rather than in centralized data centers. This will reduce latency and enable faster decision-making.
- **IoT Data Integration:** Big Data Analytics will play a crucial role in analyzing the vast amounts of data generated by IoT devices, enabling applications in smart cities, autonomous vehicles, and industrial automation.
- **Data Privacy and Compliance:** As data regulations like GDPR become more stringent, Big Data Analytics will need to focus on ensuring compliance with privacy laws. Techniques like differential privacy and federated learning will become more important to protect individual data while still enabling analysis.
- **Ethical AI and Analytics:** There will be a growing emphasis on the ethical use of data and AI, ensuring that analytics practices are fair, transparent, and free from bias.
- **Cloud-Native Analytics:** The migration to cloud-based analytics platforms will continue, providing scalability, flexibility, and cost-efficiency. Hybrid architectures that combine on-premises and cloud resources will also become more common.
- **Serverless and Managed Services:** The adoption of serverless computing and managed analytics services will increase, allowing organizations to focus on data analysis without worrying about infrastructure management.
- **Data Lakes and Data Fabrics:** The future will see more sophisticated data lake architectures and the rise of data fabrics, which provide a unified data management framework across different environments and data sources.

7 th Semester	Professional Elective-III (PE) AI FOR CYBER SECURITY	M23BCE704A
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1. Prerequisites

S/L	Proficiency	Prerequisites
1	Basic Understanding of Cybersecurity	Core Concepts: Familiarize yourself with fundamental concepts such as threat models, attack vectors, security policies, and encryption. Common Threats: Learn about different types of cyber threats and attacks, including malware, phishing, and denial-of-service attacks..
2	Knowledge of AI and Machine Learning	Basic AI Concepts: Understand what AI is, including supervised, unsupervised, and reinforcement learning. Machine Learning Algorithms: Learn about common algorithms and techniques such as regression, classification, clustering, and neural networks. Data Handling: Be comfortable with data preprocessing, feature engineering, and data augmentation.
3	Programming Skills	Languages: Proficiency in programming languages such as Python is crucial, as it's widely used in both AI and cybersecurity. Libraries and Frameworks: Familiarize yourself with machine learning libraries (e.g., TensorFlow, PyTorch) and data manipulation tools (e.g., Pandas, NumPy).
4	Mathematics and Statistics	Linear Algebra: Basics of vectors, matrices, and tensor operations. Probability and Statistics: Concepts like distributions, statistical tests, and probabilistic models are important for understanding and developing algorithms. Optimization: Techniques for optimizing algorithms, such as gradient descent.
5	Understanding of Networks and Systems	Networking Basics: Knowledge of network protocols (TCP/IP, DNS, HTTP/HTTPS), and network architectures. Operating Systems: Familiarity with various operating systems, particularly Linux, as it's often used in cybersecurity environments.
6	Data Security and Privacy	Data Handling Practices: Understanding data privacy regulations and best practices for handling sensitive data. Ethics: Awareness of ethical considerations when dealing with personal and sensitive information.
7	Practical Experience	Hands-On Projects: Engage in projects or internships that provide practical experience with AI and cybersecurity. Capture the Flag (CTF) Challenges: Participate in CTF competitions to apply your knowledge in real-world scenarios.
8	Stay Updated	Current Trends: Cybersecurity and AI fields are rapidly evolving. Stay informed about the latest trends, tools, and research.
9	Resources to Explore	Online Courses: Platforms like Coursera, edX, and Udacity offer courses on AI, machine learning, and cybersecurity. Books: Look for books on AI for cybersecurity and practical guides to machine learning in security contexts. Communities and Forums: Join cybersecurity and AI communities to learn from peers and experts.

2. Competencies

S/L	Competency	KSA Description
1	Introduction to AI and Cybersecurity	Knowledge Fundamentals of AI: Basic concepts of artificial intelligence, including machine learning, neural networks, and natural language processing. Key algorithms and techniques used in AI, such as supervised and unsupervised

		<p>learning.</p> <p>Understanding of how AI systems are trained and evaluated.</p> <p>Fundamentals of Cybersecurity:</p> <p>Basic principles of cybersecurity, including confidentiality, integrity, and availability (CIA triad).</p> <p>Common types of cyber threats and attacks (e.g., malware, phishing, ransomware).</p> <p>Basic concepts of network security, cryptography, and secure communications.</p> <p>Intersection of AI and Cybersecurity:</p> <p>How AI can be applied to enhance cybersecurity (e.g., anomaly detection, threat intelligence).</p> <p>Potential risks and vulnerabilities of AI systems (e.g., adversarial attacks, data poisoning).</p> <p>Ethical considerations and implications of using AI in cybersecurity.</p> <p>Skills</p> <p>AI Skills:</p> <p>Ability to use AI tools and frameworks (e.g., TensorFlow, PyTorch) for basic tasks.</p> <p>Proficiency in programming languages commonly used in AI (e.g., Python).</p> <p>Skills in data preprocessing, feature selection, and model evaluation.</p> <p>Cybersecurity Skills:</p> <p>Ability to perform basic security assessments and identify vulnerabilities in systems.</p> <p>Proficiency in using cybersecurity tools (e.g., intrusion detection systems, firewalls).</p> <p>Skills in incident response and understanding of basic forensics.</p> <p>Cross-Disciplinary Skills:</p> <p>Ability to integrate AI solutions into cybersecurity strategies effectively.</p> <p>Skills in analyzing and interpreting data to identify and mitigate cybersecurity threats.</p> <p>Understanding of how to secure AI systems and ensure their reliability and trustworthiness.</p> <p>Attitudes</p> <p>Curiosity and Continuous Learning:</p> <p>A proactive attitude towards staying updated with the latest advancements in AI and cybersecurity.</p> <p>Openness to learning new technologies and adapting to evolving threats and solutions.</p> <p>Ethical Considerations:</p> <p>Awareness of ethical implications in both AI and cybersecurity practices.</p> <p>Commitment to applying ethical principles in the development and deployment of AI systems.</p> <p>Critical Thinking and Problem-Solving:</p> <p>Ability to approach problems analytically and think critically about potential solutions.</p> <p>Willingness to question assumptions and explore different angles when dealing with complex issues.</p> <p>Collaboration and Communication:</p> <p>Willingness to work collaboratively with others in interdisciplinary teams.</p> <p>Ability to communicate complex technical concepts clearly to non-experts.</p>
2	AI for Threat Detection	<p>Knowledge</p> <p>AI and Machine Learning Fundamentals:</p> <p>Understanding of basic AI concepts and machine learning algorithms, such as supervised and unsupervised learning.</p> <p>Familiarity with neural networks, deep learning, and their application in detecting anomalies and patterns.</p> <p>Threat Detection Techniques:</p> <p>Knowledge of common threat detection methods, including signature-based,</p>

	<p>anomaly-based, and behavior-based detection.</p> <p>Understanding how AI can enhance traditional methods by identifying new or evolving threats.</p> <p>Data Handling and Processing:</p> <p>Understanding of data types and sources used for threat detection, such as network traffic logs, system logs, and user behavior data.</p> <p>Knowledge of data preprocessing techniques, including normalization, feature extraction, and data augmentation.</p> <p>Security Concepts:</p> <p>Basic understanding of cybersecurity concepts and types of cyber threats (e.g., malware, intrusion attempts, phishing).</p> <p>Familiarity with concepts like attack vectors, threat actors, and common vulnerabilities.</p> <p>Ethical and Privacy Considerations:</p> <p>Awareness of ethical issues related to the use of AI in monitoring and surveillance.</p> <p>Understanding of privacy concerns and regulations (e.g., GDPR, CCPA) that impact data collection and analysis.</p> <p>Skills</p> <p>Programming and Data Analysis:</p> <p>Proficiency in programming languages commonly used in AI and data analysis, such as Python or R.</p> <p>Skills in using AI and machine learning libraries and frameworks (e.g., TensorFlow, PyTorch, Scikit-learn).</p> <p>Model Development and Evaluation:</p> <p>Ability to develop and train machine learning models for threat detection, including supervised, unsupervised, and reinforcement learning models.</p> <p>Skills in evaluating model performance using metrics such as accuracy, precision, recall, and F1 score.</p> <p>Feature Engineering:</p> <p>Competence in selecting and engineering relevant features from raw data to improve model performance.</p> <p>Ability to identify which features are most indicative of potential threats.</p> <p>Anomaly Detection:</p> <p>Skills in implementing and tuning anomaly detection algorithms, such as clustering, outlier detection, and statistical methods.</p> <p>Ability to distinguish between false positives and genuine threats.</p> <p>Integration and Deployment:</p> <p>Knowledge of how to integrate AI-based threat detection systems with existing security infrastructure.</p> <p>Skills in deploying models in real-world environments and handling issues related to scalability and performance.</p> <p>Attitudes</p> <p>Analytical Thinking:</p> <p>A detail-oriented mindset to analyze complex data and identify subtle patterns or anomalies indicative of potential threats.</p> <p>Willingness to iterate and refine models based on feedback and new data.</p> <p>Adaptability and Continuous Learning:</p> <p>Openness to learning about emerging threats and evolving AI technologies.</p> <p>Adaptability to new challenges and willingness to update and improve detection systems.</p> <p>Problem-Solving Mindset:</p> <p>Proactive approach to troubleshooting and addressing issues with AI models and threat detection processes.</p>
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		<p>Creative thinking in designing new approaches to detect sophisticated threats.</p> <p>Ethical Responsibility: Commitment to using AI responsibly and ethically, respecting user privacy and data security. Awareness of the impact of false positives and false negatives on security operations and users.</p> <p>Collaboration and Communication: Ability to work effectively with other cybersecurity professionals, data scientists, and stakeholders. Skills in communicating findings and insights clearly to non-technical team members and decision-makers.</p>
3	Intrusion Detection and Prevention Systems	<p>Knowledge</p> <p>Fundamentals of Network Security: Understanding of network architectures, protocols, and the types of network attacks (e.g., DoS, DDoS, man-in-the-middle). Knowledge of network topologies, firewalls, and other network security measures.</p> <p>IDPS Concepts: Familiarity with different types of IDPS: Network-based (NIDS) and Host-based (HIDS). Understanding of how IDPS systems work, including signature-based, anomaly-based, and hybrid detection methods.</p> <p>Threat Landscape: Knowledge of common threats and vulnerabilities, such as malware, spyware, ransomware, and advanced persistent threats (APTs). Awareness of the tactics, techniques, and procedures (TTPs) used by attackers.</p> <p>Detection and Prevention Techniques: Understanding of various detection techniques, including pattern matching, statistical analysis, and behavioral analysis. Familiarity with prevention techniques, such as automated blocking, alerting, and response strategies.</p> <p>Security Policies and Compliance: Knowledge of security policies, standards, and regulations related to intrusion detection (e.g., GDPR, HIPAA). Understanding of compliance requirements and best practices for deploying and managing IDPS.</p> <p>Log Management and Analysis: Familiarity with log generation, collection, and analysis related to IDPS. Understanding of how to interpret logs and correlate data from various sources for effective threat detection.</p> <p>Skills</p> <p>Technical Proficiency: Skills in configuring and managing IDPS tools and platforms (e.g., Snort, Suricata, OSSEC). Proficiency in network monitoring tools and techniques, including packet analysis and traffic inspection.</p> <p>Incident Response: Ability to respond to and manage security incidents detected by IDPS, including containment, eradication, and recovery. Skills in documenting and reporting incidents effectively.</p> <p>Threat Analysis: Skills in analyzing alerts and false positives generated by IDPS to determine the validity and severity of threats. Ability to perform forensic analysis to understand attack vectors and impact.</p> <p>Network Traffic Analysis:</p>

		<p>Ability to analyze network traffic to identify suspicious activity or anomalies. Proficiency in using network analysis tools (e.g., Wireshark) and interpreting network data.</p> <p>Integration and Customization: Skills in integrating IDPS with other security tools and systems (e.g., SIEM systems, firewalls). Ability to customize IDPS rules and signatures to suit the specific needs of the environment.</p> <p>Attitudes</p> <p>Attention to Detail: A meticulous approach to configuring IDPS systems and analyzing logs to ensure no critical threat is missed. Careful examination of alerts to differentiate between genuine threats and false positives.</p> <p>Curiosity and Continuous Learning: Enthusiasm for staying up-to-date with the latest threats, attack methods, and IDPS technologies. Openness to learning new techniques and tools for improving intrusion detection and prevention capabilities.</p> <p>Problem-Solving Mindset: A proactive attitude towards identifying and resolving issues related to IDPS performance and effectiveness. Willingness to experiment with different configurations and techniques to enhance detection capabilities.</p> <p>Resilience and Adaptability: Ability to handle high-pressure situations during security incidents and adapt to evolving threat landscapes. Flexibility in adapting IDPS strategies and configurations based on emerging threats and changes in the environment.</p> <p>Ethical Responsibility: Commitment to ethical practices in managing and using IDPS, ensuring the privacy and security of data. Awareness of the potential impact of IDPS actions on network performance and user experience.</p> <p>Collaboration and Communication: Skills in working effectively with other IT and security professionals to manage and respond to threats. Ability to communicate technical findings and incident reports clearly to both technical and non-technical stakeholders.</p>
4	Adversarial AI and Security	<p>Knowledge</p> <p>Adversarial AI Fundamentals: Understanding what adversarial attacks is, including various types such as adversarial examples, data poisoning, and model inversion. Knowledge of how adversarial attacks exploit weaknesses in machine learning models.</p> <p>Machine Learning and AI: Proficiency in core machine learning concepts, algorithms, and models (e.g., neural networks, decision trees, SVMs). Familiarity with how these models can be vulnerable to adversarial manipulations.</p> <p>Security and Privacy in AI: Understanding security principles relevant to AI, such as model robustness, secure training practices, and privacy-preserving techniques. Knowledge of cryptographic methods and privacy-enhancing technologies (e.g.,</p>

	<p>differential privacy, secure multiparty computation).</p> <p>Attack and Defense Strategies: Awareness of common adversarial attack techniques and corresponding defense strategies (e.g., adversarial training, defensive distillation, input sanitization). Understanding of current research trends and advancements in adversarial machine learning.</p> <p>Ethics and Regulatory Compliance: Knowledge of ethical implications and legal requirements related to adversarial AI and the use of AI systems in sensitive areas. Understanding of regulations and standards that govern the secure and ethical use of AI technologies.</p> <p>Skills</p> <p>Technical Expertise: Proficiency in programming languages and tools relevant to AI and machine learning, such as Python, TensorFlow, PyTorch, and Scikit-learn. Skills in implementing and testing adversarial attacks and defenses in various machine learning models.</p> <p>Model Evaluation and Testing: Ability to design and conduct experiments to assess the robustness of AI models against adversarial attacks. Skills in using evaluation metrics specific to adversarial robustness (e.g., attack success rate, robustness curves).</p> <p>Security Implementation: Ability to apply and integrate security measures to protect AI systems from adversarial threats. Skills in developing and applying countermeasures and robustification techniques to enhance model security.</p> <p>Data Handling and Analysis: Skills in preprocessing and handling data to prevent data poisoning and ensure data integrity. Ability to analyze and interpret the impact of adversarial attacks on model performance and security.</p> <p>Research and Innovation: Ability to stay current with the latest research and developments in adversarial AI and apply innovative solutions to emerging threats. Skills in contributing to the academic and practical advancement of adversarial AI techniques and security measures.</p> <p>Attitudes</p> <p>Critical Thinking: A questioning attitude towards the assumptions and vulnerabilities inherent in AI systems. Willingness to critically evaluate the effectiveness of both adversarial attacks and defenses.</p> <p>Continuous Learning: Commitment to keeping up with the rapidly evolving field of adversarial AI and security through continuous education and research. Openness to experimenting with new approaches and adapting to emerging threats and technologies.</p> <p>Ethical Responsibility: Strong sense of ethical responsibility in developing and deploying AI systems, ensuring they are secure and used responsibly. Awareness of the potential societal impacts of adversarial attacks and a commitment to mitigating these risks.</p> <p>Resilience and Problem-Solving:</p>
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		<p>Persistence in addressing complex security challenges and finding solutions to counteract adversarial threats.</p> <p>Ability to handle and learn from failures or setbacks in security measures or model robustness.</p> <p>Collaboration and Communication:</p> <p>Ability to work collaboratively with other experts in cybersecurity, data science, and AI research.</p> <p>Skills in effectively communicating complex technical concepts and findings to both technical and non-technical stakeholders.</p>
5	Ethical and Legal Considerations	<p>Knowledge</p> <p>Legal Frameworks and Regulations:</p> <p>Data Protection Laws: Familiarity with key regulations such as the General Data Protection Regulation (GDPR), California Consumer Privacy Act (CCPA), Health Insurance Portability and Accountability Act (HIPAA), and others relevant to the jurisdiction.</p> <p>Cybersecurity Laws: Understanding laws related to cybersecurity and data breaches, such as the Computer Fraud and Abuse Act (CFAA) and the Cybersecurity Information Sharing Act (CISA).</p> <p>Intellectual Property: Knowledge of intellectual property laws including copyright, patents, and trademarks, and their implications for technology and AI.</p> <p>Ethical Principles:</p> <p>AI Ethics: Awareness of ethical issues related to AI, such as bias, fairness, transparency, accountability, and the impact on employment and society.</p> <p>Cybersecurity Ethics: Understanding ethical considerations in cybersecurity, including responsible disclosure, privacy, and the balance between security and user rights.</p> <p>Industry Standards and Guidelines:</p> <p>Familiarity with industry standards such as ISO/IEC 27001 (information security management), NIST Cybersecurity Framework, and other relevant guidelines for ethical and legal compliance.</p> <p>Knowledge of best practices for ethical technology development and deployment.</p> <p>Case Studies and Precedents:</p> <p>Awareness of historical and recent cases involving ethical and legal issues in technology.</p> <p>Understanding the outcomes and lessons learned from these cases to inform current practices.</p> <p>Skills</p> <p>Compliance Management:</p> <p>Legal Research: Ability to research and interpret relevant laws and regulations that impact technology and data practices.</p> <p>Policy Development: Skills in developing and implementing policies that ensure compliance with legal and ethical standards.</p> <p>Risk Assessment:</p> <p>Risk Analysis: Ability to conduct risk assessments to identify potential ethical and legal issues in technology deployments.</p> <p>Mitigation Strategies: Skills in developing strategies to mitigate identified risks and ensure adherence to legal and ethical standards.</p> <p>Ethical Decision-Making:</p> <p>Scenario Analysis: Ability to analyze ethical dilemmas and make decisions that balance business objectives with ethical considerations.</p> <p>Stakeholder Engagement: Skills in engaging with stakeholders to understand their perspectives and address ethical concerns.</p> <p>Documentation and Reporting:</p>

