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MAHARAJA INSTITUTE OF TECHNOLOGY MYSORE

Autonomous Institution Affiliated to VTU

Competency Based Syllabus (CBS)
for

Electronics and Communication Engineering

(Under Outcome Based Education (OBE) and

Choice-Based Credit System (CBCS))

Offered from 7th to 8th Semesters of Study
in

Partial Fulfillment for the Award of Bachelor's Degree in

Electronics and Communication Engineering

2023 Scheme

Scheme Effective from the academic year 2023-24

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7th Semester	Professional Course (PC) TECHNICAL INNOVATION AND MANAGEMENT ENTREPRENEURSHIP (TIME)	M23BEC701

1. Prerequisites

S/L	Proficiency	Prerequisites
1	Communication skills:	• Effective communication is crucial for building relationships with customers, investors, and team members. • Employ effective communication skills to ensure clear dissemination of information and instructions.
2	Creativity and innovation:	• The ability to think outside the box and generate new ideas is essential. • Ability to generate innovative ideas and solutions to address market needs and challenges.
3	Strong foundation in STEM:	• A solid understanding of science, technology, engineering, and mathematics is essential for developing innovative solutions.
4	Teamwork:	• Collaboration and the ability to work effectively with others are essential for success. • Capability to inspire, motivates, and guides the project team towards achieving project goals.

2. Competencies

S/L	Competency	KSA Description
1	Planning and Management	**Knowledge:** This involves understanding industry-specific information, best practices, and organizational processes. It includes awareness of market trends, regulations, and strategic frameworks. Effective managers need to continually update their knowledge to make informed decisions and anticipate future challenges. **Skills:** Assign tasks and projects based on the specific skills of to maximize efficiency and effectiveness. **Attitudes:** Encourage attitudes that promote teamwork, collaboration, and effective conflict resolution
2	Different Functions of Management	**Knowledge:** Apply knowledge of resource management to allocate human and material resources effectively. Use knowledge of motivational strategies to inspire and engage team members. Apply knowledge of quality control standards to ensure outputs meet required specifications. **Skills:** Analyze organizational needs and processes to optimize structure and efficiency. Engage interpersonal skills to build rapport and trust with team members. Apply problem-solving skills to address deviations and implement corrective actions. **Attitudes:** Promote a collaborative attitude to encourage teamwork and shared responsibilities. Maintain a positive attitude to motivate and uplift the team. Encourage an attitude of accountability to ensure responsibility for performance and outcomes.
3	Social Responsibilities and Entrepreneurship	**Knowledge:** Knowledge of various business models and their applicability to different industries and markets. Proficiency in financial planning, budgeting, and funding strategies to ensure business viability. **Skills:** Ability to develop and implement strategic CSR initiatives that align with the company's goals and values. Ability to generate innovative ideas and solutions to address market needs and challenges. **Attitudes:**

		A strong ethical compass to prioritize social and environmental considerations in business decisions. Determination to overcome obstacles and persist through challenges.
4	Project Management	**Knowledge:** Knowledge of financial planning, budgeting, and cost management to ensure projects stay within financial constraints. Knowledge of tools like Microsoft Project, Asana, Trello, Jira, or other project management software to plan, execute, and monitor projects. **Skills:** Ability to create detailed project plans, set timelines, and allocate resources effectively. Critical thinking skills to evaluate options and choose the best course of action. **Attitudes:** A strong commitment to project goals and a dedication to seeing the project through to completion. Flexibility to adapt to changing project requirements, unexpected challenges, and new information.
5	Business plans and Institutions supporting Business opportunities	**Knowledge:** Understanding the regulatory framework, market trends, and economic conditions affecting MSMEs. Awareness of central and state government schemes, subsidies, grants, and financial assistance programs available for MSMEs **Skills:** Skills in writing proposals to secure grants and funding from central government programs. Ability to build relationships with state government officials, industry associations, and other stakeholders. **Attitudes:** A long-term perspective on creating sustainable business practices and development outcomes. Openness to collaborate with NGOs and other stakeholders to achieve common goals.

3. Syllabus

TECHNICAL INNOVATION AND MANAGEMENT ENTREPRENEURSHIP SEMESTER – VII			
Course Code	**M23BEC701**	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. Understand basic skills of Management
2. Understand the need for Entrepreneurs and their skills
3. Identify the Management functions and Social responsibilities.
4. Understand the identification of Business, drafting the Business plan and sources of funding.
5. Discuss Project selection, classification and design process.

Module -1

Management: Nature and Functions of Management –Importance, Definition, Management Functions, Levels of Management, Roles of Manager, Managerial Skills, Management & Administration.
Planning: Planning-Nature, Importance, Types, Steps and Limitations of Planning; Decision Making – Meaning, Types and Steps in Decision Making. Management as a Science, Art &Profession.

Module -2

Organizing and Staffing: Organization-Meaning, Characteristics, Process of Organizing, Principles of Organizing, Departmentalization, Committees– Meaning, Types of Committees and Responsibility; Staffing-Need and Importance, Recruitment and Selection Process.
Directing and Controlling: Meaning and Requirements of Effective Direction; Motivation-Nature of Motivation; Motivation Theories (Maslow's Need- Hierarchy Theory and Herzberg's Two Factor Theory); Communication – Meaning, Importance and Purposes; Leadership-Meaning, Characteristics, Behavioral Approach of Leadership; Controlling – Meaning, Need for Control System, Benefits of Control, Steps in Control Process. Coordination-Meaning, Types, Techniques.

Module -3

Social Responsibilities of Business: Meaning of Social Responsibility, Social Responsibilities of Business towards Different Groups, Social Audit, Business Ethics and Corporate Governance.
Entrepreneurship: Definition of Entrepreneur, Importance of Entrepreneurship, concepts of Entrepreneurship, Characteristics of successful Entrepreneur, Classification of Entrepreneurs,

Entrepreneurial Development models, Entrepreneurial development cycle. Problems faced by Entrepreneurs.
Module -4
Projects Management: A Project, Search for a Business idea: Introduction, Choosing an Idea, Product Innovation, Product Planning and Development Strategy & Development Process. Concepts of Projects and Classification: Meaning, Characteristics of a Project, Project Levels and Classification, The project Cycle, Features and Phases of Project management. **Project Design and Network Analysis:** Introduction, Importance of Network Analysis, Origin of PERT and CPM, Network Techniques, need for Network Techniques, Steps in PERT, CPM, Advantages & Limitations. Project Formulation: Meaning, Steps in Project formulation, Project Evaluation.
Module -5
Business plans: Introduction, purpose of a Business plan, contents of a Business plan, presenting a Business plan, why do some Business plans fail? Procedure for setting up an Enterprise. **Institutions supporting Business opportunities:** Central level institutions- National Board for micro, small & medium Enterprises(NBMSME), MSME-DO, National Small Industries Corporation. State level institutions- state Directorate Industries and commerce, District Industries Centres, state financial Corporations, State Industrial Development Corporation. (SIDC), State Industrial Area Development Board (SIADB). Other Institutions - NABARD, Technical consultancy organisation (TCO), Small Industries Development Bank of India(SIDBI), Export Promotion Councils, Nongovernmental Organisations.
TEXTBOOKS: 1. Principles of Management– P.C Tripathi, P.N. Reddy, McGraw Hill Education, 6thEdition, 2017. ISBN-13:978-93-5260-535-4. 2. Entrepreneurship Development Small Business Enterprises-Poornima M Charantimath, Pearson Education 2008, ISBN 978-81-7758-260-4. 3. Dynamics of Entrepreneurial Development and Management by Vasant Desai. HPH 2007, ISBN: 978-81-8488-801-2. **REFERENCE BOOKS:** 1. Essentials of Management: An International, Innovation and Leadership perspective by Harold Koontz, Heinz Weihrich McGraw Hill Education, 10th Edition 2016. ISBN- 978-93-392-2286-4. VIDEO LINKS: 1. https://nptel.ac.in/courses/110107094 2. https://nptel.ac.in/courses/110106141 3. https://nptel.ac.in/courses/122106031 Activity Based Learning (Suggested Activities in Class)/ Practical Based learning • Industrial visit • Group discussion • Role play • Think pair share activity

4. Syllabus Timeline

S/L	Syllabus Timeline	Description
1	Week 1-3: Management and Planning	Understand the fundamental concepts of Management and its functions. To know the basic skills of Management and managerial skills.
2	Week 4-6: Functions of Management	Understand the different functions to be performed by managers/Entrepreneur such as organizing, staffing, directing and controlling.
3	Week 8-11: Social Responsibilities and Entrepreneurship	Understand and classify the different Social Responsibilities of Business. Understand the Concepts of Entrepreneurship and the need for Entrepreneurs and their skills
4	Week 7-8: Project Management	Discuss Project selection, classification and design process and also to Exhibit the knowledge on the concepts of Management and Entrepreneurship using various individual and team activities.
5	Week 9-12: Business plans and Institutions supporting Business opportunities	Understand the Concepts to identify Business opportunities and also the components in developing a business plan and awareness about various sources of funding and Institutions supporting Entrepreneur.

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 Management 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	Management and Planning	To understand the Nature and Functions of Management, Management Functions, Levels of Management, Roles of Manager, Managerial Skills, Management & Administration. To know Nature, Importance, Types, Steps and Limitations of Planning and decision Making.
2	Functions of Management	To understand the Process of Organizing, Departmentalization, Committees, Staffing, Recruitment and Selection Process. To know the concepts of Directing and Controlling, Motivation, Motivation Theories, and Communication.
3	Social Responsibilities and Entrepreneurship	To understand Leadership, Coordination, Types, Techniques of Coordination, Controlling, and Social Responsibilities of Business. To know the concepts of Entrepreneurship and types of Entrepreneurs.
4	Project Management	To understand, Product Innovation, Product Planning and Development Strategy & Development Process. To know Project Design and Network Analysis.
5	Business plans	To understand the purpose of a business plan, the contents of a Business plan, presenting a Business plan, Procedure for setting up an Enterprise.
6	Institutions supporting Business opportunities	To understand Central-level institutions, MSME, state-level institutions, other institutions, and non-governmental organisations.

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

Course Outcomes (COs)

Cos	Description
M23BEC701.1	**Understand** the fundamental concepts of management, functions, roles and skills of managers
M23BEC701.2	**Understand** the concepts of organizing, staffing, nature of directing, and steps in controlling,
M23BEC701.3	**Understand** the the leadership concepts and social responsibilities of business and entrepreneurship.
M23BEC701.4	**Exhibit** the knowledge on the concepts of Management and Entrepreneurship using

	Various individual and team activities.
M23BEC701.5	**Present** the comprehension of the concepts in business opportunities and components in developing a business plan and awareness about various sources of funding and institutions supporting entrepreneur.

CO-PO-PSO Mapping

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
M23BEC701.1	-	-	-	-	-	-	3	2	3	-	3	-	-	-
M23BEC701.2	-	-	-	-	-	-	3	2	3	-	-	-	-	-
M23BEC701.3	-	-	-	-	-	-	3	2	3	-	-	-	-	-
M23BEC701.4	-	-	-	-	-	-	3	2	3	-	-	-	-	-
M23BEC701.5	-	-	-	-	-	-	3	2	3	3	3	-	-	-
M23BEC701	**-**	**-**	**-**	**-**	**-**	**-**	**3**	**2**	**3**	**3**	**2**	**-**	**-**	**-**

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 and Machine Learning: The development and application of AI and ML will continue to revolutionize industries. Entrepreneurs will find immense potential in creating AI-powered solutions for various sectors like healthcare, finance, and transportation.
- Space Exploration: With increasing private sector involvement in space exploration, there will be a growing need for technical expertise and entrepreneurial drive to develop innovative space technologies.
- Virtual and Augmented Reality: These technologies are transforming various industries, from gaming and entertainment to education and training. Entrepreneurs can explore new applications and user experiences in these domains.
- Biotechnology and Healthcare: Advancements in biotechnology hold immense promise for improving human health and well-being. This sector will offer opportunities for innovation in drug development, medical devices, and personalized medicine.
- Industry 4.0: The convergence of physical and digital technologies will create opportunities for innovative solutions in manufacturing, supply chain management, and logistics.
- Digital Health: The use of technology to improve healthcare delivery and patient outcomes will be a major growth area.
- FinTech: Financial technology is disrupting traditional banking and financial services. There will be continued opportunities for innovation in payments, lending, and investment.

7th Semester	Integrated Professional Core Course (IPC) MICROWAVE AND ANTENNA	M23BEC702

1. Prerequisites

S/L	Proficiency	Prerequisites
1	Basic Understanding of Electromagnetic Theory	Knowledge of basic concepts in electromagnetic fields, such as electric and magnetic fields, and wave propagation.
2	Fundamentals of Transmission Lines	Basic understanding of transmission lines, including what they are and how they work.
3	Introduction to Microwave Components	Familiarity with simple microwave components like waveguides and cavities, and their basic uses.
4	Basic Problem-Solving Skills	Ability to solve basic engineering problems using mathematics and physics principles.
5	Basic Microwave Circuit Concepts	Awareness of simple microwave circuits, like filters and amplifiers, and their basic characteristics.

2. Competencies

	Competency	KSA Description
1	Application of Electromagnetic Principles	**Knowledge:** Understand how basic electromagnetic principles apply to real-world communication systems. **Skills:** Use these principles to solve practical problems related to signal propagation and system design. **Attitudes:** Recognize the relevance of electromagnetic theory in designing effective communication systems.
2	Designing and Analyzing Transmission Lines	**Knowledge:** Learn to calculate and optimize transmission line parameters for efficient signal transfer. **Skills:** Design transmission lines and use matching techniques to minimize signal loss. **Attitudes:** Appreciate the importance of proper design and matching for signal integrity.
3	Practical Use of Microwave Components	**Knowledge:** Identify and understand the function of key microwave components in circuits. **Skills:** Use these components effectively in basic microwave system designs. **Attitudes:** Value the role of each component in ensuring proper system operation and performance.
4	Antenna Design and Optimization	**Knowledge:** Understand how different types of antennas are designed for specific applications. **Skills:** Design and optimize antennas based on requirements for gain, directivity, and radiation patterns. **Attitudes:** Recognize the significance of antenna performance in communication efficiency.
5	Application of Microwave and Antenna Technologies	**Knowledge:** Learn about real-world applications of microwave and antenna technologies in various fields. **Skills:** Apply theoretical knowledge to solve practical problems and optimize designs for specific applications. **Attitudes:** Show interest in advancing technology and its applications in communication systems.

