



MAHARAJA INSTITUTE OF TECHNOLOGY MYSORE

Autonomous Institution Affiliated to VTU

Competency Based Syllabus (CBS)

For

Computer Science & Engineering (AI&ML)

(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 Science & Engineering (AI&ML)

2023 Scheme

Scheme Effective from the academic year 2023-24

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7th Semester	Management Science (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:	<p>Knowledge: Originates from a thirteenth-century French verb, entrepreneur, meaning “to do something” or “to undertake.”</p> <p>Skills: Include various skill sets such as leadership, business management, time management, creative thinking and problem-solving.</p> <p>Attitudes: Entrepreneurs are business people who find their success by taking risks. In their pursuits, they often become disruptors in established industries.</p>
7	Small scale industries:	<p>Knowledge: In which manufacturing, providing services, productions are done on a small scale or micro scale.</p> <p>Skills: Industries that manufacture produce and render services on a small or micro scale level.</p> <p>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.</p>
8	Institutional support	<p>Knowledge: Refers to the assistance, frameworks, and resources provided by formal and informal institutions to individuals</p> <p>Skills: The organization is running various schemes to meet its objectives.</p> <p>Attitudes: Approved Colleges/Registered facilitators with objective for enhancing their Employment/ Self-Employment opportunities</p>

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			
<p>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,</p> <p>Planning: Nature, importance and purpose of planning process objectives - Types of plans (meaning only) - Decision making, Importance of planning - steps in planning & planning premises</p>			
Module -2			
<p>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).</p> <p>Directing: Meaning and nature of directing Leadership styles, Motivation, Theories, Communication - Meaning and importance - coordination, meaning and importance and Techniques of coordination.</p>			
Module -3			
<p>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;</p>			
Module -4			

<p>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 5 year 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).</p> <p>Institutional support: Different Schemes; TECKSOK; KIADB; KSSIDC;</p>
Module -5
<p>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.</p> <p>Industrial ownership: Definition and meaning of Partnership, Characteristics of Partnership, Kinds of Partners, Partnership Agreement or Partnership Deed</p>
<p>TEXTBOOKS:</p> <ol style="list-style-type: none"> 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 – Pearson Education - 2006 (2 & 4) <p>Reference Books</p> <ol style="list-style-type: none"> 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	<p>Competency: Understand the basic functions managements and planning</p> <p>Knowledge: Management is how businesses organize and direct workflow, operations, and employees to meet company goals.</p> <p>Skills: The primary goal of management is to create an environment that empowers employees to work efficiently and productively.</p>
2	Week 4-6: Organizing and staffing: Directing:	<p>Competency: Understand the basic functions managements, committee, centralised and decentralised authority and responsibility and directing.</p> <p>Knowledge: Arranging resources and tasks to implement the plan.</p> <p>Skills: Staffing: Recruiting, selecting, evaluation and training individuals for specific roles within the organization</p>
3	Week 7-8: Small scale industries and Institutional support	<p>Competency: Learn the scope and manufacturing development OF SSI and institution.</p> <p>Knowledge: In which manufacturing, providing services, productions are done on a small scale or micro scale.</p> <p>Skills: Industries that manufacture produce and render services on a small or micro scale level.</p>
4	Week 8-11: Entrepreneur:	<p>Competency: Student will able to do, arrange and relate the work, so that it can be done efficiently and – specifically.</p> <p>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.</p> <p>Skills: Include various skill sets such as leadership, business management, time management, creative thinking and problem-solving.</p>
5	Week 9-12: Preparation of project and Industrial ownership	<p>Competency: student able to understand the project identification, selection, preparation and report, and also knowledge about industrial ownership.</p> <p>Knowledge: Students able to analyse difference between single and partner ownership and Identification of. Business Opportunities.</p> <p>Skills:</p>

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

6. Assessment Details (both CIE and SEE)

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

Continuous Internal Evaluation:

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

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

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	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, centralized and decentralized authority and responsibility and directing.
3	Entrepreneur:	Analyze 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	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

ownership	industrial ownership.
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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	Analyze 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	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PS O1	PS O2
M23BCS701.1	3	-	-	-	-	-	-	-	-	-	3	-	3	-
M23BCS701.2	-	3	-	-	-	-	-	-	-	-	-	-	3	3
M23BCS701.3	-	-	-	-	-	-	-	-	-	-	-	-	3	-
M23BCS701.4	-	-	3	3	3	-	-	-	3	-	-	-	3	3
M23BCS701.5	-	-	3	3	-	-	-	-	3	-	-	-	3	-
M23BCS701	3	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 small scale 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 industrial processes. Industrial Management focuses on the management of industrial processes.

7th Semester	Integrated Professional Course (IPC) Natural Language processing	M23BCS702
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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, 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	KSA Description
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	Knowledge: Understand various grammar-based and statistical language models, including modern models like Transformers. Skills: Develop and evaluate language models for different NLP tasks, implement n-gram models, and apply modern models like BERT or GPT. Attitude: Show enthusiasm for innovation and continuous learning in rapidly evolving NLP technologies. Maintain a critical perspective when evaluating models.

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>
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3. Syllabus

Natural Language Preprocessing SEMESTER – VII			
Course Code	M23BIS702	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 Hours 20 Hours Practical	Total Marks	100
Credits	04	Exam Hours	03
<p>Course objectives: This course will enable students to</p> <p>CO 1. Analyze the natural language text.</p> <p>CO 2. Define the importance of natural language.</p> <p>CO 3. Understand the concepts Text mining.</p> <p>CO 4. Illustrate information retrieval techniques.</p>			
Module -1			
<p>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</p>			
Module -2			
<p>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</p>			
Module -3			
<p>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</p>			
Module -4			
<p>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-Matrix, 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 2: Chapter 6, 7, 8, 9</p>			
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: Chapter 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:

3. Daniel Jurafsky and James H Martin, “Speech and Language Processing: An introduction to Natural Language Processing, Computational Linguistics & Speech Recognition”, 2nd Edition, Prentice Hall, 2008.
4. James Allen, “Natural Language Understanding”, 2nd edition, Benjamin/Cummings publishing company, 1995.

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	Week1-2: Overview and Language Modelling	<p>Competency:</p> <ul style="list-style-type: none"> • Understand the fundamental concepts and challenges of Natural Language Processing (NLP). • Develop a foundational understanding of language models and their application in NLP. <p>Knowledge:</p> <ul style="list-style-type: none"> • Origins and evolution of NLP. • Challenges in processing Indian languages. • Key applications of NLP, such as information retrieval. • Different types of grammar-based and statistical language models. <p>Skills:</p> <ul style="list-style-type: none"> • Analyse and differentiate between various NLP challenges and applications. • Apply knowledge of language models to develop basic NLP

		solutions.
2	Week 3-4: Word Level and Syntactic Analysis	<p>Competency:</p> <ul style="list-style-type: none"> Analyse 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>Knowledge:</p> <ul style="list-style-type: none"> Basics of word-level analysis, including regular expressions and finite-state automata. Techniques for morphological parsing, spelling error detection, and correction. Syntactic analysis using context-free grammar and constituency parsing. <p>Skills:</p> <ul style="list-style-type: none"> Implement regular expressions and finite-state automata for text analysis. Perform morphological parsing and correct spelling errors in text.
3	Week 5-6: Extracting Relations from Text and Case Studies	<p>Competency:</p> <ul style="list-style-type: none"> Extract and analyse relations from text using advanced NLP techniques. Understand and apply knowledge roles and semantic role labelling in specific domains. <p>Knowledge:</p> <ul style="list-style-type: none"> Techniques for extracting relations from word sequences and dependency paths. Subsequence kernels and dependency-path kernels for relation extraction. <p>Skills:</p> <ul style="list-style-type: none"> Apply relation extraction techniques to analyze text. Analyze real-world case studies and apply NLP techniques for web search.
4	Week 7-8: Evaluating Self-Explanations and Textual Signatures	<p>Competency:</p> <ul style="list-style-type: none"> Evaluate and enhance textual explanations using advanced NLP techniques. Identify and classify text types based on cohesion and structure. <p>Knowledge:</p> <ul style="list-style-type: none"> Techniques for evaluating self-explanations using word matching, latent semantic analysis (LSA), and topic models. Introduction to iSTART feedback systems and analyzing texts using LSA to identify textual signatures and measure cohesion. <p>Skills:</p> <ul style="list-style-type: none"> 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 modelling for

		<p>document separation.</p> <ul style="list-style-type: none"> Develop and test novel approaches for semantically-based text mining.
5	<p>Week 9-10: Information Retrieval and Lexical Resources</p>	<p>Competency:</p> <ul style="list-style-type: none"> Design and evaluate information retrieval systems using various models. Utilize lexical resources effectively in NLP applications. <p>Knowledge:</p> <ul style="list-style-type: none"> 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>Skills:</p> <ul style="list-style-type: none"> 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. Develop custom stemmers and POS taggers for specific applications.

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 NLP 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
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6. Assessment Details (both CIE and SEE)

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

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
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

Final CIE Marks = (A) + (B)

Semester End Examination pattern:

- 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.
- The question paper may include at least one question from the laboratory component.
- Marks scored will be proportionally scaled down to 50 mark

7. Learning Objectives

S/L	Learning Objectives	Description
1	Analyze Natural Language Text	Analyze natural language text understanding linguistic and computational techniques, enabling them to identify, extract, and interpret patterns, relationships, and structures within diverse text corpora.
2	Define the Importance of NLP	Explain the role of NLP in enhancing human-computer interaction through applications like virtual assistants, chatbots, and automated translation services.
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
M23BIS702.1	Articulate the Foundations of NLP by understanding linguistic structures and contextual meaning.
M23BIS702.2	Analyze the role of language and grammar in NLP, applying concepts processing and information extraction.
M23BIS702.3	Development of Document Separation Techniques and Semantically-Based Text Mining Models
M23BIS702.4	Applying both classical and alternative models of information retrieval to optimize user satisfaction and retrieval performance.

