CURRICULUM
CHOICE BASED CREDIT SYSTEM

EVALUATION SCHEME

AND

COURSE OF STUDY

ACCORDING TO AICTE MODEL CURRICULUM

IN

B.TECH

ELECTRONICS AND COMMUNICATION ENGINEERING

APPROVED BY
BOARD OF SYLLABUS FOR THIRD AND FOURTH YEAR
25 JUNE 2025
(w.e.f. Batch 2025 and onwards)

FACULTY OF ENGINEERING AND TECHNOLOGY
GURUKUL KANGRI (DEEMED TO BE) UNIVERSITY
HARIDWAR-249404

Website: https://www.gkv.ac.in/departments/ece/

VISION

To become an excellence in higher education and learning center, that will provide inter disciplinary knowledge with impartment of human values and professional ethics among the youth, so as to serve as a valuable resource for industry and human society.

MISSION

"Educate everyone for technological transformation"

Motivate the students to serve the nation and globe by their knowledge in the field of Electronics and Communication Engineering and the allied areas through constant interaction with research organizations and industries.

CORE VALUES

Ethics, Human Values, Professionalism, Commitment, Integrity, Team Work and Innovation.

Program Objectives

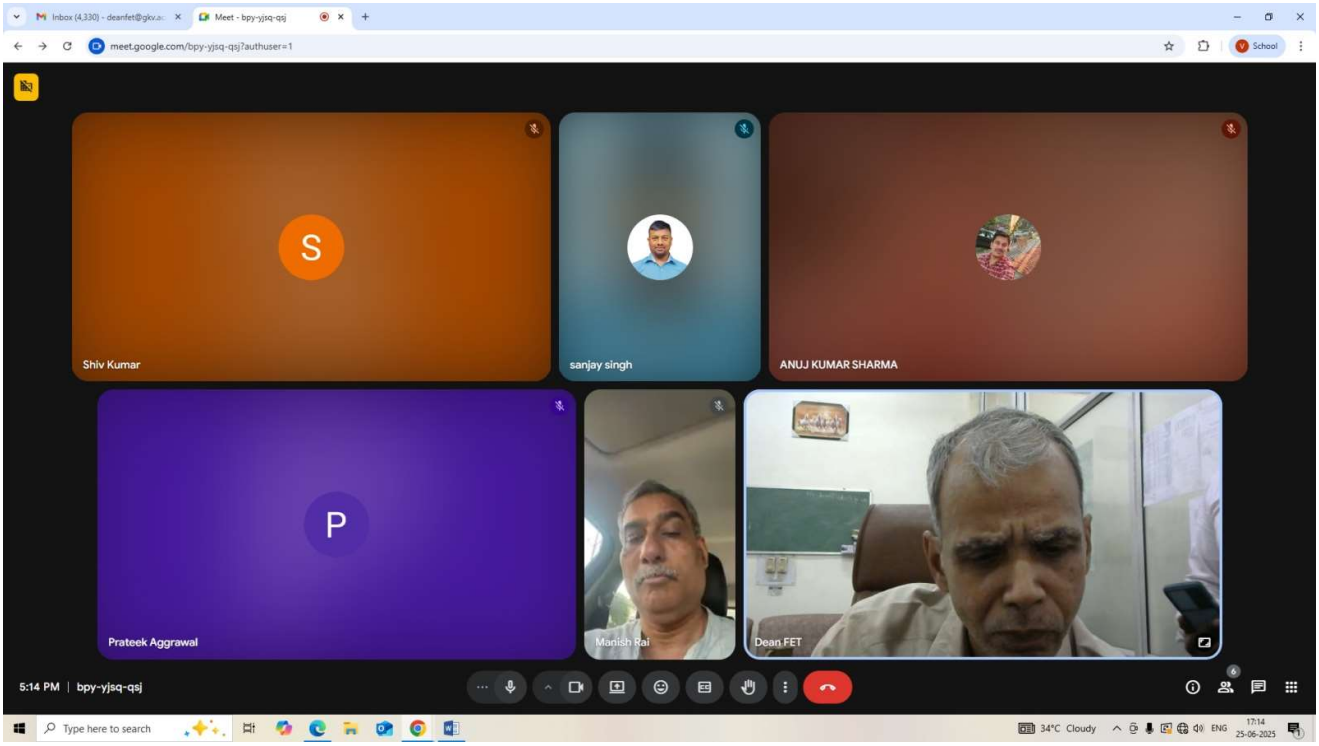
1. To provide students with strong foundation in basic sciences, Vedic knowledge, mathematics, computing, engineering principles and human values.
2. To confer in profundity information in center zones ofElectronics and Communication Engineering so as to comprehend, analyze, design, and create novel products and solutions for various real life problems.
3. To provide students with an academic environment to promote teamwork, ethics, multidisciplinary approach and lifelong learning required for a successful professional carrier.

Program Outcomes

1. Impart knowledge of mathematics, sciences, and engineering fundamentals in the domain of Electronics and Communication Engineering.
2. Potential to analyze an engineering problem and formulate its suitable solution.
3. Ability to design systems and processes that met the requirements of public safety and offer solutions for societal and environmental issues.
4. Ability to formulate and analyze complex engineering problems by using mathematical principles and engineering fundamentals.
5. Select appropriate techniques and modern automation tools for the system design and analysis.
6. Skills to develop environment friendly and sustainable solutions.
7. Understanding and commitment towards professional ethics, responsibilities and norms of engineering practices so as to become good citizens.
8. Ability to function effectively, individually and in a team.
9. Proficiency in communication, both verbal and written forms, which will enable them to complete globally.
10. Recognize the need for and have the ability to engage in independent and lifelong learning and hence participate and succeed in competitive examinations, higher studies etc.
11. Willingness and ability to take up administrative responsibilities involving both project and financial management confidently.
12. Development of a holistic perspective based on self-exploration about themselves (human being), family, society and nature/existence.

- AICTE rules regarding NEP will be accepted as such.

Batch 2025-2026 and onwards



Batch 2025-2026 and onwards

(Effective from the academic session 2025-26)

GURUKULA KANGRI VISHWAVIDYALAYA, HARIDWAR

Faculty of Engineering & Technology

Electronics & Communication Engineering

B. Tech. Third Year (SEMESTER-V)

Syllabus in accordance with AICTE Model Curriculum

SEMESTER-V

DSC/SEC /DSE/AEC	SUBJECT	PERIODS			EVALUATION SCHEME				Subject Total	Credits
					SESSIONAL EVALUATION			EXAM ESE		
		L	T	P	CT	TA	Total			
THEORY										
BET-C515	Communication Systems	3	0	0	20	10	30	70	100	3
BET-C516	Digital Signal Processing	3	0	0	20	10	30	70	100	3
BET-C517	Embedded Systems	3	0	0	20	10	30	70	100	3
BET-M001	Universal Human Values	3	0	0	20	10	30	70	100	3
BET-C518	VLSI Design	3	0	0	20	10	30	70	100	3
BET-C513	Control System	3	0	0	20	10	30	70	100	3
		TOTAL CREDITS								18
PRACTICAL										
BET-C565	Communication System Lab	0	0	2	10	5	15	35	50	1
BET-C566	DSP Lab	0	0	2	10	5	15	35	50	1
BET-C567	Embedded Systems Lab	0	0	2	10	5	15	35	50	1
BET-S559	Summer Training and Internship Program-II/mini project (3-4 weeks)	To be pursued during summer vacation, submit a certificate of completion in the department(in summer break after IV semester exam and will be assessed during V semester)							50	1
		TOTAL CREDITS								4
TOTAL		18	0	6	150	75	225	525	800	22

Batch 2025-2026 and onwards

(Effective from the academic session 2025-26)

GURUKULA KANGRI VISHWAVIDYALAYA, HARIDWAR

Faculty of Engineering & Technology

Electronics & Communication Engineering

B. Tech. Third Year (SEMESTER-VI)

Syllabus in accordance with AICTE Model Curriculum

SEMESTER-VI

DSC/SEC/ DSE/AEC	SUBJECT	PERIODS			EVALUATION SCHEME				Subject Total	Credits
					SESSIONAL EVALUATION			EXAM ESE		
		L	T	P	CT	TA	Total			
THEORY										
BCE-C647	Java based Object Oriented Programming	3	0	0	20	10	30	70	100	3
BET-C614	Antenna and Wave Propagation	3	0	0	20	10	30	70	100	3
BET-E6XX	Elective – I	3	0	0	20	10	30	70	100	3
BET-E6XX	Elective – II	3	0	0	20	10	30	70	100	3
B-6XX	Open elective	3	0	0	20	10	30	70	100	3
BET-C615	Wireless Communication	3	0	0	20	10	30	70	100	3
		TOTAL CREDITS								18
PRACTICAL										
BCE-C667	Java based Object Oriented Programming Lab	0	0	2	10	5	15	35	50	1
BET-E6XX	Elective Lab	0	0	2	10	5	15	35	50	1
BET-C663	Seminar	0	0	2	10	5	15	35	50	1
		TOTAL CREDITS								3
TOTAL		18	0	6	150	75	225	515	750	21

Electives are the B.Tech. specialization subjects for specific stream. Three specializations are there.

1. Chip Design and Manufacturing
2. IoT and Embedded systems
3. Machine Learning

OpenElective Subject List:

BCE-O648: Cloud Computing
BET-O634: Introduction to PLC and SCADA Systems
BET-O632:Sensors and Transducers
BCE-O633:Introduction to Data Science and Design Thinking
BET-O633: Data Communication & Network Protocols

Batch 2025-2026 and onwards

(Effective from the academic session 2026-27)

GURUKULA KANGRI VISHWAVIDYALAYA, HARIDWAR

Faculty of Engineering & Technology

Electronics & Communication Engineering

B. Tech. Fourth Year(SEMESTER-VII)

Syllabus in accordance with AICTE Model Curriculum

SEMESTER-VII

DSC/SEC/ DSE/AEC	SUBJECT	PERIODS			EVALUATION SCHEME				Subject Total	Credits
					SESSIONAL EVALUATION			EXAM ESE		
		L	T	P	CT	TA	Total			
THEORY										
BET-C710	Microwave Engineering	3	0	0	20	10	30	70	100	3
BHU-S702	Industrial Economics and Intellectual Property Rights	2	0	0	20	10	30	70	100	2
BET-E7XX	Elective – III	3	0	0	20	10	30	70	100	3
BET-E7XX	Elective – IV	3	0	0	20	10	30	70	100	3
BET-E7XX	Elective – V	3	0	0	20	10	30	70	100	3
BET-P7XX	Programme Elective	3	0	0	20	10	30	70	100	3
		TOTAL CREDITS								17
PRACTICAL										
BET-C761	Microwave Lab	0	0	2	10	5	15	35	50	1
BET-C772	Minor Project	0	0	8	0	30	30	70	100	4
		TOTAL CREDITS								5
TOTAL		17	0	10	130	95	225	525	750	22

Students can choose Program Elective for seventh semester from the list given below:

ProgrammeElective Subject List:

BET-P720: Satellite Communication
BET-P721: Bio-Medical Electronics
BET-P722: Optical Fiber Communication
BET-P723: Next generation communication technology
BET-P724: Robotics Engineering
BET-P725: Electrical Vehicles and Energy Storage System
BET-P726:Fundamental of Radar and Navigation

Batch 2025-2026 and onwards

(Effective from the academic session 2026-27)

GURUKULA KANGRI VISHWAVIDYALAYA, HARIDWAR
Faculty of Engineering & Technology
Electronics & Communication Engineering
B. Tech. Fourth Year (SEMESTER-VIII)
Syllabus in accordance with AICTE Model Curriculum

SEMESTER-VIII

DSC/SEC/DSE/AEC	SUBJECT	PERIODS			EVALUATION SCHEME				Subject Total	Credits
					SESSIONAL EVALUATION			EXAM ESE		
		L	T	P	CT	TA	TOTAL			
PRACTICAL										
BET-P860	Major Project with Research paper/ Internship (Projects Inside FET or Internship outside in any company or startup)	0	0	16	0	100	100	300	400	16
BET-S860	General Proficiency and seminar	0	0	2	Students demonstrate their specific skills and knowledge in various academic areas and present PPT				50	1
		TOTAL CREDITS								17
	TOTAL	0	0	16	0	100	100	300	450	17

Specialization in Chip Design and Manufacturing

S. No	Paper Code	Applicability	Semester	Course title	L	T	P	Credit
1	BET-E601	Elective I	6th	Digital Electronics Design WithVHDL	3	0	0	3
2	BET-E602	Elective II	6th	FPGA based system Design	3	0	0	3
3	BET-E701	Elective III	7th	VLSI Verification & Testing	3	0	0	3
4	BET-E702	Elective IV	7th	Low power VLSI Design	3	0	0	3
5	BET-E703	Elective V	7th	System on-Chip Design	3	0	0	3
6	BET-E651	Elective lab 1	6th	VLSI lab	0	0	2	1
				Total				16

Specialization in IOT & Embedded systems

S. No	Paper Code	Applicability	Semester	Course title	L	T	P	Credit
1	BET-E610	Elective I	6th	Introduction to Internet of Things	3	0	0	3
2	BET-E611	Elective II	6th	Embedded system for IOT	3	0	0	3
3	BET-E710	Elective III	7th	IOT with Arduino, ESP and Raspberry Pi	3	0	0	3
4	BET-E711	Elective IV	7th	Cyber security and privacy in IOT	3	0	0	3
5	BET-E712	Elective V	7th	IOT based data analytics and application	3	0	0	3
6	BET-E652	Elective lab 1	6th	IOT lab	0	0	2	1
				Total				16

Specialization in Machine Learning

S. No	Paper Code	Applicability	Semester	Course title	L	T	P	Credit
1	BET-E620	Elective I	6th	Machine Learning	3	0	0	3
2	BET-E621	Elective II	6th	Soft computing Techniques	3	0	0	3
3	BET-E720	Elective III	7th	Introduction of AI	3	0	0	3
4	BET-E721	Elective IV	7th	Deep Learning	3	0	0	3
5	BET-E722	Elective V	7th	Natural language Processing	3	0	0	3
6	BET-E653	Elective lab 1	6th	Machine Learning lab	0	0	2	1
				Total				16

Batch 2025-2026 and onwards

Course Code: BET-515

Course Name: Communication systems

MM:100 **Time: 3Hr.** L T P 3 0 0	**Sessional: 30** **ESE: 70** **Credit: 3**
Prerequisites :	Electronics Devices, Electromagnetics.
Course Objectives:	1. To understand the basic building blocks of the analog and digital communication system. 2. To analyze the signal flow/ characteristics of the modulated signals with different types of analog and digital modulation techniques. 3. To analyze error performance of analog and digital communication systems in presence of noise and other interferences. 4. To introduce the concept of information theory, the fundamentals of error control coding techniques, and their applications. 5. To examine performance of coding schemes in noisy environments
Course Coordinator	Mr. Sanjay Singh
NOTE:	The question paper shall consist of two sections (Section-A and Section-B). Section-A shall contain of ten (10) short answer type questions of six (06) mark each and student shall be required to attempt any five (05) questions. Section-B shall contain eight (08) long answer type questions of ten (10) marks each and student shall be required to attempt any four questions. Questions shall be uniformly distributed from the entire syllabus

UNIT	Module	Course Content	No. of Hours	POs mapped	PSOs mapped
UNIT-I	Module-1	Analog Communication techniques: Basic elements of Communication system, Need for modulation, Baseband and Passband signals, Analog Modulation Techniques, Modulators and demodulators of AM and FM.	**5**	PO1, PO2, PO3	PSO1, PSO2
	Module-2	Angle Modulation: Frequency Modulation (FM) and Phase Modulation (PM), AM Radio Broadcasting, FM Radio Broadcasting, Television Broadcasting.	**5**		
UNIT-II	Module-3	Digital Transmission Techniques: Sampling process- Sampling theorem, Spectrum of Sampled Signal, Aliasing, Nyquist Criterion, Signal Reconstruction from Sampled Signal. Pulse Code Modulation (PCM)- Sampler, quantizer, encoder; Noise considerations in PCM	**4**	PO1, PO2, PO3, PO4, PO5	PSO1, PSO2
	Module-4	Companding- A-Law and μ -Law; DPCM; Delta modulation, Adaptive Delta modulation; Line codes- RZ, NRZ, Bipolar, Unipolar, Machester coding, AMI and other codes; Typical multiplexed systems-Frequency Division Multiplexing (FDM) and Time Division Multiplexing (TDM); Inter Symbol Interference (ISI), Eye diagram	**4**		
Unit-III	Module-5	Digital Modulation Techniques: Baseband Transmission of Digital Data; Digital bandpass modulation techniques- Binary ASK, PSK, and FSK, Differential PSK, QPSK, MSK, M-Ary PSK, M-ary QAM; Signal constellation	**8**	PO1, PO2, PO3, PO4,	PSO1, PSO2
Unit IV:	Module-6	Signaling over AWGN Channels; Optimum Filter, Matched Filter Optimum Receivers Using Coherent Detection; Probability of Error; optimal detection and Error Probabilities of Various digital modulation Techniques Equalization principles:	**7**	PO1, PO2, PO3, PO4, PO5	PSO1, PSO2
Unit V:	Module-	Information Theory and coding: Mathematical models for information sources, Source-coding Theorem, Variable-Length	**7**	PO1, PO2,	PSO1,

	7	Source Coding, The Huffman Coding Algorithm, Block codes, Cyclic codes, convolution codes.		PO4, PO5	PSO2
Total No. of Hours			**40**		

Textbooks

1. Taub, Schilling, Guha (2013) "Principle of Communication Systems", McGraw Hill Publication. ISBN: 9781259029851.

Reference Books

1. Simon Haykin& Michael Moher "Communication Systems", 4th Edition, Wiley India Publication
2. J. G. Proakis and Masoud Salehi "Fundamentals of Communication Systems", Prentice Hall, 2008, ISBN: 978-81-317-0573-5
3. B.P. Lathi, Zhi Ding, "Modern Digital and Analog Communication Systems (4/e)", Oxford university Press, 2010, ISBN: 0195384938, 9780195384932.

Course Outcomes		
On completion of this course, the students will be able to		
1	**CO 1**	Understand different analog and digital modulation techniques.
2	**CO 2**	Analyse the performance of the analog communication and digital transmission processes and coding techniques.
3	**CO 3**	Analyse the performance of a digital pass band modulation schemes.
4	**CO 4**	Apply the knowledge of information theory and coding in digital communication systems.
5	**CO 5**	Evaluate performance of coding schemes in noisy environments

CO-PO Mapping

CO/PO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	3	3	2	3	1	-	-	-	-	-	-	3	2	2
CO2	3	3	2	2	1	-	-	-	-	-	-	3	3	3
CO3	3	3	2	2	1	-	-	-	-	-	-	3	3	3
CO4	3	3	2	2	1	-	-	-	-	-	-	3	3	3
CO5	3	3	2	2	1	-	-	-	-	-	-	3	3	3
Average	3	3	2	2	1	-	-	-	-	-	-	3	3	3

CO-PO Mapping

POs	**Learning Outcome 1**	**Learning Outcome 2**	**Learning Outcome 3**	**Learning Outcome 4**	**Learning Outcome 5**
PO1	Y	Y	Y	Y	Y
PO2	Y	Y	Y	Y	Y
PO3	Y	Y	Y	Y	Y
PO4	N	Y	Y	Y	Y
PO5	Y	Y	Y	Y	Y
PO6	N	N	N	N	N
PO7	N	N	N	N	N
PO8	N	N	N	N	N
PO9	N	N	N	N	N
PO10	N	N	N	N	N
PO11	N	N	N	N	N
PO12	N	N	N	N	N

PSOs	**Learning Outcome 1**	**Learning Outcome 2**	**Learning Outcome 3**	**Learning Outcome 4**	**Learning Outcome 5**
PSO1	Y	Y	Y	Y	Y
PSO2	Y	Y	Y	Y	Y
PSO3	N	N	N	N	N
PSO4	N	N	N	N	N

Batch 2025-2026 and onwards

Course Code: BET-C516

Course Name: DIGITAL SIGNAL PROCESSING

MM: 100 **Time: 3 Hr.** **L T P** **3 0 0**	**Sessional: 30** **ESE: 70** **Credit : 3**

Prerequisites:	Signal and system , Mathematics, Different Transforms (Fourier, Laplace, Z-transforms)
Objectives:	• To instruct the students to design the analog and digital IIR, FIR filters. • To introduce the students, the diverse structures for realizing digital filters. • To teach students the usage of appropriate tools for realizing signal processing modules • To understand the fast computation of DFT and appreciate the FFT processing. • Apply the principles of signal analysis to filtering • To study fundamentals of time, frequency and z-plane analysis and to discuss the interrelationships of these analytic method
Course Coordinator	Dr. Gorav Kumar Malik

NOTE:	The question paper shall consist of two sections (Section-A and Section-B). Section-A shall contain of ten (10) short answer type questions of six (06) mark each and student shall be required to attempt any five (05) questions. Section-B shall contain eight (08) long answer type questions of ten (10) marks each and student shall be required to attempt any four questions. Questions shall be uniformly distributed from the entire syllabus

UNIT	Module	Course Content	No. of Hours	POs mapped	PSOs mapped
UNIT-1	*Module-1*	Frequency Domain Sampling: The Discrete Fourier Transform Frequency-Domain Sampling and Reconstruction of Discrete-Time Signals. The Discrete Fourier Transform (DFT).	**6**	PO1/ PO2/ PO3/ PO4/ PO5	PSO1/ PSO2/
	Module-2	The DFT as a linear Transformation.Relationship of the DFT to Other Transforms. Properties of the DFT. Periodicity, Linearity, and Symmetry Properties. Multiplication of two DFTs and Circular Convolution. Additional DFT Properties. Frequency analysis of signals using the DFT.	**6**	PO1/ PO2/ PO3/ PO4/ PO5	PSO1/ PSO2/
UNIT-2	*Module-3*	Efficient Computation of the DFT: FFT Algorithms, Direct Computation of the DFT. Radix-2 FFT algorithms	**4**	PO1/ PO2/ PO3/ PO4/ PO5	PSO1/ PSO2/
	Module-4	Efficient computation of the DFT of two real sequences, computations, efficient computation of the DFT of a 2NPointreal sequences, Gortezel Algorithm, Chirp Z-transform algorithm.	**4**		
UNIT-3	*Module-5*	Direct forms (I & II), cascade and parallel realizations. Signal flow graph, Transposed structure, Basic FIR filter structures-. Direct form structure, frequency sampling structure, Lattice structure, Linear phase FIR structure. FIR structures	**6**	PO1/ PO2/ PO3/ PO4/ PO5	PSO1/ PSO2/
UNIT-4	*Module-6*	Symmetric and Anti-symmetric FIR Filters, Design of Linear-Phase FIR Filters Using Windows,	**4**	PO1/ PO2/ PO3/ PO4/ PO5	PSO1/ PSO2/

	Module-7	Design of Linear-Phase FIR Filters by the Frequency Sampling Method, Design of FIR, Equi-ripple filter design Differentiators. Design of Hilbert Transformers.	**3**	PO1/ PO2/ PO3/ PO4/ PO5	PSO1/ PSO2/
UNIT-5	*Module-8*	IIR Filter Design by Approximation of Derivatives, IIR Filter Design by Impulse Invariance. IIR Filter Design by the Bilinear Transformation. The Matched-z Transformation,	**3**	PO1/ PO2/ PO3/ PO4/ PO5	PSO1/ PSO2/
	Module-8	Characteristics of Commonly Used Analog Filters. Application of above technique to the design of Butterworth & Chebyshev filters. Introduction to wavelets.	**4**		
Total No. of Hours			**40**		

Learning Outcomes:	1. Understand and analyze the role of signal processingin terms of Discrete Fourier transform and DSP. 2. Understand the significance of various digital filter structure and role of DFT and FFT 3. Apply digital signal processing algorithms to various areas 4. Able to analyze and exploit the real-time signal processing applications 5. Able to create filters structures using delay elements, subtraction, summers etc.

Suggested books:

S. No.	Name of Authors /Books /Publisher	Year of Publication
1.	Proakis, J.G & Manolakis, D.G., "***Digital Signal Processing: Principles Algorithms and Applications", 4th***, Prentice Hall (India), ISBN- 9788131710005	2007
2.	Sanjit K. Mitra, "***Digital Signal Processing",3***Ed, TMH, ISBN- 0070667563	2007
3.	Oppenheim A.V. & Schafer, Ronald W, "***Digital Signal Processing",*** 1st, Pearson Education., ISBN- 9332550336	2015
4.	Tarun Kumar Rawat, "***Digital Signal Processing***", 1st,edition, Oxford University Press,ISBN-0070086656	2014
5.	Li Tan , Jean Jiang, "**Digital Signal Processing fundamentals and Applications"** , 2nd edition, Academic Press, ISBN- 9351070450	2012

Batch 2025-2026 and onwards

Course Code: BET-C517

Course Name: EMBEDDED SYSTEMS

MM: 100 **Time: 3 Hr.** **L T P** **3 0 0**	**Sessional: 30** **ESE: 70** **Credit :3**

Prerequisites:	Microprocessor & interfacing
Objectives:	1. Understand the Fundamentals of Embedded Systems. 2. Develop Programming Skills for Embedded Systems. 3. Understand Real-Time Operating Systems (RTOS). 4. To explore serial, parallel, and wireless communication protocols. 5. To develop skills for real-world peripheral interfacing.
Course Coordinator	Mr. ANUJ KUMAR SHARMA

NOTE:	The question paper shall consist of two sections (Section-A and Section-B). Section-A shall contain of ten (10) short answer type questions of six (06) mark each and student shall be required to attempt any five (05) questions. Section-B shall contain eight (08) long answer type questions of ten (10) marks each and student shall be required to attempt any four questions. Questions shall be uniformly distributed from the entire syllabus

UNIT	Module	Course Content	No. of Hours	POs mapped	PSOs mapped
UNIT-1	*Module-1*	Embedded systems and its applications, Embedded Operating system, Design parameters of an embedded system and its significance, design life cycle, tools introduction, hardware and software partitioning and co-design. Open collector outputs Tristate outputs I/O sinking and Sourcing, PLD's, Watchdog Timers, Hardware design and development.	**06**	PO1/ PO2/ PO3	PSO1/ PSO2/..
UNIT-2	*Module-2*	Microcontroller families and classifications (8-bit, 16-bit, 32-bit), 8051 Microcontroller, AVR Microcontroller, Features of ATmega328 used in Arduino, PIC Microcontrollers, ARM Cortex-M Series (e.g., STM32), ESP32 / ESP8266 (Wi-Fi-enabled microcontrollers), Programming via Arduino IDE and ESP-IDF.	**08**	PO1/ PO2/ PO3	PSO1/ PSO2/..
UNIT-3	*Module-3*	Introduction to Microcontrollers and Micoprocessors, Embedded versus external memory devices, CISC and RISC processors, Harvard and Von Neumann Architectures. 8051 Microcontrollers-Assembly language, architecture, registers, Addressing modes, Instruction set, I/O ports and memory organization Interrupts Timer/counter and serial communication.	**12**	PO2/ PO3/ PO4/	PSO1/ PSO2/..
UNIT-4	*Module-4*	RTOS: Introduction, structure of OS, System calls, Tasks, inter task communication, task scheduling, pre-emptive and non-pre-emptive scheduling, priorities, inversion, Semaphore, events, messages, queues,Mailboxes.	**04**	PO1/ PO2/ PO3	PSO1/ PSO2/..
UNIT-5	*Module-5*	Communication basics, Microprocessor Interfacing I/O Addressing, Direct memory access, Arbitration, multilevel bus architecture, Serial protocols, Parallel protocols and wireless protocols. Real world Interfacing: LCD, Stepping Motor, ADC, DAC, LED, Push Buttons, Key board, Latch Interconnection, PPI.	**10**	PO2/ PO4/ PO5	PSO1/ PSO2/..

Total No. of Hours	**40**		

Learning Outcomes:	After completing this course, the student will be able to 1. **Explain** the fundamentals of embedded systems and their applications in real-world scenarios. 2. **Develop** basic embedded programs using 8051, AVR (ATmega328), PIC, ARM Cortex-M, and ESP32/ESP8266 microcontrollers. 3. **Describe** the structure and functions of a Real-Time Operating System (RTOS), including tasks, semaphores, shared data, queues, and mailboxes. 4. **Compare** serial, parallel, and wireless communication protocols for use in embedded applications. 5. **Interface** real-world devices (LCD, stepper motors, ADC/DAC, LEDs, push buttons, keyboards) with microcontrollers.

