K.K. Wagh Institute of Engineering Education and Research, Nashik

Curriculum
T.Y. B. Tech

Electronics and Telecommunication Engineering

w.e.f.: AY 2024-2025

T.Y. B. Tech wef AY 2024-25																
SEM-V																
Course Code	**Course Type**	**Title of Course**	**Teaching Scheme**			**Evaluation Scheme and Marks**							**Credits**			
			TH	**TU**	**PR**	**INSEM**	**ENDSEM**	**CCE**	**TUT**	**TW**	**PR /OR**	**TOTAL**	**TH**	**TU**	**PR**	**TOTAL**
ETC223001	DCC	Electromagnetics Engineering	3	-	-	20	60	20				**100**	3	-	-	**3**
ETC223002	DCC	Cellular Networks	3	-	-	20	60	20				**100**	3	-	-	**3**
ETC223003	DCC	Problem solving using Python	3	-	-	20	60	20				**100**	3	-	-	**3**
ETC223004	DCC	Lab work in Cellular Network	-	-	2	-	-	-		25	25	**50**	-	-	1	**1**
ETC223005	DCC	Lab work in Problem solving using Python	-	-	2					25	25	**50**	-	-	1	**1**
ETC223006	DEC	Elective 1	3	-	-	20	60	20				**100**	3	-	-	**3**
ETC223007	DEC	Lab work in Elective 1	-	-	2	-	-	-		25	25	**50**	-	-	1	**1**
ETC223008	ESC	Internet of Things	3	-	-	20	60	20	-	-	-	**100**	3	-	-	**3**
ETC223009	OEC	Project management	2	-	-	-	-	50	-	-	-	**50**	2	-	-	**2**
ETC223010	PSI	Mini Project	-	1	2	-	-	-	25	25	-	**50**	-	1	1	**2**
Total			**17**	**01**	**08**	**100**	**300**	**150**	**25**	**100**	**75**	**750**	**17**	**1**	**4**	**22**

T.Y. B. Tech wef AY 2024-25															
SEM-VI															
Course Code	**Course Type**	**Title of Course**	**Teaching Scheme**			**Evaluation Scheme and Marks**						**Credits**			
			TH	**TU**	**PR**	**INSEM**	**ENDSEM**	**CCE**	**TUT /TW**	**PR /OR**	**TOTAL**	**TH**	**TU**	**PR**	**TOTAL**
ETC223011	DCC	Embedded Processor	3	-	-	20	60	20			**100**	3	-	-	**3**
ETC223012	DCC	Power Electronics	3	-	-	20	60	20			**100**	3	-	-	**3**
ETC223013	DCC	Lab work in Power Electronics	-	-	2	-	-	-	25	25	**50**	-	-	1	**1**
ETC223014	DEC	Elective 2	3	-	-	20	60	20			**100**	3	-	-	**3**
ETC223015	DEC	Elective 3	3	-	-	20	60	20	-	-	**100**	3	-	-	**3**
ETC223016	DEC	Lab work in Elective 2	-	-	2	-	-	-	25	25	**50**	-	-	1	**1**
ETC223017	ESC	Industry 4.0 and industrial IoT (IIoT)	3	-	-	20	60	20			**100**	3	-	-	**3**
ETC223018	OEC	Digital Marketing	2	-	-	-	-	50	-	-	**50**	2	-	-	**2**
ETC223019	ASM	Web Design	-	1	2				25	25	**50**	-	1	1	**2**
ETC223020	PSI	Project phase-I	-	-	2	-	-	-	50	-	**50**	-	-	1	**1**
Total			**17**	**01**	**08**	**100**	**300**	**150**	**125**	**75**	**750**	**17**	**1**	**4**	**22**

Elective Streams #1	Elective 1 (SEM 5) – PEC1	Elective 2 (SEM 6) – PEC2
Communication-A	Software Defined Radio	Microwave Engineering
Automation-B	Mechatronics	Process Instrumentation
Embedded Systems-C	Interfacing Techniques	Advanced Processors
Artificial Intelligence-D	Foundation course in ML	Neural network and Fuzzy control

Elective Streams #2	Elective 3 (SEM 6) – PEC3
Signal Processing-A	Advanced DSP
Advanced VLSI Design-B	FPGA Based System Design
Recent trends-C	Circular economy
e- Mobility-D	Automotive Electronics

Semester-I

K. K. Wagh Institute of Engineering Education and Research, Nashik
(Autonomous from Academic Year 2022-23)

T. Y. B. Tech. Pattern 2022 Semester: V
ETC223001: Electromagnetic Engineering

Teaching Scheme:	**Credit Scheme:**	**Examination Scheme:**
Theory :03 hrs/week	**03**	**Continuous Comprehensive Evaluation: 20 Marks** **InSem Exam: 20 Marks** **EndSem Exam: 60 Marks**

Prerequisite Courses, if any: Applied Physics, Applied Mathematics

Companion course, if any: Nil

Course Objectives:

1. To study basic electrostatic and magneto static laws and theorems.
2. To learn Maxwell's equations and apply them to basic electromagnetic problem.
3. To make the students able to apply Maxwell's equations in practical applications.
4. To introduce the students to transmission lines and propagation of uniform plane waves.
5. To make the students aware of basics of microwaves and antenna.

Course Outcomes: On completion of the course, students will be able to–

	Course Outcomes	**Bloom's Level**
CO1	Study electrostatic field parameters and their distributions in different media and Apply it solve the problems related to the electrostatic field.	3 - Apply
CO2	Study magnetostatic field parameters and their distributions in different media and Apply it solve the problems related to the electrostatic field.	3 - Apply
CO3	Interpret the electromagnetic problem and solve using Maxwell's equations.	3 - Apply
CO4	Analyze problems related to transmission lines and uniform plane wave propagation	4 - Analyze
CO5	Elaborate the basic concepts of microwaves, waveguides and antennas	2 - Understand

COURSE CONTENTS

Unit I	**Electrostatics**	**(08 hrs)**	**COs Mapped - CO1**

Coulomb's Law & Electric Field Intensity, Electric Flux Density, Gauss's Law, Divergence theorem, Electric potential, Relationship between E & V, Potential Gradient, Poission's and Laplace's equation, Application of Poission's and Laplace's equations, Boundary Condition.

Unit II	**Magnetostatics**	**(07 hrs)**	**COs Mapped - CO2**

Biot-Savart's Law, Ampere's Circuital Law, magnetic flux density, Magnetic potentials, Derivations of Biot-savart's law and Ampere's law based on Magnetic Potential, Forces due to magnetic field, Magnetic boundary condition.

Unit III	Time Varying Fields & Maxwell's Equations	(07 hrs)	COs Mapped – CO3
Faraday's Law, Transformer and Motional Electromotive Forces, Displacement Current, Maxwell's Equations in Point Form and Integral Form, Time-Varying Potentials, Time Harmonic Fields, Maxwell's Equations in Phasor Form.			
Unit IV	**Transmission Lines and Uniform Plane Waves**	**(07 hrs)**	**COs Mapped – CO4**
Introduction, Transmission Line parameters, Propagation constant, Characteristic Impedance, Reflection Coefficient, VSWR, Transmission line equation Lossless and Distortion less line Wave Equation, Wave Propagation in Free Space and Good Conductors, Skin Depth, Electromagnetic Power and Poynting Theorem			
Unit V	**Waveguides and Antennas**	**(07 hrs)**	**COs Mapped – CO5**
Microwave Frequency Bands, Advantages and Applications of Microwaves, Waveguide & Its Types, Rectangular Waveguide: Cutoff Frequency, Cutoff Wavelength, Guide Wavelength, Phase Velocity, Group Velocity and Wave Impedance, Fundamental Equation for Free Space Propagation, Introduction to Antenna, Types of Antenna, Radiation Mechanism, Antenna Terminology: Radiation Pattern, Radiation Power Density, Radiation Intensity, Directivity, Gain, Antenna Efficiency.			

Text Books

1. Principles of Electromagnetics, Mathew N. O. Sadiku, Oxford University Press Inc.
2. Networks, Lines and Fields, J. D. Ryder, PHI
3. Antenna & Wave Propagation, K. D. Prasad, Satya Prakashan, New Delhi
4. Microwave and Radar Engineering, M. Kulkarni, Umesh Publications
5. Antenna Theory - Analysis and Design, C. A. Balanis, John Wiley

Reference Books

1. Engineering Electromagnetics, William H. Hayt and John A. Buck, Tata McGraw Hill
2. Electromagnetic Waves and Radiating Systems, Jordan and Balmain, PHI
3. Microwave Engineering, David M. Pozar, Wiley

Strength of CO-PO Mapping													CO-PSO Mapping	
	PSO												PSO	
	1	1	3	4	5	6	7	8	9	10	11	12	1	2
CO1	**3**	**3**	-	-	-	-	-	-	-	-	-	-	-	-
CO2	**3**	**3**	-	-	-	-	-	-	-	-	-	-	-	-
CO3	**3**	**3**	-	-	-	-	-	-	-	-	-	-	-	-
CO4	**3**	**3**	**3**	-	-	-	-	-	-	-	-	-	**3**	**3**
CO5	**3**	**3**	-	-	-	-	-	-	-	-	-	-	-	-

Guidelines for Continuous Comprehensive Evaluation of Theory Course		
Sr. No.	**Components for Continuous Comprehensive Evaluation**	**Marks Allotted**
1	**Assignment:** Assignment No. 1 - Unit 1, 2 (30 Marks) Assignment No. 2 - Unit 3, 4, 5 (30 Marks) **Note:** These 60 marks of two assignments will be converted into 10 marks.	10
2	**Online Quiz:** Unit No. 1 (10 Questions - 10 Marks) Unit No. 2 (10 Questions - 10 Marks) Unit No. 3 (10 Questions - 10 Marks) Unit No. 4 (10 Questions - 10 Marks) Unit No. 5 (10 Questions - 10 Marks) **Note:** These 50 marks of five quizzes will be converted into 10 marks.	10
	Total	**20**

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T. Y. B. Tech. Pattern 2022 Semester: V
ETC223002: Cellular Networks

Teaching Scheme:	Credit Scheme:	Examination Scheme:
Theory :03 hrs/week	**03**	**Continuous Comprehensive Evaluation: 20 Marks** **InSem Exam: 20 Marks** **EndSem Exam: 60 Marks**

Prerequisite Courses, if any: Basic knowledge of - Probability, Random variables and Modulation.

Companion course, if any: Lab work in Cellular Network

Course Objectives:

1. Various propagation Model and Estimation techniques of wireless communication system.
2. OFDM and MIMO technologies to explain modern wireless systems.
3. Various aspects of mobile communication system
4. Different Generation of Mobile Networks

Course Outcomes: On completion of the course, students will be able to–

	Course Outcomes	Bloom's Level
CO1	Understand fundamentals of wireless communications.	2-Understand
CO2	Discuss and study OFDM and MIMO concepts	2-Understand
CO3	Elaborate fundamentals mobile communication	2-Understand
CO4	Describes aspects of wireless system planning.	2-Understand
CO5	Understand of modern and futuristic wireless networks architecture.	2-Understand

COURSE CONTENTS

Unit I	**Introduction of Wireless Channel**	**(07 hrs)**	**COs Mapped - CO1**

Introduction, Free Space Propagation Model, Ground-Reflection Scenario, Hata Model and Receiver-Noise Computation. Channel Estimation techniques and Diversity in wireless communications

Unit II	**Orthogonal Frequency Division Multiplexing**	**(07 hrs)**	**COs Mapped - CO2**

Introduction, Motivation and Multicarrier basics, OFDM example, bit error rate for OFDM. Multiple-Input Multiple-Output Wireless Communications: Introduction to MIMO Wireless Communications, MIMO System Model and MIMO-OFDM.

Unit III	**Introduction to Mobile Communication**	**(08 hrs)**	**COs Mapped – CO3**

Introduction to Cellular Service Progression, Cell Geometry, Overview of Cellular mobile and Network architecture, Cellular radio system design-- Frequency assignments, frequency reuse channels, Concept of cell splitting and Cell sectoring. Significance of Handover in cellular systems with Handoff algorithms and roaming.

Unit IV	**Wireless System Planning**	**(07 hrs)**	**COs Mapped – CO4**

Link-Budget Analysis, Tele-traffic Theory, Tele-traffic System Model and Steady State Analysis.

Unit V	: Wireless and Mobile Technologies and Protocols and their performance evaluation	(07 hrs)	COs Mapped – CO5

Introduction, Wireless and mobile technologies, LTE- advanced, 5G – Architecture, wireless local area network and Simulations of wireless networks.

Text Books

1. Rappaport, T. S., "Wireless Communications--Principles and Practice", Pearson, 2nd Edition. 2. Jagannatham, A. K., "Principles of Modern Wireless Communication Systems", McGraw-Hill Education.

Reference Books

1. Cristopher Cox, "An Introduction to LTE: LTE, LTE-Advanced, SAE, VoLTE and 4G Mobile Communications", Wiley, 2nd Edition.
2. E. Dahlman, J. Skold, and S. Parkvall, "4G, LTE-Advanced Pro and The Road to 5G", Academic Press, 3 rd Edition.
3. B. P. Lathi, "Modern Digital and Analog Communications Systems". Oxford university press, 2015, 4th Edition.
4. Obaidat, P. Nicopolitids, "Modeling and simulation of computer networks and systems: Methodologies and applications" Elsevier, 1st Edition.

Strength of CO-PO Mapping													CO-PSO Mapping	
	PSO												PSO	
	1	1	3	4	5	6	7	8	9	10	11	12	1	2
CO1	**2**	**2**	**2**	-	-	-	-	-	-	-	-	-	-	-
CO2	**2**	**2**	**2**	-	-	-	-	-	-	-	-	-	-	-
CO3	**2**	**2**	-	-	-	-	-	-	-	-	-	-	-	-
CO4	**2**	**2**	-	-	-	-	-	-	-	-	-	-	-	**2**
CO5	**2**	**2**	-	-	-	-	-	-	-	-	-	-	-	**2**

Guidelines for Continuous Comprehensive Evaluation of Theory Course		
Sr. No.	**Components for Continuous Comprehensive Evaluation**	**Marks Allotted**
1	Five Assignments on Unit-1, Unit-2, Unit-3, Unit-4 and Unit-5	10
2	Performance in Unit Tests (5 tests, one on each unit)	10
	Total	**20**

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T. Y. B. Tech. Pattern 2022 Semester: V
ETC223003: Problem Solving Using Python

Teaching Scheme:	Credit Scheme:	Examination Scheme:
Theory :03 hrs/week	**03**	**Continuous Comprehensive Evaluation: 20 Marks** **In Sem Exam: 20 Marks** **End Sem Exam: 60 Marks**

Prerequisite Courses, if any : basic understanding of programming concepts, C, C++

Companion course, if any: Lab work in Problem Solving Using Python

Course Objectives:

1. Describe the core syntax and semantics of Python programming language.
2. Discover the need for working with the strings and functions.
3. Illustrate the process of structuring the data using lists, dictionaries, tuples and sets.
4. Indicate the use of regular expressions and built-in functions to navigate the file system.
5. Infer the Object-oriented Programming concepts in Python.

Course Outcomes: On completion of the course, students will be able to–

	Course Outcomes	Bloom's Level
CO1	Interpret the fundamental Python syntax and semantics and be fluent in the use of Python control flow statements.	2-Understand
CO2	Express proficiency in the handling of strings and functions.	2-Understand
CO3	Determine the methods to create and manipulate Python programs by utilizing the data structures like lists, dictionaries, tuples and sets.	3-Apply
CO4	Identify the commonly used operations involving file systems and regular expressions.	2-Understand
CO5	Articulate the Object-Oriented Programming concepts such as encapsulation, inheritance and polymorphism as used in Python.	3-Apply

COURSE CONTENTS

Unit I	Basics of Python Programming Language	(08 hrs)	COs Mapped - CO1

Identifiers, Keywords, Statements and Expressions, Variables, Operators, Precedence and Associativity, Data Types, Indentation, Comments, Reading Input, Print Output, Type Conversions, The type() Function and Is Operator, Dynamic and Strongly Typed Language, Control Flow Statements, The if Decision Control Flow Statement, The if…else Nested if Statement, The while Loop, The for Loop, The continue and break Statements, The return Statement and void Function, Scope and Lifetime of Variables, Default Parameters, Keyword Arguments, Command Line Arguments.

Unit II	Strings	(07 hrs)	COs Mapped - CO2

Creating and Storing Strings, Basic String Operations, Accessing Characters in String by Index Number, String Slicing and Joining, String Methods, Formatting Strings, Lists, Creating Lists, Basic List Operations, Indexing and Slicing in Lists, Built-In Functions Used on Lists, List Methods, The del Statement.

Unit III	Dictionaries	(07 hrs)	COs Mapped – CO3

Creating Dictionary, Accessing and Modifying key:value Pairs in Dictionaries, Built-In Functions Used on Dictionaries, Dictionary Methods, The del Statement, Tuples and Sets, Creating Tuples, Basic Tuple Operations, Indexing and Slicing in Tuples, Built-In Functions Used on Tuples, Relation between Tuples and Lists, Relation between Tuples and Dictionaries, Tuple Methods, Using zip() Function, Sets, Set Methods, Traversing of Sets, Frozenset.

Unit IV	**Files**	**(07 hrs)**	**COs Mapped – CO4**

Types of Files, Creating and Reading Text Data, File Methods to Read and Write Data, Reading and Writing Binary Files, The Pickle Module, Reading and Writing CSV Files, Python os and os.path Modules, Regular Expression Operations, Using Special Characters, Regular Expression Methods, Named Groups in Python Regular Expressions, Regular Expression with glob Module.

Unit V	**Object-Oriented Programming**	**(07 hrs)**	**COs Mapped – CO5**

Classes and Objects, Creating Classes in Python, Creating Objects in Python, The Constructor Method, Classes with Multiple Objects, Class Attributes versus Data Attributes, Encapsulation, Inheritance, The Polymorphism.

Text Books

1. Gowrishankar S, Veena A, "Introduction to Python Programming", 1st Edition, CRC Press/Taylor & Francis, 2018. ISBN-13: 978-0815394372

Reference Books

1. Jake VanderPlas, "Python Data Science Handbook: Essential Tools for Working with Data", 1st Edition, O'Reilly Media, 2016. ISBN-13: 978-1491912058
2. Aurelien Geron, "Hands-On Machine Learning with Scikit-Learn and TensorFlow: Concepts, Tools, and Techniques to Build Intelligent Systems", 2nd Edition, O'Reilly Media, 2019. ISBN – 13: 978-9352139057.
3. Wesley J Chun, "Core Python Applications Programming", 3rd Edition, Pearson Education India, 2015. ISBN-13: 978-9332555365
4. Miguel Grinberg, "Flask Web Development: Developing Web Applications with Python", 2nd Edition, O'Reilly Media, 2018. ISBN-13: 978-1491991732.