CO-PO-PSO Mapping

COs/ POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
M23BIS702.1	3										3			
M23BIS702.2		3									3			
M23BIS702.3			3									3	3	3
M23BIS702.4				3								3	3	3
M23BIS702	3	3	3	3							3	3	3	3

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

	CO1	CO2	CO3	CO4	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	20	50

Semester End Examination (SEE)

	CO1	CO2	CO3	CO4	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	40	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 of advanced Java development is poised to evolve with advancements in technology and shifts in software development practices.

1. Career Opportunities in Technology and Industry

- Artificial Intelligence and Machine Learning Roles: NLP is a core component of AI and ML. Students can pursue careers as NLP engineers, data scientists, or machine learning engineers, working on developing intelligent systems that understand and process human language.
- Speech and Voice Recognition: With the rise of voice-activated technologies (like virtual assistants), there's a growing demand for experts in speech recognition and synthesis. Careers in companies like Google, Amazon, and Apple, focusing on improving voice-controlled devices, are strong options.
- Healthcare Applications: NLP is increasingly used in healthcare for tasks like medical records analysis, predictive modeling, and patient interaction through chatbots. Careers in

health tech companies or research labs focusing on medical NLP are promising.

- **Financial Technology (FinTech):** NLP is vital in automating tasks such as sentiment analysis for stock trading, fraud detection, and customer service automation. Careers in FinTech, working on developing NLP-based financial models, are on the rise.

2. Research and Academic Opportunities

- **Advanced NLP Research:** Students can pursue advanced degrees (Master's or Ph.D.) to engage in cutting-edge research in areas like deep learning for NLP, multilingual NLP, or cognitive modeling. Universities and research institutions worldwide are constantly exploring new frontiers in NLP.
- **Cross-disciplinary Research:** NLP intersects with psychology, cognitive science, and linguistics, offering opportunities to explore how language processing aligns with human cognition, language acquisition, and communication patterns.

3. Entrepreneurship and Innovation

- **Startup Opportunities:** NLP is a hotbed for innovation, with numerous startups focusing on areas like chatbots, automated customer service, and content creation tools. Students with entrepreneurial aspirations can leverage their NLP skills to develop new products and services.
- **Product Development:** Companies across industries are looking to integrate NLP into their products. Students can lead or contribute to product development teams, creating NLP-driven applications like personalized recommendations, automated content generation, or advanced analytics tools.

4. Societal Impact and Global Challenges

- **Bridging Language Barriers:** NLP is crucial for developing translation services that help bridge language barriers globally, promoting cross-cultural communication and understanding. This can have profound effects on education, diplomacy, and global business.
- **Information Accessibility:** NLP can make information more accessible by improving search engines, summarization tools, and content recommendation systems, ensuring that people can find and understand information more efficiently.
- **Fighting Misinformation:** NLP techniques are essential in the fight against misinformation by automating fact-checking, analyzing the credibility of sources, and detecting fake news.

7th Semester	Professional Course (PC) Deep Learning	M23BCI702
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1. Prerequisites

S/L	Proficiency	Prerequisites
1	Basic Mathematics	<ul style="list-style-type: none"> 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	<ul style="list-style-type: none"> 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	<ul style="list-style-type: none"> 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	<ul style="list-style-type: none"> 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	<ul style="list-style-type: none"> 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	<ul style="list-style-type: none"> 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	<p>Knowledge: Neural Network Architecture, Training and Optimization, Loss Functions.</p> <p>Skills: Programming and Implementation: Python Proficiency, Model Development, Data Pre-processing.</p> <p>Attitudes: Curiosity and Continuous Learning: A willingness to explore new deep learning techniques, stay updated with advancements, and integrate cutting-edge methods.</p>
2	Advanced Techniques	<p>Knowledge: Deep Learning Architectures, Regularization and Optimization, Transfer Learning.</p> <p>Skills: Model Evaluation and Optimization: Hyperparameter Tuning, Performance Assessment.</p> <p>Attitudes:</p>

		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	M23BCI702	CIE Marks	50
Number of Lecture Hours/Week(L: T: P: S)	(4:0:0:0)	SEE Marks	50
Total Number of Lecture Hours	40 hours Theory	Total Marks	100
Credits	04	Exam Hours	03
Course Objectives:			
<ol style="list-style-type: none"> 1. Understanding Fundamental Concepts Deep Learning, Neural Networks Basics and Training Neural Networks. 2. Understand concepts of overfitting and under fitting and basic strategies for addressing them. 3. Explore simple real-world applications of deep learning, such as image classification or basic text analysis. 4. 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, Data Types, 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. Hands-On Machine Learning with Scikit-Learn, Keras & TensorFlow by Aurélien Géron, O'Reilly Media, 2019.

REFERENCE BOOKS:

1. Neural Networks: A systematic Introduction Raúl Rojas 1996.
2. Pattern Recognition and machine Learning Christopher 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 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)

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

(SEE), and a minimum of 40% (40 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together

Continuous Internal Evaluation:

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)

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. 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
M23BCI702.1	Understand and Apply the knowledge of Deep Neural Networks and related machine learning methods

M23BCI702.2	Apply appropriate deep learning algorithms for analysing the data for a variety of problems.
M23BCI702.3	Analyse the results of their trained models to identify issues.
M23BCI702.4	Analyse the performance of different deep learning architectures and make recommendations based on their suitability for specific tasks.
M23BCI702.5	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	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PS O1	PS O2
M23BCI702.1	-	3	-	-	-	-	-	-	-	-	-	-	3	3
M23BCI702.2	-	3	-	-	-	-	-	-	-	-	-	-	3	3
M23BCI702.3	-	-	3	-	-	-	-	-	-	-	-	-	3	3
M23BCI702.4	-	-	3	-	-	-	-	-	-	-	-	-	3	3
M23BCI702.5	-	-	-	3	-	-	-	-	-	-	-	-	3	3
M23BCI702	-	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.

7th Semester	Professional Elective – III (PE) AI OF THINGS	M23BCI704A
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1. Prerequisites

S/L	Proficiency	Prerequisites
1	Internet of Things	Knowledge of IoT devices, sensors, actuators, data collection methods, and communication protocols
2	Networking and Communication Protocols	Understanding of wireless communication technologies, Knowledge of network architecture and cloud infrastructure to support IoT ecosystems.
3	Machine Learning	Ability to train, deploy, and optimize machine learning models that can be embedded into IoT devices. Knowledge of how to integrate AI algorithms into IoT devices with limited processing power.
4	Cyber-security	Implementing strong security protocols to protect data and devices from cyber threats.
5	Data Management	Efficient collection of data from IoT devices, often in real-time, Knowledge of databases, data lakes, or cloud storage solutions to handle large volumes of data.
6	Introduction to Python	Knowledge of programming using python for AIoT applications

2. Competencies

S/L	Competency	KSA Description
1	Introduction to AI	Knowledge: Understanding what AI is, including its goals of creating systems that can perform tasks requiring human-like intelligence, such as learning, reasoning, problem-solving, perception, and language understanding. Skills: Skills in image processing, object detection, facial recognition, and image generation using AI techniques. Attitudes: Ability to stay updated with the latest developments in AI, including new algorithms, tools, and ethical considerations.
2	Problem solving in AI	Knowledge: Awareness of which AI techniques are most appropriate for different types of problems (e.g., using deep learning for image recognition or reinforcement learning for autonomous decision-making). Skills: Ability to apply AI strategies such as predictive modeling, pattern recognition, and anomaly detection to solve complex problems. Attitudes: Ability to think strategically about the long-term implications of AI solutions, including how they will evolve and integrate with other systems over time.
3	Machine learning	Knowledge Understanding of various ML algorithms such as regression, classification, clustering, and reinforcement learning. Skills: Skill in designing, implementing, and fine-tuning machine learning models to solve specific problems Attitudes: Ability to develop or modify algorithms to meet specific problem requirements, especially in cases where existing algorithms may not suffice.
4	Smart Objects	Knowledge: Knowledge of IoT security practices, including encryption, authentication, and secure communication protocols. Skills: Ability to implement and deploy IoT solutions, including setting up devices, configuring networks, and ensuring system interoperability. Attitudes: Ability to design and implement solutions to access IoT technologies using sensors/actuators

5	Developing IoT's	<p>Knowledge: Understanding of how to design and develop RESTful APIs and work with APIs for integrating and managing IoT devices.</p> <p>Skills: Ability to plan and manage IoT projects, including defining requirements, setting milestones, and allocating resources.</p> <p>Attitudes: An attitude of creativity and innovation when faced with complex problems or challenges in IoT system design and implementation.</p>
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3. Syllabus

