AC – 20/5/2025
Item No. – 6.31 (N)

As Per NEP 2020

University of Mumbai

Syllabus for Major Vertical – 1, 4, 5 & 6		
Name of the Programme – B.E. (Electronics and Telecommunication Engineering)		
Faculty of Engineering		
Board of Studies in Electronics and Telecommunication Engineering		
U.G. Second Year Programme	**Exit Degree**	**U.G. Diploma in Electronics and Telecommunication Engineering**
Semester		**III & IV**
From the Academic Year		**2025-26**

University of Mumbai

(As per NEP 2020)

Sr. No.	Heading	Particulars
1	**Title of program** **O:_____**	**B.E. (Electronics and Telecommunication Engineering)**
2	**Exit Degree**	**U.G. Diploma in Electronics and Telecommunication Engineering.**
3	**Scheme of Examination** **R: _____**	NEP 40% Internal 60% External, Semester End Examination Individual Passing in Internal and External Examination
4	**Standards of Passing** **R: _____**	**40%**
5	**Credit Structure** **R. TEU-560C** **R. TEU-560D**	**Attached herewith**
6	**Semesters**	**Sem. III & IV**
7	**Program Academic Level**	**5.00**
8	**Pattern**	**Semester**
9	**Status**	**New**
10	**To be implemented from Academic Year**	**2025-26**

Sd/-	**Sd/-**	**Sd/-**
Dr. Faruk Kazi	**Dr. Deven Shah**	**Prof. Shivram S. Garje**
BoS-Chairman- Electronics and Telecommunication Engineering	**Associate Dean**	**Dean**
Faculty of Technology	**Faculty of Science & Technology**	**Faculty of Science & Technology**

Preamble

To meet the challenge of ensuring excellence and NEP 2020 policy in engineering education, the issue of quality needs to be addressed, debated, and taken forward systematically. Accreditation is the principal means of quality assurance in higher education. The major emphasis of the accreditation process is to measure the outcomes of the program that is being accredited. In line with this, the Faculty of Science and Technology (in particular Engineering) of the University of Mumbai has taken the lead in incorporating the philosophy of NEP 2020 education in the process of curriculum development.

The second-year engineering course is a core training program to impart scientific and logical thinking training to learners in general, with a choice of course selection from the program core course, multidisciplinary minor, and vocational skill-enhanced course. Simultaneously, the objectives of NEP 2020 demand nurturing the core program and skills required for the Electronics and Telecommunication Engineering Branch of the learner. Keeping this in view, a pool of courses is offered in Core Courses covering fundamentals required to understand core and modern engineering practices and emerging trends in technology. Considering the shift in pedagogy and the convenience of a stress-free learning process, a choice-based subject pool is offered in the coursework under the heads of Electronics and Telecommunication Engineering for open electives and multidisciplinary minor courses in the third and fourth semesters. Essentially, to give a glimpse of trends in the industry under vocational and enhanced skill practices, the pool is offered to nurture and develop creative skills in contemporary industrial practices. Criteria met in the structure is the opportunity for learners to choose the course of their interest in all disciplines.

The Program Core Course Covers Electronics and Telecommunication engineering core courses. Also, OE and MDM where a pool of subjects are given for selection. Considering the present scenario, diverse choices need to be made available to fulfill the expectation of a learner to aspire for a career in the field of current trends of Technology and interdisciplinary research. Ability enhancement can be achieved in Undergraduate training by giving an objective viewpoint to the learning process and transitioning a learner from a rote learner to a creative professional. for the purpose Design Thinking is introduced in the First Semester to orient a journey learner to become a skilled professional. Considering the NEP-2020 structure of award of Certificate & Diploma at multiple exit-point pools of Vocational skills is arranged for giving exposure to the current Industry practices.

The faculty resolved that course objectives and course outcomes are to be clearly defined for every course so that all faculty members in affiliated higher education institutes understand the depth and approach of the course to be taught, which will enhance the learner's learning process. NEP 2020 grading system enables a much-required shift in focus from teacher-centric to continuous-based learner-centric education since the workload estimated is based on the investment of time in learning and not in teaching. It also focuses on continuous evaluation, which will enhance the quality of education. Credit assignment for courses is based on a 15-week teaching-learning process for NEP 2020, however, the content of courses is to be taught in 12-13 weeks, and the remaining 2-3 weeks are to be utilized for revision, tutorial, guest lectures, coverage of content beyond the syllabus, etc.

There was a concern that in the present system, the second-year syllabus must not be heavily loaded to the learner and it is of utmost importance that the learner entering into the second year of an engineering course should feel at ease by lowering the burden of syllabus and credits. This is necessary for a learner to get accustomed to the new environment of a college and to create a bond between the teacher and the learner. The present curriculum will be implemented for the Second Year of Engineering from the academic year 2025-26. Subsequently, this system will be carried forward for Third Year and Final Year Engineering in the academic years 2026-27, and 2027-28, respectively.

Sd/-	**Sd/-**	**Sd/-**
Dr. Faruk Kazi	**Dr. Deven Shah**	**Prof. Shivram S. Garje**
BoS-Chairman-	**Associate Dean**	**Dean**
Electronics and Telecommunication Engineering	**Faculty of Science & Technology**	**Faculty of Science & Technology**
Faculty of Technology		

Under Graduate Diploma in Engineering- Electronics and Telecommunication.

Credit Structure (Sem. III & IV)

	R. TEU-560C								
Level	**Semester**	**Major**		**Minor**	**OE**	**VSC, SEC (VSEC)**	**AEC, VEC, IKS**	**OJT, FP, CEP, CC,RP**	**Cum. Cr. / Sem.**	**Degree/ Cum. Cr.**
		Mandatory	**Electives**							
5.0	III	PCC301:3 PCC302:3 PCC303:3 PCC304:3 PCL301: 1 PCL302:1	--	--	OE:2	--	VEC: 2 HSL: 2	CEP: 2	22	**UG Diploma 45**
	R. TEU-560D									
	IV	PCC401:3 PCC402:3 PCC403:3 PCL401:1 PCL402:1	--	MDM: 4	OE:2	VSEC:2	VEC: 2 EEM:2	--	23	
	Cum Cr.	25	--	4	4	2	*2+2+2+2*	2	45	

Exit option: Award of UG Diploma in Major and MDM with 90 credits and additional 4 credits core **one** theory subject with 3 credits and **one** lab with 1 credit from one third year from where they want to take Exit degree. Along with theory and practical course student must compulsory do internship for **one month or 160 hours** which internship is equal to 4 credits.

[Abbreviation - OE – Open Electives, VSC – Vocation Skill Course, SEC – Skill Enhancement Course, (VSEC), AEC – Ability Enhancement Course, VEC – Value Education Course, IKS – Indian Knowledge System, OJT – on Job Training, FP – Field Project, CEP – Continuing Education Program, CC – Co-Curricular, RP – Research Project]

S.E. Electronics and Telecommunication Engineering Scheme

Semesters III and IV

Program Structure for Second Year of Electronics and Telecommunication Engineering

UNIVERSITY OF MUMBAI (With Effect from 2025-2026)

SEMESTER IV

Course Code	Course Description	Teaching Scheme (Contact Hours)			Credit Assigned			
		Theory	Practical	Tutorial	Theory	Tutorial	Practical	Total Credits
2304111	Neural Network and Fuzzy Logic	2	--	1	2	1	–	3
2304112	Microcontroller	3	–	--	3	–	–	3
2304113	Analog and Digital Communication	3	--	--	3	–	–	3
MDC401	Multidisciplinary Minor	3@	–	--	3	–	–	3
OEC401	Open Elective	2#	–	--	2	–	–	2
2304114	Microcontroller Laboratory	–	2	–	–	–	1	1
2304115	Analog and Digital Communication Laboratory	–	2	–	–	–	1	1
MDL401	Multidisciplinary Minor	–	2	–	–	–	1	1
2304411	Smart Embedded Systems with ATmega168/328	–	2*+2	–	–	–	2	2
2994511	Business Model Development	–	2*+2	–	–	–	2	2
2994512	Design Thinking	–	2*+2	–	–	–	2	2
Total		**13**	**18**	**01**	**13**	**01**	**09**	**23**

* Two hours of practical class to be conducted for full class as demo/discussion.

Theory / Tutorial 1 credit for 1 hour and Practical 1 credit for 2 hours

\# Students must select course for Open Elective from Science/Commerce/Management stream bucket provided by the University of Mumbai.

@ Institute shall offer a course for MDM from other Engineering Boards.

Course Code	Course Description	Examination scheme							
		Internal Assessment Test (IAT)			End Sem. Exam Marks	End Sem. Exam Duration (Hrs)	Term Work (Tw)	Oral & Pract.	Total
		IAT-I	IAT-II	Total (IAT-I) + IAT-II)					
2304111	Neural Network and Fuzzy Logic	20	20	40	60	2	25	--	125
2304112	Microcontroller	20	20	40	60	2	--	--	100
2304113	Analog and Digital Communication	20	20	40	60	2	--	--	100
MDC401	Multidisciplinary Minor	20	20	40	60	2	--	--	100
OEC401	Open Elective	20	20	40	60	2	--	--	100
2304114	Microcontroller Laboratory	--	--	--	--	--	25	25	50
2304115	Analog and Digital Communication Laboratory	--	--	--	--	--	25	25	50
MDL401	Multidisciplinary Minor	--	--	--	--	--	25	--	25
2304411	Smart Embedded Systems with ATmega168/328	--	--	--	--	--	50	25	75
2994511	Business Model Development	--	--	--	--	--	50	--	50
2994512	Design Thinking	--	--	--	--	--	50	--	50
Total		**100**	**100**	**200**	**300**	**10**	**250**	**75**	**825**

Vertical – 1
Major

Detail Syllabus

Course Code	Course Name	Teaching Scheme (Contact Hours)			Credits Assigned			
		Theory	Pract.	Tut.	Theory	Pract.	Tut.	Total
2304111	Neural Networks and Fuzzy Logic	2	--	1	2	--	1	3

		Theory					Term work	Pract / Oral	Total
		Internal Assessment			End Sem Exam	Exam Duration (in Hrs)			
		Test 1	Test 2	Total					
2304111	Neural Networks and Fuzzy Logic	20	20	40	60	2	25	--	125

Prerequisite:

1. Applied Mathematics-I
2. Applied Mathematics-II
3. Digital System Design

Course Objectives:

1. To study the basics of biological Neural Networks.
2. To understand the various terminologies in Artificial Neural networks.
3. To understand the different types of Artificial Neural Networks.
4. To study fuzzy logic and to provide knowledge of fuzzy logic to design the real-world fuzzy systems.