3. Syllabus

MICROWAVE and ANTENNA SEMESTER–VII			
Course Code	**M23BEC702**	CIE Marks	**50**
Number of Lecture Hours/Week(L: T: P: S)	**3:0:2:0**	SEE Marks	**50**
Total Number of Lecture Hours	**40hr theory+10 hr Lab**	Total Marks	**100**
Credits	**04**	Exam Hours	**03**
Course Objectives: Describe the use and advantages of microwave transmission			

Analyze various parameters related to microwave transmission lines and waveguides Identify microwave devices for several applications Analyze various antenna parameters necessary for building a RF system Recommend various antenna configurations according to the applications. Analysis to design strong and safe structures.
Module -1
Microwave Transmission Lines: Microwave Frequencies, Microwave devices, Microwave Systems, Transmission Line equations and solutions, Reflection Coefficient and Transmission Coefficient, Standing Wave and Standing Wave Ratio, Smith Chart, Single Stub matching.(Except Double stub matching)
Module -2
Microwave sources: Introduction: Gunn diode. Reflex Klystron Oscillator. **Microwave Network theory:** Introduction, Symmetrical Z and Y-Parameters for reciprocal Networks, S matrix representation of Multi-Port Networks.
Module -3
Microwave Passive Devices: Coaxial Connectors and Adapters, Attenuators, Phase Shifters, Waveguide Tees, Magic tee, circulators and Isolators. **Strip Lines:** Introduction, Micro Strip lines.
Module -4
Antenna Basics: Introduction, Basic Antenna Parameters, Patterns, Beam Area, Radiation Intensity, Beam Efficiency, Directivity and Gain, Antenna Apertures, Effective Height, Radio Communication Link, Antenna Field Zones. **Electric Dipoles:** Introduction, Short electric dipole, Fields of Short electric dipole, Radiation resistance of a short electric dipole.
Module -5
Loop and Horn Antenna: Introduction, Small loop, The Loop Antenna General Case, The Loop Antenna as a special case, Radiation resistance of loops, Horn antennas, Rectangular Horn Antennas. **Antenna Types:** The Helix geometry, Helix modes, Helical Antenna, Yagi-Uda array, Parabolic Reflector.
TEXTBOOKS: 1. Microwave Engineering – Annapurna Das, Sisir K Das, TMH, Publication, 2nd, 2010. 2. Microwave Devices and circuits- Samuel Y Liao, Pearson Education Antennas and Wave Propagation- John D. Krauss, Ronald J Marhefka, Ahmad S Khan, 4 th Edition, McGraw Hill Education, 2013 **REFERENCE BOOKS:** 1. Microwave Engineering - David M Pozar, John Wiley India Pvt. Ltd., 3rd Edn, 2008. 2. Microwave Engineering – Sushrut Das, Oxford Higher Education, 2ndEdn, 2015 Antennas and Wave Propagation – Harish and Sachidananda: Oxford University Press, 2007

PRACTICAL COMPONENT OF IPCC	
1.	Study of characteristics of Magic Tee
2.	Coupling and Isolation characteristics of microstrip directional coupler
3.	Determination of power division of microstrip power divider
4.	Measurement of frequency, guide wavelength, power and attenuation in a microwave Test bench
5.	Study of characteristics of E plane Tee / H plane Tee.
6.	To measure unknown impedance using Smith chart through test bench setup
7.	Measurement of VSWR and reflection coefficient and attenuation in a microwave test bench setup.
8.	Obtain the radiation pattern of a Yagi-Uda Antenna array and calculate its directivity.
9.	Calculate the aperture of a Dipole Antenna.
10.	Obtain the near and far fields of a given antenna and compare the fields
11.	Open ended experiment- To measure the S-parameters of a reciprocal device, the reflection co-efficient, and standing wave ratio.

4. Syllabus Timeline

S/L	Syllabus Timeline	Description
1	Week 1-2: Microwave Basics	Understand the fundamental concepts of microwave communication. Grasp the advantages and uses of microwaves in communication. Identify microwave components and systems.
2	Week 3-5: Transmission Lines	Analyze various microwave transmission lines and waveguides. Understand the behavior and properties of transmission lines. Solve problems related to impedance, reflection, and standing

		waves.
3	Week 6-8: Microwave Devices	Identify and evaluate microwave devices for specific applications. Study various microwave devices such as isolators, circulators, and directional couplers.
4	Week 9-10: Antenna Theory	Analyze various antenna parameters and configurations. Understand antenna basics, radiation patterns, and antenna arrays.
5	Week 11-12: Microwave System Applications	Explore the application of microwave engineering in radar, satellite, and wireless communication systems. Explain theoretical concepts to real-world microwave system design and optimization.

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

6. Assessment Details (both CIE and SEE)

Continuous Internal Evaluation:

Formative, Summative and other Assessments shall be conducted as per the Institution's calendar of events in all the courses of the programme offered to the students, within the framework of the Scheme of Teaching and Evaluation.

Assessments and Evaluation Process:

A	**Continuous Internal Evaluation (CIE)**	**25 marks**
B	**Internal Assessment Tests (IAT)**	**25 marks**
Total of CIE (A+B)		**50 marks**
C	**Semester End Examination (SEE)**	**50 marks**
Total of CIE and SEE (A+B+C)		**100 marks**

CIE Split up for Integrated Professional Core Course (IPC)

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

Final CIE Marks = (A) +(B)

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 Microwave Fundamentals	Students will understand the core concepts of microwave frequencies, wave propagation, and the advantages of microwave communication.
2	Analyze Microwave Transmission Lines and Waveguides	Students will be able to analyze the behavior and characteristics of microwave transmission lines and waveguides, including impedance, reflection, and standing waves.
3	Microwave Device Applications	Students will be able to identify, evaluate, and apply microwave devices like isolators, circulators, and directional couplers in various communication systems.
4	Antenna Design and Analysis	Students will be able to design, analyze, and optimize antennas, understanding key parameters such as gain, directivity, radiation patterns, and bandwidth.
5	Integration of Microwave Systems	Students will be able to integrate microwave concepts into practical applications, including radar, satellite, and wireless communication systems, and understand emerging trends in microwave technology.

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

Course Outcomes (COs)

COs	Description
M23BEC702.1	**Understand** the fundamental principles of microwaves, microwave generation, transmission lines, strip lines and antennas.
M23BEC702.2	**Apply** basic concepts of microwave engineering to calculate various parameters related to microwave transmission lines, Passive devices and antennas.
M23BEC702.3	**Compute** various parameters for impedance matching using smith chart and various types of antennas.
M23BEC702.4	**Analyze** the behaviour of Klystron generator, transmission lines, and microwave devices like waveguide tees, attenuators, phase shifters and antenna parameters for suitable applications

CO-PO-PSO Mapping

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
M23BEC702.1	3	2	2	-	2	-	-	-	-	-	-	-	3	-
M23BEC702.2	2	3	2	-	2	-	-	-	-	-	-	-	-	3
M23BEC702.3	2	-	3	3	-	-	-	-	-	-	-	-	3	-
M23BEC702.4	2	2	-	3	2	-	-	-	-	-	-	-	-	3
M23BEC702	**2.25**	**1.75**	**1.75**	**3**	**2**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**3**	**3**

9. Assessment Plan

Continuous Internal Evaluation (CIE)

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

Semester End Examination (SEE)

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

10. Future with this Subject:

- The "Microwave and Antenna" course prepares students for a future where they can contribute to advanced communication systems, radar technology, and various high-frequency applications. This course equips students with the knowledge, skills, and attitudes needed to excel in the rapidly evolving fields of microwave engineering and antenna design.
- Future Trends in Microwave and Antenna Engineering
- 5G and Beyond: Focus: High-frequency communication and advanced antenna technologies.

- Applications: Designing antennas for 5G networks and improving data rates and network capacity.
- Satellite Communication: Focus: Satellite systems and antennas. Applications: Enhancing satellite constellations and high-performance communication.
- Microwave Imaging and Sensing: Focus: Microwave-based imaging technologies. Applications: Medical imaging, security screening, and environmental monitoring.
- Radar Technology: Focus: Radar systems and components. Applications: Aviation, automotive safety, and military applications.

7th Semester	Professional Course (PC) WIRELESS COMMUNICATION	M23BEC703

1. Prerequisites

S/L	Proficiency	Prerequisites
1	Basic Electronics and Digital Logic	Familiarity with digital logic fundamentals, including binary numbers, logic gates, flip-flops, and state machines and requirements of basic electronics fundamentals
2	Fundamentals of signals	Basic knowledge of signal transmission between the transmitter and the receiver
3	Basics of Digital Communication	Basic knowledge of Spectrum mechanism in the circuits.
4	Fundamentals of protocols	Basics of different protocols are required
5	Microcontroller Fundamentals	Basic knowledge of what microcontrollers , their architecture, and how they are used .

2. Competencies

S/L	Competency	KSA Description
1	Mobile Communication Engineering	**Knowledge:** Mobile Communication Engineering requires a deep understanding of various concepts related to wireless communication, signal processing, and telecommunications infrastructure. Here are the key areas of knowledge **Skills:** Communication Engineers require a combination of technical, analytical, and problem-solving skills to design, develop, and maintain mobile communication systems **Attitudes:** Mobile communication technologies evolve rapidly. Engineers must stay updated on the latest standards and be willing to learn new tools, techniques, and methodologies
2	Multiple Access Techniques	**Knowledge:** Multiple access techniques are fundamental in allowing multiple users or devices to share the same communication resources efficiently, without interference. A deep understanding of these techniques is essential for communication systems engineers **Skills:** To design and implement multiple access systems, an engineer requires both theoretical and practical skills **Attitudes:** Wireless communication technology is rapidly evolving. Engineers should have a constant curiosity and motivation to stay updated on emerging multiple access technologies
3	Global System for Mobile (GSM)	**Knowledge:** To work effectively with the Global System for Mobile Communications (GSM), engineers must understand its architecture, protocols, and technologies **Skills:** Working with GSM requires practical and technical skills in network design, optimization, and troubleshooting. **Attitudes:** GSM systems are complex, requiring careful attention to detail in planning, designing, and troubleshooting to avoid disruptions and optimize performance
4	CDMA Digital Cellular Standards	**Knowledge**: CDMA (Code Division Multiple Access) is a widely used multiple access technology in wireless communications that allows multiple users to share the same frequency band by assigning unique codes to each user. Understanding CDMA requires a deep knowledge of its principles, architecture, and applications **Skill**: Skills in designing and deploying CDMA networks, including base station placement, power control planning, and ensuring optimal coverage and capacity **Attitudes**: CDMA systems require precise code assignment, power control, and interference management. A meticulous and detail-oriented approach is necessary to avoid errors that could lead to performance degradation or security vulnerabilities
5	Wireless Network Technologies	**Knowledge:** An Understanding wireless network technology involves grasping their fundamental concepts, architectures, protocols, and applications. **Skill:** Proficiency in designing wireless networks, considering coverage, capacity, and user requirements.

		Attitudes: Wireless networks are sensitive to small changes in configuration, placement, and environmental factors. Engineers need a detail-oriented approach to ensure optimal performance and minimize interference

3. Syllabus

WIRELESS COMMUNICATION SEMESTER – VII			
Course Code	**M23BEC703**	CIE Marks	**50**
Number of Lecture Hours/Week(L: T: P: S)	**4:0:0:0**	SEE Marks	**50**
Total Number of Lecture Hours	**50 hour theory**	Total Marks	**100**
Credits	**04**	Exam Hours	**03**

Course Objectives:

1. Understand the concepts of propagation over wireless channels from a physics standpoint.
2. Understand the multiple access techniques used in cellular communications standards.
3. Application of Communication theory both Physical and networking to understand GSM systems that handle mobile telephony.
4. Application of Communication theory both Physical and networking to understand CDMA systems that handle mobile telephony.

Module -1

Mobile Communication Engineering: Wireless Network generations, Basic propagation Mechanisms, Mobile radio Channel.
Principles of Cellular Communications: Cellular terminology, Cell structure and Cluster, Frequency reuse concept, Cluster size and system capacity, Frequency Reuse Distance, Cochannel Interference and signal quality.

Module -2

Multiple Access Techniques: FDMA, TDMA, CDMA, SDMA, Hybrid Multiple Access Techniques, Multicarrier Multiple Access Schemes.
A Basic Cellular System: A basic cellular system connected to PSTN, Parts of basic cellular system, Operation of a cellular system.

Module -3

Global System for Mobile (GSM): GSM Network Architecture, GSM signalling protocol architecture, Identifiers used in GSM system, GSM Channels, Frame structure for GSM, GSM Call procedures, GSM hand-off Procedures, GSM Services and features.

Module -4

CDMA Digital Cellular Standards: The Concept of Spread Spectrum, Architecture of CDMA System, CDMA Air Interface, The IS-95 CDMA Forward Channels, The IS-95 CDMA Reverse Channels.

Module -5

Wireless Network Technologies: IEEE 802.11 WLAN Technology, IEEE 802.15 WPAN Technology, IEEE 802.16 WMAN Technology, Mobile Ad-hoc Networks (MANETs), Wireless Sensor Networks (WSNs)

TEXTBOOKS:

1. T L Singal, Wireless Communications, McGraw Hill Education (India) Private Limited, 2016, ISBN: 0 07-068178-3.
2. Theodore Rappaport, Wireless Communications: Principles and Practice, 2nd Edition, Prentice Hall Communications Engineering and Emerging Technologies Series, 2002, ISBN 0-13-042232

REFERENCE BOOKS:

1. Gary Mullet, Introduction to Wireless Telecommunications Systems and Networks, First Edition, Cengage Learning India Pvt Ltd., 2006, ISBN - 13: 978-81-315-0559-5.

3. Syllabus Timeline

S/L	Syllabus Timeline	Description
1	Week 1-2: Mobile Communication Engineering	Introduction to basic propagation mechanisms, radio channels, cellular terminology, cellular cluster, cellular reuse, frequency reuse and cochannel interference.
2	Week 3-5: Multiple Access Techniques	Studying about frequency division multiple access, time division multiple access, code division multiple access, and the basics of the public switch telephone network.

3	Week 6-8: Global system for mobile communication	Studying about the GSM network and architecture and the protocols involved in and the GSM signaling, GSM frames and handoff procedures.
4	Week 9-10: Code division multiple access	Studying about network architecture, CDMA air interface mechanism and the interim standards of forward and reverse logical channels
5	Week 9-10: Wireless network technologies	Understanding about various protocols and the network architecture WLAN, wireless sensor networks, mobile ad hoc networks.

4. 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 wireless protocols architecture
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	Laboratory Learning	Utilize the facilities available in the laboratories to understand the behavior of signal propagation.

5. Assessment Details (both CIE and SEE)

Continuous Internal Evaluation:

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

A	Continuous Internal Evaluation(CIE)	25marks
B	Internal Assessment Tests(IAT)	25marks
Total of CIE (A+B)		50marks
C	Semester End Examination(SEE)	50marks
Total of CIE and SEE(A+B+C)		100marks

Continuous Internal Evaluation (CIE)

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

CIE Split up for Professional Course(PC)

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 2tests conducted.

Semester End Examinations

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 2question 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 answer5 full questions selecting one full question from each module.

6. Learning Objectives

S/L	Learning Objectives	Description
1	Mobile Communication Engineering	Understand the basic principles of mobile communication, comprehend the architecture of cellular networks, including cells, clusters, frequency reuse, and the concept of handoff.
2	Multiple Access Techniques	Understand the basic principles of multiple access techniques, including how they allow multiple users to share a limited communication resource efficiently

3	Global system for mobile communication	Understand the historical context and development of GSM as a 2G mobile communication standard, Understand the overall architecture of a GSM network, including its main components: Mobile Station (MS), Base Station Subsystem (BSS), Network and Switching Subsystem (NSS), and Operation and Support System (OSS)
4	Code division multiple access	Understand the basic principles of CDMA and how it differs from other multiple access techniques like FDMA and TDMA
5	Wireless network technologies	Learn about the different types of wireless networks, including Personal Area Networks (PAN), Local Area Networks (LAN), Metropolitan Area Networks (MAN), and Wide Area Networks (WAN)

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

Course Outcomes (COs)

COs	Description
M23BEC703.1	**Present** the concepts of propagation mechanism & cellular concept over wireless channels.
M23BEC703.2	**Apply** the concept of communication theory associated with multiple access techniques for the wireless network
M23BEC703.3	**Develop** a scheme for handling the calls in GSM& CDMA cellular network.
M23BEC703.4	**Analyze** the operation of different wireless network technologies such as wireless land area network, Mobile ad hoc networks, and wireless sensor networks.