AI of things			
Course Code	M23BCI704A	CIE Marks	50
Number of Lecture Hours/Week(L: P: SDA)	(3:0:0)	SEE Marks	50
Total Hours of Pedagogy	40 hours	Total Marks	100
Credits	03	Exam Hours	03
Course Learning objectives:			
At the end of the course the student will be able to:			
<ul style="list-style-type: none"> • Overview of formulating research problem and significance of the literature review. • Demonstrate the types of research designs with experimentation. • Importance of thesis writing skills. • Understand the basic concepts of intellectual property and its impact on society. 			
Module -1			
Introduction:			
History of AI, Intelligent agents: Agents and environment, Concept of Rationality, The nature of environment, The structure of agents.			
Module -2			
Problem-solving:			
Problem-solving agents, Example problems, Searching for Solutions Uninformed Search Strategies: Breadth First search, Depth First Search, Iterative deepening depth first search, Heuristic functions, Greedy best first search, A*search. Heuristic Functions, Knowledge-based agents.			
Module -3			
Machine learning:			
Introduction, Bayes theorem, Bayes theorem and concept learning, ML and LS error hypothesis, ML for predicting probabilities, MDL principle, Naive Bayes classifier, Bayesian belief networks, EM algorithm			
Module -4			
Smart Objects:			
The “Things” in IoT, Sensors, Actuators, and Smart Objects, Sensor Networks, Connecting Smart Objects, Communications Criteria, IoT Access Technologies.			
Module -5			
Developing IoTs:			
Introduction to Python, Introduction to different IoT tools, Developing applications through IoT tools, Developing sensor based application through embedded system platform, Implementing IoT concepts with python.			
Text Books:			
<ol style="list-style-type: none"> 1. Stuart J. Russell and Peter Norvig , Artificial Intelligence, 3rd Edition, Pearson,2015 2. Tom M. Mitchell, Machine Learning, India Edition 2013, McGraw Hill Education. 3. David Hanes, Gonzalo Salgueiro, Patrick Grossetete, Robert Barton, Jerome Henry, "IoT Fundamentals: Networking Technologies, Protocols, and Use Cases for the Internet of Things”, 1st Edition, Pearson Education (Cisco Press Indian Reprint). (ISBN: 978-9386873743) 4. Vijay Madiseti and Arshdeep Bahga, “Internet of Things (A Hands-on-Approach)”, 1st Edition, VPT, 2014. (ISBN: 978-8173719547) 			
Reference books:			
<ol style="list-style-type: none"> 1. George F Lugar, Artificial Intelligence Structure and strategies for complex, Pearson Education, 5th Edition, 2011 2. Srinivasa K G, “Internet of Things”, CENGAGE Learning India, 2017 3. Walteneus Dargie,Christian Poellabauer, "Fundamentals of Wireless Sensor Networks: Theory and Practice" 			

4. Syllabus Timeline

S/L	Syllabus Timeline	Description
1	Week 1-2: Introduction to AI	Knowledge of how networks operate, including concepts like IP addresses, DNS, HTTP/HTTPS, TCP/IP, and basic networking topologies. Understanding how web protocols work, including HTTP/HTTPS and WebSockets, which are essential for communication in IoT and WoT. Basic understanding of HTML and CSS for web interfaces, which are often used to visualize and interact with IoT devices.
2	Week 3-4: Problem solving in AI	Problem-solving agents, Example problems, Searching for Solutions Uninformed Search Strategies: Breadth First search, Depth First Search, Iterative deepening depth first search, Heuristic functions, Greedy best first search, Heuristic Functions.
3	Week 5-6: Machine learning	Introduction to machine learning, Bayes theorem, Bayes theorem and concept learning, ML for predicting probabilities, MDL principle, Naive Bayes classifier, Bayesian belief networks, EM algorithm.
4	Week 7-8: Smart Objects	Familiarity with basic IoT concepts, such as sensors, actuators, data collection, and the general architecture of IoT systems. Understanding basic electronic components and circuits can be helpful, especially for hands-on IoT projects involving sensors and actuators.
5	Week 9-10: Introduction to python	Understanding basic python programming for developing machine learning algorithms for real time IoT applications.
6	Week 11-12: Hands-on Experience	Engage in hands-on projects to develop and deploy IoT applications

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	Collaborative Learning	Encourage collaborative learning for improved competency application.
3	Higher Order Thinking (HOTS) Questions:	Pose HOTS questions to stimulate critical thinking related to each competency.
4	Problem-Based Learning (PBL)	Implement PBL to enhance analytical skills and practical application of competencies
5	Multiple Representations	Introduce topics in various representations to reinforce competencies
6	Real-World Application	Discuss practical applications to connect theoretical concepts with real-world competencies.
7	Flipped Class Technique	Utilize a flipped class approach, providing materials before class to facilitate deeper understanding of competencies
8	Programming Assignments	Assign programming tasks to reinforce practical skills associated with competencies.

6. Assessment Details (both CIE and SEE)

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 for Professional Elective Course (PE)

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 best two test marks from the 3 tests conducted.

Semester End Examinations: UG Program

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	Fundamentals of AI and IoT	Grasp the basic principles of Artificial Intelligence (AI) and the Internet of Things (IoT), including how they interrelate. Recognize potential applications of AIoT across various industries, such as smart homes, healthcare, manufacturing, and transportation.
2	Data Collection and Management	Learn how to gather data from IoT devices and sensors, ensuring accuracy and relevance. Understand the different data storage options, including cloud-based storage and data lakes, and their suitability for AIoT applications.
3	AI and Machine Learning Integration	Gain the ability to design, train, and deploy AI and machine learning models tailored to IoT data. Learn to apply AI algorithms to process IoT data in real-time, enabling immediate insights and actions.
4	Networking and Connectivity	Understand how different network architectures support IoT devices and AIoT systems, including edge and cloud computing.
5	Embedded Systems and Edge Computing	Learn how to integrate AI models into embedded systems, balancing performance and power consumption. Understand the role of edge computing in AIoT, including how to process data locally on devices to reduce latency and bandwidth usage.
6	Practical Implementation and Prototyping	Gain experience in building AIoT prototypes, from sensor integration to AI model deployment. Learn techniques for testing AIoT systems, including validation of AI models and ensuring reliable performance in real-world conditions.

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

CO's	DESCRIPTION OF THE OUTCOMES
M23BCI704A.1	Apply knowledge of agent architecture, searching and reasoning techniques for different applications.
M23BCI704A.2	Differentiate various Searching and Inferencing Techniques.
M23BCI704A.3	Apply the concepts of probability and statistics related to machine learning
M23BCI704A.4	Compare and contrast the deployment of smart objects and the technologies to connect them to network Compare and contrast the deployment of smart objects and the technologies to connect them to network Compare and contrast the deployment of smart objects and the technologies to connect them to network Compare and contrast the deployment of smart objects and the technologies to connect them to network Compare and contrast the deployment of smart objects and the technologies to connect them to network Compare and contrast the deployment of smart objects and the technologies to connect them to network

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M23BCI704A.5	Develop the sensor based embedded applications.

CO-PO-PSO Mapping

CO's	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PS O1	PS O2
M23BCI704A.1	3	-	-	-	-	-	-	-	-	-	-	-	3	3
M23BCI704A.2	3	-	-	-	-	-	-	-	-	-	-	-	3	3
M23BCI704A.3	3	-	-	3	-	-	-	-	-	-	-	-	3	3
M23BCI704A.4	3	-	3	-	-	-	-	-	-	-	-	3	3	3
M23BCI704A.5	3	-	3	3	-	3	-	-	-	-	-	3	3	3
M23BCI704A	3	-	3	3	-	3	-	-	-	-	-	3	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	10	10	10	10	10	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	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

- **Industry 4.0 and Smart Manufacturing:** AIoT will allow manufacturers to predict equipment failures before they occur, reducing downtime and maintenance costs. Factories will become increasingly automated, with AIoT systems managing production lines, quality control, and supply chains with minimal human intervention.

- **Smart Cities and Infrastructure:** AIoT will enable smart city initiatives by integrating sensors and actuators into infrastructure, improving traffic management, energy consumption, waste management, and public safety.
- **Healthcare and Wellness:** AIoT will facilitate continuous health monitoring through wearable devices and smart home systems, enabling early diagnosis and personalized treatment. Medical devices will become more intelligent, capable of making real-time decisions based on patient data, improving the accuracy and speed of treatment.
- **Transportation and Autonomous Vehicles:** AIoT will play a crucial role in the development of autonomous vehicles, enabling them to navigate complex environments safely and efficiently. AIoT systems will optimize traffic flow, reducing congestion, lowering emissions, and improving overall transportation efficiency.
- **AI and Machine Learning Integration:** Combining IoT data with AI and machine learning will enable advanced analytics, predictive insights, and autonomous decision-making across various applications. AI-driven automation in IoT systems will lead to more intelligent and adaptive behaviors, improving efficiency and user experience.
- **Security and Privacy Enhancements:** As IoT devices proliferate, advancements in security will be crucial to protect data and ensure privacy. This includes implementing advanced encryption, authentication, and anomaly detection mechanisms. Future IoT systems will increasingly incorporate privacy considerations from the design phase, offering users more control over their data and how it is used.

7 th Semester	Professional Course -III (PC) ETHICAL HACKING AND NETWORK DEFENSE	M23BCI704B
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1. Prerequisites

S/L	Proficiency	Prerequisites
1.	Operating Systems	Familiarity with Windows, Linux, and macOS.
2.	Networking	Understanding of TCP/IP, subnetting, network masks, and common networking protocols.
3.	Cyber security Fundamentals	Basic understanding of information security principles and practices. Knowledge of common threats, vulnerabilities, and attack vectors.
4.	Programming Skills	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> <p>Integrity and a strong sense of ethical responsibility and adherence to legal guidelines.</p>

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: Understanding of firewalls, intrusion detection/prevention systems (IDS/IPS), and endpoint security solutions.</p> <p>Skills: Ability to configure and manage security devices, monitor network traffic, and respond to security incidents.</p> <p>Attitudes: Proactive and defensive mindset towards protecting systems and networks.</p>

3. Syllabus

ETHICAL HACKING AND NETWORK DEFENSE			
VII SEMESTER			
Course Code	M23BCS704B	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	Total Marks	100
Credits	03	Exam Hours	03
<p>Course objectives: This course will enable students to:</p> <ul style="list-style-type: none"> ● To understand the core concepts of Ethical Hacking ● To understand how security vulnerabilities are exploited ● To analyze the impact of security vulnerabilities in systems ● To understand popular Network Defense solutions deployed at large organizations ● To configure basic firewall and IDS solution 			
Module – 1			
<p>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</p>			
Module - 2			
<p>Network and Computer Attacks –Malware, Protecting Against Malware Attacks, Intruder Attacks , Addressing Physical Security - Textbook 1: Chapter 3</p> <p>Casing the Establishment: What is foot printing, Internet Foot printing, Scanning, Enumeration, basic banner grabbing, Enumerating Common Network services. Textbook 2: Chapter</p>			
Module - 3			
<p>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</p>			
Module-4			
<p>Embedded Operating Systems: Introduction to Embedded Operating Systems, Windows and Other Embedded Operating Systems, Vulnerabilities of Embedded OS. Textbook 1: Chapter 9</p>			
Module - 5			
<p>Network Protection Systems: Understanding Network Protection Systems, Understanding Firewalls, Understanding Intrusion Detection and Prevention Systems, Understanding Honeypots. Textbook 1: Chapter 13</p>			

Text Books:

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:

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	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.
2	Week 3-4: Networking Primer	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.
3	Week 5-6: Techniques for Network Intrusion Detection System	Understanding of firewalls, intrusion detection/prevention systems (IDS/IPS), and endpoint security solutions.