Course Outcomes:

After successful completion of the course student will be able to

1. Differentiate Biological system from Artificial Neuron.
2. Explain the different learning models and distinguish between the different types of supervised and unsupervised learning neural networks.
3. Evaluate the given neural network for specific input patterns and activation functions.
4. Apply the concept of competitive neural networks for clustering applications.
5. Understand the basic concept of fuzzy sets and fuzzy relations.
6. Develop innovative solutions to real-world problems using fuzzy logic

DETAILED SYLLABUS:

Sr. No.	Name of Module	Detailed Content	Hours	CO Mapping
I	**Introduction to Neural Networks**	Biological neurons and its working Artificial neurons, Terminologies used in Artificial Neural Networks, Artificial Neuron Model, Applications of ANN, McCulloch-Pitts Model for AND, OR and NOT Gates	4	CO1
II	**Fundamentals of Artificial Neural Networks**	Activation Functions, Neural network architectures, Supervised, Unsupervised, Reinforcement learning rules, Linear Separability, Design of AND / OR gate using linear separability, XOR problem	4	CO2
III	**Supervised Learning**	Single Layer Perceptron, Adaline Network, Multilayer Perceptron, Error Back propagation algorithm	5	CO3
IV	**Unsupervised Learning**	Neural network based on competition: Kohonen Self Organizing Maps and Applications, learning vector quantization	4	CO4
V	**Introduction to Fuzzy Logic**	Introduction to Fuzzy Sets, Fuzzy set operations, Properties of Fuzzy sets. Fuzzy Relations: Cartesian product of Relation, Fuzzy Max-Min and Max-Product Composition.	4	CO5
VI	**Fuzzy Systems**	Features of Membership functions, Fuzzification (Intuition Method), Defuzzification (Centroid and mean of Maximum), Fuzzy Inference System and its types, Designing Fuzzy logic control systems like washing machines, and train brake control.	5	CO6

Text Books:

1. S.N. Sivanandam & S.N.Deepa , “Principles Of Soft Computing “, Wiley India Pvt. Limited, 2007
2. Timothy J Ross, “Fuzzy Logic With Engineering Applications”, John Willey And Sons, West Sussex, England, 2005.
3. Jack M. Zurada, “Introduction To Artificial Neural Systems”, PWS Publishing Co., Boston, 2002.

References:

1. Kosko, B, “Neural Networks And Fuzzy Systems: A Dynamical Approach To Machine Intelligence”, Prentice hall, New Delhi, 2004.

2. S. Rajasekaran, And G. A. Vijayalakshmi Pai , "Neural Networks, Fuzzy Logic And Genetic Algorithms : Synthesis, And Applications", Prentice Hall Of India, 2007.
3. D. K. Pratihar , "Soft Computing" , Narosa, 2008.
4. Simon Haykin, "Neural Networks: A Comprehensive Foundation," 2nd Edition, Prentice-Hall, 1999

Recommended Swayam NPTEL Courses:

1. Fuzzy Logic and Neural Networks by Prof. Dilip Kumar Pratihar , IIT Kharagpur
2. Fuzzy Sets, Logic and Systems & Applications, By Prof. Nishchal Kumar Verma, IIT Kanpur
3. Soft Computing Techniques, By Dr. T Subha , National Institute of Technical Teachers Training and Research (NITTTR), Taramani, Chennai.

Term Work: General Instructions

1. Batch wise tutorials are to be conducted. The number of students per batch should be as per University pattern for practical.
2. Students must be encouraged to write Python Programs in tutorial class only.
3. Each Student has to write at least 4 Python tutorials and at least 6 class tutorials on entire syllabus.
4. Suggested List for Python tutorials

   i. Write a program to evaluate various activation functions
   ii. Write a program for perceptron training algorithm and test it for two input AND & OR gate function
   iii. Write a program for training and testing of Multilayer Perceptron for two input EX-OR gate
   iv. Write a program for training and testing of Kohonen Self Organizing map for clustering application
   v. Write a program to do the Fuzzy Set Operations: AND, OR, D-Morgan's theorem.
   vi. Write a program to find the fuzzy relations and compositions

The distribution of Term Work marks will be as follows

1	Attendance (Theory and Tutorial)	**05**
2	Class Tutorials on entire syllabus	**15**
3	Python Tutorials	**05**

Assessment:

Internal Assessment (IA) Test:

Assessment consists of two class tests of 20 marks each. The first class test (Internal Assessment I) is to be conducted when approx. 40% syllabus is completed and second class test (Internal Assessment II) when additional 35% syllabus is completed. Duration of each test shall be one hour.

End Semester Examination:

1. Question paper will comprise of total 06 questions, each carrying 15 marks.

2. Total 04 questions need to be solved.

3. Question No: 01 will be compulsory and should cover maximum content of the entire syllabus.

4. Remaining questions will be randomly selected from all the modules as per the weightage of each module (which is proportional to number of respective lecture hours mentioned in the syllabus).

Course Code	Course Name	Teaching Scheme (Contact Hours)			Credits Assigned			
		Theory	Pract.	Tut.	Theory	Pract.	Tut.	Total
2304112	Microcontrollers	3	-	-	3	-	-	3

		Theory					Term work	Pract / Oral	Total
		Internal Assessment			End Sem Exam	Exam Duration (in Hrs)			
		Test 1	Test 2	Total					
2304112	Microcontrollers	20	20	40	60	2	--	--	100

Prerequisite:
Digital System Design

Course Objectives:

1. To acquire a comprehensive understanding of the essential components and systems that constitute microcomputers
2. To understand the underlying principles, structures, and functionalities of memory systems
3. To understand the architecture and instructions of 8051 microcontrollers.
4. To apply the knowledge of 8051 I/O ports, Timer, Counter, Interrupts, serial port and write the programs related to same
5. To understand the concepts of advanced microcontroller ARM7
6. To apply the concepts of embedded systems and recent microcontrollers

Course Outcomes:

After successful completion of the course student will be able to

1. Understand of the fundamental components and systems integral to microcomputers
2. Understand the memory systems to optimize system performance.
3. Understand the architecture and instructions of 8051 microcontrollers
4. Apply the concepts of I/O ports, Timer, Counter, Interrupts, serial port for 8051 microcontroller programming.
5. Understand the ARM7 microcontroller architecture and its suitability for embedded systems and real-time applications.
6. Apply the concept of embedded systems and recent advancements in microcontroller technologies and explore their impact on modern applications.

DETAILED SYLLABUS:

Sr. No.	Name of Module	Detailed Content	Hours	CO Mapping
0	**Prerequisite**	Digital system design	-	-
I	**Overview of Microprocessor based System**	**Overview of Components and Systems of Microcomputers** Introduction to the basic components of microcomputers, Significance of signal lines of memory. The actions performed by the microprocessor to fetch and execute instructions from memory after RESET. Concept of RISC & CISC Architecture. Harvard & Von Neumann Architecture. **Self-learning Topics:** Comparative study of different microprocessors	05	CO1
II	**The Memory Systems**	Concepts of primary memory and secondary memory, Need of Secondary memory. Types of Semiconductor Memory, Features of SRAM and DRAM. Cache Memory and its need. Concept of virtual memory, Segmentation and Paging.	04	CO2
III	**8051 Microcontroller & Assembly Language Programming**	Comparison between Microprocessor and Microcontroller. Features, architecture and pin configuration. CPU timing and machine cycle. Memory organization. Addressing modes. Instruction set. Need of Assembler & Compiler, Assembler Directives, Programs related to: arithmetic, logical operations.	09	CO3
IV	**8051 I/O Ports, Timer/Counters, Interrupts, Serial Port communication & Interfacing**	8051 Input / Output ports and Port structure. 8051 Timer/Counter, Timer modes. 8051 Interrupt, 8051 serial communication & modes. Assembly language program related to: delay subroutine, input & output port, timer, counter, serial port and Interrupt. Interfacing LEDs, Relay and switches.	09	CO4
V	**ARM7**	Introduction and Features of ARM 7, Architectural inheritance, Pipelining, Programmer's Model, Brief introduction of exception and interrupt handling. Concept of cortex A, cortex R and Cortex M. Instruction Set, Data processing, Data Transfer, Control flow.	08	CO5
VI	**Study 8 bit microcontroller Applications**	Definition of Embedded System, Embedded Systems Vs General Computing Systems. Factors to be Considered in Selecting a Microcontroller for an	04	CO6

		Application. Understanding features of ATMEGA 328, LPC 2148, MSP 430 and STM 32 Microcontrollers. Case Study on microcontroller based applications		

Text Books:

1. M. A. Mazidi, J. G. Mazidi and R. D. Mckinlay, "The 8051 Microcontroller & Embedded systems", Pearson Publications, Second Edition 2006.
2. C. Kenneth J. Ayala and D. V. Gadre, "The 8051 Microcontroller & Embedded system using assembly & 'C' ", Cengage Learning, Edition 2010
3. Raj Kamal, "Microcontrollers" Architecture, Programming, Interfacing and System Design", Pearson Education India, Second Edition 2011
4. N. Senthil Kumar, M. S. P. S. A. Kumar, "Microprocessor and Microcontroller", Oxford University Press, 2nd edition
5. I. Scott MacKenzie and Raphael C.W. Phan, "The 8051 Microcontroller", Pearson Education International, 4th edition
6. Steve Furber, "ARM System on chip Architecture", Pearson, 2nd edition

References:

1. "MCS@51 Microcontroller, Family User's Manual" Intel
2. ATmega328P 8-bit AVR Microcontroller with 32K Bytes In-System Programmable Flash datasheet, Atmel
3. James A. Langbridge, "Professional Embedded Arm Development", Wrox, John Wiley Brand& Sons Inc., Edition 2014
4. Andrew N. Sloss, Dominic Symes, Chris Wright, "ARM System Developer's Guide: Designing and Optimizing System Software", Elsevier
5. The 8051 Microcontroller and Embedded Systems, "Manish K Patel", McGraw Hill 2014

Online References:

Sr. No.	Website Name
1.	Microprocessors and Microcontrollers By Prof. Santanu Chattopadhyay (IIT Kharagpur) - https://swayam.gov.in/nd1_noc20_ee42/preview
2.	PLC and Microcontroller By Dr Ritula Thakur (NITTTR, Chandigarh) - https://onlinecourses.swayam2.ac.in/ntr25_ed25/preview

Assessment:

Internal Assessment (IA) Test:

Assessment consists of two class tests of 20 marks each. The first class test (Internal Assessment I) is to be conducted when approx. 40% syllabus is completed and second class test (Internal Assessment II) when additional 35% syllabus is completed. Duration of each test shall be one hour.

End Semester Examination:

1. Question paper will comprise of total 06 questions, each carrying 15 marks.
2. Total 04 questions need to be solved.
3. Question No: 01 will be compulsory and should cover maximum content of the entire syllabus.
4. Remaining questions will be randomly selected from all the modules as per the weightage of each module (which is proportional to number of respective lecture hours mentioned in the syllabus).

Course Code	Course Name	Teaching Scheme (Contact Hours)			Credits Assigned			
		Theory	Pract.	Tut.	Theory	Pract.	Tut.	Total
2304113	Analog and Digital Communication	3	-	-	3	-	-	3

		Theory					Term work	Pract / Oral	Total
		Internal Assessment			End Sem Exam	Exam Duration (in Hrs)			
		Test 1	Test 2	Total					
2304113	Analog and Digital Communication	20	20	40	60	2	--	--	100

Prerequisite:

- Elements of Telecommunication
- Electronic Devices and Linear Circuits
- Digital System Design

Course Objectives:

1. To demonstrate the fundamental concepts of Analog and Digital Communication Systems.
2. To understand various Analog and Digital Modulation and Demodulation techniques.
3. To analyze and compare the different Modulation and Demodulation techniques.
4. To explain the key concepts of Analog and Digital Pulse Modulation and Demodulation techniques.
5. To illustrate various source and channel coding techniques.
6. To examine the impact of noise and distortions in communication systems.