CO-PO-PSO Mapping

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
M23BEC703.1	3	-	-	-	-	-	-	-	-	-	-	-	3	-
M23BEC703.2	-	3	-	-	-	-	-	-	-	-	-	-	3	-
M23BEC703.3	-	3	-	-	-	-	-	-	-	-	-	-	3	-
M23BEC703.4	-	-	3	-	-	-	-	-	-	-	-	-	3	-
M23BEC703	**3**	**3**	3	-	-	-	-	-	-	-	-	-	3	-

8. 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**	**20**	**10**	**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**	**40**	**20**	**100**

9.Future with this Subject:

Internet of Things (IoT) Expansion: Connectivity: The proliferation of IoT devices will require seamless wireless connectivity, leading to advancements in low-power wide-area networks (LPWAN) and technologies like NB-IoT and LoRaWAN **Smart Cities**: Wireless communication will play a crucial role in developing smart cities, enabling smart transportation, energy management, public safety, and more efficient urban services

Development of 6G; Emerging Technology: Research and development of 6G networks are already underway, with expectations of rollout around 2030.

Enhanced Wireless Security: i**ncreased Threat Awareness**: As wireless communication expands, security threats will also increase, necessitating robust security measures and protocols

Satellite Communication: Advances in satellite technology, including Low Earth Orbit (LEO) satellites, will enable global high-speed internet coverage, especially in remote and underserved areas.

7th Semester	Professional Elective -III (PE -III) DIGITAL IMAGE PROCESSING	M23BEC704A

1. Prerequisites

S/L	Proficiency	Prerequisites
1	Mathematics	• Calculus (I and II) • Linear Algebra • Probability and Statistics
2	Signal Processing	• Understanding of signal processing concepts (e.g., Fourier transforms, filtering)
3	Digital Signal Processing	• Familiarity with DSP concepts (e.g., sampling, quantization, convolution)

2. Competencies

S/L	Competency	KSA Description
1	Knowledge on Fundamentals of image processing	**Knowledge:** Understanding of image representation, formats, and compression techniques **Skills:** Ability to read, write, and manipulate image files **Attitude:** Appreciation for the importance of image data in various applications
2	Image Enhancement	**Knowledge:** Understanding of image enhancement techniques (e.g., filtering, histogram equalization) **Skills:** Ability to implement image enhancement algorithms using software tools (e.g., MATLAB, Open CV) **Attitude:** Critical thinking to evaluate the effectiveness of enhancement techniques
3	Image Filtering	**Knowledge:** Understanding of spatial and frequency domain filtering techniques **Skills:** Ability to design and implement filters using software tools **Attitude:** Analytical thinking to analyze filter performance
4	Image Transforms	**Knowledge:** Understanding of image transforms (e.g., Fourier, DCT, Wavelet) **Skills:** Ability to apply transforms using software tools **Attitude:** Appreciation for the role of transforms in image analysis
5	Image Segmentation	**Knowledge:** Understanding of segmentation techniques (e.g., thresholding, edge detection) **Skills:** Ability to implement segmentation algorithms using software tools **Attitude:** Critical thinking to evaluate segmentation results
6	Image Compression	**Knowledge:** Understanding of image compression techniques (e.g., lossless, lossy) **Skills:** Ability to implement compression algorithms using software tools **Attitude:** Critical thinking to evaluate compression trade-offs
7	Project Development	**Knowledge:** Understanding of DIP concepts and techniques **Skills:** Ability to design, implement, and evaluate a DIP project **Attitude:** Creativity, critical thinking, and problem-solving skills to tackle real-world image processing challenges.

3. Syllabus

DIGITAL IMAGE PROCESSING SEMESTER – VII			
Course Code	**23BEC704A**	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: The objectives of this course are to:

1. Understand the fundamentals of digital image processing
2. Understand the image transform used in digital image processing
3. Understand the image enhancement techniques used in digital image processing
4. Understand the image restoration techniques and methods used in digital image processing
5. Understand the Morphological Operations and Segmentation used in digital image processing

Module -1

Introduction: What is Digital Image Processing? Origins of Digital Image Processing, Examples of fields that use DIP, Fundamental Steps in Digital Image Processing, Components of an Image Processing System, Elements of Visual Perception, Image Sensing and Acquisition, Image Sampling and Quantization, Some Basic Relationships Between Pixels, Linear and Nonlinear Operations.

Module -2
Spatial Domain: Some Basic Intensity Transformation Functions, Histogram Processing, Fundamentals of Spatial Filtering, Smoothing Spatial Filters, Sharpening Spatial Filters **Frequency Domain:** Preliminary Concepts, The Discrete Fourier Transform (DFT) of Two Variables, Properties of the 2-D DFT, Filtering in the Frequency Domain, Image Smoothing and Image Sharpening Using Frequency Domain Filters, Selective Filtering.
Module -3
Restoration: Noise models, Restoration in the Presence of Noise Only using Spatial Filtering and Frequency Domain Filtering, Linear, Position Invariant Degradations, Estimating the Degradation Function, Inverse Filtering, Minimum Mean Square Error (Wiener) Filtering, Constrained Least Squares Filtering.
Module -4
Color Image Processing: Color Fundamentals, Color Models, Pseudo color Image Processing. **Wavelets:** Background, Multi resolution Expansions. **Morphological Image Processing:** Preliminaries, Erosion and Dilation, Opening and Closing, The Hit-or-Miss Transforms, Some Basic Morphological Algorithms.
Module -5
Segmentation: Point, Line, and Edge Detection, thresholding, Region Based Segmentation, Segmentation Using Morphological Watersheds. **Representation and Description:** Representation, Boundary descriptors.
Text Book: Digital Image Processing- Rafel C Gonzalez and Richard E. Woods, PHI 3rd Edition 2010. **Reference Books:** 1. Digital Image Processing- S.Jayaraman, S.Esakkirajan, T.Veerakumar, Tata McGraw Hill 2014. 2. Fundamentals of Digital Image Processing-A. K. Jain, Pearson 2004.

4. Syllabus Timeline

S/L	Syllabus Timeline	Description
1	Week 1-3: Image fundamentals	What is Digital Image Processing? Origins of Digital Image Processing, Examples of fields that use DIP, Fundamental Steps in Digital Image Processing, Components of an Image Processing System, Elements of Visual Perception, Image Sensing and Acquisition, Image Sampling and Quantization, Some Basic Relationships Between Pixels, Linear and Nonlinear Operations
2	Week 4-6: Spatial Domain And Frequency Domain	Some Basic Intensity Transformation Functions, Histogram Processing, Fundamentals of Spatial Filtering, Smoothing Spatial Filters, Sharpening Spatial Filters Preliminary Concepts, The Discrete Fourier Transform (DFT) of Two Variables, Properties of the 2-D DFT, Filtering in the Frequency Domain, Image Smoothing and Image Sharpening Using Frequency Domain Filters, Selective Filtering. [Text: Chapter 3: Sections 3.2 to 3.6 and Chapter 4: Sections 4.2, 4.5 to 4.10]
3	Week 8-11: Restoration	Noise models, Restoration in the Presence of Noise only using Spatial Filtering and Frequency Domain Filtering, Linear, Position Invariant Degradations, Estimating the Degradation Function, Inverse Filtering, Minimum Mean Square Error (Wiener) Filtering, Constrained Least Squares Filtering.
4	Week 7-8: Color Image Processing Wavelets Morphological Image Processing	Color Fundamentals, Color Models, Pseudo color Image Processing. Background, Multi resolution Expansions. Preliminaries, Erosion and Dilation, Opening and Closing, The Hit-or-Miss Transforms, Some Basic Morphological Algorithms.
5	Week 9-12: Segmentation Representation and Description	Point, Line, and Edge Detection, Thresholding, Region Based Segmentation, Segmentation Using Morphological Watersheds. Representation, Boundary descriptors.

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 image processing 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	Laboratory Learning	Utilize the facilities available in the laboratories to understand the image processing concepts by simulating in MATLAB.

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	Image fundamentals	Understand the fundamentals of digital image processing
2	Image transformation	Understand the image transform used in digital image processing
3	Image restoration	Understand the image restoration techniques and methods used in digital image processing
4	Image enhancement	Understand the image enhancement techniques used in digital image processing
5	Morphology and segmentation	Understand the Morphological Operations and Segmentation used in digital image processing

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

Course Outcomes (COs)

COs	Description
M23BEC704A.1	**Explain** the fundamental concepts of digital image processing, image transformation, segmentation, restoration, morphological processing, feature extraction and color models.
M23BEC704A.2	**Apply** basic pixel relations, image enhancement, segmentation, restoration and morphological techniques on different images to solve image processing problems.
M23BEC704A.3	**Analyze** various image transformation techniques both in spatial and frequency domain for image enhancement.
M23BEC704A.4	**Implement** the various image processing algorithms for practical applications**.**

CO-PO-PSO Mapping

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
M23BEC704A.1	3	-	-	-	-	-	-	-	-	2	-	-	2	-
M23BEC704A.2	3	-	-	-	2	-	-	-	-	-	-	-	3	-
M23BEC704A.3	2	3	-	-	2	-	-	-	-	-	-	-	2	-

M23BEC704A.4	3	3	2	-	2	-	-	-	2	-	-	-	3	2
M23BEC704A	**2.66**	**3**	**2**	**-**	**2**	**-**	**-**	**-**	**2**	**2**	**-**	**-**	**2.5**	**2**

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:

By acquiring a strong foundation in Digital Image Processing, undergraduate students can unlock numerous career opportunities and applications in various fields The future with Digital Image Processing (DIP) for undergraduate students is promising. Here are some potential future directions:

- **Computer Vision**: DIP will play a crucial role in developing autonomous vehicles, robots, and drones.
- **Healthcare:** Medical imaging analysis, disease detection, and personalized medicine.
- **Surveillance**: Enhanced security systems, facial recognition, and object detection.
- **Virtual Reality (VR) and Augmented Reality (AR):** Immersive experiences, 3D modeling, and image-based rendering.
- **Artificial Intelligence (AI) and Machine Learning (ML):** Image data analysis, pattern recognition, and decision-making.
- **Remote Sensing:** Environmental monitoring, land cover classification, and natural resource management.
- **Quality Control:** Automated inspection, defect detection, and quality assessment.
- **Biometrics:** Fingerprint, iris, and facial recognition for secure authentication.
- **Digital Forensics**: Image tampering detection, forgery analysis, and digital evidence enhancement.

7th Semester	Professional Elective -III (PE -III) DEEP LEARNING	M23BEC704B

1. Prerequisites

S/L	Proficiency	Prerequisites
1	Mathematics:	• Understanding vectors, matrices, and operations on these (like matrix multiplication) is crucial. Concepts like eigenvalues and eigenvectors can also be important for more advanced topics. • Differentiation and integration are essential, particularly for understanding how back propagation works. Partial derivatives and gradient descent are key topics. • Basic concepts like probability distributions, expectation, variance, and statistical inference are useful for understanding various models and evaluating their performance.
2	Programming Skills	• Most neural network frameworks, like TensorFlow and PyTorch, are written in Python. Being comfortable with Python programming is essential. • Familiarize yourself with libraries such as NumPy (for numerical operations), Pandas (for data manipulation), and Matplotlib or Seaborn (for data visualization). Knowledge of deep learning frameworks like Tensor Flow or PyTorch is also important.
3	Neural Network Fundamentals	• Familiarity with concepts such as neurons, activation functions (e.g., ReLU, sigmoid, tanh), and basic network architectures (e.g., feed forward networks, convolutional networks) is necessary • Understanding different loss functions (e.g., mean squared error, cross-entropy) and their role in model training is crucial.
4	Machine Learning Fundamentals	• Understanding basic machine learning concepts, including supervised learning (e.g., classification, regression) and unsupervised learning (e.g., clustering, dimensionality reduction), is necessary for context. • Familiarity with concepts such as cross-validation, over fitting, under fitting, and metrics (e.g., accuracy, precision, recall, F1 score) is important for assessing model performance.

2. Competencies

S/L	Competency	KSA Description
1	Introduction to Deep Learning and Machine Learning Basics	**Knowledge:** Basic understanding of what neural networks are, including neurons, layers (input, hidden, output), and how they are structured. **Skills:** Ability to use deep learning frameworks to build and train models, including writing code for constructing neural networks, defining loss functions, and performing optimization. **Attitudes:** An attitude of experimenting with different models, algorithms, and techniques to find the best solution to a problem.
2	Feed forward Networks	**Knowledge:** Knowledge of various activation functions used in feed forward networks, such as ReLU, sigmoid, tanh, and their effects on network performance. **Skills:** Skills in writing clean, efficient code to build, train, and evaluate feed forward networks, including the use of libraries for data handling and model evaluation. **Attitudes:** A proactive approach to identifying and solving problems related to network training and performance.
3	Optimization for Training Deep Models and Algorithms with Adaptive Learning Rates	**Knowledge:** Understanding what the objective function (loss function) is and how it guides the training of deep learning models. **Skills:** Skills in tuning hyper parameters, such as learning rates and momentum coefficients, to optimize model training and performance. **Attitudes:**

		A focus on the details of the optimization process, including the careful adjustment of hyper parameters and monitoring of training metrics.
4	Convolution Networks	**Knowledge:** Understanding how convolution operations work, including kernels (filters), stride, padding, and how they detect features in input data. **Skills:** Ability to implement CNNs using deep learning frameworks like Tensor Flow, Keras, or PyTorch, including defining layers, specifying filters, and setting up the training process. **Attitudes:** An eagerness to stay updated with the latest research and advancements in CNNs and related technologies.
5	Recurrent and Recursive Neural Networks	**Knowledge:** Understanding the basic structure of RNNs, including their feedback loops and how they maintain state across time steps. **Skills:** Ability to implement RNNs, LSTMs, GRUs, and recursive networks using deep learning frameworks like Tensor Flow, Keras, or PyTorch. **Attitudes:** A focus on the details of model design and training processes, ensuring precision and effectiveness in handling sequential and hierarchical data.

3. Syllabus

DEEP LEARNING SEMESTER – VII			
Course Code	**M23BEC704B**	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. Understand the fundamentals of deep learning. Know the theory behind Convolution Neural Networks, Auto encoders, RNN.
2. Illustrate the strength and weaknesses of many popular deep learning approaches.
3. Introduce major deep learning algorithms, the problem settings, and their applications to solve real world problems.
4. Learn the open issues in deep learning, and have a grasp of the current research directions.

Module -1

Introduction to Deep Learning: Introduction, Deep learning Model, Historical Trends in Deep Learning.
Machine Learning Basics: Learning Algorithms, Supervised Learning Algorithms, Unsupervised Learning Algorithms.

Module -2

Feed forward Networks: Introduction to feed forward neural networks, Gradient-Based Learning, Back Propagation and Other Differentiation Algorithms. Regularization for Deep Learning.

Module -3

Optimization for Training Deep Models: Empirical Risk Minimization, Challenges in Neural Network Optimization, Basic Algorithms: Stochastic Gradient Descent, Parameter Initialization Strategies, **Algorithms with Adaptive Learning Rates**: The AdaGrad algorithm, The RMSProp algorithm, Choosing the Right Optimization Algorithm.