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	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)

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

Continuous Internal Evaluation:

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.
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 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	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
M23BCS704B.1	3	-	-	-	-	-	-	-	-	-	-	-		
M23BCS704B.2	-	3	-	-	-	-	-	-	-	-	-	-		
M23BCS704B.3	-	-	3	-	-	-	-	-	-	-	-	-		
M23BCS704B.4	3	-	-	-	-	-	-	-	-	-	-	-		
M23BCS704B.5	3	-	-	-	-	-	-	-	-	-	-	-		
M23BCS704B	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.

7th Semester	Professional Elective -III (PE) Data Engineering and MLOPs	M23BCI704C
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1. Prerequisites

S/L	Proficiency	Prerequisites
1	Programming Languages	Python: Essential for developing machine learning models and scripts. R: Useful for statistical analysis and data visualization.
2	Machine Learning Fundamentals	Algorithms: Understanding of common machine learning algorithms. Libraries: Proficiency in libraries like TensorFlow, Keras, PyTorch, and scikit-learn.
3	DevOps Practices	CI/CD: Understanding of Continuous Integration and Continuous Deployment. Tools: Familiarity with Jenkins, Travis CI, CircleCI, or GitHub Actions.
4	Big Data Technologies	Hadoop: Understanding of HDFS and MapReduce. Spark: Proficiency in distributed data processing. Kafka: Experience with data streaming.
5	Fundamentals of Machine Learning	Familiarity with basic machine learning concepts, including supervised and unsupervised learning, and common algorithms such as linear regression and decision trees.
6	Data Modeling	Concepts: Understanding of data modeling techniques for relational and non-relational databases.
7	Data Visualization	Tools: Proficiency in tools like Tableau, Power BI, or Looker

2. Competencies

S/L	Competency	KSA Description
1	Data Architecture and Design	<p>Knowledge:</p> <ol style="list-style-type: none"> 1. Data Architecture and Design 2. Database Management 3. Big Data Technologies 4. Cloud Platforms 5. Data Security and Privacy <p>Skills:</p> <ol style="list-style-type: none"> 1. Programming and Scripting 2. Data Integration and ETL 3. Performance Optimization 4. Data Quality and Governance 5. Data Visualization: <p>Abilities:</p> <ol style="list-style-type: none"> 1. Problem-Solving 2. Collaboration and Communication 3. Adaptability
2	MLOps	<p>Knowledge:</p> <ol style="list-style-type: none"> 1. Machine Learning Fundamentals 2. Containerization and Orchestration 3. Monitoring and Logging 4. Security and Compliance <p>Skills:</p> <ol style="list-style-type: none"> 1. Model Deployment and Serving 2. CI/CD for ML 3. Automation and Scripting 4. Data Versioning and Management 5. Cloud Platforms <p>Abilities:</p> <ol style="list-style-type: none"> 1. Problem-Solving 2. Collaboration and Communication, Adaptability
3	Introduction to Data Engineering	<p>Knowledge:</p> <ol style="list-style-type: none"> 1. Cloud Computing 2. Data Governance and Compliance

		3. Data Storage Solutions 4. .ETL Processes Skills: 1. Data Pipeline Development 2. Automation and Scripting 3. Data Modeling 4. Problem-Solving Attitude: 1. Curiosity and Lifelong Learning 2. Attention to Detail 3. Resilience and Adaptability
4	Cloud Platforms	Knowledge: 1. Cloud Service Models 2. Cloud Storage Solutions 3. Data Processing and Analytics 4. Machine Learning Services Skills: 1. Cloud Infrastructure Management 2. Data Pipeline Development 3. Automation and Scripting 4. Monitoring and Logging Attitude: 1. Resilience and Adaptability 2. Attention to Detail 3. Collaboration and Team Spirit

3. Syllabus

DATA ENGINEERING AND MLOP SEMESTER – VII			
Course Code	M23BCI704C	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 Outcome:			
	Understand the Data Engineering Fundamentals		
	Apply Big Data and Cloud Technologies		
	Evaluating the Effective Data Ingestion and Processing Pipelines		
	Operationalize Machine Learning Models (MLOps)		
Module -1			
Introduction to Data Engineering: Overview of Data Engineering, Data Engineering vs. Data Science vs. Data Analytics			
Data Modeling: Conceptual, Logical, and Physical Data Models, Entity-Relationship Diagrams, Normalization and Denormalization			
Database Systems: Relational Databases (SQL), Non-Relational Databases (NoSQL), Data Warehousing and Data Lakes			
Data Sources and Types: Structured, Semi-structured, and Unstructured Data			
Data Ingestion Techniques: Batch Processing, Stream Processing			
Module -2			
Introduction to Big Data: Characteristics of Big Data, Challenges in Big Data Management			
Hadoop Ecosystem : HDFS (Hadoop Distributed File System), MapReduce, YARN			
Apache Spark: Core Concepts and Architecture, RDDs (Resilient Distributed Datasets), Data Frames and Spark SQL			
Module -3			
Cloud Platforms: AWS, Google Cloud Platform, Microsoft Azure			
Data Storage on Cloud: S3, Google Cloud Storage, Azure Blob Storage			
Cloud Data Warehouses: Amazon Redshift, Google BigQuery, Azure Synapse Analytics			
Serverless Data Processing: AWS Lambda, Google Cloud Functions, Azure Functions			
Module -4			

<p>Introduction to MLOps : Overview and Importance of MLOps, Key Components of MLOps Version Control and CI/CD for ML: Git and GitHub/GitLab, CI/CD Tools: Jenkins, GitHub Actions, GitLab CI Model Training and Deployment: Automated Model Training, Model Serving: Flask, FastAPI, TensorFlow Serving Monitoring and Maintenance: Model Drift and Retraining, Monitoring Tools: Prometheus, Grafana</p>
Module -5
<p>Data Pipeline Orchestration: Apache Airflow, Prefect, Luigi Data Quality and Governance: Data Lineage, Data Catalogs, Tools: Apache Atlas, Data Hub Security and Compliance: Data Encryption, Data Masking Regulatory Compliance: GDPR, CCPA</p>
<p>TEXTBOOKS: 1. Data Engineering: A Comprehensive Guide to Data Management, Processing, and Analysis by David Loshin, Morgan Kaufmann Publishers, 2019 2. Machine Learning Engineering by Andriy Burkov, O'Reilly Media, 2020</p>
<p>Reference Books: 1. "Fundamentals of Data Engineering" by Joe Reis and Matt Housley 2. "CI/CD for Machine Learning with Jenkins" by Chi Wang, Faisal Masood 3. "GDPR and CCPA: Compliance in Practice" by Preston Bukaty</p>

4. Syllabus Timeline

S/L	Syllabus Timeline	Description
1	Week 1-3:	<p>Introduction to Data Engineering: Overview of Data Engineering, Data Engineering vs. Data Science vs. Data Analytics Data Modeling: Conceptual, Logical, and Physical Data Models, Entity-Relationship Diagrams, Normalization and Denormalization Database Systems: Relational Databases (SQL), Non-Relational Databases (NoSQL), Data Warehousing and Data Lakes Data Sources and Types: Structured, Semi-structured, and Unstructured Data Data Ingestion Techniques: Batch Processing, Stream Processing</p>
2	Week 4-6:	<p>Introduction to Big Data: Characteristics of Big Data, Challenges in Big Data Management Hadoop Ecosystem: HDFS (Hadoop Distributed File System), MapReduce, YARN Apache Spark: Core Concepts and Architecture ,RDDs (Resilient Distributed Datasets), Data Frames and Spark SQL</p>
3	Week 7-8:	<p>Cloud Platforms: AWS, Google Cloud Platform, Microsoft Azure Data Storage on Cloud: S3, Google Cloud Storage, Azure Blob Storage Cloud Data Warehouses: Amazon Redshift, Google BigQuery, Azure Synapse Analytics Server less Data Processing: AWS Lambda, Google Cloud Functions, Azure Functions</p>
4	Week 9-11:	<p>Introduction to MLOps : Overview and Importance of MLOps, Key Components of MLOps Version Control and CI/CD for ML: Git and GitHub/GitLab, CI/CD Tools: Jenkins, GitHub Actions, GitLab CI Model Training and Deployment: Automated Model Training, Model Serving: Flask, FastAPI, TensorFlow Serving Monitoring and Maintenance: Model Drift and Retraining, Monitoring Tools: Prometheus, Grafana</p>
5	Week 12-13 :	<p>Data Pipeline Orchestration: Apache Airflow, Prefect, Luigi Data Quality and Governance: Data Lineage, Data Catalogs, Tools: Apache Atlas, Datahub Security and Compliance: Data Encryption, Data Masking Regulatory Compliance: GDPR, CCPA</p>