Suggested books:

S. No.	**Name of Authors /Books /Publisher**	**Year of Publication**
1.	Muhammad Ali Mazidi and Janice Gillispie"***The 8051 Microcontroller and embedded systems***" ISBN: 978-0131194021	1999
2.	Tony Givargis Frank Vahid"***Embedded System Design: A Unified Hardware / Software Introduction",*** IV, McGraw-Hill, ISBN-9780071371766	2006
3.	Kenneth Hintz, Daniel Tabak "***Microcontrollers (Architecture, Implementation & Programming)***" Tata McGraw-Hill,	2005
4.	Sampath Kr "***Microcontrollers & Embedded Systems 2nd Edition***" KatsonBooks	206

	Learning Outcome 1	Learning Outcome 2	Learning Outcome 3	Learning Outcome 4	Learning Outcome 5
PO1	Y	N	Y	Y	Y
PO2	Y	Y	N	Y	Y
PO3	Y	N	Y	Y	Y
PO4	N	Y	N	N	Y
PO5	Y	N	Y	Y	Y
PO6	Y	Y	N	Y	Y
PO7	N	N	N	N	Y
PO8	Y	Y	N	Y	Y
PO9	Y	N	Y	N	Y
PO10	Y	Y	N	Y	Y
PO11	Y	N	N	Y	Y
PO12	Y	Y	N	Y	Y

	Learning Outcome 1	Learning Outcome 2	Learning Outcome 3	Learning Outcome 4	Learning Outcome 5
PSO1	N	Y	N	N	N
PSO2	Y	N	Y	Y	N
PSO3	Y	N	Y	Y	N
PSO4	N	N	Y	Y	Y

Batch 2025-2026 and onwards

Course Code: BET-M001

Course Name: UNIVERSAL HUMAN VALUES

MM: 100 **Time: 3 Hr.** **L T P** **3 0 0**	**Sessional: 30** **ESE: 70** **Credit : 3**

Prerequisites:	Moral Education and Human Ethics
Objectives:	1. To help the students appreciate the essential complementarily between 'VALUES' and 'SKILLS' to ensure sustained happiness and prosperity which are the core aspirations of all human beings. 2. To facilitate the development of a Holistic perspective among students towards life and profession as well as towards happiness and prosperity based on a correct understanding of the Human reality and the rest of existence. Such a holistic perspective forms the basis of Universal Human Values and movement towards value-based living in a natural way. 3. To highlight plausible implications of such a Holistic understanding in terms of ethical human conduct, trustful and mutually fulfilling human behavior and mutually enriching interaction with Nature. 4. Development of a holistic perspective based on self-exploration about themselves (human being), family, society and nature/existence. 5. Understanding (or developing clarity) of the harmony in the human being, family, society and nature/existence.
Course Coordinator	Mr. SHIV KUMAR SINGH

NOTE:	The question paper shall consist of two sections (Section-A and Section-B). Section-A shall contain of ten (10) short answer type questions of six (06) mark each and student shall be required to attempt any five (05) questions. Section-B shall contain eight (08) long answer type questions of ten (10) marks each and student shall be required to attempt any four questions. Questions shall be uniformly distributed from the entire syllabus

UNIT	Module	Course Content	No. of Hours	POs mapped	PSOs mapped
UNIT-1	*Module-1*	**Course Introduction - Need, Basic Guidelines, Content and Process for Value Education**. Purpose and motivation for the course, recapitulation from Universal HumanValues-I Self-Exploration–what is it? - Its content and process; 'Natural Acceptance'and Experiential Validation- as the process for self-exploration Continuous Happiness and Prosperity- A look at basic Human Aspirations Priority Right understanding, Relationship and Physical Facility- the basic requirements for fulfilment of aspirations of every human being with their correct Understanding Happiness and Prosperity correctly- A critical appraisal of the current scenario. Method to fulfil the above human aspirations: understanding and living in harmony at various levels. Include practice sessions to discuss natural acceptance in human being as the innate acceptance for living with responsibility (living in relationship, harmony and co-existence) rather than as arbitrariness in choice based on liking-disliking.	**08**	PO1/ PO2/ PO3	PSO1/ PSO2/..
UNIT-2	*Module-2*	**Understanding Harmony in the Human Being - Harmony in Myself!** Understanding human being as a co-existence of the sentient 'I'& the Material 'Body'. Understanding the needs of Self ('I') and 'Body' - happiness and	**08**	PO1/ PO2/ PO3	PSO1/ PSO2/..

		physical facility Understanding the Body as an instrument of 'I' (I being the doer, seer and enjoyer) Understanding the characteristics and activities of 'I' and harmony in 'I'Understanding the harmony of I with the Body: Sanyam and Health; correct appraisal of Physical needs, meaning of Prosperity in detail Programs to ensure Sanyam and Health. Include practice sessions to discuss the role others have played in making material goods available to me. Identifying from one's own life. Differentiate between prosperity and accumulation. Discuss program for ensuring health vs dealing with disease.			
UNIT-3	*Module-3*	**Understanding Harmony in the Family and Society- Harmony in Human- Human Relationship** Understanding values in human-human relationship; meaning of Justice (nine universal values in relationships) and program for its fulfilment to ensure mutual happiness; Trust and Respect as the foundational values of relationship. Understanding the meaning of Trust; Difference between intention & competence. Understanding the meaning of Respect, Difference between respect and differentiation; the other salient values in relationship. Understanding the harmony in the society (society being an extension of family): Resolution, Prosperity, fearlessness (trust) and co-existence as comprehensive Human Goals, Visualizing a universal harmonious order in society- Undivided Society, Universal Order- from family to world family. Include practice sessions to reflect on relationships in family, hostel and institute as extended family, real life examples, teacher-student relationship, goal of education etc. Gratitude as a universal value in relationships. Discuss with scenarios. Elicit examples from students' lives.	**06**	PO2/ PO3/ PO4/	PSO1/ PSO2/..
UNIT-4	*Module-4*	**Understanding Harmony in the Nature and Existence - Whole existence asCoexistence.** Understanding the harmony in the Nature, Interconnectedness and mutual fulfilment among the four orders of nature-recyclability and self-regulation in nature. Understanding Existence as Co-existence of mutually interacting units in all- pervasive space. Holistic perception of harmony at all levels of existence. Include practice sessions to discuss human being as cause of imbalance in nature (film "Home" can be used), pollution, depletion of resources and role of technology etc.	**09**	PO1/ PO2/ PO3	PSO1/ PSO2/..
UNIT-5	*Module-5*	**Implications of the above Holistic Understanding of Harmony on Professional Ethics** Natural acceptance of human values. Definitiveness of Ethical Human Conduct.Basis for Humanistic Education, Humanistic Constitution and Humanistic Universal Order. Competence in professional ethics: a. Ability to utilize the professional competence for augmenting universal human order b. Ability to identify the scope and characteristics of people friendly and eco-friendly production systems, c. Ability to identify and develop appropriate	**09**	PO2/ PO4/ PO5	PSO1/ PSO2/..

		technologies and management patterns for above production systems. Case studies of typical holistic technologies, management models and production systems. Strategy for transition from the present state to Universal Human Order: At the level of individual: as socially and ecologically responsible engineers, technologists and managers. At the level of society: as mutually enriching institutions and organizations. Sum up Include practice Exercises and CaseStudies will be taken up in Practice (tutorial) Sessions eg. To discuss the conduct as an engineer or scientist etc.			
Total No. of Hours			**40**		

Learning Outcomes:	After completing this course, the student will be able to 1. By the end of the course, students are expected to become more aware of themselves, and their surroundings (family, society, nature). 2. They would become more responsible in life, and in handling problems with sustainable solutions, while keeping human relationships and human nature in mind. They would also become sensitive to their commitment towards what they have understood (human values, human relationship and human society). 3. It is hoped that they would be able to apply what they have learnt to their own self in different situation of life. 4. Holistic vision of life 5. Socially responsible behavior 6. Environmentally responsible work 7. Ethical human conduct 8. Having Competence and Capabilities for Maintaining Health and Hygiene 9. Appreciation and aspiration for excellence (merit) and gratitude for all

Suggested books:

S. No.	Name of Authors /Books /Publisher	Year of Publication
1.	The Textbook - A Foundation Course in Human Values and Professional Ethics, R R Gaur, R Asthana, G P Bagaria, 2nd Revised Edition, Excel Books, New Delhi ISBN 978-93-87034-47-1	2019
2.	Manual for A Foundation Course in Human Values and Professional Ethics, RR Gaur, R Asthana, G P Bagaria, 2nd Revised Edition, Excel Books, New Delhi. ISBN 978-93-87034-53	2019
3.	Professional Ethics and Human Values, Premvir Kapoor, ISBN: 978-93-86173-652, Khanna Book Publishing Company, New Delhi.	2022
4.	Human Values, A.N. Tripathi, New Age Intl. Publishers, New Delhi.	2004

Batch 2025-2026 and onwards

Course Code: BET-C518

Course Name: VLSI DESIGN

MM: 100 **Time: 3 Hr.** **L T P** **3 0 0**	**Sessional: 30** **ESE: 70** **Credit : 3**

Prerequisites:	Basic Electronics and Semiconductor Physics,Digital Logic Design,VLSI Technology
Objectives:	1. To learn the design aspects of the different MOSFET ICs and their fabrication processes. 2. To understand the different CMOS circuits, layout design, and stick diagrams. 3. To analyze the different MOS circuits under low power circuit level and logic level design techniques. 4. To Simulate and synthesize the combinational and sequential circuits based on Systems and modules on FPGA.
Course Coordinator	Mr. PRATEEK AGARWAL

NOTE:	The question paper shall consist of two sections (Section-A and Section-B). Section-A shall contain of ten (10) short answer type questions of six (06) mark each and student shall be required to attempt any five (05) questions. Section-B shall contain eight (08) long answer type questions of ten (10) marks each and student shall be required to attempt any four questions. Questions shall be uniformly distributed from the entire syllabus

UNIT	**Module**	**Course Content**	**No. of Hours**	**POs mapped**	**PSOs mapped**
UNIT-1	*Module-1*	MOSFET Technology: Introduction to MOSFET technology, device structure, and physical operation NMOS, PMOS, CMOS, Enhancement and depletion mode operation, V-I Characteristics, transfer Characteristics, Body effect, channel length modulation, charge control model, velocity saturation effect, temperature effects, breakdown and input protection, MOSFET Parameters, Models of MOSFET.	**08**	PO1/ PO2/ PO3	PSO1/ PSO2/..
UNIT-2	*Module-2*	MOSFET Fabrication: Fabrication Process of MOSFET, N-Well and P-Well Fabrication, twin tub, SOI Process in CMOS, Latch-up problem in CMOS, BiCMOS, MOS Scaling, Parasitic capacitances.	**10**	PO1/ PO2/ PO3	PSO1/ PSO2/..
UNIT-3	*Module-3*	MOSFET Design NMOS and CMOS inverter, Euler's Theorem, (W/L) ratio, Logic gates realization using NMOS and CMOS, Stick diagram and Layout design, static and dynamic CMOS, Ratioed and Ratioless dynamic logic, Pass transistor, Domino CMOS logic, Zipper CMOS design, Shifters, Adders, ALUs, Multipliers, Parity generators, Comparators, Zero/One Detectors, Counters, SRAM, DRAM, ROM, Serial Access Memories.	**08**	PO2/ PO3/ PO4/	PSO1/ PSO2/..
UNIT-4	*Module-4*	CMOS Testing and Low Power Design: CMOS Testing, test Principles, design strategies for test, chip-level test techniques, low power VLSI design, Principles of low power design, probabilistic power analysis, Need of low power, CMOS leakage current, static current, random signal probability, and frequency, Power analysis technique, signal entropy, circuitlevel, and logic level design techniques.	**06**	PO1/ PO2/ PO3	PSO1/ PSO2/..
UNIT-5	*Module-5*	Simulation and Synthesis: FPGA and ASIC Design, CMOS Level Design for PLDs, CPLDs, Combinational and Sequential Circuit Design using	**08**	PO2/ PO4/ PO5	PSO1/ PSO2/..

		VHDL/ Verilog HDL, FPGA Design Flow, FPGA Synthesis, Finite state machine design using HDL.			
Total No. of Hours			**40**		

Learning Outcomes:	After completing this course, the student will be able to 1.Understand the fundamentals of MOSFET Integrated Circuits. 2.Apply the different fabrication techniques for different MOSFET IC. 3.Analyse, and test different signals in low-power VLSI design, layouts and circuits. 4.Design and synthesize different combinational, sequential circuits and finite state machines on FPGA.

Suggested books:

S. No.	Name of Authors /Books /Publisher	Year of Publication
1.	Pucknell D.A. and Eshraghian Kamran ***"Basic VLSI Design"***,III,PHI, ISBN: 978-8120309869	2013
2.	Sedra ADEL. S. and Smith Kenneth C ***"Microelectronics Circuit: Theory and Applications"***,V,Oxford University Press,ISBN: 978-0195323030	2013
3.	Pedroni, V. A.***"Circuit design and simulation with VHDL"***,III,MIT Press, ISBN-13: 978-0262042642	2020
4.	Perry L Douglas ***"VHDL: Programming by Example"***,IV,TMH,ISBN: 978-0071400701	2002
5.	S.M. SZE (2017***), "VLSI Technology"***,II, McGraw Hill Education, Indian Edition,ISBN:978-0070582910	2017

	Learning Outcome 1	Learning Outcome 2	Learning Outcome 3	Learning Outcome 4	Learning Outcome 5
PO1	Y	Y	Y	Y	Y
PO2	Y	Y	Y	Y	Y
PO3	N	Y	Y	Y	Y
PO4	N	Y	Y	Y	Y
PO5	Y	Y	Y	Y	Y
PO6	N	N	N	N	N
PO7	N	N	N	N	N
PO8	N	N	N	N	N
PO9	N	N	N	N	N
PO10	N	N	N	N	N
PO11	N	N	N	N	N
PO12	N	N	N	N	N

	Learning Outcome 1	Learning Outcome 2	Learning Outcome 3	Learning Outcome 4	Learning Outcome 5
PSO1	Y	Y	Y	Y	Y
PSO2	Y	Y	Y	Y	Y
PSO3	N	N	N	N	N
PSO4	N	N	N	N	N

Batch 2025-2026 and onwards

Course Code: BET-C513

Course Name: CONTROL SYSTEM

MM: 100 **Time: 3 Hr.** **L T P** **3 0 0**	**Sessional: 30** **ESE: 70** **Credit : 3**

Prerequisites:	Mathematics
Objectives:	1. Define modeling of linear-time-invariant systems using transfer function and state-space representations. 2. Explain the basic concept of stability and its assessment for linear-time invariant systems. 3. Construct simple feedback controllers. 4. Analyze Controllability and observability and their testing. 5. Demonstrate Techniques in time domain and frequency domain.
Course Coordinator	Dr. Atul Varshney

NOTE:	The question paper shall consist of two sections (Section-A and Section-B). Section-A shall contain of ten (10) short answer type questions of six (06) mark each and student shall be required to attempt any five (05) questions. Section-B shall contain eight (08) long answer type questions of ten (10) marks each and student shall be required to attempt any four questions. Questions shall be uniformly distributed from the entire syllabus

UNIT	Module	Course Content	No. of Hours	POs mapped	PSOs mapped
UNIT-1	*Module-1*	Control System: Open loop & closed control; servomechanism, Physical examples. Transfer functions, Block diagram algebra	**4**	PO1/ PO2/ PO3/ PO4/ PO5	PSO1/ PSO2
	Module-2	Signal flow graph, Mason's gain formula Reduction of parameter variation and effects of disturbance by using negative feedback	**4**	PO1/ PO2/ PO3/ PO4/ PO5	PSO1/ PSO2
UNIT-2	*Module-3*	Time Response Analysis: Standard test signals, time response of first and second order systems, time response specifications, steady state errors and error constants Design specifications of second order systems: Derivative error,	**4**	PO1/ PO2/ PO3/ PO4/ PO5	PSO1/ PSO2
	Module-4	derivative output, integral error and PID compensations, design considerations for higher order systems, performance indices	**4**	PO1/ PO2/ PO3/ PO4/ PO5	PSO1/ PSO2
UNIT-3	*Module-5*	Control System Components: Constructional and working concept of ac servomotor, synchros and stepper motor. Stability and Algebraic Criteria: Concept of stability and necessary conditions, Routh- Hurwitz criteria and limitations.	4	PO1/ PO2/ PO3/ PO4/ PO5	PSO1/ PSO2
	Module-6	Root Locus Technique: The root locus concepts, construction of root loci.	**4**	PO1/ PO2/ PO3/ PO4/ PO5	PSO1/ PSO2
UNIT-4	*Module-7*	Frequency Response Analysis: Frequency response, correlation between time and frequency responses, polar and inverse polar plots, Bode plots.	4	PO1/ PO2/ PO3/ PO4/ PO5	PSO1/ PSO2
	Module-8	Stability in Frequency Domain: Nyquist stability criterion, assessment of relative stability: gain margin and phase margin, constant M&N circles.	**4**	PO1/ PO2/ PO3/ PO4/ PO5	PSO1/ PSO2
UNIT-5	*Module-9*	Introduction to Design: The design problem and preliminary considerations lead, lag and lead-lag networks, design of closed loop systems using	**4**	PO1/ PO2/ PO3/ PO4/ PO5/PO6	PSO1/ PSO2

		compensation techniques in time domain and frequency domain.			
	Module-10	Review of State Variable Technique: Review of state variable technique, conversion of state variable model to transfer function model and vice-versa, diagonalization, Controllability and observability and their testing.	**4**	PO1/ PO2/ PO3/ PO4/ PO5	PSO1/ PSO2
Total No. of Hours			**40**		

Learning Outcomes:	1.	Characterize a system and find its study state behavior
	2.	Investigate stability of a system using different tests
	3.	Design various controllers
	4.	Solve liner, non-liner and optimal control problems
	5.	Controllability and observability and their testing.
	6.	Techniques in time domain and frequency domain.

Suggested books:

S. No.	Name of Authors /Books /Publisher	Year of Publication
1.	Nagrath& Gopal, Control System Engineering, 4th Edition, New age International.	2021
2.	K. Ogata, Modern Control Engineering, Prentice Hall of India.	2009
3.	M.Gopal, Control System; Principle and design, Tata McGraw Hill	2008
4.	D.Roy Choudhary, Modern Control Engineering, Prentice Hall of India.	2005
5.	Norman S. Mise, Control System Engineering 4th edition, Wiley Publishing Co	2003

Batch 2025-2026 and onwards

Course Code: BET-S559

Course Name: Summer Training and Internship Program-I/mini project (3-4 weeks)

MM: 100 **Time: 3 Hr.** **L T P** **3 0 0**	**Sessional: 30** **ESE: 70** **Credit : 3**

Guidelines:

1. The internship certificate will have to be submitted in the department after summer vacation for evaluation.
2. Students can choose to do internship or mini project or industrial training.
3. The mini-project is a team activity having 2-3 students in a team. This is electronic product design work with a focus on electronic circuit design.
4. The mini project may be a complete hardware or a combination of hardware and software. The software part in mini project should be less than 50% of the total work.
5. Mini Project should cater to a small system required in laboratory or real life.
6. It should encompass components, devices, analog or digital ICs, micro controller with which functional familiarity is introduced.
7. After interactions with course coordinator and based on comprehensive literature survey/need analysis, the student shall identify the title and define the aim and objectives of mini-project.
8. Student is expected to detail out specifications, methodology, resources required, critical issues involved in design and implementation and submit the proposal within first week of the semester.
9. The student is expected to exert on design, development and testing of the proposed work as per the schedule.
10. Art work and Layout should be made using CAD based PCB simulation software. Due considerations should be given for power requirement of the system, mechanical aspects for enclosure and control panel design.
11. Completed mini project and documentation in the form of mini project report is to be submitted at the end of semester.
12. The tutorial sessions should be used for discussion on standard practices used for electronic circuits/product design, converting the circuit design into a complete electronic product, PCB design using suitable simulation software, estimation of power budget analysis of the product, front panel design and mechanical aspects of the product, and guidelines for documentation/report writing.

Course Outcomes:

At the end of the course, students will demonstrate the ability to:

1. Conceive a problem statement either from rigorous literature survey or from the requirements raised from need analysis.
2. Design, implement and test the prototype/algorithm in order to solve the conceived problem.
3. Write comprehensive report on mini project work.

Batch 2025-2026 and onwards

Course Code: BET-567

Course Name: EMBEDDED SYSTEMS LAB

L T P 0 0 2	Sessional: 15 ESE: 35 Credit : 1

Prerequisites:	Microprocessor and Interfacing
Objectives:	Students will perform Microcontrollers interfacing with LED, Seven segment display, LCD, Keypad, ADC,DAC etc. Experiments.
Course Coordinator	Mr. Anuj Kumar Sharma
Notes	1.Minimum of 8 experiments have to be conducted. 2.The programs have to be tested on 8051/89C51 Development board/equivalent using Embedded C Language/Assembly Language on Keil IDE or Equivalent 3. In practical examination the student shall be required to perform one experiment. 4. A teacher shall be assigned 20 students for daily practical work in laboratory. 5. No batch for practical class shall consist of more than 20 students. 6. The number of students in a batch allotted to an examiner for practical examination shall not exceed 20 students. 7. Addition/deletion in above list may be made in accordance with the facilities available with the approval of H.O.D./Dean.

LIST OF EXPERIMENTS:

1.Program to interface LED display unit with using microcontroller 8051, ESP32 board andArduino UNO board.
2. Program to interface LED display unit with STM32 microcontroller.
3. Program to interface LCD display unit using microcontroller 8051, ESP32 board andArduino UNO board.
4. Program to interface LCD display unit with STM32 microcontroller.
5. Program to interface keypad. Whenever a key is pressed, it should be displayed on LCD using microcontroller 8051, ESP32 board andArduino UNO board.
6. Program to interface seven segment display unit using microcontroller 8051, ESP32 board andArduino UNO board.
7. Program to interface seven segment display unit withSTM32 microcontroller.
8.Read analog sensor's data (e.g., humidity, temperature) usingmicrocontroller 8051, ESP32 board andArduino UNO board.

Course Outcomes:		Bloom's Knowledge Level
CO1	Understanding the Program to interface LCD data pins to port P1 and display a message on it.	L2
CO2	Understanding the Program to interface keypad. Whenever a key is pressed, it should be displayed on LCD.	L2
CO3	Analyze the program to copy a block of 10 bytes of data from RAM locations, starting at 35H to RAM locations starting at 60H.	L4
CO4	Evaluate and design Program to toggle only the bit P1.5 continuously with some delay. Use Timer 0, mode 1 to create delay.	L5
CO5	Design program to clear 16 RAM locations starting at RAM address 60H	L6
CO6	Design Program to toggle all the bits of Port P1 continuously with 250 mS delay	L6

Batch 2025-2026 and onwards

Course Code: BET-C566

Course Name: DIGITAL SIGNAL PROCESSING LAB

L T P 0 0 2	Sessional: 15 ESE: 35 Credit : 1

Prerequisites:	Signal and system , Mathmatics –II, Different Transforms (Fourier, Laplace, Z-transforms)
Objectives:	• To design the analog and digital IIR, FIR filters. • To understand the fast computation of DFT and appreciate the FFT processing. • Apply the principles of signal analysis to filtering • To study different digital modulation technique.
Course Coordinator	Dr. Gorav Kumar Malik

NOTE:	1. In practical examination the student shall be required to perform one experiment. 2. A teacher shall be assigned 30 students for daily practical work in laboratory. 3. No batch for practical class shall consist of more than 30 students. 4. The number of students in a batch allotted to an examiner for practical examination shall not exceed 30 students. 5. Addition/deletion in above list may be made in accordance with the facilities available with the approval of H.O.D./Dean. 6. The programming to be done in mixed programming platform i.e. using Sci-Lab.

List of Experiment

Perform the experiment on Digital Starter Kit TMS320C6713 and on Hardware also.

1. To study the sampling & waveform Generation.
2. To study the PCM Encoding.
3. To study the delta modulation.
4. To study the digital modulation schemes ASK.
5. To study the digital modulation schemes PSK.
6. To study the digital modulation schemes FSK
7. To study the DFT Computation.
8. To study the Fast Fourier Transform.
9. To study the FIR filter implementation.
10. To study the IIR filter implementation.

Total No. of Hours	**2 hr./week**	

Learning Outcomes:	• Understand the significance of various IIR and FIR digital filter and role of DFT and FFT • Experiment with different digital modulation technique and observe the waveform. • Examine different steps in the process of analog to digital conversion. • Analyze the real-time signal processing applications.

Suggested books:

S. No.	Name of Authors /Books /Publisher	Year of Publication
1.	Proakis, J.G & Manolakis, D.G., "***Digital Signal Processing: Principles Algorithms and Applications", 4th***, Prentice Hall (India), ISBN- 9788131710005	2007
2.	Sanjit K. Mitra, "***Digital Signal Processing",3*** Ed, TMH, ISBN- 0070667563	2007
3.	Oppenheim A.V. & Schafer, Ronald W, "***Digital Signal Processing",*** 1st, Pearson Education., ISBN- 9332550336	2015
4.	Li Tan , Jean Jiang, "**Digital Signal Processing fundamentals and Applications"** , 2nd edition, Academic Press, ISBN- 9351070450	2012

Batch 2025-2026 and onwards

Course Code: BET-565

Course Name: Communication systems LAB

L T P **0 0 2**	**Sessional: 15** **ESE: 35** **Credit : 1**
Prerequisites:	For this course, no pre-requisites are required. But should have knowledge of communication,
Course Objectives:	1. To understand the basic Experiments of the analog and digital communication system. 2. To analyze the signal flow/ characteristics of the modulated signals with different types of analog and digital modulation techniques. 3. To analyze error performance of analog and digital communication systems in presence of noise and other interferences.
Course Coordinator	Mr. Shiv Kumar Singh

LIST OF EXPERIMENTS:

Experiment No. 1

Study amplitude modulation and Demodulation.

1. To study amplitude modulation.
2. Investigating the depth of modulation.
3. Study amplitude demodulation.
4. Recovering the message using an envelope detector.

Experiment No. 2

Study double sideband modulation and demodulation.

1. Setting up the DSBSC modulator.
2. Recovering the message using a product detector.

Experiment No. 3

Study single sideband modulation and demodulation.

1. Generating an SSB using a simple message.
2. Using the product detector to recover the message.

Experiment No. 4

Study frequency modulation and Demodulation.

1. Setting up the Frequency modulor (direct)
2. Setting up the FM modulator.
3. Transmitting and recovering a sinewave using FM.

Experiment No. 5

Study of sampling & reconstruction of message signal.

1. Sampling a simple message.
2. Reconstructing a sampled message.

Experiment No. 6

Study & Verification of PCM encoding.

1. PCM encoding using static DC voltage.
2. PCM encoding of a variable DC voltage.
3. PCM encoding of continuously changing voltage.

Experiment No. 7

Study of PCM decoding.

1. Setting up a PCM encoder.
2. Decoding the PCM data.

Experiment No. 8

Study of Amplitude shift keying modulation & demodulation.

1. Generating an ASK signal.

2. Demodulating an AKS signal using an envelope detector.

Experiment No. 9

Study of frequency shift keying modulation & demodulation.

1. Generating a FSK signal.
2. Demodulating an FSK signal using filtering and an envelope detector.

Experiment No. 10

Study of BPSK.

1. Generating a BPSK signal.
2. Demodulating a BPSK signal using product detection.

Experiment No. 11

Study of QPSK.

1. Generating a QPSK signal.
2. Using phase discrimination to pick- out one of the QPSK signal's BPSK signals.

Textbooks

1. Taub, Schilling, Guha (2013) "Principle of Communication Systems", McGraw Hill Publication. ISBN: 9781259029851.
2. J. G.Proakis, Masoud Salehi "Digital Communication", McGraw- Hill, 2008, ISBN 978–0–07–295716–7; 0–07–295716–6.

Reference Books

1. B.P. Lathi, Zhi Ding, "Modern Digital and Analog Communication Systems (4/e)", Oxford university Press, 2010, ISBN: 0195384938, 9780195384932.
2. S. Haykin& Michael Moher "Communication Systems", 4th Edition, Wiley India Publication

Course Outcomes		
On completion of this course, the students will be able to		
1	**CO 1**	Understand the general principles of modulation and demodulation.
2	**CO 2**	Apply modem techniques for baseband and passband signal at modulator and demodulator.
3	**CO 3**	Evaluate and test the analog and digital communication system.

CO-PO Mapping

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	2	3	-	-	-	-	-	-	-	3	2	2
CO2	3	3	2	2	-	-	-	-	-	-	-	3	3	2
CO3	3	3	2	2	-	-	-	-	-	-	-	3	3	3
Average	3	3	2	2	-	-	-	-	-	-	-	3	3	2

Batch 2025-2026 and onwards

Course Code: BCE-C647

Course Name: JAVA BASED OBJECT ORIENTED PROGRAMMING

MM: 100 **Time: 3 Hr.** **L T P** **3 0 0**	**Sessional:30** **ESE:70** **Credit :3**

Prerequisites:	Basic knowledge of programming(C/C++) and concept of algorithm development.
Objectives:	• To acquire programming skills in core Java and Python. • To acquire Object Oriented Skills in Java. • To solve simple problems using the fundamental syntax and semantics of Java & Python. • To learn how to use lists, tuples, and dictionaries in Python programs.

NOTE:	The question paper shall consist of two sections A and B. Section A contains 10 short type questions of 6 marks each and student shall be required to attempt any five questions. Section B contains 8 long type questions of ten marks each and student shall be required to attempt any four questions. Questions shall be uniformly distributed from the entire syllabus.

UNIT/ Module	Course Content	No. of Hours	POs mapped	PSOs mapped
Module-1	**Introduction:** Features of Java byte code, data types, variables, declaring variables, arrays, operators, control statements, type conversion and casting, compiling and running of simple Java program. **Classes and Objects:** Concepts of classes and objects, class fundamentals Declaring objects, assigning object reference variables, introducing methods, constructors, usage of static with data and methods, usage of final with data, access control, this key word, overloading methods and constructors, parameter passing – call by value, nested classes and inner classes, exploring the String class.	**08**	PO 1/ PO 2	PSO1/ PSO2
Module-2	**Inheritance:** Basic concepts, member access rules, usage of super key word, forms of inheritance, method overriding, abstract classes, dynamic method dispatch, using final with inheritance, the Object class. **Packages and Interfaces:** Defining, Creating and Accessing a Package, understanding class path, importing packages, differences between classes and interfaces, defining an interface, implementing interface, applying interfaces, variables in interface and extending interfaces.	**08**	PO1/ PO3	PSO1/ PSO2
Module-3	**Exception Handling and Multithreading:** Concepts of Exception handling, types of exceptions, usage of try, catch, throw, throws and finally keywords, Built-in exceptions, creating own exception sub classes, Concepts of Multithreading, thread life cycle, creating multiple threads using Thread class, Runnable interface, Synchronization.	**08**	PO1/ PO4	PSO1/ PSO2

Module-4	**Event Handling:** Events, Event sources, Event classes, Event Listeners, Delegation event model, handling mouse and keyboard events, Adapter classes	**08**	PO1/ PO2/ PO4	PSO1/ PSO2
Module-5	JDBC: The connectivity Model, JDBC/ODBC Bridge, java.sql package, connectivity to remote Database, navigating through multiple rows retrieved from a database, selection, insertion, updating and deletion in database using JDBC.	**08**	PO1/ PO3	PSO1/ PSO2
Total No. of Hours		**40**		

Learning Outcomes:	• Describe the features of Java & Python. • Design classes with object-oriented features in Java • Describe advanced features of Java like exception handling, multithreading etc. • Write programs in JAVA and Python featuring its core capabilities

Suggested books:

S. No.	Name of Authors /Books /Publisher/Year
1.	Herbert schildt (2010), The complete reference, 7th edition, Tata Mc graw Hill, New Delhi.
2.	Y. Daniel Liang (2010), Introduction to Java programming, 7th edition, Pearson education, India.
3.	Python Programming: A Modern Approach, VamsiKurama, Pearson.
4.	Learning Python, Mark Lutz, Orielly.
5.	Herbert Schildt, The Complete Reference Java J2SE 5th Edition, TMH Publishing Company Ltd.
6.	Head First Java, O'rielly publications.
7.	J. Nino, F. A. Hosch (2002), An Introduction to programming and OO design using Java, John Wiley & sons, New Jersey.
8.	Think Python, Allen Downey, Green Tea Press.
9.	Core Python Programming, W.Chun, Pearson.