	<p>Record-Keeping: Skills in maintaining thorough documentation of compliance efforts, ethical decisions, and risk management activities.</p> <p>Reporting: Ability to report on ethical and legal compliance to management, regulatory bodies, and other stakeholders.</p> <p>Training and Education:</p> <p>Awareness Programs: Skills in creating and delivering training programs to educate employees about legal and ethical considerations in technology.</p> <p>Continual Learning: Ability to stay informed about changes in laws, regulations, and ethical standards.</p> <p>Attitudes</p> <p>Integrity and Accountability:</p> <p>Commitment to Principles: A strong commitment to upholding ethical standards and legal requirements in all professional activities.</p> <p>Personal Accountability: Willingness to take responsibility for ensuring compliance and addressing ethical issues.</p> <p>Transparency and Honesty:</p> <p>Open Communication: An attitude of openness in communicating about ethical and legal practices, including the willingness to disclose issues and seek solutions.</p> <p>Transparency: Commitment to transparent practices in technology development and data handling.</p> <p>Empathy and Respect:</p> <p>Stakeholder Sensitivity: Understanding and respecting the impact of decisions on various stakeholders, including users, employees, and the broader community.</p> <p>Cultural Awareness: Sensitivity to cultural differences and their implications for ethical and legal considerations.</p> <p>Continuous Improvement:</p> <p>Adaptability: Openness to adapting practices based on evolving laws, ethical standards, and societal expectations.</p> <p>Learning Orientation: A proactive approach to learning about new ethical and legal issues and integrating best practices.</p> <p>Critical Thinking:</p> <p>Analytical Approach: A critical mindset to analyze complex ethical and legal issues and make informed decisions.</p> <p>Problem-Solving: Willingness to explore creative solutions to ethical dilemmas while maintaining compliance with legal standards.</p>
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3. Syllabus

AI for Cyber Security SEMESTER – VII			
Course Code	M23BCS704A	CIE Marks	50
Number of Lecture Hours/Week(L: T: P: S)	(3:0:0:0)	SEE Marks	50
Total Number of Lecture Hours	40 hours Theory	Total Marks	100
Credits	03	Exam Hours	03
<p>Course Objectives:</p> <ul style="list-style-type: none"> To, learn what stress and strain are and how materials behave under pressure. To analyzing structures figure out how different structures respond to different types of forces. To Calculating Forces and learn how to calculate the forces and moments acting on beams, shafts, and columns. Testing Materials to understand how materials respond to stress and when they might break. Designing Structures: Use stress analysis to design strong and safe structures. Get familiar with computer programs that help with stress analysis and design. 			
Module -1			

Introduction to AI and Cybersecurity: Overview of AI: Definitions and Types, Importance of AI in Cybersecurity, Fundamental Cybersecurity Concepts, The Role of AI in Enhancing Cybersecurity
Module -2
AI for Threat Detection: Anomaly Detection Techniques, Malware Detection and Analysis, Phishing Detection Using NLP, Behavioural Analysis and User Profiling.
Module -3
Intrusion Detection and Prevention Systems: Network Intrusion Detection Systems (NIDS) and AI Integration, Host-Based Intrusion Detection Systems (HIDS), AI for Real-Time Threat Analysis, Case Studies of AI in Intrusion Detection
Module -4
Adversarial AI and Security: Adversarial Attacks on AI Models, Techniques for Defending Against Adversarial Attacks, Ensuring Robustness and Security in AI Models, Real-World Examples and Mitigation Strategies
Module -5
Ethical and Legal Considerations : Ethical Issues in AI and Cybersecurity, Privacy Concerns and Data Protection, Legal and Regulatory Frameworks (e.g., GDPR, CCPA), Responsible AI Practices and Compliance
TEXTBOOKS: 1. "AI for Cybersecurity: A Data-Driven Approach" by Y. Liu and S. R. Rao 2. "Cybersecurity and Artificial Intelligence: A Comprehensive Guide" by B. C. H. Y. Sharmila and R. Kumar
Reference books: 1. "Artificial Intelligence: A Modern Approach" by Stuart Russell and Peter Norvig, third edition. 2. "Machine Learning for Cybersecurity Cookbook" by Emmanuel Tsukerman

4. Syllabus Timeline

S/L	Syllabus Timeline	Description
1	Week 1-3: Introduction to AI and Cybersecurity	Overview of AI: Definitions and Types, Importance of AI in Cybersecurity, Fundamental Cybersecurity Concepts, The Role of AI in Enhancing Cybersecurity
2	Week 4-6: AI for Threat Detection	Anomaly Detection Techniques, Malware Detection and Analysis, Phishing Detection Using NLP, Behavioural Analysis and User Profiling.
3	Week 8-11: Intrusion Detection and Prevention Systems	Network Intrusion Detection Systems (NIDS) and AI Integration, Host-Based Intrusion Detection Systems (HIDS), AI for Real-Time Threat Analysis, Case Studies of AI in Intrusion Detection
4	Week 7-8: Adversarial AI and Security	Adversarial Attacks on AI Models, Techniques for Defending Against Adversarial Attacks, Ensuring Robustness and Security in AI Models, Real-World Examples and Mitigation Strategies
5	Week 9-12: Ethical and Legal Considerations	Ethical Issues in AI and Cybersecurity, Privacy Concerns and Data Protection, Legal and Regulatory Frameworks (e.g., GDPR, CCPA), Responsible AI Practices and Compliance

5. Teaching-Learning Process Strategies

S/L	TLP Strategies:	Description
1	Lecture Method	Utilize various teaching methods within the lecture format to reinforce competencies.
2	Video/Animation	Incorporate visual aids like videos/animations to enhance understanding of concepts.
3	Collaborative Learning	Encourage collaborative learning for improved competency application.
4	Real-World	Discuss practical applications to connect theoretical concepts with real-world

	Application	competencies.
6	Laboratory Learning	Utilize the facilities available in the laboratories to understand the behavior of the materials by performing few experiments.

6. Assessment Details (both CIE and SEE)

Continuous Internal Evaluation:

The minimum CIE marks requirement is 40% of maximum marks in each component.

CIE Split up

	Components	Number	Weightage	Max. Marks	Min. Marks
(i)	Internal Assessment-Tests (A)	2	50%	25	10
(ii)	Assignments/Quiz/Activity (B)	2	50%	25	10
	Total Marks			50	20

$$\text{Final CIE Marks} = (A) + (B)$$

Average internal assessment shall be the average of the 2 test marks conducted.

Semester End Examination:

- Question paper pattern will be ten questions. Each question is set for 20marks. The medium of the question paper shall be English unless otherwise it is mentioned.
- There shall be 2 question from each module, each of the two questions under a module (with a maximum of 3 sub questions), may have mix of topics under that module if necessary.
- The students have to answer 5 full questions selecting one full question from each module.
- Marks scored will be proportionally scaled down to 50 marks

7. Learning Objectives

S/L	Learning Objectives	Description
1	Introduction to AI and Cybersecurity	Describe the role and impact of AI in cybersecurity. Explain basic cybersecurity concepts and terminology.
2	AI for Threat Detection	Design AI models for detecting anomalies, malware, and phishing attempts. Utilize NLP and behavioral analysis techniques in cybersecurity.
3	Intrusion Detection and Prevention Systems	Develop AI-driven intrusion detection and prevention systems. Analyze and improve real-time threat detection with AI.
4	Adversarial AI and Security	Identify and mitigate adversarial threats to AI models. Enhance the robustness of AI systems in cybersecurity contexts.
5	Ethical and Legal Considerations	Understand the ethical and legal implications of AI in cybersecurity. Implement responsible AI practices in cybersecurity projects.

8. Course Outcomes (COs) and Mapping with POs/ PSOs

Course Outcomes (COs)

COs	Description
M23BCE704A.1	Understand and Apply fundamental concepts of AI in cyber security concept and terminology.
M23BCE704A.2	Analyze and design AI models and use NLP and behavioral analysis techniques in cybersecurity.
M23BCE704A.3	Develop AI driven intrusion detection and prevention systems. Analyze and improve real-time threat detection with AI.
M23BCE704A.4	Identify adversarial threats to AI and enhance robustness of AI System.
M23BCE704A.5	Understand the ethical and legal implications of AI in cybersecurity. Implement responsible AI practices in cybersecurity projects.

CO-PO-PSO Mapping

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
M23BCE704A.1	3	-	-	-	-	-	-	-	-	-	-	-	3	3
M23BCE704A.2	-	3	-	-	-	-	-	-	-	-	-	-	3	3
M23BCE704A.3	-	-	3	3	-	-	-	-	-	-	-	-	3	3
M23BCE704A.4	-	-	-	3	-	-	-	-	-	-	-	-	3	3
M23BCE704A.5	3	-	3	-	-	-	-	-	-	-	-	-	3	3
M23BCE704A	3	3	3	3	-	-	-	-	-	-	-	-	3	3

9. Assessment Plan**Continuous Internal Evaluation (CIE)**

	CO1	CO2	CO3	CO4	CO5	Total
Module 1	10					10
Module 2		10				10
Module 3			10			10
Module 4				10		10
Module 5					10	10
Total	10	10	10	10	10	50

Semester End Examination (SEE)

	CO1	CO2	CO3	CO4	CO5	Total
Module 1	20					20
Module 2		20				20
Module 3			20			20
Module 4				20		20
Module 5					20	20
Total	20	20	20	20	20	100

10. Future with this Subject:**1. Advanced Threat Detection and Response****AI-Powered Threat Detection:**

- **Behavioral Analysis:** AI will use advanced behavioral analytics to identify deviations from normal behavior, detecting sophisticated threats that traditional systems might miss.
- **Real-Time Analysis:** AI systems will offer real-time threat detection by analyzing vast amounts of network traffic and security data faster than humanly possible.
- **Predictive Analytics:** Leveraging machine learning models to predict potential threats before they occur based on patterns and trends.

Automated Response:

- **Incident Response Automation:** AI will automate incident response actions, such as isolating compromised systems, blocking malicious IPs, or deploying countermeasures, reducing response times and mitigating damage.
- **Adaptive Defense Mechanisms:** AI systems will continuously learn and adapt their defenses based on new threats, improving their effectiveness over time.

2. Enhanced Cybersecurity Tools and Platforms**AI-Driven Security Tools:**

- **Next-Generation Antivirus (NGAV):** AI will enhance antivirus solutions by using machine learning to identify and block new and unknown malware variants.
- **AI-Enhanced SIEM Systems:** Security Information and Event Management (SIEM) systems will integrate AI for more accurate correlation of security events and faster identification of complex attack patterns.

Unified Security Platforms:

- **Integrated Threat Intelligence:** AI will enable the integration of threat intelligence across various security tools and platforms, providing a comprehensive view of the threat landscape and improving coordination.

3. Improved Vulnerability Management**Automated Vulnerability Assessment:**

- **AI-Driven Scanners:** AI will enhance vulnerability scanning tools by identifying potential weaknesses more accurately and prioritizing them based on risk.
- **Predictive Vulnerability Management:** AI will predict which vulnerabilities are likely to be exploited based on emerging threats and attack trends.

Patch Management:

- **Automated Patch Deployment:** AI systems will manage and deploy patches more efficiently, ensuring timely updates and reducing the risk of exploitation.

4. Advanced Fraud Detection

Financial Sector Innovations:

- **Real-Time Fraud Detection:** AI will enhance fraud detection in financial transactions by analyzing transaction patterns and identifying anomalies in real-time.
- **Adaptive Fraud Prevention:** Machine learning models will continuously adapt to new fraud tactics, providing dynamic and robust fraud prevention.

5. AI-Enhanced Privacy Protection

Data Privacy:

- **Anomaly Detection for Privacy Breaches:** AI will detect anomalies that might indicate data breaches or unauthorized access to personal information.
- **Automated Privacy Compliance:** AI will help organizations comply with data protection regulations by automating the monitoring and management of data privacy practices.

6. Integration of AI and Human Expertise

Augmented Security Operations:

- **Human-AI Collaboration:** AI will augment human expertise by handling routine tasks and providing actionable insights, allowing cybersecurity professionals to focus on complex problems and strategic planning.
- **Enhanced Threat Intelligence Sharing:** AI will facilitate the sharing of threat intelligence across organizations, improving collective defenses and collaboration.

7. Ethical and Legal Considerations

Ethical AI Use:

- **Bias and Fairness:** Efforts will be made to ensure AI systems are free from biases and operate fairly, particularly in decision-making processes related to security and privacy.
- **Transparency and Accountability:** There will be a focus on developing transparent AI systems with clear accountability for decisions made by AI, especially in sensitive areas like surveillance and data privacy.

7 th Semester	Professional Elective-III (PE) ETHICAL HACKING AND NETWORK DEFENSE	M23BCS704B
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1. Prerequisites

S/L	Proficiency	Prerequisites
1.	Operating Systems	<ul style="list-style-type: none"> Familiarity with Windows, Linux, and macOS.
2.	Networking	<ul style="list-style-type: none"> Understanding of TCP/IP, subnetting, network masks, and common networking protocols.
3.	Cyber security Fundamentals	<ul style="list-style-type: none"> Basic understanding of information security principles and practices. Knowledge of common threats, vulnerabilities, and attack vectors.
4.	Programming Skills	<ul style="list-style-type: none"> Ability to write scripts to automate tasks and exploit vulnerabilities.

2. Competencies

S/L	Competency	KSA Description
1.	Basics of Ethical Hacking Techniques	<p>Knowledge:</p> <ul style="list-style-type: none"> Familiarity with reconnaissance, exploitation, and post-exploitation techniques. Awareness of cybersecurity laws, regulations, and ethical hacking guidelines. <p>Skills:</p> <ul style="list-style-type: none"> Proficiency in using tools like Nmap, Wireshark, Metasploit, and Burp Suite for ethical hacking. Ability to ensure compliance with legal standards and ethical practices. <p>Attitudes:</p> <ul style="list-style-type: none"> Integrity and a strong sense of ethical responsibility and adherence to legal guidelines.
2.	Embedded Systems, Networking Fundamentals & Cryptography	<p>Knowledge:</p> <ul style="list-style-type: none"> Familiarity with Windows, Linux, and macOS operating systems. Understanding of TCP/IP, DNS, DHCP, subnetting, and common networking protocols. Understanding of cryptographic principles such as public-key cryptography, cryptographic hashing, and digital signatures. <p>Skills:</p> <ul style="list-style-type: none"> Proficiency in using command-line interfaces, managing system processes, and configuring system settings. Ability to configure and troubleshoot network devices, analyze network traffic, and understand network topologies. Implement cryptographic algorithms like Secret Key Cryptography (SKC), Public Key Cryptography (PKC) & Hash Functions. <p>Attitudes:</p> <ul style="list-style-type: none"> Willingness to explore and experiment with different operating systems. Curiosity and a proactive approach to learning about network infrastructures.
3.	Defensive Strategies	<p>Knowledge:</p> <ul style="list-style-type: none"> Understanding of firewalls, intrusion detection/prevention systems (IDS/IPS), and endpoint security solutions. <p>Skills:</p> <ul style="list-style-type: none"> Ability to configure and manage security devices, monitor network traffic, and respond to security incidents. <p>Attitudes:</p> <ul style="list-style-type: none"> Proactive and defensive mindset towards protecting systems and networks.

3. Syllabus

ETHICAL HACKING AND NETWORK DEFENSE			
SEMESTER – VII			
Course Code	M23BCS704B	CIE Marks	50
Number of Lecture Hours/Week(L: T: P: S)	(3:0:0:0)	SEE Marks	50
Total Number of Lecture Hours	40 Hours	Total Marks	100
Credits	03	Exam Hours	03
Course objectives: This course will enable students to: <ol style="list-style-type: none"> 1. To understand the core concepts of Ethical Hacking 2. To understand how security vulnerabilities are exploited 3. To analyze the impact of security vulnerabilities in systems 4. To understand popular Network Defense solutions deployed at large organizations 5. To configure basic firewall and IDS solution 			
Module – 1			
Introduction: Ethical Hacking Overview - Role of Security and Penetration Testers, Penetration-Testing Methodologies, Laws of the Land, Overview of TCP/IP, The Application Layer, The Transport Layer, The Internet Layer, IP Addressing – Textbook 1: Chapter 1 & 2			
Module - 2			
Network and Computer Attacks –Malware, Protecting Against Malware Attacks, Intruder Attacks , Addressing Physical Security - Textbook 1: Chapter 3 Casing the Establishment: What is foot printing, Internet Foot printing, Scanning, Enumeration, basic banner grabbing, Enumerating Common Network services. Textbook 2: Chapter			
Module - 3			
Desktop and Server OS Vulnerabilities: Windows OS Vulnerabilities, Tools for Identifying Vulnerabilities in Windows, Best Practices for Hardening Windows Systems, Linux OS Vulnerabilities Textbook 1: Chapter 8			
Module-4			
Embedded Operating Systems: Introduction to Embedded Operating Systems, Windows and Other Embedded Operating Systems, Vulnerabilities of Embedded OS. Textbook 1: Chapter 9			
Module - 5			
Network Protection Systems: Understanding Network Protection Systems, Understanding Firewalls, Understanding Intrusion Detection and Prevention Systems, Understanding Honeypots. Textbook 1: Chapter 13			
Text Books: <ol style="list-style-type: none"> 1. Michael T. Simpson, Kent Backman, and James E. Corley, Hands-On Ethical Hacking and Network Defense, Course Technology, Delmar Cengage Learning, 2010. 2. Stuart McClure, Joel Scambray and Goerge Kurtz, Hacking Exposed 7: Network Security Secrets & Solutions, Tata Mc Graw Hill Publishers, 2010 			
Reference Books: <ol style="list-style-type: none"> 1. Stuart McClure, Joel Scambray and Goerge Kurtz, “Hacking Exposed Network Security Secrets & Solutions”, 5th Edition, Tata Mc Graw Hill Publishers, 2010. 2. Black Hat Python: Python Programming for Hackers and Pentesters, Justin Seitz , 2014. 			

4. Syllabus Timeline

S/L	Syllabus Timeline	Description
1	Week 1-2: Fundamentals of Ethical hacking & Operating systems	<ul style="list-style-type: none"> • Competency: Basics of Ethical Hacking Techniques & Operating Systems • Knowledge: Familiarity with reconnaissance, exploitation, and post-exploitation techniques. Awareness of cybersecurity laws, regulations, and ethical hacking guidelines. Familiarity with Windows, Linux, and macOS operating systems. • Skills: Proficiency in using tools like Nmap, Wireshark, Metasploit, and Burp Suite for ethical hacking. Proficiency in using command-line interfaces, managing system processes, and configuring system settings.

2	Week 3-4: Networking Primer	<ul style="list-style-type: none"> • Competency: Networking Fundamentals & Cryptography • Knowledge: Understanding of TCP/IP, DNS, DHCP, subnetting, and common networking protocols. Understanding of cryptographic principles such as public-key cryptography, cryptographic hashing, and digital signatures. • Skills: Ability to configure and troubleshoot network devices, analyze network traffic, and understand network topologies. Implement cryptographic algorithms like Secret Key Cryptography (SKC), Public Key Cryptography (PKC) & Hash Functions.
3	Week 5-6: Techniques for Network Intrusion Detection System	<ul style="list-style-type: none"> • Competency: Defensive Strategies • Knowledge: Understanding of firewalls, intrusion detection/prevention systems (IDS/IPS), and endpoint security solutions. • Skills: Ability to configure and manage security devices, monitor network traffic, and respond to security incidents.