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 MLOP 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 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:

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	Foundations of Data Engineering	Understand the Role of Data Engineering: Comprehend the role and importance of data engineering in the data lifecycle and its distinction from data science and data analytics. Recognize the responsibilities of a data engineer in various industry contexts. Master Data Modeling Techniques: Develop skills in creating conceptual, logical, and physical data models. Interpret and design Entity-Relationship Diagrams (ERDs) and understand normalization and denormalization processes. Proficiency in Database Systems: Gain knowledge of relational (SQL) and non-relational (NoSQL) databases. Understand the principles of data warehousing and data lakes.
2	Data Collection and Ingestion	Identify Various Data Sources and Types: Understand the characteristics and differences between structured, semi-structured, and unstructured data. Recognize different data sources and the methods to collect data from them.
3	Big Data Technologies	Introduction to Big Data Concepts: Understand the characteristics, challenges, and opportunities of big data management. Gain insights into the various components of the Hadoop ecosystem, including HDFS, MapReduce, and YARN. Master Apache Spark: Learn core concepts, architecture, and functionalities of Apache Spark. Develop skills in working with RDDs, Data Frames, and performing large-scale data processing using Spark SQL.
4	Machine Learning Operations (MLOps)	Introduction to MLOps: Understand the principles and importance of MLOps in the deployment and maintenance of machine learning models. Learn about the key components and practices involved in MLOps. Version Control and CI/CD for ML: Gain proficiency in using version control systems like Git. Implement continuous integration and continuous deployment (CI/CD) pipelines using tools like Jenkins, GitHub Actions, and GitLab CI. Model Training, Deployment, and Monitoring: Learn automated model

		training techniques and tools. Develop skills in deploying machine learning models using frameworks such as Flask, FastAPI, and TensorFlow Serving. Understand how to monitor and maintain deployed models, addressing model drift and performance issues.
5	Data Engineering and MLOps Tools and Best Practices	Orchestrate Data Pipelines: Develop skills in using data pipeline orchestration tools like Apache Airflow, Prefect, and Luigi. Ensure Data Quality and Governance: Learn about data quality management, data lineage, and data cataloging. Understand the use of tools like Apache Atlas and Databricks for data governance. Implement Data Security and Compliance: Gain knowledge of data security practices, including data encryption and masking. Understand regulatory compliance requirements such as GDPR and CCPA. Capstone Project: Apply learned skills in a comprehensive project involving planning, building data pipelines, developing and deploying models, and presenting findings.

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

COs	Description
M23BCI704C.1	Understand the Data Engineering Fundamentals
M23BCI704C.2	Apply Big Data and Cloud Technologies
M23BCI704C.3	Evaluating the Effective Data Ingestion and Processing Pipelines
M23BCI704C.4	Designing of Machine Learning Models (MLOps)

CO-PO-PSO Mapping

COs/POs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PS O1	PS O2
M23BCI704C.1	3	-	-	-	-	-	-	-	-	-	-	-	3	-
M23BCI704C.2	-	3	-	-	-	-	-	-	-	-	-	-	-	3
M23BCI704C.3	-	-	3	3	-	-	-	-	-	-	-	-	3	-
M23BCI704C.4	-	-	-	3	-	-	-	-	-	-	-	-	-	3
M23BCI704C	3	3	3	3									3	3

9. Assessment Plan

Continuous Internal Evaluation (CIE)

	CO1	CO2	CO3	CO4	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	20	50

Semester End Examination (SEE)

	CO1	CO2	CO3	CO4	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	40	100

10. Future with this Subject:

- ❖ **Growing Demand for Expertise:**As organizations continue to leverage big data and machine learning for competitive advantage, there is an increasing demand for skilled data engineers and MLOps professionals. This trend is expected to continue as data-driven decision-making becomes central to business strategy.
- ❖ **Diverse and Evolving Career Opportunities:** Graduates will find diverse career paths including roles such as Data Engineer, MLOps Engineer, Data Scientist, and Cloud Data Architect. The

field is evolving with new technologies and methodologies, offering opportunities for specialization and advancement.

- ❖ **High Impact on Business and Technology:** Data engineers and MLOps professionals play a crucial role in optimizing data infrastructure and automating machine learning workflows, leading to more efficient business operations and innovative technological solutions.
- ❖ **Competitive Salaries and Job Stability:** Due to the high demand and specialized skills required, careers in data engineering and MLOps offer competitive salaries and job stability, with opportunities for career growth and development.
- ❖ **Continuous Learning and Innovation:** The rapid evolution of technologies in big data and machine learning means that professionals will continually engage in learning and adapting to new tools and practices, ensuring dynamic and challenging career paths.

7th Semester	Professional Elective-III (PE) USER INTERFACE DESIGN	M23BCS704D
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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	<p>Knowledge: Importance of User Interface Design for any application. Understanding of the basics of User Interface Design.</p> <p>Skills: Ability to know the basic principles of Interface Design for the Users.</p> <p>Attitudes: Appreciation to understand the importance of Interface Design and implement the same with respect to user's perspective.</p>
2	Design Process: Requirement Analysis	<p>Knowledge: Understanding of the need of requirement analysis before any design is to be made. Principles of Requirement Analysis and techniques.</p> <p>Skills: Steps to understand with proper guidelines to collect the requirements for the design.</p> <p>Attitudes: Appreciation for the procedure to gather the appropriate requirements for the design.</p>
3	Design Process: Business Function & Screen Design	<p>Knowledge: Understanding the basic business functions with respect to user interface design. Importance of Screen Design.</p> <p>Skills: Defining appropriate Business Protocols and strategies. Designing of Screen Elements to produce Good Screen Design.</p> <p>Attitudes: Valuing the importance of Business Strategies and Screen Design which is appropriate for different types of Users.</p>
4	Design Process: Menus	<p>Knowledge: Understanding the importance of Menus and its items for user interaction.</p> <p>Skills: Applying Guidelines of Menu Design and its Items to create proper structure of menu usage.</p> <p>Attitudes: Creativeness to design the menu and its items for effective usage.</p>
5	Design Process: Window	<p>Knowledge: Understanding of issues and structures of windows and its types</p>

		<p>Skills: Constructing window structure to suit the best design for the elements of the screen for user interaction.</p> <p>Attitudes: Appreciation for the way types of windows can be designed and used with good design.</p>
6	Design Process: Controls	<p>Knowledge: Understanding the characteristics and importance of Screen Controls.</p> <p>Skills: Designing and analyzing the appropriate Screen Controls.</p> <p>Attitudes: Recognizing the significance of screen controls.</p>
7	Design Process: Tests	<p>Knowledge: Understanding the importance of Testing.</p> <p>Skills: Designing and analyzing elements of the screen through testing.</p> <p>Attitudes: Valuing the importance of Testing and Re-Testing</p>

3. Syllabus

USER INTERFACE DESIGN SEMESTER – VII			
Course Code	M23BCS704D	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:			
<ol style="list-style-type: none"> 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. **Designing Interfaces** by Jennifer Tidwell, O'Reilly Media, 2010.

REFERENCE BOOKS:

1. Ben Sheiderman, “Design the User Interface”, Pearson Education, 1998.
2. 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 Designing 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
	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:

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 examine Window 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
M23BCS704D.1	Understand and apply the fundamental characteristics of computer interface, graphics interface and web interface
M23BCS704D.2	Apply the various components of user interface design during the design process
M23BCS704D.3	Analyse the various characteristics of user interface components during the design process.
M23BCS704D.4	Implement the appropriate design strategies for good interface design.
M23BCS704D.5	Design the prototypes of user interface and examine with testing process.

CO-PO-PSO Mapping

COs/POs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PS O1	PS O2
M23BCS704D.1	3	-	-	-	-	-	-	-	-	-	-	-	3	-
M23BCS704D.2	3	-	-	-	-	-	-	-	-	-	-	-	3	-
M23BCS704D.3	-	3	-	-	-	-	-	-	-	-	-	-	3	-
M23BCS704D.4	-	-	3	-	-	-	-	-	-	-	-	-	3	3
M23BCS704D.5	-	-	-	3	-	-	-	-	-	-	-	-	3	3
M23BCS704D	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 User Interface 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.

7th semester	Professional Elective - IV Quantum Computing	M23BCS705A
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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	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 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	M23BCS705A	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: 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</p>			

quantum Fourier Transform – eigenvalue estimation. 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).
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. 2. V. Sahni, “Quantum Computing”, Tata McGraw-Hill Publishing Company, 2007.
Reference Books: 1. Quantum Computing and Quantum Information, Michael A. Nielsen & Isaac L. Chuang, 10th Anniversary edition, Cambridge University Press, 2010. 2. 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 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)

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

Continuous Internal Evaluation:

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 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	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
M23BCS705A.1	Analyze the fundamental concepts and principles of quantum computing
M23BCS705A.2	Analyze the Qubits and Quantum Model of Computation Management
M23BCS705A.3	Evaluate and understand various Quantum Algorithms
M23BCS705A.4	Analyze and understand various Quantum Algorithms
M23BCS705A.5	Examine the various concepts of Quantum Computational Complexity and Error Correction

CO-PO-PSO Mapping

Cos/POs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 110	PO 111	PO 112	PS O1	PS O2
M23BCS705A.1	3	2	-	-	3	-	-	-	-	-	-	3	3	
M23BCS705A.2	3	3	3	-	-	-	-	-	-	-	-		3	
M23BCS705A.3	-	3		2	-	-	-	-	-	-	-	3		

M23BCS705A.4	-	3	-	2	-	-	-	-	-	-	-	3		
M23BCS705A.5	-	-	3	-	-	-	-	-	-	-	-	-	3	
Avg	3	3	3	2								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	10	10	10	10	10	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	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 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

7th Semester	Professional Elective-IV(PE) Angular JS	M23BCI705B
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1. Prerequisites

S/L	Proficiency	Prerequisites
1	HTML & CSS	HTML: Basic understanding of HTML is essential since Angular JS 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 Angular JS 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 Angular JS interacts with the DOM.
3	Basic	Angular JS follows the Model-View-Controller (MVC) architecture.