Course Outcomes:

After successful completion of the course student will be able to

1. Define the fundamental concepts of Analog and Digital Communication.
2. Explain the various Analog, Digital Modulation and Demodulation Techniques and Multiplexing Techniques.
3. Apply the concepts of information theory of source coding and channel coding techniques.
4. Analyse the various modulation and demodulation techniques.
5. Evaluate the performance of various error control codes.
6. Design an encoder and decoder for error control system with the given specifications.

DETAILED SYLLABUS:

Sr. No.	Name of Module	Detailed Content	Hours	CO Mapping
0	**Prerequisite**	Need for Modulation, Basics concepts of Amplitude and Frequency Modulation and Demodulation. Sampling Theorem and Pulse Code Modulation. Definition and waveforms of ASK, FSK and PSK.	**01**	**--**
I	**Introduction**	Block diagram of Analog and Digital Communication System, Signal-to-noise ratio, Noise factor, Noise Figure, Noise Temperature. Friis Formula. **Self-Learning Topics:** Types of Noise and Electromagnetic Spectrum.	**02**	**CO1**
II	**Analog Modulation and Demodulation**	**Amplitude Modulation and Demodulation-** Mathematical and Graphical Representation AM wave, Voltage distribution and Power Calculations. Basic Concepts of DSBSC and SSB. AM Diode Detectors - (Simple and Practical). **Self-Learning Topics:** Low level and High-level Transmitter.	**10**	**CO1 CO2 CO4**
		Frequency Modulation and Demodulation - Mathematical Representation of FM wave, deviation ratio, bandwidth requirement, Narrowband and Wideband FM, Pre-emphasis and De-emphasis, Noise-triangle, FM Generation (Varactor Diode and Armstrong method) , FM Detectors- Foster-Seeley Detector		
		Radio Receivers – Characteristics of radio receivers, Superheterodyne AM and FM receivers. **Self-learning Topics:** Use of AM and FM in Modern Communication Technology. Challenges faced by radio broadcasting industry.		
III	**Pulse Modulation and Multiplexing**	Sampling Theorem, Nyquist Criteria, Sampling Techniques, Aliasing error and Aperture effect.	**07**	**CO2 CO4**
		Generation and Detection of PAM, PWM and PPM. PCM Transmitter and Receiver. Concepts of Delta modulation (DM) and Adaptive Delta Modulation (ADM).		
		Need of Multiplexing, Block Diagram explanation of TDM and FDM Systems. **Self-learning Topics:** Applications of Multiplexing		
IV	**Source Coding and Channel Coding**	Basics of Information Theory, Entropy, Shannon Hartley theorem Source Coding Techniques: Huffman coding and	**07**	**CO3 CO5 CO6**

	Techniques	Shannon-Fano coding. Channel Coding for Error Detection and Correction - Linear Block Codes and Convolutional Codes. **Self-learning Topics:** Applications of Source Coding and Channel Coding Techniques.		
V	**Baseband Transmission and Reception**	Block diagram of baseband Transmitter-Receiver system, Need of line codes, Properties, Types of line codes - RZ and NRZ Unipolar formats, RZ and NRZ Polar formats, RZ and NRZ Bipolar format (AMI format), Split phase Manchester format and Polar Quaternary formats. Inter Symbol Interference, Inter Channel Interference, Matched Filter. **Self-Learning Topics:** Equalizers	**04**	**CO1** **CO2**
VI	**Bandpass Transmission and Reception**	Generation, Detection, Error probability and Bandwidth of the following modulations: BASK, BFSK, BPSK, QPSK, offset QPSK, M-ary PSK, 16-ary QASK and MSK. **Self-learning Topics**: Applications of all the Modulation Techniques	**08**	**CO2** **CO4**

Text Books:

1. Kennedy and Davis "Electronics Communication System", Tata McGraw Hill
2. Wayne Tomasi, "Electronics Communication Systems" Pearson Education, 5th Edition.
3. Herbert Taub, Donald L Schilling, Goutam Saha, "Principles of Communication Systems", Tata McGraw Hill, 3rd Edition.
4. T. L. Singal, "Analog and Digital Communication," Tata Mc-Graw Hill, New Delhi, First Ed.
5. Sklar B, and Ray P. K., "Digital Communication: Fundamentals and Applications," Pearson, Dorling Kindersley (India), Delhi, Second Edition.

References:

1. Simon Haykin, "Communication System", John Wiley and Sons,4th Ed.
2. B P Lathi, Zhi Ding, Modern Digital and Analog Communication Systems, Oxford University. 4th Ed.
3. Beharouz A. Forouzan, "Data Communication and Networking", fourth edition.

Online References:

Sr. No.	Website Name
1.	Analog communication- https://swayam.gov.in/nd1_noc20_ee69/preview
2.	Principles of Digital Communication- https://nptel.ac.in/courses/108/101/108101113/
3.	Principles of Digital Communication- https://nptel.ac.in/courses/108/102/108102120/

Assessment:

Internal Assessment (IA) Test:

Assessment consists of two class tests of 20 marks each. The first class test (Internal Assessment I) is to be conducted when approx. 40% syllabus is completed and second class test (Internal Assessment II) when additional 35% syllabus is completed. Duration of each test shall be one hour.

End Semester Examination:

1. Question paper will comprise of total 06 questions, each carrying 15 marks.

2. Total 04 questions need to be solved.

3. Question No: 01 will be compulsory and should cover maximum content of the entire syllabus.

4. Remaining questions will be randomly selected from all the modules as per the weightage of each module (which is proportional to number of respective lecture hours mentioned in the syllabus).

Course Code	Course Name	Teaching Scheme (Contact Hours)			Credits Assigned			
		Theory	Pract.	Tut.	Theory	Pract.	Tut.	Total
2304114	Microcontroller Laboratory	--	2	--	--	1	--	1

Course Code	Course Name	Examination Scheme						
		Theory Marks				Term Work	Practical/ Oral	Total
		Internal assessment			End Sem. Exam			
		Test1	Test 2	Avg. of 2 Tests				
2304114	Microcontroller Laboratory	--	--	--	--	25	25	50

Prerequisite:
Digital System Design

Laboratory Objectives:

1. To evaluate and integrate development tools for effective system design and implementation for microcontroller based system
2 To study the addressing modes of 8051 and write the program to apply the same
3 To interface I/O devices to 8051 and write the program apply the same
4. To develop microcontroller based applications.

Laboratory Outcomes:

After successful completion of the course student will be able to:

1. Students will be able to utilize development tools to effectively design, simulate, and troubleshoot microcontroller-based systems.
2. Write assembly language programs for arithmetic and logical operations,
3. Write assembly language programs for code conversion & data transfer operations.
4. Write assembly language programs for general purpose I/O, Timers & Interrupts.
5. Interface & write programs for Input and Output devices.
6. Develop microcontroller based Applications.

List of Experiments:

Sr No	List of Experiments	Hrs
01	Explore the development tools to be used (Assembler, Linker, Compiler, Simulator, Emulator. IDE: like Keil, Edsim 51,tinkercad and wokwi etc	02
02	WAP in assembly language for 8051 to perform arithmetic operations such as: a) Addition b) Subtraction c) Multiplication d) Division	02
03	WAP in assembly language for 8051 to perform multiple byte decimal addition.	02
04	WAP in assembly language for 8051 to Exchange & moving block of elements. a) Exchange block from internal RAM to internal RAM. b) Moving block from internal RAM to external RAM.	02
05	WAP in assembly language for 8051 to Conversion of codes (Any One): a) Binary to BCD b) Binary to Gray etc	02
06	To write a program to arrange numbers in Ascending order or descending order	02
07	WAP in assembly language for 8051 To generate a) Square wave or b) Triangular wave	02
08	WAP in assembly language for 8051 for blinking LED. a) Using Timer and Interrupt b) Using Delay Subroutine.	02
09	Interfacing and Programming of 7 Segment display to 8051.	02
10	Interfacing and Programming of 16 x 8 LCD Display	02
11	Study of Stepper Motor. a) Continuous Mode. b) Step mode with 180 degree rotation. (Clockwise and Anticlockwise)	02
12	To write an ALP for 8051 Serial Communication to send string of characters on serial port.	02
13	Basic programming using ARM WAP to perform arithmetic operations such as: a) Addition b) Subtraction c) Multiplication d) Division	02
14	Small mini-Project Microcontroller based Applications on simulators like - Traffic Light Controller,Touchless door bell	02

Assessment:

Term Work: Term Work shall consist of at least 10 to 12 practical's based on the above list. Also, Term work Journal must include at least 2 assignments.

Term Work Marks: 25 Marks (Total marks) = 15 Marks (Experiment) + 5 Marks (Assignments) + 5 Marks (Attendance)

Practical & Oral Exam: An Oral & Practical exam will be held based on the above syllabus.

Course Code	Course Name	Teaching Scheme (Contact Hours)			Credits Assigned			
		Theory	Pract.	Tut.	Theory	Pract.	Tut.	Total
2304115	Analog and Digital Communication Laboratory	--	2	--	--	1	--	1

Course Code	Course Name	Examination Scheme						
		Theory Marks				Term Work	Practical/ Oral	Total
		Internal assessment			End Sem. Exam			
		Test1	Test 2	Avg. of 2 Tests				
2304115	Analog and Digital Communication Laboratory	--	--	--	--	25	25	50

Prerequisite:

- Elements of Telecommunication
- Electronic Devices and Linear Circuits
- Digital System Design

Laboratory Objectives:

1. To demonstrate generation and detection of Analog and Digital Modulation techniques.
2. To demonstrate generation and detection of Pulse Modulation Techniques.
3. To learn source coding and error control coding techniques.
4. To compare different line coding methods.
5. To illustrate multiplexing techniques.
6. To use simulation tools for analog and digital communication techniques.

Laboratory Outcomes:

After successful completion of the course student will be able to:

1. Demonstrate various Analog Modulation and Demodulation techniques.
2. Demonstrate Pulse Modulation, Demodulation and Multiplexing techniques.
3. Demonstrate various Digital Modulation and Demodulation Techniques.
4. Evaluate the performance parameters of a communication system.
5. Examine various Line Coding Techniques.
6. Design different source coding and channel coding Techniques**.**

DETAILED SYLLABUS:

Sr. No.	Module	Detailed Content	Hours	LO Mapping
0	**Prerequisite**	--	--	--
I	**Introduction**	Noise voltage and Noise Power Calculations	02	LO1
II	**Analog Modulation and Demodulation**	DSBFC Modulation and Demodulation, DSBSC, Diode Detector FM Modulation and Demodulation, Pre-emphasis and De-Emphasis	06	LO1 LO4
III	**Pulse Modulation and Multiplexing**	Sampling Theorem Analog Pulse Modulation Techniques -PAM, PWM, PPM. Digital Pulse Modulation Techniques- PCM, DM, ADM Multiplexing Techniques -TDM and FDM	06	LO2
IV	**Source Coding and Channel Coding**	Source Coding Techniques- Shannon Fano Coding and Huffmann Coding Channel Coding Techniques - Linear Block Codes and Convolution Codes	04	LO6
V	**Baseband Transmission and Reception**	Line Codes, Matched Filter	02	LO4 LO5
VI	**Bandpass Transmission and Reception**	Modulation and Demodulation of ASK, FSK, PSK, QPSK Techniques	04	LO3

Text Books:

1. Kennedy and Davis "Electronics Communication System", Tata McGraw Hill
2. Wayne Tomasi, "Electronics Communication Systems" Pearson Education, 5th Edition.
3. Herbert Taub, Donald L Schilling, Goutam Saha, "Principles of Communication Systems", Tata McGraw Hill, 3rd Edition.
4. T. L. Singal, "Analog and Digital Communication," Tata Mc-Graw Hill, New Delhi, First Ed.
5. Beharouz A. Forouzan, "Data Communication and Networking" fourth edition .