5. Teaching-Learning Process Strategies

S/L	TLP Strategies:	Description
1	Lecture Method	<ul style="list-style-type: none"> • Utilize various teaching methods within the lecture format to reinforce competencies.
2	Video/Animation	<ul style="list-style-type: none"> • Incorporate visual aids like videos/animations to enhance understanding of the concepts.
3	Collaborative Learning	<ul style="list-style-type: none"> • Encourage collaborative learning for improved competency application.
4	Higher Order Thinking (HOTS) Questions:	<ul style="list-style-type: none"> • Pose HOTS questions to stimulate critical thinking related to each competency.
5	Problem-Based Learning (PBL)	<ul style="list-style-type: none"> • Implement PBL to enhance analytical skills and practical application of competencies
6	Multiple Representations	<ul style="list-style-type: none"> • Introduce topics in various representations to reinforce competencies
7	Real-World Application	<ul style="list-style-type: none"> • Discuss practical applications to connect theoretical concepts with real-world competencies.
8	Flipped Class Technique	<ul style="list-style-type: none"> • Utilize a flipped class approach, providing materials before class to facilitate deeper understanding of competencies
9	Programming Assignments	<ul style="list-style-type: none"> • Assign programming tasks to reinforce practical skills associated with competencies.

6. Assessment Details (both CIE and SEE)

Continuous Internal Evaluation:

Components		Number	Weightage	Max. Marks	Min. Marks
(i)	Internal Assessment-Tests (A)	2	50%	25	10
(ii)	Assignments/Quiz/Activity (B)	2	50%	25	10
Total Marks				50	20

Final CIE Marks = (A) + (B)

Average internal assessment shall be the average of the 2 test marks conducted.

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

Semester End Examination:

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

1. Question paper pattern will be ten questions. Each question is set for 20marks. The medium of the question paper shall be English unless otherwise it is mentioned.

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

7. Learning Objectives

S/L	Learning Objectives	Description
1	Understanding Ethical Hacking Fundamentals	Students will grasp the fundamental concepts of ethical hacking, including Life Cycle of Ethical Hacking, Types of Ethical Hacking, Fundamentals of Vulnerability Analysis and Penetration Testing.
2	Understanding Network Attack and Defense	Students will grasp the fundamental concepts of Network Attack and Defense techniques and can perform Vulnerability and Penetration testing on given Vulnerable system and generate report.
4	Collaboration and Communication Skills	Students will work collaboratively in teams on design projects, enhancing their ability to communicate effectively, share ideas, and solve problems collectively.
5	Ethical and Professional Responsibility	Students will understand the ethical and professional responsibilities associated with digital design, including respecting intellectual property rights, ensuring design reliability and security, and adhering to industry standards and best practices.

8. Course Outcomes (COs) and Mapping with POs/ PSOs**Course Outcomes (COs)**

COs	Description
M23BCS704B.1	To understand how to find security vulnerabilities in given system.
M23BCS704B.2	To suggest the remediation steps for identified security bugs.
M23BCS704B.3	To perform VAPT task on given system and submit professional report.
M23BCS704B.4	To demonstrate knowledge of Embedded OS and vulnerabilities.
M23BCS704B.5	To demonstrate knowledge of IDS Systems and IDS signatures.

CO-PO-PSO Mapping

COs/POs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO1 0	PO1 1	PO1 2	PSO1	PSO2
M23BCS704B.1	3												3	
M23BCS704B.2		3											3	
M23BCS704B.3			3											3
M23BCS704B.4	3													3
M23BCS704B.5	3												3	3

9. Assessment Plan**Continuous Internal Evaluation (CIE)**

	CO1	CO2	CO3	CO4	CO5	Total
Module 1	10					10
Module 2		10				10
Module 3			10			10
Module 4				10		10
Module 5					10	10
Total	10	10	10	10	10	50

Semester End Examination (SEE)

	CO1	CO2	CO3	CO4	CO5	Total
Module 1	20					20
Module 2		20				20
Module 3			20			20
Module 4				20		20
Module 5					20	20
Total	20	20	20	20	20	100

Conditions for SEE Paper Setting:

Each module of SEE question paper should be allocated with questions for 20% of the total SEE marks

10. Future with this Subject

The "ETHICAL HACKING AND NETWORK DEFENSE" course in the - semester of the B.E program lays a strong foundation for several future courses in the undergraduate program. The contributions of this subject extend across various areas, enhancing the students' understanding and skills in the field of cyber security. Here are some notable contributions:

- **Innovation and Research:** Working with the latest technologies and tools in cybersecurity. Engaging in research to develop new methods and tools for defending against cyber threats.
- **Continuous Learning:** Cybersecurity is a rapidly evolving field, requiring continuous learning and adaptation to new threats and technologies. Playing a crucial role in protecting sensitive data and maintaining the integrity of information systems.
- **Global Opportunities:** With the increasing number of cyber threats, there is a high demand for skilled cybersecurity professionals. Opportunities are available in various sectors including finance, healthcare, government, and technology.
- **Career Opportunities:**
 - Penetration Tester: Conducting authorized simulated attacks on computer systems to identify vulnerabilities.
 - Security Analyst: Monitoring and analyzing security systems to detect and respond to security incidents.
 - Security Consultant: Advising organizations on best practices for securing their networks and systems.
 - Incident Responder: Responding to and mitigating the impact of security breaches and incidents.
 - Network Security Engineer: Designing and implementing secure network solutions to protect against cyber threats.

7 th Semester	Professional Elective (PE)- III ADVANCED COMPUTER ARCHITECTURE	M23BCE704C
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1. Prerequisites

S/L	Proficiency	Prerequisites
1	Understanding of Computer Architecture	Knowledge of pipelining, cache memory, instruction set architecture (ISA), and CPU design.
2	Knowledge of Parallel Processing	Knowledge of parallelism, multi-core processors, and parallel execution models.
3	Proficiency in Hardware-Software Co-Design	Familiarity with co-design principles, embedded systems, and their interaction in computer architecture.
4	Knowledge of Memory Hierarchy Design	Basic understanding of memory hierarchy, cache coherence, memory access patterns, and optimization techniques.
5	Proficiency in Performance Analysis	Skills in evaluating and analyzing the performance of computer architectures using tools and benchmarks.
6	Familiarity with Modern Processor Architectures	Knowledge of advanced architectures like superscalar, VLIW (Very Long Instruction Word), and out-of-order execution.
7	Experience with Simulation Tools	Proficiency in using computer architecture simulators such as Simple Scalar or similar tools for performance evaluation and design exploration.

2. Competencies

S/L	Competency	KSA Description
1	Theory of Parallelism	<p>Knowledge: Understanding the fundamental concepts of parallel computing, including parallel architectures, algorithms, and synchronization techniques.</p> <p>Skills: Ability to design, implement, and optimize parallel algorithms to solve computational problems efficiently across multiple processors or cores.</p> <p>Attitude: Recognition of the importance of parallelism in the complexity, such as managing data dependencies, load balancing, and minimizing communication overhead.</p>
2	Hardware Technologies	<p>Knowledge: Understanding the principles and components of modern hardware technologies, including processors, memory systems, storage devices, and networking equipment.</p> <p>Skills: Ability to analyze and evaluate different hardware architectures and select appropriate technologies for specific applications and system requirements.</p> <p>Attitude: Developing a curiosity and enthusiasm for keeping up with the rapid advancements in hardware technologies and their impact on computing systems.</p>
3	Bus, Cache, and Shared Memory	<p>Knowledge: Understanding the fundamental concepts of bus architecture, cache memory, and shared memory systems, including their roles in improving system performance and data access efficiency.</p> <p>Skills: Ability to design and configure cache hierarchies, optimize bus communication, and manage shared memory resources to ensure efficient data transfer and processing.</p> <p>Attitude: Cultivating an appreciation for the complexities and challenges of balancing speed, efficiency, and coherence in systems that rely on bus, cache, and shared memory.</p>

4	Parallel and Scalable Architectures	<p>Knowledge: Understanding the core concepts of parallel and scalable architectures, including multi-core processors, distributed systems, and interconnection networks. Familiarity with key challenges in parallel architecture, such as load balancing, synchronization, and fault tolerance.</p> <p>Skills: Ability to design, implement, and optimize scalable parallel systems that can handle increasing workloads efficiently. Proficiency in using parallel programming models and tools to leverage the potential of scalable architectures in real-world applications</p> <p>Attitude: Developing a proactive mindset to explore emerging technologies and solutions that improve scalability and performance in parallel computing systems. Cultivating a commitment to continuous learning and adaptation, recognizing that parallel and scalable architecture is a rapidly evolving field with ongoing advancements.</p>
5	Software for parallel programming	<p>Knowledge: Understanding the principles of parallel programming, including task parallelism, data parallelism, and the various parallel programming models such as threads, message passing, and shared memory.</p> <p>Skills: Proficiency in writing and optimizing parallel code using languages and frameworks like OpenMP, MPI, CUDA, and Pthreads.</p> <p>Attitude: Developing a mindset that values efficiency and scalability, constantly seeking to improve performance through better parallel programming practices.</p>

3. Syllabus

ADVANCED COMPUTER ARCHITECTURE SEMESTER – VII			
Course Code	M23BIS503	CIE Marks	50
Number of Lecture Hours/Week (L: T: P: S)	(3:0:0:0)	SEE Marks	50
Total Number of Lecture Hours	40 Hours	Total Marks	100
Credits	03	Exam Hours	03
Course Objectives: <ol style="list-style-type: none"> 1. Understand the concepts of parallel computing and hardware technologies. 2. Illustrate and contrast the parallel architectures. 3. Recall parallel programming concepts. 			
Module -1			
Theory of Parallelism: Parallel Computer Models, The State of Computing, Multiprocessors and Multicomputer, Multivector and SIMD Computers, PRAM and VLSI Models, Program and Network Properties, Conditions of Parallelism, Program Partitioning and Scheduling, Program Flow Mechanisms, System Interconnect Architectures, Principles of Scalable Performance, Performance Metrics and Measures, Parallel Processing Applications, Speedup Performance Laws, Scalability Analysis and Approaches.			
Module-2			
Hardware Technologies: Processors and Memory Hierarchy, Advanced Processor Technology, Superscalar and Vector Processors, Memory Hierarchy Technology, Virtual Memory Technology.			
Module-3			
Bus, Cache, and Shared Memory: Bus Systems, Cache Memory Organizations, Shared Memory Organizations, Sequential and Weak Consistency Models, Pipelining and Superscalar Techniques, Linear Pipeline Processors, Nonlinear Pipeline Processors, Instruction Pipeline Design, Arithmetic Pipeline Design.			
Module-4			
Parallel and Scalable Architectures: Multiprocessors and Multicomputer, Multiprocessor System Interconnects, Cache Coherence and Synchronization Mechanisms, Three Generations of Multicomputer, Message-Passing Mechanisms, Multivector and SIMD Computers, Vector Processing Principles, Multivector Multiprocessors, Compound Vector Processing, SIMD Computer Organizations (Upto			

8.4), Scalable, Multithreaded, and Dataflow Architectures, Latency-Hiding Techniques, Principles of Multithreading, Fine-Grain Multicomputer, Scalable and Multithreaded Architectures, Dataflow and Hybrid Architectures.

Module-5

Software for parallel programming: Parallel Models, Languages, and Compilers, Parallel Programming Models, Parallel Languages and Compilers, Dependence Analysis of Data Arrays, Parallel Program Development and Environments, Synchronization and Multiprocessing Modes. Instruction and System Level Parallelism, Instruction Level Parallelism, Computer Architecture, Contents, Basic Design Issues, Problem Definition, Model of a Typical Processor, Compiler-detected Instruction Level Parallelism, Operand Forwarding, Reorder Buffer, Register Renaming, Tomasulo's Algorithm, Branch Prediction, Limitations in Exploiting Instruction Level Parallelism, Thread Level Parallelism.

TEXTBOOKS:

1. Kai Hwang and Naresh Jotwani, Advanced Computer Architecture (SIE): Parallelism, Scalability, Programmability, McGraw Hill Education 3/e. 2015
2. John L. Hennessy and David A. Patterson, Computer Architecture: A quantitative approach, 5th edition, Morgan Kaufmann Elsevier, 2013

Reference Book:

1. Advanced Computer Architecture 3e, Vijay Nicole Imprints Private Limited.
2. Advanced Computer Architecture, Sajjan G shiva.

4. Syllabus Timeline

S/L	Syllabus Timeline	Description
1	Week 1-2: Theory of Parallelism	Explain fundamental concepts of parallel computer models and the state of computing, using real-world examples to illustrate multiprocessors, multicomputer, and SIMD systems. Then, explain program properties, conditions of parallelism, and techniques for partitioning and scheduling, incorporating practical exercises to reinforce these concepts. Finally, focus on system interconnect architectures, performance metrics, and scalability analysis, using case studies and simulations to demonstrate principles of scalable performance and parallel processing applications.
2	Week 3-5: Hardware Technologies	Explain by covering the fundamentals of processors and memory hierarchy, using diagrams and hands-on labs to illustrate how data is processed and stored. Progress to advanced topics like superscalar and vector processors, demonstrating their design and impact on performance with practical examples and simulations. Finally, explore memory hierarchy and virtual memory technologies, employing case studies and performance analysis tools to show their role in optimizing system efficiency and managing large datasets.
3	Week 6-8: Bus, Cache, and Shared Memory.	Explain the fundamentals of bus systems, cache memory organizations, and shared memory structures with visual aids and practical demonstrations. Move on to cover consistency models, pipelining, and superscalar techniques, using interactive simulations to illustrate how these concepts enhance data processing and system performance. Conclude by diving into pipeline processor designs, including linear and nonlinear pipelines, and instruction and arithmetic pipelines, incorporating hands-on exercises to solidify understanding and application of these techniques.
4	Week 9-10: Parallel and Scalable Architectures	Explain by introducing the basics of multiprocessors, multicomputer, and their interconnects, using diagrams and case studies to illustrate their design and function. Progress to advanced topics like cache coherence, synchronization mechanisms, and message-passing mechanisms, employing simulations and practical exercises to demonstrate their impact on performance. Finally, cover scalable, multithreaded, and dataflow architectures, including vector processing

		and latency-hiding techniques, through hands-on projects and real-world applications to reinforce the principles and challenges of scalable parallel systems.
5	Week 11-12: Software for Parallel Programming.	Explain the foundational parallel programming models, languages, and compilers, using practical examples to illustrate their applications and differences. Next, focus on dependence analysis, parallel program development, and synchronization techniques, incorporating hands-on labs and coding exercises to build practical skills. Finally, explain instruction and system-level parallelism, including advanced topics like operand forwarding, register renaming, and Tomasulo's algorithm, using simulations and case studies to explore their impact on processor efficiency and limitations.

5. Teaching-Learning Process Strategies

S/L	TLP Strategies:	Description
1	Lecture Method	Utilize various teaching methods within the lecture format to reinforce competencies.
2	Video/Animation	Incorporate visual aids like videos/animations to enhance understanding of concepts.
3	Collaborative Learning	Encourage collaborative learning for improved competency application.
4	Real-World Application	Discuss practical applications to connect theoretical concepts with real-world competencies.
5	Flipped Class Technique	Utilize a flipped class approach, providing materials before class to facilitate deeper understanding of competencies

6. Assessment Details (both CIE and SEE)

Continuous Internal Evaluation:

The minimum CIE marks requirement is 40% of the maximum marks in each component.

CIE Split up

Components	Number	Weightage	Max. Marks	Min. Marks
(i) Internal Assessment-Tests (A)	2	50%	25	10
(ii) Assignments/Quiz/Activity (B)	2	50%	25	10
Total Marks			50	20

Final CIE Marks =(A) + (B)

Average internal assessment shall be the average of the 2 test marks conducted.

Semester End Examination:

- Question paper pattern will be ten questions. Each question is set for 20marks. The medium of the question paper shall be English unless otherwise it is mentioned.
- There shall be 2 questions from each module, each of the two questions under a module (with a maximum of 3 sub questions), may have mix of topics under that module if necessary.
- The students have to answer 5 full questions selecting one full question from each module.
- Marks scored will be proportionally scaled down to 50 marks

7. Learning Objectives

S/L	Learning Objectives	Description
1	Theory of Parallelism	By studying the Theory of Parallelism, students gain a comprehensive understanding of parallel computer models and architectures, including multiprocessors, multicomputer, SIMD systems, and PRAM models. They learn to analyze and optimize parallel program properties, scheduling, and system interconnect architectures for scalable performance, applying performance

		metrics and laws to real-world parallel processing applications. Additionally, students develop the ability to assess scalability and performance improvements in various parallel systems, enabling them to design and implement efficient solutions in high-performance computing.
2	Hardware Technologies	By studying Hardware Technologies, students learn about the design and operation of advanced processors, including superscalar and vector processors, and how they contribute to enhanced computing performance. They explore the intricacies of memory hierarchy, including cache and virtual memory technologies, and their role in optimizing data access and storage. Additionally, students gain insights into how these hardware technologies work together to improve system efficiency, allowing them to make informed decisions in designing and optimizing hardware architectures.
3	Bus, Cache, and Shared Memory.	By studying Bus, Cache, and Shared Memory, students learn about the design and functionality of bus systems, cache memory organizations, and shared memory architectures, including how these components manage data transfer and storage. They explore consistency models such as sequential and weak consistency, and understand how pipelining and superscalar techniques improve processor performance through linear and nonlinear pipeline designs. Additionally, students gain insights into instruction and arithmetic pipeline design, enabling them to optimize data processing and enhance overall system efficiency.
4	Parallel and Scalable Architectures	By studying Parallel and Scalable Architectures, students learn about the design and functionality of multiprocessors and multicomputer, including interconnects, cache coherence, and synchronization mechanisms. They explore various parallel processing models such as SIMD, vector processing, and multithreaded architectures, and understand how message-passing mechanisms and latency-hiding techniques contribute to scalable performance.
5	Software for Parallel Programming,	By studying Software for Parallel Programming, students learn about various parallel programming models, languages, and compilers, as well as techniques for dependence analysis and synchronization in parallel environments. They gain expertise in developing parallel programs, optimizing instruction and system-level parallelism, and understanding architectural concepts such as operand forwarding, register renaming, and Tomasulo's algorithm.

8. Course Outcomes (COs) and Mapping with POs/ PSOs

Course Outcomes (COs)

COs	Description
M23BCE704C.1	Comprehend the principles of parallel computing, system architectures, and performance scalability.
M23BCE704C.2	Apply hardware technologies like superscalar processors, memory hierarchy, and pipelining techniques.
M23BCE704C.3	Analyze parallel and scalable architectures for their effectiveness in handling synchronization and dataflow.
M23BCE704C.4	Analyzesoftware techniques in parallel programming and instruction-level parallelism for optimizing performance.

CO-PO-PSO Mapping:

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
M23BCE704C.1	3	-	-	-	-	-	-	-	-	-	-	-	3	-
M23BCE704C.2	-	3	-	-	-	-	-	-	-	-	-	-	-	3
M23BCE704C.3	-	-	3	-	-	-	-	-	-	-	-	-	3	-
M23BCE704C.4	-	-	3	-	-	-	-	-	-	-	-	-	-	3
M23BCE704C	3	3	3	-	-	-	-	-	-	-	-	-	3	3

9. Assessment Plan**Continuous Internal Evaluation (CIE)**

	CO1	CO2	CO3	CO4	CO5	Total
Module 1	10					10
Module 2		10				10
Module 3			10			10
Module 4				10		10
Module 5					10	10
Total	10	10	10	10	10	50

Semester End Examination (SEE)

	CO1	CO2	CO3	CO4	CO5	Total
Module 1	20					20
Module 2		20				20
Module 3			20			20
Module 4				20		20
Module 5					20	20
Total	20	20	20	20	20	100

10. Future with this Subject:

- The future of studying Advanced Computer Architecture will increasingly focus on addressing the challenges of extreme parallelism and heterogeneity, as systems continue to evolve with multi-core, many-core, and specialized processors.
- Innovations in quantum computing and neuromorphic computing are expected to push the boundaries of traditional architecture, leading to new paradigms in processing power and efficiency.
- Emphasis will shift towards energy-efficient designs and sustainability, incorporating techniques like dynamic voltage scaling and low-power architecture designs.