	Understanding of MVC Architecture	Understanding how data (Model), user interface (View), and business logic (Controller) are separated will help in effectively using Angular JS.
4	JavaScript Frameworks and Libraries	jQuery: While not required, familiarity with jQuery can be helpful as it shares some common concepts with Angular JS, 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)	Angular JS 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 Angular JS applications.

2. Competencies

S/L	Competency	KSA Description
1	Dynamic Web Application Development	<p>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, Angular JS Framework, Single Page Application (SPA) Development, API Interaction and Server Communication.</p> <p>Skills: Application Development, Data Binding and DOM Manipulation, Routing and Navigation, Form Management and Validation, Error Handling and Debugging, Responsive Design Integration.</p> <p>Attitudes: Attention to Detail, Problem-Solving Mindset, User-Centered Design, Continuous Learning, Collaboration and Communication</p>
2	Understanding and Applying MVC Architecture	<p>Knowledge: Model-View-Controller (MVC) Concept, Angular JS 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, Angular JS 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	<p>Knowledge: HTML Forms Basics, Angular JS Form Handling, Form Validation Techniques,</p>

	and Validation	Data Binding in Forms, Error Handling and User Feedback Security Considerations. Skills: Implementing Angular JS Forms, Validating User Input, Handling Form States, Providing User Feedback, Optimizing Form Performance, Securing Forms. Attitudes: User-Centered Design, Attention to Detail, Security-Conscious Mindset, Continuous Improvement, Collaboration and Communication.
5	Service and Server Communication	Knowledge: RESTful APIs, Angular JS Services, AJAX and Asynchronous Programming, Data Serialization and Deserialization Security in Server Communication. Skills: Implementing API Calls, Creating and Using Angular JS Services, Handling Asynchronous Operations, Data Processing, Securing Server Communication, Error Handling and Debugging. Attitudes: Security-Conscious Development, Efficiency and Performance Focus, Attention to Detail, User-Centered Design, Continuous Learning and Adaptability.

3. Syllabus

Angular JS SEMESTER – VII			
Course Code	M23BCI705B	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:			
<ol style="list-style-type: none"> 1. Explore to reduce the code to build user interface applications 2. Describe Client Side MVC 3. Understanding single page applications development 4. Understanding concept of interactive and attractive interface development techniques 5. 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 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 (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: 1. Andrew Grant — “Beginning Angular JS”, A Press 2014. 2. Green, Brad – “Angular JS”, O’Relly 2013.
REFERENCE BOOKS: 1. 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

Final CIE 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
M23BCS705D.1	Understand the basic programming to implement dynamic web pages and applications.
M23BCS705D.2	Apply the knowledge of the design patterns to control the application
M23BCS705D.3	Identify and apply the knowledge to control events handling and error handling
M23BCS705D.4	Build the knowledge to filter the data more effective way to present
M23BCS705D.5	Construct services and server communication.

CO-PO-PSO Mapping

COs/POs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PS O1	PS O2
M23BCS705D.1	3	-	-	-	-	-	-	-	-	-	-	-	3	3
M23BCS705D.2	-	3	-	-	-	-	-	-	-	-	-	-	3	3
M23BCS705D.3	-	-	3	-	-	-	-	-	-	-	-	-	3	3
M23BCS705D.4	-	-	-	3	-	-	-	-	-	-	-	-	3	3
M23BCS705D.5	-	-	3	-	-	-	-	-	-	-	-	-	3	3
M23BCS705D	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 Angular JS, 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 meet ups, 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.

7th Semester	Professional Elective-IV (PE) Business Intelligence And Analytics	M23BCS705C
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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 expert system.

3. Syllabus

BUSINESS INTELLIGENCE AND ANALYTICS SEMESTER – VII			
Course Code	M23BCS705C	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 • 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 Systems	Introduction to Automated decision system. Basics of expert system. Structure and applications of expert system.

5. Teaching-Learning Process Strategies

S/L	TLP Strategies:	Description
1	Lecture Method	6. 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	Promote teamwork through group projects that require students to collaborate

	Collaborative Learning	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
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 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 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
M23BCS705C.1	Able to analyze Business Intelligence, Analytics and Decision support
M23BCS705C.2	Understand and apply technologies for decision making
M23BCS705C.3	Apply predictive modelling techniques
M23BCS705C.4	Apply sentiment analysis techniques
M23BCS705C.5	Develop NN model for analysis.

CO-PO-PSO Mapping

COs/POs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PS O1	PS O2
M23BCS705C.1	-	3	-	-	-	-	-	-	-	-	-	-	-	-
M23BCS705C.2	3	-	-	-	-	-	-	-	-	-	-	-	-	-
M23BCS705C.3	3	-	-	-	-	-	-	-	-	-	-	-	-	-
M23BCS705C.4	3	-	-	-	-	-	-	-	-	-	-	-	-	-
M23BCS705C.5	-	-	3	-	-	-	-	-	-	-	-	-	-	-
M23BCS705C	3	3	3	-	-	-	-	-	-	-	-	-	3	3
Avg	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.

7th Semester	Professional Elective –IV (PE) Augmented Reality and Virtual reality	M23BCI705D
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1. Prerequisites

S/L	Proficiency	Prerequisites
1	Hardware Requirements	For VR: You'll need a VR headset (like Oculus Quest, HTC Vive, or PlayStation VR) and possibly additional peripherals like motion controllers. High-performance computers or consoles may also be required to run VR applications smoothly. For AR: AR experiences can be accessed through smartphones and tablets, which need to have good processing power and sensors (camera, gyroscope, and accelerometer). For advanced AR experiences, specialized AR glasses or headsets might be needed.
2	Software and Development Tools:	Both AR and VR development require software tools for creating and managing content. Common tools include Unity or Unreal Engine for creating interactive 3D environments, as well as AR-specific tools like ARKit (for iOS) or ARCore (for Android) for developing AR applications.
3	Understanding of 3D Modelling and Animation	Creating immersive AR and VR experiences often involves 3D modelling and animation. Proficiency with 3D modelling software (like Blender, 3ds Max, or Maya) is crucial for designing and animating virtual objects and environments.
4	Programming Skills	Developing AR and VR applications usually requires programming knowledge. Familiarity with languages like C# (commonly used in Unity) or C++ (often used in Unreal Engine) is important for scripting interactions, game mechanics, and other functionalities within AR/VR environments.
5	User Experience (UX) Design Knowledge:	Designing for AR and VR involves unique considerations for user experience. Understanding how users interact with 3D spaces, how to create intuitive controls, and how to ensure comfort and accessibility (to prevent issues like motion sickness) are all critical for creating effective and engaging AR/VR experiences.

2. Competencies

S/L	Competency	KSA Description
1	3D Modelling and Animation	Students are able to create and animate 3D assets that are optimized for AR/VR environments.
2	Programming and Scripting	Students will understand the use of AR/VR SDKs and APIs (e.g., Unity, Unreal Engine, ARKit, ARCore).
3	User Experience (UX) Design	Students learn Ability to analyze user behavior and feedback to improve the AR/VR experience.
4	Hardware and Sensor Integration	Students learn to address and resolve hardware and sensor integration challenges.
5	Computer Vision	Students learn to enhance the AR experience by integrating sophisticated computer vision capabilities.
6	Project Management and Collaboration	Ability to lead projects from conception through completion, ensuring timelines and goals are met.

3. Syllabus

Augmented Reality and Virtual reality
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SEMESTER – VII			
Course Code	M23BCI705D	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: This course will enable students to:</p> <ul style="list-style-type: none"> • Basic Understanding of Augmented Reality and Virtual Reality • Develop Proficiency in AR/VR Development Tools • Design and Implement Interactive Experiences • Analyze and Evaluate AR/VR Technologies and Trends 			
Module -1			
<p>Defining Virtual and Augmented Reality: Introducing Virtual Reality and Augmented Reality. Looking at Some Other Types of Virtual and Augmented Reality. Mixed reality. Augmented virtuality. Extended reality.</p> <p>Exploring the Current State of Virtual Reality: Looking at the Available Form Factors. Focusing on Features. Room-scale versus stationary experience. Inside-out tracking. Haptic feedback. Audio. Considering Controllers.</p> <p>Exploring the Current State of Augmented Reality: Mobile devices. AR Headsets, AR Glasses. Considering Controllers. Touch. Gaze. Keyboard and mouse. Voice. Hand tracking. Textbook1-Chapter 1, 2,3</p>			
Module -2			
<p>Consuming Content in Virtual Reality- Exploring Consumer-Grade Virtual Reality. High-end devices. Mid-tier devices. Low-end devices. Identifying Near-Future Hardware. HTC Vive Pro. HTC Vive Focus. Lenovo Mirage Solo.</p> <p>Consuming Content in Augmented Reality- Exploring Consumer-Grade Augmented Reality. Microsoft HoloLens. Meta 2. Magic Leap. Identifying Near-Future Hardware. Heads-up displays. AR devices. Comparing Current and Future Options. Textbook1-Chapter 4, 5</p>			
Module -3			
<p>Evaluating Project: Choosing Virtual Reality- Strengths And Weaknesses. Choosing Augmented Reality- Strengths And Weaknesses.</p> <p>Creating Content for Virtual And Augmented Reality: Assessing Design Software. Traditional design tools- VR/AR-based design tools. Capturing Real Life. Video-capture options. Still-image capture options. Audio options. Virtual reality desktop headsets. Virtual reality mobile headsets. Augmented reality headsets. Mobile augmented reality. Textbook1-Chapter 6, 9</p>			
Module -4			
<p>Exploring Virtual Reality Use Cases- Art- Tilt Brush. Google Arts & Culture V. Education- Google Expeditions V. Apollo 11. VR. Entertainment-Intel True. Healthcare- Virtual operating room. Psychological therapy. Gaming- Rec Room. VR arcade.</p> <p>Exploring Augmented Reality Use Cases- Art- Facebook Building. Education- Google Expeditions. Industry and Commerce-Worklink. Entertainment- Kinetic Sandbox. Textbook1-Chapter 10,11</p>			
Module -5			
<p>The Future of VR and AR: Assessing the Future of Virtual Reality: Anticipating the Near-Future Changes. Evaluating the market. Looking at upcoming hardware and software. Considering Virtual Reality's "Killer App".</p> <p>Assessing the Future of Augmented Reality: Analyzing Near Future Changes. Evaluating the market. Considering AR's "Killer App". Textbook1-Chapter 12,13</p>			
<p>Text Books:</p> <ol style="list-style-type: none"> 1. Virtual & Augmented Reality for Dummies by Paul Mealy. 2. Schmalstieg, D., Höllerer, T., (2016), "Augmented Reality: Principles & Practice," Pearson. 			