CO-PO/PSO MAPPING

Course Outcomes (COs)	Program Outcomes (POs)												Program Specific Outcomes (PSOs)	
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO10	PO11	PO12	PSO 1	PSO 2
CO1	√	√											√	√
CO2	√	√	√										√	√
CO3	√	√	√	√									√	√
CO4	√	√		√									√	√

Batch 2025-2026 and onwards

Course Code: BET-C614

Course Name:ANTENNA AND WAVE PROPAGATION

MM: 100 **L T P** **3 0 0**	**Sessional: 30** **ESE: 70** **Credit: 3**
Prerequisites:	For this course, no pre-requisites are required. But should have knowledge of basic antenna and advanced antennas and their frequency spectrums.
Objectives:	1. To get good knowledge of basics of Antenna Parameters. 2. Learn about the various dipole, monopole antenna systems and their radiation patterns. 3. To understand the antenna radiation pattern and antenna gains. 4. Basic knowledge of future antenna technology based on metamaterials and advanced emerging antennas.
Course Coordinator	Dr. Atul Kumar Varshney

NOTE:	The question paper shall consist of two sections (Section-A and Section-B). Section-A shall contain Ten (10) short answer type questions of six (06) mark each and student shall be required to attempt any five (05) questions. Section-B shall contain eight (08) long answer type questions of ten (10) marks each and student shall be required to attempt any four questions. Questions shall be uniformly distributed from the entire syllabus

UNIT	Module	Course Content	No. of Hours	POs mapped	PSOs mapped
UNIT-I	Module- 1	**Antenna Principles:** Potential Functions & Electromagnetic Field, Current Elements, Radiation from Monopole & Half Wave Dipole, power radiated by current element, radiation resistance. Directional Properties of Dipole Antenna.	**6**	PO1/ PO2/ PO3/ PO4/ PO5/ PO6	PSO1/ PSO2/ PSO3
	Module- 2	**Antenna parameters:**Antenna Gain, Directivity, Effective Area, Radiation efficiency, Isotropic Antenna,Input impedance,reflection coefficient and return loss, fractional bandwidth.	**3**	PO1/ PO2/ PO3/ PO4/ PO5/ PO6	PSO1/ PSO2/ PSO3
UNIT-II	Module- 3	**Antennas Arrays:** Two Element Array, Horizontal Patterns in Broadcast Arrays, Linear Arrays, Multiplication of patterns, effect of the earth on vertical patterns, Binomial array, Chebyshev Array.	**6**	PO1/ PO2/ PO3/ PO4/ PO5/ PO6	PSO1/ PSO2
UNIT-III	Module- 4	**Practical Antennas:** VLF and LF transmitting antennas, effect of antenna height, Field of short dipole, Loop antenna, Directivity of circular loop antenna with uniform current, Yagi-Uda array: Square corner Yagi-uda hybrid, Helical Antenna, circular polarization, Rhombic Antenna, Parabolic Antenna. Introduction to metamaterial, Use of metamaterial in antenna applications.	**8**	PO1/ PO2/ PO3/ PO4/ PO5/ PO6	PSO1/ PSO2
UNIT-IV	Module- 5	**Antenna Measurements:** Radiation Pattern measurement, Gain Measurement: Comparison method, Near field method, Introduction to current distribution measurement, Measurement of antenna efficiency, measurement of Noise figure and noise temperature of an antenna polarization measurement.	**3**	PO1/ PO2/ PO3/ PO4/ PO5/ PO6	PSO1/ PSO2

	Module- 6	**Advanced Antennas:**Frequency reconfigurable antenna, wearable antenna, mm-wave antenna, THz antenna. Introduction of frequency spectrum for ISM band, 5G and 6 G communications, Bluetooth, Wi-Fi types, WLAN and Wi-MAX frequencies.	**4**	PO1/ PO2/ PO3/ PO4/ PO5/ PO6	PSO1/ PSO2
UNIT-V	Module- 7	**Wave Propagation:** Modes of Propagation, Plane Earth Reflection, Space wave and Surface Wave, Reflection and refraction waves by the Ionosphere Tropospheric Wave. Ionosphere Wave Propagation in the Ionosphere, Virtual Height, MUF Critical frequency, Skip Distance, Duct Propagation, Space wave.	**10**	PO1/ PO2/ PO3/ PO4/ PO5/ PO6	PSO1/ PSO2
Total No. of Hours			**40**		

Suggested books:

S. No.	**Name of Authors /Books /Publisher**	**Year of Publication**
1.	Jordan Edwards C. and Balmain Keith G. "Electromagnetic Waves and Radiating Systems", Prentice Hall (India)	XXXX
2.	Kraus, John D. &Mashefka, Ronald J., "Antennas: For All Applications", Tata McGrawHill, 3rd Ed	XXXX
3.	Prasad, K.D., "Antennas and Wave Propagation", Khanna Publications	XXXX
4.	Collin, R., "Antennas and Radiowave Propagation", Tata McGraw-Hill	XXXX
5.	Das, Annaparna& Das, Sisir K., "Microwave Engineering", Tata McGraw Hill.	XXXX

Course Outcomes (COs)

Upon completing this course, students will be able to:

1. Understand the principles of antenna theory including radiation mechanisms, directional properties, and fundamental antenna parameters.
2. Analyze and design antenna arrays, including pattern multiplication, effects of the earth, and specialized configurations like Binomial and Chebyshev arrays.
3. Apply practical knowledge to various antenna types such as loop, Yagi-Uda, helical, and rhombic antennas while exploring metamaterial integration.
4. Conduct antenna measurements related to radiation patterns, gain, polarization, efficiency, and noise characteristics.
5. Examine wave propagation mechanisms including reflection, refraction, ionospheric behavior, and the effects of different propagation modes on signal transmission.

Program Outcomes (POs)

By the end of this program, students will be equipped to:

1. Develop expertise in electromagnetics and antenna systems for wireless communication applications.
2. Apply analytical and simulation techniques to optimize antenna performance in practical scenarios.
3. Investigate emerging technologies, including reconfigurable, wearable, and metamaterial-based antennas.
4. Utilize measurement tools to validate antenna characteristics and performance metrics.
5. Design efficient antennas for modern applications in 5G, IoT, ISM bands, satellite communication, and WiMAX/Wi-Fi technologies.
6. Evaluate propagation effects in communication systems to improve signal reliability in various environments.

Batch 2025-2026 and onwards

CO-PO Mapping

Course Outcomes (COs)	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO1: Understanding antenna principles and parameters	3	3	2	2	2	1	-	-	-	-	-	-
CO2: Analyzing and designing antenna arrays	3	3	3	2	2	2	-	-	-	-	-	-
CO3: Applying practical antenna knowledge	3	3	3	2	2	2	-	-	-	-	-	-
CO4: Conducting antenna measurements and evaluations	3	3	2	3	3	3	-	-	-	-	-	-
CO5: Examining wave propagation mechanisms	3	3	2	3	3	3	-	-	-	-	-	-

CO-PSO Mapping

Course Outcomes (COs)	**PSO1**	**PSO2**	**PSO3**
CO1: Understanding antenna principles and parameters	3	2	1
CO2: Analyzing and designing antenna arrays	3	3	2
CO3: Applying practical antenna knowledge	3	3	3
CO4: Conducting antenna measurements and evaluations	3	3	3
CO5: Examining wave propagation mechanisms	3	2	2

Legend for Mapping Levels

- 3 – High Contribution
- 2 – Moderate Contribution
- 1 – Low Contribution
- - – No Contribution

This mapping aligns the Course Outcomes (COs) with Program Outcomes (POs) and Program-Specific Outcomes (PSOs) to ensure effective learning and skill development in the field of antennas and wave propagation.

Batch 2025-2026 and onwards

Course Code: BET-C615

Course Name: WIRELESS COMMUNICATION

MM: 100 **Time: 3 Hr.** **L T P** **3 0 0**	**Sessional: 30** **ESE: 70** **Credit : 3**

Prerequisites:	Digital Communication, Antenna Theory.
Objectives:	1. To familiarize the concepts related to cellular communication and its capacity. 2. To acquaint students with different generations of mobile networks. 3. To teach students the fundamentals of multipath fading and propagation models. 4. To describe the modulation and diversity schemes as applied in mobile communication.
Course Coordinator	Mr. SHIV KUMAR SINGH

NOTE:	The question paper shall consist of two sections (Section-A and Section-B). Section-A shall contain of ten (10) short answer type questions of six (06) mark each and student shall be required to attempt any five (05) questions. Section-B shall contain eight (08) long answer type questions of ten (10) marks each and student shall be required to attempt any four questions. Questions shall be uniformly distributed from the entire syllabus

UNIT	Module	Course Content	No. of Hours	POs mapped	PSOs mapped
UNIT-1	*Module-1*	Introduction to Wireless Communication Systems: Evolution of Mobile Radio Communication, examples of wireless communication: Paging System, Cordless telephone system, Cellular telephone system	**06**	PO1/ PO2/ PO3/ PO4	PSO1/ PSO2
	Module-2	Cellular concepts- Cell structure, frequency reuse, cell splitting, channel assignment, hand off, interference, capacity in cellular system wireless standard 2G and 3G, Frequency reuse, Channel assignment strategies and Handoff strategies.	**02**	PO1/ PO2/ PO4	PSO1/ PSO2
UNIT-2	*Module-3*	Signal propagation-Propagation mechanism-reflection, refraction, diffraction and scattering, large scale signal propagation and lognormal shadowing. Fading channels-Multipath and small scale fading-Doppler shift, statistical multipath channel models, narrowband and wide band fading models, power delay profile, average and rms delay spread, coherence bandwidth and coherence time, flat and frequency selective fading, slow and fast fading, average fade durationand level crossing rate.	**08**	PO1/ PO2/ PO3/ PO4	PSO1/ PSO2
UNIT-3	*Module-4*	Multi Path Fading in Mobile Radio Propagation: Factors influencing Small scale fading, Doppler Shift. Impulse response model of Multi path Channel, Fading effect due to multi path time delay spread, Fading effect due to Doppler spread. Diversity techniques: Time diversity, frequency diversity and polarization diversity.	**08**	PO1/ PO2/ PO3/ PO4	PSO1/ PSO2

	Module-5	Receiver structure- Diversity receivers- selection and MRC receivers, RAKE receiver, equalization: linear-ZFE and adaptive, DFE. Transmit diversity-Altamonte scheme.	**02**	PO1/ PO2/ PO3/ PO4	PSO1/ PSO2
UNIT-4	*Module-6*	Multiple Access Techniques: FDMA, TDMA, CDMA and SDMA, Spread spectrum Techniques: DSSS and FHSS, Processing gain, PN sequence generation and its properties. MIMO and space time signal processing, spatial multiplexing, diversity/multiplexing trade off.	**04**	PO1/ PO2/ PO3/ PO4	PSO1/ PSO2
	Module-7	Performance measures- Outage, average snr, average symbol/bit error rate. System examples- GSM, EDGE, GPRS, IS-95, CDMA 2000 and WCDMA, 4G and 5G	**02**	PO1/ PO2/ PO4	PSO1/ PSO2
UNIT-5	*Module-8*	Global System for Mobile (GSM): GSM Services and Features, GSM System Architecture, GSM Radio Subsystems, GSM Channel types: Traffic channels, Control Channels, Frame structure in GSM, Signal Processing in GSM. Introduction to mobile wireless antennas.	**08**	PO1/ PO2/ PO3/ PO4	PSO1/ PSO2
Total No. of Hours			**40**		

Learning Outcomes:	At the end of the course, a student will be able to: 1. Understand the relation between the user features and underlying technology. 2. Understand the working principles of the mobile communication systems. 3. Analyze mobile communication systems for improved performance. 4. Interpret the functions of the building blocks of cellular network architecture. 5. Demonstrate different coding in wireless mobile communication. 6. Study of error in wireless mobile communication.

Suggested books:

S. No.	Name of Authors /Books /Publisher
1.	T.S. Rappaport, Wireless Communication, PHI, 2002
2.	W.C.Y. Lee, Mobile Communication engineering, McGraw Hill, 1997.
3.	K.O. Feher, Wireless Digital Communication, Prentice Hall, 1995.
4.	Raj Pandya, Mobile and Personal Communication Services and Systems, PHI, 2001
5.	Raymond Steele, Mobile Radio Communications, IEEE Press, New York, 1992.

	Learning Outcome 2	Learning Outcome 3	Learning Outcome 4	Learning Outcome 5
PO1	Y	Y	Y	Y
PO2	Y	Y	Y	Y
PO3	Y	Y	Y	Y
PO4	Y	Y	Y	Y

Learning Outcome 2	Learning Outcome 3	Learning Outcome 4	Learning Outcome 5
Y	Y	Y	Y
Y	Y	Y	Y

Batch 2025-2026 and onwards

Course Code: BCE-C667

Course Name: JAVA BASED OBJECT ORIENTED PROGRAMMING LAB

MM: 50 **Time: 2 Hr.** **L T P** **0 0 2**	**Sessional: 15** **ESE: 35** **Credit: 1**

Objectives:	To demonstrate the Graph traversal techniques. COB 2:To make students to learn the concepts of iterative and recursive algorithm To develop web applications in cloud • To learn the design and development process involved in creating a cloud based application • To understand the fundamental concepts of Java &Python programming language. • To implement OOPs concepts and Multithreading fundamentals in core Java and Python. • To apply programming skills to demonstrate different concepts of java like event handling, database connectivity and servlets.

NOTE:	1. In practical examination the student shall be required to perform one experiment. 2. A teacher shall be assigned 20 students for daily practical work in the laboratory. 3. No batch for practical class shall consist of more than 20 students. 4. The number of students in a batch allotted to an examiner for practical examination shall not exceed 20 students. 5. Addition/deletion in above list may be made in accordance with the facilities available with the approval of H.O.D./Dean.

LIST OF EXPERIMENTS	**No. of Hours**	**POs mapped**	**PSOs mapped**
1. Classes and Objects: Programs to illustrate the concept of object and classes. 2. Inheritance packages and interface: Programs to illustrate the concepts of Inheritance, packages and interfaces. 3. Multithreading: programs to illustrate concepts of multithreading in Java. 4. Event Handling: programs in Java to handle Mouse and Keyboard events. 5. Java Database Connectivity: Programs to connect, control and manipulate database.	**02**	PO1/ PO2/ PO3/ PO4	PSO1/ PSO2

Learning Outcomes:	To demonstrate the Graph traversal techniques. COB 2:To make students to learn the concepts of iterative and recursive algorithm To develop web applications in cloud • To learn the design and development process involved in creating a cloud based application • Apply fundamental syntax and semantics of Java & Python programming language. • Become able to implement OOPs and interface concepts in core Java. • Develop reusable code to demonstrate different fundamentals of java like event handling, database connectivity and servlets.

CO-PO/PSO MAPPING

Batch 2025-2026 and onwards

Course Outcomes (COs)	Program Outcomes (POs)												Program Specific Outcomes (PSOs)	
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO10	PO11	PO12	PSO 1	PSO 2
CO1	√	√	√	√									√	√
CO2	√	√	√										√	√
CO3	√	√	√	√									√	√

Batch 2025-2026 and onwards

Course Code: BCE-O648
Course Name: CLOUD COMPUTING

MM: 100 **Time: 3 Hr.** **L T P** **3 1 0**	**Sessional:30** **ESE:70** **Credit :4**

Prerequisites:	Discrete Mathematics, Computer Networks
Objectives:	• To understand the concepts of Cloud Computing. • To learn Taxonomy of Virtualization Techniques. • To learn Cloud Computing Architecture. • To acquire knowledge on Aneka Cloud Application Platform. • To learn Industry Cloud Platforms.

NOTE:	The question paper shall consist of two sections A and B. Section A contains 10 short type questions of 6 marks each and student shall be required to attempt any five questions. Section B contains 8 long type questions of ten marks each and student shall be required to attempt any four questions. Questions shall be uniformly distributed from the entire syllabus.

Module	Course Content	No. of Hours	POs mapped	PSOs mapped
Module-1	**Overview of cloud computing:** What is a cloud, Definition of cloud, Characteristics of cloud, why use clouds, How clouds are changing, Driving factors towards cloud, Comparing grid with cloud, Public clouds (commercial), **Cloud Service Models** (IaaS, PaaS, SaaS – Overview)	**08**	PO1	PSO1/ PSO2
Module-2	**Cloud computing concepts:** Concepts of cloud computing, Cloud computing leverages the Internet, Positioning cloud to a grid infrastructure, Elasticity and scalability, Virtualization, Characteristics of virtualization, Benefits of virtualization, Virtualization in cloud computing, Hypervisors, Multitenancy, Types of tenancy, Application programming interfaces (API), Billing and metering of services, Management, tooling, and automation in cloud computing.	**08**	PO1/ PO2	PSO1
Module-3	**Cloud service delivery:** Cloud service , Cloud service model architectures, Infrastructure as a service (IaaS) architecture , Infrastructure as a service (IaaS) details, Platform as a service (PaaS) architecture, Platform as a service (PaaS) details, Platform as a service (PaaS) , Examples of PaaS software, Software as a service (SaaS) architecture, Software as a service (SaaS) details,Function as a Service (FaaS) / Serverless Computing,Container as a Service (CaaS),AI as a Service (AIaaS) and ML as a Service (MLaaS),Backup as a Service (BaaS) , Examples of SaaS applications , Trade-off in cost to install versus , Common cloud management platform reference architecture: Architecture overview diagram, Common cloud management platform, Database as a Service - Monitoring as a Service – Communication as services.	**08**	PO2/ PO3	PSO1/ PSO2
Module-4	**Cloud deployment scenarios:** Cloud deployment models, Public clouds, Hybrid clouds, Community, Virtual private clouds, Vertical and special purpose, Migration paths for cloud, Selection criteria for cloud	**08**	PO3/ PO5/ PO12	PSO1/ PSO2

	deployment, Case study example: AWS Platform. Virtualization For Cloud Need for Virtualization – Pros and cons of Virtualization – Types of Virtualization – System Vm, Process VM, Virtual Machine monitor – Virtual machine properties - Interpretation and binary translation, HLL VM - Hypervisors – Xen, KVM , VMWare, Virtual Box, Hyper-V.			
Module-5	**Security in cloud computing:** Cloud security reference model, How security gets integrated, Cloud security, Understanding security risks, Principal security dangers to cloud computing, Data corruption or loss, User account and service hijacking, Steps to reduce cloud security breaches. Classification of Cloud Implementations: Amazon Web Services, The Elastic Compute Cloud (EC2). The Simple Storage Service (S3),AWS Lambda (Serverless), AWS RDS (Relational Database Service, The Simple Queuing Services (SQS), Google AppEngine - PaaS, Windows Azure; Aneka, Hadoop,IBM Cloud,Oracle Cloud, Alibaba Cloud, A Comparison of Cloud Computing Platforms.	**08**	PO1/ PO3	PSO1/ PSO2
Total No. of Hours		**40**		

Learning Outcomes:	• Understand the concept of virtualization and how this has enabled the development of Cloud Computing • Know the fundamentals of cloud, cloud Architectures and types of services in cloud • Understand scaling, cloud security and disaster management • Design different Applications in cloud • Ability to use AWS/IBM Cloud/Google cloud

Suggested books:

S. No.	Name of Authors /Books /Publisher/Year
1.	Practices and Paradigms in Cloud Computing, RajKumarBuyya
2.	IBM , Handouts
3.	Michael Miller, Cloud Computing (1 ed.), Que Publishing, 2008. ISBN 978-0789738035.
4.	Cloud Computing, Publisher: Jones and Barret India, Author : Kris Jasm
5.	Anthony Velte, Toby Velte and Robert Elsenpeter, Cloud Computing: A practical Approach (1 ed.), Tata McGrawHill, 2009. ISBN 978-0070683518.

CO-PO/PSO MAPPING

Course Outcomes (COs)	Program Outcomes (POs)												Program Specific Outcomes (PSOs)	
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO10	PO11	PO12	PSO 1	PSO 2
CO1	√	√											√	√
CO2	√	√	√										√	√
CO3	√	√	√										√	√
CO4	√	√										√	√	√
CO5	√	√	√		√							√	√	√

Batch 2025-2026 and onwards

Course Code: BET-O632

Course Name: SENSORS AND TRANSDUCERS

MM: 100 **Time: 3 Hr.** **L T P** **3 0 0**	**Sessional: 30** **ESE: 70** **Credit : 3**

Prerequisites:	Electronics measurement and instrumentation
Objectives:	**1.** Introduction of different sensors **2.** Introduction of transducers **3.** Telemetry & Data Acquisition System **4.** Recent Trends and Developments
Course Coordinator	Mr. Amrish

NOTE:	The question paper shall consist of two sections (Section-A and Section-B). Section-A shall contain of ten (10) short answer type questions of six (06) mark each and student shall be required to attempt any five (05) questions. Section-B shall contain eight (08)long answer type questions of ten (10) marks each and student shall be required to attempt any four questions. Questions shall be uniformly distributed from the entire syllabus

UNIT	Module	Course Content	No. of Hours	POs mapped	PSOs mapped
UNIT-1	*Module-1*	Sensor: Introduction of sensor, Definition, principle of sensing, its classification, Mechanical and Electromechanical Sensor: Strain gauge, Resistive Sensors: material, accuracy, sensitivity, Inductive sensor: common types, material, construction and input output variable	**4**	PO1, PO2, PO3, PO4, PO5, PO6	PSO1, PSO2
	Module-2	LVDT: Construction, material, output input relationship, I/O curve, Proximity Sensors.Capacitive sensors: Its type and calculation of sensitivity, ultrasonic sensors.	**4**	PO1, PO2, PO3, PO4, PO5, PO6	PSO1, PSO2
UNIT-2	*Module-3*	Sensor (Continue) Thermal sensors:Material expansion type: solid, liquid, gas & vapor, Resistance change type: RTD materials, Thermistor material, shape, ranges and accuracy specification, Junction semiconductor type IC and PTAT type, Pyroelectric type, Radiation sensor: types, characteristics and comparisons	**4**	PO1, PO2, PO3, PO4, PO5, PO6	PSO1, PSO2
	Module-4	Thermoemf sensor.Magnetic sensors: Sensor based on Villari effect for assessment of force, torque, proximity, Wiedemann effect for yoke coil sensors,Radiation sensors: LDR, Photovoltaic cells, photodiodes, photo emissive celltypes, materials, construction, response.Pneumatic Sensors, Light Sensors, Tactile Sensors, acoustic, optical sensors, and digital sensors.	**4**	PO1, PO2, PO3, PO4, PO5, PO6	PSO1, PSO2
UNIT-3	*Module-5*	Transducers-: Introduction, Classification of Transducers, Advantages and Disadvantages of Electrical Transducers, Transducers Actuating Mechanisms, Resistance Transducers, Variable Inductance Transducers, Strain gauges, Resistance thermometer	**4**	PO1, PO2, PO3, PO4, PO5, PO6	PSO1, PSO2
	Module-6	LVDT, RVDT, Capacitive, Piezoelectric Hall effect and opto-electronic transducers, Thermocouples, Thermoelectric Transducers,	**4**	PO1, PO2, PO3, PO4, PO5, PO6	PSO1, PSO2

		Photoelectric Transducers, Digital Transducers, Pyro-electric transducers and their applications. Measurement of motion, Force pressure, Temperature, Flow and liquid level.			
UNIT-4	*Module-7*	Telemetry &Data Acquisition System: General telemetry system, land line and radio frequency telemetering system, transmission channel and media, receiver and transmitter	**4**	PO1, PO2, PO3, PO4, PO6	PSO1, PSO2
	Module-8	Data Acquisition System, Various types of data acquisitionsystems, method of data transmission, Analog data acquisition system, Modern digital data acquisition system.	**4**	PO1, PO2, PO3	PSO1, PSO2
UNIT-5	*Module-9*	Display Devices and Recorders: Display devices, storage oscilloscope, spectrum analyzer, strip chart and X-Y recorders, magnetic tape and digital tape recorders.	**4**	PO1, PO2, PO3, PO4	PSO1, PSO2
	Module-10	Recent Trends and Developments: Computer aided measurements, fibre optic transducers, microprocessors, and smart. Recent trends in sensor technology, Introduction to smart sensors, basic building blocks of smart sensors, industrial applications of sensors.	**4**	PO1, PO2, PO4, PO6	PSO1, PSO2
Total No. of Hours			**40**		

Learning Outcomes:	• Understanding the classification of sensors • To understand the different transducers • Able to learn the Telemetry & Data Acquisition System • Able to learn Recent Trends and Developments with industrial applications

Suggested books:

S. No.	Name of Authors /Books /Publisher	Year of Publication
1.	B. C. Nakara and K. Chaudhary, Instrumentation, measurement and analysis, Tata Mc Graw Hill 2nd Edition.	2008
2.	Curtis Johns, Process Control Instrumentation, Prentice Hall.	2007
3.	A.K. Sawhney, Advance measurement and instrumentation, Dhanpat Rai & Sons.	1997
4.	Murthy D. V. S, "Transducers and Instrumentation", Prentice Hall, New Delhi.	2008
5.	Patranabis, "Sensors and Transducers", 2nd Edition, Prentice Hall India Pvt. Ltd.	2007
6	Doebelin E.O, "Measurement Systems - Application and Design", 4th Edition, McGraw-Hill, New York, 2003.	1971
7	John Turner and Martyn Hill, Instrumentation for Engineers and Scientists, Oxford Science Publications, 1999	1978

Batch 2025-2026 and onwards

Course Code: BET-O633
Course Name: DATA COMMUNICATION& NETWORK PROTOCOLS

MM: 100 **Time: 3 Hr.** **L T P** **3 0 0**	**Sessional: 30** **ESE: 70** **Credit : 3**

Prerequisites:	Analog and Digital communication,
Objectives:	1. To develop an understanding of modern network architectures from a design andperformance perspective. 2. To introduce the student to the major concepts involved in wide-area networks (WANs), local area networks (LANs) and Wireless LANs (WLANs). 3. To provide an opportunity to do network programming. 4. To provide a WLAN measurement ideas.
Course Coordinator	Mr. SHIV KUMAR SINGH

NOTE:	The question paper shall consist of two sections (Section-A and Section-B). Section-A shall contain of ten (10) short answer type questions of six (06) mark each and student shall be required to attempt any five (05) questions. Section-B shall contain eight (08)long answer type questions of ten (10) marks each and student shall be required to attempt any four questions. Questions shall be uniformly distributed from the entire syllabus

UNIT	Module	Course Content	No. of Hours	POs mapped	PSOs mapped
UNIT-1	*Module-1*	Introduction : Computer Network & its uses, OSI reference model, TCP/IP Reference Model, ARPANET, Protocols, Routers, Switches, Hubs, Bridges and Repeaters, Introduction to LAN/MAN/WAN.The Physical Layer: Transmission media: Twisted pair, Baseband and Broadband coaxial cable, Fiber optics; Wireless Transmission: Radio transmission, Microwave transmission, Infrared and light wave transmission; ISDN: services and architecture, ALOHA	**09**	PO1/ PO2/ PO3	PSO1/ PSO2/..
UNIT-2	*Module-2*	The Data Link Layer: Design Issues: Services provided to other Layer, framing, Error control, Flow control; Error detection and Correction; Simplex, Sliding window protocol, Using Go-Back n, Stop & Wait Protocol ARQ. The Medium Access Sub layer: Static and Dynamic Channel Allocation in LANs and MANs; IEEE standard 802.3, 802.4, 802.5; CSMA, Finite state machine model.	**09**	PO1/ PO2/ PO3	PSO1/ PSO2/..
UNIT-3	*Module-3*	The Network Layer: Network layer design issues, Shortest path routing, Flooding, flow- based routing, Broadcast routing, Congestion control and prevention policies; Traffic Shaping, Internetworking : connectionless Interworking, IP addressing, IPv4, Fragmentation, introduction to IPV-6.	**08**	PO2/ PO3/ PO4/	PSO1/ PSO2/..
UNIT-4	*Module-4*	The Transport Layer: QOS, The transport service; Transport protocols: Addressing, Establishing and releasing a connection; TCP/UDP header, Examples of transport layer.Session Layer-RPC, Synchronization, dialog management.	**07**	PO1/ PO2/ PO3	PSO1/ PSO2/..
UNIT-5	*Module-5*	The Application Layer: Network Security, FTP, SNMP, Telnet, E- mail, Multimedia, WWW, DNS, SMTP.Presentation layer: ASN, data compression, encryption.	**07**	PO2/ PO4/ PO5	PSO1/ PSO2/..

Total No. of Hours	**40**		

Learning Outcomes:	After completing this course, the student will be able to 1. Explain the functions of the different layer of the OSI Protocol. 2. Draw the functional block diagram of wide-area networks (WANs), local areanetworks (LANs) and Wireless LANs (WLANs) describe the function of each block. 3. For a given requirement (small scale) of wide-area networks (WANs), local areanetworks (LANs) and Wireless LANs (WLANs) design it based on the market availablecomponent 4. For a given problem related TCP/IP protocol developed the network programming. 5. Configure DNS DDNS, TELNET, EMAIL, File Transfer Protocol (FTP), WWW,HTTP, SNMP, Bluetooth, Firewalls using open source available software and tools.

Suggested books:

S. No.	**Name of Authors /Books /Publisher**	**Year of Publication**
1.	Andrew S. Tanenbaum (3/e), Computer Networks, PHI	2001
2.	B. A. Frouzan , Data Communications & Networking(3/e, 4/e)	2006
3.	W.Stallings (4/e), Data and Computer Communications, PHI	2009
4.	Douglas E.Comer (3/e), Interworking with TCP/IP,Principles, Protocols & Architecture	2006

CO-PO/PSO MAPPING

Course Outcomes (COs)	**Program Outcomes (POs)**												**Program Specific Outcomes (PSOs)**	
	PO 1	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO10**	**PO11**	**PO12**	**PSO 1**	**PSO 2**
CO1	√	√											√	√
CO2	√	√	√										√	√
CO3	√	√	√										√	√
CO4	√	√										√	√	√
CO5	√	√	√		√							√	√	√

Batch 2025-2026 and onwards

Course Code: BCE-O648
Course Name: CLOUD COMPUTING

MM: 100 **Time: 3 Hr.** **L T P** **3 0 0**	**Sessional:30** **ESE:70** **Credit :3**

Prerequisites:	Discrete Mathematics, Computer Networks
Objectives:	• To understand the concepts of Cloud Computing. • To learn Taxonomy of Virtualization Techniques. • To learn Cloud Computing Architecture. • To acquire knowledge on Aneka Cloud Application Platform. • To learn Industry Cloud Platforms.

NOTE:	The question paper shall consist of two sections A and B. Section A contains 10 short type questions of 6 marks each and student shall be required to attempt any five questions. Section B contains 8 long type questions of ten marks each and student shall be required to attempt any four questions. Questions shall be uniformly distributed from the entire syllabus.