Strength of CO-PO Mapping													CO-PSO Mapping	
	PSO												PSO	
	1	1	3	4	5	6	7	8	9	10	11	12	1	2
CO1	**3**	**3**	**2**	**1**	**3**	-	-	-	-	-	-	-	-	-
CO2	**2**	**2**	**2**	**1**	**3**	-	-	-	-	-	-	-	-	-
CO3	**3**	**3**	**2**	**2**	**3**	-	-	-	-	-	-	-	**2**	**2**
CO4	**2**	**2**	**2**	**2**	**3**	-	-	-	-	-	-	-	-	-
CO5	**3**	**3**	**2**	**2**	**3**	-	-	-	-	-	-	-	**2**	**2**

Guidelines for Continuous Comprehensive Evaluation of Theory Course		
Sr. No.	**Components for Continuous Comprehensive Evaluation**	**Marks Allotted**
1	Five Assignments on Unit-1, Unit-2, Unit-3, Unit-4 and Unit-5	10
2	Performance in Unit Tests (5 tests, one on each unit)	10
	Total	**20**

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T Y. B. Tech. 2022 Pattern Semester: V **ETC223004: Lab work in Cellular Network**		
Teaching Scheme:	**Credit Scheme:**	**Examination Scheme:**
Practical : **02hrs/week**	**01**	**Practical Exam: 25 Marks** **Term Work: 25 Marks**

Prerequisite Courses, if any: Analog and Digital communication, Basic electronics engineering (GSM architecture)

Companion course, if any: Cellular Network

Course Objectives:

1. Understand fundamentals of wireless communication by implementing different propagation models using MATLAB and virtual lab
2. Elaborate fundamentals mobile communication and cellular concepts like finding co-channels cells, cell clusters etc.

Course Outcomes: On completion of the course, students will be able to–

	Course Outcomes	Bloom's Level (Cognitive domain)	Bloom's Level (Psychomotor domain)
CO1	Understand fundamentals of wireless communications and able to write MATLAB code for free space propagation model, Hata and Okumura propagation models	2- Understand 3-Apply	1-Imitation
CO2	Able to Write MATLAB code to compute the RMS delay spread for a given power profile	3-Apply	1-Imitation
CO3	Understand aspects of wireless system planning and able to write MATLAB code for link budget analysis for wireless system	2- Understand 3-Apply	1-Imitation
CO4	Elaborate fundamentals mobile communication using virtual lab and able to write MATLAB codes to compute Doppler shift and system capacity.	2- Understand 3-Apply	1-Imitation

List of Laboratory Experiments		
Sr. No.	**Laboratory Experiments**	**CO Mapped**
1	Study of Free Space Propagation Model Write MATLAB code for Frii's space equation to find value of power received in watt, dBm and dBW and FSPL also plot graph of power received with respect to distance.	**CO1**

2	Write a program to find path loss using Okumura outdoor propagation model and plot the graph of path loss vs. distance	**CO1**
3	Write a program to find path loss using Hata outdoor propagation model and Plot the graph of path loss vs. distance	**CO1**
4	Compute the RMS delay spread for a given power profile and plot the graph of power vs. delay	**CO2**
5	To perform a Link-Budget analysis for a wireless communication system.	**CO3**
6	Compute Doppler shift of the received signal for different carrier frequency of mobile generations	**CO4**
7	Experiment 1 using Virtual Lab To understand the cellular frequency reuse concept fulfilling the following objectives 1. Finding the co-channel cells for a particular cell. 2. Finding the cell clusters within certain geographic area.	**CO4**
8	Experiment 2 using Virtual lab To understand pathloss prediction formula	**CO4**

Guidelines for Laboratory Conduction

1. Teacher will brief the given experiment to students, its procedure, observations calculation, and outcome of this experiment.
2. Equipment and kits required for the allotted experiment will be provided by the lab assistants using SOP.
3. Students will perform the allotted experiment in a group (two students in each group) under the supervision of faculty and lab assistants.
4. After performing the experiment students will check their readings, calculations from the teacher.
5. After checking they have to write the conclusion of the final result.

Guidelines for Student's Lab Journal

Write-up should include title, aim, and diagram, working principle, procedure, observations, graphs, calculations, conclusion and questions, if any.

Guidelines for Termwork Assessment

R1: Timely completion of experiment (10 Marks)
R2: Understanding of experiment (10 Marks)
R3: Presentation / clarity of journal writing (10 Marks)
Total 30 marks for each experiment and average marks of all experiments will be converted into 25 marks of term work.

Strength of CO-PO Mapping													CO-PSO Mapping	
	PSO												PSO	
	1	1	3	4	5	6	7	8	9	10	11	12	1	2
CO1	**3**	**3**	**-**	**-**	**3**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**3**
CO2	**3**	**3**	**-**	**-**	**3**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**3**
CO3	**3**	**3**	**-**	**-**	**3**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**3**
CO4	**3**	**3**	**-**	**-**	**3**	**-**	**-**	**-**	**--**	**-**	**-**	**-**	**-**	**3**

K. K. Wagh Institute of Engineering Education and Research, Nashik

(Autonomous from Academic Year 2022-23)

T. Y. B. Tech. 2022 Pattern Semester: V
ETC223005: Lab work in Problem Solving Using Python

Teaching Scheme:	**Credit Scheme:**	**Examination Scheme:**
Practical : 02hrs/week	**01**	**Practical: 25 Marks** **Term work: 25 Marks**

Prerequisite Courses, if any: : basic understanding of programming concepts

Companion course, if any: Problem Solving Using Python

Course Outcomes: On completion of the course, students will be able to–

	Course Outcomes	Bloom's Level (Cognitive domain)	Bloom's Level (Psychomotor do main)
CO1	Interpret the fundamental Python syntax and semantics and be fluent in the use of Python control flow statements.	2-Understand	1-Imitation
CO2	Express proficiency in the handling of strings and functions.	2-Understand	1-Imitation
CO3	Determine the methods to create and manipulate Python programs by utilizing the data structures like lists, dictionaries, tuples and sets.	3-Apply	2-Manipulation
CO4	Identify the commonly used operations involving file systems and regular expressions.	2-Understand	1-Imitation
CO5	Articulate the Object-Oriented Programming concepts such as encapsulation, inheritance and polymorphism as used in Python.	3-Apply	2-Manipulation

List of Laboratory Experiments / Assignments

Sr. No.	**Laboratory Experiments / Assignments**	**CO Mapped**
1	Write a Python program to calculate the sum of the digits in an integer.	**CO1**
2	Using Regular Expressions, develop a Python program to a) Identify a word with a sequence of one upper case letter followed by lower case letters. b) Find all the patterns of "1(0+)1" in a given string. c) Match a word containing 'z' followed by one or more o's. Prompt the user for input.	**CO1**

3	Write a program which takes a sentence from user and calculates number of digits, letters, uppercase letters, lowercase letter and spaces in sentence.	**CO2**
4	Develop a program to sort the contents of a text file and write the sorted contents into a separate text file. [Hint: Use string methods strip(), len(), list methods sort(), append(), and file methods open(), readlines(), and write()].	**CO2**
5	Develop a program to print 10 most frequently appearing words in a text file. [Hint: Use dictionary with distinct words and their frequency of occurrences. Sort the dictionary in the reverse order of frequency and display dictionary slice of first 10 items]	**CO3**
6	Develop a program to sort the contents of a text file and write the sorted contents into a separate text file. [Hint: Use string methods strip(), len(), list methods sort(), append(), and file methods open(), readlines(), and write()].	**CO4**
7	Write a program to Python program to implement concepts of OOP such as a. Types of Methods b. Inheritance c. Polymorphism d. Abstract methods and classes e. Interfaces	**CO5**
8	Develop a program that uses class Student which prompts the user to enter marks in three subjects and calculates total marks, percentage and displays the score card details. [Hint: Use list to store the marks in three subjects and total marks. Use __init__() method to initialize name, USN and the lists to store marks and total, Use getMarks() method to read marks into the list, and display() method to display the score card details.]	**CO5**

Guidelines for Laboratory Conduction

- Use of coding standards and Hungarian notation, proper indentation and comments.
- Operating System recommended:- Linux/Windows or its derivative

Guidelines for Student's Lab Journal

Student's lab journal should contain following related things -
Title, Objectives, Hardware/ Software requirement, Theory, and Conclusion

Guidelines for Termwork Assessment

- R1: Timely completion of experiment (10 Marks)
- R2: Understanding of experiment (10 Marks)
- R3: Presentation / clarity of journal writing (10 Marks)
- Total 30 marks for each experiment and average marks of all experiments will be converted into 25 marks of term work.

Strength of CO-PO Mapping													CO-PSO Mapping	
	PSO												PSO	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	**3**	**3**	**2**	**1**	**3**	-	-	-	-	-	-	-	-	-
CO2	**2**	**2**	**2**	**1**	**3**	-	-	-	-	-	-	-	-	-
CO3	**3**	**3**	**2**	**2**	**3**	-	-	-	-	-	-	-	**2**	**2**
CO4	**2**	**2**	**2**	**2**	**3**	-	-	-	-	-	-	-	-	-
CO5	**3**	**3**	**2**	**2**	**3**	-	-	-	-	-	-	-	**2**	**2**

K. K. Wagh Institute of Engineering Education and Research, Nashik

(Autonomous from Academic Year 2022-23)

T. Y. B. Tech. Pattern 2022 Semester: V **ETC223008: ESC: Internet of Things**		
Teaching Scheme:	**Credit Scheme:**	**Examination Scheme:**
Theory :03 hrs/week	**03**	**Continuous Comprehensive Evaluation: 20 Marks** **InSem Exam: 20 Marks** **EndSem Exam: 60 Marks**

Prerequisite Courses, if any: Knowledge on Programming, Problem Solving and Embedded systems

Companion course, if any: -

Course Objectives:

1. To introduce the fundamentals of sensors and actuators along with the basic concepts of an IoT & IoE.
2. To give insights into the Architecture and M2M technology for an IoT.
3. To Exposing students to the usage of Protocol Standardization for IoT with IoT Edge and Gateway Network with Communication protocols.
4. To develop design skills in industrial IoT.
5. To provide IoT Solutions with sensor-based application through embedded system platform.

Course Outcomes: On completion of the course, students will be able to–

	Course Outcomes	**Bloom's Level**
CO1	**Comprehend** and analyze concepts of sensors, actuators, IoT and IoE.	Comprehend (2-understand)
CO2	**Interpret** IoT Architecture Design Aspects	Interpret (5-evaluate)
CO3	**Comprehend** the operation of IoT protocols.	Comprehend (2-understand)
CO4	**Implement** various IoT boards, interfacing, and programming for IoT system	Implement (6-apply)
CO5	**Illustrate** the technologies, Catalysts, and precursors of IIoT using suitable use cases.	Illustrate (3-Apply)

COURSE CONTENTS

Unit I	**Sensors, Actuators, IoT & IoE**	**(06 hrs)**	**COs Mapped - CO1**

Definitions, Types of sensors, Types of Actuators, Example and Working, Networking Basics, RFID Principles and components, Wireless Sensor Networks, Definition, and characteristics of an IoT, Physical Design of an IoT, Logical design of IoT, Communication Models, Communication API's, What is the IoE? Difference between IoT and IoE, Pillars of the IoE, Connecting the Unconnected, Transitioning to the IoE, Bringing it all together.

Unit II	**IoT Architecture Design Aspects**	**(07 hrs)**	**COs Mapped - CO2**

IoT-An Architectural Overview, building architecture, Main design principles and needed capabilities, An IoT architecture outline, standards considerations. M2M and IoT Technology Fundamentals- Devices and gateways, Local and wide area networking, Data management, Business processes in IoT, Everything as a Service (XaaS), M2M and IoT Analytics, Knowledge Management

Unit III	IoT Protocols	(07 hrs)	COs Mapped – CO3
PHY/MAC Layer (3GPP MTC, IEEE 802.11, IEEE 802.15), Wireless HART, Z Wave, Bluetooth Low Energy, Zigbee Smart Energy, DASH7 - Network Layer-IPv4, IPv6, 6LoWPAN, 6TiSCH, ND, DHCP, ICMP, RPL, CORPL, CARP, Transport Layer (TCP, MPTCP, UDP, DCCP, SCTP)-(TLS, DTLS) – Session Layer HTTP, CoAP, XMPP, AMQP, MQTT			
Unit IV	**Interfacing Boards and Programming**	**(07 hrs)**	**COs Mapped – CO4**
Introduction to IoT Boards, Interfacing with IoT Boards, IoT deployment for Raspberry Pi /Arduino/Equivalent platform – Reading from Sensors, Communication: Connecting microcontroller with mobile devices – communication through Bluetooth, WiFi and USB - Contiki OS- Cooja Simulator.			
Unit V	**Industrial IoT**	**(07 hrs)**	**COs Mapped – CO5**
Introduction, Key IIOT technologies, Catalysts, and precursors of IIoT, Innovation and the IIoT, Applications of IIoT Examples: Healthcare, Oil and Gas Industry, Logistics and the Industrial Internet, Retail applications, IoT innovations and design methodologies, Industrial Internet Architecture Framework (IIAF): Control domain, operational domain and application domain, Three tier topology, Design of low power device network, legacy industrial protocols, Bluetooth, Zigbee IP, Z-wave, Wi-Fi backscatter in IIoT design.			

Text Books

1. Ovidiu Vermesan, Peter Fresiss, "Internet of Things" From research and innovation to market Deployment", River Publishers series in Communication, USA.
2. Olivier Hersent, David Boswarthick, and Omar Elloumi, "The Internet of Things: Key

Reference Books

1. Dr. Ovidiu Vermesan, Dr. Peter Friess, "Internet of Things: Converging Technologies for Smart Environments and Integrated Ecosystems", River Publishers Series in Communication
2. "Internet of Things: Case Studies", Libelium Inc, White papers, Spain
   http://www.libelium.com/resources/case-studies
3. Useful Links for IoT Applications and Use Cases:
   http://52.16.186.190/resources/case-studies/
   https://pressbooks.bccampus.ca/iotbook/chapter/iot-use-cases/
   https://research.aimultiple.com/iot-applications/
   https://www.jigsawacademy.com/101-applications-of-iot/
   https://www.youtube.com/watch?v=xmt6OCBeS94

Strength of CO-PO Mapping													CO-PSO Mapping	
	PSO												PSO	
	1	1	3	4	5	6	7	8	9	10	11	12	1	2
CO1	**3**	**3**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**3**	**-**	**-**
CO2	**3**	**3**	**3**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**3**	**-**	**-**
CO3	**3**	**3**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**3**	**-**	**-**
CO4	**3**	**3**	**3**	**-**	**3**	**-**	**-**	**-**	**-**	**-**	**-**	**3**	**2**	**2**
CO5	**3**	**3**	**3**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**3**	**-**	

Guidelines for Continuous Comprehensive Evaluation of Theory Course		
Sr. No.	**Components for Continuous Comprehensive Evaluation**	**Marks Allotted**
1	Five Assignments on Unit-1, Unit-2, Unit-3, Unit-4 and Unit-5	10
2	Performance in Unit Tests (2 tests, one on Unit 1, 2, 3 and second on Unit 4 &5)	10
	Total	**20**

K. K. Wagh Institute of Engineering Education and Research, Nashik

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T. Y. B. Tech. Pattern 2022 Semester: V **ETC223009 : OEC:Project Management**		
Teaching Scheme:	**Credit Scheme:**	**Examination Scheme:**
Theory :02hrs/week	**02**	**Continuous Comprehensive Evaluation: 50 Marks**

Prerequisite Courses, if any: Industrial Management

Course Objectives:

1. To study basics of project management and the project initiation phase.
2. To understand activities associated with project planning phase.
3. To use network techniques, resource allocation methods in project planning phase.
4. To learn the work to be carried out in project execution phase.

Course Outcomes: On completion of the course, students will be able to–

	Course Outcomes	**Bloom's Level**
CO1	Understand fundamentals of project management.	2-Understand
CO2	Explain activities involved in project planning.	2-Understand
CO3	Apply principles of planning.	3-Apply
CO4	Describe execution of a project.	2-Understand

COURSE CONTENTS

Unit I	**Project Initiation**	**(06hrs)**	**COs Mapped CO1**

Definition of Project, Why Project Management?, Project Life Cycle
Project Initiation: Project Selection and Criteria of Choice, Project Selection Models, Types
Project Manager: Special Demands, Selection
Negotiation and Conflict: Nature, Partnering, Chartering, and Scope Change, Conflict and Project Life Cycle, Requirements and Principles of Negotiation
Project in the Organizational Structure: Types of organizational structure, Choosing an Organizational Form,
The Project Team, Human Factors and the Project Team

Unit II	**Project Planning - I**	**(06hrs)**	**COs Mapped – CO2**

Project activity planning: Initial Project Coordination and the Project Plan, Systems Integration, The Action Plan, The Work Breakdown Structure and Linear Responsibility Chart, Interface Coordination through Integration Management
Budgeting and Cost estimation: Estimating Project Budgets, Improving the Process of Cost Estimation

Unit III	**Project Planning - II**	**(06hrs)**	**COs Mapped – CO3**

Scheduling: Network Techniques: PERT (ADM) and CPM (PDM), Risk Analysis Using Simulation with Crystal Ball

Resource allocation: Critical Path Method—Crashing a Project, Resource Allocation Problem, Resource Loading, Resource Leveling, Constrained Resource Scheduling, Multi-project Scheduling and Resource Allocation, Goldratt's Critical Chain			
Unit IV	**Project Execution**	**(06hrs)**	**COs Mapped – CO4**
Monitoring and Information Systems: The Planning-Monitoring-Controlling Cycle, Information Needs and Reporting, Earned Value Analysis, PMIS (Project Management Information Systems) Project Control: Purposes, Types, Design & Control Project auditing: Purpose, Audit, Use, Life Cycle Project termination: Types, When to terminate?, Process			

Text Books

1. Project Management: A Managerial Approach, Jack R. Meredith, Samuel J. Mantel, Jr., John Wiley & Sons, 7th edition
2. Projects: Planning, Analysis, Selection, Financing, Implementation, and Review, Dr Prasanna Chandra, McGraw Hill Education, 9th edition

Reference Books

1. Project Management: A Systems Approach to Planning, Scheduling, and Controlling, Kerzner Harold, John Wiley & Sons, 8th edition
2. The Practical Guide to Project Management, C. Petersen, Bookboon, 2nd edition

Strength of CO-PO Mapping													CO-PSO Mapping	
	PSO												PSO	
	1	1	3	4	5	6	7	8	9	10	11	12	1	2
CO1	**3**	**-**	**-**	**-**	**-**	**3**	**3**	**3**	**3**	**3**	**3**	**3**	**-**	**-**
CO2	**3**	**-**	**-**	**-**	**-**	**3**	**3**	**3**	**3**	**3**	**3**	**3**	**-**	**-**
CO3	**3**	**-**	**-**	**-**	**-**	**3**	**3**	**3**	**3**	**3**	**3**	**3**	**2**	**2**
CO4	**3**	**-**	**-**	**-**	**-**	**3**	**3**	**3**	**3**	**3**	**3**	**3**	**-**	**-**

Guidelines for Continuous Comprehensive Evaluation of Theory Course		
Sr. No.	**Components for Continuous Comprehensive Evaluation**	**Marks Allotted**
1	Assignments	15
2	Tests	15
3	Seminar	20

K. K. Wagh Institute of Engineering Education and Research, Nashik

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T. Y. B. Tech. Pattern 2022 Semester: V
ETC223010: Mini Project

Teaching Scheme:	Credit Scheme:	Examination Scheme:
Practical : 02hrs/week **Tutorial:01hr/week**	**01** **01**	**Tutorial : 25 Marks** **Term work: 25 Marks**

Prerequisite Courses, if any: Knowledge of all subjects studied up to current semester.