References:

1. Sklar B, and Ray P. K., "Digital Communication: Fundamentals and Applications," Pearson, Dorling Kindersley (India), Delhi, Second Edition.
2. Simon Haykin, "Communication System", John Wiley And Sons ,4th Ed.
3. B P Lathi, Zhi Ding, Modern Digital and Analog Communication Systems, Oxford University. 4th Ed.

Online Resources:

Sr. No.	Website Name
1.	Analog communication- https://swayam.gov.in/nd1_noc20_ee69/preview
2.	Principles of Digital Communication- https://nptel.ac.in/courses/108/101/108101113/
3.	Free/Libre and Open Source Software for Education project using cloud. scilab.in

List of Experiments:

Sr No	List of Experiments	Hrs
01	Generation and Detection of Amplitude Modulation	02
02	Generation and Detection of Frequency Modulation	02
03	Generation and Detection of DSBSC Signal.	02
04	Design and implementation of Pre-emphasis and De-emphasis circuit.	02
05	Verification of sampling theorem.	02
06	Generation of PAM Modulation /Demodulation.	02
07	Generation of PWM/PPM Modulation /Demodulation.	02
08	Demonstrate Digital Pulse Code Modulation Technique (PCM)	02
09	Demonstrate Delta Modulation and Adaptive Delta Modulation Techniques (DM, ADM)	02
10	Observation of Time Division multiplexing and De-multiplexing signals.	02
11	Observation of Frequency Division multiplexing and De-multiplexing signals.	02
12	Simulate Shannon-Fano Code and calculate code efficiency	02
13	Simulate Huffman code and calculate code efficiency.	02
14	Simulate Linear block code and find error detection capability.	02
15	Simulate Convolutional code as per given specification.	02
16	Observe and compare of various Line Codes.	02
17	Matched filter impulse response for a given input.	02
18	Modulation/Demodulation of Binary ASK.	02
19	Modulation/Demodulation of Binary FSK.	02
20	Modulation/Demodulation of Binary PSK.	02
21	Modulation/Demodulation of QPSK.	02
22	Generation (and detection) of MSK	02

Assessment:

Term Work: Term Work shall consist of at least 10 to 12 practicals' based on the above list. Also, Term work Journal must include at least 2 assignments.

Term Work Marks: 25 Marks (Total marks) = 15 Marks (Experiment) + 5 Marks (Assignments) + 5 Marks (Attendance)

Practical& Oral Exam: An Oral & Practical exam will be held based on the above syllabus.

Vertical – 4

Vocational and Skill Enhancement Course (VSEC)

Detail Syllabus

Sem. – IV

Course Code	Course Name	Teaching Scheme (Contact Hours)			Credits Assigned			
		Theory	Pract.	Tut.	Theory	Pract.	Tut.	Total
2994511	Business Model Development	--	2*+2	-	--	2*+2	-	2

Course Code	Course Name	Theory					Term work	Pract / Oral	Total
		Internal Assessment			End Sem Exam	Exam Duration (in Hrs)			
		IAT-I	IAT-II	IAT-I+IAT-II					
2994511	Business Model Development	--	--	--	--	--	50	--	50

Note: * Two hours of practical class to be conducted for full class as demo/discussion/theory.

Lab Objectives:

1. To introduce a learner to entrepreneurship and its role in economic development.
2. To familiarize a learner with the start-up ecosystem and government initiatives in India.
3. To explain the process of starting a business.
4. To familiarize a learner with the building blocks of a business.
5. To teach a learner to plan their own business with the help of Business Model Canvas.
6. To teach a learner to have financial plan for a business model.

Lab Outcomes:

The learner will be able to:

1. Discuss the role of entrepreneurship in the economic development of a nation and describe the process of starting a business.
2. Describe start-up ecosystems in Indian and global context.
3. Identify different types of business models.
4. Identify customer segments, channels and customer relationship components for a particular business.
5. Identify key activities, key partners and key resources for a particular business.
6. Develop a financial plan for a business with the help of cost structure and revenue model.

DETAILED SYLLABUS:

Sr. No.	Module	Detailed Content	Hours	LO Mapping
0	**Prerequisite**	Basic Design Thinking principles	**01**	**--**
I	**Introduction to Entrepreneurship**	**Introduction to Entrepreneurship**: Definition, the role of entrepreneurship in the economic development, the entrepreneurial process, Women entrepreneurs, Corporate entrepreneurship, Entrepreneurial mindset **Self-learning Topics:** Case studies: Henry Ford https://www.thehenryford.org/docs/default-source/default-document-library/default-document-library/henryfordandinnovation.pdf?sfvrsn=0 The Tatas: How a Family Built a Business and a Nation by Girish Kuber, April 2019, Harper Business	**04**	**L1, L2**
II	**Entrepreneurship Development**	**Entrepreneurship Development**: Types of business ownerships: Proprietorship, Public and Private Companies, Co-operative businesses, Micro, Small and Medium Enterprises (MSME): Definition and role of MSMEs in economic	**05**	**L2, L3, L4**

		development		
III	**Start-up financing**	**Start-up financing:** Cost and revenue models, Sources of start-up fundings: Angel investors, Venture capitalists, Crowd funding, Government schemes for start-up funding **Self-learning Topics:** Successful business pitching	**04**	**L2, L3, L4, L5**
IV	**Intellectual Property Rights (IPR)**	**Intellectual Property Rights (IPR):** Types of IPR: Patents, trademarks and copyrights, Patent search and analysis, Strategies for IPR protection, Ethics in technology and innovation	**04**	**L2, L3, L4**
V	**Business Model Development**	**Business Model Development:** Types of business models, Value proposition, Customer segments, Customer relationships, Channels, Key partners, Key activities, Key resources, Prototyping and MVP **Self-learning Topics:** The Art of the Start 2.0: The Time-Tested, Battle-Hardened Guide for Anyone Starting Anything by Guy Kawasaki	**04**	**L3, L4, L5, L6**
VI	**Digital Business Management**	**Digital Business Management:** Digital Business models (Subscription, Freemium *etc*), Digital marketing: Search Engine Optimization (SEO), Search Engine Marketing (SEM), Social media and influencer marketing, Disruption and innovation in digital business **Self-learning Topics:** Case study: Airbnb https://www.prismetric.com/airbnb-business-m	**04**	**L2, L3**

Textbooks:

1. Entrepreneurship: David A. Kirby, McGraw Hill, 2002
2. Harvard Business Review: Entrepreneurs Handbook, HBR Press, 2018
3. Business Model Generation; Alexander Ostlewalder and Yves Pigneur, Strategyzer, 2010
4. E- Business & E– Commerce Management: Strategy, Implementation, Practice – Dave Chaffey, Pearson Education

Reference books:

1. Entrepreneurship: New venture creation by David Holt, Prentice Hall of India Pvt. Ltd.
2. E- Business & E– Commerce Management: Strategy, Implementation, Practice – Dave Chaffey, Pearson Education

Online Resources:

Sr. No.	Website Name
3.	Entrepreneurship by Prof. C Bhaktavatsala Rao https://onlinecourses.nptel.ac.in/noc20_mg35/preview
4.	Innovation, Business Models and Entrepreneurship by Prof. Rajat Agrawal, Prof. Vinay Sharma https://onlinecourses.nptel.ac.in/noc21_mg63/preview
3.	Sarasvathy's principles for effectuation https://innovationenglish.sites.ku.dk/model/sarasvathy-effectuation/

List of Experiments.

The lab activities are to be conducted in a group. One group can be formed with 4-5 students. A group has to develop a Business Model Canvas and a digital prototype (Web App/ mobile app). Weekly activities are to be conducted as follows:

Sr No	Lab activities	Hrs
01	Problem identification (Pain points, Market survey)	2
02	Design a digital solution for the problem (Ideation techniques)	2
03	Preparing a business model canvas: Value proposition, Key partners, Key resources, Key activities	2
04	Preparing a business model canvas: Customer segment, Customer relationships and channels	2
05	Preparing a business model canvas: Cost and Revenue structure	2
06	Prototype development: Low fidelity	2
07	Prototype development: Customer feedback	2
08	Prototype development: High fidelity	2
09	Presentation of high-fidelity prototype	2

Sr No	List of Assignments / Tutorials	Hrs
01	Presentation on case study of a failed business model	2
02	Presentation on case study of a woman entrepreneur	2

Assessment:

Term Work: Term Work shall consist of 09 lab activities based on the above list. Also, Term work journal must include any 2 assignments from the above list.

Term Work Marks: 50 Marks (Total marks) = 25 Marks (Experiment) + 10 Marks (Assignments) + 5 Marks (Attendance)+10 Marks (Report).

Course Code	Course Name	Teaching Scheme (Contact Hours)			Credits Assigned			
		Theory	Pract.	Tut.	Theory	Pract.	Tut.	Total
2994512	Design Thinking	--	2*+2	-	--	2*+2	-	2

Course Code	Course Name	Theory					Term work	Pract / Oral	Total
		Internal Assessment			End Sem Exam	Exam Duration (in Hrs)			
		IAT-I	IAT-II	IAT-I+IAT-II					
2994512	Design Thinking	--	--	--	--	--	50	--	50

Note: * Two hours of practical class to be conducted for full class as demo/discussion/theory.

Lab Objectives:

1. To introduce a learner to the principles of Design Thinking.
2. To familiarize a learner with the process (stages) of Design Thinking.
3. To introduce various design thinking tools.
4. Study of the techniques for generation of solutions for a problem.
5. To expose a learner to various case studies of Design Thinking.
6. Create and test a prototype.