UNIT/ Module	Course Content	No. of Hours	POs mapped	PSOs mapped
Module-1	**Overview of cloud computing:** What is a cloud, Definition of cloud, Characteristics of cloud, why use clouds, How clouds are changing, Driving factors towards cloud, Comparing grid with cloud, Public clouds (commercial), **Cloud Service Models** (IaaS, PaaS, SaaS – Overview)	**08**	PO 1	PSO1/ PSO2
Module-2	**Cloud computing concepts:** Concepts of cloud computing, Cloud computing leverages the Internet, Positioning cloud to a grid infrastructure, Elasticity and scalability, Virtualization, Characteristics of virtualization, Benefits of virtualization, Virtualization in cloud computing, Hypervisors, Multitenancy, Types of tenancy, Application programming interfaces (API), Billing and metering of services, Management, tooling, and automation in cloud computing.	**08**	PO1/ PO2	PSO1
Module-3	**Cloud service delivery:** Cloud service , Cloud service model architectures, Infrastructure as a service (IaaS) architecture , Infrastructure as a service (IaaS) details, Platform as a service (PaaS) architecture, Platform as a service (PaaS) details, Platform as a service (PaaS) , Examples of PaaS software, Software as a service (SaaS) architecture, Software as a service (SaaS) details,Function as a Service (FaaS) / Serverless Computing,Container as a Service (CaaS),AI as a Service (AIaaS) and ML as a Service (MLaaS),Backup as a Service (BaaS) , Examples of SaaS applications , Trade-off in cost to install versus , Common cloud management platform reference architecture: Architecture overview diagram, Common cloud management platform, Database as a Service - Monitoring as a Service –Communication as services.	**08**	PO2/ PO3	PSO1/ PSO2
Module-4	**Cloud deployment scenarios:** Cloud deployment models, Public clouds, Hybrid clouds, Community, Virtual private clouds, Vertical and special purpose, Migration paths for cloud, Selection criteria for cloud deployment, Case study example: AWS Platform. Virtualization For Cloud Need for Virtualization – Pros and cons of Virtualization – Types of Virtualization –System Vm, Process VM, Virtual Machine	**08**	PO3/ PO5/ PO1 2	PSO1/ PSO2

	monitor – Virtual machine properties - Interpretation and binary translation, HLL VM - Hypervisors – Xen, KVM , VMWare, Virtual Box, Hyper-V.			
Module-5	**Security in cloud computing:** Cloud security reference model, How security gets integrated, Cloud security, Understanding security risks, Principal security dangers to cloud computing, Data corruption or loss, User account and service hijacking, Steps to reduce cloud security breaches. Classification of Cloud Implementations: Amazon Web Services, The Elastic Compute Cloud (EC2). The Simple Storage Service (S3),AWS Lambda (Serverless), AWS RDS (Relational Database Service, The Simple Queuing Services (SQS), Google AppEngine - PaaS, Windows Azure; Aneka, Hadoop,IBM Cloud,Oracle Cloud, Alibaba Cloud, A Comparison of Cloud Computing Platforms.	**08**	PO1/ PO3	PSO1/ PSO2
Total No. of Hours		**40**		

Learning Outcomes:	• Understand the concept of virtualization and how this has enabled the development of Cloud Computing • Know the fundamentals of cloud, cloud Architectures and types of services in cloud • Understand scaling, cloud security and disaster management • Design different Applications in cloud • Ability to use AWS/IBM Cloud/Google cloud

Suggested books:

S. No.	Name of Authors /Books /Publisher/Year
1.	Practices and Paradigms in Cloud Computing, RajKumarBuyya
2.	IBM , Handouts
3.	Michael Miller, Cloud Computing (1 ed.), Que Publishing, 2008. ISBN 978-0789738035.
4.	Cloud Computing, Publisher: Jones and Barret India, Author : Kris Jasm
5.	Anthony Velte, Toby Velte and Robert Elsenpeter, Cloud Computing: A practical Approach (1 ed.), Tata McGrawHill, 2009. ISBN 978-0070683518.

CO-PO/PSO MAPPING

Course Outcomes (COs)	Program Outcomes (POs)												Program Specific Outcomes (PSOs)	
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO10	PO11	PO12	PSO 1	PSO 2
CO1	√	√											√	√
CO2	√	√	√										√	√
CO3	√	√	√										√	√
CO4	√	√										√	√	√
CO5	√	√	√		√							√	√	√

Batch 2025-2026 and onwards

Course Code: BCE-O633
Course Name: INTRODUCTION TO DATA SCIENCE AND DESIGN THINKING

MM: 100 **Time: 3 Hr.** **L T P** **3 0 0**	**Sessional:30** **ESE:70** **Credit :3**

Prerequisites:	Elementary programming knowledge
Objectives:	• An understanding of problems solvable with data science and an ability to attack them from a statistical perspective. • An understanding of when to use supervised and unsupervised statistical learning methods on labeled and unlabeled data-rich problems. • The ability to create data analytical pipelines and applications in Python. • Familiarity with the Python data science ecosystem and the various tools needed to continue developing as a data scientist. • To learn the basics of design thinking and good design concepts • To explore design thinking applications in computer science • To understand design-based issues of product and services • Demonstrate the value of developing a local network and assist students in making lasting connections with the business community. • Students develop a portfolio of work to set them apart in the job market. • Provide an authentic opportunity for students to develop teamwork and leadership skills.

NOTE:	The question paper shall consist of two sections A and B. Section A contains 10 short type questions of 6 marks each and student shall be required to attempt any five questions. Section B contains 8 long type questions of ten marks each and student shall be required to attempt any four questions. Questions shall be uniformly distributed from the entire syllabus.

Module	Course Content	No. of Hours	POs mapped	PSOs mapped
Module-1	**Introduction to Data Science –**Evolution of Data Science – Data Science Roles – Stages in a Data Science Project – Applications of Data Science in various fields – Data Security Issues.	**09**	PO1/ PO2/	PSO1/ PSO2
Module-2	**Data Collection Strategies –**Data Pre-Processing Overview – Data Cleaning – Data Integration and Transformation – Data Reduction – Data Discretization.	**09**	PO2/ PO4/ PO5	PSO1/ PSO2
Module-3	Descriptive Statistics – Mean, Standard Deviation, Skewness and Kurtosis – Box Plots – Pivot Table – Heat Map – Correlation Statistics – ANOVA.	**07**	PO1/ PO2/ PO3/ PO5	PSO1/ PSO2
Module-4	**Introduction to Design Thinking:**Definition of design thinking, good design and bad design, importance of design thinking, applications of design thinking. Stages of Design thinking: Empathize, Define, Ideate, Prototype, Test and Implement. The evolution of technology using design thinking, innovative examples of design thinking - Life Saving Dot, Embrace Incubator, Project Bloks, Pillpack, Aarambh Desk.	**07**	PO1/ PO3/ PO4/ PO5/ PO1 1	PSO1/ PSO2
Module-5	**Case Studies, Design for Specific Culture:**Case studies of Zip line, Tesla, AirBNB, The body Shop, Patagonia, Ben & Jerry's, 23 and Me, War child, Warby Parker and Toms Shoes.	**08**	PO4/ PO5/ PO1 2	PSO1/ PSO2

Total No. of Hours	**40**		

Learning Outcomes:	• Demonstrate proficiency with statistical analysis of data. • Demonstrate skill in data management. • Apply data science concepts and methods to solve problems in real-world. • Develop a strong understanding of the design process • Learn how to create physical prototypes / a visual representation of an idea

Suggested books:

S. No.	**Name of Authors /Books /Publisher/Year**
1.	Saltz, Jeffrey S., and Jeffrey M. Stanton. *An introduction to data science*. Sage Publications, 2017.
2.	JojoMoolayil, "Smarter Decisions: The Intersection of IoT and Data Science", PACKT, 2016.
3.	Cathy O'Neil and Rachel Schutt, "Doing Data Science", O'Reilly, 2015.
4.	Luchs, Michael G. "A brief introduction to design thinking." *Design thinking: New product development essentials from the PDMA* (2015): 1-12.
5.	Suyash Bhardwaj, "*10 Amazing Stories of Design Thinking that Shaped the Future: Learning Through Design Thinking*", Amazon, 2023. ISBN - 978-93-5906-723-0
6.	David Dietrich, Barry Heller, Beibei Yang, "Data Science and Big data Analytics", EMC 2013
7.	Raj, Pethuru, "Handbook of Research on Cloud Infrastructures for Big Data Analytics", IGI Global.
8.	Cross, Nigel. *Design thinking: Understanding how designers think and work*. Berg, 2011.
9.	Meinel, Christoph, and Larry Leifer. "Design thinking research." *Design thinking research*. Springer, Berlin, Heidelberg, 2012. 1-11.

CO-PO/PSO MAPPING

Course Outcomes (COs)	**Program Outcomes (POs)**												**Program Specific Outcomes (PSOs)**	
	PO 1	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO10**	**PO11**	**PO12**	**PSO 1**	**PSO 2**
CO1	√	√											√	√
CO2	√	√	√								√		√	√
CO3	√	√	√	√								√	√	√
CO4	√	√		√	√							√	√	√
CO5	√	√	√	√	√							√	√	√

Batch 2025-2026 and onwards

Course Code: BET-O634
Course Name: INTRODUCTION TO PLC AND SCADA SYSTEMS

MM: 100 **Time: 3 Hr.** **L T P** **3 0 0**	**Sessional: 30** **ESE: 70** **Credit: 3**

Prerequisites:	For this course, no pre-requisites are required. But should have knowledge of basic antenna and advanced antennas and their frequency spectrums.
Objectives:	1. Learn the Introduction of Automation system. 2. PLC and I/O processing. 3. Programming of PLC 4. PLC interface to various circuits SCADA Systems
Course Coordinator	Dr. Atul Kumar Varshney

NOTE:	The question paper shall consist of two sections (Section-A and Section-B). Section-A shall contain Ten (10) short answer type questions of six (06) mark each and student shall be required to attempt any five (05) questions. Section-B shall contain eight (08) long answer type questions of ten (10) marks each and student shall be required to attempt any four questions. Questions shall be uniformly distributed from the entire syllabus

UNIT	Module	Course Content	No. of Hours	POs mapped	PSOs mapped
UNIT-I	Module- 1	Introduction of Automation system: Introduction to Industrial Automation, Requirement of automation systems, Application areas, Architecture of Industrial Automation system, Introduction of PLC and supervisory control and data acquisition (SCADA). Industrial communication protocols: Modbus &profibus.	**8**	PO1/ PO2/ PO3/ PO4/ PO5/ PO6	PSO1/ PSO2/ PSO3
UNIT-II	Module- 2	PLC and I/O processing: Programmable Logic Controller basics, overview of PLC systems – Architecture of PLC, Principle of Operation, input/output Units – power supplies and isolators, current sinking and current sourcing, types of PLC memory, fundamental PLC wiring diagram, relays, switches, transducers, sensors –seal-in circuits. Input/output units Signal conditioning. Remote connections Networks Processing inputs I/O addresses.	**8**	PO1/ PO2/ PO3/ PO4/ PO5/ PO6	PSO1/ PSO2/ PSO3
UNIT-III	Module- 3	Programming of PLC: Fundamentals of logic, PLC programming languages. Ladder diagrams, Ladder Diagram Instruction, Logic functions, Latching, Multiple outputs. Timer and counter- types along with timing diagrams, shift registers, sequencer function, latch instruction; Arithmetic and logical instruction with various examples. ON/OFF switching devices, I/O analog devices, Analog PLC operation, PID control of continuous processes, simple closed loop systems, closed loop system using Proportional, Integral & Derivative (PID), PLC interface, and Industrial process example.	**8**	PO1/ PO2/ PO3/ PO4/ PO5/ PO6	PSO1/ PSO2/ PSO3
UNIT-IV	Module- 4	PLC interface to various circuits: Encoders, transducer and advanced sensors. Measurement of temperature, flow, pressure, force, displacement, speed, level. Developing a ladder logic for	**8**	PO1/ PO2/ PO3/ PO4/	PSO1/ PSO2/ PSO3

		Sequencing of motors, Tank level control, ON-OFF temperature control, elevator, bottle filling plant, car parking etc. Motors Controls: AC Motor starter, AC motor overload protection, DC motor controller, Variable speed (Variable Frequency) AC motor Drive.		PO5/ PO6	
UNIT-V	Module- 5	SCADA Systems: Introduction, Communication requirements, Desirable Properties of SCADA system, features, advantages, disadvantages and applications of SCADA. SCADA Architectures (First generation - Monolithic, second generation - Distributed, Third generation – Networked Architecture), SCADA systems in operation and control of interconnected power system, Power System Automation (Automatic substation control and power distribution). Open systems interconnection (OSI) Model, Process Field bus (Profibus). Interfacing of SCADA with PLC.	**8**	PO1/ PO2/ PO3/ PO4/ PO5/ PO6	PSO1/ PSO2/ PSO3
Total No. of Hours			**40**		

Suggested books:

S. No.	Name of Authors /Books /Publisher
1.	Gary Dunning, "Introduction to Programmable Logic Controllers", Thomson, 2nd Edition.
2.	John R. Hackworth, Frederick D., Hackworth Jr., "Programmable Logic Controllers Programming Methods and Applications", PHI Publishers.
3.	John W. Webb, Ronald A. Reis, "Programmable Logic Controllers: Principles and Application", PHI Learning, New Delhi, 5th Edition.
4.	Stuart A Boyer, "SCADA supervisory control and data acquisition", ISA, 4th Revised edition.
5.	L.A. Bryan, E. A. Bryan, "Programmable Controllers Theory and Implementation" Industrial Text Company Publication, Second Edition.
6	Industrial Instrumentation and Control, by Singh, McGraw Hill.
7	Stuart A. Boyer: "SCADA- Supervisory Control and Data Acquisition", Instrument Society of America Publications, USA, The Instrumentation system and Automation Society, 4th Edition, 2010.
8	Gordon Clarke, Deon Reynders" Practical Modern SCADA Protocols: DNP3, 60870.5 and Related Systems", Newnes an imprint of Elsevier Publications, 1st Edition, 2004
9	Batten G. L., "Programmable Controllers", McGraw Hill Inc., Second Edition.
10	Gordan Clark, Deem Reynders, "Practical Modern SCADA Protocols", ELSEVIER
11	P. K. Srivstava, "Programmable Logic Controllers with Applications", BPB Publications.

Course Outcomes (COs)

Upon completing this course, students will be able to:

1. Understand the fundamentals of industrial automation, including PLCs and SCADA systems.
2. Analyze and implement industrial communication protocols such as Modbus and Profibus.
3. Develop and troubleshoot PLC programs, including ladder logic, timers, counters, and PID control.
4. Interface PLCs with various sensors and actuators, enabling automation of industrial processes.
5. Apply SCADA systems for real-time monitoring, control, and automation of industrial operations.
6. Evaluate wave propagation concepts in automation-related signal transmission and communication systems.

Program Outcomes (POs)

By the end of this program, students will be equipped to:

1. Apply automation principles to industrial processes for increased efficiency and productivity.
2. Design and develop PLC-based automation solutions for various control applications.
3. Implement communication protocols for seamless data exchange in industrial environments.
4. Analyze real-time control and monitoring systems using SCADA technology.
5. Utilize programming skills to develop reliable and optimized control logic.
6. Integrate sensors, transducers, and actuators for accurate data acquisition and process control.
7. Understand advanced motor control techniques, including AC/DC motor protection and speed control.
8. Develop automation solutions for applications like power system control, factory automation, and industrial processes.

9. Ensure safety and reliability in automation systems through proper circuit design and fault tolerance mechanisms.

CO-PO Mapping

Course Outcomes (COs)	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO1: Understand the fundamentals of industrial automation	3	3	2	2	2	1	-	-	-	-	-	-
CO2: Analyze and implement industrial communication protocols	3	3	3	2	2	2	-	-	-	-	-	-
CO3: Develop and troubleshoot PLC programs	3	3	3	2	2	2	-	-	-	-	-	-
CO4: Interface PLCs with various sensors and actuators	3	3	2	3	3	3	-	-	-	-	-	-
CO5: Apply SCADA systems for real-time monitoring and control	3	3	2	3	3	3	-	-	-	-	-	-
CO6: Evaluate wave propagation concepts in automation systems	3	3	2	3	3	3	-	-	-	-	-	-

Batch2026-2027andonwards

CourseCode BET-C710

CourseName: MICROWAVE THEORY AND TECHNIQUE

MM:100 **Time:3Hr.** **LTP** **3 0 0**	**Sessional:30** **ESE:70** **Credit:3**

Prerequisites:	Electromagnetic Waves, Antenna and wave Propagation
Objectives:	1. An understanding of microwave waveguides, passive & active devices, tubes and network analysis. 2. An ability to design microwave matching networks. 3. An ability to perform microwave measurements. 4. An understanding of RADARs and its applications.
Course Coordinator	Mr.Shiv KumarSingh

NOTE:	The question paper shall consist of two sections (Section-A and Section-B).Section-Ashall contain Ten (10) short answer type questions of six (06) mark each and student shallbe required to attempt any five (05) questions. Section-B shall contain eight (08)longanswertypequestionsoften(10)markseachandstudentshallberequiredtoattemptany fourquestions. Questions shall beuniformlydistributed fromthe entiresyllabus

UNIT	Module	CourseContent	No.ofHours	POsmapped	PSOsmapped
UNIT-1	Module-1	Electromagnetic spectrum, Microwave frequency bands, Application areas of microwaves. Waveguides: TEM, TE and TM modes, Rectanglar waveguide, Cylindrical waveguide, excitation of waveguides, Resonators rectangular and cylindrical and their application, Quasi TEM mode and propagation in metamaterial structure, SIW Waveguide.	**8**	PO1/PO2/	PSO1/PSO2
UNIT-2	Module-2	Ferrites, Faraday rotation ferrite devices, isolators, Circulators, and phase shifters. Microwave components: S-parameters and their applications to Tee network, Magic Tee, Directional Couplers, Attenuators, Wave meters.	**9**	PO1/PO2/ PO4	PSO1/PSO2
UNIT-3	Module-3	Microwave Tubes: UHF limitation in conventional vacuum tubes, M-type and O-type tubes, Klystron Amplifier and Reflex Klystron, TWT Theory, characteristics parameters and applications, Backward wave oscialltor (BWO), and applications.	**10**	PO1/PO3/	PSO1/PSO2
UNIT-4	Module-4	Magnetron, principle of operation, applications and characteristics parameters, mode jumping in magnetron. Solid-state microwave devices: Varactordoade, PIN diode, Tunnel diode, V-I characteristics of T.D., T.D. amplifiers, and oscillator.	**8**	PO1/PO3/PO4	PSO1/PSO2
UNIT-5	Module-5	Transferred electron devices, Gunn diode, Gunn Effect devices, Avalanche Transit time devices, Fundamental ideas of Microwave filters, Measurement of low and high microwave powers, Measurement of unknown impedance, wavelength measurements, VSWR measurements.	**7**	PO1/ PO2/ PO3/	PSO1/PSO2
TotalNo. ofHours			**40**		

LearningOutcomes:	At the end of the course, students will demonstrate the ability to: 1. Understand various microwave system components their properties. 2. Appreciate that during analysis/ synthesis of microwave systems, the different mathematical treatment is required compared to general circuit analysis. 3. Design microwave systems for different practical application.

Suggestedbooks:

S. No.	NameofAuthors/Books/Publisher
1.	Leo, Sanuer---Microwave & Solid state devices-Prentice Hall
2.	Watson, H.A. ---Microwave Semiconductor Devices-McGraw Hill.
3.	Collin, R.E. ---Fundamental of Microwave Engineering.

PO/PSOMAPPING

Course Outcomes(COs)	ProgramOutcomes(POs)												ProgramSpecific Outcomes(PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	
CO1	3	2	3	3	3								3	3	
CO2	3	3	3	3	3								3	3	
CO3	3	3	3	3	3								3	3	
CO4	3	1	2	1	3								3	3	
CO5	3	2	2	1	3								3	3	

Course Code: BHU-S702
Course Name: INDUSTRIAL ECONOMICS AND INTELLECTUAL PROPERTY RIGHTS

MM: 100 **Time: 3 Hr.** **L T P** **3 0 0**	**Sessional: 30** **ESE: 70** **Credit : 2**

Prerequisites:	Entrepreneurship Development
Objectives:	1. To provide knowledge regarding the basic concepts, principles and functions of management. 2. To develop business and entrepreneurial aptitude among the students. 3. To provide knowledge and requisite skills in different areas of management like human resource, finance, operations and marketing to give a holistic understanding of a business system. 4. To provide knowledge about IP, IPRs, patent, copyrights, trademarks and GI etc. 5. To identify IP as an effective policy tool for national, economic, social, and cultural development.
Course Coordinator	Dr. Ashish Nainwal

NOTE:	The question paper shall consist of two sections (Section-A and Section-B). Section-A shall contain of ten (10) short answer type questions of six (06) mark each and student shall be required to attempt any five (05) questions. Section-B shall contain eight (08) long answer type questions of ten (10) marks each and student shall be required to attempt any four questions. Questions shall be uniformly distributed from the entire syllabus

UNIT	Module	Course Content	No. of Hours	POs mapped	PSOs mapped
UNIT-1	*Module-1*	**Industrial Economics**: Elasticity of demand and supply, Demand forecasting methods, Consumption laws, Types of competition, Break even analysis, National income accounting, Trends in Industrialization in India, Economies of scale, Production Planning and control.	**09**	PO1/ PO2/ PO3/ PO4/ PO5…	PSO1/ PSO2/..
UNIT-2	*Module-2*	**Money, Banking and Financial Management**: Nature and functions of money, Functions of commercial and central banks, Credit creation in the banks, Balance of payment and trade, Foreign Exchange, Exchange control, Devaluation and Revaluation, Sources of Industrial Finance, Principles of accounting, Balance sheet & P & L A/C, Cash flow statement.	09		PSO1/ PSO2/..
UNIT-3	*Module-3*	**Principles of Management**: Managerial functions - Planning, Organizing Leading & Controlling.	06		PSO1/ PSO2/..
UNIT-4	*Module-4*	**Marketing Management**: Concept of marketing management, P's of marketing, Product life cycle, Market segmentation.	08		PSO1/ PSO2/..
UNIT-5	*Module-5*	**Intellectual Property Rights**: Introduction to intellectual property, historical evolution of IPR protection-	08		PSO1/ PSO2/..

		Patent, Copyright, Trademark, Design, GI, Plant Varieties, Biodiversity, Lay-out designs of ICs, Patent law-meaning, subject matter and patentability criteria, FER.			
Total No. of Hours			**40**		

Learning Outcomes:	At the end of the course, a student will be able to: 1. To familiarize the students to what constitutes professional practice, introduction of various stakeholders and their respective roles; understanding the fundamental ethics governing the profession. 2. To give a good insight into contracts and contracts management in Electronics and Communication engineering, dispute resolution mechanisms; laws governing engagement of labour. 3. To give an understanding of Intellectual Property Rights, Patents, Copyright, Trademark, Design, GI and patent law. 4. To make the students understand the types of roles they are expected to play in the society as practitioners of their profession. 5. To develop good ideas of the legal and practical aspects of their profession.

Suggested books:

1.	Dewtt. K.K., Modern Economic Theory" S. Chand, & Co (r) Ltd (r)	1999
2.	Robbins (r) P. Stephen, Coutter Mary, 'Management' PHI	1998
3.	Kotler Philip, 'Marketing Management', PHI latest edition.	2017
4.	Nair N.G.,Latha Nair,Personnel Management and Industrial Relations', S.Chand & Co	1999
5.	Singh S.P. "Industrial Economics & Management" AITBS, New Delhi	2006
6.	Kooutsnnis, 'Modern Economic Theory', PHI	1996
7.	Maheswari S.N., 'An Introduction to Accountancy' Vikas Publishing House	1999
8.	Koontz Harold, O Donnel Cyril, Weihirch Heniz, 'Management', TMH	1983
9.	Monoppan Arun, Sayadain S (r) Mirza, 'Personnel Management', TMH	1997

Course Code: BET-C761
Course Name: MICROWAVE THEORY AND TECHNIQUE LAB

MM : 100 **Sessional : 15**
Time : 2Hr **ESE : 35**
L T P **Credit : 1**
0 0 2

Course Objective:

1. To understand the basic concepts of microwave and wireless communication
2. To demonstrate the electromagnetic propagation using microwave sources and antennas at S and X bands frequencies.
3. To provide the state-of-art softwares for the design and development of various microwave circuits and antennas.

LIST OF EXPERIMENT:

1. Study of characteristics of Klystron tube and to determine its electronic tuning range.
2. To determine the frequency & wavelength in a rectangular wave-guide working on
3. TE10 mode.
4. To determine the Standing Wave Ratio, Reflection Coefficient.
5. To measure an unknown Impedance with Smith chart.
6. To study V-I characteristics of Gunn Diode.
7. To measure the polar pattern and the gain of wave-guide horn antenna.
8. Study the function of multi hole directional coupler by measuring the following parameters:
   - **(a)** Main-line and Auxiliary-line VSWR.
   - **(b)** Coupling factor and Directivity.
9. Study of Magic Tee.
10. Setting up a Fiber Optic Analog Link.
11. Setting up a Fibre Optic Digital Link.
12. Measurement of Numerical Aperture.
13. Study of Electromagnetic/Radio Frequency Interference.
14. Simulation using HFSS
15. Introduction to biological interaction with RF or microwave signals using HFSS or some other software.

Learning Outcome : The student after undergoing this course will be able to:

1. Explain different types of waveguides and their respective modes of propagation.
2. Analyze typical microwave networks using impedance, admittance, transmission and scattering matrix representations.
3. Design microwave matching networks using L section, single and double stub and quarter wave transformer.
4. Explain working of microwave passive circuits such as isolator, circulator, Directional couplers, attenuators etc.
5. Describe and explain working of microwave tubes and solid state devices.
6. Perform measurements on microwave devices and networks using power meter

Course Outcomes (COs)			ProgramOutcomes(POs)												ProgramSpecific Outcomes (PSOs)	
			PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	Define	L1	3												3	3
CO2	Interpret	L2	3	2	2										3	3
CO3	Explain	L2	3	2	2	2									2	2
CO4	Experimentwith	L3	3	3	3	3									2	3
CO5	Analyze	L4	3	3	2	2									3	3

BET-C772
MINOR PROJECT

MM : 100 **ESE: 70**
Credit : 4 **Sessional : 30**

OBJECTIVE: The object of Minor Project Work is to enable the student to take up investigative study in the broad field of Electronics & Communication Engineering, either fully theoretical/practical or involving both theoretical and practical work to be assigned by the Department on an individual basis or two/three students in a group, under the guidance of a Supervisor. This is expected to provide a good initiation for the student(s) in R&D work. The assignment to normally include:

1. Survey and study of published literature on the assigned topic;
2. Working out a preliminary Approach to the Problem relating to the assigned topic;
3. Conducting preliminary Analysis/Modelling/Simulation/Experiment/Design/Feasibility;
4. Preparing a Written Report on the Study conducted for presentation to the Department;
5. Final Seminar, as oral Presentation before a departmental committee.

INSTRUCTIONS FOR STUDENTS: Each student shall be assigned a Minor Project by departmental committee. The student shall be required to perform his project work under the supervision of the supervisor(s). There shall be a seminar on the project work of the student to be evaluated by a departmental committee chaired by H.O.D. The student shall be required to submit his project report in the form of dissertation 15 days before the end of VII semester. The student shall be required to submit three copies of the project work with certificate from the supervisor(s) that the work is authentic record of the work performed by him. The report shall be forwarded by H.O.D. The report of the project work shall be evaluated by the external examiner(s). The same external examiner(s) shall hold the viva-voce examination.

THE DISTRIBUTION OF MARKS FOR THE MINOR PROJECT SHALL BE AS FOLLOWS:

MINOR PROJECT	
Project**	50
Viva-voce/Presentation**	20
Seminar (Internal)***	30
Total	100

** - Marks for the project work shall be awarded jointly by the external and internal examiners after viva-voce examination.

*** - There shall be a seminar on the project work of the student to be evaluated by the departmental committee chaired by H.O.D.

BET-P860
MAJOR PROJECT

MM : 400 **ESE : 300**
Credit : 16 **Sessional : 100**

OBJECTIVE: The object of Major Project Work & Dissertation is
To enable the student to extend further the investigative study taken up, either fully theoretical/practical or involving both theoretical and practical work, under the guidance of a Supervisor from the Department alone or jointly with a Supervisor drawn from R&D laboratory/Industry.
This is expected to provide a good training for the student(s) in R&D work and technical leadership.
The assignment to normally include:
1. In depth study of the topic assigned in the light of the Report prepared under the guidance of a Supervisor.
2. Review and finalization of the Approach to the Problem relating to the assigned topic;
3. Preparing an Action Plan for conducting the investigation, including team work;
4. Detailed Analysis/Modelling/Simulation/Design/Problem Solving/Experiment as needed;
5. Final development of product/process, testing, results, conclusions and future directions;
6. Preparing a paper for Conference presentation/Publication in Journals, if possible;
7. Preparing a Dissertation in the standard format for being evaluated by the Department.
8. Final Seminar Presentation before a Departmental Committee.

INSTRUCTIONS FOR STUDENTS: Each student shall be assigned a Major Project by departmental committee. The student shall be required to perform his project work under the supervision of the supervisor(s). There shall be a seminar on the project work of the student to be evaluated by a departmental committee chaired by H.O.D. The student shall be required to submit his project report in the form of dissertation 15 days before the end of VIII semester. The student shall be required to submit three copies of the project work with certificate from the supervisor(s) that the work is authentic record of the work performed by him. The report shall be forwarded by H.O.D. The report of the project work shall be evaluated by the external examiner(s). The same external examiner(s) shall hold the viva-voce examination.

THE DISTRIBUTION OF MARKS FOR THE MAJOR PROJECT SHALL BE AS FOLLOWS:

MAJOR PROJECT	
Project**	200
Viva-voce/Presentation**	100
Seminar (Internal)***	100
Total	400

** - Marks for the project work shall be awarded jointly by the external and internal examiners after viva-voce examination.
*** - There shall be a seminar on the project work of the student to be evaluated by the departmental committee chaired by H.O.D.

Batch 2025-2026 and onwards

Course Code: BET-P720
Course Name: SATELLITE COMMUNICATION

MM: 100 **Time: 3 Hr.** **L T P** **3 0 0**	**Sessional: 30** **ESE: 70** **Credit : 3**

Prerequisites:	Analog and Digital communication,
Objectives:	1. To understand basics of satellite communications 2. To study various effects on satellite communications and to understand types of antennas used. 3. To study various components in satellite and satellite TV systems. 4. To analyse and design satellite communication link and study various access techniques. 5. To study various applications of satellite communications in practical world.
Course Coordinator	Mr. SHIV KUMAR SINGH

NOTE:	The question paper shall consist of two sections (Section-A and Section-B). Section-A shall contain of ten (10) short answer type questions of six (06) mark each and student shall be required to attempt any five (05) questions. Section-B shall contain eight (08)long answer type questions of ten (10) marks each and student shall be required to attempt any four questions. Questions shall be uniformly distributed from the entire syllabus

UNIT	Module	Course Content	No. of Hours	POs mapped	PSOs mapped
UNIT-1	*Module-1*	Elements of Satellite Communication, Orbital mechanics, look angle and orbit determination, launches & launch vehicle, orbital effects, Geostationary Orbit.	**08**	PO1/ PO2/ PO3	PSO1/ PSO2/..
UNIT-2	*Module-2*	Satellite subsystems, attitude and orbit control systems, TTC&M, communication subsystem, satellite antenna, satellite link design: basic transmission theory, system noise temperature and G/T ratio, downlink design, uplink design, satellite systems using small earth station, design for specified C/N.	**08**	PO1/ PO2/ PO3	PSO1/ PSO2/..
UNIT-3	*Module-3*	Modulation and multiplexing techniques for satellite links: FM, pre-emphasis and de-emphasis, S/N ratios for FM video transmission, digital transmission, digital modulation and demodulation, TDM. Multiple access: FDMA, TDMA, DAMA and CDMA.	**06**	PO2/ PO3/ PO4/	PSO1/ PSO2/..
UNIT-4	*Module-4*	Error control for digital satellite links: error detection and correction, channel capacity, error control coding, convolutional codes, linear and cyclic block codes. Propagation effects and their impact on satellite-earth links: attenuation and depolarization, atmospheric absorption, rain, cloud and ice effects etc.	**09**	PO1/ PO2/ PO3	PSO1/ PSO2/..
UNIT-5	*Module-5*	Introduction of various satellite systems: VSAT, low earth orbit and non-geostationary, direct broadcast satellite television and radio, satellite navigation and the global positioning systems. Pseudo-satellite, brief about satellite pay loads.	**09**	PO2/ PO4/ PO5	PSO1/ PSO2/..
Total No. of Hours			**40**		

Learning Outcomes:	After completing this course, the student will be able to 1. Explain principle, working and operation of satellite.