Module -4

Convolutional Networks: The Convolution Operation, 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- LeNet, AlexNet.

Module -5

Recurrent and Recursive Neural Networks: Unfolding Computational Graphs, Recurrent Neural Network, Bidirectional RNNs, Deep Recurrent Networks, Recursive Neural Networks, The Long Short-Term Memory and Other Gated RNNs.
Applications: Large-Scale Deep Learning, Computer, Speech Recognition, Natural Language Processing and Other Applications**.**

TEXTBOOKS:

1. Ian Goodfellow, YoshuaBengio, Aaron Courville, "Deep Learning", MIT Press, 2016.

2. Nikhil Buduma, "Fundamentals of Deep Learning: Designing Next-Generation Machine Intelligence Algorithms", O'Reilly publications.

REFERENCE BOOKS:

1. Bengio, Yoshua. "Learning deep architectures for AI." Foundations and trends in Machine Learning, 2009.
2. N.D. Lewis, "Deep Learning Made Easy with R: A Gentle Introduction for Data Science", January 2016.

VIDEO LINKS:

1. https://faculty.iitmandi.ac.in/~aditya/cs671/index.html
2. https://nptel.ac.in/courses/106/106/106106184/
3. https://www.youtube.com/watch?v=7x2YZhEj9Dw

4. Syllabus Timeline

S/L	Syllabus Timeline	Description
1	Week 1-2: Introduction to Deep Learning and Machine Learning Basics	Introduction, Deep learning Model, Historical Trends in Deep Learning. Learning Algorithms, Supervised Learning Algorithms, Unsupervised Learning Algorithms.
2	Week 3-4: Feed forward Networks	Introduction to feed forward neural networks, Gradient-Based Learning, Back Propagation and Other Differentiation Algorithms. Regularization for Deep Learning
3	Week 5-6: Optimization for Training Deep Models and Algorithms with Adaptive Learning Rates	Empirical Risk Minimization, Challenges in Neural Network Optimization, Basic Algorithms: Stochastic Gradient Descent, Parameter Initialization Strategies. The AdaGrad algorithm, The RMS Prop algorithm, Choosing the Right Optimization Algorithm.
4	Week 7-8: Convolutional Networks	The Convolution Operation, 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- LeNet, AlexNet.
5	Week 9-10: Recurrent and Recursive Neural Networks	Unfolding Computational Graphs, Recurrent Neural Network, Bidirectional RNNs, Deep Recurrent Networks, Recursive Neural Networks, The Long Short-Term Memory and Other Gated RNNs. Large-Scale Deep Learning, Computer, Speech Recognition, Natural Language Processing and Other 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 Neural 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	Laboratory Learning	Utilize the facilities available in the laboratories to understand the behavior of the materials by performing few experiments.

6. Assessment Details (both CIE and SEE)

Continuous Internal Evaluation:

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

CIE Split up

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

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	Introduction to Deep Learning and Machine Learning Basics	Deep Learning concept covers the foundational principles of deep learning, including its definition and core models like neural networks. It also explores the historical evolution of deep learning, highlighting key advancements and breakthroughs that have shaped the field. Machine Learning concept introduces the fundamentals of machine learning, detailing various learning algorithms. It differentiates between supervised learning (where models are trained on labeled data) and unsupervised learning (where models find patterns in unlabeled data), providing a foundation for understanding different approaches and techniques in machine learning.
2	Feed forward Networks	This concept covers the basics of feed forward neural networks, where data moves in one direction from input to output. It includes gradient-based learning techniques, such as back propagation, used for training these networks by updating weights based on error gradients. Additionally, it addresses regularization methods to prevent over fitting and improve the generalization of deep learning models.
3	Optimization for Training Deep Models and Algorithms with Adaptive Learning Rates	Delves into optimizing deep learning models by minimizing empirical risk and tackling challenges such as vanishing gradients and slow convergence. It covers foundational algorithms like Stochastic Gradient Descent (SGD) and various parameter initialization strategies. Additionally, it explores adaptive learning rate algorithms, including AdaGrad and RMSProp, and emphasizes the importance of selecting the most suitable optimization method for specific training scenarios.
4	Convolutional Networks	Explores the core components of convolutional networks, including the convolution operation and pooling, which together help in feature extraction and dimensionality reduction. It examines how these processes act as strong priors in modeling spatial hierarchies and introduces various convolutional variants and efficient algorithms. The concept also covers practical implementations, such as LeNet and AlexNet, demonstrating their impact on image recognition and classification tasks.
5	Recurrent and Recursive Neural Networks	Covers the architectures and mechanisms of recurrent and recursive neural networks, including RNNs, Bidirectional RNNs, and advanced models like Long Short-Term Memory (LSTM) networks. It explores their ability to handle sequential data and hierarchical structures through techniques such as unfolding computational graphs and using gated mechanisms. Additionally, it highlights applications in large-scale deep learning, speech recognition, natural language processing, and other areas where these networks are particularly effective.

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

Course Outcomes (COs)

Cos	Description
M23BEC704B.1	**Demonstrate** a comprehensive understanding of deep learning models, including their historical evolution, and articulate the basics of machine learning algorithms, both supervised and unsupervised.
M23BEC704B.2	**Implement** feed forward neural networks, including the application of gradient-based learning techniques, back propagation, and regularization methods.
M23BEC704B.3	**Optimize** deep learning models by applying empirical risk minimization strategies, selecting appropriate optimization algorithms, and utilizing advanced techniques like stochastic gradient descent and adaptive learning rates.

M23BEC704B.4	**Apply** convolutional and recurrent neural networks to solve real-world problems in areas such as image recognition, speech recognition, and natural language processing, including the implementation of architectures like LeNet, AlexNet, and LSTMs.

CO-PO-PSO Mapping

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
M23BEC704B.1	3	3	-	-	-	-	-	-	-	-	-	-	3	3
M23BEC704B.2	-	-	3	3	-	-	-	-	-	-	-	-	-	-
M23BEC704B.3	-	-	-	-	3	3	-	-	-	-	-	-	-	-
M23BEC704B.4	-	-	-	-	-	-	3	3	-	-	-	-	-	-
M23BEC704B	**3**	**3**	**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	**3**	**2**	**3**	**2**	**10**
Total	**13**	**12**	**13**	**12**	**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	**5**	**5**	**5**	**5**	**20**
Total	**25**	**25**	**25**	**25**	**100**

10. Future with this Subject:

- **Advancements in Model Architectures**: Enhanced Neural Network Architectures: Ongoing research is likely to produce more sophisticated neural network architectures that improve efficiency, scalability, and performance. Innovations like transformers, graph neural networks, and advanced generative models (e.g., GANs) are expected to play a significant role. Neural Architecture Search (NAS): Automating the design of neural network architectures through NAS will become more prevalent, enabling the discovery of highly optimized models tailored to specific tasks.
- **Applications Across Industries**: Healthcare: Deep learning will increasingly be used for personalized medicine, medical imaging, drug discovery, and genomics. Predictive models will improve diagnostics and patient outcomes. Autonomous Systems: In autonomous vehicles and robotics, deep learning will advance capabilities in perception, decision-making, and navigation, leading to more reliable and intelligent systems. Natural Language Processing (NLP): Continued improvements in NLP will enhance language translation, sentiment analysis, conversational AI, and content generation, making interactions with machines more natural and intuitive.
- **Integration with Other Technologies**: Edge Computing: Deep learning models will be increasingly deployed on edge devices, enabling real-time processing and decision-making without relying on cloud infrastructure. Quantum Computing: The integration of quantum computing with deep learning could lead to breakthroughs in computational power, allowing for faster training and more complex models.
- **Scalability and Efficiency**: Resource Optimization: Future research will focus on optimizing computational resources and energy consumption associated with training and deploying deep learning models. Scalable Training: Techniques for distributed and scalable training will enable the development of larger and more complex models efficiently.

7th Semester	Professional Elective -III (PE -III) SATELLITE COMMUNICATION	M23BEC704C

1. Prerequisites

S/L	Proficiency	Prerequisites
1	Fundamentals of Communication	• Signal Processing: Understanding how signals are modulated, transmitted, received, and demodulated. • Modulation Techniques: Knowledge of various modulation techniques (AM, FM, PM, QPSK) used to encode information onto carrier waves. • Frequency Allocation: Understanding the allocation of frequency bands by regulatory bodies like the International Telecommunication Union (ITU). • Standards Compliance: Knowledge of relevant standards and specifications (e.g., those set by IEEE, ETSI).
2	Electromagnetic theory	• Wave Propagation: Understanding how electromagnetic waves propagate through space, including concepts like line-of-sight, free-space loss, and the effects of atmospheric conditions.
3	Mathematics	• Calculus and Algebra: Proficiency in calculus and algebra for analyzing and designing communication systems. • Statistics: Understanding of statistical methods for analyzing data and performance metrics.
4	Networking Concepts	• Routing and Switching: Understanding how data is routed and switched in satellite networks. • Protocols: Familiarity with network protocols and standards used in satellite communication, including TCP/IP and various data link protocols.

2. Competencies

S/L	Competency	KSA Description
1	Technical Knowledge	Satellite Systems: Understanding the architecture, types (geostationary, low Earth orbit, medium Earth orbit), and functions of satellites. Transponders and Payloads: Knowledge of how these components work to receive, process, and transmit signals. Frequency Bands: Familiarity with different frequency bands (L-band, C-band, Ku-band, Ka-band) and their applications. Modulation and Coding: Expertise in modulation techniques (e.g., QPSK, QAM) and error correction coding to ensure signal integrity.
2	Communication Protocols	Data Link Protocols: Understanding of protocols used in satellite communications, such as DVB-S2, DVB-RCS2, and others. Network Protocols: Knowledge of how satellite networks integrate with terrestrial networks, including TCP/IP and routing protocols.
3	Signal Processing	Amplification and Filtering: Skills in signal amplification and filtering to manage noise and interference. Demodulation and Decoding: Expertise in demodulating received signals and decoding data for accurate transmission.
4	Ground and Regulatory systems	Ground Stations: Knowledge of the design and operation of ground stations, including antennas, modems, and tracking systems. Tracking and Telemetry: Understanding the systems used to track satellite position and collect performance data. Regulatory Bodies: Familiarity with regulations and standards set by organizations like the International Telecommunication Union (ITU) and national regulatory agencies. Frequency Coordination: Competency in managing frequency assignments and avoiding interference with other systems.
5	Problem-Solving and Emerging Technologies	Fault Diagnosis: Skills in diagnosing and resolving issues related to signal quality, connectivity, and equipment malfunctions. Maintenance and Support: Competency in maintaining and supporting satellite communication systems, including preventive and corrective measures. Advancements in Satellite Technology: Staying updated with the latest innovations, such as high-throughput satellites (HTS), low Earth orbit (LEO) constellations, and software-defined satellites. Integration with Other Technologies: Understanding how satellite communication integrates with emerging technologies like 5G and the Internet of Things (IoT).

3. Syllabus

SATELLITE COMMUNICATION SEMESTER – VII			
Course Code	**M23BEC704C**	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. To enable the student to become familiar with satellites and satellite services.
2. Study of satellite orbits and launching.
3. Study of earth segment and space segment components
4 Study of satellite access by various users.

Module -1

Satellite Orbits: Kepler's Laws, Newton's law, orbital parameters, orbital perturbations, station keeping, geostationary and non-geostationary orbits – Look Angle Determination, Limits of visibility, eclipse-Sub-satellite point – Sun transit outage-Launching Procedures- launch vehicles and propulsion.

Module -2

Space Segment: Spacecraft Technology- structure, primary power, attitude and orbit control, Thermal control and propulsion, communication Payload and supporting subsystems, telemetry, tracking and Command-Transponders-The Antenna subsystem.

Module -3

Satellite Link Design: Basic link analysis, Interference analysis, Rain-induced attenuation and interference, Ionospheric characteristics, Link Design with and without frequency reuse.

Module -4

Modulation and Multiplexing: Voice, data, video, analog – digital transmission system, digital video broadcast, multiple access: FDMA, TDMA, CDMA, DAMA assignment Methods, compression – encryption, coding Schemes.

Module -5

Satellite Applications: INTELSAT series, INSAT, VSAT, mobile satellite services: GSM, GPS, INMARSAT, LEO, MEO, satellite Navigational System. GPS Position Location principles, differential GPS, Direct Broadcast satellites (DBS/DTH).

TEXTBOOKS:

1. Dennis Roddy," Satellite Communication", 4th Edition, McGraw Hill International,2006.
2. Timothy Pratt, Charles Bostain, Jeremy Allnutt," Satellite Communication", 2nd Edition, Wiley Publications, 2002.

REFERENCE BOOKS:

1. Wilbur L. Pritchard, Hendri G. Suyderhoud, Robert A. Nelson," Satellite Communication Systems Engineering", Prentice Hall/Pearson, 2007.
2. M. Richharia," Satellite Communication Systems - Design Principles", Macmillan, 2003.

4. Syllabus Timeline

S/L	Syllabus Timeline	Description
1	Week 1-3: Satellite Orbits	Introduction to concepts of Kepler's Laws, Newton's law, orbital parameters, orbital perturbations, station keeping, geostationary and non-geostationary orbits – Look Angle Determination, Limits of visibility, eclipse-Sub-satellite point – Sun transit outage-Launching Procedures - launch vehicles and propulsion.
2	Week 4-6: Space Segment	Spacecraft Technology- Structure, Primary power, Attitude and Orbit control, Thermal control and Propulsion, communication Payload and supporting subsystems, Telemetry, Tracking and command-Transponders-The Antenna Subsystem.
3	Week 8-11: Satellite link design	Studying the different types of basic link analysis, Interference analysis, Rain-induced attenuation and interference, Ionospheric characteristics, Link Design with and without frequencyreuse.
4	Week 7-8: Modulation and multiplexing	Introduction to the concepts of Voice, Data, Video, Analog-digital transmission system, Digital video Broadcast, multiple access: FDMA, TDMA, CDMA, DAMA Assignment Methods, compression – -encryption, Coding Schemes.

5	Week 9-12: Satellite applications.	INTELSAT Series, INSAT, VSAT, Mobile satellite services: GSM, GPS, INMARSAT, LEO, MEO, Satellite Navigational System. GPS Position Location Principles, Differential GPS, Direct Broadcast satellites (DBS/DTH).

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

6. Assessment Details (both CIE and SEE)

Continuous Internal Evaluation:

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

CIE Split up

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

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	Basics of satellite communication	Understand Satellite Orbits: Learn about different types of orbits (geostationary, polar, medium Earth orbit) and their applications. Satellite Components: Identify the key components of a satellite communication system, including satellites, ground stations, transponders, and antennas.
2	Signal Propagation and Link Budget	Understand how signals travel from the ground to the satellite and back, including concepts like free-space loss, rain fade, and Doppler effect. Learn to calculate the link budget for a satellite communication system to ensure reliable signal transmission.
3	Modulation and Coding Techniques	Study of various modulation schemes used in satellite communication (e.g., QPSK, 8PSK, QAM). Understand the importance of error correction codes (e.g., Reed-Solomon, Turbo Codes) to enhance data integrity.
4	System Design and Communication Networks	Explore how to design a satellite communication system, including frequency allocation, bandwidth management, and system Learn about different types of satellite networks (e.g., point-to-point, point-to-multipoint, and mesh networks).