Companion course, if any: --

Course Objectives:

1. To understand the ―Product Development Process including budgeting through Mini Project.
2. To plan for various activities of the project and distribute the work amongst team members.
3. To inculcate electronic hardware implementation skills by –
   - Learning PCB artwork design using an appropriate EDA tool.
   - Imbibing good soldering and effective trouble-shooting practices.
   - Following correct grounding and shielding practices
4. To develop student‘s abilities to transmit technical information clearly and test the same by delivery of Seminar based on the Mini Project.
5. To understand the importance of document design by compiling Technical Report on the Mini Project work carried out
6. To understand the ―Product Development Process including budgeting through Mini Project.

Course Outcomes: On completion of the course, students will be able to–

	Course Outcomes	Bloom’s Level
CO1	**Design and Implement** electronic hardware by learning PCB artwork design, soldering techniques, trouble shooting etc.	5-Create 2-Understand
CO2	**Understand**, **plan**, **execute** and **validate** Mini Project with team.	2-Understand 3-Apply 4-Analyze
CO3	**Prepare** a technical report based on the Mini project.	2-Understand
CO4	**Deliver** technical seminar based on the Mini Project work carried out.	2-Understand

COURSE CONTENTS

On completion of this course student should understand, plan and execute a Mini Project with team. Student should be able to deliver seminar on project along with team member with proper documentation (Report writing).

Course Content: (Syllabus)

Maximum Group Size: Minimum 2 and maximum 3 students can form a group for the mini project.
Project Type: The selected mini project must be based on development of a prototype electronic system/product mandatorily having a hardware component with supporting software.

Unit I	**Ptoject topic selection, Circuit design and simulation**	**3 Weeks**	**COs Mapped - CO1**

Execution steps for Mini Projects:

1. Complete Paper work Design using datasheets specifying:

- Selection criteria of the components to be used.
- Specifications of system i/p and desired o/p.
- Module based hardware design.
- Test points at various stages in various modules
- Certifications and Industrial standards
- New electronic product development stages

2. Design and Simulation phase: The circuit should be simulated using any of the standard simulation software available (either complete circuit to be simulated, if possible or an appropriate part of the circuit can be simulated) Algorithm and the flow chart of the software part must be defined.

Unit II	**Building and testing phase:**	**3 Weeks**	**COs Mapped – CO1,2**

Result verification for hardware and testing the algorithms.

Comparison with the paper design to identify the discrepancies, if any. Justification of the same must be given.

Verified circuit should be assembled and tested on breadboard or general purpose board. Simulation results and/or the snapshots indicating the current and voltage readings or detailing the test point results at various stages must be preserved and included in the project report.

Unit III	**PCB Layout and circuit mounting phase:**	**3 Weeks**	**COs Mapped – CO1,2**

Art work / layout of the circuit using standard layout tools.

Assembling and testing of circuit on final PCB.

Design and fabrication of suitable enclosure and outside fittings such as switches, Buttons, knobs, meters, indicators, displays etc

Unit IV	**Reliability testing and Enclosure design:**	**2 Weeks**	**COs Mapped – CO1,2**

Understand importance of different types of testing. Learn steps, importance of enclosure design and design proper enclosure for mini project.

Unit V	**Project report and bill of material:**	**1 Weeks**	**COs Mapped – CO3,4**

Final testing of the circuit using the earlier defined test points.

Preparing Bill of components and materials.

Drawing entire circuit diagram (component level), outlining various blocks indicating test points, inputs and outputs at various stages on A3 graph sheet,

Deliver technical seminar on project designed.

Text Books
1. Thomas C Hayes, Paul Horowitz,, ―The Art of Electronics‖,Newens Publication 2. Analog Circuit Design: Art, Science and Personalities, by Jim Williams (Editor) , EDN series for Design Engineers, 3. M Ashraf Rizvi,‟ Effective Technical Communication‟, Tata McGraw Hill Education Pvt. Ltd.
Reference Books
1.Robert Boylested, ― Essentials of Circuit Analysis‖, PHI Puublications 2. Meenakshi Raman, Sangeeta Sharma,‟ Technical Communication, Principles and Practice‟, Oxford University Press 3. A.E. Ward, Angus, ― Electronic Product Design‖, Stanley thornes Publishers, UK. 4. C Muralikrishna, Sunita Mishra,‟ Communication Skills for Engineers‟, Pearson

Strength of CO-PO/PSO Mapping													CO-PSO Mapping	
	PSO												PSO	
	1	1	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**
CO1	**3**	**2**	**2**	**2**	**3**	**2**	**2**	**2**	**3**	**-**	**2**	**3**	**2**	**2**
CO2	**3**	**3**	**3**	**2**	**3**	**2**	**2**	**2**	**3**	**-**	**3**	**3**	**2**	**2**
CO3	**2**	**-**	**-**	**-**	**-**	**-**	**-**	**2**	**2**	**3**	**2**	**-**	**2**	**2**
CO4	**2**	**-**	**-**	**-**	**-**	**-**	**-**	**1**	**2**	**3**	**3**	**-**	**2**	**2**

Log book for all these activities shall be maintained and shall be produced at the time of examination.

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T. Y. B. Tech. Pattern 2022 Semester: V
ETC223006A: Software Defined Radio- (Elective 1)

Teaching Scheme:	Credit Scheme:	Examination Scheme:
Theory :03 hrs/week	**03**	**Continuous Comprehensive Evaluation: 20 Marks** **InSem Exam: 20 Marks** **EndSem Exam: 60 Marks**

Prerequisite Courses, if any: Communication Engineering

Companion course, if any: Lab work in Software Defined Radio

Course Objectives:

1. To understand how SDR platform provides easy access to wireless network system
2. To understand Digital Modulation Techniques using SDR.
3. To understand the concept of Cognitive Radio and Spectrum sharing

Course Outcomes: On completion of the course, students will be able to–

	Course Outcomes	Bloom's Level
CO1	Discuss digital modulation techniques for SDR	2- Understand
CO2	Understand RF implementation	2- Understand
CO3	Understand SDR Architecture	2- Understand
CO4	Understand Cognitive radio architecture	2- Understand
CO5	Explore the applications of SDR	2- Understand

COURSE CONTENTS

Unit I	**Digital communication fundamentals for SDR/cognitive radio**	**(08 hrs)**	**COs Mapped - CO1**

Data Transmission ,Digital Modulation Techniques :Representation of Signals , Euclidean Distance between Signals , Decision Rule , Power Efficiency , M-ary Phase Shift Keying , M-ary Quadrature Amplitude Modulation Probability of Bit Error , Derivation of Probability of Bit Error , Probability of Bit Error of M-ary Phase Shift Keying ,Spread spectrum techniques

Unit II	**Introduction to SDR and RF Implementation**	**(07 hrs)**	**COs Mapped - CO2**

Introduction to SDR required hardware specifications, Software/Hardware platform,
Radio frequency spectrum and regulation Purpose of RF front End, Dynamic Range ,RF receiver Front End topologies, Flexibility of RF chain with software radio, Duplexer ,Diplexer ,RF filter ,LNA ,Image reject filters , IF filters , RF Mixers Local Oscillator , AGC, Transmitter Architecture and their issues, Reconfigurable computing architecture

Unit III	**SDR Architecture**	**(07 hrs)**	**COs Mapped – CO3**

Architecture of SDR-Open Architecture, Software Communication Architecture, Transmitter Receiver Homodyne/heterodyne architecture, RF front End, ADC, DAC, DAC/ADC Noise Budget, ADC and DAC Distortion, Role of FPGA/CPU/GPU in SDR, Applications of FPGA in SDR, Design Principles using FPGA, Trade –offs in using DSP, FPGA and ASIC, Power Management Issues in DSP, ASIC, FPGA

Unit IV	**Cognitive Radio Architecture**	**(07 hrs)**	**COs Mapped – CO4**

Cognitive Radio Architecture, The Technologies Required : Radio Flexibility and Capability, Available Technologies for Cognitive Radios, Cognitive Geo-location Applications, Update of CR-Specific Technologies, Spectrum Sensing in CR, Spectrum Awareness and Access Considerations, CR Network, ,OFDM Modulator and Demodulator, Benefits of OFDM in CR,

Unit V	**Applications of SDR**	**(07 hrs)**	**COs Mapped – CO5**

Applications of SDR in Advance Communication System-Case Study, Challenges and Issues, Implementation, Parameter Estimation –Environment, Location, other factors, Vertical Handoff, Network Interoperability. Case Study : 1)CR for Public Safety –PSCR , Modes of PSCR, Architecture of PSCR 2)Beagle board based SDR 3)Embedded PCSR using GNU radio

Text Books

1. Jeffrey.H.Reed ,"Software Radio : A Modern Approach to Radio Engineering ", Pearson , LPE
2. Alexander M. Wyglinski, Worcester Maziar Nekovee., Thomas Hou, "Cognitive Radio Communications and Networks Principles and Practice", 2010 ELSEVIER

Reference Books

1. Markus Dillinger , KambizMadani ,Nancy Alonistioti, "Software Defined Radio : Architectures , Systems and Functions" ,Wiley
2. Tony .J. Rouphael , "RF and DSP for SDR", Elsevier Newness Press ,2008
3. SDR –Handbook , 8th Edition , PENTEK
4. Bruce a. Fette , "Cognitive Radio Technology, Newness", Elsevier

Strength of CO-PO Mapping													CO-PSO Mapping	
	PSO												PSO	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	**3**	**3**	**3**	-	-	-	-	-	-	-	-	-	-	-
CO2	**3**	**3**	-	-	-	-	-	-	-	-	-	-	-	-
CO3	**3**	**3**	-	-	-	-	-	-	-	-	-	-	-	-
CO4	**3**	**3**	**3**	-	-	-	-	-	-	-	-	-	-	-
CO5	**3**	**3**	-	-	-	-	-	-	-	-	-	-	**2**	**2**

Guidelines for Continuous Comprehensive Evaluation of Theory Course		
Sr. No.	**Components for Continuous Comprehensive Evaluation**	**Marks Allotted**
1	Five Assignments on Unit-1, Unit-2, Unit-3, Unit-4 and Unit-5	10
2	Performance in Unit Tests (5 tests, one on each unit)	10
	Total	**20**

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T Y. B. Tech. Pattern 2022 Semester: V **ETC223007A: Lab work in Software Defined Radio**		
Teaching Scheme:	**Credit Scheme:**	**Examination Scheme:**
Practical : 02hrs/week	**01**	**Continuous Comprehensive Practical: 25 Marks** **Term Work: 25 Marks**
Prerequisite Courses, if any: Semiconductor Theory, Mathematics		
Companion course, if any: Software Defined Radio		

Course Objectives:

1. To understand how SDR platform provides easy access to wireless network system
2. To understand Digital Modulation Techniques for SDR.
3. To understand the concept of Cognitive Radio and Spectrum sharing

Course Outcomes: On completion of the course, students will be able to–

	Course Outcomes	Bloom's Level (Cognitive domain)	Bloom's Level (Psychomotor domain)
CO1	**Understand** the fundamental principles of communication, including modulation techniques, transmission schemes, and spectrum analysis.	2- Understand	1-Imitation
CO2	**Demonstrate** the ability to set up and configure SDR hardware and software platforms for different applications.	3- Apply	3-Precision

List of Laboratory Experiments

Sr. No.	**Laboratory Experiments**	**CO Mapped**
1	SDR Hardware Setup: Setting up SDR hardware (e.g., RTL-SDR dongle) and software (e.g., GNU Radio).	**CO1**
2	Design and implement an FM radio receiver using SDR hardware and software, including tuning, demodulation, and audio playback.	**CO2**
3	Build a simple AM radio transmitter and receiver using SDR, exploring the principles of amplitude modulation.	**CO2**
4	Develop a QAM modulation system for digital data transmission using SDR, investigating its advantages in high-speed communication.	**CO2**
5	Design a satellite communication system using Binary Phase Shift Keying (BPSK) modulation with SDR, focusing on its applications in space communication.	**CO2**
6	Design a Radio Frequency Identification (RFID) system using Frequency Shift Keying (FSK) modulation with SDR, exploring its applications in tracking and identification.	**CO2**
7	Implement Quadrature Phase Shift Keying (QPSK) modulation for digital television broadcasting using SDR, exploring its role in modern TV standards.	**CO2**

8	Design a Radio Frequency Identification (RFID) system using Frequency Shift Keying (FSK) modulation with SDR, exploring its applications in tracking and identification.	**CO2**

Guidelines for Laboratory Conduction

1. Teacher will brief the given experiment to students, its procedure, observations calculation, and outcome of this experiment.
2. Equipment and kits required for the allotted experiment will be provided by the lab assistants using SOP.
3. Students will perform the allotted experiment in a group (two students in each group) under the supervision of faculty and lab assistants.
4. After performing the experiment students will check their readings, calculations from the teacher.
5. After checking they have to write the conclusion of the final result.

Guidelines for Student's Lab Journal

Write-up should include title, aim, and diagram, working principle, procedure, observations, graphs, calculations, conclusion and questions, if any.

Guidelines for Termwork Assessment

1. R1: Timely completion of experiment (10 Marks)
2. R2: Understanding of experiment (10 Marks)
3. R3: Presentation / clarity of journal writing (10 Marks)
4. Total 30 marks for each experiment and average marks of all experiments will be converted into 25 marks of term work.

Strength of CO-PO Mapping													CO-PSO Mapping	
	PSO												PSO	
	1	1	3	4	5	6	7	8	9	10	11	12	1	2
CO1	**3**	**3**	**3**	**-**	**3**	**-**	**-**	**-**	**-**	**-**	**-**	**3**	**-**	**-**
CO2	**3**	**3**	**3**	**-**	**3**	**-**	**-**	**-**	**-**	**-**	**-**	**3**	**2**	**2**

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T. Y. B. Tech. Pattern 2022 Semester: V **ETC223006B : Mechatronics (Elective I)**		
Teaching Scheme:	**Credit Scheme:**	**Examination Scheme:**
Theory :03 hrs/week	**03**	**Continuous Comprehensive Evaluation: 20 Marks** **InSem Exam: 20 Marks** **EndSem Exam: 60 Marks**

Prerequisite Courses, if any: Control Systems

Companion course, if any: Lab work in Mechatronics

Course Objectives:

1. To introduce basics of mechatronics system.
2. To expose different sensors & actuators.
3. To explain designing of hydraulic circuit.
4. To explain designing of pneumatic circuit.
5. To explore applications of mechatronics.

Course Outcomes: On completion of the course, students will be able to–

	Course Outcomes	**Bloom's Level**
CO1	Understand fundamentals of mechatronics.	2-Understand
CO2	Describe the operation of sensors and actuators.	2-Understand
CO3	Design simple hydraulic circuit.	3-Apply
CO4	Design simple pneumatic circuit.	3-Apply
CO5	Illustrate applications of mechatronics.	2-Understand

COURSE CONTENTS

Unit I	**Introducing Mechatronics**	**(07hrs)**	**COs Mapped CO1**

Mechatronics: Definitions, Elements, Design Process, Levels
Design Approach: Functions, Ways of Integration, Information Processing Systems, Concurrent Design Procedure, Integrated Design Issues
Mechatronics System: Input & Output Signals, Signal Conditioning, Microprocessor & Software Control, Testing & Instrumentation, Gear and geartrains
Applications: CNC Machines, Flexible Manufacturing System, Computer Integrated Manufacturing, Humanoid Robot, Advanced Vehicle Control System, etc.

Unit II	**Sensors & Actuators**	**(08hrs)**	**COs Mapped – CO2**

Transducers: Types, Characteristics Parameters
Displacement Sensors, Position Sensors, Proximity Sensors, Velocity Sensors, Motion Sensors, Force Sensors, Acceleration Sensors, Torque Sensors, Fluid Pressure Sensors
Liquid Flow Sensors, Liquid Level Sensors, Temperature Sensors, Light Sensors, Digital Transducer, Selection of Sensors
Concept of electrical actuator, single acting and double acting cylinder.

Unit III	Hydraulic Systems	(07hrs)	COs Mapped – CO3
Basic Principles of Hydraulics, Hydraulic Pumps, Hydraulic Actuators, Pressure-Control Valves, Accumulators, Directional Control Valves, Design of simple hydraulic circuit			
Unit IV	**Pneumatic Systems**	**(07hrs)**	**COs Mapped – CO4**
Basic Principles, Compressors, Dryers, and Tanks, Pressure Regulators, Pneumatic Control Valves, Pneumatic Actuators, Comparison of Hydraulic & Pneumatic Systems, Flow Control Valves, Design of simple pneumatic circuit			
Unit V	**Case Studies of Mechatronics systems**	**(07hrs)**	**COs Mapped – CO5**
Case study of mechatronics systems from various domains such as automotive electronics, automation. Illustrative examples: Boat Autopilot, High-Speed Tilting Trains, Automatic Car Park System, Coin Counter, Engine Management System, Autonomous Mobile System, Antilock Brake System Control, Timed Switch, Pick-and-place robot, Bar code reader, Hard Disk Drive and others.			

Text Books

1. The Mechatronics Handbook, R H Bishop, CRC Press
2. Mechatronics: Integrated Mechanical Electronic Systems, G. K. Vijayaraghavan, M. S. Balasundaram, K. P. Ramachandran, Wiley
3. Modern Control Technology, Christopher T. Kilian, Delmar Thomson Learning

Reference Books

1. Mechatronics: Electronic control systems in mechanical and electrical engineering, W. Bolton, Pearson
2. Introduction to Mechatronics and Measurement Systems (Mechanical Engineering), David G. Alciatore and Michael B. Histand, Mc Graw Hill Education, Fourth edition
3. Sensor Technology Handbook, Jon Wilson, Newnes
4. Mechatronics System Design, Devdas Shetty, Richard Kolk, Cengage Learning, Second edition
5. Mechatronics : Principles, Concepts and Applications, Nitaigour Mahalik, Tata McGraw Hill Education
6. Advances In Mechatronics, Horacio Martínez-Alfaro, InTech Publication

Strength of CO-PO Mapping													CO-PSO Mapping	
	PSO												PSO	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	**3**	-	-	-	-	-	-	-	-	-	-	-	-	-
CO2	**3**	-	-	-	-	-	-	-	-	-	-	-	-	-
CO3	**3**	**2**	**2**	-	**3**	-	-	-	-	-	-	-	**3**	**3**
CO4	**3**	**2**	**2**	-	**3**	-	-	-	-	-	-	-	**3**	**3**
CO5	**3**	-	-	-	-	-	-	-	-	-	-	-	-	-

Guidelines for Continuous Comprehensive Evaluation of Theory Course		
Sr. No.	**Components for Continuous Comprehensive Evaluation**	**Marks Allotted**
1	Assignments	**10**
2	Tests	**10**

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T. Y. B. Tech. Pattern 2022 Semester: V
ETC223007B : Lab Work in Mechatronics (Elective I)

Teaching Scheme:	**Credit Scheme:**	**Examination Scheme:**
Practical :02hrs/week	**01**	**Practical: 25 Marks** **Term Work: 25 Marks**

Prerequisite Courses, if any: Control Systems

Companion course, if any: Lab work in Mechatronics

Course Objectives:
1. To expose different sensors & actuators.
2. To explain designing of hydraulic / pneumatic circuit.
3. To explore applications of mechatronics.