	2. Illustrate various effects on satellite communications and its antennas. 3. To study the design of Earth station and tracking of the satellites. 4. Understand the communication satellite and Earth station components. 5. Understand how analog and digital technologies are used for satellite communication networks. 6. Illustrate role of satellite in various applications.

Suggested books:

S. No.	Name of Authors /Books /Publisher	Year of Publication
1.	Pratt, Bostian, Allnutt, "***Satellite Communications",*** III, Wiley, ISBN-10 : 1119482178, ISBN-13 : 9781119482178	2003
2.	Dennis Roddy, "***Satellite Communication",*** IV, McGraw-Hill, ISBN-9780071371766	2006
3.	Author, "***Title",*** Ed, Publisher, ISBN-XXXX	XXXX
5.	3. Digital Satellite Communications/ Tri T. Ha./ McGraw-Hill.	XXXX

Batch 2025-2026 and onwards

Course Code: BET-P722
Course Name: Optical Fiber Communication

MM: 100 **Time: 3 Hr.** **L T P** **3 0 0**	**Sessional: 30** **ESE: 70** **Credit : 3**

Prerequisites:	Digital Communication
Objectives:	• To discuss technology developments in Optical Communication system. • To provide an in-depth knowledge on various types of fibers and their transmission characteristics, the construction, working principle and characteristics of transmitters, receivers and various optical amplifiers used in long distance communication. • To describe the concepts of Wavelength Division Multiplexing technique, components used and the estimation of rise-time and power budget for digital transmission system.
Course Coordinator	Dr. Ashish Nainwal

NOTE:	The question paper shall consist of two sections (Section-A and Section-B). Section-A shall contain of ten (10) short answer type questions of six (06) mark each and student shall be required to attempt any five (05) questions. Section-B shall contain eight (08)long answer type questions of ten (10) marks each and student shall be required to attempt any four questions. Questions shall be uniformly distributed from the entire syllabus

UNIT	Module	Course Content	No. of Hours	POs mapped	PSOs mapped
UNIT-1	*Module-1*	**Introduction:** Block diagram of optical fiber communication system, Advantages of optical fiber Communication.Optical fiber waveguides: structure of optical wave guide, light propagation in optical fiber using ray theory, acceptance angle, numerical aperture, skew rays, wave theory for optical propagation, modes in a planar and cylindrical guide, mode volume, single mode fibers, cutoff wavelength, mode field diameter, effective refractive index and group and mode delay factor for single mode fiber.	**8**	PO1/ PO2/ PO3	PSO1/PSO2
UNIT-2	*Module-2*	Transmission Characteristics of Optical fiber, Attenuation in optical fibers, intrinsic and extrinsic absorption, linear and non linear scattering losses, fiber bend losses. Dispersion and pulse broadening, intramodal and intermodal dispersion for step and graded index fibers, modal noise, over all fiber dispersion for multimode and monomode fiber, dispersion shifted fibers, modal birefringence and polarization maintaining fibers	**8**	PO1/ PO2/ PO3	PSO1/PSO2
UNIT-3	*Module-3*	**Optical Sources:** Basic concepts Einstein relations and population inversion optical feedback and threshold conditions, direct and indirect band gap semiconductors spontaneous and stimulated emission in p-n junction, threshold current density, Hetero junction & DH structure, semiconductor injection lasers structure & Characteristics of injection laser. Drawback and advantages of LED, DH, LED, LED structures and Characteristics	**8**	PO1/ PO2/ PO3	PSO1/PSO2
UNIT-4	*Module-4*	**Optical Detectors:** Requirement for photo detections p-n photodiode, characteristics of	**8**	PO1/ PO2/	PSO1/PSO2

		photo detections, p-i-n and avalanche photodiodes, phototransistors & photoconductors. Direct detection receiver performance considerations: Noise sources in optical fiber communication, noise in p-n, p-i-n and APD receivers, Receiver structures		PO3	
UNIT-5	*Module-5*	**Optical Fiber Communication Systems:** Principal components of an optical fiber communication system, source laminations, optical transmitter circuits, LED and laser drive circuits, optical receiver block diagram, simple circuits for pre-amplifier, automatic gain control and equalization, Regenerative repeater, BER of optical receiver, channel losses, ISI penalty and optical power budgeting for digital optical fiber system, line coding, analog systems, Direct intercity and sub carrier intensity modulation using AM, FM and PM. Block diagram and detection principle of coherent optical fiber system. Broad applications of fiber optics.	**8**	PO1/ PO2/ PO3/PO4 /PO5	PSO1/PS O2
Total No. of Hours			**40**		

Learning Outcomes:	• Define the concept of optical communication. • Understand the basic concepts of optical transmitters, modulators and nonlinear effects. • Analyze the concepts of photo detectors and receivers and various optical amplifiers. • Select fiber and optoelectronic components to evaluate an optical communication system.

Suggested books:

S. No.	Name of Authors /Books /Publisher	Year of Publication
1.	Optical fiber Communication: John M.S Senior,Publisher-PHI 2nd Ed ,ISBN-8120308824	2014
2.	Optical Communication System (Optoelectronics): J. Gowar,3rd edition Publisher:Prentice Hall, ISBN-978-0136387275	1993
3.	Optical fiber Communication: G.E. Keiser3rd Ed , Publisher-McGraw-HillISBN-007-2321016	2000
4.	Optoelectronics: Wilson & Hawkes, 3rd edition Publisher- Pearson Education ISBN-978-9352866663	2018

Batch 2025-2026 and onwards

Course Code: BET-P721
Course Name: BIO-MEDICAL ELECTRONICS

MM: 100 **Time: 3 Hr.** **L T P** **3 0 0**	**Sessional: 30** **ESE: 70** **Credit : 3**

Prerequisites:	Signals & Systems and Digital Signal Processing
Objectives:	1. This course introduces basic requirement for diagnosis of various ailments in human body through the study of various biomedical signals and image processing. 2. Classification of different bio medical signals e.g. ECG, EEG, EMG etc. 3. Data analysis and monitoring techniques. 4. Data reduction algorithms and coding techniques.
Course Coordinator	Dr. Ashish Nainwal

NOTE:	The question paper shall consist of two sections (Section-A and Section-B). Section-A shall contain of ten (10) short answer type questions of six (06) mark each and student shall be required to attempt any five (05) questions. Section-B shall contain eight (08)long answer type questions of ten (10) marks each and student shall be required to attempt any four questions. Questions shall be uniformly distributed from the entire syllabus

UNIT	Module	Course Content	No. of Hours	POs mapped	PSOs mapped
UNIT-1	*Module-1*	**Introduction to Bio-Medical Instrumentation**: Components of the man-instrumentation system, Physiological systems of the body, Problems encountered in measuring a living system, Basics of Electrocardiography, Electroencephalography & Electromyography, Transducer and transducer principles, active transducer, passive transducer, transducer for biomedical applications, Resting and active potentials, Propagation of action potentials.	**08**	PO1/ PO2/ PO3	PSO1/ PSO2/..
UNIT-2	*Module-2*	**ECG:**Role of Computers in the Analysis, Processing, Monitoring & Control and image reconstruction in bio-medical field, Temperature Measurements, Principles of ultrasonic measurement, Instrumentation for Diagnostic X Rays.	**06**	PO1/ PO2/ PO3	PSO1/ PSO2/..
	Module-3	**Electrical safety in medical equipment:** Physiological effects of electrical current, shock hazards from electrical equipment, methods of accident prevention.	**05**		
UNIT-3	*Module-4*	**ECG:** ECG data acquisition, ECG lead system, Removal of Baseline Wander and Power Line Interferences, ECG parameters and their estimation: QRS Detection (Different Methods), Estimation of R-R Interval, ST Segment Analysis, Arrhythmia Analysis	**06**	PO2/ PO3/ PO4/	PSO1/ PSO2/..
UNIT-4	*Module-5*	**Data Reduction:** Turning Point algorithm, AZTEC Algorithm, Fan Algorithm, Huffman and Modified Huffman Coding, Run Length Coding.	**07**	PO1/ PO2/ PO3	PSO1/ PSO2/..
UNIT-5	*Module-6*	**EEG:** Neurological Signal Processing, The electrophysiological origin of brain waves, The EEG signals & characteristic, linear prediction theory, the autoregressive method, spectral error measure, Transient detection and estimation – the case of	**08**	PO2/ PO4/ PO5	PSO1/ PSO2/..

		epileptic patients, Sleep EEG, markov model and markov chain, Dynamics of Sleep/Wake transition.			
Total No. of Hours			**40**		

Learning Outcomes:	1. Student will understand how to interface human body for data monitoring. 2. Demonstrate different technique for data reduction and data acquisition. 3. Apply how to remove artifacts with different filtering technique. 4. Analyze the application of the electronic systems in biological and medical applications. 5. It will provide design guideline for biomedical instrumentation.

Suggested books:

S. No.	Name of Authors /Books /Publisher	Year of Publication
1.	Willis J Tomkin, "***Biomedical Digital Signal Processing",***First, PHI, ISBN-0130672165, 9780130672162	1993
2.	D.C Reddy, "***Biomedical Signal Processing",*** Sixth, TMH, ISBN- 0070583889, 9780070583887	2005
3.	Rangaraj M. Rangayyan, "***Biomedical Signal Analysis",*** Second, John Wiley and Sons Inc, ISBN- 9781119067931, 1119067936	2015
4.	John G. Webster, "***Medical instrumentation Application and Design,",*** Fifth, Second, John Wiley and Sons Inc,, ISBN-9781119457336	2020

Batch 2025-2026 and onwards

Course Code: BET-P724
Course Name: ROBOTICS ENGINEERING

MM: 100 **Time: 3 Hr.** **L T P** **3 0 0**	**Sessional: 30** **ESE: 70** **Credit : 3**

Prerequisites:	Embedded System
Objectives:	1. Understand Fundamental Terminology and Components of Robotics. 2. Explore Drive Systems and Sensor Technologies. 3. Develop Competency in Robot Kinematics and Dynamics. 4. Gain Practical Skills in Robot Programming and Control. 5. Introduce Mobile Robotics and Locomotion Mechanisms.
Course Coordinator	Mr. ANUJ KUMAR SHARMA

NOTE:	The question paper shall consist of two sections (Section-A and Section-B). Section-A shall contain of ten (10) short answer type questions of six (06) mark each and student shall be required to attempt any five (05) questions. Section-B shall contain eight (08)long answer type questions of ten (10) marks each and student shall be required to attempt any four questions. Questions shall be uniformly distributed from the entire syllabus

UNIT	Module	Course Content	No. of Hours	POs mapped	PSOs mapped
UNIT-1	*Module-1*	**Introduction:** Basic terminology- Accuracy, Repeatability, Resolution, Degree of freedom. Mechanisms and transmission, End effectors, Grippers-different methods of gripping, Mechanical Grippers-Slider crank mechanism, Screw type, Rotary actuators, Cam type gripper, Magnetic grippers, Vacuum grippers, Air operated grippers; Specifications of robot.	**08**	PO1/ PO2/ PO3	PSO1/ PSO2/..
UNIT-2	*Module-2*	**Drive systems and Sensors:** Drive system-hydraulic, pneumatic and electric systems, Sensors in robot – Touch sensors, Tactile sensor, Proximity and range sensors, Robotic vision sensor, Force sensor, Light sensors, Pressure sensors.	**08**	PO1/ PO2/ PO3	PSO1/ PSO2/..
UNIT-3	*Module-3*	**Kinematics and Dynamics of Robots:** 2D, 3D Transformation, Scaling, Rotation, Translation, Homogeneous coordinates, multiple transformation, Simple problems. Matrix representation, Forward and Reverse Kinematics of Three Degree of Freedom, Homogeneous Transformations, Inverse kinematics of Robot, Robot Arm dynamics, D-H representation of robots, Basics of Trajectory Planning.	**08**	PO2/ PO3/ PO4/	PSO1/ PSO2/..
UNIT-4	*Module-4*	**Robot Control, Programming and Applications:** Control actions, Feedback devices, Encoder, Resolver, LVDT, Motion Interpolations, Adaptive control, Introduction to Robotic Programming, On-line and off-line programming, programming examples. Robot applications-Material handling, Machine loading and unloading, assembly, Inspection,	**08**	PO1/ PO2/ PO3	PSO1/ PSO2/..

		Welding, Spray painting.			
UNIT-5	*Module-5*	**Introduction of Mobile Robotics, Mechanics and Locomotion:** A brief history of mobile robotics, Recent advances in the mobile robotics for RISE (RiskyIntervention and Surveillance Environment) applications, Locomotion, Key issues in locomotion, legged, wheeled and aerial mobile robots. **Mobile Robot Kinematics:** Introduction, kinematic models and constrains, mobile robot workspace, beyond basic kinematics, motion control (kinematic control).	**08**	PO2/ PO4/ PO5	PSO1/ PSO2/..
Total No. of Hours			**40**		

Learning Outcomes:	After completing this course, the student will be able to 1. Identify and explain basic robotic concepts such as accuracy, repeatability, resolution, and degrees of freedom 2. Demonstrate the working of various robot end effectors and grippers (mechanical, magnetic, vacuum, air-operated), and understand their mechanism and actuation. 3. Compare different drive systems (hydraulic, pneumatic, electric) and evaluate their suitability for specific robotic applications. 4. Interface and analyze sensor data from different types of sensors (touch, proximity, tactile, force, light, vision, pressure) used in robotic systems. 5. Develop and simulate simple robotic programs using on-line and off-line programming methods for applications such as material handling, assembly, and inspection.

Suggested books:

S. No.	Name of Authors /Books /Publisher	Year of Publication
1.	Bruno S and Sciavicco L "***Robotics: Modelling, Planning and Control***", Springer	2009
2.	John J C, "***Introduction to Robotics: Mechanics and Control***", Addison-Wesley	1989
3.	Fu K S, Ralph G and Lee C S G "***Robotics: Control Sensing. Vision, and Intelligence***", Tata McGraw-Hill	1987
4.	Mukhopadhyay S, Sen S and Deb A K, "***Industrial Instrumentation, Control and Automation***", Jaico	1999

	Learning Outcome 1	Learning Outcome 2	Learning Outcome 3	Learning Outcome 4	Learning Outcome 5
PO1	Y	N	Y	Y	Y
PO2	Y	Y	N	Y	Y
PO3	Y	N	Y	Y	Y
PO4	N	Y	N	N	Y
PO5	Y	N	Y	Y	Y
PO6	Y	Y	N	Y	Y
PO7	N	N	N	N	Y
PO8	Y	Y	N	Y	Y
PO9	Y	N	Y	N	Y
PO10	Y	Y	N	Y	Y

PO11	Y	N	N	Y	Y
PO12	Y	Y	N	Y	Y

	Learning Outcome 1	Learning Outcome 2	Learning Outcome 3	Learning Outcome 4	Learning Outcome 5
PSO1	Y	Y	Y	N	Y
PSO2	Y	Y	Y	Y	N
PSO3	Y	N	N	Y	Y
PSO4	N	Y	Y	Y	N

Batch 2025-2026 and onwards

Course Code: BET-P723
Course Name: Next Generation Communication Technology

MM: 100 **Time: 3 Hr.** **L T P** **3 0 0**	**Sessional: 30** **ESE: 70** **Credit : 3**

Prerequisites: Basic knowledge of wireless and digital communication systems is recommended.

Course Objectives

- Understand the evolution of mobile cellular networks from 1G to 5G.
- Explore 5G architecture, spectrum, waveform, and enabling technologies.
- Analyze 5G use cases including IoT, URLLC, and industrial automation.
- Examine radio access techniques, spectrum challenges, and waveform innovations.
- Understand the key enabling technologies like massive MIMO, mmWave, and small cells.

Course Coordinator: Mr. Shiv Kumar Singh

UNIT	Module	Course Content	No. of Hours	POs Mapped	PSOs Mapped
Unit-I	*Module-1*	Introduction to Cellular Systems, Evolution: 1G to 5G, Features & Challenges, 5G Vision & Roadmap, Pillars of 5G	4	PO1, PO2	PSO1
	Module-2	5G Use Cases: IoT, URLLC, VR, Industrial Automation, 5G Radio Network Specifications	4	PO1, PO2, PO3	PSO1, PSO2
Unit-II	*Module-3*	5G Spectrum Landscape, Requirements, Challenges; Spectrum Bands for 5G	4	PO1, PO2, PO4	PSO1
	Module-4	Spectrum Access Modes, Sharing Scenarios, Techno-Economic Perspective	4	PO1, PO2, PO3	PSO2
Unit-III	*Module-5*	5G Waveform Techniques: OFDM, FBMC, GFDM, UFMC, OTFS	4	PO1, PO2, PO4	PSO1
	Module-6	Multi-user Access: NOMA, Filtering, Access for Dense Deployments, V2X, mMTC	4	PO1, PO3, PO4	PSO1, PSO2
Unit-IV	*Module-7*	5G Enabling Technologies: Channel Models, Networking, Massive MIMO, mmWave	4	PO2, PO3, PO5	PSO1, PSO2
	Module-8	Small Cells: Densification, Coverage, Capacity, Interference, Demand vs Capacity	4	PO1, PO2	PSO2
Unit-V	*Module-9*	Device-to-Device (D2D) Communication Architecture, IoT Integration	4	PO2, PO3, PO5	PSO1, PSO2
	Module-10	Spectrum Sharing for IoT, Future Research Trends	4	PO1, PO4	PSO2

Total Hours: 40

Textbooks

1. Andrews, J.G. et al. – Fundamentals of 5G Mobile Networks, Wiley, ISBN: 9781118864013
2. Saad, W., and Bennis, M. – 6G and Beyond: The Future of Wireless Communications, Cambridge University Press

Reference Books

1. Sauter, M. – From GSM to LTE-Advanced Pro and 5G, Wiley, 2017
2. Dahlman, E., Parkvall, S., and Skold, J. – 5G NR: The Next Generation Wireless Access Technology, Academic Press, 2018

Course Outcomes (COs)

- CO1: Understand the evolution and vision of 5G communication systems.
- CO2: Analyze spectrum needs and access mechanisms for 5G networks.
- CO3: Evaluate 5G waveform techniques and access technologies.
- CO4: Explore key enabling technologies like MIMO, mmWave, and small cells.
- CO5: Assess integration of 5G in real-world use cases and IoT applications.

CO-PO Mapping

CO/PO	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2
CO1	3	3	2	2	1	3	2
CO2	3	3	3	2	2	3	3
CO3	3	3	2	2	2	3	3
CO4	3	3	3	2	2	3	3
CO5	3	3	3	2	2	3	3
Average	3	3	2.6	2	1.8	3	2.8

Batch 2025-2026 and onwards

Course Code: BET-P725
Course Name: Electric Vehicles and Energy Storage Systems

MM: 100 **Time: 3 Hr.** **L T P** **3 0 0**	**Sessional: 30** **ESE: 70** **Credit : 3**

Prerequisites:	Electrical machines and power systems
Objectives:	1. Understand the basic concepts, classification, and components of Electric Vehicles (EVs). 2. Calculate tractive effort and explore different types of EV architectures including solar-based designs. 3. Explore electric motors and controllers used in EVs and their sizing and configuration. 4. Understand energy storage solutions, battery design, layout, and Battery Management System (BMS). 5. Learn control strategies, software-based supervisory control, and high-level EV operational behavior.
Course Coordinator	Mr. SHIV KUMAR SINGH

NOTE:	The question paper shall consist of two sections (Section-A and Section-B). Section-A shall contain of ten (10) short answer type questions of six (06) mark each and student shall be required to attempt any five (05) questions. Section-B shall contain eight (08)long answer type questions of ten (10) marks each and student shall be required to attempt any four questions. Questions shall be uniformly distributed from the entire syllabus

UNIT	Module	Course Content	No. of Hours	POs mapped	PSOs mapped
UNIT-1	*Module-1*	Introduction to Electric Vehicles: History, Components of EVs, Comparison with Internal Combustion Engines (Technology, Benefits, and Challenges), Classification of EVs, Electrification Levels, and EV Terminology.	**08**	PO1/ PO2/ PO3	PSO1/ PSO2/..
UNIT-2	*Module-2*	Tractive Effort: Rolling Resistance, Grade Resistance, Acceleration Force, Total Tractive Effort, Drive Wheel Torque. EV Architecture: Types, Components, Electrical Protection, System Requirements.	**08**	PO1/ PO2/ PO3	PSO1/ PSO2/..
UNIT-3	*Module-3*	Solar and Fuel Alternatives: Photovoltaic Solar EVs, BEV, HEV, PHEV, FCEV, Electrification Levels, Comparison of Fuel vs Electric and Solar Power, Solar Power Operated EVs.	**08**	PO2/ PO3/ PO4/	PSO1/ PSO2/..
UNIT-4	*Module-4*	Electric Drive and Controllers: Motor Types, Selection and Sizing, RPM and Torque Calculations, Motor Controllers, Component and Connection Design (Mechanical/Electrical).	**08**	PO1/ PO2/ PO3	PSO1/ PSO2/..
UNIT-5	*Module-5*	Energy Storage Systems: Cell Types (Lead Acid, Li, NiMH), Charging/Discharging, Battery Design and Layout, Battery Pack Configuration and Construction, BMS, Rule-based and Optimization Control, High-Level Supervisory Control.	**08**	PO2/ PO4/ PO5	PSO1/ PSO2/..
Total No. of Hours			**40**		

Learning Outcomes:	After completing this course, the student will be able to 1. Identify and describe the primary components of EVs, including electric motors, battery systems, and power electronics.

	2. Analyze the operation of electric motors, including DC, AC, and permanent magnet motors, and their integration into EV drivetrains. 3. Evaluate the role of energy storage in enhancing the efficiency and reliability of renewable energy systems, 4. Compare different battery chemistries (e.g., lithium-ion, nickel-metal hydride) and understand charging systems.

Suggested books:

Textbooks

1. MehrdadEhsani, Yimi Gao, Sebastian E. Gay, Ali Emadi, Modern Electric, Hybrid Electric and Fuel Cell Vehicles: Fundamentals, Theory and Design, CRC Press, 2004.

Reference Books

• Iqbal Hussein, Electric and Hybrid Vehicles: Design Fundamentals, CRC Press, 2003.

• James Larminie, John Lowry, Electric Vehicle Technology Explained, Wiley, 2003.

• M. Ehsani, Y. Gao, S. E. Gay and A. Emadi, Modern Electric, Hybrid Electric, and Fuel Cell Vehicles: Fundamentals, Theory, and Design, CRC Press, 2004.

• S. Onori, L. Serrao and G. Rizzoni, Hybrid Electric Vehicles: Energy Management Strategies, Springer, 2015.

Batch 2025-2026 and onwards

Course Code: BET-P726
Course Name: FUNDAMENTAL OF RADAR AND NAVIGATION

MM: 100 **Time: 3 Hr.** **L T P** **3 0 0**	**Sessional: 30** **ESE: 70** **Credit : 3**

Prerequisites:	Signals and Systems, Control Systems.
Objectives:	1.Provide students with foundational knowledge of radar systems, including their components, operation principles, and performance metrics. 2. Develop understanding of different radar types, including pulse radar, CW radar and FM-CW radar and their operational characteristics. 3. Equip students with analytical tools to understand and compare various radar signal processing and detection techniques. 4. Introduce the principles and applications of modern navigation systems and navigational aids. 5. Encourage the application of radar and navigation theory to practical examples and problem-solving.
Course Coordinator	Mr. PRATEEK AGARWAL

NOTE:	The question paper shall consist of two sections (Section-A and Section-B). Section-A shall contain of ten (10) short answer type questions of six (06) mark each and student shall be required to attempt any five (05) questions. Section-B shall contain eight (08)long answer type questions of ten (10) marks each and student shall be required to attempt any four questions. Questions shall be uniformly distributed from the entire syllabus

UNIT	Module	Course Content	No. of Hours	POs mapped	PSOs mapped
UNIT-1	*Module-1*	BASICS OF RADAR: Introduction, Maximum Unambiguous Range, Simple form of Radar Equation, Radar Block Diagram and Operation, Radar Frequencies and Applications, Prediction of Range Performance, Minimum Detectable Signal, Receiver Noise, Modified Radar Range Equation, Illustrative Problems. Radar Equation: SNR, Envelope Detector, False Alarm Time and Probability, Integration of Radar Pulses, Radar Cross Section of Targets (simple targets - sphere, cone-sphere), Transmitter Power, PRF and Range Ambiguities, System Losses (qualitative treatment).	**08**	PO1/ PO2/ PO3	PSO1/ PSO2/..
UNIT-2	*Module-2*	CW AND FREQUENCY MODULATED RADAR: Doppler Effect, CW Radar - Block Diagram, Isolation between Transmitter and Receiver, Non-zero IF Receiver, Receiver Bandwidth Requirements, Applications of CW radar, Illustrative Problems.FM-CW Radar, Range and Doppler Measurement, Block Diagram and Characteristics (Approaching/ Receding Targets), FM-CW altimeter, Multiple Frequency CW Radar.	**06**	PO1/ PO2/ PO3	PSO1/ PSO2/..
UNIT-3	*Module-3*	MTI AND PULSE DOPPLER RADAR: Introduction, Principle, MTI Radar with - Power Amplifier Transmitter and Power Oscillator Transmitter, Delay Line Cancellers - Filter Characteristics, Blind Speeds, Double Cancellation,	**10**	PO2/ PO3/ PO4/	PSO1/ PSO2/..

		And Staggered PRFs. Range Gated Doppler Filters, MTI Radar Parameters, Limitations to MTI Performance,MTI versus Pulse Doppler radar. TRACKING RADAR: Tracking with Radar, Sequential Lobing, Conical Scan, Monopulse Tracking Radar - Amplitude Comparison Monopulse (one- and two-coordinates), Phase Comparison Monopulse, Tracking in Range, Acquisition and Scanning Patterns, Comparison of Trackers.			
UNIT-4	*Module-4*	Radio Direction Finding: loop direction finder, goniometer, errors in direction finding, adcock and automatic direction finders, commutated aerial direction finder. Radio Ranges: LF/MF four course radio range, VOR, ground equipment & receiver, VOR errors. Hyberbolic System of Navigation: LORAN, Decca & Omega system. DME & TECAN	**08**	PO1/ PO2/ PO3	PSO1/ PSO2/..
UNIT-5	*Module-5*	NAVIGATIONAL AIDS: Introduction, Four Methods of Navigation, Radio Direction Findings, Radio Ranges, Hyperbolic Systems of Navigation, Aids to approach and Landing. MODERN NAVIGATION: Doppler navigation-Doppler Effect, New configuration, Doppler frequency equations, Track stabilization, Doppler navigation system, GPS principle operation, Position location determination, principle of GPS receiver.	**08**	PO2/ PO4/ PO5	PSO1/ PSO2/..
Total No. of Hours			**40**		

Learning Outcomes:	After completing this course, the student will be able to 1. Explain the fundamental principles and working of radar systems, including radar range equations, system components, and limitations. 2. Describe and compare various types of radar systems such as CW radar, FM-CW radar, MTI radar and Pulse Doppler radar. 3. Analyze signal detection concepts, including SNR, envelope detection, radar cross-section and system losses. 4. Understand and evaluate tracking radar techniques such as sequential lobing, conical scan and monopulse tracking. 5. Illustrate the working of navigation systems including direction finding, radio ranges, and hyperbolic navigation systems (e.g., LORAN, Decca). 6. Understand the functioning and principles of modern navigation systems, particularly Doppler-based systems and GPS.

Suggested books:

S. No.	Name of Authors /Books /Publisher	Year of Publication
1.	S Kolnik, M.L,***"Introdution to Radar Systems"***,III,McGraw Hill,ISBN-978-0070445338.	2017
2.	Peebles Jr. P. Z., "***Radar Principles",*** IV, Wiley, ISBN-978-0471252054.	1998
3.	Mark A Richards, ***"Fundamentals of Radar Signal Processing",*** III, McGraw-Hill, ISBN-978-1260468717.	2022
4.	Byron Edde, ***"Radar Principals, Technology, Applications",*** I,Prentice Hall, ISBN-978-0137523467.	1992
5.	N. S. Nagraja, ***"Elements of Electronics Navigation",*** I,McGraw Hill Education, ISBN-978-0074623015.	2017

	Learning Outcome 1	Learning Outcome 2	Learning Outcome 3	Learning Outcome 4	Learning Outcome 5

PO1	Y	Y	Y	Y	Y
PO2	Y	Y	Y	Y	Y
PO3	Y	Y	Y	Y	Y
PO4	N	N	Y	Y	N
PO5	N	N	N	N	N
PO6	N	N	N	N	N
PO7	N	N	N	N	N
PO8	N	N	N	N	N
PO9	N	N	N	N	N
PO10	N	N	N	N	N
PO11	N	N	N	N	N
PO12	N	N	N	N	N

	Learning Outcome 1	Learning Outcome 2	Learning Outcome 3	Learning Outcome 4	Learning Outcome 5
PSO1	Y	Y	Y	Y	Y
PSO2	Y	Y	Y	Y	Y
PSO3	N	N	N	N	N
PSO4	N	N	N	N	N

Batch 2025-2026 and onwards

Course Code: BET-E601
Course Name: DIGITAL ELECTRONICS DESIGN WITH VHDL

MM: 100 **Time: 3 Hr.** **L T P** **3 0 0**	**Sessional: 30** **ESE: 70** **Credit : 3**

Prerequisites:	Basic Digital Logic Design, Basic Computer Architecture
Objectives:	The course is aimed at: 1. Introduce the fundamentals of Hardware Description Languages(HDL) with a focus on VHDL syntax and semantics. 2. Familiarize students with design and modelling of combinational and sequential circuits using VHDL. 3. Enable students to develop and simulate modular VHDL code using functions, procedures, packages, and libraries. 4. Train students to synthesize VHDL models for hardware implementation using modern tools. 5. Provide hands-on exposure to Programmable Logic Devices (PLDs) such as ROMs, PLAs, PALs andField Programmable Gate Arrays (FPGAs)including industry-standard architectures like Xilinx.
Course Coordinator	PRATEEK AGARWAL

NOTE:	The question paper shall consist of two sections (Section-A and Section-B). Section-A shall contain of ten (10) short answer type questions of six (06) mark each and student shall be required to attempt any five (05) questions. Section-B shall contain eight (08) long answer type questions of ten (10) marks each and student shall be required to attempt any four questions. Questions shall be uniformly distributed from the entire syllabus

UNIT	Module	Course Content	No. of Hours	POs mapped	PSOs mapped
UNIT-1	*Module-1*	IntroductiontoHardwareDescription Languages (HDL)andHDLbased design,VHDL-Variables,Signalsandconstants, Arrays,VHDLoperators	**08**	PO1/ PO2/ PO3/ PO4/ PO5…	PSO1/ PSO2/ ..
UNIT-2	*Module-2*	Expressions and signal assignments, Entities, architecture specification, Componentinstantiation,VHDLdescription of combinationalnetworks,VHDLmodels for amultiplexer	**08**	PO1/ PO2/ PO3/ PO4/ PO5…	PSO1/ PSO2/ ..
UNIT-3	*Module-3*	VHDLfunctions,VHDLprocedures,Packagesandlibraries ,Compilation, simulationof VHDLcode.	**06**	PO1/ PO2/ PO3/ PO4/ PO5…	PSO1/ PSO2/ ..
UNIT-4	*Module-4*	Modelingflip-flops usingVHDL, Modelingasequential machine, VHDL modelforacounter,SynthesisofCombinationalandsequential circuits.	**08**	PO1/ PO2/ PO3/ PO4/ PO5…	PSO1/ PSO2/ ..
UNIT-5	*Module-5*	Designing with Programmable Logic Devices: Read-only memories (ROM,EPROM, EEPROM/FLASH), Programmable logic arrays (PLAs), Programmablearraylogic(PLAs),DesigningwithFPGAs, Xilinx4000seriesFPGAs,usingaone-hotstate assignment	**10**	PO1/ PO2/ PO3/ PO4/ PO5…	PSO1/ PSO2/ ..
Total No. of Hours			**40**		

Learning Outcomes:	At the end of the course, a student will be able to: 1. Understand the basics of HDL and write simple VHDL code using variables, signals, arrays, and operators. 2. Design and model combinational logic using entities, architectures, and component instantiation in VHDL. 3. Develop reusable and modular VHDL code using functions, procedures, packagesand perform simulations. 4. Model and synthesize sequential circuits such as flip-flops, counters, and FSMs using VHDL. 5. Design digital systems using Programmable Logic Devices and implement on FPGAs with one-hot state encoding.