5	Applications and Services	Commercial and Military Applications: Understand various applications of satellite communication, including television broadcasting, internet access, navigation, and remote sensing. Emerging Technologies: Explore new and emerging technologies in satellite communication, such as satellite constellations and high-throughput satellites (HTS).
6	Regulations and Policies	Regulatory Framework: Learn about the regulatory environment for satellite communications, including frequency allocation and licensing. International Cooperation: Understand the role of international organizations and treaties in managing satellite communications.

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

Course Outcomes (COs)

Cos	
M23BEC704C.1	**Understanding of satellite orbits, including Kepler's Laws, Newton's laws, and orbital parameters.**
M23BEC704C.2	**Understanding** modulation and multiplexing techniques, including voice, data, video transmission, digital video broadcast, and multiple access methods such as FDMA, TDMA, CDMA, and DAMA.
M23BEC704C.3	**Apply** the components and subsystems of spacecraft technology including structure, power systems, attitude and orbit control, thermal control, propulsion, and communication payloads.
M23BEC704C.4	**Analyze** satellite link designs, considering factors such as basic link analysis, interference analysis, rain-induced attenuation, ionospheric characteristics, and frequency reuse.
M23BEC704C.5	**Implement** applications of Satellite Communication like INTELSAT series, INSAT, VSAT, mobile satellite services: GSM, GPS, INMARSAT, LEO, MEO, satellite Navigational System. GPS Position Location principles, differential GPS, Direct Broadcast satellites (DBS/DTH).

CO-PO-PSO Mapping

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
M23BEC704C.1	3	3	-	-	-	-	-	-	-	-	-	-	3	3
M23BEC704C.2	3	-	3	-	-	-	-	-	-	-	-	-	3	-
M23BEC704C.3	-	3	-	-	-	-	-	-	-	-	-	-	-	3
M23BEC704C.4	-	-	3	-	-	-	-	-	-	-	-	-	-	-
M23BEC704C.5	-	-	-	-	-	-	-	-	-	-	-	-	-	-
M23BEC704C	**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

- **Mega-Constellations**: The deployment of large satellite constellations in low Earth orbit (LEO) is a major trend. Companies like SpaceX (Starlink), Amazon (Project Kuiper), and OneWeb are launching thousands of small satellites to provide global, high-speed internet coverage. This approach aims to improve internet access in remote and underserved areas and enhance overall connectivity.
- **Increased Bandwidth and Speed**: Advances in satellite technology are enabling higher data transfer rates and greater bandwidth. This is crucial for supporting applications such as 5G networks, IoT, and high-definition streaming.
- **Smarter Satellites**: Next-generation satellites are incorporating advanced technologies like artificial intelligence and machine learning to optimize their operations. These smart satellites can adjust their position and focus dynamically, manage network traffic more efficiently, and even detect and mitigate interference.
- **Enhanced Security**: As satellite communication becomes more integral to various sectors, including defense, finance, and critical infrastructure, there is a growing emphasis on security. This includes developing encryption technologies and other measures to protect data and prevent unauthorized access.
- **Integration with Terrestrial Networks**: The seamless integration of satellite and terrestrial networks is becoming more common. Hybrid systems that combine satellite and ground-based infrastructure can offer more reliable and resilient communication networks.
- **Improved Launch Technologies**: The development of reusable rockets and more cost-effective launch solutions is making it easier and cheaper to deploy satellites. Companies like SpaceX and Blue Origin are leading this innovation, which supports the rapid expansion of satellite networks.
- **Advanced Antenna Technologies**: New types of antennas, such as phased-array antennas, are being developed to improve signal quality and allow for more flexible and precise satellite communication.
- **Miniaturization and Cost Reduction**: The trend towards smaller, more affordable satellites is making space more accessible. Small satellites, or CubeSats, are being used for a variety of applications, from Earth observation to scientific research, and their reduced cost lowers the barrier for entry for new players in the space industry.

7th Semester	Professional Elective -III (PE -III) ANALOG and MIXED MODE VLSI	M23BEC704D

1. Prerequisites

S/L	Proficiency	Prerequisites
1	**Basic Electronics Principles**	• Understanding of fundamental electronic components (resistors, capacitors, inductors) and how they work.
2	Circuit Analysis Techniques	• Familiarity with Ohm's Law, Kirchhoff's Voltage and Current Laws, and basic circuit analysis methods (nodal analysis, mesh analysis).
3	Analog vs. Digital (Discrete-Time) Signals	• Continuous-time signals that very smoothly and can represent real-world phenomena like temperature, sound, or voltage. • Discrete-time signals represented by a sequence of values or samples, usually in binary form, which are suitable for processing by digital systems.

2. Competencies

S/L	Competency	KSA Description
1	MOS	**Knowledge:** **Understanding MOSFET Structure:** Knowledge of gate, drain, source, and body terminals. **Operating Regions:** Familiarity with the cut-off, triode (linear), and saturation regions. **Current-Voltage Characteristics:** Ability to interpret the I-V curves for different operating regions. **Skills:** **Amplifier Design:** Ability to design MOS amplifiers based on desired specifications. **Troubleshooting:** Skills in diagnosing and resolving issues in MOS amplifier circuits. **Attitudes:** An analytical approach to identifying and resolving issues in circuit design and implementation.
2	ADC and DAC	**Knowledge:** Studying conversion processes, types of Analog-to-Digital Converters (ADCs) and Digital-to-Analog Converters (DACs), performance metrics, and applications **Skills:** Design, optimization, simulation, prototyping, testing, and troubleshooting of ADC and DAC circuits. **Attitudes:** Ensuring precision in the design, implementation, and testing of ADCs and DACs to achieve accurate and reliable performance.
3	Phase locked loop	**Knowledge:** **Phase Detector:** Understand how it compares the phase of the input signal with the phase of the output signal from the voltage-controlled oscillator (VCO). **Voltage-Controlled Oscillator (VCO):** Understanding how it generates a frequency proportional to the input voltage. **Skills:** **Designing PLL Circuits:** Ability to design PLL circuits including phase detectors, loop filters, and VCOs. **Component Selection:** Choosing appropriate components for phase detectors, loop filters, and VCOs based on performance requirements. **Attitudes:** **Attention to Detail:** Ensuring precision in PLL design, analysis, and testing to achieve reliable performance. **Curiosity and Continuous Learning:** A continuous desire to learn about new PLL technologies, advancements, and best practices.

3. Syllabus

ANALOG and MIXED MODE VLSI SEMESTER – VII			
Course Code	**M23BEC704D**	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. To learn fundamentals of data converters.
2. To learn various types of ADC and DAC.
3. To understand the concept of phase locked loop.

Module -1

Data converter fundamentals: Analog versus digital (or discrete time) signals, converting analog signals to data signals, sample and hold circuits, sample and hold characteristics, switched capacitor circuits, DAC specifications, ADC specifications.

Module -2

Data converters-1: DAC architectures – digital input code, R-2R ladder networks, current steering, charge scaling DACs, cyclic DAC, pipeline DAC, ADC architectures – flash ADC, 2-step flash ADC, pipeline ADC, integrating ADC, successive approximation ADC.

Module -3

Data converters -2 ADC architectures – flash ADC, 2-step flash ADC, pipeline ADC, integrating ADC, successive approximation ADC

Module -4

Non-Linear Analog Circuits: Basic CMOS Comparator Design (Excluding Characterization), Analog Multipliers, Multiplying Quad (Excluding Stimulation), Level Shifting (Excluding Input Level Shifting For Multiplier).

Module -5

Phase locked loop: simple PLL, frequency/phase detectors, charge pump PLL, application as frequency multiplier.

TEXTBOOKS:

1. Behzad Razavi, Design of Analog CMOS Integrated Circuits McGraw-Hill International Edition 2016.
2. Baker, R. Jacob, CMOS: Circuit design, Layout, and Simulation. John Wiley & Sons, 2019.
3. Design, Layout, Stimulation ,R. Jacob Baker, Harry W Li, David E Boyce, CMOS Circuit, PHI Education, 2005

REFERENCE BOOKS:

1. Phillip E. Allen and Douglas R. Holberg, CMOS Analog Circuit Design, Oxford University Press, 2003.
2.Behzad Razavi, Fundamentals of Microelectronics, Second edition, Wiley, 2013
3.P. R. Gray, P. J. Hurst, S. H. Lewis and R. G. Meyer, Analysis And Design Of Analog Integrated Circuits, 5th edition, John Wiley & Sons, Inc., 2009.

4. Syllabus Timeline

S/L	Syllabus Timeline	Description
1	Week 1-3: Data converter fundamentals	Analog versus digital (or discrete time) signals, converting analog signals to data signals, sample and hold circuits, sample and hold characteristics, switched capacitor circuits, DAC specifications, ADC specifications.
2	Week 4-6: Data converters	DAC architectures – digital input code, R-2R ladder networks, current steering, charge scaling DACs, cyclic DAC, pipeline DAC,
3	Week 8-11: Data converter	ADC architectures – flash ADC, 2-step flash ADC, pipeline ADC, integrating ADC, successive approximation ADC.
4	Week 7-8: Non-Linear Analog Circuits	Basic CMOS Comparator Design, Analog Multipliers, Multiplying Quad ,Level Shifting
5	Week 9-12: Phase locked loop	Simple PLL, frequency/phase detectors, charge pump PLL, application as frequency multiplier.

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 sensors and instrumentation 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.

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	MOSFET	Describe the physical structure of MOSFETs, including the gate, source, and drain terminals and the role of the oxide layer in controlling current flow between the source and drain.
2	Beam Analysis and Design	Identify and differentiate between the main types of data converters: Analog-to-Digital Converters (ADCs) and Digital-to-Analog Converters (DACs). Understand the general principles behind each type and their respective functions in electronic systems.
3	PLL	Explain the fundamental operation of a PLL, including how it compares the phase of the reference signal with the output signal and adjusts the VCO to maintain synchronization. Describe the feedback loop mechanism and how it achieves phase locking.

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

Course Outcomes (COs)

COs	Description
M23BEC704D.1	**Describe** the fundamentals of data converters
M23BEC704D.2	**Describe** Main components of PLL system ,such as phase deterctor, loop filter and VCO
M23BEC704D.3	**Apply** the concepts of data converters design Analog to digital converter and digital to analog converter.
M23BEC704D.4	**Apply** the concepts of data converters design CMOS Comparator and analog multiplier

CO-PO-PSO Mapping

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
M23BEC704D.1	3	-	-	-	-	-	-	-	-	-	-	-	3	-

M23BEC704D.2	3	-	-	-	-	-	-	-	-	-	-	-	3	-
M23BEC704D.3	-	3	3	-	-	-	-	-	-	-	-	-	3	-
M23BEC704D.4	**-**	**3**	3	-	-	-	-	-	-	-	-	-	3	-
M23BEC704D	**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**	**20**	**10**	**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**	**40**	**20**	**100**

10. Future with this Subject:

- **Integration with Digital Systems:** Improved integration of analog-to-digital converters with digital processing units will enhance overall system performance and efficiency. design practices to minimize environmental impact while ensuring structural integrity.
- **Higher Resolution and Speed:** Demand for higher resolution and faster ADCs will continue to grow, pushing advancements in data converter design and performance.
- **Enhanced Accuracy:** Improved design techniques and materials will enable higher precision in analog signal processing, critical for applications such as data converters, sensors, and analog front-ends.
- **Calibration and Compensation:** Advanced calibration techniques and on-chip self-testing will enhance the accuracy and reliability of mixed-signal systems.

7th Semester	Professional Elective – IV (PE-IV) BIOMEDICAL SIGNAL PROCESSING	M23BEC705A

1. Prerequisites

S/L	Proficiency	Prerequisites
1	Mathematics	• Proficiency in differential and integral calculus, including applications. • Basic Knowledge of Statistics and Linear Algebra.
2	Signals and systems	• Basic Knowledge of different types of signal and their operations. • Proficiency in different properties of signals and systems...
3	Digital Signal Processing	• Basic Knowledge of Discrete Fourier Transform and their Properties. • Proficiency in Fourier analysis of signals and filtering technique.
4	Sensor and Instrumentation	• Basic Knowledge about the working of sensors. • Proficiency in different types of instruments available to record biomedical signals.

2. Competencies

S/L	Competency	KSA Description
1	Knowledge on Types of Biomedical signals	**Knowledge:** By studying various biomedical signals like EEG, ECG, and EMG, students unlock the ability to analyze these electrical whispers of the body. They learn to filter out noise and interpret the signals' characteristics, revealing vital health information. **Skills:** Studying diverse biomedical signals like EEG, ECG, and EMG equips students with a powerful skill set. They can dissect complex electrical signals from the body, filtering out noise and interpreting hidden patterns. **Attitudes:** After delving into the world of biomedical signals, students develop a profound appreciation for the body's intricate electrical language.
2	Familiarity in concepts on Signal Averaging	**Knowledge:** Students understand how averaging repetitive signals can significantly reduce random, unwanted noise. This allows them to extract the underlying, weaker signal of interest, leading to clearer and more accurate data analysis**.** **Skills:** Studying biomedical signal averaging equips students to **clean noisy data** by separating weak signals from background interference. **Attitudes:** Students learn to see past noise and unearth hidden patterns in biological signals. This empowers them to extract crucial information for better diagnoses and potentially unlock new possibilities in brain-computer interfaces
3	Knowledge on different Data Compression Techniques.	**Knowledge:** Knowledge about different data reduction techniques like Turning point algorithm, AZTEC algorithm, Fan algorithms and Huffman coding. **Skills:** Creating and interpreting reduced data sets of biomedical signals by applying data compression techniques. **Attitudes:** Attention to detail with power spectrum estimation of biomedical signals.
4	Knowledge on ECG	**Knowledge:** Studying biomedical ECG equips students to decipher the electrical language of the heart. They gain knowledge of the heart's electrical cycle reflected in ECG waves **Skills:** They develop the skills to analyze ECG wave patterns, acting like detectives deciphering electrical clues. This allows them to diagnose heart rhythm issues, measure heart rate, and potentially identify abnormalities for better patient care. **Attitudes:** Studying biomedical ECG fosters a deep appreciation for the heart's silent symphony. Students move from seeing it as a pump to recognizing its intricate electrical language
5	Knowledge on EEG	**Knowledge:**

		Studying biomedical EEG equips students to understand the brain's electrical whispers. They learn to interpret brainwave patterns, revealing information about activity, sleep stages, and even potential neurological issues. **Skills:** They develop the skills to analyze and interpret complex EEG patterns, acting like wranglers deciphering the electrical whispers of the brain. **Attitudes:** Students see beyond the skull to a world of electrical conversations, fostering a desire to decode these messages and unlock the brain's secrets for better diagnoses and potential mind-machine interfaces

3. Syllabus

BIOMEDICAL SIGNAL PROCESSING SEMESTER – VI			
Course Code	**M23BEC705A**	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:
This course will enable students to:
1. To understand the biomedical signals acquisition and its analysis.
2. To understand the fundamentals of ECG and EEG.
3. To understand the Data Compression Techniques used for ECG.
4. To Apply the concepts of Parametric algorithms to analyze EEG signals.

Module -1

Introduction to Biomedical Signals: The nature of Biomedical Signals, Examples of Biomedical Signals, Objectives and difficulties in Biomedical analysis.
Signal Conversion: Simple signal conversion systems, Conversion requirements for biomedical signals, signal conversion circuits.