Reference Books:

1. Coiffet, P., Burdea, G. C., (2003), “Virtual Reality Technology,” Wiley-IEEE Press.

Web links and Video Lectures (e-Resources):<https://arvr.google.com/><https://www.goshort.nlhttps://www.8thwall.com/>**4. Syllabus Timeline**

S/L	Syllabus Timeline	Description
1	Week 1-2: Introduction to Augmented and Virtual Reality	Knowledge: Understanding of 3D modeling techniques, textures, and animations. Skills: Ability to create and animate 3D assets that are optimized for AR/VR environments.
2	Week 3-4: Consuming Content In Virtual And Augmented Reality	Knowledge: develop skills in breaking down problems and designing efficient solutions. Skills: Ability to create and animate 3D assets that are optimized for AR/VR environments.
3	Week 5-6: Creating Content In Virtual And Augmented Reality	Knowledge: Understanding of computer vision techniques used in AR, such as object recognition and image tracking. Skills: skill in using computer vision libraries and frameworks (e.g., OpenCV).
4	Week 7-8: Virtual And Augmented Reality In The World	Knowledge: how operating systems manage memory resources efficiently to support multiple processes. Skills: Skill in creating wireframes, prototypes, and conducting usability testing for AR/VR applications
5	Week 9-10: The Future of VR and AR: Assessing the	Knowledge: Familiarity with the collaborative aspects of AR/VR development, including team dynamics and communication. Skills: Skill in coordinating with multidisciplinary teams, including designers, developers, and stakeholders.
6	Week 11-12: Integration and Practical Applications	Apply learned concepts and competencies to real-world scenarios. Hands-on practice with AR and VR.

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 ARVR 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)

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

Continuous Internal Evaluation:

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 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	Understand AR/VR Fundamentals	Students Learn the core concepts and technologies behind AR and VR.
2	Develop AR/VR Content	Acquire skills in creating and programming interactive 3D content for AR/VR.
3	Design Immersive UX	Master user experience principles specific to AR/VR environments.
4	Optimize AR/VR Systems	Implement and fine-tune AR/VR applications for performance and usability
5	Explore Trends and Applications	Stay updated on the latest AR/VR advancements and industry applications.

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

Cos	Description
M23BIS705D.1	Analyse the fundamental concepts and principles of AR and VR.
M23BIS705D.2	Design and develop AR/VR projects, demonstrating the ability to create immersive and interactive experiences using appropriate development tools and technologies.
M23BIS705D.3	Apply key principles of AR and VR, including spatial awareness, user interaction, and real-time rendering, to create functional and engaging applications.
M23BIS705D.4	Analyze the performance of AR/VR applications, optimizing aspects such as graphics rendering, user interaction, and system efficiency to ensure high-quality user experiences.
M23BIS705D.5	Evaluate and critique different AR/VR technologies and platforms, understanding their features, capabilities, and limitations, and making informed decisions about their use in various contexts.

CO-PO-PSO Mapping

Cos/POs	PO	PO	PO	PO	PO	PO	PO	PO	PO	PO	PO	PS	PS	
	1	2	3	4	5	6	7	8	9	10	11	12	O1	O2
M23BIS705D.1	3	-	-	-		-	-	-	-	-	-	3	3	

M23BIS705D.2	-	-	3	2	3	-	-	-	-	-	-	3	3	
M23BIS705D.3	-	-	3	2	3	-	-	-	-	-	-	3		3
M23BIS705D.4	3	-	3	2	3	-	-	-	-	-	-	3	3	
M23BIS705D.5	-	-	3	-		-	-	-	-	-	-	-	3	
M23BIS705D	3		3	2	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

- Enhanced Immersive Experiences:** Future AR and VR systems will offer even more immersive experiences with advancements in hardware and software, including higher resolution displays, more accurate motion tracking, and improved sensory feedback. Innovations like haptic feedback suits and advanced spatial audio will further enhance the sense of presence and immersion.
- Integration with Artificial Intelligence (AI):** AR and VR will increasingly integrate with AI to create more intelligent and responsive environments. AI could enhance real-time object recognition, personalize user experiences, and enable dynamic content generation, making interactions more intuitive and context-aware.
- Broader Applications across Industries:** The application of AR and VR will expand significantly across various industries. For example, AR might revolutionize fields like healthcare with surgical visualization tools or remote diagnostics, while VR could transform education through virtual classrooms and hands-on simulations.
- Advancements in Wearable Technology:** Future developments will lead to more compact, comfortable, and less intrusive AR/VR wearables. This could include lightweight AR glasses with enhanced functionalities or VR headsets with improved ergonomics and wireless capabilities, making them more accessible and practical for daily use.
- Social and Collaborative Virtual Spaces:** AR and VR will increasingly facilitate social interactions and collaboration in virtual spaces. Enhanced social VR platforms could allow for more natural and engaging virtual meetings, social gatherings, and collaborative work environments, bridging geographical gaps and fostering global connectivity.

7th Semester	Professional Course Lab (PCL) DEEP LEARNING LABORATORY	M23BCIL706
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1. Prerequisites

S/L	Proficiency	Prerequisites
1	Fundamental Knowledge	<ul style="list-style-type: none"> Basic Machine Learning Concepts: Understanding of fundamental machine learning principles, including supervised and unsupervised learning, model evaluation metrics, and basic algorithms. Deep Learning Basics: Familiarity with core concepts of deep learning such as neural networks, activation functions, loss functions, and basic training procedures.
2	Mathematics and Statistics	<ul style="list-style-type: none"> Linear Algebra: Knowledge of vectors, matrices, matrix operations, and understanding of eigenvalues and eigenvectors as these are crucial for implementing and understanding neural networks. Calculus: Basic understanding of derivatives and gradients, especially in the context of optimization techniques used in training neural networks (e.g., gradient descent). Probability and Statistics: Familiarity with probability distributions, statistical measures, and concepts such as expectation and variance.
3	Programming Skills	<ul style="list-style-type: none"> Python Programming: Proficiency in Python, as it is the primary language used in most deep learning frameworks. Students should be comfortable with Python syntax, functions, loops, and data structures. Libraries and Frameworks: Basic experience with data manipulation and analysis libraries like NumPy and pandas, as well as familiarity with visualization libraries such as Matplotlib or Seaborn.
4	Experience with Deep Learning Frameworks	<ul style="list-style-type: none"> Framework Familiarity: Prior exposure to deep learning frameworks such as TensorFlow, PyTorch, or Keras is beneficial. Basic knowledge of how to build, train, and evaluate models using these tools.
5	Data Handling and Pre-processing	<ul style="list-style-type: none"> Data Manipulation: Experience with handling and preprocessing data, including techniques such as normalization, scaling, and splitting datasets. Data Augmentation: Understanding of data augmentation techniques and their application in improving model performance.
6	Computational Tools	<ul style="list-style-type: none"> Development Environments: Familiarity with using development environments or tools like Jupyter Notebooks or integrated development environments (IDEs) for writing and running code. Version Control: Basic knowledge of version control systems like Git for managing code changes and collaborating on projects.
7	Problem-Solving and Analytical Skills	<ul style="list-style-type: none"> Critical Thinking: Ability to approach problems systematically, diagnose issues in model performance, and apply problem-solving techniques to address challenges.