Suggested books:

1.	Bhasker, J.*A,*"***VHDL Primer*****",**3rd Edition, Pearson Education,ISBN: 978-0130965752	2001
2.	Stephen Brown, ZvonkoVranesic, **"*Fundamentals of Digital Logic with VHDL Design*",**4th Edition, McGraw-Hill Higher Education, ISBN:978-1265093608	2023

	Learning Outcome 1	Learning Outcome 2	Learning Outcome 3	Learning Outcome 4	Learning Outcome 5
PO1	Y	N	N	N	N
PO2	Y	N	Y	N	N
PO3	N	Y	N	Y	N
PO4	N	Y	N	Y	Y
PO5	N	N	Y	N	Y
PO6	N	N	N	N	N
PO7	N	N	N	N	N
PO8	N	N	N	N	N
PO9	N	N	N	N	N
PO10	N	N	N	N	N
PO11	N	N	N	N	N
PO12	N	N	N	N	N

	Learning Outcome 1	Learning Outcome 2	Learning Outcome 3	Learning Outcome 4	Learning Outcome 5
PSO1	Y	Y	N	Y	N
PSO2	N	Y	Y	Y	Y
PSO3	N	N	N	N	N
PSO4	N	N	N	N	N

Batch 2025-2026 and onwards

Course Code: BET-E602

Course Name: FPGA BASED SYSTEM DESIGN

MM: 100 **Time: 3 Hr.** **L T P** **3 0 0**	**Sessional: 30** **ESE: 70** **Credit : 3**

Prerequisites:	Digital LogicDesign, Computer Architecture,VHDL/Verilog and Electronic Devices
Objectives:	The course is aimed at: 1. Introduce students to digital system design methodologies, trade-offs, and high-level architectural modelling using HDLs (Verilog). 2. Provide a detailed understanding of various programmable logic devices(ROM, PLA, PAL, CPLD and FPGA) and their implementation techniques. 3. Explain the internal architecture of FPGAs, including logic block design, interconnects, timing, and power dissipation. 4. Teach students placement and routing techniques, with practical insight into embedded system and DSP design using FPGAs. 5. Familiarize students with commercial FPGA platforms (Xilinx, Altera, Actel) and guide them through real-world case studies and circuit implementation.
Course Coordinator	PRATEEK AGARWAL

NOTE:	The question paper shall consist of two sections (Section-A and Section-B). Section-A shall contain of ten (10) short answer type questions of six (06) mark each and student shall be required to attempt any five (05) questions. Section-B shall contain eight (08) long answer type questions of ten (10) marks each and student shall be required to attempt any four questions. Questions shall be uniformly distributed from the entire syllabus

UNIT	**Module**	**Course Content**	**No. of Hours**	**POs mapped**	**PSOs mapped**
UNIT-1	*Module-1*	Introduction:Digital system design options and trade-offs, Design methodology and technology overview, High Level System Architecture and Specification:Behavioralmodellingandsimulation,Hardwaredescriptionlanguages (emphasis on Verilog), combinational and sequential design, state machine design, synthesis issues, test benches	**08**	PO1/ PO2/ PO3/ PO4/ PO5 …	PSO1/ PSO2/ ..
UNIT-2	*Module-2*	Programmable logic Devices: ROM, PLA, PAL, CPLD, FPGA Features, Limitations,ArchitecturesandProgramming.ImplementationofMSIcircuitsusing Programmable logic Devices.	**08**	PO1/ PO2/ PO3/ PO4/ PO5 …	PSO1/ PSO2/ ..

UNIT-3	*Module-3*	FPGAArchitecture:FPGA Architectural options, granularity of function and wiringresources,coarsev/sfinegrained, vendorspecificissues(emphasisonXilinxand Altera), Logic block architecture: FPGA logic cells, timing models, power dissipation I/O block architecture: Input and Output cell characteristics, clock input, Timing, Power dissipation.	**10**	PO1/ PO2/ PO3/ PO4/ PO5 …	PSO1/ PSO2/ ..
UNIT-4	*Module-4*	Placementand Routing: Programmableinterconnect - Partitioning and Placement,Routingresources,delays;Applications- Embeddedsystemdesignusing FPGAs, DSP using FPGAs.	**08**	PO1/ PO2/ PO3/ PO4/ PO5 …	PSO1/ PSO2/ ..
UNIT-5	*Module-5*	Commercial FPGAs: Xilinx, Altera, Actel (Different series description only), CasestudyXilinxArtix:implementationofsimplecombinationalandsequentialcircuits	**06**	PO1/ PO2/ PO3/ PO4/ PO5 …	PSO1/ PSO2/ ..
Total No. of Hours			**40**		

Learning Outcomes:	At the end of the course, a student will be able to: 1. Understand various digital system design approaches, modelling techniques and HDL-based simulation (Verilog). 2. Identify and implement digital designs using programmable logic devices like ROM, PAL, PLA, CPLD and FPGAs. 3. Analyze FPGA architecture and evaluate the trade-offs in logic cells, I/O blocks and power/timing aspects. 4. Apply placement, routing, and partitioning strategies in FPGA-based digital systems including embedded/DSP. 5. Develop and implement basic combinational and sequential circuits using commercial FPGA tools (e.g., Xilinx).

Suggested books:

1.	Wayne Wolf, ***"FPGA-Based System Design",***1st Edition, Prentice Hall, ISBN:978-0131424616	2004
2.	Wayne Wolf, ***"Modern VLSI Design: System-on-Chip Design",*** 3rd Edition, Prentice Hall, ISBN:978-0130619709	2002
3.	S. Trimberger (Ed.), ***"Field-Programmable Gate Array Technology",*** 1st Edition, Kluwer Academic Publishers, ISBN:978-0792394082	1994
4.	Chan, P. K., and S. Mourad,***"Digital Design Using Field Programmable Gate Array",***1st ed., Prentice Hall, ISBN: 978-0132124607.	1994
5.	Brown, Stephen, Robert J. Francis, Jonathan Rose, and Zvonko G. Vranesic, ***"Field Programmable Gate Array",*** 1st ed., Springer, ISBN: 978-0387269374.	2007

6.	Navabi, Zainalabedin,***"Embedded Core Design with FPGAs"***, 1st ed., McGraw Hill Education (India) Private Limited, ISBN: 9780070249011.	2008
7.	Kilts, Steve, ***"Advanced FPGA Design: Architecture, Implementation, and Optimization"***, Wiley Interscience, ISBN: 9780470128743.	2007

	Learning Outcome 1	Learning Outcome 2	Learning Outcome 3	Learning Outcome 4	Learning Outcome 5
PO1	Y/N	Y/N	Y/N	Y/N	Y/N
PO2	Y/N	Y/N	Y/N	Y/N	Y/N
PO3	Y/N	Y/N	Y/N	Y/N	Y/N
PO4	Y/N	Y/N	Y/N	Y/N	Y/N
PO5	Y/N	Y/N	Y/N	Y/N	Y/N
PO6	Y/N	Y/N	Y/N	Y/N	Y/N
PO7	Y/N	Y/N	Y/N	Y/N	Y/N
PO8	Y/N	Y/N	Y/N	Y/N	Y/N
PO9	Y/N	Y/N	Y/N	Y/N	Y/N
PO10	Y/N	Y/N	Y/N	Y/N	Y/N
PO11	Y/N	Y/N	Y/N	Y/N	Y/N
PO12	Y/N	Y/N	Y/N	Y/N	Y/N

	Learning Outcome 1	Learning Outcome 2	Learning Outcome 3	Learning Outcome 4	Learning Outcome 5
PSO1	Y/N	Y/N	Y/N	Y/N	Y/N
PSO2	Y/N	Y/N	Y/N	Y/N	Y/N
PSO3	Y/N	Y/N	Y/N	Y/N	Y/N
PSO4	Y/N	Y/N	Y/N	Y/N	Y/N

Batch 2025-2026 and onwards

Course Code: BET-E701

Course Name: VLSI Verification and Testing

MM: 100 **Time: 3 Hr.** **L T P** **3 0 0**	**Sessional: 30** **ESE: 70** **Credit : 3**

Prerequisites:	Digital Electronics, VLSI Design, HDL and Computer Architecture.
Objectives:	1. Introduce the importance, challenges and lifecycle of testing in VLSI systems. 2. Develop an understanding of design-for-testability (DFT) techniques, including scan-based methods and RTL-level testability. 3. Explain logic and fault simulation methodologies to analyze circuit behavior and identify faults. 4. Provide insight into the verification process**,** including planning, flows, levels and verification languages. 5. Enable students to design and implement functional verification using testbenches with real-world case studies.
Course Coordinator	Mr. PRATEEK AGARWAL

NOTE:	The question paper shall consist of two sections (Section-A and Section-B). Section-A shall contain of ten (10) short answer type questions of six (06) mark each and student shall be required to attempt any five (05) questions. Section-B shall contain eight (08)long answer type questions of ten (10) marks each and student shall be required to attempt any four questions. Questions shall be uniformly distributed from the entire syllabus

UNIT	Module	Course Content	No. of Hours	POs mapped	PSOs mapped
UNIT-1	*Module-1*	Introduction:ImportanceofTesting,TestingduringVLSILifecycle, ChallengesinVLSI Testing,LevelsofAbstractioninVLSI Testing, Historical Review of VLSI Test Technology.	**10**	PO1/ PO2/ PO3	PSO1/ PSO2/..
UNIT-2	*Module-2*	Design and Testability: Introduction, Testability Analysis, Design for TestabilityBasics,ScanCell Designs, Scan Architectures,ScanDesign Rules,ScanDesignFlow,SpecialpurposeScanDesigns,RTLDesign for Testability.	**10**	PO1/ PO2/ PO3	PSO1/ PSO2/..
UNIT-3	*Module-3*	Logic and Fault Simulation: Introduction, Simulation Models, Logic Simulation, Fault Simulation.	**06**	PO2/ PO3/ PO4/	PSO1/ PSO2/..
UNIT-4	*Module-4*	Verification: Importance of verification, Verification plan,Verification flow, Levels of verification, Verification methods and languages.	**07**	PO1/ PO2/ PO3	PSO1/ PSO2/..
UNIT-5	*Module-5*	FunctionalVerification:Introductiontotestbench,Testbench architecture,Typesoftestbenches,case study.	**07**	PO2/ PO4/ PO5	PSO1/ PSO2/..
Total No. of Hours			**40**		

Learning Outcomes:	After completing this course, the student will be able to 1. Understand the significance and challenges of VLSI testing across various abstraction levels. 2. Apply design-for-testability principles including scan architectures and RTL-level testability techniques. 3. Perform logic and fault simulation to evaluate circuit performance and detect potential failures.

	4. Develop a verification plan and use appropriate verification methods, flows, and languages. 5. Design and implement testbenches for functional verification and analyze verification results using case studies.

Suggested books:

S. No.	Name of Authors /Books /Publisher	Year of Publication
1.	Wang, Laung-Terng, Cheng-Wen Wu, and Xiaoqing Wen, **"*VLSI Test Principles and Architectures: Design for Testability*",** 1st ed., Morgan Kaufmann, ISBN: 978-0123705976.	2006
2.	Bushnell, M., and V. D. Agrawal, **"*Essentials of Electronic Testing for Digital, Memory and Mixed-Signal VLSI Circuits*",** 1st ed., Kluwer Academic Publishers, 2000. ISBN: 978-0792379412.	2000
3.	Abramovici, M., M. A. Breuer, and A. D. Friedman, **"*Digital Systems Testing and Testable Design*",** 1st ed.,IEEE Press, ISBN: 978-0780310078.	1990
4.	Kropf, T, **"*Introduction to Formal Hardware Verification",*** 1st ed., Springer-Verlag,ISBN: 978-3540673682.	2000
5.	Rashinkar, Prakash, Peter Paterson, and Leena Singh, **"*System-on-a-Chip Verification: Methodology and Techniques*",** 1st ed., Kluwer Academic Publishers,ISBN: 978-0792372797.	2001
6.	Bergeron, Janick**"*Writing Testbenches: Functional Verification of HDL Models*",**2nd ed., Springer, ISBN: 978-0306478029.	2003

	Learning Outcome 1	Learning Outcome 2	Learning Outcome 3	Learning Outcome 4	Learning Outcome 5
PO1	Y	Y	Y	Y	Y
PO2	Y	Y	Y	Y	Y
PO3	N	Y	N	Y	Y
PO4	N	N	Y	N	Y
PO5	N	Y	Y	Y	Y
PO6	N	N	N	N	N
PO7	N	N	N	N	N
PO8	N	N	N	N	N

	Learning Outcome 1	Learning Outcome 2	Learning Outcome 3	Learning Outcome 4	Learning Outcome 5
PSO1	Y	Y	Y	Y	Y
PSO2	Y	Y	Y	Y	Y
PSO3	N	N	N	N	N
PSO4	N	N	N	N	N

Batch 2025-2026 and onwards

Course Code: BET-E702
Course Name: LOW POWER VLSI DESIGN

MM: 100 **Time: 3 Hr.** **L T P** **3 0 0**	**Sessional: 30** **ESE: 70** **Credit : 3**

Prerequisites:	Electronic Devices and Circuits, VLSI Design
Objectives:	The course is aimed at: 1. Preliminaries on Power dissipation. 2. Fundamentals of low power circuits. 3. Basic synthesis for low power circuits. 4. Basics of SRAM memory. 5. Basics of design and test of low voltage circuits.
Course Coordinator	PRATEEK AGARWAL

NOTE:	The question paper shall consist of two sections (Section-A and Section-B). Section-A shall contain of ten (10) short answer type questions of six (06) mark each and student shall be required to attempt any five (05) questions. Section-B shall contain eight (08) long answer type questions of ten (10) marks each and student shall be required to attempt any four questions. Questions shall be uniformly distributed from the entire syllabus

UNIT	Module	Course Content	No. of Hours	POs mapped	PSOs mapped
UNIT-1	*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.	**08**	PO1/ PO2/ PO3/ PO4/ PO5 …	PSO 1/ PSO 2/..
UNIT-2	*Module-2*	DESIGN OF LOW POWER CIRCUITS: Transistor and Gate Sizing: Sizing an Inverter Chain, Transistor and Gate Sizing for Dynamic Power Reduction, Transistor Sizing for Leakage Power Reduction, Network Restructuring and Reorganization: Transistor Network Restructuring, Transistor Network Partitioning and Reorganization, Special Latches and Flip-flops: Self-gating Flip-flop, Varieties of Boolean Functions, Adjustable Device Threshold Voltage.	**10**	PO1/ PO2/ PO3/ PO4/ PO5 …	PSO 1/ PSO 2/..
UNIT-3	*Module-3*	SYNTHESISFORLOWPOWER: BehavioralLevelTransforms,LogicLevelOptimizationforLowpower,CircuitLevelOptimization.	**06**	PO1/ PO2/ PO3/	PSO 1/ PSO 2/..
UNIT-4	*Module-4*	LOWPOWERSTATICRAMARCHITECTURES: Organization of a static RAM, MOS Static RAM Memory cell, Banked organization of SRAMs, Reducing voltage swings on bitlines, Reducing power in write driver circuits, Reducing power in sense amplifier circuits, method for achieving low core voltagesfromasinglesupply.	**08**	PO1/ PO2/ PO3/ PO4/ PO5 …	PSO 1/ PSO 2/..
UNIT-5	*Module-5*	DESIGNANDTEST OFLOW VOLTAGECMOSCIRCUITS: CircuitDesignstyle,Leakagecurrentindeepsubmicrometertransistors, Deepsubmicrometerdevicedesignissues,Lowvoltagecircuitdesign techniques,DesigningdeepsubmicrometerICswithelevated intrinsic leakage,multiplesupply voltages.	**08**	PO1/ PO2/ PO3/ PO4/ PO5 …	PSO 1/ PSO 2/..
Total No. of Hours			**40**		

Learning Outcomes:	At the end of the course, a student will be able to: 1. To understandbasicsofPower Dissipation. 2. To learnlow powercircuitdesign. 3. To learn circuit level optimization. 4. To acquire knowledgeonSRAM. 5. Todesignlowpower circuit atsubmicronlevel.

Suggested books:

1.	Roy, Kaushik, and Sharat C. Prasad, **"*Low Power CMOS VLSI Circuit Design*",** 3rd ed., John Wiley & Sons, ISBN: 9780471332040.	2009
2.	Rabaey, Jan M., **"*Low Power Design Essentials*",** 1st ed., Springer,ISBN: 9780387717134.	2009
3.	Chandrakasan, Anantha, and Robert W. Brodersen, **"*Low-Power CMOS Design*",**1st ed., IEEE Press,ISBN: 9780780311444.	1995
4.	Chandrakasan, Anantha, Doug Bowhill, and William J. Bowhill, **"*Design of High-Performance Microprocessors*",** 1st ed., IEEE Press, ISBN: 9780780353734.	2000

	Learning Outcome 1	Learning Outcome 2	Learning Outcome 3	Learning Outcome 4	Learning Outcome 5
PO1	Y	N	N	Y	N
PO2	Y	N	Y	N	N
PO3	N	Y	N	N	Y
PO4	N	Y	N	Y	Y
PO5	N	N	Y	N	Y
PO6	N	N	N	N	N
PO7	N	N	N	N	N
PO8	N	N	N	N	N
PO9	N	N	N	N	N
PO10	N	N	N	N	N
PO11	N	N	N	N	N
PO12	N	N	N	N	N
	Learning Outcome 1	Learning Outcome 2	Learning Outcome 3	Learning Outcome 4	Learning Outcome 5
PSO1	Y	Y	N	Y	Y
PSO2	N	Y	Y	N	Y
PSO3	N	N	N	N	N
PSO4	N	N	N	N	N

Batch 2025-2026 and onwards

Course Code: BET-E703

Course Name: SYSTEMON-CHIP DESIGN

MM: 100 **Time: 3 Hr.** **L T P** **3 1 0**	**Sessional: 30** **ESE: 70** **Credit : 4**

Prerequisites:	Computer Architecture, Hardware Description Languages
Objectives:	The course is aimed at: 1. Introduce the fundamentals of System on Chip (SoC) architecture and the evolution of ASIC technologies. 2. Understand design methodologies for logic cores, soft/hard/firm cores, and integration strategies for SoC systems. 3. Explore the design and integration of memory and analog **cores** including A/D converters and phase-locked loops. 4. Examine SoC validation methods including simulation, co-simulation, and hardware/software co-verification. 5. Learn SoC testing techniques**,** reuse strategies, boundary scan methods, and built-in self-test (BIST) for embedded cores.
Course Coordinator	PRATEEK AGARWAL

NOTE:	The question paper shall consist of two sections (Section-A and Section-B). Section-A shall contain of ten (10) short answer type questions of six (06) mark each and student shall be required to attempt any five (05) questions. Section-B shall contain eight (08) long answer type questions of ten (10) marks each and student shall be required to attempt any four questions. Questions shall be uniformly distributed from the entire syllabus

UNIT	Module	Course Content	No. of Hours	POs mapped	PSOs mapped
UNIT-1	*Module-1*	Introduction System tradeoffs and evolution of ASIC Technology, System on chip concepts and methodology, SoC design issues, SoC challenges and components.	**08**	PO1/ PO2/ PO3/ PO4/ PO5…	PSO1/ PSO2/..
UNIT-2	*Module-2*	Design Methodological For Logic Cores, SoC Design Flow, On-chip buses, Design process for hard cores, Soft and firm cores, Core and SoC design examples	**08**	PO1/ PO2/ PO3/ PO4/ PO5…	PSO1/ PSO2/..
UNIT-3	*Module-3*	Design Methodology for Memory and Analog Cores, Embedded memories, Simulation modes Specification of analog circuits, A to D converter, Phaselocked loops, High I/O.	**08**	PO1/ PO2/ PO3/ PO4/ PO5…	PSO1/ PSO2/..
UNIT-4	*Module-4*	Design Validation, Core level validation, Test benches, SoC design validation, Co-simulation, hardware/Softwareco-verification, CaseStudy: Validation and test of systems on chip.	**08**	PO1/ PO2/ PO3/ PO4/ PO5…	PSO1/ PSO2/..
UNIT-5	*Module-5*	SoC Testing, SoC Test Issues, Cores with boundary scan, Test methodology for design reuse, Testing of microprocessor cores, Built in self-method, testing of embedded memories.	**08**	PO1/ PO2/ PO3/ PO4/ PO5…	PSO1/ PSO2/..
Total No. of Hours			**40**		

Learning Outcomes:	At the end of the course, a student will be able to: 1. Describe the architecture and evolution of SoC design and analyze trade-offs in ASIC technologies. 2. Apply appropriate methodologies to design and integrate logic cores using SoC design flow and core types. 3. Design and model embedded memory and analog cores such as A/D converters and PLLs for SoC applications. 4. Perform design validation using test benches, co-simulation, and hardware/software co-verification tools. 5. Apply testing strategies for SoC, including boundary scan, BIST, and test reuse for embedded systems.

Suggested books:

1.	Rajsuman, Rochit, **"*System-on-a-Chip: Design and Test*",** 1st ed., ArtechHouse,ISBN: 9781580537928.	2007
2.	Rashinkar, Prakash, Peter Paterson, and Leena Singh, **"*System-on-a-Chip Verification: Methodology and Techniques*",** 1st ed., Kluwer Academic Publishers, ISBN: 9780792372792.	2000
3.	Keating, Michael, David Flynn, Robert Aitken, Alan Gibbons, and Kaijian Shi, **"*Low Power Methodology Manual for System-on-Chip Design*",** 1st ed., Springer,ISBN: 9780387718186.	2007

	Learning Outcome 1	Learning Outcome 2	Learning Outcome 3	Learning Outcome 4	Learning Outcome 5
PO1	Y	Y	Y	Y	Y
PO2	Y	Y	N	Y	Y
PO3	N	Y	Y	Y	Y
PO4	N	Y	Y	Y	N
PO5	N	Y	Y	Y	Y
PO6	N	N	Y	Y	Y
PO7	N	N	N	N	N
PO8	N	N	N	N	N

	Learning Outcome 1	Learning Outcome 2	Learning Outcome 3	Learning Outcome 4	Learning Outcome 5
PSO1	Y	Y	Y	Y	Y
PSO2	N	Y	Y	Y	Y
PSO3	N	N	N	N	N
PSO4	N	N	N	N	N

Batch 2025-2026 and onwards

Course Code: BET-E651
Course Name: VLSI DESIGN LAB

MM: 50 **Time: 2 Hr.** **L T P** **0 0 2**	**Sessional:15** **ESE:35** **Credit:1**

Prerequisites:	Digital Logic Design, VLSI Design and Verilog/VHDL.
Objectives:	1. Provide hands-on experience in modelling digital circuits using Verilog/VHDL. 2. Introduce students to simulation, synthesis and implementation processesusing FPGA platforms (Spartan-2/3). 3. Enable understanding of combinational and sequential logic design through practical implementation. 4. Develop skills to analyze RTL schematics, synthesis reports and debug hardware description language (HDL) code. 5. Familiarize students with state machine design (Mealy and Moore) and implementation on reconfigurable hardware.
Course Coordinator	Prateek Agarwal

NOTE:	1. In practical examination the student shall be required to perform one experiment. 2. A teacher shall be assigned 30 students for daily practical work in laboratory. 3. No batch for practical class shall consist of more than 30 students. 4. The number of students in a batch allotted to an examiner for practical examination shall not exceed 30 students. 5. Addition/deletion in above list may be made in accordance with the facilities available with the approval of H.O.D.

LIST OF EXPERIMENTS	1. To write a VHDL/Verilog code for All Logic Gates and to generate synthesis report, RTL schematic and to implement designs using FPGA (Spartan-3). 2. To write a VHDL/Verilog code for 4-bit ripple carry and carry look ahead adder and to generate synthesis report, RTL schematic and to implement designs using FPGA (Spartan-3). 3. To write a VHDL/Verilog code for 16:1 Mux generate synthesis report, RTL schematic and to implement designs using FPGA (Spartan-2). 4. To write a VHDL/Verilog code for 3x8 Decoder and to generate synthesis report, RTL schematic and to implement designs using FPGA (Spartan-2). 5. To write a VHDL/Verilog code for 8:3 Encoder and to generate synthesis report, RTL schematic and to implement designs using FPGA (Spartan-3). 6. To write a VHDL/Verilog code for Parity generator and checker synthesis report, RTL schematic and to implement designs using FPGA (Spartan-3). 7. To write a VHDL/Verilog code for Flip Flop and to generate synthesis report, RTL schematic and to implement designs using FPGA (Spartan-2). 8. To write a VHDL/Verilog code for 4-bit sequence detector through Mealy and Moore state machines and to generate synthesis report, RTL schematic and to implement designs using FPGA (Spartan-2).
Total No. of Hours	8 Hours
Learning Outcomes:	At the end of the course the students can able to: 1. Design and implement basic combinational circuits using HDL and synthesize them for FPGA platforms.

	2. Create HDL models for arithmetic circuits (e.g., adders) and interpret synthesis and RTL results. 3. Develop and test sequential logic circuits (flip-flops, FSMs) using Verilog/VHDL and FPGA tools. 4. Analyze synthesis reports and interpret RTL schematics to evaluate functional correctness. 5. Demonstrate state machine design (Mealy and Moore) for applications like sequence detection in HDL.

Suggested books:

S. No.	Name of Authors /Books /Publisher	Year of Publication
1.	Bhasker, J, **"*VHDL Primer*",** 3rd ed., Pearson Education Asia, ISBN: 9789332557161	2001
2.	Samir Palnitkar, ***"Verilog HDL:A Guide to Digital Design and Synthesis",*** 2nd Edition, Pearson,ISBN- 978-817758918	2003
3.	Douglas L. Perry, ***"VHDL: Programming by Example",*** 4th ed., McGraw-Hill, ISBN 978-0071409544.	2006
4.	Ashenden, Peter J, ***"The Designer's Guide to VHDL",*** 3rd ed., Elsevier Science, ISBN 978-0080568850.	2010

	Learning Outcome 1	Learning Outcome 2	Learning Outcome 3	Learning Outcome 4	Learning Outcome 5
PO1	Y	Y	Y	Y	Y
PO2	N	Y	Y	Y	N
PO3	Y	Y	Y	N	Y
PO4	N	N	Y	Y	Y
PO5	Y	Y	Y	Y	Y
PO6	N	N	N	N	N
PO7	N	N	N	N	N
PO8	N	N	N	N	N
PO9	N	N	N	N	N

	Learning Outcome 1	Learning Outcome 2	Learning Outcome 3	Learning Outcome 4	Learning Outcome 5
PSO1	Y	Y	Y	Y	Y
PSO2	Y	Y	Y	Y	Y
PSO3	N	N	N	N	N
PSO4	N	N	N	N	N

Batch 2025-2026 and onwards

Course Code: BET-E610
Course Name: Introduction to Internet of Things

MM: 100 **Time: 3 Hr.** **L T P** **3 0 0**	**Sessional: 30** **ESE: 70** **Credit : 3**

Prerequisites:	Basic knowledge of programming and computer networks
Course Objectives:	To understand the fundamentals of IoT and its applications. To explore the architecture, technologies, and protocols of IoT. To get hands-on experience with IoT hardware and software platforms. To learn about data management, security, and cloud integration in IoT systems.
Course Coordinator	Mr. Shiv Kumar Singh

NOTE:	The question paper shall consist of two sections (Section-A and Section-B). Section-A shall contain of ten (10) short answer type questions of six (06) mark each and student shall be required to attempt any five (05) questions. Section-B shall contain eight (08)long answer type questions of ten (10) marks each and student shall be required to attempt any four questions. Questions shall be uniformly distributed from the entire syllabus

UNIT	Module	Course Content	No. of Hours	POs mapped	PSOs mapped
UNIT-1	*Module-1*	**Overview of IoT** – Definition, Evolution, and Characteristics IoT Architecture: Perception, Network, and Application Layers	**4**	PO1/PO2/PO3	PSO1/ PSO2
	Module-2	Applications of IoT: Smart Cities, Smart Homes, Industrial IoT, Healthcare, Agriculture, etc. Challenges and Opportunities in IoTRole of IoT in Digital Transformation	**4**	PO1/PO2/PO3	PSO1/ PSO2
UNIT-2	*Module-3*	**IoT Device Architecture M2M Communication Models**: M2M Communicationor Device-to-Device, Device-to-Cloud, Gateway Models used in IoT	**4**	PO1/PO3	PSO1/ PSO2
	Module-4	IoT Protocol Stack OverviewComparison of IoT and Traditional NetworksProtocols: MQTT, CoAP, AMQP, HTTP/HTTPS, WebSockets	**4**	PO1/PO2/PO4	PSO1/ PSO2
UNIT-3	*Module-5*	**Introduction to Sensors and Actuators**Light sensor, temperature sensor with hermistor, voltage sensor, ADC and DAC, DHT11,	**4**	PO1/PO3	PSO1/ PSO2
	Module-6	Motion Detection Sensors, Wireless Bluetooth Sensors, Level Sensors, USB Sensors, Embedded Sensors, Distance Measurement with ultrasound sensor	**4**	PO1/PO3	PSO1/ PSO2
UNIT-4	*Module-7*	**Network Topologies in IoT Wireless Technologies**: Wi-Fi, Bluetooth, Zigbee, LoRa, NB-IoTCloud Platforms: AWS IoT, Google Cloud IoT, Microsoft Azure IoT Hub	**4**	PO1/PO2	PSO1/ PSO2
	Module-8	Data Acquisition and StorageIntroduction to Big Data in IoT	**4**	PO1/PO2	PSO1/ PSO2
UNIT-5	*Module-9*	**IoT Security Challenges:** Authentication, Confidentiality, Integrity Secure	**4**	PO1/PO3/PO5	PSO1/ PSO2

		Communication and Encryption Techniques			
	Module-10	Privacy Issues in IoT ApplicationsRegulatory and Ethical ConsiderationsReal-world Case Studies: Smart Home System, Industrial IoT (IIoT), Wearable Devices	**4**	PO1/PO2	PSO1/ PSO2
Total No. of Hours			**40**		

Course Outcome

CO1	Explain the fundamentals and architecture of IoT systems and applications.
CO2	Analyze different communication models and protocols used in IoT.
CO3	Design simple IoT systems using sensors, actuators, and microcontrollers.
CO4	Integrate IoT systems with networking and cloud platforms for data exchange and analytics.
CO5	Assess security, privacy, and ethical issues in deploying IoT solutions.