7 th Semester	Professional Elective (PE)-III USER INTERFACE DESIGN	M23BCE704D
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1. Prerequisites

S/L	Proficiency	Prerequisites
1	Basic Computer Skills	Basic computer skills, such as saving files in multiple versions and formats.
2	Programming basic tools	Familiar with Programming tools like assemblers, compilers, linkers translate, flowchart, algorithms which can be used to form a program from a human write-able and readable source language into the bits and bytes that can be executed by a computer.
3	Programming Fundamentals	Familiar with general coding concepts like variables, basic data types, Conditional Statements, Looping, Functions, creation of source file, compilation process, program execution techniques.
4	Basic Object Orientation Concepts	Basic of four basic principles: encapsulation, inheritance, polymorphism, and abstraction. Where these four OOP principles can be used enable to create objects and collaborate to create powerful applications too.

2. Competencies

S/L	Competency	KSA Description
1	Understanding basic User Interface Design	Knowledge: Importance of User Interface Design for any application. Understanding of the basics of User Interface Design. Skills: Ability to know the basic principles of Interface Design for the Users. Attitudes: Appreciation to understand the importance of Interface Design and implement the same with respect to user's perspective.
2	Design Process: Requirement Analysis	Knowledge: Understanding of the need of requirement analysis before any design is to be made. Principles of Requirement Analysis and techniques. Skills: Steps to understand with proper guidelines to collect the requirements for the design. Attitudes: Appreciation for the procedure to gather the appropriate requirements for the design.
3	Design Process: Business Function & Screen Design	Knowledge: Understanding the basic business functions with respect to user interface design. Importance of Screen Design. Skills: Defining appropriate Business Protocols and strategies. Designing of Screen Elements to produce Good Screen Design. Attitudes: Valuing the importance of Business Strategies and Screen Design which is appropriate for different types of Users.
4	Design Process: Menus	Knowledge: Understanding the importance of Menus and its items for user interaction.

		Skills: Applying Guidelines of Menu Design and its Items to create proper structure of menu usage. Attitudes: Creativeness to design the menu and its items for effective usage.
5	Design Process: Window	Knowledge: Understanding of issues and structures of windows and its types Skills: Constructing window structure to suit the best design for the elements of the screen for user interaction. Attitudes: Appreciation for the way types of windows can be designed and used with good design.
6	Design Process: Controls	Knowledge: Understanding the characteristics and importance of Screen Controls. Skills: Designing and analyzing the appropriate Screen Controls. Attitudes: Recognizing the significance of screen controls.
7	Design Process: Tests	Knowledge: Understanding the importance of Testing. Skills: Designing and analyzing elements of the screen through testing. Attitudes: Valuing the importance of Testing and Re-Testing

3. Syllabus

USER INTERFACE DESIGN SEMESTER – VII			
Course Code	M23BCE704D	CIE Marks	50
Number of Lecture Hours/Week(L: T: P: S)	(3:0:0:0)	SEE Marks	50
Total Number of Lecture Hours	40 Hours of Theory	Total Marks	100
Credits	03	Exam Hours	03
Course Objectives: To study the concept of menus, windows, interfaces To study about business functions To study the characteristics and components of windows and the various controls for the windows. To study about various problems in windows design with color, text, graphics and study the testing methods			
Module -1			
Overview Introduction to User Interface, Defining the User Interface, The Importance of Good Design, A Brief History of the Human-Computer Interface, The Concept of Direct Manipulation, Graphical Systems: Advantages and Disadvantages, Characteristics of the Graphical User Interface, Characteristics of a Web Interface, General Principles of User Interface Design.			
Textbook 1: Selected Topics from Part-1			
Module -2			
Introduction to The User Interface Design Process, Obstacles and Pitfalls in the Development Path, Designing for People: The Five Commandments, Usability, Important Human Characteristics in Design, Human Considerations in Design, Human Interaction speeds.			
Textbook 1: Selected Topics from Part-2 Step-1			
Module -3			
Introduction to Understand the Business Function, Business Definition and Requirements Analysis, Determining Basic Business Functions, Basic business functions, Design standards. Understand the Principles of Good Screen Design, Human Considerations in Screen Design.			
Textbook 1: Selected Topics from Part-2 and Step-3			

Module -4	
Introduction to Develop System Menus and Navigation Schemes, Structures of Menus, Functions of Menus, Contents of Menus, Formatting of Menus, Phrasing the Menu, Selecting Menu Choices, Navigating Menus, Kinds of Graphical Menus.	
Textbook 1: Selected Topics from Part-2 Step-4	
Module -5	
Introduction to Select the Proper Kinds of Windows, Window Characteristics, Components of window, Window presentation styles, Types of Windows, Characteristics of Device Based Controls. Introduction to Choose the Proper Screen Based Controls, Operable Controls, Windows Tests-prototypes, kinds of tests.	
Textbook 1: Selected Topics from Part-2 Step-5, Step-6, Step-7 & Step-14	
TEXTBOOKS:	
1. Wilbert O. Galitz, "The Essential Guide to User Interface Design", John Wiley & Sons, Second Edition 2002	
2. Ben Sheiderman, "Design the User Interface", Pearson Education, 1998.	
REFERENCE BOOKS:	
1. Alan Cooper, "The Essential of User Interface Design", Wiley- Dream Tech Ltd., 2002.	

4. Syllabus Timeline

S/L	Syllabus Timeline	Description
1	Week 1-3: Introduction to User Interface	Understanding the importance of User Interface design and Defining the User Interface, get to know the history of the Human-Computer Interface with Direct Manipulation and indirect manipulation along with the Characteristics of a Web Interface.
2	Week 4-6: Requirement Analysis for Design Process	Understanding the initial step of User Interface Design Process by knowing the Obstacles and Pitfalls in the Development Path and how People should be involved in the Design process.
3	Week 7-8: Business Functions in Design Process	Understand the Business Function and Business Definition with Design standards with the importance of Good Screen Design by considering Human interaction in the process.
4	Week 9-10: Menus in Design Process	To Understand about Menus with its Structures, Functions, Contents, Formatting, Phrasing, Selection of Menu Items and Navigation of Menus with its Kinds.
5	Week 11-12: Windows, Controls and Test in Design Process	Selection of Proper Kinds of Windows by knowing the Window Characteristics with its Components and the styles to present it, Device Controls which can be used with Proper Screen Based Controls and Finally how Windows Tests-prototypes can be conducted knowing the kinds of tests.

5. Teaching-Learning Process Strategies

S/L	TLP Strategies:	Description
1	Lecture Method	Utilize various teaching methods within the lecture format to reinforce competencies.
2	Image/Video/Animation	Incorporate visual aids like image/videos/animations to enhance understanding of programming constructs.
3	Collaborative Learning	Encourage collaborative learning for improved competency application.
4	Higher Order Thinking (HOTS) Questions:	Pose HOTS questions to stimulate critical thinking related to each competency.
5	Group-Based Learning (GBL)	Implement GBL to enhance analytical skills and Design Skills
6	Real-World Application	Discuss practical applications to connect theoretical concepts with real-

		world competencies.
8	Flipped Class Technique	Utilize a flipped class approach, providing materials before class to facilitate deeper understanding of competencies

6. Assessment Details (both CIE and SEE)**Continuous Internal Evaluation:**

This section of regulations is applicable to all theory-based courses. The minimum CIE marks requirement is 40% of maximum marks in each component.

CIE Split up

	Components	Number	Weightage	Max. Marks	Min. Marks
(i)	Internal Assessment-Tests (A)	2	50%	25	10
(ii)	Assignments/Quiz/Activity (B)	2	50%	25	10
	TotalMarks			50	20

FinalCIE Marks =(A) + (B)

Average internal assessment shall be the average of the 2 test marks conducted.

Semester End Examination:

1. Question paper pattern will be ten questions. Each question is set for 20marks. The medium of the question paper shall be English unless otherwise it is mentioned.
2. There shall be 2 questions from each module, each of the two questions under a module (with a maximum of 3 sub questions), may have mix of topics under that module if necessary.
3. The students have to answer 5 full questions selecting one full question from each module.
4. Marks scored will be proportionally scaled down to 50 marks.

7. Learning Objectives

S/L	Learning Objectives	Description
1	Understanding and applying the basic User Interface Design	Students will grasp the fundamental concepts of User Interface Design by applying the basic elements of the design.
2	Applying the System Requirements during Design Process	Students will apply strategies for requirement analysis as part of the design process.
3	Analyse the Business Function & Screen Layouts	Students will become analyse the Business functions with respect to User Interface Design and uses the appropriate Screen Design.
4	Implement the appropriate Menus	Students will implement various types of Menus and its usage while designing the screen elements.
5	Examine the Design Process with Window, Controls and Tests	Students will examineWindow and its element design with proper device controllables. Later the design test and retest process applications.

8. Course Outcomes (COs) and Mapping with POs/ PSOs**Course Outcomes (COs)**

COs	Description
M23BCE704D.1	Understand and apply the fundamental characteristics of computer interface, graphics interface and web interface
M23BCE704D.2	Apply the various components of user interface design during the design process

M23BCE704D.3	Analyse the various characteristics of user interface components during the design process.
M23BCE704D.4	Implement the appropriate design strategies for good interface design.
M23BCE704D.5	Design the prototypes of user interface and examine with testing process.

CO-PO-PSO Mapping

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
M23BCE704D.1	3	-	-	-	-	-	-	-	-	-	-	-	3	-
M23BCE704D.2	3	-	-	-	-	-	-	-	-	-	-	-	3	-
M23BCE704D.3	-	3	-	-	-	-	-	-	-	-	-	-	3	-
M23BCE704D.4	-	-	3	-	-	-	-	-	-	-	-	-	3	3
M23BCE704D.5	-	-	-	3	-	-	-	-	-	-	-	-	3	3
M23BCE704D	3	3	3	3	-	-	-	-	-	-	-	-	3	3

9. Assessment Plan**Continuous Internal Evaluation (CIE)**

	CO1	CO2	CO3	CO4	CO5	Total
Module 1	10					10
Module 2		10				10
Module 3			10			10
Module 4				10		10
Module 5					10	10
Total	10	10	10	10	10	50

Semester End Examination (SEE)

	CO1	CO2	CO3	CO4	CO5	Total
Module 1	20					20
Module 2		20				20
Module 3			20			20
Module 4				20		20
Module 5					20	20
Total	20	20	20	20	20	100

10. Future with this Subject:

- ❖ **Advanced UserInterface Design Courses:** The knowledge gained in this course, covering principles of Design and Human Interaction Can be used to have more advanced complete design courses.
- ❖ **User-Centric Design:** Companies are prioritizing user-centric design to differentiate themselves in a competitive market, leading to increased demand for UI/UX professionals.
- ❖ **Mobile and Web Applications:** The proliferation of mobile devices and web applications has created a need for well-designed interfaces that provide seamless experiences across various platforms.
- ❖ **Emerging Technologies:** As emerging technologies like AI, AR/VR, and voice interfaces become more prevalent, UI/UX designers will be needed to create intuitive and engaging experiences.
- ❖ **Accessibility and Inclusive Design:** There is a growing focus on designing products that are accessible to all users, including those with disabilities, opening up opportunities for UI/UX professionals with expertise in inclusive design.
- ❖ **Continuous Iteration and Improvement:** The iterative nature of UI/UX design means that there will always be a need for designers to collect user feedback, analyze data, and make improvements to existing products.
- ❖ **Project Work and Research:** The hands-on experience gained through design process and its fundamentals can be utilized to design front-end of project work.
- ❖ **Industry Applications:** The course provides some fundamentals and guidelines which can be used in real-time project works.

7 th semester	Professional Elective- IV QUANTUM COMPUTING	M23BCE705A
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1. Prerequisites

S/L	Proficiency	Prerequisites
1	Linear Algebra	Essential for understanding quantum states, gates, and transformations. Proficiency in vector spaces, matrices, eigenvalues, eigenvectors, and tensor products.
2	Probability Theory	Necessary for understanding quantum measurements and probability amplitudes. Proficiency in basic probability concepts is required.
3	Complex Numbers	Fundamental for quantum state representation. Proficiency in complex arithmetic and complex plane visualization.
4	Algorithms	Required for understanding classical algorithms before quantum ones. Proficiency in designing and analyzing classical algorithms.
5	Programming	Essential for implementing quantum algorithms. Proficiency in Python and familiarity with quantum programming frameworks like Qiskit.

2. Competencies

S/L	Competency	KSA Description
1	Understanding of Quantum Computing Concepts	<p>Knowledge: Understand and articulate the fundamental principles of quantum mechanics, such as superposition, entanglement, and quantum interference, and how they apply to quantum computing.</p> <p>Skills: Demonstrate proficiency in designing, simulating, and optimizing quantum algorithms using quantum programming languages.</p> <p>Attitudes: Adopt a mindset for applying quantum computing techniques to real-world challenges in areas like cryptography and artificial intelligence.</p>
2	Problem-solving Skills	<p>Knowledge: Understand the potential of quantum computing to solve complex problems faster than classical computers, including problems related to cryptography, optimization, and data analysis.</p> <p>Skills: Demonstrate the ability to design and implement quantum algorithms that address specific problems, utilizing quantum principles like superposition and entanglement to optimize solutions.</p> <p>Attitudes: Adopt a creative and critical approach to problem-solving, exploring innovative quantum computing solutions to real-world challenges in fields such as machine learning, logistics, and materials science.</p>
3	Critical Thinking	<p>Knowledge: Understand the theoretical foundations of quantum computing and its limitations, including the challenges of noise, decoherence, and error correction in quantum systems.</p> <p>Skills: Demonstrate the ability to critically analyze and evaluate quantum algorithms and quantum hardware, identifying potential issues and improvements for more efficient solutions.</p> <p>Attitudes: Cultivate a mindset of curiosity and skepticism, continuously questioning assumptions and exploring innovative approaches to overcome challenges in the development of quantum technologies.</p>
4	Mathematical Foundations	<p>Knowledge: Understand the mathematical principles underlying quantum computing, including linear algebra, complex numbers, probability theory, and quantum</p>

		<p>state representation.</p> <p>Skills: Demonstrate the ability to apply mathematical tools to model quantum systems, analyze quantum algorithms, and solve problems related to qubits, quantum gates, and entanglement.</p> <p>Attitudes: Adopt a detail-oriented approach to problem-solving, valuing precision and accuracy in mathematical modeling to ensure the correct application of quantum computing concepts..</p>
5	Classical Computing Fundamentals	<p>Knowledge: Understand the core principles of classical computing, including algorithms, data structures, and computational complexity, and how they contrast with quantum computing concepts.</p> <p>Skills: Demonstrate the ability to apply classical computing knowledge to identify the limits of classical systems and determine when quantum computing provides a potential advantage.</p> <p>Attitudes: Adopt an interdisciplinary mindset, recognizing the complementary roles of classical and quantum computing in solving complex problems and driving technological advancements.</p>

3. Syllabus

Quantum Computing SEMESTER – VII			
Course Code	M23BCE705A	CIE Marks	50
Number of Lecture Hours/Week(L: T: P: S)	(3:0:0)	SEE Marks	50
Total Number of Lecture Hours	40 hours Theory	Total Marks	100
Credits	03	Exam Hours	03
<p>Course objectives: This course will enable students to:</p> <ul style="list-style-type: none"> • Understanding of the basic principles of Quantum Computing and Information. • Understand the Quantum Operations and Quantum Gates. • Understand the basic features of Quantum Coding and Algorithms. • Understand the Quantum Computational Complexity and Error Correction. 			
Module -1			
<p>Foundation: Overview – Church-Turing Thesis – The circuit model of computation– reversible computation – quantum physics – quantum physics and computation – Dirac notation and Hilbert Spaces – dual vectors – operators – the spectral theorem – functions of operators – tensor products – Schmidt decomposition theorem.</p> <p>Textbook 1- Chapter 1(1.1,1.2,1.3,1.5,1.6,1.7) Chapter 2 (2.1,2.2,2.3,2.4,2.5,2.6,2.7)</p>			
Module -2			
<p>Qubits and Quantum Model of Computation Management: State of a quantum system – time evolution of a closed system – composite systems – measurement – mixed states and general quantum operations – quantum circuit model – quantum gates – universal sets of quantum gates – unitary transformations – quantum circuits.</p> <p>Textbook 1-Chapter 3(3.1,3.2,3.3,3.4,3.5) Chapter 4(4.1,4.2,4.3,4.4,4.5)</p>			
Module -3			
<p>Quantum Algorithms - 1: Superdense coding – quantum teleportation – applications of teleportation – probabilistic versus quantum algorithms – phase kick-back – the Deutsch algorithm – the Deutsch - Jozsa algorithm – Simons algorithm – Quantum phase estimation and quantum Fourier Transform – eigenvalue estimation.</p> <p>Textbook 1-Chapter 5(5.1,5.2,5.3) Chapter 6(6.1,6.2,6.3,6.4,6.5) Chapter 7(7.1,7.2)</p>			
Module -4			

Quantum Algorithms - 2: Order-finding problem – eigenvalue estimation approach to order finding – Shor’s algorithm for order finding – finding discrete logarithms – hidden subgroups – Grover’s quantum search algorithm – amplitude amplification – quantum amplitude estimation – quantum counting – searching without knowing the success probability.

Textbook 1-Chapter 7(7.3.1,7.3.3,7.3.4,7.4,7.5) Chapter 8(8.1-8.4)

Module -5

Quantum Computational Complexity and Error Correction: Computational complexity – black-box model – lower bounds for searching – general black-box lower bounds – polynomial method – block sensitivity – adversary methods – classical error correction – classical three-bit code – fault tolerance – quantum error correction – three- and nine-qubit quantum codes – fault-tolerant quantum computation.

Textbook 1-Chapter 9(9.1-9.7) Chapter 10(10.1-10.6)

Text Books:

1. Phillip Kaye, R. Laflamme, and M. Mosca, “An Introduction to Quantum Computing”, Oxford University Press, 2007.

Reference Books:

1.V. Sahni, “Quantum Computing”, Tata McGraw-Hill Publishing Company, 2007.

2. Quantum Computing and Quantum Information, Michael A. Nielsen & Isaac L. Chuang, 10th Anniversary edition, Cambridge University Press, 2010.