Module -2

Signal Averaging: Basics of signal averaging, signal averaging as a digital filter, a typical average, software for signal averaging, limitations of signal averaging.
Adaptive Noise Cancelling: Principal noise canceller model, 60-Hz adaptive cancelling using a sine wave model, other applications of adaptive filtering.

Module -3

Data Compression Techniques: Turning point algorithm, AZTEC algorithm, Fan algorithm, Huffman coding, data reduction algorithms, The Fourier transform, Correlation ,Convolution, Power spectrum estimation, Frequency domain analysis of the ECG.

Module -4

Cardiological signal processing: Basic Electrocardiography, ECG data acquisition, ECG lead system, ECG QRS detection techniques, Estimation of ST Segment Inclination, Long term continuous ECG recording.

Module -5

Neurological signal processing: The brain and its potentials, The electrophysiological origin of brain waves, The EEG signal and its characteristics.
Analysis of EEG channels: Parametric Model, Linear prediction theory, Autoregressive method (AR), The Levinson's Algorithm, Adaptive Segmentation Algorithm.

TEXTBOOKS:

1. Biomedical Digital Signal Processing'-Willis J Tompkins, Prentice Hall of India, 2001.
2. Biomedical Signal Processing Principles and Techniques-D C Reddy, McGraw-Hill publications 2005.

REFERENCE BOOKS:

Biomedical Signal Analysis- Rangaraj M. Rangayyan, John Wiley & Sons 2002.

4. Syllabus Timeline

S/L	Syllabus Timeline	Description
1	Week 1-3: Introduction to Biomedical signals	Introduce basics of biomedical signals, like ECG, EEG, and EMG, emphasizing acquisition methods and signal processing techniques. Use practical demonstrations, real-world examples, and interactive sessions to engage students.

2	Week 4-6: Signal Averaging	Teach principles of signal averaging, emphasizing its role in noise reduction and enhancing signal quality. Demonstrate techniques such as ensemble averaging and time averaging with practical examples and simulations.
3	Week 8-11: Data Compression Techniques	Teach the different types of data compression techniques like Turning point algorithms, AZTEC, Fan algorithm, Huffman coding by taking the different data sets of ECG.
4	Week 7-8: Analysis of ECG	Teach ECG signal analysis by covering basics of cardiac physiology, waveform interpretation, and common abnormalities. Utilize practical exercises with real ECG recordings and interactive software for rhythm identification and morphological analysis.
5	Week 9-12: Analysis of EEG	Introduce EEG signal analysis by covering brainwave types, electrode placement, and recording techniques. Use interactive tools and real EEG datasets for practical analysis of neural oscillations, event-related potentials, and spectral features.

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 biomedical signal processing 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	Laboratory Learning	Utilize the facilities available in the laboratories to understand the behavior of the materials by performing few experiments.

6. Assessment Details (both CIE and SEE)

Continuous Internal Evaluation:

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

CIE Split up

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

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 Biomedical signal Fundamentals	Students will be able to understand the basics of biomedical signals ECG,EEG,EMG and EOG etc.
2	Proficiency in Signal Averaging and Adaptive filters	Students will learn to analyze signal averaging techniques, noise removal techniques and different signal conversion techniques.
3	Proficiency in Data Compression Techniques.	Analyze data compression techniques with different algorithms to get compressed data sets.

4	Proficiency in ECG and EEG	Evaluate Cardiological details and Neurological details of human body.

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

Course Outcomes (COs)

COs	Description
M23BEC705A.1	**Explain** the basic mathematical, scientific and computational skills necessary to understand ECG and EEG signals.
M23BEC705A.2	**Apply** classical and modern filtering and compression techniques for ECG and EEG signals.
M23BEC705A.3	**Apply** the Cardiological and Neurological signal spectrum to estimate and optimize the various biomedical signal parameters.
M23BEC705A.4	**Analyze** the Cardiological signal spectrum based on different applications.

CO-PO-PSO Mapping

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
M23BEC705A.1	3	-	-	-	-	-	-	-	-	-	-	-	3	-
M23BEC705A.2	3	2	-	-	-	-	-	-	-	-	-	-	3	-
M23BEC705A.3	3	2	-	-	-	-	-	-	-	-	-	-	3	-
M23BEC705A.4	3	-	-	-	3	-	-	-	-	-	-	-	3	-
M23BEC705A	3	2	-	-	-	-	-	-	-	-	-	-	3	-

9. Assessment Plan

Continuous Internal Evaluation (CIE)

	CO1	CO2	CO3	CO4	Total
Module 1	**10**				**10**
Module 2		**05**		**05**	**10**
Module 3		**10**			**10**
Module 4			**05**		**05**
Module 5			**10**	**05**	**15**
Total	**10**	**15**	**15**	**10**	**50**

Semester End Examination (SEE)

	CO1	CO2	CO3	CO4	Total
Module 1	**20**			**5**	**25**
Module 2		**20**		**5**	**25**
Module 3			**20**	**5**	**25**
Module 4		**10**			**10**
Module 5			**5**	**10**	**15**
Total	**20**	**30**	**20**	**20**	**100**

10. Future with this Subject:

- **Machine Learning and AI:** Machine learning algorithms are already being incorporated into biomedical signal processing for tasks like automated analysis of EEG (brainwaves) or ECG (heart signals) data. This trend is expected to continue, leading to more sophisticated analysis and the ability to detect subtle changes that might be missed by human doctors.
- **Sensor Technology:** The development of miniaturized, wearable, and even ingestible sensors will allow for continuous, long-term monitoring of a wider range of biological signals. This will provide a much richer dataset for analysis and could enable the detection of diseases at earlier stages.
- **Internet of Things (IoT):**:With the growth of IoT, medical devices will become increasingly interconnected, allowing for real-time data transmission and remote patient monitoring. This could revolutionize healthcare delivery, enabling more personalized care and earlier intervention.
- **Personalized Medicine:** Biomedical signal processing can be used to develop personalized treatment plans based on an individual's unique biological data.
- **Early Disease Detection:**: By continuously monitoring physiological signals, healthcare professionals may be able to identify diseases like heart failure or even cancer much earlier, leading to better treatment outcomes

7th Semester	Professional Elective – IV (PE-IV) BIG DATA ANALYTICS	M23BEC705B

1. Prerequisites

S/L	Proficiency	Prerequisites
1	Linear Algebra	Understanding vectors, matrices, and their operations is essential, especially for algorithms like PCA (Principal Component Analysis) and recommendation systems.
2	Probability and Statistics	Concepts like probability distributions; statistical inference, hypothesis testing, and regression are vital for data analysis and machine learning.
3	Data Structures and Algorithms	Knowledge of basic data structures (arrays, linked lists, trees, graphs) and algorithms (sorting, searching) is necessary to optimize data processing and analysis tasks.
4	Machine Learning Basics	A fundamental understanding of machine learning algorithms, including supervised and unsupervised learning, can be beneficial for advanced analytics.
5	Basic Knowledge of data mining	Familiarity with frameworks like Apache Kafka (for stream processing) and Apache Flink (for real-time data processing).

2. Competencies

S/L	Competency	KSA Description
1	Big Data Frameworks	**Knowledge:** Understanding of big data processing frameworks. **Skills:** Ability to use data analysis and metrics to inform decisions and strategies. **Attitudes:** Ability to critically evaluate large volumes of data, identify trends, and draw actionable insights that can influence decisions.
2	Data Management	**Knowledge:** Knowledge of various data storage solutions, including relational databases (SQL), NoSQL databases. **Skills:** Skill in cleaning, transforming, and organizing large datasets using tools like Pandas, Spark SQL, and Hadoop MapReduce. **Attitudes:** Ability to quickly learn and adapt to new tools, technologies, and methodologies in the rapidly evolving field of big data.
3	Machine Learning	**Knowledge:** Knowledge of machine learning models and techniques, including supervised and unsupervised learning, neural networks, and deep learning. **Skills:** Ability to apply machine learning algorithms of data analysis. **Attitudes:** Ability to build machine learning algorithms to data analysis.
4	Statistical Analysis	**Knowledge:** Understanding of statistical methods and techniques, including hypothesis testing, regression analysis, and probability theory. **Skills:** Ability to create clear and effective visual representations of data. **Attitudes:** Keen attention to detail, ensuring accuracy and reliability in data analysis and reporting.

3. Syllabus

BIG DATA ANALYTICS SEMESTER – VII			
Course Code	**M23BEC705B**	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:

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

Module -1

Introduction to Big Data Analytics: Big Data, Scalability and Parallel Processing, Designing Data Architecture, Data Sources, Quality, Pre-Processing and Storing, Data Storage and Analysis, Big Data Analytics Applications and Case Studies.
Module -2
Introduction to Hadoop (T1): Introduction, Hadoop and its Ecosystem, Hadoop Distributed File System, MapReduce Framework and Programming Model, Hadoop Yarn, Hadoop Ecosystem Tools. **Hadoop Distributed File System Basics (T2):** HDFS Design Features, Components, HDFS User Commands. **Essential Hadoop Tools (T2):** Using Apache Pig, Hive, Sqoop, Flume, Oozie, HBase.
Module -3
NoSQL Big Data Management, and MongoDB: Introduction, NoSQL Data Store, NoSQL Data Architecture Patterns, NoSQL to Manage Big Data, Shared-Nothing Architecture for Big Data Tasks, MongoDB, Databases.
Module -4
MapReduce, Hive and Pig: Introduction, MapReduce Map Tasks, Reduce Tasks and MapReduce Execution, Composing MapReduce for Calculations and Algorithms, Hive, HiveQL, Pig.
Module -5
Machine Learning Algorithms for Big Data Analytics: Introduction, Estimating the relationships, Outliers, Variances, Probability Distributions, and Correlations,Regression analysis, Finding Similar Items, Similarity of Sets and Collaborative Filtering, Frequent Itemsets and Association Rule Mining.
TEXTBOOKS: 1. Raj Kamal and Preeti Saxena, "Big Data Analytics Introduction to Hadoop, Spark, and Machine-Learning", McGraw Hill Education, 2018 ISBN: 9789353164966, 9353164966 2. Douglas Eadline, "Hadoop 2 Quick-Start Guide: Learn the Essentials of Big Data Computing in the Apache Hadoop 2 Ecosystem", 1stEdition, Pearson Education, 2016. ISBN-13: 978-9332570351 **REFERENCE BOOKS:** 1. 1. Tom White, "Hadoop: The Definitive Guide", 4th Edition, O"Reilly Media, 2015.ISBN-13: 978-9352130672 2. ArshdeepBahga, Vijay Madisetti, "Big Data Analytics: A Hands-On Approach", 1st Edition, VPT Publications, 2018. ISBN-13: 978-0996025577

4. Syllabus Timeline

S/L	Syllabus Timeline	Description
1	Week 1-3: Introduction to Big Data Analytics	Introduction to Big data, Designing data structure. Pre-processing and storing data
2	Week 4-6: Introduction to Hadoop	Understand the basics of Hadoop. Map reduce framework, Distributed file system structure.
3	Week 8-11: NoSQL big data management.	Understand the fundamentals of NoSQL big data management. Introduction to MangoDB.
4	Week 7-8: MapReduce, Hive and Pig	Introduction to the basics of Map Reduce and Hive.
5	Week 9-12: Machine Learning Algorithms for Big Data Analytics	Introduction to Machine Learning. Use of Machine Learning in Data analytics. Analysis using different machine learning methods.

5. Teaching-Learning Process Strategies

S/L	TLP Strategies:	Description
1	Lecture Method	Utilize various teaching methods within the lecture format to reinforce competencies.
2	Simulation Based Learning	Use simulations to mimic real-world scenarios where learners can practice big data analytics in a risk-free environment.
3	Experiential Learning	Focus on learning through experience, where learners engage in activities that involve problem-solving, experimentation, and reflection.
4	Case Based Learning	Use case studies to illustrate real-world applications of big data analytics.
5	Group Discussion and Presentation	Encourage group work learning where learners collaborate on share knowledge.
6	Project-Based Learning	Engage learners in real-world projects where they apply big data analytics concepts to solve actual problems.

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	Understand Core Big Data Concepts:	Understand the fundamental concepts of big data.
2	Proficiency in Big Data Tools and Technologies:	Demonstrate proficiency in using key big data tools and technologies, such as Hadoop, and NoSQL databases.
3	Statistical Analysis and Data Mining:	Apply statistical methods and data mining techniques to analyze large datasets and uncover patterns.
4	Machine Learning for Big Data:	Understand machine learning algorithms for analysing on large datasets to make predictions and discover trends.
5	Data Visualization and Interpretation:	Create effective data visualizations that communicate insights clearly and effectively.

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

Course Outcomes (COs)

COs	Description
M23BEC705B.1	**Understand** fundamentals of Big Data analytics.
M23BEC705B.2	**Analyze** different data to provide analytics with relevant visualization.
M23BEC705B.3	**Apply** Machine Learning algorithms for real world big data.
M23BEC705B.4	**Demonstrate** the MapReduce programming model to process the big data along with Hadoop tools.
M23BEC705B.5	**Illustrate** the concepts of NoSQL using MongoDB for Big Data.

CO-PO-PSO Mapping

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
M23BEC705B.1	3	-	-	-	-	-	-	-	-	-	-	-	-	-
M23BEC705B.2	3	3	-	-	-	-	-	-	-	-	-	-	-	-
M23BEC705B.3	3	-	-	-	-	-	-	-	-	-	-	-	-	-
M23BEC705B.4	3	-	3	-	3	-	-	-	-	-	-	-	-	-
M23BEC705B.5	3	-	3	-	3	-	-	-	-	-	-	-	-	-
M23BEC705B	**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:

- Use AI and ML:Artificial Intelligence (AI) and Machine Learning (ML) are becoming integral to Big Data Analytics.
- Augmented Analytics: Augmented analytics combines AI, ML, and natural language processing (NLP) to enhance data preparation, insight discovery, and sharing.
- Data Privacy: Concerns around data privacy and security are growing as organizations handle larger volumes of sensitive information.

7th Semester	Professional Elective – IV (PE-IV) DATA SCIENCE	M23BEC705C

1. Prerequisites

S/L	Proficiency	Prerequisites
1	Basic of mathematics	Understanding the basics of mathematics and Familiarity on Linear algebra, calculus, probability and statistics
2	Programming Fundamentals	Basic programming skills, understanding of programming concepts of python etc.,
3	Knowledge on Machine learning	Understanding algorithms like linear regression, decision trees, SVM, and neural networks. Familiarity with clustering methods
4	Previous course work	Machine learning, programming related courses.

2. Competencies

S/L	Competency	KSA Description
1	Knowledge on Programming Skills	**Knowledge:** Proficiency in Python, SQL **Skills:** Proficiency in programming languages like Python, SQL **Attitudes:** Ability to write clean, efficient, and reproducible code.
2	Familiarity on Data manipulation and wrangling	**Knowledge:** Concepts of Pandas (Python) or dplyr (R). **Skills:** Handling large dataset **Attitudes:** Ability to cleaning, transforming, and preparing data for analysis
3	Knowledge on Statistical Analysis for data science	**Knowledge:** Understanding of statistical methods, probability theory **Skills:** Apply statistical tests. **Attitudes:** Ability to apply statistical tests appropriately.
4	Expertise in Data Visualization	**Knowledge:** Create compelling visualizations **Skills:** Tools like Matplotlib, Seaborn, ggplot2, Tableau, or Power BI **Attitudes:** Tools to communicate insights effectively
5	Familiarity in Database management and machine learning	**Knowledge:** Understanding of SQL, machine learning algorithms **Skills:** Database querying and familiarity with NoSQL databases like Mongo DB for handling unstructured data and Scikit-learn, Tensor Flow, or Keras. **Attitudes:** Understanding of neural networks, especially for those working in areas requiring advanced AI techniques.