Suggested books:

S. No.	Name of Authors /Books /Publisher	Year of Publication
1.	**ArshdeepBahga, Vijay Madisetti**, Internet of Things: A Hands-On Approach, Universities Press, 2014.	
2.	**Olivier Hersent, David Boswarthick, Omar Elloumi**, The Internet of Things: Key Applications and Protocols, Wiley, 2012.	
3.	**Adrian McEwen, Hakim Cassimally**, Designing the Internet of Things, Wiley, 2014.	
4.	**Honbo Zhou**, The Internet of Things in the Cloud: A Middleware Perspective, CRC Press, 2012.	
5.	**Pethuru Raj, Anupama C. Raman**, The Internet of Things: Enabling Technologies, Platforms, and Use Cases, CRC Press, 2017.	

			CO-PO/PSO MAPPING													
Course Outcomes (COs)			**Program Outcomes (POs)**											**Program Specific Outcomes (PSOs)**		
			PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	
CO1			**3**	**0**	**0**	**0**	**0**								**3**	**2**	
CO2			**3**	**3**	**2**	**1**	**0**								**3**	**3**	
CO3			**3**	**2**	**1**	**0**	**0**								**2**	**1**	
CO4			**3**	**2**	**0**	**1**	**0**								**1**	**2**	
CO5			**3**	**0**	**0**	**0**	**3**								**2**	**2**	

Batch 2025-2026 and onwards

Course Code: BET-E611
Course Name: Embedded Systems for IoT

MM: 100 **Time: 3 Hr.** **L T P** **3 0 0**	**Sessional: 30** **ESE: 70** **Credit : 3**

Prerequisites:	Digital Electronics, Basic Programming, Microcontrollers
Course Objectives:	Understand the architecture and role of embedded systems in IoT applications. Learn to interface sensors, actuators, and communication modules with microcontrollers. Develop firmware for embedded systems used in IoT projects. Explore power management and real-time capabilities. Implement secure and optimized embedded IoT solutions.
Course Coordinator	Mr. Shiv Kumar Singh

NOTE:	The question paper shall consist of two sections (Section-A and Section-B). Section-A shall contain of ten (10) short answer type questions of six (06) mark each and student shall be required to attempt any five (05) questions. Section-B shall contain eight (08)long answer type questions of ten (10) marks each and student shall be required to attempt any four questions. Questions shall be uniformly distributed from the entire syllabus

UNIT	Module	Course Content	No. of Hours	POs mapped	PSOs mapped
UNIT-1	*Module-1*	**Introduction to Embedded Systems and IoT** Definition and characteristics of Embedded SystemsOverview of IoT and embedded system integrationEmbedded vs General-Purpose Systems	**4**	PO1/PO2/PO3	PSO1/ PSO2
	Module-2	Components of Embedded IoT System: Sensors, MCU, Communication Module, PowerApplications in Smart Homes, Healthcare, Industry	**4**	PO1/PO2/PO3	PSO1/ PSO2
UNIT-2	*Module-3*	**Microcontrollers for IoT** Overview of AVR, ARM Cortex-M, and ESP32 microcontrollersMemory architecture, clock system, interrupt handlingGPIO, Timers, ADC, DAC, PWM	**4**	PO1/PO3	PSO1/ PSO2
	Module-4	Development environments: Arduino IDE, PlatformIO, ESP-IDF	**4**	PO1/PO2/PO4	PSO1/ PSO2
UNIT-3	*Module-5*	**Interfacing and Communication** Interfacing: LEDs, Switches, Relays, Displays, MotorsSensor Interfacing (DHT11, MQ-series, PIR, Ultrasonic)	**4**	PO1/PO3	PSO1/ PSO2
	Module-6	Communication Protocols: UART, I2C, SPIWireless Communication Modules: Wi-Fi (ESP8266/ESP32), BLE, Zigbee	**4**	PO1/PO3	PSO1/ PSO2
UNIT-4	*Module-7*	**Firmware Development and RTOS Basics** Embedded C and MicroPython basicsEvent-driven programmingInterrupt Service Routines (ISRs)Real-Time	**4**	PO1/PO2	PSO1/ PSO2
	Module-8	Operating System (RTOS) concepts: tasks, scheduling, synchronizationRTOS implementation using FreeRTOS on ESP32	**4**	PO1/PO2	PSO1/ PSO2
UNIT-5	*Module-9*	**Embedded System Design for IoT** System Design Considerations: Power,	**4**	PO1/PO3/PO5	PSO1/ PSO2

		Performance, CostBattery Management and Low Power ModesEmbedded IoT Security Basics (Secure Boot, OTA Updates)			
	Module-10	Case Studies: Smart Meter, Smart Garden, WearablesCapstone Mini Project using MCU and sensors with real-time data logging	**4**	PO1/PO2	PSO1/ PSO2
Total No. of Hours			**40**		

Course Outcome

CO1	Understand the fundamentals and architecture of embedded systems in IoT.
CO2	Interface sensors and actuators with microcontrollers using appropriate protocols.
CO3	Develop firmware using embedded C and MicroPython.
CO4	Integrate RTOS concepts into IoT applications.
CO5	Design and implement embedded IoT applications considering power and security constraints.

Suggested books:

S. No.	Name of Authors /Books /Publisher	Year of Publication
1.	**Raj Kamal** – Embedded Systems: Architecture, Programming and Design, Tata McGraw Hill.	
2.	**Muhammad Ali Mazidi** – AVR Microcontroller and Embedded Systems: Using Assembly and C, Pearson.	
3.	**Jonathan Valvano** – *Embedded Systems: Introduction to ARM Cortex-M Microcontrollers*	
4.	**Peter Barry, Patrick Crowley** – *Modern Embedded Computing: Designing Connected, Pervasive, Media-Rich Systems*	
5.	**Shibu K.V.** – *Introduction to Embedded Systems*, McGraw Hill	
6.	**Donald Norris** – *The Internet of Things: Do-It-Yourself Projects with Arduino and Raspberry Pi*	

			CO-PO/PSO MAPPING													
Course Outcomes (COs)			**Program Outcomes (POs)**											**Program Specific Outcomes (PSOs)**		
			PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	
CO1			**3**	**0**	**0**	**0**	**0**								**3**	**2**	
CO2			**3**	**3**	**2**	**1**	**0**								**3**	**3**	
CO3			**3**	**2**	**1**	**0**	**0**								**2**	**1**	
CO4			**3**	**2**	**0**	**1**	**0**								**1**	**2**	
CO5			**3**	**0**	**0**	**0**	**3**								**2**	**2**	

Batch 2025-2026 and onwards

Course Code: BET-E710
Course Name: IoT with Arduino, ESP, and Raspberry Pi

MM: 100 **Time: 3 Hr.** **L T P** **3 0 0**	**Sessional: 30** **ESE: 70** **Credit : 3**

Prerequisites:	Basic knowledge of programming and Embedded Systems
Course Objectives:	To develop skill knowledge of Arduino, ESP, Paspberry pi. To provide skills for interfacing sensors and actuators with different IoT architectures. To develop skills on data collection and logging in the cloud. To get hands-on experience with IoT hardware and software platforms.
Course Coordinator	Mr. Shiv Kumar Singh

NOTE:	The question paper shall consist of two sections (Section-A and Section-B). Section-A shall contain of ten (10) short answer type questions of six (06) mark each and student shall be required to attempt any five (05) questions. Section-B shall contain eight (08)long answer type questions of ten (10) marks each and student shall be required to attempt any four questions. Questions shall be uniformly distributed from the entire syllabus

UNIT	Module	Course Content	No. of Hours	POs mapped	PSOs mapped
UNIT-1	*Module-1*	IoT- introduction and its components, IoT building blocks, Sensors and Actuators, IoT Devices,	**4**	PO1/PO2/PO3	PSO1/ PSO2
	Module-2	IoT boards (Arduino Uno, ESP 8266-12E Node MCU, and Raspberry Pi 3).	**4**	PO1/PO2/PO3	PSO1/ PSO2
UNIT-2	*Module-3*	Arduino Uno – getting started with the Uno boards, blink program, connection of sensors to the Uno board, reading values of sensors from the Uno board, interrupts.	**4**	PO1/PO3	PSO1/ PSO2
	Module-4	Case study: Temperature/Humidity Control; Case Study: Sending values Temperature/Humidity values to the Internet via GSM module.	**4**	PO1/PO2/PO4	PSO1/ PSO2
UNIT-3	*Module-5*	ESP 8266-12E Node MCU – getting started with the ESP board, Micropython and Esplorer IDE, Flushing the ESP8266 board with micropython, connecting sensors to the ESP board, Connecting ESP board to WiFi, Interfacing ESP with the Cloud (REST API-GET, POST, MQTT), interrupts, comparison of ESP 32 board with the ESP 8266 board.	**4**	PO1/PO3	PSO1/ PSO2
	Module-6	Case Study: Switching light on /off remotely. Case Study: Voice-based Home Automation for switching lights on/off (Android phone – Google Assistant (Assistant <-> IFTTT), MQTT (ESP <-> IFTTT), ESP 8266 <-> Lights).	**4**	PO1/PO3	PSO1/ PSO2
UNIT-4	*Module-7*	Raspberry Pi 3 - Rpi3 introduction and installing the Raspbian Stretch OS, Headless - Computer and Rpi3 configuration to connect through SSH via Ethernet,	**4**	PO1/PO2	PSO1/ PSO2
	Module-8	Headless - connecting Rpi3 remotely without Ethernet cable via SSH, IP	**4**	PO1/PO2	PSO1/ PSO2

		address, Rpi 3 - Testing the GPIO pins through Scripts.			
UNIT-5	*Module-9*	Raspberry pi3 interfacing with Sensor DHT11, Raspberry pi3 python library install and reading sensor feed, 'Plug and play ' type cloud platform overview for integration to IOT devices, 'Plug and play' cloud platform for integration to IOT device - actuator (LED),	**4**	PO1/PO3/PO5	PSO1/ PSO2
	Module-10	Plug and play platform - Custom widget (DHT11-Sensor) integration through Python. New - Raspeberry Pi 4 Vs Raspberry Pi3 Mobel B Comparison, LoRawan /LPWAN – Overview.	**4**	PO1/PO2	PSO1/ PSO2
Total No. of Hours			**40**		

Course Outcome

CO1	To understand Arduino Uno, NODE MCU 8266 and Raspberry PI along with critical protocols and its communication to cloud.
CO2	To apply commonly used IOT protocols such as REST API, MQTT through IOT based demonstration.
CO3	To solve analog sensor and digital sensor interfacing with IOT devices.
CO4	Integrate IoT systems with networking and cloud platforms for data exchange and analytics.
CO5	Assess security, privacy, and ethical issues in deploying IoT solutions.

Suggested books:

S. No.	**Name of Authors /Books /Publisher**
1.	**Rao, M**. (2018). Internet of Things with Raspberry Pi 3: Leverage the power of Raspberry Pi 3 and JavaScript to build exciting IoT projects. Packt Publishing Ltd
2.	**Baichtal, J.** (2013). Arduino for beginners: essential skills every maker needs. Pearson Education.
3.	**Schwartz, M**. (2016). Internet of Things with ESP8266. Packt Publishing Ltd.
4.	**Richardson, M., & Wallace, S**. (2012). Getting started with raspberry PI. " O'Reilly Publisher Media, Inc."

			CO-PO/PSO MAPPING												
Course Outcomes (COs)			**Program Outcomes (POs)**											**Program Specific Outcomes (PSOs)**	
			PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	
CO1			**3**	**0**	**0**	**0**	**0**								**3**	**2**	
CO2			**3**	**3**	**2**	**1**	**0**								**3**	**3**	
CO3			**3**	**2**	**1**	**0**	**0**								**2**	**1**	
CO4			**3**	**2**	**0**	**1**	**0**								**1**	**2**	
CO5			**3**	**0**	**0**	**0**	**3**								**2**	**2**	

Batch 2025-2026 and onwards

Course Code: BET-E711
Course Name: Cybersecurity and Privacy in IoT

MM: 100 **Time: 3 Hr.** **L T P** **3 0 0**	**Sessional: 30** **ESE: 70** **Credit : 3**

Prerequisites:	Fundamentals of IoT, Computer Networks, Basic Cryptography
Course Objectives:	Understand the security challenges and threat landscape specific to IoT systems. Explore cryptographic mechanisms and access control techniques applicable to resource-constrained IoT devices. Examine privacy issues, data protection strategies, and regulatory requirements in IoT. Learn secure communication and update mechanisms in IoT deployments. Analyze real-world IoT security breaches and best practices.
Course Coordinator	Dr. Ashish Nainwal

NOTE:	The question paper shall consist of two sections (Section-A and Section-B). Section-A shall contain of ten (10) short answer type questions of six (06) mark each and student shall be required to attempt any five (05) questions. Section-B shall contain eight (08)long answer type questions of ten (10) marks each and student shall be required to attempt any four questions. Questions shall be uniformly distributed from the entire syllabus

UNIT	Module	Course Content	No. of Hours	POs mapped	PSOs mapped
UNIT-1	*Module-1*	**Introduction to IoT Security**Overview of IoT Security and PrivacyUnique Challenges in IoT SecurityAttack Surface in IoT (Device, Network, Cloud, Application)	**4**	PO1/PO2/PO3	PSO1/ PSO2
	Module-2	Common Attacks: Eavesdropping, Man-in-the-Middle, Replay, Firmware TamperingSecurity Goals: Confidentiality, Integrity, Availability (CIA Triad)	**4**	PO1/PO2/PO3	PSO1/ PSO2
UNIT-2	*Module-3*	**Cryptography and Secure Communication in IoT**Symmetric and Asymmetric Encryption in IoT ContextLightweight Cryptography (e.g., PRESENT, SPECK, LEA)Hashing, MACs, and Digital SignaturesSecure	**4**	PO1/PO3	PSO1/ PSO2
	Module-4	Communication Protocols: TLS, DTLS, HTTPS, MQTT with SSLKey Management in Constrained Environments	**4**	PO1/PO2/PO4	PSO1/ PSO2
UNIT-3	*Module-5*	**Authentication, Access Control, and Secure Boot** Authentication Mechanisms (Password-based, Token-based, Biometrics) Role-Based and Attribute-Based Access Control (RBAC, ABAC)	**4**	PO1/PO3	PSO1/ PSO2
	Module-6	Device Identity and Secure Onboarding Secure Boot, Trusted Execution Environment (TEE)Firmware Integrity and Over-the-Air (OTA) Updates	**4**	PO1/PO3	PSO1/ PSO2
UNIT-4	*Module-7*	**Privacy in IoT Systems**IoT Data Collection and Privacy RisksAnonymization, Pseudonymization,	**4**	PO1/PO2	PSO1/ PSO2

		and Data MinimizationPrivacy by Design and by Default			
	Module-8	Legal Frameworks: GDPR, HIPAA, CCPA and their relevance to IoTPrivacy Threat Modeling	**4**	PO1/PO2	PSO1/ PSO2
UNIT-5	*Module-9*	**IoT Security Frameworks, Standards & Case Studies** Overview of Standards: ISO/IEC 27030,NIST IoT Cybersecurity Framework, OWASP IoT Top 10 Security Lifecycle Management	**4**	PO1/PO3/PO5	PSO1/ PSO2
	Module-10	Case Studies: Mirai Botnet, Jeep Hack, Baby Monitor ExploitBest Practices for IoT SecuritySecure System Design Methodology	**4**	PO1/PO2	PSO1/ PSO2
Total No. of Hours			**40**		

Course Outcome

CO1	Identify and analyze key cybersecurity and privacy threats in IoT systems.
CO2	Apply appropriate cryptographic and secure communication methods for IoT.
CO3	Design access control and secure boot mechanisms tailored for IoT environments.
CO4	Evaluate privacy risks and apply compliance strategies for IoT data protection.
CO5	Critically assess real-world IoT security issues and recommend mitigation techniques.

Suggested books:

S. No.	Name of Authors /Books /Publisher	Year of Publication
1.	**Fei Hu** – *Security and Privacy in Internet of Things (IoTs): Models, Algorithms, and Implementations*, CRC Press	
2.	**Brian Russell, Drew Van Duren** – *Practical Internet of Things Security*, PacktPublishin	
3.	**Sunil Cheruvu et al.** – *Demystifying Internet of Things Security*, Apress	
4.	**Alan Grau, Eric Greenwald** – *Securing the Internet of Things*, Elsevier	
5.	**HwaiyuGeng** – *Internet of Things and Data Analytics Handbook*, Wiley	
6.	**OWASP Foundation** – *OWASP IoT Project* (freely available online resources)	

CO-PO/PSO MAPPING															
Course Outcomes (COs)	**Program Outcomes (POs)**												**Program Specific Outcomes (PSOs)**		
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	
CO1	**3**	**0**	**0**	**0**	**0**								**3**	**2**	
CO2	**3**	**3**	**2**	**1**	**0**								**3**	**3**	
CO3	**3**	**2**	**1**	**0**	**0**								**2**	**1**	
CO4	**3**	**2**	**0**	**1**	**0**								**1**	**2**	
CO5	**3**	**0**	**0**	**0**	**3**								**2**	**2**	

Batch 2025-2026 and onwards

Course Code: BET-E712
Course Name: IoT-Based Data Analytics and Applications

MM: 100 **Time: 3 Hr.** **L T P** **3 0 0**	**Sessional: 30** **ESE: 70** **Credit : 3**

Prerequisites:	Basics of IoT, Python Programming, Fundamentals of Data Science
Course Objectives:	Understand the role of data analytics in IoT ecosystems. Learn how to collect, store, process, and visualize IoT data. Explore real-time and batch analytics techniques for IoT. Implement machine learning models on IoT datasets for intelligent decision-making. Examine real-world applications of IoT analytics across various domains.
Course Coordinator	Dr. Ashish Nainwal

NOTE:	The question paper shall consist of two sections (Section-A and Section-B). Section-A shall contain of ten (10) short answer type questions of six (06) mark each and student shall be required to attempt any five (05) questions. Section-B shall contain eight (08)long answer type questions of ten (10) marks each and student shall be required to attempt any four questions. Questions shall be uniformly distributed from the entire syllabus

UNIT	Module	Course Content	No. of Hours	POs mapped	PSOs mapped
UNIT-1	*Module-1*	**Introduction to IoT Data Analytics** Data in IoT: Types, Sources, CharacteristicsIoT Data Pipeline: Sensing, Collection, Storage, Processing, VisualizationStructured vs Unstructured	**4**	PO1/PO2/PO3	PSO1/ PSO2
	Module-2	Data in IoTRole of Analytics in IoT Decision-MakingOverview of Tools and Platforms (Node-RED, Python, ThingSpeak, Power BI)	**4**	PO1/PO2/PO3	PSO1/ PSO2
UNIT-2	*Module-3*	**Data Acquisition and Storage** Sensor Data Collection using Arduino, ESP, and Raspberry PiData Transmission Protocols: MQTT, CoAP, HTTP	**4**	PO1/PO3	PSO1/ PSO2
	Module-4	Data Logging in Local Storage and Cloud Time-Series Databases: InfluxDB, Firebase, MongoDBReal-time Data Ingestion with Node-RED and Python Scripts	**4**	PO1/PO2/PO4	PSO1/ PSO2
UNIT-3	*Module-5*	**Data Processing and Real-Time Analytics** Data Cleaning and Preprocessing TechniquesStream Processing vs Batch ProcessingReal-Time Analytics with Apache Kafka, Apache Spark Streaming	**4**	PO1/PO3	PSO1/ PSO2
	Module-6	Edge Analytics vs Cloud AnalyticsUse Cases: Anomaly Detection, Predictive Maintenance	**4**	PO1/PO3	PSO1/ PSO2
UNIT-4	*Module-7*	**Machine Learning for IoT Analytics** Introduction to ML in IoT: Supervised, Unsupervised, Reinforcement LearningFeature Engineering from Sensor DataCase Study: Smart Home Energy Prediction	**4**	PO1/PO2	PSO1/ PSO2
	Module-8	ML Models: Regression, Classification,	**4**	PO1/PO2	PSO1/

		ClusteringModel Deployment on IoT Devices (e.g.,TensorFlow Lite, Edge Impulse)			PSO2
UNIT-5	*Module-9*	**Applications and Visualization** Application Domains: Smart Cities, Healthcare, Industry 4.0, AgricultureDashboards and Visualization Tools: Grafana, Power BI, Google Data Studio	**4**	PO1/PO3/PO5	PSO1/ PSO2
	Module-10	Integration of IoT with Cloud Platforms: AWS IoT, Azure IoT Hub, Google Cloud IoTEnd-to-End Analytics Pipeline: Sensor to InsightCapstone Project: Develop and Present an IoT Analytics Application	**4**	PO1/PO2	PSO1/ PSO2
Total No. of Hours			**40**		

Course Outcome

CO1	Understand the architecture and importance of data analytics in IoT systems.
CO2	Collect, store, and manage data from IoT devices using appropriate tools.
CO3	Process real-time and historical IoT data for analytical insights.
CO4	Apply machine learning techniques to build intelligent IoT applications.
CO5	Design and implement complete IoT data analytics solutions with visualization.

Suggested books:

S. No.	Name of Authors /Books /Publisher	Year of Publication
1.	**Pethuru Raj, Anupama C. Raman** – *The Internet of Things: Enabling Technologies, Platforms, and Use Cases*, CRC Press	
2.	**Charu C. Aggarwal** – *Machine Learning for Data Streams*, Springer	
3.	**Alok Mani Tripathi** – IoT and Analytics for Smart Cities, BPB Publications	
4.	**Yogesh Kulkarni** – *IoT and Data Science*, Wiley	
5.	**Michael Margolis, Simon Monk** – Programming the Internet of Things, O'Reilly	
6.	**ArshdeepBahga, Vijay Madisetti** – *Internet of Things: A Hands-on Approach*	

CO-PO/PSO MAPPING															
Course Outcomes (COs)			**Program Outcomes (POs)**											**Program Specific Outcomes (PSOs)**		
			PO 1	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PO 12**	**PS O1**	**PS O2**	
CO1			**3**	**0**	**0**	**0**	**0**								**3**	**2**	
CO2			**3**	**3**	**2**	**1**	**0**								**3**	**3**	
CO3			**3**	**2**	**1**	**0**	**0**								**2**	**1**	
CO4			**3**	**2**	**0**	**1**	**0**								**1**	**2**	
CO5			**3**	**0**	**0**	**0**	**3**								**2**	**2**	

Batch 2025-2026 and onwards

Course Code: BET-E652
Course Name: IoT LAB

MM: 100 **Time: 2 Hr.** **L T P** **0 0 2**	**Sessional: 30** **ESE: 70** **Credit : 1**

Prerequisites:	Electronic Devices Lab and embedded systems Lab
Objectives:	1. 1.To introduce Internet of Things (IoT) environment and its technologies for designing smart systems 2. To explore open-source computer hardware/software platform, development and debugging environment, programming constructs and necessary libraries 3. To learn embedded programming constructs and real time systems
Course Coordinator	Mr. Shiv Kumar Singh

NOTE:	1. In practical examination the student shall be required to perform one experiment. 2. A teacher shall be assigned 30 students for daily practical work in laboratory. 3. No batch for practical class shall consist of more than 30 students. 4. The number of students in a batch allotted to an examiner for practical examination shall not exceed 30 students. 5. Addition/deletion in above list may be made in accordance with the facilities available with the approval of H.O.D./Dean.

LIST OF EXPERIMENTS		
1	Interfacing LED and Buzzer with Arduino – Digital Output Basics	
2	Sensor Interfacing: Read Temperature and Humidity using DHT11 Sensor	
3	IoT Communication using ESP8266 with MQTT Protocol	
4	Control Devices Remotely using Blynk or Thingspeak with ESP32	
5	Interfacing PIR Motion Sensor and Triggering Alarm on Detection	
6	Smart Lighting System using LDR and Relay Module	
7	Send Sensor Data to Cloud Platform (ThingSpeak/Firebase) using ESP32	
8	IoT Data Logging and Visualization using Node-RED and Raspberry Pi	
9	Build a Web Dashboard to Control Devices using Flask (Raspberry Pi)	
10	Home Automation using Google Assistant and IFTTT	
11	Real-Time Health Monitoring using Pulse Sensor and IoT Cloud	
12	Mini Project: Develop a Complete IoT Application (Smart Agriculture / Smart Home / Air Quality Monitor)	
Total No. of Hours		**30**

Learning Outcomes: At the end of this course students will demonstrate the ability to

CO1	Interface and program IoT hardware such as sensors, actuators, and microcontrollers.
CO2	Implement real-time IoT solutions using open-source platforms like Arduino, ESP, and Raspberry Pi.
CO3	Transmit and receive data via standard IoT communication protocols like MQTT and HTTP.
CO4	Connect IoT devices to cloud services and visualize data effectively.
CO5	Develop and demonstrate a complete working IoT project using acquired skills.

Suggested books:

S. No.	Name of Authors /Books /Publisher	Year of Publication

1.	Yamanoor, Sai, and Srihari Yamanoor. Python Programming with Raspberry Pi,1st edition, Packt Publishing Ltd,UK.	2017
2.	Donald Norris, The Internet of Things: Do-It-Yourself Projects with Arduino, Raspberry Pi, and BeagleBone Black, 1st edition,McGraw Hill Education, USA.	2015
3.	Schwartz, Marco. Home Automation with Arduino: Automate your Home using OpenSource Hardware. 1st Edition, CreateSpace Independent Publishing, USA.	2013
4.	Kooijman, Matthijs. Building Wireless Sensor Networks Using Arduino, 1st edition, Packt Publishing Ltd, UK	2015
5.	ArshdeepBahga, Vijay Madisetti – Internet of Things: A Hands-On Approach, Universities Press	
6.	Donald Norris – The Internet of Things: Do-It-Yourself Projects with Arduino and Raspberry Pi, McGraw-Hill	

Batch 2025-2026 and onwards

Course Code: BET-E620
Course Name: Machine Learning

MM: 100 **Time: 3 Hr.** **L T P** **3 0 0**	**Sessional: 30** **ESE: 70** **Credit : 3**

Prerequisites:	Basic knowledge of programming, data structures, linear algebra, and probability/statistics.
Objectives:	1. To introduce foundational concepts and types of learning in machine learning. 2. To prepare and preprocess data for model building. 3. To implement and evaluate supervised and unsupervised learning algorithms. 4. To explore neural networks and ensemble methods. 5. To gain hands-on experience using tools like Scikit-learn and TensorFlow.
Course Coordinator	Mr. SHIV KUMAR SINGH

NOTE:	The question paper shall consist of two sections (Section-A and Section-B). Section-A shall contain of ten (10) short answer type questions of six (06) mark each and student shall be required to attempt any five (05) questions. Section-B shall contain eight (08)long answer type questions of ten (10) marks each and student shall be required to attempt any four questions. Questions shall be uniformly distributed from the entire syllabus

UNIT	Module	Course Content	No. of Hours	POs mapped	PSOs mapped
UNIT-1	Module-1	Introduction to Machine Learning: Human vs Machine learning, Types of ML (Supervised, Unsupervised, Reinforcement), Applications (Banking, Healthcare, etc.), Issues in ML, Tools (Python, R, Matlab)	5	PO1/PO2/PO3/PO4/PO5	PSO1/PSO2
	Module-2	Data Preparation and Exploration: Data types and structure, Numerical and Categorical Data Exploration, Missing values handling, Outliers, Dimensionality Reduction, Feature Selection	5	PO1/PO2/PO3/PO4/PO5	PSO1/PSO2
UNIT-2	Module-3	Model Building and Evaluation: Predictive vs Descriptive Models, Holdout & Cross-validation, Bias-Variance Tradeoff, Underfitting & Overfitting, Model Evaluation Metrics	4	PO1/PO2/PO3/PO4/PO5	PSO1/PSO2
	Module-4	Probability Review: Bayes Theorem, Discrete/Continuous Distributions, Sampling, Central Limit Theorem, Hypothesis Testing, Monte Carlo Approximation	4	PO1/PO2/PO3/PO4/PO5	PSO1/PSO2
UNIT-3	Module-5	Supervised Learning - Classification: kNN, Decision Trees, Random Forest, SVM, Classification Steps and Applications	8	PO1/PO2/PO3/PO4/PO5	PSO1/PSO2
UNIT-4	Module-6	Supervised Learning - Regression: Linear Regression, Polynomial Regression, Logistic Regression, MLE, Model Improvement Techniques	7	PO1/PO2/PO3/PO4/PO5	PSO1/PSO2
UNIT-5	Module-7	Unsupervised Learning and Neural Networks: Clustering (k-Means, DBSCAN, Hierarchical), Apriori Algorithm, Introduction to Neural Networks, Activation Functions, Backpropagation, Basics of Deep Learning	7	PO1/PO2/PO3/PO4/PO5	PSO1/PSO2

		Total No. of Hours	40		

Learning Outcomes:	After completing this course, the student will be able to 1. Understand core concepts and learning types in ML. 2. Prepare and explore datasets for ML. 3. Apply classification and regression techniques. 4. Evaluate and optimize model performance. 5. Implement unsupervised learning and basic neural networks.

Suggested books:

S. No.	Name of Authors /Books /Publisher
1.	Name of Authors / Books / Publisher
2.	Aurélien Géron, 'Hands-On Machine Learning with Scikit-Learn, Keras, and TensorFlow', O'Reilly.
3.	Christopher Bishop, 'Pattern Recognition and Machine Learning', Springer.
4.	Ethem Alpaydin, 'Introduction to Machine Learning', MIT Press.
5.	Tom Mitchell, 'Machine Learning', McGraw-Hill.