Lab Outcomes:

Students will be able to …

1. Compare traditional approach to problem solving with the Design Thinking approach and discuss the principles of Design Thinking
2. Define a user persona using empathy techniques
3. Frame a problem statement using various Design Thinking tools
4. Use ideation techniques to generate a pool of solutions for a problem
5. Create prototypes using different techniques
6. Test the prototypes and gather feedback for refining the prototype

DETAILED SYLLABUS:

Sr. No.	Module	Detailed Content	Hours	LO Mapping
0	Prerequisite	No perquisites	-	-
I	**Introduction to Design Thinking**	**Introduction to Design Thinking:** Definition, Comparison of Design Thinking and traditional problem-solving approach, Need for Design Thinking approach, Key tenets of Design Thinking, 5 stages of Design Thinking (Empathize, Define, Ideate, Prototype, Test) **Self-learning Topics:** Design thinking case studies from various domains https://www.design-thinking-association.org/explore-design-thinking-topics/external-links/design-thinking-case-study-index	**05**	**L1, L2**
II	**Empathy**	**Empathy:** Foundation of empathy, Purpose of empathy, Observation for empathy, User observation technique, Creation of empathy map	**05**	**L2, L3**

		Self-learning Topics: Creation of empathy maps https://www.interaction-design.org/literature/topics/empathy-mapping		
III	**Define**	**Define:** Significance of defining a problem, Rules of prioritizing problem solving, Conditions for robust problem framing, Problem statement and POV **Self-learning Topics:** Creating a Persona – A step-by-step guide with tips and examples https://uxpressia.com/blog/how-to-create-persona-guide-examples	**05**	**L2, L3**
IV	**Ideate**	**Ideate:** What is ideation? Need for ideation, Ideation techniques, Guidelines for ideation: Multi-disciplinary approach, Imitating with grace, Breaking patterns, Challenging assumptions, Looking across value chain, Looking beyond recommendation, Techniques for ideation: Brainstorming, Mind mapping **Self-learning Topics:** How To Run an Effective Ideation Workshop: A Step-By-Step Guide https://uxplanet.org/how-to-run-an-effective-ideation-workshop-a-step-by-step-guide-d520e41b1b96	**05**	**L3**
V	**Prototype**	**Prototype:** Low and high-fidelity prototypes, Paper prototype, Story board prototype, Scenario prototype	**03**	**L6**
VI	**Test**	**Test:** 5 guidelines of conducting test, The end goals of test: Desirability, Feasibility and Viability, Usability testing	**03**	**L4, L5**

Textbooks:

1. Design Your Thinking: The Mindsets, Toolsets, and Skill Sets for Creative Problem-solving, Pavan Soni, Penguin Random House India Private Limited
2. Design Thinking: Methodology Book, Emrah Yayichi, 2016
3. Handbook of Design Thinking: Christian Mueller-Roterberg, 2018

Reference books:

1. Design Thinking for Strategic Innovation: What They Can't Teach You at Business or Design School, Idris Mootee, Wiley, 2013
2. Change by Design, Tim Brown, Harper Business, 2009

Online Resources:

Sr. No.	Website Name
5.	Design Thinking and Innovation by Ravi Poovaiah https://onlinecourses.swayam2.ac.in/aic23_ge17/preview
6.	Introduction to Design Thinking by Dr. Rajeshwari Patil, Dr. Manisha Shukla, Dr.

	Deepali Raheja, Dr. Mansi Kapoor https://onlinecourses.swayam2.ac.in/imb24_mg37/preview
3.	Usability Testing https://www.interaction-design.org/literature/topics/usability-testing

List of Experiments.

The experiments are to be performed in groups. A practical batch may be divided into groups of 4-5 students.

Sr No	List of Experiments	Hrs
01	Customer Journey Mapping: Visualize the steps users take to interact with a product or service. Map out the customer journey from discovering a product to making a purchase and using the product. Identify pain points and opportunities for improvement.	2
02	Stakeholder mapping: Identify all relevant stakeholders in a project. Create a stakeholder map, categorizing stakeholders based on their influence and interest. Include management of relationships with key stakeholders.	2
03	"How Might We" Problem Framing: Transform user insights into actionable problem statements. After empathizing with users, turn challenges into "How Might We" statements that define the problem without prescribing a solution.	2
04	Brainstorming Session: Generate a pool of ideas in a creative, non-judgmental environment. Using ideation techniques like mind mapping and brainwriting, students brainstorm as many solutions as possible to their "How Might We" problem statements.	2
05	Affinity Diagramming: Organize group ideas to find patterns and insights. After brainstorming, students will categorize their ideas into themes by placing sticky notes on a wall and moving them into groups based on similarities.	2
06	Rapid Prototyping: Create quick, low-fidelity versions of solutions. Use materials like paper, cardboard, and markers to build a prototype of their solution within 30 minutes. The focus is on speed and functionality, not aesthetics.	2
07	Wireframing: Create a visual guide for digital interfaces for mobile app / web app for the problems identified in earlier lab sessions. Students will sketch wireframes of the user interface for their product or service. Use tools like Balsamiq or paper and pen for low-fidelity wireframes.	2
08	Role-Playing: Walk through a prototype from the user's perspective. Students act as both users and designers, role-playing scenarios where they interact with their prototype (Developed in earlier lab sessions). Gather feedback from participants on how to improve the experience.	2
09	Usability Testing: Evaluation of the effectiveness and user-friendliness of a prototype (developed in earlier lab sessions). Students will have peers or target users test their prototypes, observe how they interact with it, and collect feedback on any issues or improvements needed.	2
10	Feedback Loop and Iteration: Refine solutions based on user feedback. After usability testing, students will refine their prototypes. Document changes made based on feedback and discuss how continuous iteration improves the design.	2

Sr No	List of Assignments (Any two)	Hrs
01	Create an empathy map for a target user group. Break them into four sections: *Says, Thinks, Feels, and Does*. Interview users or research their experiences to	3

	fill in the map.	
02	Based on research, students will create user personas including demographic details, motivations, pain points, and goals. Each group will present their persona to the class.	3
03	Consider 3 examples of real-life products which have good design and bad design. Write down reasons why do you think they are good or bad designs. May take user survey to support your work.	3
04	Study any open-source design thinking tool and write a brief report about it.	3

Assessment:

Term Work: Term Work shall consist of 08 to 10 lab activities based on the above list. Also, Term work journal must include any 2 to 4 assignments from the above list.

Term Work Marks: 50 Marks (Total marks) = 25 Marks (Experiment) + 10 Marks (Assignments) + 5 Marks (Attendance)+ 10 Marks (Report).

Vertical – 6

Experiential Learning Courses

(CEP)

Detailed Syllabus

Course Code	Course Name	Teaching Scheme (Contact Hours)			Credits Assigned			
		Theory	Pract.	Tut.	Theory	Pract.	Tut.	Total
2303611	Smart Embedded Systems with Atmega 168/328	-	4	-	-	2	-	2

Course Code	Course Name	Examination Scheme						
		Theory Marks				Term Work	Practical/ Oral	Total
		Internal assessment			End Sem. Exam			
		Test 1	Test 2	Avg. of 2 Tests				
2303611	Smart Embedded Systems with Atmega 168/328	--	--	--	--	50	25	75

Prerequisite:

- C++ and Java Programming
- Electronic Devices and Circuit
- Digital System Design

Course Objectives:

1. To understand the architecture, memory organization, and peripheral features of the ATmega168/328 microcontroller.
2. To explore internal functional blocks like timers, ADC, PWM, and serial communication interfaces.
3. To gain proficiency in embedded C programming using development tools for microcontroller programming and interfacing.
4. To interface wireless modules, sensors, actuators, and integrate IoT platforms for real-time control and monitoring.
5. To design, develop, and convert a prototype into a marketable embedded product considering DFM and cost analysis.
6. To design schematics and PCB layouts using EDA tools and apply fabrication standards

Course Outcomes:

After successful completion of the course student will be able to:

1. Identify pin configurations, explain memory types, and write simple code to configure I/O ports.
2. Configure and program internal peripherals like timers, interrupts, and serial communication modules (USART, SPI, I2C).
3. Develop, compile, and upload programs using IDEs, and implement sensor interfacing and interrupt handling.

4. Design and build embedded applications integrating sensors, actuators, displays, and wireless modules with cloud-based data logging and control.
5. Create a prototype, optimize it for production, and present a final project report including BOM and feasibility study.
6. Create a PCB layout, follow design rules, and generate Gerber files for the fabrication of microcontroller-based projects

DETAILED SYLLABUS:

Sr No	Detailed Content	Hours	LO Mapping
I	**Introduction to ATmega168/328 Microcontroller**	**05**	LO1
	Focus: This unit introduces the fundamental concepts of **microcontrollers**, their difference from microprocessors, and specifically focuses on the **AVR family** with an emphasis on **ATmega168/328**. It covers **architecture, pin configuration, memory organization, and peripheral features**, helping students understand how to work with these controllers in embedded systems.		
	Key Skills: • Understanding microcontroller architecture • Pin Mapping and Peripheral Understanding • Memory Organization & Power Management • Programming I/O Ports • Clock and Power Management		
	Syllabus: • Overview of Microcontrollers and Microprocessors • Introduction to AVR Family • Features and Specifications of ATmega168/328 • Pin Diagram and Pin Description • Clocking and Power Management • Memory Organization: Flash, SRAM, EEPROM • I/O Ports and Peripheral Features		
	Activities: • Study and analyze the **ATmega168/328** datasheet • Identify and explain **pin configurations** and their functions • Discuss **Flash, SRAM, EEPROM**, and clocking system • Write simple **code to configure and control I/O ports** • Explore different **clock sources and power-saving modes**		
	Self-Learning:		
	• RAM and its Types of RAM • ROM and Its Types • Difference between RAM and ROM • Different ways of Clock Generation		

II	ATmega168/328 Architecture	07	LO2
	Focus: This unit explores the **internal architecture and functionality** of the **ATmega168/328 microcontroller**, covering essential components such as registers, timers, interrupts, ADC, PWM, and communication protocols (USART, SPI, and I2C). The primary objective is to help students understand how the microcontroller processes data, interacts with external components, and handles real-time operations.		
	Key Skills:		
	• Understanding the ATmega168/328 Architecture • Register and Memory Utilization • Timers and Counters • Interrupt Handling • ADC (Analog to Digital Conversion) • PWM (Pulse Width Modulation) • USART, SPI, and I2C Communication		
	Syllabus: • Detailed Architecture and Block Diagram • Registers and Memory Mapping • Timers and Counters • Interrupt Handling • ADC (Analog to Digital Conversion) • PWM (Pulse Width Modulation) USART, SPI, and I2C Communication		
	Activities: • Study the **block diagram** and analyze internal components. • **Hands-on coding** for configuring **registers and memory-mapped I/O**. • Write a **program to implement delay generation** using timers. • Configure and test **external and internal interrupts** using ISR functions. • Interface a **potentiometer or sensor** and read analog values. • Generate **PWM signals** to control LED brightness or motor speed. • Establish serial communication between **ATmega168/328 and peripherals** (e.g., sensors, LCD, Bluetooth module).		
	Self-Learning:		
	• Types of IO Mapping • Interrupt and its types • PWM (Pulse Width Modulation) • Types of Communication (serial and Parallel) • Difference between Serial and Parallel Communication		

	• Serial Communication Frame format(UART)		
III	**Programming ATmega168/328**	**10**	LO3
	Focus: This unit introduces **Embedded C programming** and the necessary **software tools (IDEs)** for programming microcontrollers. It focuses on **basic coding, hardware interfacing**, and **handling interrupts**, providing students with the fundamental skills required for embedded system development.		
	Key Skills: • Understanding Embedded C Programming • Installing and Setting Up IDEs • Writing and Compiling Code in Arduino IDE • GPIO (General Purpose Input/Output) Interfacing • Sensor Interfacing • Serial Communication • Interrupt Handling		
	Syllabus: • Introduction to Embedded C Programming • Basic Data types, Functions & Pointers, Data Structures, • Memory & Optimization, Bit Manipulation & Efficiency. • Installation and Setup of IDEs like Keil, Atmel Studio / Microchip Studio, PlatformIO (with VS Code), Eclipse with AVR Plugin (AVR-Eclipse),AVR-GCC + Makefiles (Bare Metal CLI) • GPIO Interfacing and LED Blinking • Analog and Digital Sensor Interfacing • Serial Communication Programming • ISR for Interrupt handling		
	Activities: • **Write and execute basic C programs** for microcontrollers. • Install **Atmel Studio, or PlatformIO** and configure settings. • Develop **basic programs**, compile and upload them to a microcontroller. • Implement **LED blinking** and control output pins using code. • Interface **analog (e.g., temperature sensor) and digital sensors (e.g., IR sensor)**. • Implement **UART communication** to send and receive data. • Use **Interrupt Service Routines (ISRs)** to handle external events (e.g., button press detection).		
	Self-Learning:		
	• Basics of embedded c programming • Various IDE for microcontroller programming • I/O pins and sensor interfacing • Serial communication and interrupt handling		