3. Syllabus

DATA SCIENCE SEMESTER – VI			
Course Code	**M23BEC705C**	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. Programming data science concepts and Big Data, modeling using python language
2. Analyze Basic tools of EDA, Data science process with case studies and Different algorithms.
3. Optimize & solve real life problems with different spam filter.
4. Explore Feature Generation and Feature Selection.

Module -1

Preparing And Gathering Data And Knowledge: Philosophies of data science - Data science in a big data world - Benefits and uses of data science and big data - facts of data: Structured data, Unstructured data, Natural Language, Machine generated data, Audio, Image and video streaming data - The Big data Eco system: Distributed file system, Distributed Programming framework, Data Integration frame work, Machine learning Framework, NoSQL Databases, Scheduling tools, Benchmarking Tools, System Deployment, Service programming and Security.
Module -2
The Data Science Process-Overview of the data science process- defining research goals and creating project charter, retrieving data, cleansing, integrating and transforming data, exploratory data analysis, Build the models, presenting findings and building application on top of them.
Module -3
Data Visualization–Introduction to data visualization, Data visualization options, Filters, Map Reduce , Dashboard development tools.
Module -4
Application of machine learning in data science- Tools used in machine learning modeling Process, Training model, Validating model, Predicting new observations, Types of machine learning Algorithm: Supervised learning algorithms, Unsupervised learning algorithms.
Module -5
Case Studies: Distributing data storage and processing with frameworks - Case study: e.g, Assessing risk when lending money. MINIST dataset, IRIS dataset.
TEXTBOOKS: 1. Introducing Data Science, Davy Cielen, Arno D. B. Meysman and Mohamed Ali,Manning Publications, 2016. 2. Doing Data Science, Straight Talk from the Frontline, Cathy O'Neil, Rachel Schutt, O' Reilly, 1st edition, 2013. **REFERENCE BOOKS:** 1. Mining of Massive Datasets, Jure Leskovec, Anand Rajaraman, Jeffrey David Ullman, Cambridge University Press, 2nd edition, 2014 2. An Introduction to Statistical Learning: with Applications in R, Gareth James, Daniela Witten, Trevor Hastie, Robert Tibshirani, Springer, 1st edition, 2013 3. Think Like a Data Scientist, Brian Godsey, Manning Publications, 2017. **VIDEO LINKS:** 1. https://archive.nptel.ac.in/courses/106/105/106105162/ 2. https://www.simplilearn.com/tutorials/data-science-tutorial/what-is-data-science 3. https://www.youtube.com/watch?v=N6BghzuFLIg 4. https://www.coursera.org/lecture/what-is-datascience/fundamentals-of-data-science-tPgFU 5. https://www.youtube.com/watch?v=ua-CiDNNj30

4. Syllabus Timeline

S/L	Syllabus Timeline	Description
1	Week 1-3: Preparing And Gathering Data And Knowledge	Understanding Programming data science concepts and Big Data, modelling using R language
2	Week 4-6: The Data Science Process	Analyze Basic tools of EDA, Data science process and Different algorithms.
3	Week 8-11: Machine Learning	Acquire the knowledge with case studies and Different algorithms of machine learning
4	Week 7-8: Visualization	Visualize the different algorithms results using visualization tools
5	Week 9-12: Case studies	Explore Feature Generation and Feature Selection for different datasets.

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

6. Assessment Details (both CIE and SEE)

Continuous Internal Evaluation:

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

CIE Split up

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

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 a 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	Knowledge on Programming Skills	Knowledge and Proficiency in programming languages like Python, R, SQL and ability to write clean, efficient, and reproducible code.
2	Familiarity on Data manipulation and wrangling	Concepts of Pandas (Python) or dplyr (R) and Handling large dataset with ability to cleaning, transforming, and preparing data for analysis
3	Knowledge on Statistical Analysis for data science	Understanding of statistical methods, probability theory and ability to apply statistical tests appropriately.
4	Expertise in Data Visualization	Create compelling visualizations with Tools like Matplotlib, Seaborn, ggplot2, Tableau, or Power BI to communicate insights effectively
5	Familiarity in Database management and machine learning	Understanding of SQL, machine learning algorithms and familiarity with NoSQL databases like MongoDB for handling unstructured data and Scikit-learn, TensorFlow, or Keras. And working in areas requiring advanced AI techniques.

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

Course Outcomes (COs)

COs	Description
M23BEC705C.1	Understand the fundamental concepts of data science.
M23BEC705C.2	**Apply** the data analysis, data science process and program for the algorithms.
M23BEC705C.3	**Analyze** feature section algorithms and recommendation systems using basic tools of Exploring Data Analysis.
M23BEC705C.4	**Design** map reduce solutions for large data for data visualizations.

CO-PO-PSO Mapping

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
M23BEC705C.1	3	-	-	-	3	-	-	-	-	-	-	-	3	-
M23BEC705C.2	3	3	-	-	3	-	-	-	-	-	-	-	3	-
M23BEC705C.3	-	3	-	3	3	-	-	-	-	-	-	-	3	3
M23BEC705C.4	-	-	3	-	3	-	-	-	2	-	-	-	-	3
M23BEC705C	**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:

- **Adaptation to Technological Advancements**: As new materials and manufacturing techniques emerge, the curriculum will need to adapt to incorporate these advancements, ensuring graduates are equipped with the latest knowledge.
- **Increased Automation and AI Integration:** Auto ML and No-Code Platforms: Tools that automate machine learning model development, such as Auto ML, are becoming more sophisticated. These platforms allow non-experts to build models with minimal coding, democratizing access to data science.
- **AI-Driven Data Science**: AI will increasingly be used to automate parts of the data science workflow, from data cleaning to model selection and optimization. This can lead to faster, more efficient processes and allow data scientists to focus on higher-level tasks.
- **Advancements in Deep Learning and AI:** Advanced Neural Networks: Deep learning models, particularly in natural language processing (NLP) and computer vision, will continue to advance, enabling more complex and nuanced tasks like real-time translation, advanced image recognition, and predictive analytics.
- **Edge Computing and IoT Integration:** Real-Time Analytics at the Edge: With the rise of the Internet of Things (IoT), data science will increasingly move towards edge computing, where data is processed closer to where it is generated, reducing latency and allowing for real-time decision-making.
- **Data-Driven Culture and Decision-Making:** Data-Driven Organizations: Companies will increasingly adopt data-driven cultures, where data science insights inform decision-making at all levels. This will require data scientists to work closely with business leaders to ensure that insights are actionable and aligned with strategic goals.
- **Augmented Decision-Making:** AI and machine learning will augment human decision-making by providing data-driven insights and recommendations, enabling faster and more informed decisions.

7th Semester	Professional Elective – IV (PE-IV) LOW POWER VLSI	M23BEC705D

1. Prerequisites

S/L	Proficiency	Prerequisites
1	**Mathematics**	Strong analytical skills and understanding of linear algebra, calculus, and probability/statistics are useful for modeling and analyzing power consumption and performance trade-offs.
2	Digital Logic Design	Understanding basic digital logic gates, combinational and sequential circuits, and design principles. Familiar with concepts like Boolean algebra, flip-flops, counters, and multiplexers.
3	VLSI design Fundamentals	Basic knowledge of VLSI design, including CMOS technology, logic gates, and the general design flow from RTL (Register Transfer Level) to GDSII (Graphic Data System II) layout, is essential.
4	Circuit Design	A good grasp of analog and digital circuit design principles, including understanding transistors, resistors, capacitors, and operational amplifiers, is important.
6	Semiconductor Physics	Knowledge of semiconductor devices, especially CMOS transistors, is necessary for understanding how low power techniques impact performance and power consumption.
7	Signal Processing	Familiarity with basic signal processing techniques on low-power designs that involve signal conditioning or communication.
8	Power Consumption and Management	Concepts related to power dissipation. Knowing about various power management techniques and trade-offs will be beneficial.
9	Software Tools and Simulation:	Proficiency in using EDA (Electronic Design Automation) tools like SPICE for circuit simulation and tools for layout and verification (like Cadence, Synopsys, or Mentor Graphics) is important.

2. Competencies

S/L	Competency	KSA Description
1	VLSI Design Techniques	**Knowledge:** Understanding of CMOS transistor operation and its role in low power design. **Skills:** Knowledge of techniques like clock gating, power gating, voltage scaling, and multi-threshold CMOS (MTCMOS). **Attitudes:** A proactive approach to solving complex power-related issues and optimizing designs.
2	Circuit Design and Optimization	**Knowledge:** Understanding of fundamental circuit components (transistors, resistors, capacitors) and their functions in both analog and digital circuits. Knowledge of design strategies for optimizing performance, power, and area (PPA). **Skills:** Ability to design and analyze circuits using tools and techniques to meet performance and power specifications. This includes schematic design and simulation **Attitudes:** Attentions to designing and optimizing circuits, ensuring all details are considered to achieve desired performance and efficiency. Applying new techniques and tools to improve circuit design and optimization processes as technology evolves.
3	Power Analysis and Estimation	**Knowledge:** Understanding of different types of power consumption—dynamic (switching) power, static (leakage) power, and short-circuit power. Knowledge of power models and their applications in VLSI design (e.g., empirical models, analytical models). **Skills:** Proficiency in using tools for power analysis and estimation (e.g., Cadence, Synopsys Power Compiler). Ability to perform detailed power calculations for

		both digital and analog components. Skill in applying power reduction techniques to design to minimize power consumption while maintaining performance. **Attitudes:** Attention to power analysis, ensuring that all aspects of power consumption are accurately measured and accounted for
4	Digital Design and Verification	**Knowledge:** Understanding of basic digital logic elements (gates, flip-flops, multiplexers, etc.), and how they are used to build digital circuits. Knowledge of designing and analyzing combinational and sequential circuits. **Skills:** Proficiency in writing, debugging, and synthesizing HDL code for various digital circuits and systems Skill in reviewing HDL code for correctness, efficiency, and adherence to design specifications. Ability to create and manage test benches for verifying the functionality of digital designs. **Attitudes:** A proactive attitude towards identifying and solving complex issues encountered during design and verification.
5	EDA Tools and Simulation	**Knowledge:** Understanding the purpose and capabilities of various EDA tools (e.g., Cadence, Synopsys, Mentor Graphics) for circuit design, layout, and verification. Knowledge of different types of simulations (e.g., SPICE, behavioral, timing) and their applications in design **Skills:** Ability to effectively use EDA tools for tasks such as schematic capture, layout design, and physical verification. Skills in using EDA tools to debug designs, analyze results, and optimize performance. **Attitudes:** Attention to using EDA tools and interpreting simulation results to ensure accuracy and avoid design errors. Attention towards troubleshooting and solving issues encountered during simulation and design.

3. Syllabus

Low Power VLSI **SEMESTER – VII**			
Course Code	**M23BEC705D**	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. Identify sources of power in an IC.
2. Identify the power reduction techniques based on technology independent and
3. technology dependent
4. Power dissipation mechanism in various MOS logic style.
5. Identify suitable techniques to reduce the power dissipation.
6. Design memory circuits with low power dissipation

Module -1

POWER DISSIPATION IN CMOS

Sources of power dissipation – Physics of power dissipation in MOSFET devices: The MIS structure, long channel MOSFET, Submicron MOSFET , gate induced drain leakage– Power dissipation in CMOS : short circuit dissipation, dynamic dissipation, load capacitance– Low power VLSI design: Limits – principles of low power design.

Module -2

LOW-POWER CMOS LOGIC CIRCUITS

Introduction, Overview of Power Consumption, Low-Power Design Through Voltage Scaling , Estimation and Optimization of Switching Activity , Reduction of Switched Capacitance , Adiabatic Logic Circuits .

Module -3

SYNTHESIS FOR LOW POWER

Behavioural Level Transforms: Algorithm level transform for low power, power constrained least-squares optimization for adaptive and non adaptive filters. Logic Level Optimization for Low power's and combinational logic synthesis. Circuit Level Optimization: circuit level transforms,CMOS gates, Transistor sizing.
Module -4
LOW POWER STATIC RAM ARCHITECTURES Organization of a static RAM, MOS Static RAM Memory cell, Banked organization of SRAMs, Reducing voltage swings on bit lines, Reducing power in write driver circuits, Reducing power in sense amplifier circuits, method for achieving low core voltages from a single supply.
Module -5
DESIGN AND TEST OF LOW VOLTAGE CMOS CIRCUITS Circuit Design style, Leakage current in deep sub micrometer transistors, Deep sub micrometer device design issues, Low voltage circuit design techniques, Designing deep sub micrometerics with elevated intrinsic leakage, multiple supply voltages.
TEXTBOOKS: 1. J.B.Kulo and J.H Lou, ―low power digital VLSI design‖, New York 2000. 2 R.W.Broadersen, CMOS Digital Integrated Circuits –Analysis and Design –Sung-Mo Kang, Yusuf Leblebici, TMH,2011. **REFERENCE BOOKS:** 1.Introduction to VLSI Systems: A Logic, Circuit and System Perspective –Ming-BO Lin, CRC Press,2011 2.Low Power CMOS VLSI Circuit Design –Kaushik Roy, Sharat C. Prasad, John Wiley & Sons, 2000. 3. Practical Low Power Digital VLSI Design –Gary K. Yeap, Kluwer Academic Press, 2002. 4. Leakage in Nanometer CMOS Technologies –Siva G. Narendran, Anatha Chandrakasan, Springer,2005.

4. Syllabus Timeline

S/L	Syllabus Timeline	Description
1	Week 1-3: power dissipation in CMOS	Introduction to concepts of Sources of power dissipation – Physics of power dissipation in MOSFET devices: The MIS structure, long channel MOSFET, Submicron MOSFET , gate induced drain leakage– Power dissipation in CMOS : short circuit dissipation, dynamic dissipation, load capacitance– Low power VLSI design: Limits – principles of low power design
2	Week 4-6: low-power CMOS logic circuits	Understanding the concepts Power Consumption, Low-Power Design Through Voltage Scaling, Estimation and Optimization of Switching Activity, Reduction of Switched Capacitance, Adiabatic Logic Circuits .
3	Week 8-11: synthesis for low power	Studying the different types of optimization like Behavioral Level Transforms, Logic Level Optimization for Low power, Circuit Level Optimization
4	Week 7-8: low power static ram architectures	Understanding the concept of static RAM, MOS Static RAM Memory cell, Banked organization of SRAMs, Reducing voltage swings on bit lines,
5	Week 9-12: design and test of low voltage CMOS circuits	Understanding the concepts of Circuit Design style, Leakage current in deep sub micrometer transistors, Deep sub micrometer device design issues, Low voltage circuit design techniques.

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 Verilog 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	Laboratory Learning	Uti Utilize the facilities available in the laboratories to understand the behavior of the materials by performing few experiments.