	Learning Outcome 1	Learning Outcome 2	Learning Outcome 3	Learning Outcome 4	Learning Outcome 5
PO1	Y	N	Y	Y	Y
PO2	Y	Y	N	Y	Y
PO3	Y	N	Y	Y	Y
PO4	N	Y	N	N	Y
PO5	Y	N	Y	Y	Y
PO6	Y	Y	N	Y	Y
PO7	N	N	N	N	Y
PO8	Y	Y	N	Y	Y

	Learning Outcome 1	Learning Outcome 2	Learning Outcome 3	Learning Outcome 4	Learning Outcome 5
PSO1	N	Y	N	N	N
PSO2	Y	N	Y	Y	N
PSO3	Y	N	Y	Y	N
PSO4	N	N	Y	Y	Y

Course Code: BET-E621
Course Name: Soft Computing Techniques

MM: 100 **Time: 3 Hr.**	**Sessional: 30** **ESE: 70**

Batch 2025-2026 and onwards

L T P 3 0 0	Credit : 3

Prerequisites:	Basic knowledge of programming and mathematical foundations.
Objectives:	1. To understand the fundamental concepts of soft computing techniques. 2. To gain insights into fuzzy logic systems and neural networks. 3. To explore genetic algorithms and their applications in optimization. 4. To implement hybrid soft computing systems using MATLAB/C/C++.
Course Coordinator	Mr. SHIV KUMAR SINGH

NOTE:	The question paper shall consist of two sections (Section-A and Section-B). Section-A shall contain of ten (10) short answer type questions of six (06) mark each and student shall be required to attempt any five (05) questions. Section-B shall contain eight (08)long answer type questions of ten (10) marks each and student shall be required to attempt any four questions. Questions shall be uniformly distributed from the entire syllabus

UNIT	Module	Course Content	No. of Hours	POs mapped	PSOs mapped
UNIT-1	Module-1	Introduction: What is Soft Computing? Difference between Hard and Soft computing, Applications of Soft Computing. Neural Networks:What is Neural Network, biological neural network, Learning (supervised, unsupervised, Reinforcement) and various activation functions, Terminologies of ANN: Weights, bias, threshold, learning rate, momentum factor.	8	PO1/PO2/PO3 /PO4/PO5	PSO1/PSO2
UNIT-2	Module-2	Neural Networks: Single layer Perceptrons , Back Propagation networks, Architecture of Backpropagation(BP) Networks, Backpropagation Learning, Variation of Standard Back propagation Neural Network, Introduction to Associative Memory, Adaptive Resonance theory and Self Organizing Map, Recent Applications.	8	PO1/PO2/PO3 /PO4/PO5	PSO1/PSO2
UNIT-3	Module-3	Fuzzy Systems: Fuzzy Set theory, Fuzzy versus Crisp set, Fuzzy Relation, Fuzzification, Minmax Composition, Defuzzification Method, Fuzzy Logic, Fuzzy Rule based systems, Predicate logic, Fuzzy Decision Making, Fuzzy Control Systems, Fuzzy Classification.	8	PO1/PO2/PO3 /PO4/PO5	PSO1/PSO2
UNIT-4	Module-4	Genetic Algorithm: History of Genetic Algorithms (GA), Working Principle, Various Encoding methods, Fitness	8	PO1/PO2/PO3 /PO4/PO5	PSO1/PSO2

		function, GA Operators-Reproduction, Crossover, Mutation, Convergence of GA, Bit wise operation in GA, Multi-level Optimization.			
UNIT-5	Module-5	Hybrid Systems: Sequential Hybrid Systems, Auxiliary Hybrid Systems, Embedded Hybrid Systems, Neuro-Fuzzy Hybrid Systems, Neuro-Genetic Hybrid Systems, Fuzzy-Genetic Hybrid Systems.	8	PO1/PO2/PO3 /PO4/PO5	PSO1/PSO2
		Total No. of Hours	40		

Learning Outcomes:	After completing this course, the student will be able to 1. Understand neural network models and their application in classification and regression. 2. Analyze associative and unsupervised learning networks. 3. Apply fuzzy logic principles and inference systems to control systems. 4. Design optimization problems using genetic algorithms and evolutionary methods. 5. Develop and implement hybrid soft computing systems using software tools.

Suggested books:

S. No.	Name of Authors /Books /Publisher
1.	Principles of Soft Computing, 3ed S.N. Sivanandam, S.N. Deepa ISBN: 9788126577132
2.	Samir Roy and UditChakraborty, 'Introduction to Soft Computing: Neuro-Fuzzy and Genetic Algorithms', Pearson.
3.	S. Rajasekaran and G. A. VijayalakshmiPai, 'Neural Networks, Fuzzy Logic and Genetic Algorithms', PHI.
4.	R. L. Haupt and S. E. Haupt, 'Practical Genetic Algorithms', Wiley.
5.	Chin-Teng Lin and C. S. George Lee, 'Neuro-Fuzzy Systems', PHI.

Batch 2025-2026 and onwards

Course Code: BET-E720
Course Name: INTRODUCTION TO AI

MM: 100 **Time: 3 Hr.** **L T P** **3 0 0**	**Sessional:30** **ESE:70** **Credit :3**

Prerequisites:	Probability and statistics, Automata and languages
Objectives:	1. Provide the most fundamental knowledge to the students so that they can understand what the AI is. 2. eliminate theoretic proofs and formal notations as far as possible, so that the students can get the full picture of AI easily. 3. Students who become interested in AI may go on to the graduate school for further study.
Course Coordinator	Dr. Ashish Nainwal

NOTE:	The question paper shall consist of two sections A and B. Section A contains 10 short type questions of 6 marks each and student shall be required to attempt any five questions. Section B contains 8 long type questions of ten marks each and student shall be required to attempt any four questions. Questions shall be uniformly distributed from the entire syllabus.

UNIT	Module	Course Content	No. of Hours	POs mapped	PSOs mapped
UNIT-1	*Module-1*	**Introduction:** Introduction to Artificial Intelligence, Foundations and History of Artificial Intelligence, Applications of Artificial Intelligence, Intelligent Agents, Structure of Intelligent Agents. Computer vision, Natural Language Processing.	**08**	PO1 / PO2	PSO1/ PSO2
UNIT-2	*Module-2*	**Introduction to Search**: Searching for solutions, Uniformed search strategies, Informed search strategies, Local search algorithms and optimistic problems, Adversarial Search, Search for games, Alpha - Beta pruning.	**08**	PO2/ PO3	PSO1/ PSO2
UNIT-3	*Module-3*	**Knowledge Representation & Reasoning**: Propositional logic, Theory of first order logic, Inference in First order logic, Forward & Backward chaining, Resolution, Probabilistic reasoning, Utility theory, Hidden Markov Models (HMM), Bayesian Networks.	**08**	PO1/ PO2/ PO4	PSO1/ PSO2
UNIT-4	*Module-4*	**Machine Learning**: Supervised and unsupervised learning, Decision trees, Statistical learning models, Learning with complete data - Naive Bayes models. **Expert System:** Existing Systems (DENDRAL, MYCIN) domain exploration Meta Knowledge, Self-Explaining System	**08**	PO2/ PO3	PSO1/ PSO2
UNIT-5	*Module-5*	**Capstone Project:** Choose a real-world Problem and develop an AI solution end-to-end, Build the AI Model / Use API, Create a User Interface: Web App / Android App/iOS App, Deploy AI App, Documentation: Problem, model, results, future scope, Live demo.	**08**	PO1/ PO3/ PO4	PSO1/ PSO2
	Total No. of Hours		**40**		

Learning Outcomes:	1. Understand AI's fundamental concepts and methods 2. Acquire knowledge of modern AI tools, including Deep Learning framework TensorFlow and Deep Learning capabilities of RapidMiner. 3. Learn how to apply AI-based methods to solving practical business problems 4. Understand implications of AI for business strategies

	5. Examine where the AI technologies are heading within the next few years.

Suggested books:

S. No.	Name of Authors /Books /Publisher/Year
1.	Rich & Knight, Artificial Intelligence
2.	Stuart Russell, Peter Norvig, "Artificial Intelligence – A Modern Approach", Pearson Education
3.	Charnick, Introduction to A.I., Addision Wesley
4.	Winston, LISP, Addision Wesley
5.	Marcellous, Expert System Programming, PHI
6.	Elamie, Artificial Intelligence, Academic Press
7.	Lioyed, Foundation of Logic Processing, Springer Verlag

CO-PO/PSO MAPPING

Course Outcomes (COs)	Program Outcomes (POs)												Program Specific Outcomes (PSOs)	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	√	√											√	√
CO2	√	√	√										√	√
CO3	√	√	√	√									√	√
CO4	√	√		√									√	√
CO5	√	√	√	√									√	√

Batch 2025-2026 and onwards

Course Code: BET-E721
Course Name: Deep Learning

MM: 100 **Time: 3 Hr.** **L T P** **3 0 0**	**Sessional:30** **ESE:70** **Credit :3**

Prerequisites:	Basic understanding of machine learning, linear algebra, and probability.
Objectives:	1. To enable students to understand the mathematical, statistical and computational challenges of building neural networks. 2. To enable students to understand the concept of deep networks and dimensionality reduction techniques. 3. To enable students to solve engineering problems using deep learning algorithms.
Course Coordinator	Dr. Ashish Nainwal

NOTE:	The question paper shall consist of two sections A and B. Section A contains 10 short type questions of 6 marks each and student shall be required to attempt any five questions. Section B contains 8 long type questions of ten marks each and student shall be required to attempt any four questions. Questions shall be uniformly distributed from the entire syllabus.

UNIT	Module	Course Content	No. of Hours	POs mapped	PSOs mapped
UNIT-1	*Module-1*	Introduction to neural network, artificial neuron model, activation functions, neural architectures, feedforward networks, gradient descent, backpropagation, neural networks as function approximators.	8	PO1/PO2/ PO3/PO4/ PO5	PSO1/PSO 2
UNIT-2	*Module-2*	Deep Networks and Dimensionality Reduction: History, backpropagation, regularization, batch normalization, PCA, autoencoders, data compression and reconstruction.	7	PO1/PO2/ PO3/PO4/ PO5	PSO1/PSO 2
UNIT-3	*Module-3*	Convolutional Neural Networks: Architecture, convolution and pooling, padding, famous networks (LeNet, AlexNet, VGG, ResNet, etc.), training methods, hyperparameter tuning.	9	PO1/PO2/ PO3/PO4/ PO5	PSO1/PSO 2
UNIT-4	*Module-4*	Recurrent Neural Networks: RNNs, LSTMs, GRUs, encoder-decoder, language models, deep reinforcement learning.	8	PO1/PO2/ PO3/PO4/ PO5	PSO1/PSO 2
UNIT-5	*Module-5*	Applications: Image segmentation, object detection, GANs, NLP, attention models, Word2Vec, face recognition, bioinformatics.	8	PO1/PO2/ PO3/PO4/ PO5	PSO1/PSO 2
	Total No. of Hours		**40**		

Learning Outcomes:	1. Understand the basics of dimensionality reduction and deep neural networks. 2. Analyze convolutional and recurrent neural networks for different data types. 3. Implement deep learning models to solve real-world engineering problems.

Suggested books:

S. No.	Name of Authors /Books /Publisher/Year
1.	Deep Learning by Ian Goodfellow, Yoshua Bengio and Aaron Courville, MIT Press.
2.	Neural Networks and Deep Learning, Michael Nielsen, Determination Press.
3.	Deep Learning from Scratch, Seth Weidman, O'Reilly.
4.	Deep Learning with Python, Francois Chollet, Manning.
5.	Neural Networks and Learning Machines, Simon Haykins, PHI.

CO-PO/PSO MAPPING														
Course Outcomes (COs)	**Program Outcomes (POs)**												**Program Specific Outcomes (PSOs)**	
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	√	√											√	√
CO2	√	√	√										√	√
CO3	√	√	√	√									√	√
CO4	√	√		√									√	√
CO5	√	√	√	√									√	√

Batch 2025-2026 and onwards

Course Code: BET-E722
Course Name: Natural Language Processing

MM: 100 **Time: 3 Hr.** **L T P** **3 0 0**	**Sessional:30** **ESE:70** **Credit :3**

Prerequisites:	Basic programming, statistics, and machine learning knowledge.
Objectives:	1. Develop a comprehensive understanding of the fundamental concepts and techniques of natural language processing (NLP), including language modeling, parsing, and text classification. 2. Learn to apply NLP techniques to real-world problems, such as sentiment analysis, machine translation, and text summarization. 3. Understand the limitations and challenges of NLP, including issues of data quality, interpretability, and ethical considerations. 4. Develop the ability to critically evaluate and design NLP systems, and to communicate research findings and results effectively.
Course Coordinator	Dr. Ashish Nainwal

NOTE:	The question paper shall consist of two sections A and B. Section A contains 10 short type questions of 6 marks each and student shall be required to attempt any five questions. Section B contains 8 long type questions of ten marks each and student shall be required to attempt any four questions. Questions shall be uniformly distributed from the entire syllabus.

UNIT	Module	Course Content	No. of Hours	POs mapped	PSOs mapped
UNIT-1	*Module-1*	Introduction to NLP: Overview, history, key terminologies, text representation and pre-processing.	6	PO1/PO2/ PO3/PO4/ PO5	PSO1/PSO 2
UNIT-2	*Module-2*	Syntax and Parsing: Sentence structure, parsing algorithms, CFGs, PCFGs, shift-reduce parsing, and their applications.	8	PO1/PO2/ PO3/PO4/ PO5	PSO1/PSO 2
UNIT-3	*Module-3*	Semantics and Pragmatics: Meaning, semantic representation, word-sense disambiguation, semantic parsing, applications.	8	PO1/PO2/ PO3/PO4/ PO5	PSO1/PSO 2
UNIT-4	*Module-4*	Machine Learning in NLP: Supervised/unsupervised learning, feature representation, applications in sentiment analysis and NER.	9	PO1/PO2/ PO3/PO4/ PO5	PSO1/PSO 2
UNIT-5	*Module-5*	Advanced Topics: Text summarization, dialogue systems, translation, chatbots, virtual assistants, multilingual NLP.	9	PO1/PO2/ PO3/PO4/ PO5	PSO1/PSO 2
	Total No. of Hours		**40**		

Learning Outcomes:	1. Understand and apply fundamental concepts of NLP, such as language structure, syntax, semantics, and pragmatics. 2. Design and implement NLP algorithms including machine learning techniques for classification and named entity recognition. 3. Evaluate and compare NLP methods, understanding their strengths and limitations. 4. Apply NLP techniques to real-world problems like dialogue systems, summarization, and translation.

Suggested books:

S. No.	Name of Authors /Books /Publisher/Year
1.	Daniel Jurafsky and James H. Martin, Speech and Language Processing.

2.	T. Ganegedara, Natural Language Processing with TensorFlow.
3.	Richard Sproat, Natural Language Processing and Computational Linguistics.
4.	Christopher Manning and Hinrich Schütze, Foundations of Statistical Natural Language Processing.

CO-PO/PSO MAPPING

Course Outcomes (COs)	Program Outcomes (POs)												Program Specific Outcomes (PSOs)	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	√	√											√	√
CO2	√	√	√										√	√
CO3	√	√	√	√									√	√
CO4	√	√		√									√	√
CO5	√	√	√	√									√	√

Batch 2025-2026 and onwards

Course Code: BET-E653
Course Name: Machine Learning LAB

MM: 100 **Time: 2 Hr.** **L T P** **0 0 2**	**Sessional: 30** **ESE: 70** **Credit : 1**

Prerequisites:	Mathematics, Python and Soft Computing
Objectives:	1. To introduce the basic concepts and techniques of Machine learning and the need of Machine learning techniques in real-world problems. 2. To provide understanding of various Machine Learning algorithms and the wayto evaluate performance of the Machine Learning algorithms. 3. To apply Machine Learning to learn, predict and classify the real-world problems in the Supervised Learning paradigms as well as discover the Unsupervised Learning paradigms of Machine Learning. 4. To inculcate in students professional and ethical attitude, multidisciplinary approach and an ability to relate real-world issues and provide a cost effective solution to it by developing ML applications.
Course Coordinator	Mr. Shiv Kumar Singh

NOTE:	1. In practical examination the student shall be required to perform one experiment. 2. A teacher shall be assigned 30 students for daily practical work in laboratory. 3. The number of students in a batch allotted to an examiner for practical examination shall not exceed 30 students. 4. Addition/deletion in above list may be made in accordance with the facilities available with the approval of H.O.D./Dean. 5. Details of the Experiments is in the lab manual.

LIST OF EXPERIMENTS		
1	Implementation of Python Basic Libraries such as Statistics, Math, Numpy and Scipy.	
2	Implementation of Python Libraries for ML application such as Pandas and Matplotlib.	
3	Creation and Loading different types of datasets in Python using the required libraries.	
4	Write a python program to compute Mean, Median, Mode, Variance, Standard Deviation using Datasets	
5	Demonstrate various data pre-processing techniques for a given dataset.	
6	Implement Dimensionality reduction using Principle Component Analysis (PCA) method on a dataset (For example Iris).	
7	Write a program to demonstrate the working of the decision tree based ID3 algorithm by considering a dataset.	
8	Consider a dataset, use Random Forest to predict the output class. Vary the number of trees as follows and compare the results: i. 20 ii. 50 iii. 100 iv. 200 v. 500	
9	Write a Python program to implement Simple Linear Regression and plot the graph.	
10	Write a Python program to implement Logistic Regression for iris using sklearn and plot confusion matrix	
11	Build KNN Classification model for a given dataset. Vary the number of k values as follows and compare the results: i. 1 ii. 3 iii. 5 iv. 7 v. 11	
12	Implement Support Vector Machine for a dataset and compare the accuracy by applying The following kernel functions: i. Linear ii. Polynomial iii. RBF	
13	Write a python program to implement K-Means clustering Algorithm. Vary the number of k values as follows and compare the results: i. 1 ii. 3 iii. 5	
Total No. of Hours		**30**

Learning Outcomes: At the end of this course students will demonstrate the ability to

CO1	Design and implement machine learning solutions to classification, regression problems.
CO2	Analyze the complexity of Machine Learning algorithms and their limitations.

CO3	Apply appropriate data sets to the Machine Learning algorithms.
CO4	Identify and apply Machine Learning algorithms to solve real world problems
CO5	Apply supervised and unsupervised techniques on various data sets.

Suggested books:

S. No.	Name of Authors /Books /Publisher
1.	AurélienGéron - Hands-On Machine Learning with Scikit-Learn, Keras, and TensorFlow, 2nd Edition. September 21019, O'Reilly Media, Inc., ISBN: 9781492032649.
2.	Tom Mitchel “Machine Learning”, Tata McGraW Hill, 2017.

Batch 2025-2026 and onwards

Course Code: DET-C403
Course Name: ANALOG ELECTRONICS

MM: 100 **Time: 3 Hr.** **L T P** **3 1 0**	**Sessional: 30** **ESE: 70** **Credit : 3**

Prerequisites:	
Objectives:	The course is aimed at: [1] Imparting knowledge about basics of semiconductor physics, electronic devices such as PN-Junction Diode and its circuits, Zener diode, BJT, FET, their uses as an amplifier. [2] Teaching about the different biasing circuits of BJT and FET with their ac equivalent circuits and solving various transistor parameters. [3] Design, construct and take measurement of various analog circuits and compare experimental results in the laboratory with theoretical analysis. [4] Determine parameter values for large and small signal models for diodes, BJTs and MOSFETs based on knowledge of the device structure, dimensions, and bias conditions.
Course Coordinator	AMRISH

NOTE:	The question paper shall consist of two sections (Section-A and Section-B). Section-A shall contain of ten (10) short answer type questions of six (06) mark each and student shall be required to attempt any five (05) questions. Section-B shall contain eight (08) long answer type questions of ten (10) marks each and student shall be required to attempt any four questions. Questions shall be uniformly distributed from the entire syllabus

UNIT	Module	Course Content	No. of Hours	POs mapped	PSOs mapped
UNIT-1	*Module-1*	Semi conductor physics: Review of basic atomic structure and energy levels, concept of insulators, conductors and semi conductors, atomic structure of Ge and Si, covalent bonds, Concept of intrinsic and extrinsic semi conductor, P and N type impurities, doping of impurity, P and N type semiconductors and their conductivity. Effect of temperature on conductivity of intrinsic semi conductor, Energy level diagram of conductors, insulators and semi conductors; minority and majority carriers.	**8**	PO1/ PO2/ PO3/ PO4	PSO1/ PSO2
UNIT-2	*Module-2*	Semi conductor diode: PN junction diode, mechanism of current flow in PN junction, Drift and diffusion current, equivalent circuits of junction diode, diode equation, depletion layer, forward and reverse biased PN junction, potential barrier, concept of junction capacitance in forward and reverse bias condition, V-I characteristics, static and dynamic resistance and their calculation from diode characteristics	**08**	PO1/ PO2/ PO3/ PO4	PSO1/ PSO2
UNIT-3	*Module-4*	Diode circuits & diode types: Diode as half wave, full wave and bridge rectifier. PIV, rectification efficiencies and ripple factor calculations, shunt filter, capacitor filter, series inductor filter, LC Filter and RC Filters, Types of diodes – Zener Diode, Zener breakdown and avalanche breakdown. Characteristics and applications of Zener diode. Varactor Diode, Photo Diode, LED.	**08**	PO1/ PO2/ PO3/ PO4	PSO1/ PSO2
UNIT-4	*Module-5*	Introduction to Bipolar transistor: Concept of bipolar transistor, structure, PNP and NPN transistor, their symbols and mechanism of current flow, current	**08**	PO1/ PO2/ PO3/	PSO1/ PSO2

		relations in transistor, concept of leakage current, CB, CE, CC configuration of the transistor, Input and output characteristics in CB and CE configurations, input and output dynamic resistance in CB and CE configurations, Current amplification factors. Comparison of CB, CE and CC Configurations, Transistors as an amplifier in CE Configurations, d.c load line and calculation of current gain, voltage gain using d.c load line.		PO4	
UNIT-5	*Module-6*	Transistor biasing & FET: need of biasing, Concept of transistor biasing and selection of operating point. Need for stabilization of operating point. Different types of biasing circuits,Field Effect Transistors(FETs), Construction, operation and characteristics of FET and its application, Construction, operation and characteristics of MOSFET in depletion and enhancement modes and its applications.	**08**	PO1/ PO2/ PO3/ PO4	PSO1/ PSO2
Total No. of Hours			**40**		

Learning Outcomes:	At the end of the course, a student will be able to: • **Define**construction, characteristics, operations, various biasing circuits and configurations of bipolar junction transistors. • **Explain** the theory of p-n junction and zener diode with their characteristics and applications. • **Analyze and explain** basics of FETs and MOSFETs. • **Compare** the energy band structure of materials with emphasis on their properties and classification and **Analyze** the fermi–dirac function and fermi levels in semiconductors. • **Design** the basic diode and BJT circuits.

Suggested books:

1.	Jacob Millman & C.C. Halkias, "Integrated Electronics**",** 2nd edition, Mcgraw Hill Higher Education, ISBN- 978-0074622452	2002
2.	Basic Electronics and Linear Circuit by NN Bhargava and Kulshreshta, Tata McGraw Hill Publishing Co, New DelhiISBN: 978-1-25-900646-3	2003
3.	Principles of Electrical and Electronics Engineering by VK Mehta; S Chand and Co., New Delhi, ISBN : 9789352837199	2019
4.	Electronic Components and Materials by SM Dhir, Tata McGraw Hill Publishing Co, New Delhi 4. ISBN 13, 9780074630822	2018
5.	Robert Bolyestad, "Electronic devices and circuit**",** 11th edition, PHI, ISBN- 978-9332542600	2015

	Learning Outcome 1	Learning Outcome 2	Learning Outcome 3	Learning Outcome 4	Learning Outcome 5
PO1	Y	Y	Y	Y	Y
PO2	Y	Y	Y	Y	Y
PO3	Y	Y	Y	Y	Y
PO4	Y	Y	Y	Y	Y

	Learning Outcome 1	Learning Outcome 2	Learning Outcome 3	Learning Outcome 4	Learning Outcome 5
PSO1	Y	Y	Y	Y	Y
PSO2	Y	Y	Y	Y	Y

Batch 2025-2026 and onwards

Course Code: DET-C453
Course Name: ANALOG ELECTRONICS LAB

MM :50 **Sessional: 15**
Time : 2 hrs **ESE: 35**
L T P **Credit : 1**
0 0 2

LIST OF EXPERIMENTS

1. Plot V-I characteristics for PN junction diode.
2. Plot V-I characteristics of Zener diode.
3. Observe the wave shape of Half wave rectifier
4. Observe the wave shape of Full wave center tap rectifier.
5. Observe the wave shape of Full Wave Bridge rectifier.
6. Study of diode as clipper circuit.
7. Study of diode as clamper circuit
8. Plot input and output characteristics and calculate parameters of transistors in CE configuration.
9. Plot input and output characteristics and calculate parameters of transistors in CB configuration.
10. Plot input, output and transfer characteristics of JFET.
11. Plot input, output and transfer characteristics of MOSFET.

NOTE

1. In practical examination the student shall be required to perform one experiment.
2. A teacher shall be assigned 20 students for daily practical work in laboratory.
3. No batch for practical class shall consist of more than 20 students.
4. The number of students in a batch allotted to an examiner for practical examination shall not exceed 20 students.
5. Addition/deletion in above list may be made in accordance with the facilities available with the approval of H.O.D./Dean.

Batch 2025-2026 and onwards

Course Code: BET-C203
Course Name: BASIC ELECTRONICS ENGINEERING

MM: 100 **Time: 3 Hr.** **L T P** **3 1 0**	**Sessional: 30** **ESE: 70** **Credit : 4**

Prerequisites:	
Objectives:	The course is aimed at: [1] Imparting knowledge about basics of semiconductor physics, electronic devices such as PN-Junction Diode and its circuits, Zener diode, BJT, FET, their uses as an amplifier. [2] Teaching about the different biasing circuits of BJT and FET with their ac equivalent circuits and solving various transistor parameters. [3] Design, construct and take measurement of various analog circuits and compare experimental results in the laboratory with theoretical analysis. [4] Determine parameter values for large and small signal models for diodes, BJTs and MOSFETs based on knowledge of the device structure, dimensions, and bias conditions.
Course Coordinator	AMRISH

NOTE:	The question paper shall consist of two sections (Section-A and Section-B). Section-A shall contain of ten (10) short answer type questions of six (06) mark each and student shall be required to attempt any five (05) questions. Section-B shall contain eight (08) long answer type questions of ten (10) marks each and student shall be required to attempt any four questions. Questions shall be uniformly distributed from the entire syllabus

UNIT	Module	Course Content	No. of Hours	POs mapped	PSOs mapped
UNIT-1	*Module-1*	Semiconductors, energy band description of semiconductors, effect of temperature on semiconductors, intrinsic and extrinsic semiconductors, donor and acceptor impurities, electron and hole concentration, conductivity of a semiconductor, mobility and resistivity, Generation and Recombination, Hall effect, Fermi level, mass action law, charge densities in a semiconductor.	**8**	PO1/ PO2/ PO3/ PO4	PSO1/ PSO2
UNIT-2	*Module-2*	P-N junction and its properties, V-I characteristics of P-N junction, application of junction diode as clippers, clampers and rectifiers (Half-wave, Full-wave and bridge), Zener and avalanche breakdown mechanism, Zener diode and its characteristics, equivalent circuit of Zener diode, Zener diode as a voltage regulator, LED.	**08**	PO1/ PO2/ PO3/ PO4	PSO1/ PSO2
UNIT-3	*Module-4*	Introduction to Bipolar transistor: Structure, PNP and NPN transistor, their symbols and mechanism of current flow, concept of leakage current, CB, CE, CC configuration of the transistor, Input and output characteristics in CB and CE configurations, input and output dynamic resistance in CB and CE configurations, Current amplification factors. Comparison of CB, CE and CC Configurations, Transistors as an amplifier in CE Configurations, d.c load line.	**08**	PO1/ PO2/ PO3/ PO4	PSO1/ PSO2
UNIT-4	*Module-5*	Transistor biasing: Need of biasing, Concept of transistor biasing and selection of operating point. Need for stabilization of operating point, Different types of biasing circuits, Transistor as a switch.	**08**	PO1/ PO2/ PO3/ PO4	PSO1/ PSO2
UNIT-5	*Module-6*	Field Effect Transistor: JFET and its characteristics, configurations of JFET, MOSFET, CMOSFET	**08**	PO1/ PO2/	PSO1/ PSO2

		biasing, Fixed-bias configuration, Self-bias configuration, Voltage-Divider biasing, MESFET (Enhancement & depletion types) their construction and characteristics, configuration of MOSFET.		PO3/ PO4	
Total No. of Hours			**40**		

Learning Outcomes:	At the end of the course, a student will be able to: • **Define**construction, characteristics, operations, various biasing circuits and configurations of bipolar junction transistors. • **Explain** the theory of p-n junction and zener diode with their characteristics and applications. • **Analyze and explain** basics of FETs and MOSFETs. • **Compare** the energy band structure of materials with emphasis on their properties and classification and **Analyze** the fermi–dirac function and fermi levels in semiconductors. • **Design** the basic diode and BJT circuits.

Suggested books:

1.	Jacob Millman & C.C. Halkias, "Integrated Electronics**",** 2nd edition, Mcgraw Hill Higher Education, ISBN- 978-0074622452	2002
2.	Basic Electronics and Linear Circuit by NN Bhargava and Kulshreshta, Tata McGraw Hill Publishing Co, New Delhi ISBN: 978-1-25-900646-3	2003
3.	Principles of Electrical and Electronics Engineering by VK Mehta; S Chand and Co., New Delhi, ISBN : 9789352837199	2019
4.	Electronic Components and Materials by SM Dhir, Tata McGraw Hill Publishing Co, New Delhi 4. ISBN 13, 9780074630822	2018
5.	Robert Bolyestad, "Electronic devices and circuit**",** 11th edition, PHI, ISBN- 978-9332542600	2015

	Learning Outcome 1	Learning Outcome 2	Learning Outcome 3	Learning Outcome 4	Learning Outcome 5
PO1	Y	Y	Y	Y	Y
PO2	Y	Y	Y	Y	Y
PO3	Y	Y	Y	Y	Y
PO4	Y	Y	Y	Y	Y

	Learning Outcome 1	Learning Outcome 2	Learning Outcome 3	Learning Outcome 4	Learning Outcome 5
PSO1	Y	Y	Y	Y	Y
PSO2	Y	Y	Y	Y	Y

Batch 2025-2026 and onwards

Course Code: BET-C253
Course Name: BASIC ELECTRONICS ENGINEERING LAB

MM :50 **Sessional: 15**
Time : 2 hrs **ESE: 35**
L T P **Credit : 1**
0 0 2

LIST OF EXPERIMENTS

1. Plot V-I characteristics for PN junction diode.
2. Plot V-I characteristics of Zener diode.
3. Observe the wave shape of Half wave rectifier
4. Observe the wave shape of Full wave center tap rectifier.
5. Observe the wave shape of Full Wave Bridge rectifier.
6. Study of diode as clipper circuit.
7. Study of diode as clamper circuit
8. Plot input and output characteristics and calculate parameters of transistors in CE configuration.
9. Plot input and output characteristics and calculate parameters of transistors in CB configuration.
10. Plot input, output and transfer characteristics of JFET.
11. Plot input, output and transfer characteristics of MOSFET.

NOTE

6. In practical examination the student shall be required to perform one experiment.
7. A teacher shall be assigned 20 students for daily practical work in laboratory.
8. No batch for practical class shall consist of more than 20 students.
9. The number of students in a batch allotted to an examiner for practical examination shall not exceed 20 students.
10. Addition/deletion in above list may be made in accordance with the facilities available with the approval of H.O.D./Dean.