2. Competencies

S/L	Competency	KSA Description
1	Foundational Concepts	<p>Knowledge:</p> <p>Neural Networks: Understanding the architecture and functioning of various neural networks, including feedforward networks, convolutional networks (CNNs), and recurrent networks (RNNs).</p> <p>Learning Algorithms: Knowledge of different learning algorithms such as backpropagation, gradient descent, and advanced optimizers like Adam.</p> <p>Mathematical Foundations: Comprehension of the mathematical principles underpinning deep learning, such as matrix operations, activation functions, and loss functions.</p> <p>Advanced Topics: Awareness of cutting-edge topics such as attention mechanisms, transformers, and generative adversarial networks (GANs).</p> <p>Skills:</p> <p>Model Development: Ability to design, implement, and train deep learning</p>

		<p>models for various tasks such as classification, regression, and generation. Data Preparation: Skills in pre-processing data, including normalization, data augmentation, and splitting datasets into training, validation, and test sets. Experimentation: Proficiency in setting up and conducting experiments, adjusting model parameters, and analysing results to refine model performance. Attitudes: Continuous Learning: A strong desire to stay updated with the latest research, techniques, and advancements in deep learning. Experimentation: A willingness to experiment with new ideas and approaches to solve problems effectively.</p>
2	Tools and Frameworks	<p>Knowledge: Programming Languages: Proficiency in programming languages commonly used in deep learning, primarily Python. Libraries and Frameworks: Familiarity with deep learning libraries and frameworks such as TensorFlow, PyTorch, and Keras. Skills: Debugging: Competence in troubleshooting issues during model training and inference, including handling convergence problems and debugging code. Optimization: Skill in optimizing models for better performance, including techniques for hyperparameter tuning and computational efficiency. Attitudes: Ethics Awareness: Understanding and applying ethical principles in the development and deployment of deep learning models, such as ensuring fairness, avoiding bias, and protecting user privacy.</p>
, 3	Data Handling	<p>Knowledge: Grasp data pre-processing techniques, data augmentation, and the importance of large datasets and GPUs in deep learning. Skills: Ability to pre-process data for deep learning models, including normalization, resizing, and augmentation. Attitudes: Emphasize teamwork, communication, and collaboration, understanding the value of diverse perspectives in solving complex problems.</p>
4	Model Evaluation	<p>Knowledge: Performance Metrics: Understanding various metrics for evaluating model performance, including accuracy, precision, recall, F1 score, and ROC-AUC. Validation Techniques: Knowledge of cross-validation, hyperparameter tuning, and techniques to prevent overfitting. Skills: Code Documentation: Ability to write clean, well-documented code that is easy to understand and maintain. Report Writing: Competence in documenting experiments, results, and insights in a clear and comprehensive manner. Attitudes: Teamwork: Ability to work effectively in a team, sharing knowledge and collaborating on projects to achieve common goals. Effective Communication: Skill in communicating complex technical concepts and findings to both technical and non-technical audiences.</p>

3. Syllabus

DEEP LEARNING LABORATORY SEMESTER – VII			
Course Code	M23BCIL706	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. Develop the ability to build and implement various deep learning models using frameworks such as			

TensorFlow, PyTorch, or Keras.
<ol style="list-style-type: none"> Learn techniques for data preprocessing, including normalization, data augmentation, and handling missing values. Gain experience in tuning hyperparameters to optimize model performance. Learn how to deploy trained models into production environments and integrate them into applications or services. Develop skills in conducting research and experiments to test hypotheses and analyze results.
LIST OF EXPERIMENTS
<ol style="list-style-type: none"> Build a deep neural network model start with linear regression using a single variable. Build a deep neural network model start with linear regression using multiple variables. Write a program to convert speech into text. Write a program to convert text into speech. Write a program to convert video into frames. Write a program for Time-Series Forecasting with the LSTM Model. Build a feed forward neural network for prediction of logic gates. Write a program to implement deep learning Techniques for image segmentation. Write a program for object detection using image labelling tools. Write a program to predict a caption for a sample image using LSTM. Write a program for character recognition using CNN. Write a program to predict a caption for a sample image using CNN. Write a program for character recognition using RNN and compare it with CNN.
TEXTBOOKS: <ol style="list-style-type: none"> Deep Learning Ian Good fellow and Yoshua Bengio and Aaron Courville MIT Press 2016. Navin Kumar Manaswi ,Deep Learning with Applications Using Python Chatbots and Face, Object, and Speech Recognition With TensorFlow and Keras , Apress,2018. Josh Patterson and Adam Gibson, “Deep learning: A practitioner's approach”, O'Reilly Media, First Edition, 2017.

4. Syllabus Timeline

S/L	Syllabus Timeline	Description
1	Week 1-2:	Program1, Program2.
2	Week 3-4:	Program3, Program4.
3	Week 5-6:	Program5, Program6.
4	Week 7-8:	Program7, Program8.
5	Week 9-10:	Program9, Program10.
6	Week 11-12:	Program11, Program12, Program13

5. Teaching-Learning Process Strategies

S/L	TLP Strategies:	Description
1	Interactive Lectures	Use interactive lectures to introduce new concepts. Incorporate questions and discussions to engage students.
2	Coding Sessions:	Demonstrate the implementation of Deep Learning algorithms live, showing step-by-step coding and debugging.
3	Lab Exercises	Design lab exercises that require students to implement and manipulate data.
4	Coding Assignments	Assign regular coding tasks that reinforce lecture material and provide practical experience.
5	Group Projects	Encourage students to work in groups for larger projects, fostering teamwork and collaborative problem-solving.
6	Code Documentation:	Practice writing clear and comprehensive documentation for all coding assignments and projects.

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	Design and Implement Neural Networks	Develop the ability to design, implement, and train various neural network architectures. Students will be able to create and fine-tune models such as feedforward neural networks, convolutional neural networks (CNNs), recurrent neural networks (RNNs), and transformers for different types of tasks.
2	Data Preparation and Augmentation	Learn techniques for preparing and augmenting data to improve model performance. Students will effectively pre-process data, including normalization, scaling, and data augmentation techniques, to prepare datasets for training deep learning models.
3	Apply Regularization and Optimization Techniques	Understand and apply regularization methods and optimization algorithms to enhance model generalization and performance. Students will implement techniques such as dropout, L2 regularization, and various optimization algorithms (e.g., Adam, RMSprop) to prevent overfitting and improve training efficiency.
4	Experiment with Hyperparameter Tuning	Gain experience in tuning hyperparameters to optimize deep learning models. Students will conduct experiments with different hyperparameters, such as learning rates, batch sizes, and network architecture parameters, and use techniques like grid search or random search for optimization.
5	Evaluate Model Performance and Interpret Results	Evaluate and interpret the performance of deep learning models using appropriate metrics. Students will assess model performance using metrics such as accuracy, precision, recall, F1 score, and ROC-AUC, and will be able to interpret and communicate the results effectively.
6	Deploy Models to Production Environments	Learn the basics of deploying deep learning models in production settings. Students will gain skills in deploying models using tools and platforms such as Flask, Docker, and cloud services (e.g., AWS, Google Cloud) and will understand the considerations for model scalability and integration.
7	Document and Present Findings	Learn to document and present deep learning projects and findings clearly and effectively. Students will prepare comprehensive reports, presentations, and code documentation that clearly convey their methods, results, and insights.

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

COs	Description
M23BCIL706.1	Understand and apply the fundamental concepts of deep learning algorithms.
M23BCIL706.2	Apply pre-trained models and transfer learning techniques to solve specific tasks
M23BCIL706.3	Analyze and evaluate the performance of different deep learning models
M23BCIL706.4	Design and develop custom deep learning solutions for complex problems by integrating multiple models and techniques.

CO-PO-PSO Mapping

COs/POs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PS O1	PS O2

M23BCIL706.1	-	3	-	-	-	-	-	-	-	-	-	-	3	3
M23BCIL706.2	-	3	-	-	-	-	-	-	-	-	-	-	3	3
M23BCIL706.3	-	-	3	-	-	-	-	-	-	-	-	-	3	3
M23BCIL706.4	-	-	-	3	-	-	-	-	-	-	-	-	3	3
M23BCIL706	-	3	3	3	-	-	-	-	-	-	-	-	3	3

9. Assessment Plan

Continuous Internal Evaluation (CIE)

	CO1	CO2	CO3	CO4	Total
Program 1 to 13	12	13	13	12	50
Total	12	13	13	12	50

Semester End Examination (SEE)

	CO1	CO2	CO3	CO4	Total
Program 1 to 13	24	26	26	24	100
Total	24	26	26	24	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:

- ❖ **Integration of Emerging Technologies:** The lab will explore and implement cutting-edge deep learning architectures such as transformers, attention mechanisms, and self-supervised learning models. Experimentation with hybrid models that combine deep learning with other AI techniques, such as reinforcement learning or symbolic AI, to address more complex problems.
- ❖ **Increased Focus on Practical Applications:** Strengthening partnerships with industry to work on real-world problems and develop practical, scalable solutions. Tailoring deep learning research and projects to specific domains such as healthcare, finance, autonomous systems, and environmental monitoring.
- ❖ **Enhanced Data Handling and Management:** Developing methods to handle and process large-scale datasets efficiently, including techniques for distributed computing and cloud-based solutions. Utilizing synthetic data generation to overcome challenges related to data scarcity and privacy concerns.
- ❖ **Innovation in Model Training and Optimization:** Leveraging AutoML tools to automate the process of model selection and hyperparameter tuning. Exploring federated learning to train models across decentralized data sources while preserving data privacy.
- ❖ **Educational Advancements:** Continuously updating the lab curriculum to include the latest advancements in deep learning and related fields. Incorporating new and diverse projects that reflect current trends and real-world challenges in deep learning.

7th Semester	Project Work (PW) MAJOR PROJECT PHASE-II	M23BCI707
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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.

3. 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
M23BCI707.1	Successfully execute the project plan and achieve the defined objectives.
M23BCI707.2	Analyze and interpret experimental data to derive meaningful conclusions.
M23BCI707.3	Demonstrate the ability to apply engineering and management principles effectively within a team, managing project timelines, resources, and deliverables to achieve project goals.
M23BCI707.4	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
M23BCI707.1			3		3				3		3		3	3
M23BCI707.2	3	3		3		3					3		3	3
M23BCI707.3			3				3						3	3
M23BCI707.4								3		3	3	3	3	3
M23BCI707	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 endeavors, and professional roles in engineering.

8th 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.

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

8th 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