Course Outcomes: On completion of the course, students will be able to–

	Course Outcomes	Bloom's Level (Cognitive domain)	Bloom's Level (Psychomotor domain)
CO1	Describe the operation of sensors and actuators.	2-Understand	1-Imitation
CO2	Design simple hydraulic / pneumatic circuit.	3-Apply	2-Manipulation
CO3	Illustrate applications of mechatronics.	2-Understand	1-Imitation

List of Laboratory Experiments / Assignments

Sr. No.	**Laboratory Experiments / Assignments (Any 8)**	**CO Mapped**
1	Weight measurement using strain gauge.	CO1
2	Liquid level measurement using capacitive transducer.	CO1
3	Displacement measurement using sliding potentiometer.	CO1
4	Velocity measurement using photo interruptive sensor and photo reflective sensor.	CO1
5	Temperature measurement using thermocouple / RTD.	CO1
6	To use data acquisition system for DC voltage & DC current measurement.	CO3
7	Design of simple hydraulic / pneumatic circuits.	CO2
8	Design of hydraulic / pneumatic circuits using different types of valves.	CO2
9	Verify operation of proximity sensors.	CO1
10	Simulation of hydraulic / pneumatic circuits.	CO2

Guidelines for Laboratory Conduction

1. Teacher will brief the given experiment to students, its procedure, observations calculation, and outcome of this experiment.
2. Apparatus and equipment required for the allotted experiment will be provided by the lab assistants using SOP.
3. Students will perform the allotted experiment in a group (two students in each group) under the supervision of faculty and lab assistants.
4. After performing the experiment students will check their readings, calculations. After checking they have to write the conclusion of the final result.

Guidelines for Student's Lab Journal

Write-up should include title, aim, and diagram, working principle, procedure, observations, graphs, calculations, conclusion and questions, if any.

Strength of CO-PO Mapping													CO-PSO Mapping	
	PSO												PSO	
	1	1	3	4	5	6	7	8	9	10	11	12	1	2
CO1	**3**	-	-	-	-	-	-	-	-	-	-	-	-	-
CO2	**3**	**2**	**2**	-	**3**	-	-	-	-	-	-	-	**3**	**3**
CO3	**3**	-	-	-	-	-	-	-	-	-	-	-	-	-

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T. Y. B. Tech. Pattern 2022 Semester: V **ETC223006C: Interfacing techniques (Elective 1)**		
Teaching Scheme:	**Credit Scheme:**	**Examination Scheme:**
Theory :03 hrs/week	**03**	**Continuous Comprehensive Evaluation: 20 Marks** **InSem Exam: 20 Marks** **EndSem Exam: 60 Marks**

Prerequisite Courses, if any: 8 bit and 32 bit Microcontrollers

Companion course, if any: Lab work in interfacing techniques

Course Objectives:

1. To learn different I/O techniques architectures.
2. To study serial communication and its programming.
3. To learn to Interface analog devices to microcontroller.
4. To learn to Interface memory to microcontroller.
5. To learn DMA technique to microcontroller.

Course Outcomes: On completion of the course, students will be able to–

	Course Outcomes	**Bloom's Level**
CO1	**Compare** I/O and fast I/O and their features.	3-Application, 4-Analysis
CO2	**Interface** serial peripherals with microcontroller	3-Application
CO3	**Interface** analog devices with microcontroller	3-Application
CO4	**Interface** memory with microcontroller	3-Application
CO5	**Interface** of DMA with microcontroller	3-Application

COURSE CONTENTS

Unit I	**Parallel interfacing**	**(07 hrs)**	**COs Mapped - CO1**
GPIO, FAST GPIO: The need of speed, High speed I/O application, approaches to high speed interfaces Interfacing with GLCD, relays solenoid, dc motor, stepper motor, High speed signal generation			
Unit II	**Serial interfacing**	**(08 hrs)**	**COs Mapped - CO2**
UART, CAN, I2C,SPI,USB CAN interfaces with GPS, GSM modem communication, Wireless device interface such as Bluetooth			
Unit III	**Analog interface**	**(07 hrs)**	**COs Mapped – CO3**
ADC,DAC,I2C ADC interface ,SPI ADC interface ,Sensor interface(tem,pre) DAS system, Internal ADC			
Unit IV	**Memory interface**	**(07 hrs)**	**COs Mapped – CO4**
Address decoding, Timing syntax, General Memory bus timing, External bus timing, SD card interface			

Unit V	DMA interface	(07 hrs)	COs Mapped – CO5
DMA cycles, DMA initiation, Burst verses cycle still DMA, Single address vs Dual Address DMA CASE study :Tem controller using fuzzy logic or IOT			

Text Books

1. Embedded microcomputer systems: real time interfacing (3rd edition), Jonatham W. Valvano.
2. Embedded system: An integrated approach, Lyla B.Das.
3. Introduction to embedded system: A cyber physical systems approach(2nd edition), Edward Ashford Lee and Sanjit Arunkumar Seshia

Reference Books

1. Embedded Systems Architecture - A Comprehensive Guide- T. Noergaard (Newnes, 2005)
2. LPC2148_Education_Board_Users_Guide-Version_2.1_Rev_B

Strength of CO-PO/PSO Mapping (Sample):

Attainment of a PO/PSO depends both on the attainment levels of associated COs of courses and the strengths to which it is mapped.

Each Course Outcome addresses a sub-set of POs and PSOs to varying levels.

(Strengths: 1- Low, 2 – Medium, 3 - Strong)

Strength of CO-PO Mapping													CO-PSO Mapping	
	PSO												PSO	
	1	1	3	4	5	6	7	8	9	10	11	12	1	2
CO1	**3**	**2**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**3**	**3**
CO2	**2**	**-**	**-**	**-**	**2**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**3**	**3**
CO3	**2**	**2**	**3**	**-**	**3**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**3**	**3**
CO4	**2**	**2**	**2**	**-**	**3**	**-**	**-**	**-**	**-**	**-**	**-**	**3**	**3**	**3**
CO5	**2**	**2**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**3**	**3**	**3**

Guidelines for Continuous Comprehensive Evaluation of Theory Course		
Sr. No.	**Components for Continuous Comprehensive Evaluation**	**Marks Allotted**
1	Five Assignments on Unit-1, Unit-2, Unit-3, Unit-4 and Unit-5	10
2	Performance in Unit Tests (5 tests, one on each unit)	10
	Total	**20**

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T. Y. B. Tech. Pattern 2022 Semester: V
ETC223007C: Lab work in Interfacing techniques

Teaching Scheme:	Credit Scheme:	Examination Scheme:
Practical : 02hrs/week	**02**	**Practical: 25 Marks** **Term work: 25 Marks**

Prerequisite Courses, if any: 8 bit and 32 bit Microcontrollers

Companion course, if any: Interfacing techniques

Course Outcomes: On completion of the course, students will be able to–

	Course Outcomes	Bloom's Level (Cognitive domain)	Bloom's Level (Psychomotor domain)
CO1	**Interface** serial peripherals with microcontroller	3-Application	3-Precision
CO2	**Interface** analog devices with microcontroller	3-Application	3-Precision
CO3	**Interface** memory with microcontroller	3-Application	3-Precision
CO4	**Interface** of DMA with microcontroller	3-Application	3-Precision

List of Laboratory Experiments / Assignments

Sr. No.	Laboratory Experiments / Assignments	CO Mapped
1	Interfacing TI processor / (PIC/ARM/8051) with GLCD	**CO2,CO3**
2	Using UART of TI processor /(PIC/ARM/8051) for serial reception and transmission from/to computer	**CO2**
3	Interfacing GSM with TI processor /(PIC/ARM/8051) for sending and receiving message and voice call	**CO2,CO3**
4	Interface I2C ADC to TI processor/(PIC/ARM/8051) for displaying its values.	**CO3**
5	Write a program to generate different waveform for SPI DAC of TI processor/(PIC/ARM/8051)	**CO2,CO3**
6	Interfacing SD card to TI processor /(PIC/ARM/8051)	**CO4**
7	Mini Project based on TI processor/(PIC/ARM/8051) - Data acquisition system	**CO 2,CO3,CO4,CO5**

Guidelines for Laboratory Conduction

1. Teacher will brief the given interfacing of embedded system to students
2. Microcontroller Kits and interfacing modules will be provided in the Lab
3. Students will perform the allotted experiment in a group (two students in each group) under the supervision of faculty and lab assistant.
4. After performing the interfacing and programming students will check their results from the teacher.

5. After checking they have to write the conclusion of the final result.

Guidelines for Student's Lab Journal

Write-up should include title, aim, interfacing diagram, algorithm, procedure, calculations, waveform, conclusion and questions, if any

Guidelines for Term work Assessment

Each experiment from the lab journal is assessed for thirty marks based on three rubrics.
Rubrics R-1 for timely completion
R-2 for understanding
R-3 for presentation/journal writing where each rubric carries ten marks

Strength of CO-PO Mapping													CO-PSO Mapping	
	PSO												PSO	
	1	1	3	4	5	6	7	8	9	10	11	12	1	2
CO1	**3**	**3**	**3**	**-**	**3**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**3**	**3**
CO2	**3**	**3**	**3**	**-**	**3**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**3**	**3**
CO3	**3**	**3**	**3**	**-**	**3**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**3**	**3**

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T. Y. B. Tech. Pattern 2022 Semester: V
ETC223006D: Foundation Course in ML (Elective 1)

Teaching Scheme:	Credit Scheme:	Examination Scheme:
Theory :03 hrs/week	03	Continuous Comprehensive Evaluation: 20 Marks InSem Exam: 20 Marks EndSem Exam: 60 Marks

Prerequisite Courses, if any: Knowledge in Programming languages (C,C++,python)

Companion course, if any: Lab work in Foundation Course in ML

Course Objectives:

- To introduce the fundamental concepts of machine learning and its applications
- To learn the classification, clustering and regression based machine learning algorithms
- To understand the deep learning architectures
- To understand the methods of solving real life problems using the machine learning techniques
- To understand the multiple learners, boosting and stacked generalization

Course Outcomes: On completion of the course, students will be able to–

	Course Outcomes	Bloom's Level
CO1	Understand the basic concepts of Bayesian theory and normal densities	2-Understand
CO2	Implement different classification algorithms used in machine learning	3-Apply
CO3	Implement clustering and component analysis techniques	3-Apply
CO4	Design and implement deep learning architectures for solving real life problems	3-Apply
CO5	Combine the evidence from two or more models/methods for designing a system	3-Apply

COURSE CONTENTS

Unit I	Introduction to Machine Learning	(08 hrs)	COs Mapped - CO1

Introduction – Types of Machine Learning – Supervised Learning – The Brain and the Neuron –Design a Learning System – Perspectives and Issues in Machine Learning – Concept Learning Task –Concept Learning as Search- Finding a Maximally Specific Hypothesis – Version Spaces and the Candidate Elimination Algorithm – Linear Discriminants – Perceptron – Linear Regression.

Unit II	Machine Learning Models	(07 hrs)	COs Mapped - CO2

Linear Models – Multi-Layer Perceptron – Going Forwards – Going Backwards: Back Propagation Error – Multi-Layer Perceptron in Practice – Examples of using the MLP – Overview – Deriving Back-Propagation – Radial Basis Functions and Splines – Concepts – RBF Network – Curse of Dimensionality – Interpolations and Basis Functions – Support Vector Machines.

Unit III	Tree and Probabilistic Model	(07 hrs)	COs Mapped – CO3
Tree and Probabilistic Models – Learning with Trees – Decision Trees – Constructing Decision Trees – Classification and Regression Trees – Ensemble Learning – Boosting – Bagging – Different ways to Combine Classifiers - Probability and Learning – Data into Probabilities – Basic Statistics – Gaussian Mixture Models – Nearest Neighbor Methods – Unsupervised Learning – K means Algorithms –Vector Quantization – Self Organizing Feature Map.			
Unit IV	**Dimensionality Reduction and Evolutionary Models**	**(07 hrs)**	**COs Mapped – CO4**
Dimensionality Reduction and Evolutionary Models - Dimensionality Reduction – Linear Discriminant Analysis – Locally Linear Embedding – Isomap – Least Squares Optimization –Evolutionary Learning – Genetic Algorithms – Genetic Offspring – Genetic Operators – Using Genetic Algorithms – Reinforcements Learning – Overview – Getting Lost Example–Markov Decision Process.			
Unit V	**Graphical Model**	**(07 hrs)**	**COs Mapped – CO5**
Graphical Models – Markov Chain Monte Carlo Methods – Sampling – Proposal Distribution – Markov Chain Monte Carlo – Graphical Models – Bayesian Networks – Markov Random Fields – Hidden Markov Models – Tracking Methods.			

Text Books

1. Ethem Alpaydin, (2014), "Introduction to Machine Learning (Adaptive Computation and Machine Learning Series", (3rd Edn.), MIT Press

Reference Books

1. Jason Bell, (2014), "- Machine Learning – Hands on for Developers and Technical professionals", (1st Edn.), Wiley
2. Peter Flach,(2012), "Machine Learning: The Art and Science of Algorithms that Make Sense of Data", (1st Edn.), Cambridge University Press.

Strength of CO-PO Mapping													CO-PSO Mapping	
	PSO												PSO	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	**3**	**3**	**2**	**1**	**3**	**-**	**-**	**-**	**-**	**-**	**-**	**3**	**-**	**-**
CO2	**2**	**2**	**2**	**1**	**3**	**-**	**-**	**-**	**-**	**-**	**-**	**3**	**1**	**1**
CO3	**3**	**3**	**2**	**2**	**3**	**-**	**-**	**-**	**-**	**-**	**-**	**3**	**1**	**2**
CO4	**2**	**2**	**2**	**2**	**3**	**-**	**-**	**-**	**-**	**-**	**-**	**3**	**1**	**2**
CO5	**3**	**3**	**2**	**2**	**3**	**-**	**-**	**-**	**-**	**-**	**-**	**3**	**1**	**2**

Guidelines for Continuous Comprehensive Evaluation of Theory Course		
Sr. No.	**Components for Continuous Comprehensive Evaluation**	**Marks Allotted**
1	Five Assignments on Unit-1, Unit-2, Unit-3, Unit-4 and Unit-5	10
2	Performance in Unit Tests (5 tests, one on each unit)	10
	Total	**20**

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T. Y. B. Tech. Pattern 2022 Semester: V **ETC223007D: Lab work in Foundation Course in ML**		
Teaching Scheme:	**Credit Scheme:**	**Examination Scheme:**
Practical : **02hrs/week**	**01**	**Practical: 25 Marks** **Term work: 25 Marks**
Prerequisite Courses, if any: Knowledge in Programming languages (C,C++,python)		
Companion course, if any: Foundation Course in ML		

Course Outcomes: On completion of the course, students will be able to–

	Course Outcomes	Bloom's Level (Cognitive domain)	Bloom's Level (Psychomotor domain)
CO1	Understand the basic concepts of Bayesian theory and normal densities	2-Understand	1-Imitation
CO2	Implement different classification algorithms used in machine learning	3-Apply	1-Imitation
CO3	Implement clustering and component analysis techniques	3-Apply	1-Imitation
CO4	Design and implement deep learning architectures for solving real life problems	3-Apply	2-Manipulation
CO5	Combine the evidence from two or more models/methods for designing a system	3-Apply	2-Manipulation

List of Laboratory Experiments / Assignments

Sr. No.	**Laboratory Experiments / Assignments**	**CO Mapped**
1	Implement Principal Component Analysis (PCA) on an unsupervised dataset using NumPy.	**CO1**
2	Implement and demonstrate the Singular Value Decomposition (SVD) on a given set of training data samples. Read the training data from a .CSV file and use NumPy.	**CO2**
3	Write a program to demonstrate the working of the decision tree based ID3 algorithm. Use an appropriate data set for building the decision tree and apply this knowledge to classify a new sample.	**CO3**
4	Write a program to implement the naïveBayesian classifier for a sample training data set stored as a .CSV file. Compute the accuracy of the classifier, considering few test data sets.	**CO4**
5	Assuming a set of documents that need to be classified, use the naïve Bayesian Classifier model to perform this task. Built-in Java classes/API can be used to	**CO4**

	write the program. Calculate the accuracy, precision, and recall for your classifier.	
6	Apply EM algorithm to cluster a set of data stored in a .CSV file. Use the same data set for clustering using k-Means algorithm. Compare the results of these two algorithms and comment on the quality of clustering. You can add Java/Python ML library classes/API in the program.	**CO4**
7	Write a program to construct a Bayesian network considering medical data. Use this model to demonstrate the diagnosis of heart patients using standard Heart Disease Data Set. You can use Java/Python ML library classes/API.	**CO5**
8	Create the following plots using Matplotlib, Pandas Visualization, Seaborn on iris dataset, wine reviews datasets. a) Scatter Plot b) Line chart c) Histogram d) Heatmap	**CO5**

Guidelines for Laboratory Conduction

- 1 Use of coding standards and Hungarian notation, proper indentation and comments.

Operating System recommended:- Linux/Windows or its derivative

Guidelines for Student's Lab Journal

Student's lab journal should contain following related things -
Title, Objectives, Hardware/ Software requirement, Theory, and Conclusion

Guidelines for Term work Assessment

- R1: Timely completion of experiment (10 Marks)
- R2: Understanding of experiment (10 Marks)
- R3: Presentation / clarity of journal writing (10 Marks)

Total 30 marks for each experiment and average marks of all experiments will be converted into 25 marks of term work.

Strength of CO-PO Mapping													CO-PSO Mapping	
	PSO												PSO	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	**3**	**3**	**2**	**1**	**3**	**-**	**-**	**-**	**-**	**-**	**-**	**3**	**-**	**-**
CO2	**2**	**2**	**2**	**1**	**3**	**-**	**-**	**-**	**-**	**-**	**-**	**3**	**1**	**1**
CO3	**3**	**3**	**2**	**2**	**3**	**-**	**-**	**-**	**-**	**-**	**-**	**3**	**1**	**2**
CO4	**2**	**2**	**2**	**2**	**3**	**-**	**-**	**-**	**-**	**-**	**-**	**3**	**1**	**2**
CO5	**3**	**3**	**2**	**2**	**3**	**-**	**-**	**-**	**-**	**-**	**-**	**3**	**1**	**2**

Semester-II

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T. Y. B. Tech. Pattern 2022 Semester: VI **ETC223011: Embedded Processor**		
Teaching Scheme:	**Credit Scheme:**	**Examination Scheme:**
Theory :03 hrs/week	**03**	**Continuous Comprehensive Evaluation: 20 Marks** **InSem Exam: 20 Marks** **EndSem Exam: 60 Marks**

Prerequisite Courses, if any: Embedded system

Companion course, if any:

Course Objectives:

1. To make the students aware of the need of Embedded C and programming in Embedded C.
2. To get the students acquainted with the need and applications of ARM Microprocessors in Embedded systems.
3. To get insight of architecture and features of ARM 7 microcontrollers.
4. To enhance the capabilities of students to interface of various I/O devices, sensors and communication devices.

Course Outcomes: On completion of the course, students will be able to–

	Course Outcomes	**Bloom's Level**
CO1	Understand the architectures of ARM 7,9 and 11	2-Understand
CO2	Programming of ARM 7 based microcontroller with embedded C	3-Apply
CO3	Understand different peripherals interface of LPC 2148.	2-Understand
CO4	Implement the real world interfacing external peripherals and programming of ARM 7 based microcontroller	3-Apply
CO5	Implement serial interface using ARM 7 based microcontroller	3-Apply,

COURSE CONTENTS

Unit I	Embedded Processor Fundamentals	**(07 hrs)**	**COs Mapped - CO1**

Embedded Processor definition and classification, The RISC and CISC, von Neumann and Harvard Architecture, ARM processors and its versions, features of ARM Processor Families: ARM7, ARM9 & ARM11,survey of different 32 bit microcontroller, ARM Design Philosophy and assembly language instruction of ARM7

Unit II	Programming in Embedded C for 32 bit microcontroller	**(07 hrs)**	**COs Mapped - CO2**

Using C for Embedded C, data types, storage class, operators, Branching: if, else-if, Looping: for, while, do-while. Embedded System Development Environment: IDE (Introduction) types of file generated on cross compilation, assembler, disassembler, Simulators and Debuggers.