6. Assessment Details (both CIE and SEE)

Continuous Internal Evaluation:

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

CIE Split up

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

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	Understand Power Consumption Mechanisms:	Comprehend the different sources of power consumption in VLSI circuits, including dynamic power, static power, and leakage power..
2	Apply Power Reduction Techniques:	Learn and apply techniques for reducing power consumption, such as voltage scaling, frequency scaling, clock gating, and power gating.
3	Utilize Power Estimation and Analysis Tools:	Develop the skills to estimate and analyze power consumption at various levels of abstraction (e.g., transistor level, gate level, and system level).
4	Implement Low Power Design Strategies:	Apply low power design methodologies to create and optimize circuits with minimal power consumption..
5	Analyze Power Management Techniques:	Gain insights into various power management techniques, including thermal management and power-aware scheduling.
6	Solve Practical Design Problems:	Develop problem-solving skills by working on hands-on projects and case studies that require designing low power VLSI circuits.

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

Course Outcomes (COs)

COs	Description
M23BEC705D.1	Explain the sources of power consumption in VLSI circuits, including dynamic power, static power, and leakage power, and how these sources impact overall power efficiency.
M23BEC705D.2	Applying techniques for reducing power consumption, such as voltage scaling, clock gating, and power gating and multi-threshold CMOS design, to optimize VLSI circuits for minimal power usage.
M23BEC705D.3	Evaluate power consumption at different levels of abstraction and identify potential areas for improvement in VLSI designs.
M23BEC705D.4	Designing VLSI circuits with a focus on power efficiency, demonstrating their ability to balance power, performance, and area constraints in practical design scenarios.
M23BEC705D.5	Evaluate power management techniques, such as dynamic power management and thermal management, and integrate them into VLSI systems to enhance overall power efficiency and reliability.

CO-PO-PSO Mapping

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
M23BEC705D.1	3	-	-	-	-	-	-	-	-	-	-	-	3	-
M23BEC705D.2	-	3	-	-	-	-	-	-	-	-	-	-	-	3
M23BEC705D.3	-	-	3	3	-	-	-	-	-	-	-	-	3	-
M23BEC705D.4	-	2	-	3	2	-	-	-	-	-	-	-	-	3

M23BEC705D.5	**-**	**-**	3	-	-	-	-	-	-	-	-	-	3	3
M23BEC705D	**3**	**3**	3	3	2	-	-	-	-	-	-	-	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:

- **Advancements in Semiconductor Technology**: The continued miniaturization of transistors, moving towards technologies like 3nm and beyond, will enable more powerful and efficient chips. This trend also involves exploring new materials, such as grapheme or transition metal dichalcogenides, to overcome the limitations of silicon.
- **3D Integration and Packaging**: 3D ICs (Integrated Circuits) and advanced packaging techniques are gaining traction to overcome the limitations of traditional 2D planar designs. This approach allows for higher performance, reduced latency, and better power efficiency by stacking chips and integrating them in novel ways.
- **Neuromorphic and Quantum Computing**: Neuromorphic computing, which mimics the neural structures of the human brain, and quantum computing are emerging fields that could revolutionize VLSI design. These technologies require new types of circuits and architectures, potentially leading to major breakthroughs in computing power and efficiency.
- **AI and Machine Learning**: AI and machine learning are becoming integral to VLSI design and verification processes. These technologies are used for optimizing circuit layouts, predicting performance, and even automating parts of the design process, making it more efficient and accurate.

7th Semester	Professional Core Course Laboratory (PCL) ADVANCED IOT LAB	M23BECL706

1. Prerequisites

S/L	Proficiency	Prerequisites
1	Basic electronics	• Knowledge of sensors, and actuators and their working principle
2	Embedded systems	• Knowledge of Embedded systems and interfacing of sensors and actuators with controller.
3	IoT and Computer Networks:	• Essential for understanding data communication and networking aspects of IoT systems.
4	Basic Programming	• Basic programming skills, as the course involves using Python and network programming using protocols.

2. Competencies

S/L	Competency	KSA Description
1	Interfacing I/O devices and communication modules.	**Knowledge:** Understanding of interfacing sensors, and actuators with Raspberry Pi Knowledge of communication modules like Bluetooth and their role in IoT. Familiarity with Python libraries for Bluetooth communication. **Skills:** Proficiency in writing Python programs to interface with I/O devices and sensors. Ability to configure and use communication modules to send and receive data. **Attitudes:** Curiosity about emerging IoT technologies and applications.
2	Cloud-Based Data Monitoring and Control	**Knowledge:** Understanding of cloud platforms like Adafruit IO, Google Sheets, and communication protocols like HTTP. **Skills:** Proficiency in using cloud services for real-time monitoring and data storage, as well as designing web-based control systems. **Attitudes:** Enthusiasm for exploring innovative IoT use cases.
3	IoT Integration with Industry Tools	**Knowledge:** Understanding of IoT architecture, industry standards, APIs, and SDKs for IoT integration. **Skills:** Competency in integrating IoT devices with industrial tools like Cisco and using SDKs to develop IoT applications. **Attitudes:** Systems-thinking approach with a focus on scalability, efficiency, and adherence to industry best practices.

3. Syllabus

ADVANCED IoT LAB SEMESTER – VII			
Course Code	**M23BECL706**	CIE Marks	**50**
Number of Lecture Hours/Week(L: T: P: S)	**0:0:2:0**	SEE Marks	**50**
Total Number of Lab Hours	**12 Lab sessions**	Total Marks	**100**
Credits	**01**	Exam Hours	**03**

Course Objectives:

1. To build IoT systems that collect real-time data from environmental sensors (e.g., temperature, humidity) and integrate this data with cloud platforms.
2. To develop IoT applications that allow remote control of devices via smart phones and web interfaces.
3. Design IoT solutions that integrate voice recognition and Bluetooth communication for controlling devices and visualizing data on cloud platforms, enhancing their understanding of human-device interaction in IoT contexts.
4. To use industry tools and platforms, such as Cisco IoT tools, SDKs, and APIs (e.g., WITHINGS), for building scalable and interoperable IoT systems.

Sl. No.	Experiments

1	Design and implement a basic smart home system using Raspberry Pi, controlling devices like lights, and fans
2	Build a system to turn on the LED using voice commands through Bluetooth devices and display the LED status in an Adafruit IO cloud platform.
3	Build an IoT-based system to monitor temperature, and humidity in an Adafruit IO cloud platform.
4	Build an IoT-based system to control LED via HTTP web server using Raspberry Pi.
5	Build an IoT-based system to control LED remotely using a smart phone using Raspberry Pi.
6	Build an IoT-based system to monitor temperature, and humidity and store collected data in a Google sheet database.
7	Implementation of the master-slave scenario using Raspberry Pi.
8	Implementation of IoT in Cisco tools.
9	Implementation of API types in IoT like WITHINGS.
10	Implementations of SDKs for IoT.
Open Ended Experiment	
11	Build an IoT-based system to control LED remotely using a smart phone and monitor the status in Adafruit IO cloud platform using Raspberry Pi.

4. Syllabus Timeline

S/L	Syllabus Timeline	Description
1	Week 1	Lab Introduction.
2	Week 2	Design and implement a basic smart home system using Raspberry Pi, controlling devices like lights, and fans
3	Week 3	Build an IoT-based system to monitor temperature, and humidity in an Adafruit IO cloud platform.
4	Week 4	Build an IoT-based system to control LED via HTTP web server using Raspberry Pi.
5	Week 5	Build an IoT-based system to control LED remotely using a smart phone using Raspberry Pi.
6	Week 6	Build an IoT-based system to monitor temperature, and humidity and store collected data in a Google sheet database.
7	Week 7	Implementation of the master-slave scenario using Raspberry Pi.
8	Week 8	Implementation of IoT in Cisco tools.
9	Week 9	Implementation of API types in IoT like WITHINGS.
10	Week 10	Implementations of SDKs for IoT.
11	Week 11	Repetition
12	Week 12	Internals

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 IoT and WSN concepts.
3	Interactive Lectures	Clear explanations of concepts with real-world examples. Engage students through questions and discussions.
4	Flipped Class Technique	Utilize a flipped class approach, providing materials before class to facilitate a deeper understanding of competencies
6	Improve the Experiments	Assign changes in the experiment and ask to show the result.

6. Assessment Details (both CIE and SEE)

- CIE marks for apracticalcourseshallbe50marks.
- The split up of CIE marks for record / journal and test to be split in the ratio 60:40
- Record write up for individual experiment will be evaluated for 10 Marks
- Total marks scored for record writing and conduction shall be scaled downed to 30 marks (60% of maximum marks)
- One test for100 marks after the completion of the experiments at the end of the semester

Marks distribution for experiment based Practical Course for CIE

Sl. No.	Description	%of Marks	In Marks
1	Write-up, Conduction, result and Procedure	60%	60
2	Viva-Voce	40%	40
Total		100%	100

The Test marks should be scaled down to 20 marks (40% of the maximum CIE Lab Marks (50))

Final CIE in Practical Course:

Marks distribution for Experiment based Practical Course for Final CIE

Sl. No.	Description	% of Marks	In Marks
1	Scaled Down marks of record / journal	60% of the maximum	30
2	Scaled Down marks of test	40% of the maximum	20
Total		100%	50

CIE for Practical Courses (Program Based):

Internal test for laboratory course with software experiments shall be conducted for a total of 100 mark at the end the semester and the assessment pattern is:

Marks distribution for Program based Practical Course for CIE

Sl. No.	Description	% of Marks	InMarks
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 for100 are scaled down to 50marks.

SEE for practical Course (Irrespective of Experiment or program based):

1. SEE marks for practical course shallbe50marks.
2. SEE for practical course is evaluated for 100 marks and scored marks shall be scaled down to 50 marks.
3. Change of experiment/program is allowed only once and 20% marks allotted to the procedure/write-up part to be made zero.
4. Duration of SEE shall be 3 hours.

Marks distribution for Experiment based Practical Course for Final SEE

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

7. Learning Objectives

S/L	Learning Objectives	Description
1	Smart Home Automation and Device Control	Learn to design and implement smart home systems using Raspberry Pi, controlling devices via various interfaces such as smartphones and voice commands.
2	Data Monitoring	Build IoT systems to monitor environmental parameters (temperature, humidity) and store data in cloud platforms like Adafruit IO and Google Sheets.
3	IoT Communication Architectures	Understand and implement communication models such as master-slave using Raspberry Pi and IoT protocols.
4	IoT Tools, APIs, and SDKs	Gain proficiency in using industry tools (Cisco) and implement APIs (WITHINGS) and SDKs for IoT system development.

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

Course Outcomes (COs)

Cos	Description
M23BECL706.1	**Explain** the fundamental concepts and working principles of sensors, actuators, and communication modules used with Raspberry Pi

M23BECL706.2	**Interface** sensors and actuators with Raspberry Pi for specific tasks like sensor data monitoring and control device.
M23BECL706.3	**Develop** IoT system for remote monitoring and control of IoT devices through web servers, voice commands, and mobile devices.
M23BECL706.4	**Apply** IoT concepts to build master-slave systems and IoT application systems using cloud platform, APIs, SDKs.

CO-PO-PSO Mapping

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
M23BECL706.1	3	-	-	-	-	-	-	-	-	-	-	-	3	-
M23BECL706.2	3	2	-	-	2	-	-	-	2	-	-	2	3	2
M23BECL706.3	3	2	3	-	2	-	-	-	2	-	-	2	3	2
M23BECL706.4	3	2	3	-	2	-	-	-	2	-	-	-	3	2
M23BECL706	**3**	**2**	**3**	-	**2**	-	-	-	**2**	-	-	**2**	**3**	**2**

9. Assessment Plan

Continuous Internal Evaluation (CIE)

	CO1	CO2	CO3	CO4	CO5	Total
Experiment 1	**20**	**30**				**50**
Experiment 2	**10**	**10**	**30**			**50**
Experiment 3	**10**	**10**		**30**		**50**
Experiment 4	**10**	**10**	**30**			**50**
Experiment 5	**10**	**10**	**30**			**50**
Experiment 6	**10**	**10**	**30**			**50**
Experiment 7	**10**	**10**		**30**		**50**
Experiment 8	**10**	**10**		**30**		**50**
Experiment 9	**10**	**10**		**30**		**50**
Experiment 10	**10**	**10**		**30**		**50**
Total	**10**	**10**	**10**	**20**		**50**

Semester End Examination (SEE)

	CO1	CO2	CO3	CO4	CO5	Total
Experiment	**10**	**10**	**10**	**20**		
Total						

10. Future with this Subject:

- Industrial Automation and Control: The combination of Raspberry Pi and Python can be leveraged in industrial settings for automation, process control, and monitoring applications. These systems can be used for tasks such as data acquisition, machine control, and predictive maintenance, leading to increased efficiency and productivity.
- Robotics and Autonomous Systems: The affordability and versatility of Raspberry Pi make it an attractive platform for developing robotics applications and autonomous systems. Python programming can be used for tasks such as computer vision, motion control, and decision-making algorithms in robots and drones.
- Cross-Disciplinary Applications (AI, ML, Block chain): The integration of IoT with other technologies like artificial intelligence (AI), machine learning (ML), and blockchain is expected to drive the next wave of innovation. These technologies combined with IoT will enhance automation, predictive analytics, and secure transactions.

7th Semester	Project Work (PW) MAJOR PROJECT PHASE-II	M23BEC707

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
M23BEC707.1	Successfully execute the project plan and achieve the defined objectives.
M23BEC707.2	Analyze and interpret experimental data to derive meaningful conclusions.
M23BEC707.3	Demonstrate the ability to apply engineering and management principles effectively within a team, managing project timelines, resources, and deliverables to achieve project goals.
M23BEC707.4	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
M23BEC707.1	3	3	2	2	3	2	2	2	-	-	-	2	3	-
M23BEC707.2	3	3	2	2	3	2	2	2	-	-	-	2	3	3
M23BEC707.3	3	3	2	2	3	2	2	2	3	3	3	2	3	3
M23BEC707.4	-	-	-	-	-	-	-	-	-	3	3	2	-	-
M23BEC707	**3**	**3**	2	2	3	2	2	2	3	3	3	2	**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	M23BEC803

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
M23BEC803.1	Conduct comprehensive research and organize technical content for a seminar presentation.
M23BEC803.2	Prepare and deliver a clear and engaging technical presentation using appropriate tools and techniques.
M23BEC803.3	Engage in technical discussions, respond to queries, and participate in group debates effectively.
M23BEC803.4	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
M23BEC803.1	3	-	-	-	-	-	-	-	-	-	-	-	3	3
M23BEC803.2	-	3	-	-	-	-	-	-	-	-	-	-	3	3
M23BEC803.3	-	-	3	-	-	-	-	-	-	-	-	-	3	3
M23BEC803.4	-	-	-	3	-	-	-	-	-	-	-	-	3	3
M23BEC803	3	3	3	3	-	-	-	-	-	-	-	-	3	3

8th Semester	Internship (IS) INTERNSHIP	M23BEC804

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
M23BEC804.1	Demonstrate the ability to apply research methodologies or industry practices to solve complex problems in a real-world context.
M23BEC804.2	Develop and implement effective solutions to technical challenges encountered during the internship, showcasing problem-solving skills.
M23BEC804.3	Communicate technical information clearly and effectively through well-structured reports and presentations.
M23BEC804.4	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
M23BEC804.1	3	-	-	-	-	-	-	-	-	-	-	-	3	3
M23BEC804.2	-	3	-	-	-	-	-	-	-	-	-	-		3
M23BEC804.3	-	-	3	-	-	-	-	-	-	-	-	-	3	3
M23BEC804.4	-	-	-	3	-	-	-	-	-	-	-	-	3	3
M23BEC804	3	3	3	3	-	-	-	-	-	-	-	-	3	3