3. Quantum Computing by Parag Lala, McGraw-Hill, Indian Edition, Reprint 2020.

Web links and Video Lectures (e-Resources):

<https://nptel.ac.in/courses/106106232>

<https://archive.nptel.ac.in/courses/115/101/115101092/>

<https://www.ibm.com/quantum>

4. Syllabus Timeline

S/L	Syllabus Timeline	Description
1	Week 1-2	Overview Church-Turing Thesis The circuit model of computation Reversible computation Quantum physics Quantum physics and computation
2	Week 3-4	Dirac notation and Hilbert Spaces Dual vectors Operators The spectral theorem Functions of operators
3	Week 5-6	Tensor products Schmidt decomposition theorem State of a quantum system Time evolution of a closed system Composite systems Measurement Mixed states and general quantum operations
4	Week 7-8:	Quantum circuit model Quantum gates Universal sets of quantum gates Unitary transformations Quantum circuits Superdense coding Quantum teleportation Applications of teleportation
5	Week 9-10	Probabilistic versus quantum algorithms Phase kick-back

		The Deutsch algorithm The Deutsch - Jozsa algorithm Simons algorithm Quantum phase estimation and quantum Fourier Transform Eigenvalue estimation
6	Week 11-12	Order-finding problem Eigenvalue estimation approach to order finding Shor's algorithm for order finding Finding discrete logarithms Hidden subgroups Grover's quantum search algorithm Amplitude amplification Quantum amplitude estimation Quantum counting Searching without knowing the success probability.
7	Week 13-14:	Computational complexity Black-box model Lower bounds for searching General black-box lower bounds Polynomial method Block sensitivity Adversary methods
8	Week 15-16:	Classical error correction Classical three-bit code Fault tolerance Quantum error correction Three- and nine-qubit quantum codes Fault-tolerant quantum computation.

5. Teaching-Learning Process Strategies

S/L	TLP Strategies:	Description
1	Lecture Method	Utilize various teaching methods within the lecture format to reinforce competencies.
2	Video/Animation	Incorporate visual aids like videos/animations to enhance understanding of Programming concepts.
3	Collaborative Learning	Encourage collaborative learning for improved competency application.
4	Higher Order Thinking (HOTS) Questions:	Pose HOTS questions to stimulate critical thinking related to each competency.
5	Problem-Based Learning (PBL)	Implement PBL to enhance analytical skills and practical application of competencies
6	Multiple Representations	Introduce topics in various representations to reinforce competencies
7	Real-World Application	Discuss practical applications to connect theoretical concepts with real-world competencies.
8	Flipped Class Technique	Utilize a flipped class approach, providing materials before class to facilitate deeper understanding of competencies
9	Programming Assignments	Assign programming tasks to reinforce practical skills associated with competencies.

6. Assessment Details (both CIE and SEE)**Continuous Internal Evaluation:**

This section of regulations is applicable to all theory-based courses. The minimum CIE marks requirement is 40% of maximum marks in each component.

CIE Split up

	Components	Number	Weightage	Max. Marks	Min. Marks
(i)	Internal Assessment-Tests (A)	2	50%	25	10
(ii)	Assignments/Quiz/Activity (B)	2	50%	25	10
	TotalMarks			50	20

$$\text{FinalCIE Marks} = (A) + (B)$$

Average internal assessment shall be the average of the 2 test marks conducted.

Semester End Examination:

1. Question paper pattern will be ten questions. Each question is set for 20marks. The medium of the question paper shall be English unless otherwise it is mentioned.
2. There shall be 2 questions from each module, each of the two questions under a module (with a maximum of 3 sub questions), may have mix of topics under that module if necessary.
3. The students have to answer 5 full questions selecting one full question from each module.
4. Marks scored will be proportionally scaled down to 50 marks.

7. Learning Objectives

S/L	Learning Objectives	Description
1	Understand Quantum Mechanics Fundamentals	Gain a foundational understanding of quantum mechanics principles, including superposition, entanglement, and quantum states.
2	Develop Proficiency in Quantum Algorithms	Learning and implement key quantum algorithms, such as Shor's and Grover's algorithms, understanding their significance and applications.
3	Apply Mathematical Concepts to Quantum Computing	Use linear algebra, complex numbers, and probability theory to model and analyze quantum systems and processes.
4	Design and Simulate Quantum Circuits	Develop the ability to design quantum circuits and simulate them using quantum programming tools like Qiskit.
5	Explore Quantum Information Theory	Understand the concepts of quantum information, quantum entropy, and quantum error correction, and their applications in quantum communication.

8. Course Outcomes (Cos) and Mapping with Pos/ PSOs**Course Outcomes (Cos)**

Cos	Description
M23BCE705A.1	Analyze the fundamental concepts and principles of quantum computing
M23BCE705A.2	Analyze the Qubits and Quantum Model of Computation Management
M23BCE705A.3	Evaluate and understand various Quantum Algorithms
M23BCE705A.4	Analyze and understand various Quantum Algorithms
M23BCE705A.5	Examine the various concepts of Quantum Computational Complexity and Error Correction

CO-PO-PSO Mapping

Cos/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO110	PO111	PO112	PSO1	PSO2
M23BCE705A.1	3	2	-	-	3	-	-	-	-	-	-	3	3	
M23BCE705A.2	3	3	3	-	-	-	-	-	-	-	-		3	
M23BCE705A.3	-	3		2	-	-	-	-	-	-	-	3		
M23BCE705A.4	-	3	-	2	-	-	-	-	-	-	-	3		
M23BCE705A.5	-	-	3	-	-	-	-	-	-	-	-	-	3	

9. Assessment Plan**Continuous Internal Evaluation (CIE)**

	CO1	CO2	CO3	CO4	CO5	Total
Module 1	10					
Module 2		10				
Module 3			10			
Module 4				10		
Module 5					10	
Total						50

Semester End Examination (SEE)

	CO1	CO2	CO3	CO4	CO5	Total
Module 1	20					
Module 2		20				
Module 3			20			
Module 4				20		
Module 5					20	
Total						100

Conditions for SEE Paper Setting:

Each module of SEE question paper should be allocated with questions for 20% of the total SEE marks.

10. Future with this Subject

- The future with Quantum Computing is likely to involve several key trends and developments:
- Revolutionizing Cryptography: Quantum computers could break traditional cryptographic schemes, like RSA, by efficiently factoring large numbers. This will lead to the development of quantum-resistant encryption methods, securing data in a post-quantum world.
- Advancements in Drug Discovery and Material Science: Quantum computing could simulate molecular interactions at an unprecedented scale, enabling the discovery of new drugs and materials with properties tailored for specific purposes, potentially revolutionizing healthcare and materials engineering.
- Optimization and Problem-Solving: Quantum algorithms can solve complex optimization problems exponentially faster than classical algorithms. This could impact logistics, finance, manufacturing, and any field that relies on solving large-scale optimization problems.
- Artificial Intelligence and Machine Learning: Quantum computing could enhance machine learning algorithms, enabling faster training and more accurate models. This could lead to breakthroughs in AI applications, such as natural language processing, image recognition, and autonomous systems.
- Accelerating Scientific Research: Quantum computers can simulate quantum systems, aiding in the understanding of fundamental physics and chemistry. This could lead to new discoveries in quantum mechanics, particle physics, and other scientific fields, pushing the boundaries of our knowledge.
- Economic and Industrial Transformation: Quantum computing has the potential to create new industries, jobs, and economic growth. Companies and countries that invest in quantum technologies could gain a significant competitive advantage, leading to shifts in global economic power.

7 th Semester	Professional Elective (PE)–IV BUSINESS INTELLIGENCE AND ANALYTICS	M23BCE705B
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1. Prerequisites

S/L	Proficiency	Prerequisites
1	Basic Statistics:	Understanding of fundamental statistical concepts such as mean, median, mode, variance, standard deviation, correlation, and regression.
2	Probability:	Familiarity with basic probability theory, including probability distributions and probability rules.
3	Introductory Programming:	Knowledge of at least one programming language, such as Python or R, which are commonly used in data analysis and BI..
4	Introduction to Business Concepts:	Basic understanding of business processes, organizational structures, and key performance indicators (KPIs).
5	Information Systems:	Familiarity with the role of information systems in organizations, including data management systems, enterprise resource planning (ERP), and customer relationship management (CRM) systems.

2. Competencies

S/L	Competency	KSA Description
1	Data Management	Knowledge: Knowledge of how to structure and store data efficiently to ensure its integrity and accessibility. Skills: The ability to analyze complex datasets, identify trends and patterns. Attitudes: This involves understanding the strategic context of data analysis and using insights to influence business strategy.
2	Business Intelligence Concepts	Knowledge: Familiarity with the fundamental concepts of BI, such as data visualization, reporting, decision support systems, and key performance indicators (KPIs). Skills: Skill in developing script for analysis. Attitudes: Ability to Analyze business data efficiently.
3	Statistical and Analytical Techniques	Knowledge: Understanding how to apply these techniques to real-world business problems. Skills: The ability to approach business problems analytically, develop hypotheses, and use data to test and validate these hypotheses. Attitudes: The ability to quickly adapt to new tools, technologies, and methodologies in the rapidly evolving field of BI and Analytics.
4	Decision Support System	Knowledge: Knowledge of ANN, Decision support system. Skills: Skill on applying ANN knowledge and Decision support system. Attitudes: Ability to apply export system.

3. Syllabus

BUSINESS INTELLIGENCE AND ANALYTICS SEMESTER – VII			
Course Code	M23BCE705B	CIE Marks	50
Number of Lecture Hours/Week(L: T: P: S)	(3:0:0:0)	SEE Marks	50
Total Number of Lecture Hours	40 hours Theory	Total Marks	100
Credits	03	Exam Hours	03
Course Objectives: <ul style="list-style-type: none"> Explain the Business Intelligence, Analytics and Decision Support system List the technologies for Decision making, Automated decision systems Explain sentiment analysis techniques 			

<ul style="list-style-type: none"> Illustrate Multi-criteria Decision making systems, predictive modelling techniques
Module -1
An Overview of Business Intelligence, Analytics, and Decision Support: Information Systems Support for Decision Making, An Early Framework for Computerized Decision Support, The Concept of Decision Support Systems, A Framework for Business Intelligence, Business Analytics Overview, Brief Introduction to Big Data Analytics.
Module -2
Decision Making: Introduction and Definitions, Phases of the Decision, Making Process, The Intelligence Phase, Design Phase, Choice Phase, Implementation Phase, Decision Support Systems Capabilities, Decision Support Systems Classification, Decision Support Systems Components.
Module -3
Neural Networks and Sentiment Analysis: Basic Concepts of Neural Networks, Developing Neural Network-Based Systems, Illuminating the Black Box of ANN with Sensitivity, Support Vector Machines, A Process Based Approach to the Use of SVM, Nearest Neighbour Method for Prediction, Sentiment Analysis Overview, Sentiment Analysis Applications, Sentiment Analysis Process,, Sentiment Analysis, Speech Analytics.
Module -4
Model-Based Decision Making: Decision Support Systems modeling, Structure of mathematical models for decision support, Certainty, Uncertainty, and Risk, Decision modeling with spreadsheets, Mathematical programming optimization, Decision Analysis with Decision Tables and Decision Trees, Multi-Criteria Decision Making With Pairwise Comparisons
Module -5
Automated Decision Systems and Expert Systems: Automated Decision Systems, The Artificial Intelligence field, Basic concepts of Expert Systems, Applications of Expert Systems, Structure of Expert Systems, Knowledge Engineering, Development of Expert Systems.
Suggested Learning Resources: TEXT BOOKS: 1. Ramesh Sharda, Dursun Delen, Efraim Turban, J.E. Aronson, Ting-Peng Liang, David King, "Business Intelligence and Analytics: System for Decision Support", 10th Edition, Pearson Global Edition, 2013 2. Data Analytics: The Ultimate Beginner's Guide to Data Analytics Paperback – 12 November 2017 by Edward Mize. REFERENCE BOOKS: 1. Kumar, U.D :Business Analytics – The Science of Data – Driven Decision Making, Wiley. 2. Bowles, M. :Machine Learning in Python – Essential Techniques for Predictive Analysis, Wiley.

4. Syllabus Timeline

S/L	Syllabus Timeline	Description
1	Week 1-3: An Overview of Business Intelligence, Analytics, and Decision Support	Introduction to concepts of Business Intelligence. Review of theory and concepts.. Basics data analytics and decision support system.
2	Week 4-6: Decision Making	Introduction to decision system. Phases of decision making system. Process of decision making system.
3	Week 8-11: Neural Networks and Sentiment Analysis	Introduction to Neural Networks and Sentiment Analysis.
4	Week 7-8: Model-Based Decision Making	Introduction to the structure of decision making system. Different decision making models.
5	Week 9-12: Automated Decision Systems and Expert	Introduction to Automated decision system. Basics of expert system. Structure and applications of expert system.

	Systems	
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5. Teaching-Learning Process Strategies

S/L	TLP Strategies:	Description
1	Lecture Method	Utilize various teaching methods within the lecture format to reinforce competencies.
2	Simulation	Use software simulations to mimic real-world business scenarios..
3	Group Projects and Collaborative Learning	Promote teamwork through group projects that require students to collaborate on analysis and decision-making.
4	Problem based Learning	Present students with real-world business problems to solve using BI tools.
5	Case Study based approach	Analyze case studies of companies that have successfully implemented BI and Analytics.
6	Labs and Workshops	Provide regular lab sessions where students can practice using BI tools like Tableau, Power BI, or SQL.

6. Assessment Details (both CIE and SEE)

Continuous Internal Evaluation:

The minimum CIE marks requirement is 40% of maximum marks in each component.

CIE Split up

	Components	Number	Weightage	Max. Marks	Min. Marks
(i)	Internal Assessment-Tests (A)	2	50%	25	10
(ii)	Assignments/Quiz/Activity (B)	2	50%	25	10
	TotalMarks			50	20

$$\text{FinalCIE Marks} = (A) + (B)$$

Average internal assessment shall be the average of the 2 test marks conducted.

Semester End Examination:

1. Question paper pattern will be ten questions. Each question is set for 20marks. The medium of the question paper shall be English unless otherwise it is mentioned.
2. There shall be 2 question from each module, each of the two questions under a module (with a maximum of 3 sub questions), may have mix of topics under that module if necessary.
3. The students have to answer 5 full questions selecting one full question from each module.
4. Marks scored will be proportionally scaled down to 50 marks

7. Learning Objectives

S/L	Learning Objectives	Description
1	Understanding Business Intelligence Concepts	Describe the role of BI in supporting strategic and operational decision-making in organizations.
2	Data Management and Preparation	Perform data extraction, transformation, and loading (ETL) processes to prepare data for analysis.
3	Analytical Skills Development	Apply statistical methods and data analysis techniques to interpret data and derive actionable insights.
4	Data Visualization and Reporting	Design and develop effective data visualizations that communicate insights clearly and concisely to stakeholders.
5	Real-World Application	Implement a comprehensive BI project that involves data collection, analysis, visualization, and reporting in response to a real-world business challenge.

8. Course Outcomes (COs) and Mapping with POs/ PSOs**Course Outcomes (COs)**

COs	Description
M23BCE705B.1	Able to analyze Business Intelligence, Analytics and Decision support
M23BCE705B.2	Understand and apply technologies for decision making
M23BCE705B.3	Apply predictive modelling techniques
M23BCE705B.4	Apply sentiment analysis techniques
M23BCE705B.5	Develop NN model for analysis.

CO-PO-PSO Mapping

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
M23BCE705B.1	-	3	-	-	-	-	-	-	-	-	-	-	-	-
M23BCE705B.2	3	-	-	-	-	-	-	-	-	-	-	-	-	-
M23BCE705B.3	3	-	-	-	-	-	-	-	-	-	-	-	-	-
M23BCE705B.4	3	-	-	-	-	-	-	-	-	-	-	-	-	-
M23BCE705B.5	-	-	3	-	-	-	-	-	-	-	-	-	-	-
M23BCE705B	3	3	3	-	-	-	-	-	-	-	-	-	3	3

9. Assessment Plan**Continuous Internal Evaluation (CIE)**

	CO1	CO2	CO3	CO4	CO5	Total
Module 1	10					10
Module 2		10				10
Module 3			10			10
Module 4				10		10
Module 5					10	10
Total	10	10	10	10	10	50

Semester End Examination (SEE)

	CO1	CO2	CO3	CO4	CO5	Total
Module 1	20					20
Module 2		20				20
Module 3			20			20
Module 4				20		20
Module 5					20	20
Total	20	20	20	20	20	100

10. Future with this Subject:

- ❖ **AI-Powered Analytics:** The integration of artificial intelligence (AI) and machine learning (ML) into BI will become more prevalent, leading to the development of more sophisticated predictive and prescriptive analytics.
- ❖ **Natural Language Processing (NLP):** NLP will allow users to interact with BI tools using conversational language, making data analysis more accessible to non-technical users.
- ❖ **IoT and Big Data:** The convergence of BI with IoT and Big Data will lead to new opportunities for analytics.

7 th Semester	Professional Elective (PE)-IV DEEP LEARNING	M23BCE705C
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1. Prerequisites

S/L	Proficiency	Prerequisites
1	Basic Mathematics	Understanding of vectors, matrices, matrix multiplication, eigenvalues, and eigenvectors is crucial. Fundamental concepts of force, motion, energy, and equilibrium. Basic knowledge of calculus, including derivatives and gradients, is essential. Understanding how optimization algorithms like gradient descent work requires a grasp of partial derivatives and the chain rule. Familiarity with basic probability theory, distributions, statistical measures (mean, variance, etc.), and concepts like expectation and maximum likelihood estimation is important for understanding model evaluation and performance.
2	Programming Skills	Proficiency in Python is often required, as it is the primary language used in most deep learning frameworks and libraries. Students should be comfortable with Python syntax, functions, loops, and data structures. Basic knowledge of Python libraries commonly used in data science and machine learning, such as NumPy, pandas, and Matplotlib, is beneficial for data manipulation and visualization.
3	Fundamentals of Machine Learning	Understanding basic supervised learning concepts like regression, classification, and model evaluation metrics (accuracy, precision, recall, F1 score) is important. Familiarity with unsupervised learning methods such as clustering and dimensionality reduction helps in understanding the broader context of machine learning.
4	Data Handling	Knowledge of data preprocessing techniques such as normalization, scaling, and splitting datasets into training and testing sets. Basic skills in managing and manipulating large datasets, including understanding data formats and performing basic data cleaning tasks.
5	Basic Understanding of Neural Networks	Introduction to the fundamental components of neural networks, such as neurons, layers, activation functions, and the general idea of how neural networks are trained. Understanding the basics of how neural networks are trained, including concepts like forward propagation and backpropagation.
6	Computational Tools	Familiarity with using development environments or tools like Jupyter Notebooks, which are often used for implementing and experimenting with machine learning models.