Unit III	ARM7 Based Microcontroller	**(08 hrs)**	**COs Mapped – CO3**

ARM core data flow model, Programmers model, Registers, CPSR and SPSR, Processor modes, ARM Nomenclature. LPC2148: Features, Block Diagram and Description, System Control Block, Memory Map, System Control Block (PLL and VPB divider), Pin Connect Block, GPIO, Timer Block for Delay Generation, LPC 2148 Interfacing with LED, Switches, Relay,			
Unit IV	Real World parallel Interfacing with ARM7 Based Microcontroller	**(08 hrs)**	**COs Mapped – CO4**
LPC 2148 interface with LCD , on-chip DAC for waveform generation, Interfacing with ARM 7 with DHT 11 sensor and servomotor. on-chip ADC using interrupt (VIC),			
Unit V	ARM7 Based Microcontroller serial interface	**(06 hrs)**	**COs Mapped – CO5**
UART Programming for transmission and reception of characters, Interfacing the peripherals to LPC2148: GSM and GPS using UART, I2C interface, SPI interface, I2C interface with EEPROM, and SPI interface with RTC			

Text Books

Text Books:

1. K.V. Shibu, "Introduction to Embedded Systems", McGraw Hill Education India Private Limited, 2n d Edition
2. Andrew Sloss, Dominic Symes, Chris Wright, "ARM System Developer's Guide – Designing and Optimizing System Software", Elsevier, 1st Edition.
3. Lyla B Das "Embedded Systems" Pearson publication

Reference Books

1. UM10139 LPC214x User manual, NXP Semiconductor

Strength of CO-PO Mapping													CO-PSO Mapping	
	PSO												PSO	
	1	1	3	4	5	6	7	8	9	10	11	12	1	2
CO1	**3**	**3**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**
CO2	**3**	**3**	**3**	**-**	**3**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**2**	**3**
CO3	**3**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**
CO4	**3**	**3**	**3**	**-**	**3**	**-**	**-**	**-**	**-**	**-**	**-**	**3**	**2**	**3**
CO5	**3**	**3**	**3**	**-**	**3**	**-**	**-**	**-**	**-**	**-**	**-**	**3**	**2**	**3**

Guidelines for Continuous Comprehensive Evaluation of Theory Course		
Sr. No.	**Components for Continuous Comprehensive Evaluation**	**Marks Allotted**
1	Five Assignments on Unit-1, Unit-2, Unit-3, Unit-4 and Unit-5	10
2	5 Quiz	10
	Total	**20**

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T. Y. B. Tech. Pattern 2022 Semester: VI **ETC223012 : Power Electronics**		
Teaching Scheme:	**Credit Scheme:**	**Examination Scheme:**
Theory :03 hrs/week	**03**	**Continuous Comprehensive Evaluation: 20 Marks** **InSem Exam: 20 Marks** **EndSem Exam: 60 Marks**

Prerequisite Courses, if any: Fundamentals of Electronics Engineering

Companion course, if any: Lab work in Power Electronics

Course Objectives:

1. To understand construction, switching characteristics and protection of power devices .
2. To understand protection circuits and triggering circuits for power devices.
3. To give an exposure to students of working & analysis of controlled rectifiers, inverters, choppers, AC voltage controllers for different loads.

Course Outcomes: On completion of the course, students will be able to–

	Course Outcomes	**Bloom's Level**
CO1	Select power devices for different power power conversion applications. **Design** & Implement gate drive circuits for power devices	6-Design
CO2	Understand the operation of Controlled rectifiers & Single phase AC voltage controller. Analyze performance parameters of Controlled rectifiers	4-Analysis 2-Understand
CO3	Understand the operation of Choppers and Analyze performance parameters of choppers	4-Analysis 2-Understand
CO4	Understand the operation of Inverters and Analyze performance parameters of Inverters	4-Analysis 2-Understand
CO5	Utilize power converters in different industrial applications	3-Apply

COURSE CONTENTS

Unit I	**Power Devices**	**(08 hrs)**	**COs Mapped - CO1**

SCR: Construction, Operation & characteristics, different ratings, Triggering Methods, Snubber Circuits.
Power MOSFET: Construction, Operation, Static characteristics, Switching characteristics, Breakdown voltages, Safe Operating Area.
IGBT: Construction, Operation, Steady state characteristics, Switching characteristics, Safe operating area, applications, Typical Gate drive circuits for Power MOSFET / IGBT.

Unit II	**Controlled Rectifiers & Single phase AC voltage controller**	**(07 hrs)**	**COs Mapped - CO2**

Single phase Semi & Full converters for R, R-L loads, Performance parameters, Three phase Semi & Full converters, Power factor improvement techniques, PWM rectifiers**,** Single phase AC voltage controller with R load. Typical Gate drive circuits for controlled rectifiers

Unit III	DC-DC Converters	(07 hrs)	COs Mapped – CO3
Step down chopper for R/RL load, Step up chopper, control strategies. 2-quadrant & 4 Quadrant choppers, Performance parameters, Applications of choppers SMPS, SMPS topologies, Flyback converter, Buck regulator TPS40200.			
Unit IV	**DC-AC Converters**	**(07 hrs)**	**COs Mapped – CO4**
Single phase full bridge inverter for R & R-L loads, performance parameters, three phase voltage source inverter for balanced star R load. Variable frequency and Voltage control of inverters, Need of PWM inverters. Design of control circuit design for inverters using PWM ICs LM3524.			
Unit V	**Power Electronics Applications**	**(07 hrs)**	**COs Mapped – CO5**
UPS, HVDC Transmission System, DC drives, Three phase VFD drive, three phase BLDC drive.			

Text Books

1. M. H. Rashid, "Power Electronics Circuits Devices and Applications" PHI 4th Edition 2017 New Delhi.
2. M. D. Singh and K.B. Khanchandani, "Power Electronics", TMH, 2nd Edition 2006.

Reference Books

1. Bogdan M. Wilamowski, J. David Irwin, "The Power Electronics and Motor Drives Handbook",CRCPress,1stEdition, 2011.eBook:ISBN 9780429165627,2019.
2. Muhammad H. Rashid, "Power Electronics Handbook", Academic Press, 2nd Edition,2001
3. Ned Mohan,T.Undeland & W. Robbins, "Power Electronics Converters Applications and Design, John Willey & sons, Singapore, 2nd Edition Oxford University Press, New Delhi,2005
4. Ali Emadi Alireza Khaligh Zhong Nie Young Joo Lee, "Integrated Power Electronic Converters and Digital Control", CRC Press, 1st Edition.
5. Vinod Kumar Khanna "Insulated Gate Bipolar Transistor IGBT Theory and Design", John Wiley & Sons, Illustrated Edition. **Print ISBN: 9780471238454; Online ISBN: 9780471722915, DOI: 10.1002/047172291.**

Strength of CO-PO Mapping													CO-PSO Mapping	
	PSO												PSO	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	**3**	**3**	**3**	-	-	-	-	-	-	-	-	-	**2**	**3**
CO2	**3**	**3**	**3**	-	**2**	-	-	-	-	-	-	-	**2**	**2**
CO3	**3**	**3**	**3**	-	**2**	-	-	-	-	-	-	-	**2**	**2**
CO4	**3**	**3**	**3**	-	**2**	-	-	-	-	-	-	-	**2**	**2**
CO5	**3**	**3**	**2**	-	**2**	-	-	-	-	-	-	**2**	**2**	**3**

Guidelines for Continuous Comprehensive Evaluation of Theory Course		
Sr. No.	**Components for Continuous Comprehensive Evaluation**	**Marks Allotted**
1	Five Assignments on Unit-1, Unit-2, Unit-3, Unit-4 and Unit-5	10
2	Performance in Unit Tests (5 tests, one on each unit)	10
	Total	**20**

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T. Y. B. Tech. Pattern 2022 Semester: VI **ETC223013: Lab work in Power Electronics**		
Teaching Scheme:	**Credit Scheme:**	**Examination Scheme:**
Practical : **02hrs/week**	**01**	**Practical: 25 Marks** **Term work: 25 Marks**
Prerequisite Courses, if any: Fundamentals of Electronics Engineering		
Companion course, if any: Power Electronics		
Course Outcomes: On completion of the course, students will be able to–		

	Course Outcomes	**Bloom's Level (Cognitive domain)**	**Bloom's Level (Psychomotor domain)**
CO1	Understand the operating principles of various power electronic devices	2-Understand	1-Imitation
CO2	Use power electronic simulation packages & hardware to develop the power converters.	3-Apply	2-Manipulation
CO3	Analyze and choose the appropriate converters for various applications	3-Apply	2-Manipulation

List of Laboratory Experiments / Assignments

Sr. No.	**Laboratory Experiments / Assignments**	**CO Mapped**
1	Plot static characteristics of SCR and decide in which region it gets turned on.	CO1
2	Plot V-I characteristics of Power MOSFET & understand its application as a Switch.	CO1
3	Plot the static characteristics of IGBT and compare it with MOSFET.	CO1
4	Design, simulate and implement single phase full converter using IGBT / SCR with R & R-L load and observe the effect of firing angle on load.	CO2
5	Simulate and implement Step down / step up chopper using power MOSFET and observe the effect of ON time period on the Output.	CO2
6	Simulate and implement Single-Phase PWM bridge inverter	CO2
7	Design 5V battery charger using IC TPS40200.	CO3
8	Study DC motor controller.	CO3
9	Study the application of solar cells for providing electrical energy to the domestic appliances such as lamp, fan and radio.	CO3

Guidelines for Laboratory Conduction

- 1. Use of coding standards and Hungarian notation, proper indentation and comments.

Operating System recommended:- Linux/Windows or its derivative

Guidelines for Student's Lab Journal

Student's lab journal should contain following related things -
Title, Objectives, Hardware/ Software requirement, Theory, and Conclusion

Guidelines for Term work Assessment
• R1: Timely completion of experiment (10 Marks) • R2: Understanding of experiment (10 Marks) • R3: Presentation / clarity of journal writing (10 Marks) Total 30 marks for each experiment and average marks of all experiments will be converted into 25 marks of term work.

Strength of CO-PO Mapping													CO-PSO Mapping	
	PSO												PSO	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	**3**	**3**	-	-	-	-	-	-	-	-	-	-	-	-
CO2	**3**	**3**	-	-	**3**	-	-	-	-	-	-	-	**3**	**3**
CO3	**3**	**3**	**3**	-	-	-	-	-	-	-	-	-	**3**	**3**

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T. Y. B. Tech. Pattern 2022 Semester: VI
ETC223017: ESC: Industry 4.0 and Industrial IoT (IIoT)

Teaching Scheme:	Credit Scheme:	Examination Scheme:
Theory :03 hrs/week	**03**	**Continuous Comprehensive Evaluation: 20 Marks** **InSem Exam: 20 Marks** **EndSem Exam: 60 Marks**

Prerequisite Courses, if any: Internet of Things, Industrial management etc.

Course Objectives:

1. To make students familiar with the Industrial IoT Systems.
2. To make the students understand the design and development of Industrial IoT Systems.
3. To enable the students to analyze the real time applications in industrial IoT Systems.

Course Outcomes: On completion of the course, students will be able to–

	Course Outcomes	Bloom's Level
CO1	**Knowledge** of theory and practice related to Industrial IoT Systems	2-Understand
CO2	Ability to **identify, formulate and solve** engineering problems by using Industrial IoT	3-Apply
CO3	Ability to **implement** real field problem by gained knowledge of Industrial applications with IoT capability	3-Apply
CO4	**Comprehend** the basics of Industrial IoT with respect to Industry 4.0	2-Understand
CO5	**Analyze** industrial process through data Analytics using Industrial Internet of Things.	4-Analysis

COURSE CONTENTS

Unit I	Introduction to the Industrial Internet	(06 hrs)	COs Mapped - CO1

What Is the Industrial Internet? Why Industrial Internet and Why Now? Catalysts and precursors of the IIoT. Technical and Business Innovators of the Industrial Internet, IoT Taxonomy, Business Avenues in IIoT, Benefits of IIoT, IoT Ecology,
Use cases of IIoT, Purdue Enterprise Reference Architecture (PERA) Model, Basics of ISA 88 /95 Standards, Levels of Control Hierarchy
Introduction to Manufacturing, Execution Systems (MES)/Manufacturing Operations Managements Systems (MOMS). Architecture of IIOT, different topologies

Unit II	Field Devices (Sensors /Actuators)	(08 hrs)	COs Mapped - CO2

Sensors- Sensor Basics, Role of sensors in IIoT, Applicability of Sensors in different Industries. Design of sensors, Special requirements for IIoT sensors, Sensor architecture. **Actuators** basics, Types of Actuators, Proximity / Field /PAN Networks, Overview of wired and wireless, Topologies of Networks. **Protocols**- Overview of Protocols like ZIGBEE, ZWAVE, MBUS, 6LoWPAN, OPC-UA

Unit III	Middleware Industrial Internet of Things, Platforms	(08 hrs)	COs Mapped – CO3

Middleware Transport Protocols , Software Patterns, Software Design, Overview of various IIoT protocols like - COAP, 6LoWPAN, LWM2M, MQTT, AMPQ etc Understanding of Edge and FOG Device Architectures, Influence of non-functional requirements on Edge and FOG devices, Edge/FOG Hardware

selection criteria. Software Architecture of Edge/FOG devices. IOT Platform Architecture. Overview & Understanding of COTS cloud platforms like Predix, Thing works, Azure etc.			
Unit IV	**IIoT Analytics and Data Management**	**(07hrs)**	**COs Mapped – CO4**
Big Data Analytics in IIoT IIoT Analytics using machine learning, deep learning, and data sciences Cloud computing in IIoT Fog Computing in IIoT Data Management with Hadoop Data Center Networks Software Defined Networks (SDN) in IIoT Security in IIoT.			
Unit V	**Industry 4.0/ Smart Factories**	**(07 hrs)**	**COs Mapped – CO5**
Defining Industry 4.0, Why Industry 4.0? Main Characteristics of Industry 4.0, Industry 4.0 Design Principles, Building Blocks of Industry 4.0, Industry 4.0 Reference Architecture. Smart Manufacturing / Smart Factories, Industry 4.0 Road Map. IT/OT Convergence and Integration. Digital Transformation Introduction, why smart manufacturing? Real world Smart Factories.			

Text Books

1. Industry 4.0: The Industrial Internet of Things 1st ed. Edition by Alasdair Gilchrist
2. Internet of Things for Architects -Perry Lea Packt Publishing ISBN 978-1-78847-059-9
3. IoT Fundamentals: Networking Technologies, Protocols, and Use Cases for the Internet of Things - David Hanes, Gonzalo Salgueiro& others, Cisco Press

Reference Books

1. Industry 4.0 : managing the digital transformation - Cevikcan, Emre, Ustundag, Alp The Singapore Smart Industry ReadinessIndex – EDB Singapore.
2. Sudip Misra, Chandana Roy, Anandarup Mukherjee, "Introduction to Industrial Internet of Things and Industry 4.0", 1st Edition, Taylor and Francis CRC Press, 2021.
3. Alasdair Gilchrist, "Industry 4.0: The Industrial Internet of Things", 1st Edition, A Press E book, 2016.
4. E. Balasubramanian, G. R. Kanagachidambaresan, R. Anand, V. Mahima, "Internet of Things for Industry 4.0: Design, Challenges and Solutions", 1st Edition, Springer International Publishing, 2019.

Strength of CO-PO Mapping													CO-PSO Mapping	
	PO												PSO	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	**3**	**3**	**-**	**-**	**2**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**
CO2	**3**	**3**	**2**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**2**	**3**
CO3	**3**	**3**	**2**	**-**	**2**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**2**	**3**
CO4	**3**	**3**	**-**	**-**	**2**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**
CO5	**3**	**3**	**3**	**-**	**2**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**2**	**3**

Guidelines for Continuous Comprehensive Evaluation of Theory Course		
Sr. No.	**Components for Continuous Comprehensive Evaluation**	**Marks Allotted**
1	Five Assignments on Unit-1, Unit-2, Unit-3, Unit-4 and Unit-5	10
2	Performance in Unit Tests (5 tests, one on each unit)	10
	Total	**20**

Video Link:

1. https://onlinecourses.nptel.ac.in/noc20_cs69/preview
   Introduction to Industry 4.0 and Industrial Internet of Things By Prof. Sudip Misra | IIT Kharagpur

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T. Y. B. Tech. Pattern 2022 Semester: VI
ETC223018: OEC: Digital Marketing

Teaching Scheme:	**Credit Scheme:**	**Examination Scheme:**
Theory :02 hrs/week	**02**	**Continuous Comprehensive Evaluation: 50 Marks**

Prerequisite Courses, if any: Knowledge of modern social media platforms.

Companion course, if any:

Course Objectives:

1. To make the students acquainted with digital marketing & process of website design.
2. To make them aware about the various Digital Marketing Tools, use of social media websites for Digital Marketing.
3. To know the recent trends in Digital Marketing.

Course Outcomes: On completion of the course, students will be able to–

	Course Outcomes	**Bloom's Level**
CO1	**Understand** the importance of Digital marketing in upcoming era.	2-Understand
CO2	**Design** websites using free tools like Wordpress and explore it for digital marketing.	6-Design
CO3	**Apply** various keywords for a website & to perform SEO	3-Apply
CO4	**Understand** the various SEM Tools and Illustrate use of Facebook, Instagram and YouTube, LinkedIn for Digital Marketing in real life.	2-Understand
CO5	**Understand** the importance of recent trends in digital marketing.	2-Understand

COURSE CONTENTS

Unit I	**Introduction to Digital Marketing**	**(05 hrs)**	**COs Mapped - CO1**

What is digital marketing?, Importance of digital marketing, Difference between traditional and digital marketing, Discuss the recent trends and current scenario of the industry ,Digital marketing has been a tool of success for companies, Use digital marketing to increase sales, Case studies on digital marketing strategies.

Unit II	**Website Planning and Creation**	**(05 hrs)**	**COs Mapped - CO2**

WWW, Buying a Domain, Core Objective of Website and Flow, One Page Website, Strategic Design of Products & Services Page, Strategic Design of Landing Page, Contact Us Page, Google Analytics Tracking Code, Designing Wordpress Website. Mobile Friendly Website, Payment Gateway like UPI, e-Commerce.

Unit III	**Search Engine Optimisation (SEO)**	**(05hrs)**	**COs Mapped – CO3**

Introduction to Search Engine Optimization, How does Search Engine work , On-page SEO – content research, keyword research, meta tags, Off-page SEO – link building ,Keyword Research, Factors affecting the rank of a webpage.

Unit IV	**Search Engine Marketing and Social**	**(05 hrs)**	**COs Mapped –**

	Media Marketing		CO4
Features of the Google Ads platform and its algorithm, Creating campaigns, Google Adwords, Ad Creation, Site & Keyword Targeting, CPC, CPA & CPM-based Accounts, Demographic Targeting, Google Keyword Planner , B to C Perspective, B to B Perspective, Major Social Media Platforms for Marketing , Facebook & Instagram Marketing, Youtube Marketing, LinkedIn Advertising, Email Marketing.			
Unit V	**Upcoming Trends in Digital Marketing**	**(04 hrs)**	**COs Mapped – CO5**
Podcast, OTT Platforms, Mob-Ad, No Click Searches, Google Verified Listing, Voice Search, Visual Search, Online Reviews, Automated and Smart Bidding, Chatbots, Affiliate Marketing.			