Unit 4	**Advanced Technologies and Project Integration**	**18**	LO4
	Focus: This unit focus **wireless communication, sensor and actuator interfacing, display modules, motor control, and IoT integration** with **ATmega microcontrollers**. The goal is to develop skills in **real-time data acquisition, processing, and remote monitoring/control** using cloud platforms.		
	Key skills: • **Wireless Communication** (Bluetooth, Wi-Fi, Zigbee, RF 434MHz, LoRa) • **Sensor Interfacing** (Gas, Fire, DHT11, Obstacle, Soil Moisture, etc.) • **Actuator Interfacing** (Relay, Motor, Buzzer) • **Display Interfacing** (LCD, LED, OLED, 7-Segment) • **Motor Control with L298N Motor Driver** • **IoT Integration with ATmega** (ThingSpeak, MQTT, Blynk,Google Firebase) • **Real-Time Data Monitoring and Control**		
	Syllabus: • Introduction to Wireless Communication (Bluetooth, Wi-Fi, Zigbee, RF434Mhz, LoRa) • Introduction to modules of Wireless identification (RFID-RC-522, EM-18, nRF24L01) • Introduction to Sensors like IR (Obstacle, Gas, Fire, DHT11, Obstacle, Soil Moisture, Ultrasonic(HC-SR-04), Touch, Biometric Pressure(BMP180/280),Soil Sensor moisture ,water Sensor, Heart Rate (Max30100),PIR, Gyroscope(MPU6050), magneto meter(HMC5883L), Accelerometer(ADXL345), Finger Print Sensor(R305), Camera Modules (e.g., OV7670), Strain Gauge, Voltage(ZMPT101B), Current(ACS712) and Power Sensor(PZEM-004T) or similar etc. • Introduction to Actuator like Relay, Motor (DC Motor, Stepper, Servo), Buzzer • Motor Control using L293D/L298N Motor Driver • Relay Control using ULN2803 • Stepper Control using ULN 2003/2803 • Servo Motor Control • Interfacing of LCD, LED, OLED,7Segment • IoT Integration with ATmega (Cloud Like Thingspeak, MQTT, Blynk, Google Firebase or Similar) • Real-Time Data Monitoring and Control • Using above Hardware/Controller define the Project define problem statement to make a project and into product		

	Activities: • Establish wireless communication between **microcontroller and other devices** for data exchange. Example: **Control LEDs using a Bluetooth app**. • Connect sensors to **ATmega** and write code to **collect and process sensor data**. Example: **Display temperature readings from DHT11**. • Use **relays and buzzers** for control actions. Example: **Activate a buzzer when gas is detected**. • Display sensor readings and system status on **LCD/OLED**. Example: **Show soil moisture levels on OLED display**. • Control **DC motors and stepper motors** using **L298N motor driver**. Example: **Move a robotic car forward and backward**. • Connect microcontroller to **cloud platforms** for **real-time monitoring and control**. Example: **Upload temperature data to ThingSpeak** and view it on a dashboard. • Develop a system to **monitor and control devices remotely**. Example: **Send sensor data to a web dashboard and control relays from a mobile app**		
	Self-Learning:		
	• Wireless communication and its type • Sensor and its pin diagram for interfacing • Actuator and its pin diagram for interfacing • Display and its pin diagram for interfacing • IOT integration with embedded system		
V	**Project Development, Testing and Product Conversion**	**4+4**	LO5
	Focus:		
	This unit focuses on **end-to-end product development**, from **conceptualization to market-ready product conversion**. It covers **system design, prototyping, testing, debugging, hardware-software integration, and final manufacturing considerations**.		
	Key Skills: • **Design for Manufacturing (DFM)** • **Enclosure Design** • **Cost Estimation & Bill of Materials (BOM)** • **Market Analysis & Feasibility Study** • **Final Project Report & Presentation**		
	Syllabus (Part-1): • System Design and Block Diagram Creation • Component Selection and Circuit Design • Prototype Development and Testing • Debugging Techniques • Software and Hardware Integration		

	Syllabus (Part-2): • Design for Manufacturing (DFM) • Enclosure Design • Cost Estimation and Bill of Materials (BOM) • Market Analysis and Feasibility Study • Final Project Report, Presentation and Research Paper		
	Activities: • Optimize the design for **mass production**. Example: **Ensure PCB layout follows industry-standard manufacturing constraints**. • Develop **3D-printed or injection-molded enclosures** for the product. Example: **Design a waterproof casing for an outdoor sensor**. • Analyze the **cost-effectiveness** of components. Example: **Prepare a BOM with pricing details for a consumer IoT device**. • Conduct a study on **potential users and competitors**. Example: **Analyze demand for a smart wearable device**. • Document findings and present the **prototype-to-product journey**. Example: **Showcase a working prototype with performance insights**.		
	Self-Learning:		
	• 3D Printing, Types of 3D printing, • Material used in 3D printing • Basics of 3D printing model • 3D modelling Software, how to use that software • Basic knowledge of cost estimation and bills of material • Idea to product development procedure		
VI	**PCB Design for Microcontroller Projects**	**04**	LO6
	Focus: This unit introduces **Printed Circuit Board (PCB) design**, covering **schematic creation, layout design, tools, design rules, and fabrication processes**. The goal is to develop skills for designing efficient and manufactural PCBs using industry-standard software		
	Key Skills: • **Understanding PCB Design** • **Schematic Creation & PCB Layout Design** • **Using PCB Design Software** (Eagle, Altium, KiCAD, EasyEDA) • **Design Rules & Guidelines** • **PCB Fabrication Process**		
	Activities: • Learn **PCB design fundamentals**, importance, and real-world applications. Example: **Exploring single-layer and multi-layer PCB designs**.		

	• Design circuit schematics and convert them into PCB layouts. Example: **Create a simple LED driver circuit in Proteus/Eagle**. • Work with **PCB design tools** to simulate and design circuits. Example: **Simulate an Arduino-based circuit in Proteus**. • Learn **trace width, spacing, ground planes, and via placement** for optimized PCB design. Example: **Follow proper clearance rules to prevent short circuits**. • Understand **etching, drilling, solder masking, and component placement** for PCB manufacturing. Example: **Design a PCB and generate Gerber files for fabrication for the project taken by students**		
	Syllabus: • Introduction to PCB Design • PCB Layout and Schematic Creation • Tools for PCB Design: Proteus, Eagle, Altium Designer, KiCAD, Easy EDA or any similar tool • Design Rules and Guidelines • PCB Fabrication Process		
	Self-Learning:		
	• PCB, Types of PCB • Material used for PCB and their advantages, Disadvantages and Application • Standard PCB design processes • Basic knowledge about PCB design tools • PCB design rules for compact design structure • PCB fabrication process		

Textbooks:

1. "AVR Microcontroller and Embedded Systems" by Muhammad Ali Mazidi, Sarmad Naimi, and Sepehr Naimi.
2. "Programming and Customizing the AVR Microcontroller" by Dhananjay V. Gadre.
3. "Embedded Systems: Real-Time Interfacing to ARM Cortex-M Microcontrollers" by Jonathan Valvano.
4. "Introduction to Embedded Systems" by Shibu K V.
5. "Embedded C Programming and the Atmel AVR" by Barnett, Cox, and O'Cull.
6. **Additive Manufacturing Technologies: 3D Printing, Rapid Prototyping, and Direct Digital Manufacturing" by** Ian Gibson, David Rosen, Brent Stucker
7. **PCB Design Tutorial" by** David L. Jones (EEVblog)

Reference Books:

1. "AVR Programming: Learning to Write Software for Hardware" by Elliot Williams
2. "Microcontroller Projects in C for the 8051" by Dogan Ibrahim

3. "The AVR Microcontroller and Embedded Systems Using Assembly and C" by Muhammad Ali Mazidi.
4. "Designing Embedded Systems with PIC Microcontrollers" by Tim Wilmshurst.
5. "Fundamentals of Microcontrollers and Applications in Embedded Systems" by Ramesh S. Gaonkar
6. **"3D Printing for Dummies"** *(Introductory & DIY-friendly)* **By** Kalani Kirk Hausman, Richard Horne
7. **"Designing Printed Circuits Boards with KiCad" by** Peter Dalmaris

Software Tools:

1. **Arduino IDE: https://www.arduino.cc/en/software**
2. **Atmel Studio: https://www.microchip.com/en-us/tools-resources/develop/microchip-studio**
3. **Microchip Studio: https://www.microchip.com/en-us/tools-resources/develop/microchip-studio**
4. **PlatformIO: https://platformio.org/install/integration**

   https://platformio.org/platformio-ide
5. **Visual Studio Code: https://code.visualstudio.com/**
6. **AVR-GCC (GNU AVR C Compiler):**

   https://gcc.gnu.org/wiki/avr-gcc
7. **SimulAVR or AVRSim (Simulation Tools): https://sourceforge.net/projects/simulavr/**
8. **3D Model Design Website**

   https://www.sketchup.com/

   Spline - 3D Design tool in the browser with real-time collaboration

   3D Models for Free - Free3D.com

Online Resources:

Sr No	Website
1	Microchip Technology – ATmega328P Datasheet: Detailed specifications and features of the ATmega328P microcontroller.
	https://ww1.microchip.com/downloads/en/DeviceDoc/Atmel-7810-Automotive-Microcontrollers-ATmega328P_Datasheet.pdf
2	AVR Libc – NonGNU.org: Comprehensive user manual for AVR Libc, providing standard C library functions for AVR microcontrollers.nongnu.org+1Courses at Washington University+1
	https://www.nongnu.org/avr-libc/user-manual/

3.	Arduino Official Website: Resources, tutorials, and documentation for Arduino boards and software.
	https://www.arduino.cc/
4.	SparkFun Inventor's Kit Experiment Guide: Step-by-step projects and experiments using the SparkFun Inventor's Kit.Microchip Docs+2SparkFun Learn+2SparkFun Learn+2
	https://learn.sparkfun.com/tutorials/sparkfun-inventors-kit-experiment-guide---v41
5	Microchip Developer Help: Comprehensive online resource for developers using Microchip's products and technologies.Developer Help
	https://developerhelp.microchip.com/xwiki/bin/view/Main/
6	KiCad EDA – Schematic Capture & PCB Design Software: Open-source software suite for electronic design automation.Altium+6Wikipedia+6KiCad EDA+6
	https://www.kicad.org/
7	Autodesk EAGLE: Electronic design automation software for PCB designers.Autodesk
	https://www.autodesk.com/products/eagle/overview
8	Altium Designer: Industry-leading PCB design software combining schematic, layout, and more.Altium
	https://www.altium.com/
9	ThingSpeak – IoT Analytics Platform: Platform for aggregating, visualizing, and analyzing live data streams in the cloud.Halvorsen Blog+3ThingSpeak+3MathWorks - Maker of MATLAB and Simulink+3
	https://thingspeak.com/
10	Blynk IoT Platform: Low-code platform for building and managing IoT applications.
	https://blynk.io/
11	3D printing : Tinkercad (by Autodesk)
	https://www.tinkercad.com
12	3D printing : FreeCAD (Open Source CAD Software)
	https://www.freecadweb.org

List of Experiments:

Sr No	List of Experiments	Hours
01	Installation of IDE used and How write program, compile, and Upload	2
02	Interfacing of Buzzer, LED, Relay, Motors	4
03	Interfacing of different Sensors	4
04	Interfacing of Different cloud Platform & Database	4
05	Designing of circuit diagram of project	2
06	Designing of PCB on Software	2
07	Preparing PCB and Testing	2

08	Assembling project and Testing	4
09	Designing of enclosure on 3d Printing Software	2
10	Printing the enclosure	
11	Preparing Bill of Material, Market analysis and Feasibility study	2
12	Writing Research Paper	4

List of Mini Projects:

Note: This is tentative list student select any other good topic which should have 2-3 sensor, 2-3 actuator, 2 Cloud Platform and database.