2. Competencies

S/L	Competency	KSA Description
1	Fundamental Concepts	Knowledge: Neural Network Architecture, Training and Optimization, Loss Functions. Skills: Programming and Implementation: Python Proficiency, Model Development, Data Pre-processing. Attitudes: Curiosity and Continuous Learning: A willingness to explore new deep learning techniques, stay updated with advancements, and integrate cutting-edge methods.
2	Advanced Techniques	Knowledge: Deep Learning Architectures, Regularization and Optimization, Transfer Learning. Skills: Model Evaluation and Optimization: Hyperparameter Tuning, Performance

		Assessment: Attitudes: Critical Thinking: Problem Solving, Analytical Mind-set.
3	Mathematics and Statistics	Knowledge: Linear Algebra, Calculus, Probability and Statistics. Skills: Problem-Solving and Application: Project Implementation, Experimentation. Attitudes: Ethical Considerations: Responsibility, Transparency.
4	Machine Learning Fundamentals	Knowledge: Supervised and Unsupervised Learning, Model Evaluation. Skills: Advanced Techniques: Transfer Learning, Deployment Attitudes: Collaboration and Communication: Teamwork, Effective Communication.
5	Ethics and Regulation	Knowledge: Bias and Fairness, Regulatory Issues Skills: Ethical Frameworks, Bias Identification, Regulatory Compliance. Attitudes: Integrity, Awareness

3. Syllabus

DEEP LEARNING SEMESTER – VII			
Course Code	M23BCE705C	CIE Marks	50
Number of Lecture Hours/Week(L: T: P: S)	(3:0:0:0)	SEE Marks	50
Total Number of Lecture Hours	40 hours Theory	Total Marks	100
Credits	03	Exam Hours	03
Course Objectives: <ul style="list-style-type: none"> Understanding Fundamental Concepts Deep Learning, Neural Networks Basics and Training Neural Networks. Understand concepts of overfitting and underfitting and basic strategies for addressing them. Explore simple real-world applications of deep learning, such as image classification or basic text analysis. Get familiar with popular deep learning frameworks (e.g., TensorFlow, Keras, PyTorch) and learn how to use them for building and training models. 			
Module -1			
Machine Learning Basics: Learning Algorithms, Capacity, Overfitting and Underfitting, Hyperparameters and Validation Sets, Estimator, Bias and Variance, Maximum Likelihood Estimation, Bayesian Statistics, Supervised Learning Algorithms, Unsupervised Learning Algorithms, Stochastic Gradient Decent, building a Machine Learning Algorithm, Challenges Motivating Deep Learning.			
Module -2			
Deep Feedforward Networks: Gradient-Based Learning, Hidden Units, Architecture Design, Back-Propagation. Regularization-I: Parameter Norm Penalties, Norm Penalties as Constrained Optimization, Regularization and Under-Constrained Problems, Dataset Augmentation, Noise Robustness, Semi-Supervised Learning			
Module -3			
Regularization-II: Multi-Task Learning, Early Stopping, Parameter Tying and Parameter Sharing, Sparse Representations, Bagging, Dropout. Optimization for Training Deep Models: How Learning Differs from Pure Optimization, Challenges in Neural Network Optimization, Basic Algorithms. Parameter Initialization Strategies, Algorithms with			

Adaptive Learning Rates.

Module -4

Convolutional Networks: The Convolution Operation, Motivation, Pooling, Convolution and Pooling as an Infinitely Strong Prior, Variants of the Basic Convolution Function, Structured Outputs, DataTypes, Efficient Convolution Algorithms, Random or Unsupervised Features, The Neuroscientific Basis for Convolutional Networks, Convolutional Networks and the History of Deep Learning

Module -5

Sequence Modelling: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 Challenge of Long-Term Dependencies, Echo State Networks, Leaky Units and Other Strategies for Multiple Time Scales, The Long Short-Term Memory and Other Gated RNNs, Optimization for Long-Term Dependencies, Explicit Memory.

TEXTBOOKS:

1. Deep Learning Ian Good fellow and Yoshua Bengio and Aaron Courville MIT Press 2016.
2. Neural Networks: A systematic Introduction Raúl Rojas 1996.

REFERENCE BOOKS:

1. Pattern Recognition and machine Learning Chirstopher Bishop 2007.

4. Syllabus Timeline

S/L	Syllabus Timeline	Description
1	Week 1-2:	Learning Algorithms, Capacity, Overfitting and Underfitting, Hyperparameters and Validation Sets, Estimator, Bias and Variance, Maximum Likelihood Estimation, Bayesian Statistics, Supervised Learning Algorithms, Unsupervised Learning Algorithms, Stochastic Gradient Decent, building a Machine Learning Algorithm, Challenges Motivating Deep Learning.
2	Week 3-4:	Gradient-Based Learning, Hidden Units, Architecture Design, Back-Propagation. Parameter Norm Penalties, Norm Penalties as Constrained Optimization, Regularization and Under-Constrained Problems, Dataset Augmentation, Noise Robustness, Semi-Supervised Learning
3	Week 5-6:	Multi-Task Learning, Early Stopping, Parameter Tying and Parameter Sharing, Sparse Representations, Bagging, Dropout.How Learning Differs from Pure Optimization, Challenges in Neural Network Optimization, Basic Algorithms. Parameter Initialization Strategies, Algorithms with Adaptive Learning Rates.
4	Week 7-8:	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, Random or Unsupervised Features, The Neuroscientific Basis for Convolutional Networks, Convolutional Networks and the History of Deep Learning
5	Week 9-10:	Unfolding Computational Graphs, Recurrent Neural Networks, Bidirectional RNNs, Encoder-Decoder Sequence-to-Sequence Architectures, Deep Recurrent Networks, Recursive Neural Networks, The Challenge of Long-Term Dependencies, Echo State Networks, Leaky Units and Other Strategies for Multiple Time Scales, The Long Short-Term Memory and Other Gated RNNs, Optimization for Long-Term Dependencies, Explicit Memory.

5. Teaching-Learning Process Strategies

S/L	TLP Strategies:	Description
1	Lecture Method	Utilize various teaching methods within the lecture format to reinforce competencies.
2	Video/Animation	Incorporate visual aids like videos/animations to enhance understanding of Programming concepts.

3	Collaborative Learning	Encourage collaborative learning for improved competency application.
4	Real-World Application	Discuss practical applications to connect theoretical concepts with real-world competencies.
5	Flipped Class Technique	Utilize a flipped class approach, providing materials before class to facilitate deeper understanding of competencies

6. Assessment Details (both CIE and SEE)

Continuous Internal Evaluation:

Components		Number	Weightage	Max. Marks	Min. Marks
(i)	Internal Assessment-Tests (A)	2	50%	25	10
(ii)	Assignments/Quiz/Activity (B)	2	50%	25	10
TotalMarks				50	20

FinalCIE Marks =(A) + (B)

Average internal assessment shall be the average of the 2 test marks conducted.

Semester End Examination:

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

1. Question paper pattern will be ten questions. Each question is set for 20marks. The medium of the question paper shall be English unless otherwise it is mentioned.
2. There shall be 2 question from each module, each of the two questions under a module (with a maximum of 3 sub questions), may have mix of topics under that module if necessary.
3. The students have to answer 5 full questions selecting one full question from each module.
4. Marks scored will be proportionally scaled down to 50 marks

7. Learning Objectives

S/L	Learning Objectives	Description
1	Foundational Knowledge	Understand Deep Learning Basics: Define deep learning and its place within artificial intelligence and machine learning. Explain the differences between deep learning and traditional machine learning methods. Neural Network Fundamentals: Describe the architecture of neural networks, including neurons, layers (input, hidden, output), weights, and biases. Explain the role and types of activation functions, such as sigmoid, ReLU, and tanh.
2	Model Training and Optimization	Training Process: Understand forward propagation and how input data flows through the network. Learn how to use loss functions to measure model performance. Explain backpropagation and gradient descent as methods for updating weights and biases. Optimization Techniques: Understand different optimization algorithms like Stochastic Gradient Descent (SGD), Adam, and RMSprop. Learn to apply techniques to avoid overfitting, such as regularization and dropout.
3	Model Evaluation and Validation	Evaluation Metrics: Understand and apply metrics for model evaluation, such as accuracy, precision, recall, F1 score, and AUC-ROC. Validation Techniques: Learn about techniques like cross-validation, train-test splits, and the use of validation sets to assess model performance.
4	Advanced Architectures and Techniques	Deep Learning Models: Explore and implement various architectures, such as convolutional neural networks (CNNs) for image tasks, and recurrent neural networks (RNNs) for sequential data. Transfer Learning: Understand and apply transfer learning by leveraging pre-

		trained models for new tasks.
5	Real-World Applications	Case Studies: Analyze and solve real-world problems using deep learning, such as image classification, object detection, and natural language processing. Project Work: Complete end-to-end projects that involve data collection, model building, evaluation, and deployment.

8. Course Outcomes (COs) and Mapping with POs/ PSOs

Course Outcomes (COs)

COs	Description
M23BCE705C.1	Understand and Apply the knowledge of Deep Neural Networks and related machine learning methods
M23BCE705C.2	Apply appropriate deep learning algorithms for analysing the data for a variety of problems.
M23BCE705C.3	Analyse the results of their trained models to identify issues.
M23BCE705C.4	Analyse the performance of different deep learning architectures and make recommendations based on their suitability for specific tasks.
M23BCE705C.5	Design and Develop a deep learning project that addresses a real-world problem, incorporating advanced techniques and optimizing model performance.

CO-PO-PSO Mapping

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
M23BCE705C.1	-	3	-	-	-	-	-	-	-	-	-	-	3	3
M23BCE705C.2	-	3	-	-	-	-	-	-	-	-	-	-	3	3
M23BCE705C.3	-	-	3	-	-	-	-	-	-	-	-	-	3	3
M23BCE705C.4	-	-	3	-	-	-	-	-	-	-	-	-	3	3
M23BCE705C.5	-	-	-	3	-	-	-	-	-	-	-	-	3	3
M23BCE705C	-	3	3	3	-	-	-	-	-	-	-	-	3	3

9. Assessment Plan

Continuous Internal Evaluation (CIE)

	CO1	CO2	CO3	CO4	CO5	Total
Module 1	10					10
Module 2		10				10
Module 3			10			10
Module 4				10		10
Module 5					10	10
Total	10	10	10	10	10	50

Semester End Examination (SEE)

	CO1	CO2	CO3	CO4	CO5	Total
Module 1	20					20
Module 2		20				20
Module 3			20			20
Module 4				20		20
Module 5					20	20
Total	20	20	20	20	20	100

Conditions for SEE Paper Setting:

Each module of SEE question paper should be allocated with questions for 20% of the total SEE marks.

10. Future with this Subject:

- ❖ **Advancements in Deep Learning Techniques:** Gain insights into the latest deep learning architectures and innovations, such as transformer models, GANs (Generative Adversarial Networks), and diffusion models.
- ❖ **Applications Across Various Domains:** Explore how deep learning is transforming medical imaging, drug discovery, and personalized medicine, self-driving cars, robotics, and automated manufacturing and Natural Language Processing.
- ❖ **Integration with Other Technologies:** Discover how deep learning integrates with Internet of Things (IoT) devices for smarter, more responsive systems.
- ❖ **Ethical and Societal Implications:** Study ongoing research and methods to address biases in deep learning models and ensure fairness in AI systems.
- ❖ **Career and Research Opportunities:** Identify potential career paths in deep learning, including roles like machine learning engineer, data scientist, AI researcher, and software developer.
- ❖ **Tools and Frameworks Evolution:** Stay updated with the latest tools and libraries in deep learning, such as TensorFlow, PyTorch, and newer or emerging platforms.
- ❖ **Educational and Professional Development:** Recognize the importance of lifelong learning and staying updated with the rapidly evolving field through online courses, workshops, and conferences.
- ❖ **Interdisciplinary Opportunities:** Explore how deep learning can be applied in interdisciplinary fields like bioinformatics, finance, and environmental science.

7 th Semester	Professional Elective(PE-IV) ANGULAR JS	M23BCE705D
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1. Prerequisites

S/L	Proficiency	Prerequisites
1	HTML & CSS	HTML: Basic understanding of HTML is essential since AngularJS extends HTML attributes with Directives and binds data to HTML with Expressions. CSS: Knowing how to style your HTML elements is important for building responsive and visually appealing user interfaces.
2	JavaScript:	Core Concepts: A good grasp of JavaScript basics, such as variables, functions, loops, and conditionals, is necessary. Objects and Arrays: Understanding how to work with objects and arrays in JavaScript is crucial, as AngularJS heavily relies on them. Functions: Knowledge of functions, especially callback functions and closures, is important. DOM Manipulation: Familiarity with how to manipulate the DOM (Document Object Model) using JavaScript will help in understanding how AngularJS interacts with the DOM.
3	Basic Understanding of MVC Architecture	AngularJS follows the Model-View-Controller (MVC) architecture. Understanding how data (Model), user interface (View), and business logic (Controller) are separated will help in effectively using AngularJS.
4	JavaScript Frameworks and Libraries	jQuery: While not required, familiarity with jQuery can be helpful as it shares some common concepts with AngularJS, such as DOM manipulation.
5	Command Line Interface (CLI)	Basic knowledge of command line tools can be useful, especially when setting up development environments and using tools like npm (Node Package Manager).
6	JSON (JavaScript Object Notation)	AngularJS often communicates with APIs using JSON. Understanding how to read and write JSON data is important.
7	Basic Version Control	Familiarity with version control systems like Git is useful for managing code changes, especially when working in teams.
8	Development Environment Setup	Ensure you have a text editor or IDE (like Visual Studio Code, Sublime Text, etc.) set up for coding. Basic knowledge of setting up a local development server can be helpful for testing AngularJS applications.

2. Competencies

S/L	Competency	KSA Description
1	Dynamic Web Application Development	Knowledge: HTML/CSS Fundamentals: Understanding of how to structure web pages using HTML. Knowledge of styling techniques using CSS, including responsive design principles. JavaScript Basics, AngularJS Framework, Single Page Application (SPA) Development, API Interaction and Server Communication. Skills: Application Development, Data Binding and DOM Manipulation, Routing and Navigation, Form Management and Validation, Error Handling and Debugging, Responsive Design Integration. Attitudes: Attention to Detail, Problem-Solving Mindset, User-Centered Design, Continuous

		Learning, Collaboration and Communication
2	Understanding and Applying MVC Architecture	<p>Knowledge: Model-View-Controller (MVC) Concept, AngularJS Implementation of MVC, Data Binding and Synchronization, Separation of Concerns, Design Patterns</p> <p>Skills: Architecting Applications, Implementing Controllers, Managing Views, Data Handling and Services, Debugging and Optimization.</p> <p>Attitudes: Structured Thinking, Attention to Modularity, User-Centered Design, Collaboration and Communication, Continuous Improvement.</p>
3	Data Handling and Filtering	<p>Knowledge: Data Structures and Storage, AngularJS Filters, Two-Way Data Binding, Data Validation and Sanitization, Performance Considerations.</p> <p>Skills: Manipulating Data Structures, Applying Built-in Filters, Creating Custom Filters, Data Binding and Synchronization, Validating and Sanitizing Data, Optimizing Data Handling.</p> <p>Attitudes: Attention to Data Integrity, User-Centered Approach to Data Presentation, Security Awareness, Efficiency and Performance Mindset, Continuous Improvement.</p>
4	Form Management and Validation	<p>Knowledge: HTML Forms Basics, AngularJS Form Handling, Form Validation Techniques, Data Binding in Forms, Error Handling and User Feedback Security Considerations.</p> <p>Skills: Implementing AngularJS Forms, Validating User Input, Handling Form States, Providing User Feedback, Optimizing Form Performance, Securing Forms.</p> <p>Attitudes: User-Centered Design, Attention to Detail, Security-Conscious Mindset, Continuous Improvement, Collaboration and Communication.</p>
5	Service and Server Communication	<p>Knowledge: RESTful APIs, Angular JS Services, AJAX and Asynchronous Programming, Data Serialization and Deserialization Security in Server Communication.</p> <p>Skills: Implementing API Calls, Creating and Using Angular JS Services, Handling Asynchronous Operations, Data Processing, Securing Server Communication, Error Handling and Debugging.</p> <p>Attitudes: Security-Conscious Development, Efficiency and Performance Focus, Attention to Detail, User-Centered Design, Continuous Learning and Adaptability.</p>

3. Syllabus

Angular JS SEMESTER – VII			
Course Code	M23BCE705D	CIE Marks	50
Number of Lecture Hours/Week(L: T: P: S)	(3:0:0:0)	SEE Marks	50
Total Number of Lecture Hours	40 hours Theory	Total Marks	100
Credits	03	Exam Hours	03
Course Objectives: <ul style="list-style-type: none"> • Explore to reduce the code to build user interface applications • Describe Client Side MVC • Understanding single page applications development • Understanding concept of interactive and attractive interface development techniques • Explore services and server communication. 			

Module -1	8hours
JAVASCRIPT YOU NEED TO KNOW: JavaScript Primer: Including Scripts on a Page, Statements, Functions, Parameters and Return Values, Types and Variables, Primitive Types, JavaScript Operators, Equality vs. Identity, Pre- vs. Post-Increment, Working with Objects: Creating Objects, Reading and Modifying an Object's Properties, Adding Methods to Objects, Enumerating Properties, Control Flow, Conditional Statements, Working with Arrays, Array Literals, Enumerating and Modifying Array Values: Call-backs, JSON (Chapter 1)	
Module -2	8hours
THE BASICS OF ANGULARJS, INTRODUCTION TO MVC: Why We Need Frameworks: What Is a Framework, Downloading and Installing Angular JS, Browser Support, Your First Angular JS Application: Declarative vs. Procedural Programming, Directives and Expressions: What Is a Directive, What Are Expressions. Design Patterns Model View Controlled, A Separation of Concerns: Why MVC Matters, MVC the Angular JS Way (Chapter 2,3)	
Module -3	8hours
FILTERS AND MODULES, DIRECTIVES: Introduction to Filters, Built-in Filters: The Number Filter, The Date Filter, The limit To Filter. Angular JS Modules: What Is a Module? Bootstrapping Angular JS, Creating a Custom Filter. The Basics of Directives, Using Directives, Built-in Directives, Event-Handling Directives, Using the API Documentation, Creating a Custom Directive. (Chapter 4,5)	
Module -4	8hours
WORKING WITH FORMS: HTML Forms Overview: The form Element, The input Element: button, submit, text, checkbox, password, radio. The text area Element, The select Element, The label Element. Model Binding, Angular JS Forms, Validating Forms. (Chapter 6)	
Module -5	8hours
SERVICES AND SERVER COMMUNICATION: Using Services: The \$window Service, The \$location Service, The \$document Service. Why Use Services, Creating Services: Promises. Server Communication, Handling Returned Data: Accessing Returned Data, Handling Errors. (Chapter 7)	
TEXTBOOKS: <ol style="list-style-type: none"> 1. Andrew Grant — “Beginning Angular JS”, A Press 2014. 2. Green, Brad – “Angular JS”, O’Relly 2013. REFERENCE BOOKS: <ol style="list-style-type: none"> 1.Sandeep Panda, “AngularJS: Novice to Ninja: Elegant, Powerful, Testable, Extendable ”, SitePoint; 1 edition , 2014. 2. Brad Green and Shyam Seshad 2.Adam Freeman, — “Pro Angular JS ”, A Press 2014. 	

4. Syllabus Timeline

S/L	Syllabus Timeline	Description
1	Week 1-3:	JAVASCRIPT YOU NEED TO KNOW: JavaScript Primer: Including Scripts on a Page, Statements, Functions, Parameters and Return Values, Types and Variables, Primitive Types, JavaScript Operators, Equality vs. Identity, Pre- vs. Post-Increment, Working with Objects: Creating Objects, Reading and Modifying an Object's Properties, Adding Methods to Objects, Enumerating Properties, Control Flow, Conditional Statements, Working with Arrays, Array Literals, Enumerating and Modifying Array Values: Call-backs, JSON
2	Week 4-6:	THE BASICS OF ANGULAR JS, INTRODUCTION TO MVC: Why We Need Frameworks: What Is a Framework, Downloading and Installing Angular JS, Browser Support, Your First Angular JS Application: Declarative vs. Procedural Programming, Directives and Expressions: What Is a Directive, What Are Expressions. Design Patterns Model View Controlled, A Separation of

		Concerns: Why MVC Matters, MVC the Angular JS Way
3	Week 7-8:	FILTERS AND MODULES, DIRECTIVES: Introduction to Filters, Built-in Filters: The Number Filter, The Date Filter, The limit To Filter. Angular JS Modules: What Is a Module? Bootstrapping Angular JS, Creating a Custom Filter. The Basics of Directives, Using Directives, Built-in Directives, Event-Handling Directives, Using the API Documentation, Creating a Custom Directive.
4	Week 9-11:	WORKING WITH FORMS: HTML Forms Overview: The form Element, The input Element: button, submit, text, checkbox, password, radio. The text area Element, The select Element, The label Element. Model Binding, Angular JS Forms, Validating Forms.
5	Week 12-13:	SERVICES AND SERVER COMMUNICATION: Using Services: The \$window Service, The \$location Service, The \$document Service. Why Use Services, Creating Services: Promises. Server Communication, Handling Returned Data: Accessing Returned Data, Handling Errors.