Text Books

1. Cory Rabazinsky, "Google-Ad words for Beginners: A Do-It-Yourself Guide to PPC Advertising"
2. Oliver J Rich, "Digital Marketing"
3. Jan Zimmerman and Deborah, "Social Media Marketing All-In-One for Dummies".
4. Ian Brodie, "Email Persuasion: Captivate and Engage Your Audience, Build Authority and Generate More Sales With Email Marketing".

Reference Books

1. Prof. Seema Gupta, "Digital Marketing", Mcgraw Hill Publications
2. Judy Strauss, Adel Ansary, Raymond Frost, Prentice Hall, "E- Marketing"
3. Cecilia Figueroa, "Introduction To Digital Marketing 101", BPB Publications.

Strength of CO-PO Mapping													CO-PSO Mapping	
	PSO												PSO	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	**3**	**3**	**-**	**-**	**3**	**-**	**-**	**-**	**-**	**-**	**-**	**3**	**-**	**-**
CO2	**3**	**3**	**3**	**-**	**3**	**-**	**-**	**2**	**-**	**-**	**-**	**3**	**-**	**3**
CO3	**3**	**3**	**3**	**-**	**3**	**-**	**-**	**2**	**-**	**-**	**-**	**3**	**-**	**3**
CO4	**3**	**3**	**-**	**-**	**3**	**-**	**-**	**2**	**-**	**-**	**-**	**3**	**-**	**-**
CO5	**3**	**3**	**-**	**-**	**3**	**-**	**-**	**2**	**-**	**-**	**-**	**3**	**-**	**-**

Guidelines for Continuous Comprehensive Evaluation of Theory Course		
Sr. No.	**Components for Continuous Comprehensive Evaluation**	**Marks Allotted**
1	Five Assignments on Unit-1, Unit-2, Unit-3, Unit-4 and Unit-5	25
2	Five Activities on Unit-1, Unit-2, Unit-3, Unit-4 and Unit-5	25
	Total	**50**

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T. Y. B. Tech. Pattern 2022 Semester: VI **ETC223019: ASM:Web Design**		
Teaching Scheme:	**Credit Scheme:**	**Examination Scheme:**
Practical : 02 hrs/week **Tutorial: 01 hr/week**	**02**	**Practical: 25 Marks** **TermWork: 25 Marks**
Prerequisite Courses, if any: Basics of Internet		
Course Outcomes: On completion of the course, students will be able to–		

	Course Outcomes	**Bloom's Level**
CO1	**Develop** Effective Web Pages with HTML and CSS	3-Apply
CO2	**Design** User-Friendly Website Navigation	6-Create
CO3	**Implement** Interactive Features with JavaScript	3-Apply
CO4	**Design** highly interactive Website with JavaScript Events	6-Create

List of Laboratory Experiments / Assignments

Sr. No.	**Laboratory Experiments / Assignments**	**CO Mapped**
1	Design a home page which displays information about your college department using headings, HTML entities and paragraphs.	**CO1**
2	Implement different types of list tags in the college departmental homepage.	**CO2**
3	Create a HTML form with the use of cascading style sheets.	**CO1**
4	Create a website for online book store with Home, Login, Catalogue, Registration page with links to all these pages in menu on top of every page.	**CO2**
5	Develop a JavaScript program that generates random quotes and displays them on a webpage each time the user refreshes the page.	**CO3**
6	Design a JavaScript application that allows users to add, edit, and delete tasks in a to-do list, with options for marking tasks as complete.	**CO4**
7	Design and implement a simple calculator using Java script for operations like addition multiplication, subtraction, division, square of a number etc.	**CO4**
8	Write a JavaScript program to create a Home page of any website and change background color using 1. On mouse over event 2. On focus event	**CO4**

Guidelines for Laboratory Conduction

1. Teacher will brief the given interfacing of embedded system to students
2. Microcontroller Kits and interfacing modules will be provided in the Lab
3. Students will perform the allotted experiment in a group (two students in each group) under the supervision of faculty and lab assistant.
4. After performing the interfacing and programming students will check their results from the teacher.

5. After checking they have to write the conclusion of the final result.
Guidelines for Student's Lab Journal
Write-up should include title, aim, interfacing diagram, algorithm, procedure, calculations, waveform, conclusion and questions, if any
Guidelines for Term work Assessment
Each experiment from the lab journal is assessed for thirty marks based on three rubrics. Rubrics R-1 for timely completion R-2 for understanding R-3 for presentation/journal writing where each rubric carries ten marks

Strength of CO-PO Mapping													CO-PSO Mapping	
	PSO												PSO	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	**3**	**3**	-	-	**3**	-	-	-	-	-	-	**3**	**3**	**3**
CO2	**3**	**3**	**3**	-	**3**	-	-	-	-	-	-	**3**	**3**	**3**
CO3	**3**	**3**	-	-	**3**	-	-	-	-	-	-	**3**	**3**	**3**
CO4	**3**	**3**	**3**	-	**3**	-	-	-	-	-	-	**3**	**3**	**3**

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T. Y. B. Tech. Pattern 2022 Semester: VI
ETC223020: PSI: Project Phase-I

Teaching Scheme:	Credit Scheme:	Examination Scheme:
Practical : 02 hrs/week	**01**	**Term work: 50 Marks**

Prerequisite Courses, if any: All subjects of E&TC

Companion course, if any: --

Course Objectives:

1. To understand the basic concepts & broad principles of projects.
2. To understand the value of achieving perfection in project implementation & completion.
3. To apply the theoretical concepts to solve real life problems with teamwork and Multidisciplinary approach.
4. To demonstrate professionalism with ethics; present effective communication skills and relate engineering issues to broader societal context.

Course Outcomes: On completion of the course, students will be able to–

	Course Outcomes	Bloom's Level
CO1	**Demonstrate** a sound technical knowledge in field of E&TC in the form of project.	3-Apply
CO2	**Undertake** real life problem identification, formulation and solution.	3-Apply 4-Analysis
CO3	**Design** engineering solutions to complex problems utilizing a systematic approach.	6-Design 4-Analysis
CO4	**Demonstrate** the knowledge, effective communication skills and attitudes as professional engineer.	3-Apply

Project phase 1 is an integral part of the project work. The project work shall be based on the knowledge acquired by the student during the graduation and preferably it should meet and contribute towards the needs of the society. The project aims to provide an opportunity of designing and building complete system or subsystems in the field of Electronics and Telecommunication where the student likes to acquire specialized skills. The student shall prepare the duly certified report of project work in standard format for satisfactory completion of the work by the concerned guide and head of the Department/Institute.

Guidelines:

1. Group Size: The student shall carry the project work individually or by a group of students. Optimum group size shall be 3 students. However, if project complexity demands a maximum group size of 4 students, the project committee should be convinced about such complexity and scope of the work. Projects selected should meet and contribute towards the needs of the society.
2. Selection and approval of topic: Topic should be related to real life application in the field of Electronics and Telecommunication engineering.
3. The topic may be based on : Investigation of the latest development in a specific field of Electronics or Communication / The investigation of practical problem in manufacture and / or testing of electronics or communication equipment/ Software based projects related to VHDL,

Communication, Instrumentation, Signal Processing agriculture Engineering etc. with the justification for techniques used / any topic in the field of E&TC may be allowed.
4. Interdisciplinary projects should be encouraged. The examination of Interdisciplinary projects shall be conducted independently in respective departments.
5. The term work assessment of project phase 1 shall be based on Innovative Idea of selected project, literature survey, Depth of understanding, Applications, Individual contributions, presentation, project report, timely completion of work.
6. The department should prepare project planner and should follow accordingly
7. A log book of work carried out during the semester should be maintained with weekly review remarks by the guide and committee.
8. A certified copy of report preferably using LATEX is required to be presented to external examiner at the time of Fourth examination.
9. The project report must undergo by plagiarism check and the similarity index must be less than 15%. The plagiarism report should be included in the project report.

Strength of CO-PO Mapping													CO-PSO Mapping	
	PSO												PSO	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	**3**	**3**	**3**	**3**	**3**	**3**	**3**	**3**	**3**	**3**	**3**	**3**	**3**	**3**
CO2	**3**	**3**	**3**	**3**	**3**	**3**	**3**	**3**	**3**	**3**	**3**	**3**	**3**	**3**
CO3	**3**	**3**	**3**	**3**	**3**	**3**	**3**	**3**	**3**	**3**	**3**	**3**	**3**	**3**
CO4	**3**	**3**	**3**	**3**	**3**	**3**	**3**	**3**	**3**	**3**	**3**	**3**	**3**	**3**

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T. Y. B. Tech. Pattern 2022 Semester: VI
ETC223014A: Microwave Engineering (Elective 2)

Teaching Scheme:	**Credit Scheme:**	**Examination Scheme:**
Theory :03 hrs/week	**03**	**Continuous Comprehensive Evaluation: 20 Marks** **InSem Exam: 20 Marks** **EndSem Exam: 60 Marks**

Prerequisite Courses, if any: Electromagnetics Engineering

Companion course, if any: Lab Work in Microwave Engineering

Course Objectives:

1. To make the students aware of various active and passive microwave components and devices.
2. To explore the students to various microwave measurement components, devices and techniques.
3. To introduce the students to various microwave systems, recent trends in microwave engineering and applications of microwaves.

Course Outcomes: On completion of the course, students will be able to–

	Course Outcomes	**Bloom's Level**
CO1	**Analyze** various passive microwave components.	4 - Analyze
CO2	**Design** and realize various power dividers and couplers.	3 - Apply
CO3	**Understand** the construction, working, characteristics and applications of various microwave tubes and diodes.	2 - Understand
CO4	**Use** various microwave measurement components and devices for different microwave measurements.	3 - Apply
CO5	**Elaborate** applications of microwaves, various microwave systems and modern trends in microwaves engineering.	2 - Understand

COURSE CONTENTS

Unit I	**Passive Microwave Components**	**(08 hrs)**	**COs Mapped - CO1**

Construction, working principle and scattering analysis of passive microwave components such as E-plane, H-plane and magic tee, Ferrite composition, characteristics and Faraday rotation principle, Construction, working principle and scattering analysis of isolator, circulator, gyrator and directional coupler

Unit II	**Power Dividers and Couplers**	**(07 hrs)**	**COs Mapped - CO2**

Design and realization of T-junction power divider, Wilkinson power divider, Quadrature (90^o) hybrid, Qualitative description of two-hole and multi-hole waveguide couplers, Coupled line directional coupler.

Unit III	**Active Microwave Components**	**(07 hrs)**	**COs Mapped – CO3**

Limitations of conventional tubes, O and M type classification of microwave tubes, re-entrant cavity, velocity modulation, Construction, operation, performance analysis and applications of single cavity and two cavity klystron, Cylindrical wave magnetron and Helix traveling wave tube, Construction, working principle and applications of two terminal microwave devices such as Tunnel Diode, Gunn Diode, PIN Diode, Schottky Barrier Diode and Varactor Diode

Unit IV	**Microwave Measurements**	**(07 hrs)**	**COs Mapped – CO4**

Microwave measurement components and devices such as Slotted Line, Tunable Detector, VSWR meter, Power meter, Network Analyzer, Spectrum Analyzer;
Microwave measurement techniques to measure S-parameters, frequency, power, attenuation, phase shift, VSWR, impedance

Unit V	**Microwave Systems**	**(07 hrs)**	**COs Mapped – CO5**

Radar, Cellular phone, Satellite communication, RFID, GPS, Microwave imaging, Modern trends in microwaves engineering, Effect of microwaves on human body, Medical and Civil applications of microwaves, Electromagnetic interference / Electromagnetic compatibility

Text Books

1. Microwave Engineering, David M. Pozar, Wiley
2. Microwave Devices and Circuits, Samuel Y. Liao, Pearson
3. Microwave Circuits and Passive Devices, M. L. Sisodia & G. S. Raghuvamshi, Wiley

Reference Books

1. Microwave and Radar Engineering, M. Kulkarni, Umesh Publications
2. Basic Microwave Techniques and Laboratory Manual, M. L. Sisodia & G. S. Raghuvanshi, New Age International Limited Publishers

Sr. No.	**Components for Continuous Comprehensive Evaluation**	**Marks Allotted**
1	**Assignment:** Assignment No. 1 - Unit 1, 2 (30 Marks) Assignment No. 2 - Unit 3, 4, 5 (30 Marks) **Note:** These 60 marks of two assignments will be converted into 10 marks.	10
2	**Online Quiz:** Unit No. 1 (10 Questions - 10 Marks) Unit No. 2 (10 Questions - 10 Marks) Unit No. 3 (10 Questions - 10 Marks) Unit No. 4 (10 Questions - 10 Marks) Unit No. 5 (10 Questions - 10 Marks) **Note:** These 50 marks of five quizzes will be converted into 10 marks.	10
	Total	**20**

Strength of CO-PO Mapping													CO-PSO Mapping	
	PSO												PSO	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	**3**	**3**	**2**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**2**
CO2	**3**	**3**	**2**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**2**
CO3	**3**	**3**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**
CO4	**3**	**3**	**2**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**2**
CO5	**3**	**3**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**

K. K. Wagh Institute of Engineering Education and Research, Nashik

(Autonomous from Academic Year 2022-23)

T. Y. B. Tech. Pattern 2022 Semester: VI
ETC223016A: Lab work in Microwave Engineering

Teaching Scheme:	Credit Scheme:	Examination Scheme:
Practical : 02hrs/week	**02**	**Practical: 25 Marks** **Term work: 25 Marks**

Prerequisite Courses, if any: Fundamentals of Basic electronics

Companion course, if any: Microwave Engineering

Course Outcomes: On completion of the course, students will be able to–

	Course Outcomes	Bloom's Level (Cognitive domain)	Bloom's Level (Psychomotor domain)
CO1	Measure and plot characteristics of microwave devices	3-Application	2-Manipulation
CO2	Measure and verify port characteristics of microwave bench components	3-Application	2-Manipulation
CO3	Measure microwave bench frequency, SWR and s-parameters.	3-Application	2-Manipulation

List of Laboratory Experiments / Assignments

Sr. No.	Laboratory Experiments / Assignments	CO Mapped
1	To measure and plot mode characteristics of reflex klystron	CO1
2	To measure VI characteristics of Gunn Diode and study of PIN Modulator	CO1
3	To measure and verify port characteristics of microwave tees (E, H, E-H or magic planes)	CO2
4	To measure and verify port characteristics of directional coupler and calculate coupling factor, insertion loss and directivity	CO2
5	To measure and verify port characteristics of isolator and circulator. Calculate insertion loss and isolation in dB.	CO2
6	To measure the wavelength of microwave using microwave test bench and verify with its theoretical value.	CO3
7	To plot standing wave pattern and measure SWR for open, short and matched termination at microwave frequency.	CO3
8	Study the network analyser and carry out the measurements of s-parameter	CO3

Guidelines for Laboratory Conduction

1. Teacher will brief the given interfacing of PLC to students
2. Sensor kits will be provided in the Lab
3. Students will perform the allotted experiment in a group (two students in each group) under the supervision of faculty and lab assistant.
4. After performing the interfacing and programming students will check their results from the teacher.

5. After checking they have to write the conclusion of the final result.
Guidelines for Student's Lab Journal
Write-up should include title, aim, interfacing diagram, algorithm, procedure, calculations, waveform, conclusion and questions, if any
Guidelines for Term work Assessment
Each experiment from the lab journal is assessed for thirty marks based on three rubrics. Rubrics R-1 for timely completion R-2 for understanding R-3 for presentation/journal writing where each rubric carries ten marks

Strength of CO-PO Mapping													CO-PSO Mapping	
	PSO												PSO	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	**3**	**3**	-	-	-	-	-	-	-	-	-	-	-	-
CO2	**3**	**3**	-	-	-	-	-	-	-	-	-	-	-	-
CO3	**3**	**3**	-	-	**3**	-	-	-	-	-	-	-	-	**3**

K. K. Wagh Institute of Engineering Education and Research, Nashik

(Autonomous from Academic Year 2022-23)

T. Y. B. Tech. Pattern 2022 Semester: VI
ETC223014B: Process Instrumentation (Elective -2)

Teaching Scheme:	Credit Scheme:	Examination Scheme:
Theory :03 hrs/week	**03**	**Continuous Comprehensive Evaluation: 20 Marks** **InSem Exam: 20 Marks** **EndSem Exam: 60 Marks**

Prerequisite Courses, if any: Sensors and Transducers, Automatic control systems, Control system component.

Companion course, if any: Lab Work in Process Instrumentation

Course Objectives:

1. To make the students familiar with different process dynamics in Process industries and different control schemes generally used to get best output.
2. To introduce process dynamics which are helpful for process design
3. To introduce control schemes which are applicable for process design
4. To aware various analysis of multivariable systems and characteristics of discrete state control and about state process control

Course Outcomes: On completion of the course, students will be able to–

	Course Outcomes	Bloom's Level
CO1	Select control action for various process dynamics.	2-Understand
CO2	Understand process dynamics and analyze control loop	4-Analysis
CO3	Implement different control schemes to various processes.	6-Design
CO4	Analyze the multivariable system & understand batch process with an example	4-Analysis
CO5	Design process control scheme	6-Design

COURSE CONTENTS

Unit I	Process Control	(07 hrs)	COs Mapped - CO1

Introduction to process control, objectives and benefits, types of processes (dead time, single/ multi-capacity, self-regulating/non self-regulating, interacting/ non-interacting, linear/ nonlinear), characteristics, and selection of control action for them. Necessity of process modeling, degree of freedom, mathematical modeling of simple processes like surge tank level, stirred tank reactor etc.

Unit II	Process Dynamics and analysis of control loops	(08 hrs)	COs Mapped - CO2

Steady state gain, process gain, valve gain, process time constant, variable time constant, transmitter gain, linearising an equal percentage valve, variable pressure drop.
Analysis of flow control, pressure control, liquid level control, temperature control, SLPC-features, faceplate, functions, MLPC- features, faceplate, functions, SLPC and MLPC comparison.
Scaling: types of scaling, examples of scaling

Unit III	Control Schemes	(07 hrs)	COs Mapped – CO3

Basic principles, design criteria, performance, controller algorithm and tuning, cascade control, feed forward control, feedback, feed-forward control, ratio control, selective control, split range control, inferential control. Examples and any special features of the individual loop and industrial applications.			
Unit IV	**Multivariable and Discrete-State Control**	**(07 hrs)**	**COs Mapped – CO4**
Block diagram analysis of multivariable systems, interaction, tuning of multivariable controllers, relative gain analysis, discrete state process control characteristics of the system, introduction to batch process with example			
Unit V	**Process control Design**	**(07 hrs)**	**COs Mapped – CO5**
Defining the problem, measurements, final elements, process operability, control structure, control algorithm, control for safety, performance monitoring. Managing the Design Process: sequence of design steps, hierarchy of control structure, process decomposition, integrating the control design methods, key guidelines.			