Mini Project Topic	
1	**Title: Smart Environment Monitor: Temperature & Gas Alert System** **Synopsis:** • This project integrates a ATMEGA168/328 with a DHT11 sensor to measure temperature and humidity, along with a gas sensor to detect harmful gas leaks. • An OLED display shows real-time data locally. The system sends sensor data to both Blynk and Thingspeak for remote monitoring. • Alerts are triggered if the values exceed safe limits, ensuring prompt action. This IoT solution is ideal for home or industrial environmental safety **Sensors used**: DHT11, Gas Sensor **Actuator used:** OLED, Buzzer,LED **Cloud Platform:** Bynk, Thingspeak
2	**Title: Smart Irrigation System: Automated Plant Watering** **Synopsis:** • Using a soil moisture sensor interfaced with **ATMEGA168/328**, this project continuously monitors the moisture level of the soil. • When moisture falls below a preset threshold, a **water pump** is automatically activated to irrigate the plants. • Data is logged and displayed remotely via **Thingspeak** and **Blynk**, allowing users to track plant health. It's a practical application of IoT in agriculture and home gardening. **Sensors used:** Soil Moisture Sensor **Actuator used:** Water Pump, Buzzer, LED **Cloud Platform:** Blynk, Thingspeak
3	**Title: Dual Sensor Alert: Obstacle & Metal Detection System** **Synopsis:** • This project combines a **proximity sensor** with an **IR sensor** on an **ATMEGA168/328** platform to detect obstacles and metallic objects. • When an object is detected, the system immediately sends a signal via the **Blynk app** for

	real-time monitoring. • It can be used for security or automated machinery, ensuring safety and operational efficiency. **Sensors used:** Proximity Sensor, IR Sensor **Actuator used:** Buzzer, LED **Cloud Platform:** Blynk
4.	**Synopsis:** • Integrating an **IR sensor** with a **servo motor**, this **ATMEGA168/328** project automates parking space management. • The IR sensor detects the presence of a vehicle, while the servo motor operates the parking gate. • Communication through **MQTT** ensures real-time updates and remote monitoring of parking slot availability. **Sensors used:** IR Sensor **Actuator used:** Servo Motor, Buzzer, LED **Cloud Platform:** MQTT
5	**Title: Clean Air Sentinel: Air Quality Monitoring & Alert System** **Synopsis:** • This project uses **ATMEGA168/328** paired with an **MQ135 sensor** and an additional gas sensor to monitor ambient air quality. • Readings are displayed on an **LCD** and transmitted via **MQTT** for remote monitoring. • When pollutant levels exceed safe thresholds, the system generates an alert. It is suitable for both indoor and outdoor environments, promoting health and safety. **Sensors used:** MQ135, Gas Sensor **Actuator used:** LCD, Buzzer,LED **Cloud Platform:** MQTT, Blynk
6	**Title: Smart Water Tank: Automated Water Level Control System** **Synopsis:** • In this project, an **ultrasonic sensor** connected to **ATMEGA168/328** monitors the water level in a tank continuously. • When water levels drop below a predetermined level, a **water pump** is automatically activated to refill the tank. • Real-time data is sent through **MQTT** to a cloud-based dashboard for remote supervision. This system ensures efficient water management and minimizes wastage. **Sensors used:** Ultrasonic Sensor **Actuator used:** Water Pump, LED, Buzzer **Cloud Platform:** MQTT, Blynk
7	**Title: Smart Waste Manager: Automated Dustbin Monitoring System** **Synopsis:** • This project employs an **ultrasonic sensor** to measure the fill level of a dustbin, with a **servo**

	motor mechanism for automated lid control. • A **buzzer** sounds an alert when the bin nears capacity. Sensor data is sent to both **Thingspeak** and **Blynk**, enabling remote monitoring and timely waste collection. • The system aims to maintain cleanliness and optimize waste management processes. **Sensors used:** Ultrasonic Sensor **Actuator used:** Servo Motor, Buzzer, LED **Cloud Platform:** Thingspeak, Blynk
8	**Title: Safety First: Temperature & Fire Early Warning System** **Synopsis:** • A **DS18B20 temperature sensor** and a **fire sensor** work with **ATMEGA168/328** to monitor critical environmental parameters. • An **LCD** provides local readouts while data is sent via **MQTT** and **ThingSpeak** to cloud platforms for remote access. • Alerts are triggered when temperature or fire hazards are detected, ensuring early intervention. **Sensors used:** DS18B20, Fire Sensor **Actuator used:** LCD, Buzzer,LED **Cloud Platform:** Thingspeak, MQT
9	**Title: CloudGuard: Comprehensive Fire & Environmental Monitoring System** **Synopsis:** • This project combines **DHT11**, **gas**, and **fire sensors** with **ATMEGA168/328** to continuously monitor temperature, humidity, and fire risks. • An **LCD** displays current readings while data is uploaded to **Thingspeak** and **Blynk** for remote access. • Automated alerts notify users of any hazardous conditions, facilitating quick responses. **Sensors used:** DHT11, Gas Sensor, Fire Sensor **Actuator used:** LCD, Buzzer,LED **Cloud Platform:** Thingspeak, Blynk
10	**Title: Guardian Fall Alert: IoT-based Fall Detection and Response** **Synopsis:** • Using a **gyroscope sensor** interfaced with **ATMEGA168/328**, this system detects abnormal movements indicative of a fall. • A **buzzer** provides immediate local alerts, while sensor data is shared with **Thingspeak** and **Blynk** for remote monitoring. • The project is designed to assist elderly individuals or those at risk by ensuring rapid response in emergencies. **Sensors used:** Gyroscope Sensor,SOS button **Actuator used:** Buzzer,LED **Cloud Platform:** Thingspeak, Blynk

11	**Title: Local IoT Controller: Web-based Device Management System** **Synopsis:** • This project connects **ATMEGA168/328** to a **relay**, **buzzer**, and **light sensor** to manage multiple devices via a **local web server**. • Users can control appliances, receive feedback from the light sensor, and get alert notifications through a web interface. • It eliminates the need for external servers, ensuring quick response times within a local network. Ideal for smart home applications requiring robust local control. **Sensors used:** Light Sensor **Actuator used:** Relay, Buzzer,LED **Cloud Platform:** Local Web Server
12	**Title: Atmospheric Insights: Multi-parameter Environmental Monitor** **Synopsis:** • Utilizing the **BMP280 sensor** with **ATMEGA168/328**, this project measures temperature, pressure, and humidity simultaneously. • An **OLED display** presents real-time environmental data, while **MQTT** transmits the readings to remote platforms. • The system provides comprehensive weather insights and alerts if values deviate from normal, applicable in both indoor and outdoor environments. **Sensors used:** BMP280 **Actuator used:** OLED,Buzzer,LED **Cloud Platform:** MQTT,Blynk
13	**Title: Wireless Switchboard: Remote Device Control using RF Communication** **Synopsis:** • This project uses an **RF434 MHz wireless module** with **ATMEGA168/328** to remotely control devices via a **relay**. • It demonstrates basic wireless communication by sending on/off commands over a distance. • Useful for home automation where remote appliance control is needed, offering a simple and effective RF-based IoT solution. **Sensors used:** — **Actuator used:** Relay **Cloud Platform:** —
14	**Title: Smart Crossing Controller: Integrated Road and Railway Signal System** **Synopsis:** • In this project, **ATMEGA168/328** is connected to four **obstacle sensors** to control traffic signals at a road-railway crossing. • Sensors detect approaching vehicles or trains, triggering appropriate signal changes and automated barrier controls. • This system enhances safety and reduces the risk of accidents at high-risk intersections. **Sensors used:** Obstacle Sensor (×4)

	Actuator used: Traffic Signal LEDs, Servo Motor (if used for barrier) **Cloud Platform:** Bynk, MQTT
15	**Title: QR-Controlled Smart Home: Automated Appliance Management** **Synopsis:** • This project employs **ATMEGA168/328** to control appliances (lights, fans, bulbs) via **QR code scanning**. • By scanning a QR code, users send commands to the controller which toggles the connected devices. • Combines traditional QR technology with IoT to provide secure and convenient home automation. **Sensors used:** QR Scanner **Actuator used:** Relay (for light, fan, bulb control), Buzzer, LED **Cloud Platform:** Blynk
16	**Title: Smart Attendance Tracker: RFID-based Monitoring System** **Synopsis:** • Using an **RFID RC522 module** with **ATMEGA168/328**, this project automates attendance for classrooms or offices. • When a tag is scanned, entry is recorded and status is displayed on an **LCD**. Data is sent to **Thingspeak** and **Blynk** for monitoring. • It reduces manual errors and improves attendance management with IoT integration. **Sensors used:** RFID RC522 **Actuator used:** LCD, Buzzr, LED **Cloud Platform:** Thingspeak, Blynk
17	**Title: Secure Access Control: RFID-based Smart Door Lock** **Synopsis:** • This project uses an **RFID RC522** sensor with **ATMEGA168/328** for door access. • Authorized users unlock the door via RFID, which triggers a **solenoid lock** and updates an **LCD** display. • Remote monitoring is available via **Blynk**, enhancing access security for homes and offices. **Sensors used:** RFID RC522 **Actuator used:** Solenoid Lock, LCD, Buzzer, LED **Cloud Platform:** Blynk, MQTT
18	**Title: Touch-Activated Controller: MQTT-based Device Interface** **Synopsis:** • **ATMEGA168/328** is integrated with a **touch sensor**, **buzzer**, and **relays** to control devices. • Touch input triggers the devices and sends real-time updates via **MQTT**, enabling low-latency IoT-based control. • Highlights efficient use of MQTT in responsive home automation systems. **Sensors used:** Touch Sensor (4 switches)

	Actuator used: Relay, Buzzer, LED **Cloud Platform:** MQTT, BlyNK **Database** :Firebase
19	**Title: Retro Metro Switch: Automated Switch Control** **Synopsis:** • This creative project repurposes a retro switch using two **servo motors** controlled by **ATMEGA168/328**. • The system mimics metro-style switching and allows remote control via **Blynk**, enhancing traditional infrastructure. • A smart approach to blending legacy tech with IoT automation. **Sensors used:** — **Actuator used:** Servo Motor (×2),LED, Buzzer **Cloud Platform:** Blynk, MQTT
20	**Title: Intelligent Entry: Smart Door Security and Access Control** **Synopsis:** • A **PIR sensor**, **servo motor**, and **buzzer** are connected to **ATMEGA168/328** for door control. • The PIR sensor detects motion and triggers servo-based door lock/unlock. • Alerts and monitoring are enabled via **Blynk**, enhancing home and office entry security. **Sensors used:** PIR Sensor **Actuator used:** Servo Motor, Buzzer, LED **Cloud Platform:** Blynk Database: Cloud Fire base
21	**Title: PillTime: Smart Medication Reminder and Tracker** **Synopsis:** • This project combines a **Real Time Clock (RTC)**, **LCD**, and **RF module** with **ATMEGA168/328** to remind users about their medication schedules. • It displays scheduled pill times on an LCD and sends reminders via **Blynk** for timely medication intake. • Especially beneficial in healthcare to improve adherence to prescribed routines. **Sensors used:** RTC **Actuator used:** LCD, RF Module, LED **Cloud Platform:** Blynk, MQTT
22	**Title: IoT Robotic Arm: Remote Manipulation and Control** **Synopsis:** • Using multiple **servo motors** interfaced with **ATMEGA168/328**, this project creates a remotely controllable robotic arm. • Movements are controlled via **Blynk**, enabling precise automation for education, industry, or remote handling.