5. Teaching-Learning Process Strategies

S/L	TLP Strategies:	Description
1	Hands-On Coding Exercises	Live Coding Sessions: Demonstrate Angular JS concepts by coding in real-time, allowing students to see how code translates into functionality. Practice Problems: Provide coding challenges and mini-projects that require students to implement Angular JS features like directives, services, and controllers.
2	Interactive Tutorials	Guided Tutorials: Create step-by-step tutorials that guide students through building a basic Angular JS application, covering core concepts progressively. Interactive Code Editors: Use online platforms like JSFiddle or Code Pen where students can write and test Angular JS code directly in their browsers.
3	Conceptual Discussions	Core Concepts: Discuss fundamental Angular JS concepts such as data binding, dependency injection, and directives in detail, ensuring students understand their purpose and use. Real-World Applications: Relate Angular JS features to real-world applications and industry use cases to provide context and relevance.
4	Project-Based Learning:	Build Projects: Assign projects that require students to apply Angular JS concepts to build functional applications, such as to-do lists, blogs, or e-commerce sites. Incremental Development: Encourage students to build their projects incrementally, integrating Angular JS features progressively.
5	Collaborative Learning	Group Projects: Have students work in groups to develop Angular JS applications, promoting collaboration and peer learning. Code Reviews: Facilitate code review sessions where students can present their work and receive feedback from peers and instructors.
6	Visual Aids and Diagrams	Architecture Diagrams: Use diagrams to explain Angular JS architecture, including components like modules, controllers, and services. Flowcharts: Create flowcharts to illustrate data binding processes, routing, and other key features.
7.	Formative Assessments	Quizzes and Polls: Use quizzes to test understanding of Angular JS concepts and techniques, providing instant feedback to guide learning. Mini-Projects: Implement smaller assignments that focus on specific Angular JS functionalities to assess progress.
8.	Real-Time Problem Solving	Debugging Sessions: Demonstrate debugging techniques and common issues in Angular JS, guiding students through the problem-solving process. Q&A Sessions: Hold regular Q&A sessions where students can ask questions and clarify doubts about Angular JS concepts and practices.

9.	Resource Utilization	Documentation and Guides: Encourage students to use Angular JS documentation, official guides, and community resources for self-study and troubleshooting. Supplemental Material: Provide additional learning materials, such as articles, videos, and online courses, to reinforce concepts.
10.	Feedback and Reflection:	Regular Feedback: Provide constructive feedback on assignments and projects to help students improve and understand Angular JS concepts better. Reflection Activities: Encourage students to reflect on what they have learned and how they can apply Angular JS in their future projects.

6. Assessment Details (both CIE and SEE)

Continuous Internal Evaluation:

The minimum CIE marks requirement is 40% of maximum marks in each component.

Components		Number	Weightage	Max. Marks	Min. Marks
(i)	Internal Assessment-Tests (A)	2	50%	25	10
(ii)	Assignments/Quiz/Activity (B)	2	50%	25	10
Total Marks				50	20

FinalCIE Marks =(A) + (B)

Average internal assessment shall be the average of the 2 test marks conducted.

Semester End Examination:

- 1.Question paper pattern will be ten questions. Each question is set for 20marks. The medium of the question paper shall be English unless otherwise it is mentioned.
- 2.There shall be 2 question from each module, each of the two questions under a module (with a maximum of 3 sub questions), may have mix of topics under that module if necessary.
- 3.The students have to answer 5 full questions selecting one full question from each module.
- 4.Marks scored will be proportionally scaled down to 50 marks

7. Learning Objectives

S/L	Learning Objectives	Description
1	Understanding Angular JS Basics	Learn about the core concepts of Angular JS, such as modules, controllers, and directives. Understand the purpose of Angular JS and how it differs from other JavaScript frameworks.
2	Data Binding and Dependency Injection	Master two-way data binding and how it simplifies synchronization between the model and the view. Understand how dependency injection works in Angular JS to manage services and components.
3	Directives and Components	Learn how to use built-in directives (e.g., ng-model, ng-repeat, ng-if) and create custom directives. Understand the concept of components and how they enhance the modularity of an application.
4	Routing and Navigation	Get familiar with Angular JS's routing capabilities, including how to set up routes and navigate between views. Learn to use the \$route Provider and configure routes in the Angular JS application.
5	Services and Factories	Understand how to create and use services and factories for reusable components and business logic. Learn about the differences between services and factories and when to use each.
6	Forms and Validation	Explore Angular JS form handling, including how to manage form inputs and perform client-side validation. Learn how to use built-in validation directives and create custom validation rules.

7.	Testing	Understand the importance of testing in Angular JS applications. Learn about different testing frameworks (e.g., Jasmine, Karma) and how to write unit tests for controllers, services, and directives.
8.	Performance Optimization	Learn techniques to optimize Angular JS application performance, including minimizing digest cycles and using one-time binding. Understand the impact of watch expressions and how to manage them effectively.

8. Course Outcomes (COs) and Mapping with POs/ PSOs

Course Outcomes (COs)

COs	Description
M23BCE705D.1	Understand the basic programming to implement dynamic web pages and applications.
M23BCE705D.2	Apply the knowledge of the design patterns to control the application
M23BCE705D.3	Identify and apply the knowledge to control events handling and error handling
M23BCE705D.4	Build the knowledge to filter the data more effective way to present
M23BCE705D.5	Construct services and server communication.

CO-PO-PSO Mapping

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
M23BCE705D.1	3	-	-	-	-	-	-	-	-	-	-	-	3	3
M23BCE705D.2	-	3	-	-	-	-	-	-	-	-	-	-	3	3
M23BCE705D.3	-	-	3	-	-	-	-	-	-	-	-	-	3	3
M23BCE705D.4	-	-	-	3	-	-	-	-	-	-	-	-	3	3
M23BCE705D.5	-	-	3	-	-	-	-	-	-	-	-	-	3	3
M23BCE705D	3	3	3	3	-	-	-	-	-	-	-	-	3	3

9. Assessment Plan

Continuous Internal Evaluation (CIE)

	CO1	CO2	CO3	CO4	CO5	Total
Module 1	10					10
Module 2		10				10
Module 3			10			10
Module 4				10		10
Module 5					10	10
Total	10	10	10	10	10	50

Semester End Examination (SEE)

	CO1	CO2	CO3	CO4	CO5	Total
Module 1	20					20
Module 2		20				20
Module 3			20			20
Module 4				20		20
Module 5					20	20
Total	20	20	20	20	20	100

10. Future with this Subject: Studying Angular JS, especially in the context of modern web development, opens up a wide range of opportunities and potential career paths. Here's how mastering Angular JS and related web technologies can shape your future:

1. Career Opportunities in Web Development: Frontend Developer: Angular JS is a powerful tool for building dynamic and responsive user interfaces. As a frontend developer, you'll be well-equipped to create sophisticated web applications that offer great user experiences. **Full-Stack Developer:** With Angular JS knowledge, combined with backend technologies (like Node.js, Python, or PHP), you can become a full-stack developer, handling both client and server-side development

2. Evolving with the Framework: Transition to Angular: Angular JS is the precursor to Angular (versions 2+). Understanding Angular JS provides a strong foundation for learning and transitioning to

Angular, which is widely used in modern enterprise applications. **Continuous Learning:** The skills and concepts learned in Angular JS, such as MVC architecture, data binding, and service-oriented architecture, are transferable to other frameworks like React or Vue.js.

3. Contributions to Open Source and Community: Open Source Contributions: With knowledge of AngularJS, you can contribute to open-source projects, enhance your portfolio, and establish yourself as an active member of the developer community. **Community Engagement:** By participating in forums, attending conferences, or joining meetups, you can stay updated with the latest trends and best practices in web development

4. Entrepreneurial Ventures: Building Your Own Products: Angular JS provides the tools needed to build robust web applications from scratch, which can be a foundation for launching your own startups or tech products. **Freelancing and Consulting:** The demand for skilled Angular JS developers allows for freelancing opportunities where you can offer your expertise to various clients and projects.

5. Expanding into Mobile Development: Progressive Web Apps (PWAs): With the skills learned, you can create Progressive Web Apps that combine the best features of web and mobile apps, providing a seamless experience across devices. **Hybrid Mobile Applications:** Angular JS can be integrated with frameworks like Ionic to build hybrid mobile apps, broadening your skill set to include mobile development.

6. Enhancing Problem-Solving and Analytical Skills: Critical Thinking: Angular JS development involves solving complex problems, which sharpens your analytical and critical thinking skills. **System Design:** Mastery of Angular JS also aids in understanding larger system design, preparing you for roles that require architectural planning and decision-making.

7. Adapting to Future Technologies: Framework Agnostic Development: The principles learned through AngularJS are applicable across various frameworks, making it easier to pick up and work with new technologies as they emerge. **Adaptation to New Standards:** As web standards evolve, the foundational knowledge from Angular JS will enable you to quickly adapt to new practices, libraries, and tools in web development.

8. Leadership and Mentorship Roles: Team Leadership: With a deep understanding of Angular JS, you can take on leadership roles, guiding teams in best practices for frontend development and architecture. **Mentorship:** As you grow in your career, you can mentor junior developers, sharing your knowledge and helping them navigate the learning curve of Angular JS and modern web development.

9. Contribution to the Digital Transformation: Enterprise-Level Applications: Companies undergoing digital transformation often require complex, scalable web applications. Your skills in Angular JS can be pivotal in these high-impact projects. **Innovation in Web Development:** By mastering Angular JS, you're positioned to contribute to innovative solutions in web technology, driving the future of how users interact with digital platforms.

7 th Semester	Professional Course (PCL) BIG DATA ANALYTICS LAB	M23BCEL706
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1. Prerequisites

S/L	Proficiency	Prerequisites
1	Basic Programming Skills	Familiarity with programming languages such as Python, Java, or Scala, as they are commonly used in Big Data tools and frameworks. Familiarity with pip for installing libraries. Knowledge of CLI for executing Python scripts.
2	Knowledge of Distributed Computing concepts	Basic knowledge of distributed computing concepts. Installation of Java Development Kit. Familiarity with Linux/Unix commands. A machine with at least 8GB RAM and adequate disk space. Internet access to download Hadoop binaries.
3	MapReduce Knowledge	Understanding of the MapReduce programming model. Basic knowledge of HDFS commands. A working Hadoop environment (single-node or multi-node cluster).
4	Knowledge of linear algebra	Understanding of matrix operations. A properly configured Hadoop or PySpark environment.
5	Understanding of NoSQL Concepts	Installation of MongoDB, Cassandra, HBase, or Hypertable. Familiarity with command-line interfaces for database management. A machine with sufficient RAM (at least 4GB) and disk space.
6	Knowledge of MongoDB Queries	Installation and basic configuration of MongoDB. Understanding of MongoDB CRUD operations and query language. Familiarity with MongoDB aggregation framework.
7	Understanding of Data Structures	Basic knowledge of probability and data structures (e.g., Bloom Filter). Setup of an IDE or command-line tools.
8	Understanding of Hadoop Ecosystem	Familiarity with the Hadoop ecosystem, including Flume, PySpark, and Hive. know about the Installation and configuration of Flume, PySpark, or Hive.

2. Competencies

S/L	Competency	KSA Description
1	Python, NumPy, and Pandas	Knowledge: Understanding of Python programming and data manipulation libraries. Skills: Ability to write and execute Python scripts using NumPy and Pandas. Attitudes: Attention to detail in data analysis and a mindset of experimentation.
2	Hadoop and HDFS	Knowledge: Fundamentals of distributed computing and Hadoop architecture. Skills: Competence in configuring and managing Hadoop and HDFS environments. Attitudes: Patience and perseverance in troubleshooting installation and configuration issues.
3	MapReduce skills	Knowledge: Understanding of the MapReduce programming model. Skills: Proficiency in writing and executing MapReduce programs. Attitudes: Problem-solving mindset and curiosity about parallel data processing.
4	Matrix operations	Knowledge: Knowledge of matrix operations and parallel algorithms. Skills: Ability to implement and optimize algorithms in the MapReduce framework.

		Attitudes: Analytical thinking and willingness to explore efficient data processing techniques.
5	Execution of NoSQL Commands	Knowledge: Basics of NoSQL databases and their architecture. Skills: Capability to install, configure, and operate NoSQL databases. Attitudes: Open-mindedness towards new database technologies and adaptability in learning.
6	Skills on MongoDB	Knowledge: Understanding of MongoDB's query language and aggregation framework. Skills: Competence in performing complex data operations using MongoDB. Attitudes: Precision in database management and a proactive approach to optimizing queries.
7	DGIM Algorithm / Bloom Filter	Knowledge: Familiarity with streaming data algorithms and probabilistic data structures. Skills: Ability to implement algorithms like DGIM and Bloom Filter in a chosen language. Attitudes: Innovation in solving data stream challenges and persistence in algorithm development.
8	Data Analysis using Flume, PySpark, or HIVE	Knowledge: Understanding of real-time data processing and ETL frameworks. Skills: Proficiency in capturing and analyzing streaming data using big data tools. Attitudes: Flexibility in handling dynamic data and enthusiasm for real-time analytics.
9	Clustering Algorithm (K-Means/CURE)	Knowledge: Knowledge of clustering algorithms and their application in big data. Skills: Ability to implement clustering using MapReduce and analyze the results. Attitudes: Critical thinking in data segmentation and an investigative approach to data patterns.
10	PageRank Algorithm	Knowledge: Understanding of graph theory and the PageRank algorithm. Skills: Competence in implementing and optimizing PageRank using MapReduce. Attitudes: Persistence in iterative algorithm development and curiosity about network analysis.

3. Syllabus

Big Data Analytics SEMESTER – III			
Course Code	M23BCEL706	CIE Marks	50
Number of Lecture Hours/Week(L: T: P: S)	0:0:2;0	SEE Marks	50
Total Number of Lecture Hours	24 hours	Total Marks	100
Credits	01	Exam Hours	03
Course Objectives:			
1. To Study Hadoop distributions, configuring Hadoop and performing File management tasks.			
2. To implement MapReduce programs for processing big data.			
3. To realize storage of big data using MongoDB.			
4. To analyze big data using machine learning techniques such as Decision tree classification and clustering.			
Program1: Install, configure and run python, numPy and Pandas.			
Program2: Install, configure and run Hadoop and HDFS.			
Program3: Develop a program to implement word count program using MapReduce.			
Program4: Experiment on Hadoop Map-Reduce / PySpark: -Implementing simple algorithms in Map-Reduce: Matrix multiplication.			
Program5: Install and configure MongoDB/ Cassandra/ HBase/ Hypertable to execute NoSQL Commands.			
Program6: Implement Functions: Count – Sort – Limit – Skip – Aggregate using MongoDB.			
Program7: Implement DGIM algorithm using any Programming Language/ Implement Bloom Filter using any programming language.			

Program8 Implement and Perform Streaming Data Analysis using flume for data capture, PYSpark / HIVE for data analysis of twitter data, chat data, weblog analysis etc.

Program9: Implement any one Clustering algorithm (K-Means/CURE) using Map-Reduce

Program10: Implement Page Rank Algorithm using Map-Reduce.

TEXTBOOKS:

1. Raj Kamal and Preeti Saxena, "Big Data Analytics Introduction to Hadoop, Spark, and Machine-Learning", McGraw Hill Education, 2018 ISBN: 9789353164966, 9353164966
2. Douglas Eadline, "Hadoop 2 Quick-Start Guide: Learn the Essentials of Big Data Computing in the Apache Hadoop 2 Ecosystem", 1st Edition, Pearson Education, 2016. ISBN 13: 978-9332570351

REFERENCE BOOKS:

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

VIDEO LINKS:

1. https://www.youtube.com/watch?v=n_Krer6YWY4
2. https://onlinecourses.nptel.ac.in/noc20_cs92/preview
3. <https://www.digimat.in/nptel/courses/video/106104189/L01.html>

4. Syllabus Timeline

S/L	Syllabus Timeline	Description
1	Week 1-2: Program1	1. Install, configure and run python, numPy and Pandas. 2. Install, configure and run Hadoop and HDFS.
2	Week 3-4: Program2, Program3	3. Develop a program to implement word count program using MapReduce. 4. Experiment on Hadoop Map-Reduce / PySpark: -Implementing simple algorithms in Map-Reduce: Matrix multiplication.
3	Week 5-7: Program4, Program5	5. Install and configure MongoDB/ Cassandra/ HBase/ Hypertable to execute NoSQL Commands. 6. Implement Functions: Count – Sort – Limit – Skip – Aggregate using MongoDB.
4	Week 8-10: Program6, Program7	7. Implement DGIM algorithm using any Programming Language/ Implement Bloom Filter using any programming language. 8. Implement and Perform Streaming Data Analysis using flume for data capture, PYSpark / HIVE for data analysis of twitter data, chat data, weblog analysis etc.
5	Week 11-12: Program8	9. Implement any one Clustering algorithm (K-Means/CURE) using Map-Reduce. 10. Implement Page Rank Algorithm using Map-Reduce.

5. Teaching-Learning Process Strategies

S/L	TLP Strategies:	Description
1	Lecture Method	Focus on clearly explaining complex concepts through real-world examples, visual aids, and interactive discussions.
2	Video/Animation	Helps visualize abstract concepts, complex data flows, and processing techniques, making the material more accessible and easier to understand.
3	Collaborative	Work together on data projects, share insights, and solve complex problems,

	Learning	fostering deeper understanding and practical skills through peer interaction.
4	Real-World Application	Connect theoretical concepts to practical scenarios, enhancing their ability to apply data analysis techniques to solve industry-specific challenges.
5	Flipped Class Technique	Explore foundational concepts independently before class, enabling more in-depth, hands-on data analysis and problem-solving during in-person sessions.
6	Laboratory Learning	Experience with data tools and technologies, enabling to apply theoretical knowledge to real datasets and develop practical data processing and analysis skills.

6. Assessment Details (both CIE and SEE)**Marks distribution for Program based Practical Course for CIE**

Sl. No.	Description	% of Marks	In Marks
1	Observation, write-up, algorithm/program/execution	80% of the maximum	80
2	Viva-Voce	20% of the maximum	20
Total		100%	100

Marks scored by the student for 100 are scaled down to 50 marks.

SEE for practical Course (Irrespective of Experiment or program based):**Marks distribution for Experiment based Practical Course for Final CIE**

SL. No.	Description	% of Marks	Marks
1	Write-up, Procedure	20%	20
2	Conduction and result	60%	60
3	Viva-Voce	20%	20
Total		100%	100

- SEE marks for practical course shall be 50 marks
- See for practical course is evaluated for 100 marks and scored marks shall be scaled down to 50 marks.
- Change of experiment/program is allowed only once and 20% marks allotted to the procedure/write-up part to be made zero.
- Duration of SEE shall be 3 hours.