Text Books

1. Instrument Engineers' Handbook: Process Control: B.G. Liptak, Chilton.
2. Optimization of Industrial Unit Processes - Bela G. Liptak

Reference Books

2. 1. Boiler Control Systems: David Lindsey, Mc GRAW-HILL
3. 2. Process Control Systems- F.G.Shinskey, TMH
4. 3. Process Control Instrumentation Technology, C. D. Johnson
5. 4. Chemical Process Control: An Introduction to Theory and Practice by George Stephanopoulos, PHI

Strength of CO-PO Mapping													CO-PSO Mapping	
	PSO												PSO	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	**3**	**3**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**
CO2	**3**	**3**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**2**	**2**
CO3	**3**	**3**	**2**	**-**	**3**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**2**	**2**
CO4	**3**	**3**	**-**	**-**	**3**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**2**	**2**
CO5	**3**	**3**	**2**	**-**	**3**	**-**	**-**	**-**	**-**	**-**	**-**	**2**	**2**	**2**

Guidelines for Continuous Comprehensive Evaluation of Theory Course		
Sr. No.	**Components for Continuous Comprehensive Evaluation**	**Marks Allotted**
1	Five Assignments on Unit-1, Unit-2, Unit-3, Unit-4 and Unit-5	10
2	Performance in Unit Tests (5 tests, one on each unit)	10
	Total	**20**

K. K. Wagh Institute of Engineering Education and Research, Nashik

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T. Y. B. Tech. Pattern 2022 Semester: VI **ETC223016B: Lab work in Process Instrumentation**		
Teaching Scheme:	**Credit Scheme:**	**Examination Scheme:**
Practical : 02hrs/week	**02**	**Practical: 25 Marks** **Term work: 25 Marks**
Prerequisite Courses, if any: Fundamentals of Basic electronics		
Companion course, if any: Process Instrumentation		
Course Outcomes: On completion of the course, students will be able to–		

	Course Outcomes	**Bloom's Level (Cognitive domain)**	**Bloom's Level (Psychomotor domain)**
CO1	Implement control actions using PLC & Feedback control technique	3-Application	2-Manipulation
CO2	Analyse characteristics of flow control loops	4-Analysis	3-Precision
CO3	Implement process control parameter measurement techniques	3-Application	2-Manipulation
CO4	Explain use of advanced controller in process control industries	1-Understanding	1-Imitation

List of Laboratory Experiments / Assignments

Sr. No.	**Laboratory Experiments / Assignments**	**CO Mapped**
1	Develop and Implement PLC program for safety Operations	CO1
2	Design and Implement P, PI & PID controller.	CO1
3	Analysis of characteristics of Ultrasonic flow control loop	CO2
4	Design and Implement liquid level measurement system	CO3
5	Design and Implement temperature measurement system using Thermocouple/RTD/Thermister	CO3
6	Study of SPLC for process control.	CO4
7	Design and Implementation of Advance process controller.(ANN/FUZZY/MPC) (Using any one simulation software)	CO4
8	Process Control Instrumentation – A case study on any plant.	CO4

Guidelines for Laboratory Conduction

1. Teacher will brief the given interfacing of PLC to students
2. Sensor kits will be provided in the Lab
3. Students will perform the allotted experiment in a group (two students in each group) under the supervision of faculty and lab assistant.
4. After performing the interfacing and programming students will check their results from the teacher.
5. After checking they have to write the conclusion of the final result.

Guidelines for Student's Lab Journal

Write-up should include title, aim, interfacing diagram, algorithm, procedure, calculations, waveform, conclusion and questions, if any

Guidelines for Term work Assessment

Each experiment from the lab journal is assessed for thirty marks based on three rubrics.
Rubrics R-1 for timely completion
R-2 for understanding
R-3 for presentation/journal writing where each rubric carries ten marks

Strength of CO-PO Mapping													CO-PSO Mapping	
	PSO												PSO	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	**3**	**3**	**2**	**-**	**3**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**2**	**2**
CO2	**3**	**3**	**2**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**2**	**2**
CO3	**3**	**3**	**3**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**2**	**2**
CO4	**3**	**3**	**-**	**-**	**2**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**

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T. Y. B. Tech. Pattern 2022 Semester: VI
ETC223014C : Advanced Processor: Elective II

Teaching Scheme:	Credit Scheme:	Examination Scheme:
Theory :03 hrs/week	**03**	**Continuous Comprehensive Evaluation: 20 Marks** **InSem Exam: 20 Marks** **EndSem Exam: 60 Marks**

Prerequisite Courses, if any: Embedded system and Embedded Processor

Companion course, if any: Lab Work in Advanced Processor

Course Objectives:

1. To make the students aware of the need of Embedded C and programming in Embedded C.
2. To get the students acquainted with the need and applications of ARM Cortex in Embedded systems.
3. To get insight of architecture and features of ARM Cortex microcontrollers.
4. To enhance the capabilities of students to interface of various I/O devices, sensors and communication devices.

Course Outcomes: On completion of the course, students will be able to–

	Course Outcomes	Bloom's Level
CO1	Understand the architectures of ARM Cortex	2-Understand
CO2	Understand different peripherals interface of STM32F4xx	2-Understand
CO3	Implement the real world interfacing external peripherals and programming of ARM cortex based microcontroller	3-Apply
CO4	Implement serial interface using ARM cortex based microcontroller	3-Apply
CO5	Programming of ARM cortex using CUBE IDE and embedded C	3-Apply,

COURSE CONTENTS

Unit I	ARM CORTEX Fundamentals	(07 hrs)	COs Mapped - CO1

Introduction to ARM CORTEX series: CORTEX A, R, M processors, survey of ARM cortex microcontroller, Firmware development using CMSIS Standard. Introduction to ARM CORTEX M4 microprocessor core, programmer model, Processor Modes, Memory Map

Unit II	ARM CORTEX –M cores	(07 hrs)	COs Mapped - CO2

Introduction Arm Cortex-M cores, STM32F4xx Architecture, ARM STM Bus Architecture, STM32F4xx Clock and SYSCLK, Peripheral Clock, PLL clock, Interrupts and Exceptions in STM32F4xx.

Unit III	STM32F4xx interfacing with different devices	(07 hrs)	COs Mapped – CO3

STM32F4xx GPIO Programming, Interfacing seven segment LED, LDR and MQ3 sensor, STM32F4xx: Counters and Timers: Timer and Delay Generation, UART Programming, on chip ADC and Onchip DAC for waveform generation			
Unit IV	**STM32F4xx interfacing with different devices and CAN bus**	**(07 hrs)**	**COs Mapped – CO4**
STM32F4xx Interfacing with accelerometer MPU 6050, Ultrasonic Sensor HC-SR04, PWM: Controlling speed and direction of DC Motor CAN Bus: Features, CAN Frame, sequence of transmitting and receiving data on CAN Bus			
Unit V	**ARM cortex board**	**(08 hrs)**	**COs Mapped – CO5**
CUBE IDE software , STM 32 board , STM32 interfacing with TFT, Raspberry PI board and interfacing for image processing application			

Text Books

1.Shujen Chen, Muhammad Ali Mazidi, Eshragh Ghaemi, "STM32 Arm Programming for Embedded Systems: Using C Language with STM32", Nucleo, Micro DigitalEd., Illustrated Edition,2018

Reference Books

1. RM0390 Reference manual, STM32F446xx advanced Arm®-based 32-bit MCUs
2. 3. Joseph Yiu, "The Definitive Guide to ARM® Cortex®-M3 and Cortex®-M4 Processors", Newnes, 3rd Edition

Strength of CO-PO Mapping													CO-PSO mapping	
	PO												PSO	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	**3**	**3**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**
CO2	**3**	**-**	**-**	**-**	**3**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**
CO3	**3**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**3**
CO4	**3**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**3**	**-**	**3**
CO5	**3**	**3**	**-**	**-**	**3**	**-**	**-**	**-**	**-**	**-**	**-**	**3**	**-**	**3**

Guidelines for Continuous Comprehensive Evaluation of Theory Course		
Sr. No.	**Components for Continuous Comprehensive Evaluation**	**Marks Allotted**
1	Five Assignments on Unit-1, Unit-2, Unit-3, Unit-4 and Unit-5	10
2	5 Quiz	10
	Total	**20**

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T. Y. B. Tech. Pattern 2022 Semester: VI
ETC223016C: Lab Work in Advanced Processor (Elective II)

Teaching Scheme:	**Credit Scheme:**	**Examination Scheme:**
Practical :02hrs/week	**01**	**Practical: 25 Marks** **Term work: 25 Marks**

Prerequisite Courses, if any: Embedded Systems and Embedded processor

Companion course, if any: Advanced Processor

Course Objectives:

1. Interface different devices with STM32F4xx
2. Write program in embedded C using CUBE IDE

Course Outcomes: On completion of the course, students will be able to–

	Course Outcomes	**Bloom's Level (Cognitive domain)**	**Bloom's Level (Psychomotor domain)**
CO1	Interface different devices to STM32F4xx microcontroller	3-Apply	2-Manipulation
CO2	Write program for different devices in embedded C using CUBE IDE	3-Apply	2-Manipulation

List of Laboratory Experiments / Assignments

Sr. No.	**Laboratory Experiments / Assignments (Any 8)**	**CO Mapped**
1	Develop a digital clock system using the STM32F4xx microcontroller and a Seven Segment LED display. The microcontroller can retrieve real-time data from an external RTC (Real-Time Clock) module or an internal timer to display hours, minutes, and seconds on the Seven Segment display	CO1,CO2
2	Create a wireless keyboard interface system where keystrokes from a wireless keyboard are transmitted via UART to the STM32F4xx microcontroller.	CO1,CO2
3	Utilize the on-chip ADC of STM32F4xx to interface with various sensors such as temperature sensors (e.g., LM35), light sensors (e.g., LDR), or pressure sensors.	CO1,CO2
4	Implement PWM-based speed and direction control with the STM32F4xx microcontroller, precise control over the motion of robotic systems	CO1,CO2
5	Implement a greenhouse monitoring system where the STM32F4xx microcontroller with DHT11 sensors is used to measure temperature and humidity levels inside the greenhouse.	CO1,CO2
6	Implement gesture recognition systems using the STM32F4xx microcontroller and MPU6050 sensor to detect and interpret human gestures and movements.	CO1,CO2

7	Develop a distance measurement and obstacle avoidance system using the STM32F4xx microcontroller and HC-SR04 sensor for robotics platforms, drones, or autonomous vehicles.	CO1,CO2
8	Develop a smart lighting system using the STM32F4xx microcontroller and LDR sensor to automatically adjust the brightness of indoor or outdoor lighting based on ambient light levels.	CO1,CO2

Guidelines for Laboratory Conduction

1. Teacher will brief the given experiment to students, its procedure, observations calculation, and outcome of this experiment.
2. Apparatus and equipment required for the allotted experiment will be provided by the lab assistants using SOP.
3. Students will perform the allotted experiment in a group (two students in each group) under the supervision of faculty and lab assistants.
4. After performing the experiment students will check their readings, calculations. After checking they have to write the conclusion of the final result.

Guidelines for Student's Lab Journal

Write-up should include title, aim, and diagram, working principle, procedure, observations, graphs, calculations, conclusion and questions, if any.

Guidelines for Term work Assessment

1. R1: Timely completion of experiment (10 Marks)
2. R2: Understanding of experiment (10 Marks)
3. R3: Presentation / clarity of journal writing (10 Marks)

Total 30 marks for each experiment and average marks of all experiments will be converted into 25 marks of term work.

Strength of CO-PO Mapping													**CO-PSO Mapping**	
	PO												PSO	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	**3**	**2**	-	-	**3**	-	-	-	-	-	-	**3**	**3**	**3**
CO2	**3**	**2**	-	-	**3**	-	-	-	-	-	-	**3**	**3**	**3**

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T. Y. B. Tech. Pattern 2022 Semester: VI **ETC223014D: Neural Network and Fuzzy Control (Elective -2)**		
Teaching Scheme:	**Credit Scheme:**	**Examination Scheme:**
Theory :03 hrs/week	**03**	**Continuous Comprehensive Evaluation: 20 Marks** **InSem Exam: 20 Marks** **EndSem Exam: 60 Marks**

Prerequisite Courses, if any: Fundamental of Computing

Companion course, if any: Lab work in Neural Network and Fuzzy Control

Course Objectives:

1. To understand the basic concept of fuzzy sets, fuzzy logic & defuzzification
2. To learn basics of Artificial Neural of theory and programming of Microprocessors
3. To analyze various techniques in feedback and feed forward Neural networks.
4. To Understand the principle of competitive neural networks and Adaptive resonance theory
5. To learn the architecture and algorithm of Cognitron, Neo cognitron The concepts of fuzzy associative memory and fuzzy systems.

Course Outcomes: On completion of the course, students will be able to–

	Course Outcomes	Bloom's Level
CO1	Understand the concept of fuzziness involved in various systems Apply the knowledge of fuzzy set theory.	2-Understand
CO2	Understand the difference between learning and programming and explore practical applications of Neural Networks (NN).	2-Understand
CO3	To analyse and appreciate the applications which can use fuzzy logic.	3-Apply
CO4	Understand the basics of genetic algorithm, use of GA operators and its applications.	2-Understand

COURSE CONTENTS

Unit I	**FUNDAMENTALS OF FUZZY LOGIC**	**(07 hrs)**	**COs Mapped - CO1**

Basic concepts: fuzzy set theory- basic concept of crisp sets and fuzzy sets- complements-unionintersection- combination of operation- general aggregation operations- fuzzy relations-compatibility relations-orderings- morphisms- fuzzy relational equations-fuzzy set and systems

Unit II	**ARCHITECTURE OF NEURAL NETWORKS**	**(08 hrs)**	**COs Mapped - CO2**

Architectures: motivation for the development of natural networks-artificial neural networks-biological neural networks-area of applications-typical Architecture-setting weights-common activations functionsBasic learning rules- Mcculloch-Pitts neuron- Architecture, algorithm, applications-single layer net for pattern classification- Biases and thresholds, linear separability - Hebb'srule- algorithm -perceptron - Convergence theorem-Delta rule

Unit III	**BASIC NEURAL NETWORK TECHNIQUES**	**(07 hrs)**	**COs Mapped – CO2**

Back propagation neural net:standard back propagation-architecture algorithm- derivation of learning rulesnumber of hidden layers--associative and other neural networks- hetro associative memory neural net, auto associative net- Bidirectional associative memory-applications-Hopfield nets-Boltzman machine			
Unit IV	**COMPETITIVE NEURAL NETWORKS**	**(07 hrs)**	**COs Mapped – CO3**
Neural network based on competition: fixed weight competitive nets- Kohonenself organizing maps and applications-learning vector quantization-counter propagation nets and applications adaptive resonance theory: basic architecture and operation-architecture, algorithm, application and analysis of ART1 & ART2			
Unit V	**SPECIAL NEURAL NETWORKS**	**(07 hrs)**	**COs Mapped – CO4**
Cognitron and Neocognitron - Architecture, training algorithm and application-fuzzy associate memories, fuzzy system architecture- comparison of fuzzy and neural systems.			

Text Books

1. T1. Kliryvan- Fuzzy System & Fuzzy logic Prentice Hall of India, First Edition.
2. Lawrence Fussett- fundamental of Neural network Prentice Hall , First Edition.

Reference Books

3. 1. Bart Kosko, ―Neural network and Fuzzy System‖ - Prentice Hall-1994.
4. 2. J.Klin and T.A.Folger, ―Fuzzy sets‖ University and information- Prentice Hall -1996.
5. 3. J.M.Zurada, ―Introduction to artificial neural systems‖-Jaico Publication house,Delhi 1994.
6. 4. VallusuRao and HayagvnaRao , ―C++ Neural network and fuzzy logic‖-BPB and Publication, New Delhi,1996.
7. 5. Intelligent Systems and Control-http://nptel.ac.in/courses/108104049/16

Strength of CO-PO Mapping													CO-PSO Mapping	
	PSO												PSO	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	**3**	**3**	**2**	**1**	**3**	**-**	**-**	**-**	**-**	**-**	**-**	**3**	**-**	**-**
CO2	**2**	**2**	**2**	**1**	**3**	**-**	**-**	**-**	**-**	**-**	**-**	**3**	**-**	**-**
CO3	**3**	**3**	**2**	**2**	**3**	**-**	**-**	**-**	**-**	**-**	**-**	**3**	**1**	**1**
CO4	**2**	**2**	**2**	**2**	**3**	**-**	**-**	**-**	**-**	**-**	**-**	**3**	**-**	**-**

Guidelines for Continuous Comprehensive Evaluation of Theory Course		
Sr. No.	**Components for Continuous Comprehensive Evaluation**	**Marks Allotted**
1	Five Assignments on Unit-1, Unit-2, Unit-3, Unit-4 and Unit-5	10
2	Performance in Unit Tests (5 tests, one on each unit)	10
	Total	**20**

K. K. Wagh Institute of Engineering Education and Research, Nashik

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T. Y. B. Tech. Pattern 2022 Semester: VI **ETC223016D: Lab work in Neural Network and Fuzzy Control (Elective-2)**		
Teaching Scheme:	**Credit Scheme:**	**Examination Scheme:**
Practical : 02hrs/week	**01**	**Practical: 25 Marks** **Term work: 25 Marks**
Prerequisite Courses, if any: Fundamental of Computing		
Companion course, if any: Neural Network and Fuzzy Control		
Course Outcomes: On completion of the course, students will be able to–		

	Course Outcomes	Bloom's Level (Cognitive domain)	Bloom's Level (Psychomotor domain)
CO1	Understand the concept of fuzziness involved in various systems Apply the knowledge of fuzzy set theory.	2-Understand	1- Imitation
CO2	Understand the difference between learning and programming and explore practical applications of Neural Networks (NN).	2-Understand	1- Imitation
CO3	To analyse and appreciate the applications which can use fuzzy logic.	3-Apply	2-Manipulation
CO4	Understand the basics of genetic algorithm, use of GA operators and its applications.	2-Understand	1- Imitation

List of Laboratory Experiments / Assignments

Sr. No.	**Laboratory Experiments / Assignments**	**CO Mapped**
1	Implementation of Fuzzy Operations.	**CO3**
2	Implementation of Fuzzy Relations (Max-min Composition)	**CO3**
3	Implementation of Fuzzy Controller (Washing Machine)	**CO3**
4	Implementation of Simple Neural Network (McCulloh-Pitts model)	**CO2**
5	Implementation of Perceptron Learning Algorithm	**CO2**
6	Implementation of Unsupervised Learning Algorithm	**CO2**
7	Implementation of Simple Genetic Application	**CO4**

Guidelines for Laboratory Conduction

- 1. Use of coding standards and Hungarian notation, proper indentation and comments.

Operating System recommended:- Linux/Windows or its derivative

Guidelines for Student's Lab Journal
Student's lab journal should contain following related things - Title, Objectives, Hardware/ Software requirement, Theory, and Conclusion
Guidelines for Term work Assessment
• R1: Timely completion of experiment (10 Marks) • R2: Understanding of experiment (10 Marks) • R3: Presentation / clarity of journal writing (10 Marks) Total 30 marks for each experiment and average marks of all experiments will be converted into 25 marks of term work.