	• Demonstrates effective integration of mechanics and IoT. **Sensors used:** — **Actuator used:** Servo Motors, Buzzer, LED **Cloud Platform:** Blynk, MQTT
23	**Title: Smart Scale: IoT-enabled Digital Weighing System** **Synopsis:** • This project uses a **load cell** with **ATMEGA168/328** to build a digital weighing scale. • Weight is displayed on an **LCD** and transmitted to **Blynk** for monitoring and analysis. • Ideal for commercial or personal use, combining accuracy and IoT analytics. **Sensors used:** Load Cell **Actuator used:** LCD, LED, Buzzer **Cloud Platform:** Blynk, MQTT
24	**Title: ColorSort Pro: Automated Color-based Sorting System** **Synopsis:** • A **color sensor** attached to **ATMEGA168/328** identifies object colors and sorts them accordingly. • An **OLED display** shows the detected color, while **MQTT** handles cloud-based monitoring. • Used in recycling or quality control for industrial automation. **Sensors used:** Color Sensor **Actuator used:** OLED,LED, Buzzer **Cloud Platform:** MQTT **Database:** Google Firebase
25	**Title: Smart Traffic Manager: IoT-Enabled 4-Way Signal Control** **Synopsis:** • This project uses an **IR sensor** and **LEDs** with **ATMEGA168/328** to manage traffic at a 4-way signal. • Sensors detect vehicle presence and optimize signal timing. • Integration with **Blynk** allows remote monitoring, improving traffic flow and safety. **Sensors used:** IR Sensor **Actuator used:** LEDs, Buzzer **Cloud Platform:** Blynk, MQTT **Database :** Google Firebase
26	**Title: Smart Assistance Stick: Multi-sensor Navigation Aid** **Synopsis:** • Designed for visually impaired individuals, this **ATMEGA168/328** project uses **ultrasonic**, **fire**, **water**, and **IR sensors**. • Real-time alerts are sent via **Blynk**, assisting safe navigation. • A powerful example of assistive technology using IoT.

	Sensors used: Ultrasonic, Fire, Water, IR **Actuator used:** Buzzer, LED **Cloud Platform:** Blynk, MQTT
27	**Title: Smart Waste Sorter: Automated Waste Segregation System** **Synopsis:** • **IR sensor** and **servo motor** with **ATMEGA168/328** automatically sort waste into separate bins. • Sensor data is transmitted over **MQTT** for remote tracking. • Promotes smart recycling by reducing manual effort. **Sensors used:** IR Sensor **Actuator used:** Servo Motor, LED, Buzzer **Cloud Platform:** MQTT, Thingspeak
28	**Title: Washroom Sentinel: Feedback and Monitoring System** **Synopsis:** • Built using **ATMEGA168/328**, this project collects user feedback via a **switch** and displays it on an **LCD**. • Data is logged and can be analyzed via **Blynk** or exported to Excel. • Helps maintain public hygiene by analyzing satisfaction levels. **Sensors used:** Switch **Actuator used:** LCD, Buzzer, LED **Cloud Platform:** Blynk **Database** Google Firebase
29	**Title: FireGuard Pro: Automated Fire and Temperature Alert System** **Synopsis:** • **Fire** and **temperature sensors** are connected to **ATMEGA168/328** to continuously monitor safety conditions. • When thresholds are exceeded, alerts are sent via **SMTP email** (HTML/text/attachments). • Excellent for proactive safety in industrial and residential spaces. **Sensors used:** Fire Sensor, Temperature Sensor **Actuator used:** Buzzer, LED **Cloud Platform:** SMTP (Email Notifications)
30	**Title: DoorWatch: Real-Time Door Status Monitoring with Telegram Alerts** **Synopsis:** • This project uses **ATMEGA168/328** with door sensors to monitor and send alerts via **Telegram**. • Notifies users instantly of door access or breaches, and logs the data for review. • Enhances home and office security using messaging platforms. **Sensors used:** Magnetic Door Sensor **Actuator used:** Buzzer, LED

	Cloud Platform: Telegram
31	**Title: MotionSense Hub: Comprehensive Inertial and Temperature Monitoring** **Synopsis:** • Combines **MPU-6050** (accelerometer, gyroscope) with **ATMEGA168/328** to monitor motion and temperature. • Data is displayed in **Blynk** and **Thingspeak** dashboards. • Ideal for asset tracking, movement analysis, and safety monitoring. **Sensors used:** MPU-6050 **Actuator used:** LED, Buzzer **Cloud Platform:** Blynk, Thingspeak
32	**Title: CloudBME: Real-time Environmental Monitoring with BME280** **Synopsis:** • **BME280** sensor with **ATMEGA168/328** monitors temperature, pressure, and humidity. • Data is sent to a real-time cloud database for access via mobile/web dashboard. • Triggers alerts on deviations, useful for both home and industry. **Sensors used:** BME280 **Actuator used:** LED, Buzzer **Cloud Platform:** Real-time Database
33	**Title: FarmSense Secure: Firebase-Integrated Sensor Dashboard** **Synopsis:** • **ATMEGA168/328** with **DS18B20 temperature sensor** and **soil moisture sensor** sends data to **Firebase**. • Secure web dashboard with Firebase authentication allows only authorized access. • Ideal for smart farming and remote environment monitoring. **Sensors used:** DS18B20, Soil Moisture Sensor **Actuator used:** Buzzer, LED **Cloud Platform:** Bynl, Thingspeak Database: Firebase
34	**Title:** Smart Energy Meter / Smart Grid System **Synopsis:** • This project utilizes **ATMEGA168/328** integrated with a **ZMPT101B voltage sensor** and an **ACS712 current sensor** to measure real-time voltage and current from the electrical supply. • The measured data is processed to calculate **power consumption**, which is displayed locally on an **OLED display**. • For remote monitoring and analytics, the data is sent to **Blynk**, **Thingspeak**, and stored in **Firebase** as a real-time database. • The system helps in monitoring energy usage, detecting overloads or abnormal consumption patterns, and promotes efficient energy management in homes or industries. • It also supports grid-level applications where power quality and usage data from multiple

	locations can be aggregated and analyzed. **Sensors used:** ZMPT101B (Voltage Sensor), ACS712 (Current Sensor) **Actuator used:** OLED Display, LED, Buzzer **Cloud Platform:** Blynk, Thingspeak Database: Firebase
35	**Title: Smart Health Monitor: Pulse Rate, Heartbeat & Oxygen Level Tracking System** **Synopsis:** • This project is based on **ATMEGA328** and integrates biomedical sensors to measure **pulse rate**, **heart rate**, and **SpO_2 (oxygen saturation)** levels. • The real-time health data is displayed on an **OLED screen**, and abnormal values trigger alerts via a **buzzer** and **LED indicator**. • For remote health tracking and data logging, the readings are uploaded to **Blynk**, **Thingspeak**, and **Firebase Real-time Database**. • This system is particularly useful for **home healthcare**, **elderly monitoring**, and **telemedicine**, allowing patients and doctors to monitor vitals remotely with real-time alerts. • It ensures timely awareness of critical health changes and supports emergency response. **Sensors used:** Pulse Sensor (or MAX30100/MAX30102 for heart rate & SpO_2) **Actuator used:** OLED Display, Buzzer, LED **Cloud Platform:** Blynk, Thingspeak Database: Firebase (Real-time Database)

Guidelines for execution of syllabus and maintain quality of mini project are as follows:

Teaching Approach:

1. Modules 1, 2, and 3 shall be taught in parallel to provide an integrated learning experience.
2. After covering the theoretical concepts of ATmega328 microcontroller architecture and its features, programming fundamentals should be introduced.
3. Embedded C programming should be taught in the context of microcontroller programming.
4. Initial programming exercises should focus on developing a strong understanding of Embedded C syntax and structure specific to microcontroller applications.
5. Subsequently, fundamental programming related to GPIO, Timers, and Interrupts must be covered along with their practical implementation on the ATmega328 microcontroller.
6. Module 4 shall focus on interfacing various sensors, actuators, and communication protocols with the ATmega328 microcontroller, covering their working principles and practical implementation on the development board.
7. Hands-on experiments must be conducted for each interfacing to ensure practical understanding and testing of sensors, actuators, and communication protocols.
8. After thorough understanding and practical exposure to Modules 1, 2, 3, and 4, students should proceed with project selection and execution based on the ATmega328 microcontroller.

Project Topic Selection and Approval:

1. A mini-project group shall consist of a minimum of THREE (03)
2. Project topic selection and approval should be done by a panel of two expert faculty members from the department.
3. Each group must maintain a logbook to record weekly work progress in terms of milestones. The guiding faculty should provide remarks/comments weekly. Both students and faculty must sign the logbook every week.

Project Report Format:

1. The mini-project report should include the following sections:
    - Abstract (maximum 1 page summarizing the complete report)
    - Introduction (justification for project selection, applications, and existing commercial products)
    - Implementation (proposed specifications, block diagram/circuit diagram, working principle/operation)

- Results & Discussion (photographs, video links, recorded results such as waveforms/observations/demonstrations)
- Conclusion and Learning Outcomes
- References
- Participation in Mini-project competition/Technical Paper Presentation (TPP), etc.

2. The report should not exceed 10 pages. Reports should be stapled to avoid the use of plastic.

Term Work & Practical/Oral Examination Evaluation:

1. Minimum six (06) experiments based on Modules 1, 2, 3, and 4 should be performed.
2. One mini project must be implemented.
3. It is not compulsory to select a project from the given sample list; students are encouraged to propose innovative ideas.
4. Students must deliver a presentation and demonstrate their mini project during the Practical and Oral Examination (25 Marks Evaluation).
5. Project reports must be checked for plagiarism using software such as Turnitin or any equivalent tool.
6. Evaluation should consider each student's individual contribution, understanding, and knowledge gained during the project execution. Marks should be awarded accordingly.

Term Work & Evaluation Scheme (Total 50 Marks):

Component	Marks
Performance in Experiments & Evaluation by Guide	15
Performance in mini project & Evaluation by Guide	10
Performance in mini project & Evaluation by Review Committee Evaluation	10
Logbook and Quality of Project Report	05
Research Paper	10