7. Learning Objectives

S/L	Learning Objectives	Description
1	Explore of Hadoop framework	Understand the architecture and components of the Hadoop ecosystem, install and configure the Hadoop framework, and explore the roles of HDFS, MapReduce, and YARN in data processing.
2	Analysis of MapReduce programming model	Implement a basic MapReduce program to perform the word count operation, explain the MapReduce programming model and its phases, and analyze the output to understand the significance of the results.
3	Effectiveness of distributed computing for handling large datasets	Implement matrix multiplication algorithms using MapReduce or PySpark, describe the steps involved in the process, and evaluate the effectiveness of distributed computing for handling large datasets.
4	NoSQL databases in real-world applications.	Install and configure a NoSQL database (MongoDB, Cassandra, HBase, or Hypertable), execute basic NoSQL commands for data manipulation and retrieval, and assess the advantages and challenges of using NoSQL databases in real-world applications.
5	Know the	Implement the DGIM algorithm and Bloom Filter using a programming language

	applications of DGIM/Bloom filter algorithm	of choice, analyze their performance and efficiency, and discuss their applications in data streaming and approximate querying.
6	streaming data analysis	Capture streaming data using Flume, analyze the data with PySpark or Hive, and interpret the results to draw insights from real-time datasets such as Twitter, chat logs, and web logs.
7	applications of clustering in various fields	Implement a clustering algorithm (K-Means or CURE) using Map-Reduce, evaluate the clustering results with appropriate metrics, and discuss the applications of clustering in various fields such as data mining and machine learning.
8	impact of Page Rank on web search	Implement the Page Rank algorithm using Map-Reduce, analyze the output to assess its accuracy and efficiency, and discuss the impact of Page Rank on web search and navigation.

8. Course Outcomes (COs) and Mapping with POs/ PSOs

Course Outcomes (COs)

COs	Description
M23BCEL706.1	Understand and Apply the key issues in Big Data Management and experiment with the Hadoop framework
M23BCEL706.2	Analyze the structure and unstructured data by using NoSQL commands.
M23BCEL706.3	Develop scientific computing algorithms for finding similar items and clustering
M23BCEL706.4	Evaluate fundamental enabling techniques and scalable algorithms for data stream mining
M23BCEL706.5	Create problem solving and critical thinking skills in fundamental enable techniques like Hadoop & MapReduce.

CO-PO-PSO Mapping

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
M23BCEL706.1	3	-	-	-	-	-	-	-	-	-	-	-	3	3
M23BCEL706.2	-	3	-	-	-	-	-	-	-	-	-	-	3	3
M23BCEL706.3	-	-	3	3	-	-	-	-	-	-	-	-	3	3
M23BCEL706.4	-	-	-	3	-	-	-	-	-	-	-	-	3	3
M23BCEL706.5	-	-	3	-	3	-	-	-	-	-	-	-	3	3
M23BCEL706	3	3	3	3	3	-	-	-	-	-	-	-	3	3

9. Assessment Plan

Continuous Internal Evaluation (CIE)

	CO1	CO2	CO3	CO4	CO5	Total
Program 1 to 10	5	10	10	5	20	50
Total	5	10	10	5	20	50

Semester End Examination (SEE)

	CO1	CO2	CO3	CO4	CO5	Total
Program 1 to 10	10	20	20	10	40	100
Total	10	20	20	10	40	100

10. Future with this Subject:

- **Python, NumPy, and Pandas:** Python will remain a dominant language in data science and analytics, with NumPy and Pandas continuing to be essential tools for data manipulation. The future will see more

advanced versions of these libraries, optimized for performance and capable of handling increasingly large datasets. **AI and Machine Learning integration** will become more seamless, enabling more sophisticated analytics.

- **Hadoop and HDFS:** Hadoop and HDFS will continue to be foundational technologies for distributed data storage and processing. **Cloud integration** will become more prevalent, with hybrid and multi-cloud deployments becoming the norm. Improvements in **security** and **scalability** will ensure that Hadoop remains relevant, particularly for managing large-scale enterprise data.
- **Word Count using MapReduce:** While MapReduce remains a fundamental concept in big data processing, the industry is shifting towards more advanced frameworks like **Apache Spark** that offer faster and more flexible processing capabilities. The concept of distributed computing will evolve with innovations in **edge computing** and **serverless architectures**.
- **Matrix Multiplication using Hadoop Map-Reduce / PySpark:** The future will bring enhanced tools for **distributed computing** and **parallel processing**, with an emphasis on integrating **GPU** and **TPU** acceleration for faster computation. **Quantum computing** may also start to play a role in complex mathematical operations, offering exponential speedups for certain tasks.
- **NoSQL Databases (MongoDB, Cassandra, HBase, Hypertable):** NoSQL databases will continue to evolve, with improvements in **scalability**, **flexibility**, and **cross-database interoperability**. The rise of **multi-model databases** will allow for the seamless integration of various data models (document, key-value, graph) within a single system, making data management more versatile and efficient.
- **MongoDB Functions Implementation:** The capabilities of NoSQL databases like MongoDB will expand with better support for **real-time analytics** and **advanced query optimization**. As data grows in volume and complexity, these functions will become more sophisticated, enabling faster and more efficient data retrieval and analysis.
- **DGIM Algorithm / Bloom Filter Implementation:** Streaming data processing will become increasingly critical, especially with the proliferation of **IoT** devices and **real-time analytics** requirements. Algorithms like DGIM and Bloom Filters will be optimized for **distributed environments**, allowing for more accurate and efficient data stream processing.
- **Streaming Data Analysis using Flume, PySpark, or HIVE:** The future of streaming data analysis will see tighter integration with **AI and machine learning**, enabling predictive analytics on streaming data. **Edge computing** will also play a larger role, allowing for real-time data processing closer to the data source, reducing latency and improving response times.
- **Clustering Algorithm (K-Means/CURE) using Map-Reduce:** Clustering algorithms will benefit from advancements in **machine learning** and **AI**, with more intelligent and scalable algorithms emerging to handle **high-dimensional data**. **AutoML** tools may automate the selection and tuning of clustering algorithms, making them more accessible and efficient.
- **PageRank Algorithm using Map-Reduce:** PageRank and similar algorithms will continue to be refined for analyzing large-scale graphs such as social networks and the web. Future innovations may include the use of graph databases and neural network-based algorithms that can handle more complex relationships and structures within data.

7 th Semester	Project Work (PW) MAJOR PROJECT PHASE-II	M23BCE707
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1. Prerequisites

S/L	Proficiency	Prerequisites
1	Project Planning and Management	Basic understanding of project management principles, acquired from earlier project work and theoretical courses.
2	Experimental Design and Analysis	Knowledge of experimental techniques and data analysis from core and elective courses.
3	Technical Documentation	Competence in technical writing and report drafting.
4	Application of Theoretical Knowledge	Strong foundation in the relevant engineering principles.
5	Team Collaboration	Experience in group projects and collaborative learning environments.

2. Competencies

S/L	Competency	KSA Description
1	Project Execution	Knowledge: Understanding of project planning, scheduling, and resource management. Skill: Ability to carry out practical work systematically and efficiently. Attitude: Proactive and solution-oriented approach to problem-solving.
2	Data Analysis	Knowledge: Advanced knowledge of data analysis techniques. Skill: Proficiency in interpreting and analyzing experimental data. Attitude: Analytical mindset with a focus on accuracy.
3	Technical Communication	Knowledge: Mastery of technical documentation standards. Skill: Ability to draft comprehensive project reports. Attitude: Precision and clarity in communication.
4	Presentation Skills	Knowledge: Understanding of audience engagement techniques. Skill: Ability to deliver clear and impactful presentations. Attitude: Confidence and professionalism in public speaking.
5	Collaboration	Knowledge: Awareness of effective teamwork strategies. Skill: Ability to work collaboratively in multidisciplinary teams. Attitude: Respect and openness to diverse perspectives.

2. Project Timeline

S/L	Timeline	Description
1	Week 1-2	Review of problem statement and project plan; setting milestones.
2	Week 3-4	Experimental setup and initial trials.
3	Week 5-6	Data collection and analysis; troubleshooting.
4	Week 7-8	Progress review and mid-term evaluation.
5	Week 9-10	Refinement of experiments and final data analysis.
6	Week 11-12	Drafting the final report.
7	Week 13-14	Presentation preparation and practice.
8	Week 15	Final project presentation and submission of the report.

4. Course Objectives

- To execute the project work based on the defined problem statement.
- To develop skills in practical application, experimentation, and analysis.
- To enhance project management, report writing, and presentation skills.

5. Assessment Details (both CIE and SEE)**CIE procedure for Project Work Phase-II:**

(1) Single discipline: The CIE marks shall be awarded by a committee consisting of the Head of the concerned Department and two senior faculty members of the Department, one of whom shall be the Guide. The CIE marks awarded for the project work, shall be based on the evaluation of the project work Report, project presentation skill, and question and answer session in the ratio 50:25:25. The marks awarded for the project report shall be the same for all the batch mates.

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

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

6. Learning Objectives

S/L	Learning Objectives	Description
1	To execute the project plan effectively.	Students will apply their theoretical knowledge to practical tasks, managing the project from start to finish.
2	To analyze data and refine project outcomes.	Students will enhance their skills in data interpretation and problem-solving.
3	To document and present the project work comprehensively.	Students will develop a final report and presentation that reflects their project work accurately.

7. Course Outcomes (COs) and Mapping with POs/ PSOs**Course Outcomes (COs)**

COs	Description
M23BCE707.1	Successfully execute the project plan and achieve the defined objectives.
M23BCE707.2	Analyze and interpret experimental data to derive meaningful conclusions.
M23BCE707.3	Demonstrate the ability to apply engineering and management principles effectively within a team, managing project timelines, resources, and deliverables to achieve project goals.
M23BCE707.4	Prepare and present a comprehensive project report.

CO-PO-PSO Mapping

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
M23BCE707.1			3		3				3		3		3	3
M23BCE707.2	3	3		3		3					3		3	3
M23BCE707.3			3				3						3	3
M23BCE707.4								3		3	3	3	3	3
M23BCE707	3	3	3	3	3	3	3	3	3	3	3	3	3	3

8. Future with this Subject

This phase solidifies the student's ability to independently execute complex engineering projects. The experience gained here is directly transferable to their future academic endeavours, and professional roles in engineering.

8 th Semester	Seminar (SR) TECHNICAL SEMINAR	M23BCS803
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1. Prerequisites

S/L	Proficiency	Prerequisites
1	Research and Information Gathering	Familiarity with academic research and access to digital libraries or databases.
2	Content Organization and Report Writing	Basic knowledge of report writing, including the use of Microsoft Word, equation editors, and drawing tools.
3	Technical Presentation Skills	Experience with PowerPoint or other presentation software, as well as fundamental public speaking skills.
4	Critical Thinking and Discussion	Experience in group discussions and the ability to analyze and critique technical content.
5	Originality and Integrity in Work	Understanding the importance of originality in academic work.

2. Competencies

S/L	Competency	KSA Description
1	Effective Research and Literature Review	Knowledge: Familiarity with technical literature, research databases, and citation practices. Skill: Ability to conduct a thorough literature review and identify key sources of information. Attitude: Curiosity and a proactive approach to learning.
2	Report Writing and Documentation	Knowledge: Understanding of technical writing formats, structure, and referencing. Skill: Proficiency in using word processors, equation editors, and drawing tools to create clear and concise reports. Attitude: Attention to detail and commitment to producing high-quality, original work.
3	Presentation and Communication	Knowledge: Understanding of effective communication techniques and presentation design. Skill: Ability to deliver clear, engaging presentations using visual aids. Attitude: Confidence and professionalism in public speaking.
4	Critical Engagement and Discussion	Knowledge: Familiarity with group discussion dynamics and debate techniques. Skill: Ability to engage with peers, ask relevant questions, and respond thoughtfully to feedback. Attitude: Openness to different viewpoints and willingness to engage in constructive criticism.
5	Ethical Standards and Academic Integrity	Knowledge: Understanding of the principles of academic honesty and the consequences of plagiarism. Skill: Ability to produce original work and properly cite all sources. Attitude: Integrity and responsibility in academic work.

3. Timeline

S/L	Timeline	Description
1	Week 1-2: Topic Selection and Literature Review	Students will select a seminar topic relevant to their specialization and conduct a literature review to gather information.
2	Week 3-4: Content Organization and Report Drafting	Organize the gathered information into a coherent structure and begin drafting the seminar report.
3	Week 5: Report Writing and Formatting	Focus on refining the report, ensuring proper formatting, citation, and use of tools like equation editors and drawing tools.
4	Week 6: Presentation Preparation	Prepare the PowerPoint slides and practice the oral presentation, focusing on clarity and engagement.
5	Week 7: Seminar Presentation and Discussion	Deliver the seminar presentation, engage in a Q&A session, and participate in group discussions.

6	Week 8: Report Submission and Final Evaluation	Submit the final report and undergo a comprehensive evaluation by the faculty committee.
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4. Assessment Details

The CIE marks shall be awarded by a committee consisting of the Head of the concerned Department and two senior faculty members of the Department, one of whom shall be the Guide.

The CIE marks awarded for the Technical Seminar shall be based on the evaluation of the report, presentation skill, and question and answer session in the ratio of 50:25:25.

5. Learning Objectives

S/L	Learning Objectives	Description
1	Conduct In-Depth Research on a Technical Topic	Students will learn to independently research a technical topic, gather and analyse information, and synthesize it into a coherent understanding.
2	Develop and Deliver a Technical Presentation	Students will gain experience in creating and delivering professional technical presentation, enhancing their communication skills.
3	Engage in Technical Discussions and Debates	Students will enhance their critical thinking and discussion skills by engaging with peers in technical debates.
4	Prepare a Detailed Technical Report	Students will learn to write a detailed, well-organized technical report, ensuring proper citation and originality.

6. Course Outcomes (COs) and Mapping with POs/ PSOs

Course Outcomes (COs)

COs	Description
M23BCS803.1	Conduct comprehensive research and organize technical content for a seminar presentation.
M23BCS803.2	Prepare and deliver a clear and engaging technical presentation using appropriate tools and techniques.
M23BCS803.3	Engage in technical discussions, respond to queries, and participate in group debates effectively.
M23BCS803.4	Produce a well-structured, original technical report with proper citations and references.

CO-PO-PSO Mapping

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
M23BCS803.1	3	-	-	-	-	-	-	-	-	-	-	-	3	3
M23BCS803.2	-	3	-	-	-	-	-	-	-	-	-	-	3	3
M23BCS803.3	-	-	3	-	-	-	-	-	-	-	-	-	3	3
M23BCS803.4	-	-	-	3	-	-	-	-	-	-	-	-	3	3
M23BCS803	3	3	3	3	-	-	-	-	-	-	-	-	3	3

8 th Semester	Internship (IS) INTERNSHIP	M23BCS804
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1. Prerequisites

S/L	Proficiency	Prerequisites
1	Understanding of fundamental concepts in the chosen field of study.	Successful completion of core courses related to the field of study.
2	Ability to analyze and solve complex problems using discipline-specific methodologies.	Analytical and problem-solving skills gained through prior coursework and lab work.
3	Capability to conduct independent research or work effectively within an industrial setup.	Experience with project-based learning or relevant coursework that involved team collaboration.
4	Communication and technical writing for the preparation of reports and presentations.	Courses in communication skills and technical writing.
5	Understanding of ethical, social, and environmental responsibilities in professional practices.	Knowledge of professional ethics and sustainable practices.

2. Competencies

S/L	Competency	KSA Description
1	Research Methodology	Knowledge: Understanding of current research trends and methodologies in the chosen field. Skill: Ability to design and conduct experiments or studies, analyze data, and draw conclusions. Attitude: Curiosity and commitment to scientific inquiry and continuous learning.
2	Practical Application	Knowledge: Familiarity with industry standards and practical applications of theoretical concepts. Skill: Ability to apply theoretical knowledge to solve real-world problems in an industrial or rural context. Attitude: Adaptability and willingness to learn from real-world experiences.
3	Presentation and Communication	Knowledge: Understanding of effective communication techniques and presentation design. Skill: Ability to deliver clear, engaging presentations using visual aids. Attitude: Confidence and professionalism in public speaking.
4	Communication and Presentation	Knowledge: Techniques for effective communication, both written and oral. Skill: Ability to prepare and present technical reports and presentations. Attitude: Confidence in public speaking and openness to feedback.
5	Teamwork and Collaboration	Knowledge: Principles of team dynamics and collaborative working. Skill: Ability to work effectively as part of a team, contributing to shared goals. Attitude: Cooperative mindset and respect for diverse perspectives.
6	Professionalism and Ethics	Knowledge: Understanding of professional ethics and legal responsibilities. Skill: Ability to make ethical decisions and demonstrate professional behavior in all activities. Attitude: Integrity and responsibility in professional conduct.

3. Assessment Details

The CIE marks shall be awarded by a committee consisting of the Head of the concerned Department and two senior faculty members of the Department, one of whom shall be the Guide/Mentor. The CIE

marks awarded for the Internship shall be based on the evaluation of the report, presentation skill, and question and answer session in the ratio of 50:25:25.

4. Learning Objectives

S/L	Learning Objectives	Description
1	Understand and Apply Research Methodologies or Industry Practices	Students will gain an understanding of current research methodologies in their chosen field or industry practices in the professional setting. They will learn how to apply these methodologies or practices to real-world problems, fostering their ability to conduct independent research or contribute effectively in an industrial environment.
2	Develop Problem-Solving Skills in Real-World Contexts	Students will enhance their problem-solving abilities by working on practical issues encountered in research, industry, or rural settings. They will learn to analyze complex problems, develop viable solutions, and implement them effectively.
3	Improve Communication and Technical Writing Skills	Students will refine their communication skills, both in writing and orally. They will learn how to prepare clear and concise technical reports and deliver presentations that effectively communicate their findings and ideas to diverse audiences.
4	Foster Teamwork and Collaborative Skills	Through collaborative projects, students will develop their ability to work effectively in teams. They will learn how to contribute to group efforts, manage interpersonal dynamics, and achieve shared goals in a professional environment.
5	Cultivate Professionalism and Ethical Responsibility	Students will understand the importance of professionalism and ethical behavior in their work. They will learn to make responsible decisions that consider the broader social, environmental, and ethical implications of their actions.

5. Course Outcomes (COs) and Mapping with POs/ PSOs

Course Outcomes (COs)

COs	Description
M23BCS804.1	Demonstrate the ability to apply research methodologies or industry practices to solve complex problems in a real-world context.
M23BCS804.2	Develop and implement effective solutions to technical challenges encountered during the internship, showcasing problem-solving skills.
M23BCS804.3	Communicate technical information clearly and effectively through well-structured reports and presentations.
M23BCS804.4	Demonstrate knowledge and understanding of engineering and management principles, applying them in a team to manage projects in multidisciplinary environments.

CO-PO-PSO Mapping

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
M23BCS804.1	3	-	-	-	-	-	-	-	-	-	-	-	3	3
M23BCS804.2	-	3	-	-	-	-	-	-	-	-	-	-		3
M23BCS804.3	-	-	3	-	-	-	-	-	-	-	-	-	3	3
M23BCS804.4	-	-	-	3	-	-	-	-	-	-	-	-	3	3
M23BCS804	3	3	3	3	-	-	-	-	-	-	-	-	3	3