Strength of CO-PO Mapping													CO-PSO Mapping	
	PSO												PSO	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	**3**	**3**	**2**	**1**	**3**	**-**	**-**	**-**	**-**	**-**	**-**	**3**	**-**	**-**
CO2	**2**	**2**	**2**	**1**	**3**	**-**	**-**	**-**	**-**	**-**	**-**	**3**	**-**	**-**
CO3	**3**	**3**	**2**	**2**	**3**	**-**	**-**	**-**	**-**	**-**	**-**	**3**	**1**	**1**
CO4	**2**	**2**	**2**	**2**	**3**	**-**	**-**	**-**	**-**	**-**	**-**	**3**	**-**	**-**

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(Autonomous from Academic Year 2022-23)

T. Y. B. Tech. Pattern 2022 Semester: VI **ETC223015A: Advance Digital Signal Processing (Elective 3)**		
Teaching Scheme:	**Credit Scheme:**	**Examination Scheme:**
Theory :03 hrs/week	**03**	**Continuous Comprehensive Evaluation: 20 Marks** **InSem Exam: 20 Marks** **EndSem Exam: 60 Marks**

Prerequisite Courses, if any: Digital Signal Processing

Companion course, if any: --

Course Objectives:

1. To understand Multirate Signal Processing fundamentals and applications.
2. To introduce wavelet transforms and digital filter implementation of wavelets and applications.
3. To study Adaptive Filters, LMS and RLS algorithms and Linear Prediction Filters
4. To introduce different methods for power Spectrum estimation of signals.
5. To understand application of signal processing to real world problems.

Course Outcomes: On completion of the course, students will be able to–

	Course Outcomes	**Bloom's Level**
CO1	**Design** of practical sampling rate converters, and applications.	6- create
CO2	**Understand** theory of wavelets and **Design** wavelet filters.	2-Understand, 6-create
CO3	**Implement** adaptive filters for given applications.	3- Apply
CO4	**Estimate** power spectrum of signals using different methods.	6- create
CO5	**Apply** signal processing tools to Biomedical and Telecommunication Applications	3- Apply

COURSE CONTENTS

Unit I	**Multirate DSP:**	**(8 hrs)**	**COs Mapped - CO1**

Down sampling, Up sampling, Relation between the Fourier transform of the input and output of the down sampling and up sampling, Representation of decimator and interpolator, Changing the sampling rate by noninteger factor, Multistage approach to sampling rate conversion, Design of practical sampling rate converters, Polyphase decomposition of decimator and interpolator, Oversampling ADC analysis, Two channel QMF bank structure, Analysis of Two-Channel QMF Bank. Design of perfect reconstruction M-channel filter banks, Tree structured filter banks, Application examples..

Unit II	**Wavelet transforms:**	**(7 hrs)**	**COs Mapped - CO2**

Time frequency representation of signals, short-time Fourier transform (STFT), Scaling functions and wavelets, Discrete wavelet transform (DWT), Multi-resolution analysis (MRA), Wavelet reconstruction,

design of decomposition and reconstruction filters for Haar, Daubechies and biorthogonal wavelets, Digital filter implementation of wavelets, Application examples			
Unit III	**Adaptive Digital Filters:**	**(7 hrs)**	**COs Mapped – CO3**
Adaptive Filter Structures, Minimum mean square criterion, LMS algorithm, Recursive Least Square algorithm, Application Examples. Linear Prediction & Optimum Linear Filters: Linear prediction, forward-backward linear prediction filters, solution of normal equations, Wiener Filters.			
Unit IV	**Power Spectrum Estimation:**	**(07 hrs)**	**COs Mapped – CO4**
Nonparametric Methods and parametric Methods for Power Spectrum Estimation, Minimum-variance spectral estimation, Eigen analysis Algorithms for Spectrum Estimation...			
Unit V	**Application of Signal Processing:**	**(07 hrs)**	**COs Mapped – CO5**
1 Biomedical Applications 2 Audio Applications 3 Telecommunication Applications(Radar)			
Text Books			
1. K. Deergha Rao and MNS Swamy, "Digital Signal Processing Theory and Practice", Springer, 2018. 2. Sanjit K. Mitra, "Digital Signal Processing", 3/e, Tata McGraw-Hill Edition, 2006.			
Reference Books			
1. J.G.Proakis and D.G. Manolakis," Digital signal processing: Principles, Algorithm and Applications", 4th Edition, Prentice Hall, 2007.. 2. S.Haykin, "Adaptive Filter Theory", 4th Edition, Prentice Hall, 2001. Steven M Kay, "Modern Spectral Estimation Theory and Application", Prentice Hall,1988.			

Strength of CO-PO Mapping													CO-PSO Mapping	
	PSO												PSO	
	1	1	3	4	5	6	7	8	9	10	11	12	1	2
CO1	**3**	**3**	**3**	**3**	**3**	-	-	-	-	-	-	-	-	**3**
CO2	**3**	**3**	**3**	**3**	**3**	-	-	-	-	-	-	-	-	**3**
CO3	**3**	**3**	**3**	-	**3**	-	-	-	-	-	-	-	-	-
CO4	**3**	**3**	**3**	**3**	**3**	-	-	-	-	-	-	-	-	**3**
CO5	**3**	**3**	**3**	-	**3**	-	-	-	-	-	-	**3**	-	-

Guidelines for Continuous Comprehensive Evaluation of Theory Course		
Sr. No.	**Components for Continuous Comprehensive Evaluation**	**Marks Allotted**
1	Five Assignments on Unit-1, Unit-2, Unit-3, Unit-4 and Unit-5	10
2	Performance in Unit Tests (5 tests, one on each unit)	10
	Total	**20**

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T. Y. B. Tech. Pattern 2022 Semester: VI **ETC223015B: FPGA Based System Design (Elective 3)**		
Teaching Scheme:	**Credit Scheme:**	**Examination Scheme:**
Theory :03 hrs/week	**03**	**Continuous Comprehensive Evaluation: 20 Marks** **InSem Exam: 20 Marks** **EndSem Exam: 60 Marks**

Prerequisite Courses, if any: VLSI design technology

Companion course, if any: --

Course Objectives:

1. To make the students understand basic architecture of FPGA
2. To make the students Understand various parameters of design abstraction used in IC technology.
3. To make the students Understand importance of FPGA for implementing FPGA based system
4. To Study and apply various design algorithms for placement and routing.
5. To Acquire knowledge of sequential machine design styles.
6. To Study of latest SOC devices

Course Outcomes: On completion of the course, students will be able to–

	Course Outcomes	**Bloom's Level**
CO1	**Demonstrate** semiconductor IC design using FPGA	3-Apply
CO2	**Analysis** of design rules and layout diagram	3-Apply, 4-Analysis
CO3	**Demonstrate** working principle of power and energy optimization	6-Design 4-Analysis
CO4	**Analyze** the performance of digital system	4-Analysis
CO5	**Explore** latest trends in SOC devices	2-Understand

COURSE CONTENTS

Unit I	**Introduction**	**(07 hrs)**	**COs Mapped - CO1**

Introduction, Basic concepts , Boolean Algebra, schematic and Logic symbols, Digital Design and FPGAs, the role of FPGAs, FPGA types, types of ASICS, FPGA Vs. Custom VLSI, FPGA Based system Design, goals and techniques, hierarchical Design, Design abstraction, Methodologies.

Unit II	**Chip Technology**	**(07 hrs)**	**COs Mapped - CO2**

IC Technology, Economics, CMOS Technology overview, Power consumption, Hierarchical design, Design Abstraction, EDA tools. MOSFET model, parasitics, latch up, advanced transistor structures; Wire parasitics; Design rules, Scalable design rules, process parameters; stick diagrams, Layout design tools; Layout synthesis, layout analysis.

Unit III	**Chip Construction**	**(08 hrs)**	**COs Mapped – CO3**

The logic design process, Combinational Network Delay, Power and energy optimization, Logic implementation for FPGAs, Physical design for FPGAs, design of algorithms for Placement and Routing, Placement algorithms: Mincut, Eigen value. Routing algorithms: Left edge, clock routing, power routing.

Unit IV	Architecture	(07 hrs)	COs Mapped – CO4
The sequential machine design process, Sequential Design styles, rules for Clocking, Performance analysis. Behavioral Design, Design methodologies and Design examples			
Unit V	**Current State of the Filed**	**(07 hrs)**	**COs Mapped – CO5**
SOC, IP Design, Design methodology, System Modeling, Hardware Software Co-design, Application Domains, Study of latest SOC device (Zinq 7000), Create a Zynq Hardware design, Fundamentals of Zynq design in Xilinx SDK, Structure of processing Logic, Difference between Processing Logic (PL) and processing Systems(PS)			

Text Books

1. FPGA Based System Design by Wanye Wolf , Pearson Publication.

Reference Books

1. Kamaran Eshraghian, "Principles of CMOS VLSI Design", Pearson Education
2. Rabey, Chandrakasan, "Digital IC Design", Preason Publication.

Strength of CO-PO Mapping													CO-PSO Mapping	
	PSO												PSO	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	**3**	**3**	**2**	**-**	**2**	**-**	**-**	**-**	**-**	**-**	**-**	**2**	**2**	**3**
CO2	**3**	**3**	**2**	**-**	**2**	**-**	**-**	**-**	**-**	**-**	**-**	**2**	**2**	**3**
CO3	**3**	**3**	**2**	**-**	**2**	**-**	**-**	**-**	**-**	**-**	**-**	**2**	**2**	**3**
CO4	**3**	**3**	**2**	**-**	**2**	**-**	**-**	**-**	**-**	**-**	**-**	**2**	**2**	**3**
CO5	**3**	**3**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**2**	**-**	**-**

Guidelines for Continuous Comprehensive Evaluation of Theory Course		
Sr. No.	**Components for Continuous Comprehensive Evaluation**	**Marks Allotted**
1	Five Assignments on Unit-1, Unit-2, Unit-3, Unit-4 and Unit-5	10
2	Performance in Unit Tests (5 tests, one on each unit)	10
	Total	**20**

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T. Y. B. Tech. Pattern 2022 Semester: VI
ETC223015C: Circular Economy (Elective-3)

Teaching Scheme:	Credit Scheme:	Examination Scheme:
Theory :03 hrs/week	**03**	**Continuous Comprehensive Evaluation: 20 Marks** **InSem Exam: 20 Marks** **EndSem Exam: 60 Marks**

Prerequisite Courses, if any: Environmental Studies & Sustainability

Course Objectives:

1. To develop graduates who have the necessary theoretical, practical and research knowledge, skill and aptitude in circularity and can get job opportunities by the industry in various sectors both public and private at national and international level.
2. To contrive skilled manpower and entrepreneurship in the field of Circular Economy.
3. To enhance interaction of students with the senior/experienced manpower who have real time knowledge / experience in the technology development, research, innovation, entrepreneurship deployment and circular business models.
4. To acquaint students about the needs of businesses related to circularity and to create zeal among students to pursue research and development (R&D), and Entrepreneurship in this domain.

Course Outcomes: On completion of the course, students will be able to–

	Course Outcomes	Bloom's Level
CO1	**Apply** the concept of circular economy to environmental engineering problems	2-Understand
CO2	Understand the concept of circularity and conduct relevant research	2-Understand
CO3	Use the principles of circularity for application to sustainable development	3- Applying
CO4	Apply complexity aspects of circular economy for creating circular business models	3-Applying

COURSE CONTENTS

Unit I	Introduction to Circular Economy	**(07 hrs)**	**COs Mapped - CO1**

Linear Economy and its emergence, Economic and Ecological disadvantages of linear economy, Replacing Linear economy by Circular Economy, Development of Concept of Circular Economy, A differential - Linear Vs Circular Economy

Unit II	Characteristics of Circular Economy	**(07 hrs)**	**COs Mapped - CO2**

Material recovery, Waste Reduction, reducing negative externalities, Explaining Butterfly diagram, Concept of Loops

Unit III	Circular design, innovation and Assessment	**(08 hrs)**	**COs Mapped – CO3**

Zero waste: Waste Management in context of Circular Economy, Circular design, Research and innovation, LCA, Circular Business Models , Business models, Solid Waste Management / Wastewater,

Unit IV	Case Studies	(09 hrs)	COs Mapped – CO2, CO4
Business models, Solid Waste Management / Wastewater, Plastics: A case study, EPR: polluters pay principle, Industrial symbiosis/ Eco-parks			
Unit V	Legal and policy framework	**(05 hrs)**	**COs Mapped – CO4**
Role of governments and networks, Sharing best practices, Universal circular economy policy goals, India and CE strategy, ESG			

Text Books

1. The Circular Economy A User's Guide ,Walter R Stahel Routledge; 1st Edition (24 June 2019)
2. Circular Economy: (Re) Emerging Movement , Shalini Goyal Bhalla Invincible Publisher
3. Linear Integrated Circuits, Salivahanan and KanchanaBhaskaran, Tata McGraw Hill.

Reference Books

1. Towards Zero Waste: Circular Economy Boost, Waste to Resources María-Laura Franco-García, Jorge Carlos Carpio-Aguilar, Hans Bressers. Springer International Publishing 2019
2. Strategic Management and the Circular Economy Marcello Tonelli, Nicolo Cristoni, Routledge 2018.
3. Circular Economy: Global Perspective Sadhan Kumar Ghosh, Springer, 2020
4. The Circular Economy: A User's Guide Stahel, Walter R. Routledge 2019
5. An Introduction to Circular Economy Lerwen Liu, Seeram Ramakrishna, Springer Singapore 2021.

Online Resources

1. https://www.coursera.org/learn/circular-economy
2. https://www.edx.org/course/circular-economy-an-introduction
3. https://www.coursera.org/learn/sustainable-digital-innovation
4. https://online-learning.harvard.edu/course/introduction-circular-economy?delta=0
5. https://ic-ce.com/product/principles-of-circular-economy/
6. https://ic-ce.com/product/circular-business-management/
7. https://ic-ce.com/product/bootcamp/
8. http://ic-ce.com/journal-on-circular-economy

Strength of CO-PO Mapping													CO-PSO Mapping	
	PSO												PSO	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	**3**	**3**	-	-	-	**3**	**3**	-	-	-	-	**3**	**3**	**3**
CO2	**3**	**3**	-	-	-	**3**	**3**	-	-	-	-	**3**	-	-
CO3	**3**	**3**	**3**	-	-	**3**	**3**	-	-	-	-	**3**	**3**	**3**
CO4	**3**	**3**	**3**	-	-	**3**	**3**	-	-	-	**3**	**3**	**3**	**3**

Sr. No.	Components for Continuous Comprehensive Evaluation	Marks Allotted
1	Assignment on Unit(1-2)	10
2	Assignment on Unit(3-5)	10
	Total	**20**

(Autonomous from Academic Year 2022-23)

T. Y. B. Tech. Pattern 2022 Semester: VI **ETC223015D: Automotive Electronics (Elective 3)**		
Teaching Scheme:	**Credit Scheme:**	**Examination Scheme:**
Theory :03 hrs/week	**03**	**Continuous Comprehensive Evaluation: 20 Marks** **InSem Exam: 20 Marks** **EndSem Exam: 60 Marks**
Prerequisite Courses, if any: Basic electronics engineering, basic electrical engineering Instrumentation system, control system, Microcontroller		
Companion course, if any: Fundamentals of Basic electronics		

Course Objectives:

1. The student should comprehend the physics & underlying principle behind vehicle control system, batteries, ignition systems, sensors and actuators & other electrical systems
2. To introduce about automotive telematics & in vehicle infotainment systems
3. At the end of the course, students are exposed to various automotive communication systems

Course Outcomes: On completion of the course, students will be able to–

	Course Outcomes	**Bloom's Level**
CO1	**Explain** the concept of batteries, starting systems, charging systems.	2-Understand
CO2	**Explain** fuel injection, ignition systems, and lightning system of automotive applications.	2-Understand
CO3	**Make use** of fundamental knowledge of instrumentation system & control System to **explain** different types of automotive control systems.	3-Apply, 2-Understand
CO4	**Explain** the principles & functionalities of ECU and automotive communication Systems.	2-Understand
CO5	**Recognize** need of telematics and infotainment systems in automotive Applications.	2-Understand

COURSE CONTENTS

Unit I	**Batteries & Charging systems**	**(08 hrs)**	**COs Mapped - CO1**

Batteries: Principles and construction of lead-acid battery. Characteristics of battery, rating capacity and efficiency of batteries. Various tests on battery condition, charging methods. Constructional aspect of alkaline battery.

Starting System: Condition at starting. Behavior of starter during starting. Series motor and its characteristics. Principle & construction of starter motor. Starter Switches.

Charging System: Generation of direct current. Shunt generator characteristics. Armature reaction. Third brush regulation. Cutout. Voltage & current regulators.

Unit II	**Ignition systems and Lightning system**	**(07 hrs)**	**COs Mapped - CO2**

Fuel Injection, **Ignition Systems:** Introduction, feedback carburetor systems. Throttle body injection and multi-port or point fuel injection, fuel injection systems, Injection system controls. , Types, Construction & working of battery coil and magneto ignition systems. Electronic ignition systems.

Lighting System & Accessories: Insulated & earth return systems. Positive & negative earth systems. Details of head light & side light. Headlight dazzling & preventive methods. Electrical fuel-pump, Speedometer, Fuel, oil & temperature gauges, Horn, Wiper system

Unit III	Automotive control system	(07 hrs)	COs Mapped – CO3
Power train Control Systems: Air–Fuel Ratio Control, Control of Spark Timing, Idle-Speed Control, Transmission control, Cruise control: analog cruise control, adaptive cruise control, advanced cruise control, traction control, antilock braking system (ABS), Electronics steering control, control for lightning, wiper control, air conditioning/Heating, Ignition systems, Remote keyless entry and anti theft systems, method of improving engine performance			
Unit IV	**ECU &Automotive communication systems**	**(07 hrs)**	**COs Mapped – CO4**
ECU Design Cycle: V-Model development cycle, Components of ECU, Examples of ECU on chassis, and in body electronics. Communication interface with ECUs, Relevance of internet protocols, wireless LAN standards, communications protocols for automotive applications such as, CAN, LIN, Flex Ray, ODBII, MOST, IE, D2B, DSI			
Unit V	**Telematics & Infotainment systems**	**(07 hrs)**	**COs Mapped – CO5**
Global positioning system, Geographical information systems, navigation systems, automotive vision systems, road recognition, driver assistance systems, In vehicle infotainment : Introduction, use of operating systems in IVI, GENEVI alliance, traffic announcement, Navigation : points of interest, Routes, waypoints, Dead reckoning position, traffic info, GLONASS, GNSS, RTK, GPS & SBAS.)			

Text Books

1. Navigation and intelligent transportation system- progress in technology, Ronald K Jurgan, SAE,USA,1988
2. Understanding Automotive electronics, William B Ribbons, Butterworth Heinmann, 7th edition- 2012

Reference Books

1. Automotive telematics, Dennis Foy, Red Hat, 2012
2. Intra & inter vehicle communication, Gilbert Held, CRC Press, 2007

Strength of CO-PO Mapping													CO-PSO Mapping	
	PSO												PSO	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	3	3	-	-	-	-	-	-	-	-	-	3	-	-
CO2	3	3	-	-	-	-	-	-	-	-	-	-	-	-
CO3	3	3	-	-	-	-	-	-	-	-	-	3	-	3
CO4	3	3	-	-	3	-	-	-	-	-	-	3	-	-
CO5	3	3	-	-	-	-	-	-	-	-	-	3	-	-

Guidelines for Continuous Comprehensive Evaluation of Theory Course		
Sr. No.	**Components for Continuous Comprehensive Evaluation**	**Marks Allotted**
1	Five Assignments on Unit-1, Unit-2, Unit-3, Unit-4 and Unit-5	10
2	Performance in Unit Tests (5 tests, one on each unit)	10
	Total	**20**