



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

**Curriculum
TY B. Tech (2023 Pattern)**

**Electronics and Telecommunication
Engineering
w.e.f. AY 2025-2026**

T.Y. B.Tech Electronics and Tele-Communication Engineering															
SEM-V															
Course Code	Course Type	Title of Course	Teaching Scheme			Evaluation Scheme and Marks						Credits			
			TH	TU	PR	IN SEM	END SEM	CCE	TUT/TW	PR/OR	TOTAL	TH	TU	PR	TOTAL
2302301	PCC	Electromagnetic Engineering	3	-	-	20	60	20			100	3		-	3
2302302	PCC	Digital Signal Processing	3	-	-	20	60	20			100	3		-	3
2302303	PCC	VLSI design and Technology	3	-	-	20	60	20			100	3		-	3
2302304	PCC	Lab work in Digital signal processing	-	-	2	-			25	25	50	-		1	1
2302305	PCC	Lab work in VLSI design and Technology	-	-	2	-			25	25	50	-		1	1
2302306	PEC	Elective 1	3	-	-	20	60	20			100	3		-	3
2302307	PEC	Lab work Elective 1	-	-	2	-			25	25	50	-		1	1
2302308	OE	OE3: Digital Business Management	2	-	-	-		50			50	2		-	2
2302309	MDM	MDM3: Cyber Security Tools Techniques and Counter Measures	3	-	-	20	60	20			100	3		-	3
		MDM3:Data Science using Python	3	-	-	20	60	20			100	3		-	3
2302310	RM	IPR	-	1	2	-			TUT-25, TW-25		50	-	1	1	2
TOTAL			17	1	8	100	300	150	125	75	750	17	1	4	22

Elective Stream	Elective 1:
Communication	Elective -1 Software Defined Radio
Automation	Elective -1 Mechantronics
Embedded System	Elective -1 Interfacing Techniques
Artificial Intelligence	Elective -1 Foundation course in ML

T.Y. B.Tech Electronics and Tele-Communication Engineering

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
2302311	PCC	Embedded Systems	3	-	-	20	60	20	-	-	100	3	-	-	3
2302312	PCC	Power Electronics	3	-	-	20	60	20	-	-	100	3	-	-	3
2302313	PCC	Lab work in Embedded systems and Power Electronics	-	-	2	-	-	-	25	25	100	-	-	1	1
2302314	PEC	Elective 2	3	-	-	20	60	20	-	-	50	3	-	-	3
2302315	PEC	Elective 3	3	-	-	20	60	20	-	-	100	3	-	-	3
2302316	PEC	Lab work Elective-2	-	-	2	-	-	-	25	25	100	-	-	1	1
2302317	MDM	MDM 4: Cyber Crime Administration	3	-	-	20	60	20	-	-	50	3	-	-	3
		MDM 4: Deep Learning	3	-	-	20	60	20	-	-	50	3	-	-	3
2302318	OE	OE 4 : Digital Marketing	2	-	-	-	-	50	-	-	50	2	-	-	2
2302319	VSEC	Web Design	-	1	2	-	-	-	25	25	50	-	1	1	2
2302320	CEP	Project Phase-1	-	-	2	-	-	-	50	-	50	-	-	1	1
TOTAL			17	1	8	100	300	150	125	75	750	17	1	4	22

Elective Stream	Elective-2	Elective Stream	Elective-3
Communication	Microwave Engineering	Signal Processing	Advanced DSP
Automation	Process Instrumentation	Advanced VLSI Design	FPGA Based System Design
Embedded System	Advanced Processor	Recent Trends	Circular economy
Artificial Intelligence	Neural network and Fuzzy Control	E-Mobility	Automotive Electronics

Elective Streams

Semester 5

Course Code	Elective Streams	Elective 1
2302306A	Communication	Software Defined Radio
2302306B	Automation	Mechatronics
2302306C	Embedded Systems	Interfacing Techniques
2302306D	Artificial Intelligence	Foundation Course in ML

Semester 6

Course Code	Elective Streams	Elective 2
2302314A	Communication	Microwave Engineering
2302314B	Automation	Process Instrumentation
2302314C	Embedded Systems	Advanced Processors
2302314D	Artificial Intelligence	Neural Network and Fuzzy Control

Semester 7

Course Code	Elective Streams	Elective 4
2302405A	Communication	MIMO Communication Systems
2302405B	Automation	Robotics
2302405C	Embedded Systems	Real Time Operating System
2302405D	Artificial Intelligence	Deep Learning and Big Data Analysis

Semester 6

Course Code	Elective Streams	Elective 3
2302315A	Signal Processing	Advanced DSP
2302315B	Advanced VLSI Design	FPGA Based System Design
2302315C	Recent trends	Circular Economy
2302315D	e-Mobility	Automotive Electronics

Semester 7

Course Code	Elective Streams	Elective 5
2302406A	Signal Processing	Speech & Audio Processing
2302406B	Advanced VLSI Design	VLSI Testing and Testability
2302406C	Recent trends	Climate Change and Green Energy
2302406D	e-Mobility	Drives and Control

Semester 8

Course Code	Elective Streams	Elective 6 (Online/MOOCs)
2302412A	Signal Processing	Image and Video Processing
2302412B	Advanced VLSI Design	Mixed Signal Design
2302412C	Recent trends	Advanced Mobile Communication
2302412D	e-Mobility	e-Mobility and Charging Infrastructure

K. K. Wagh Institute of Engineering Education and Research, Nashik
Department of Electronics and Telecommunication Engineering
Minor Offered in 2024 – 2025 (Cyber Security)

Sem	Course Code	Course Type	Title of Course	Teaching Scheme		Insem	Endsem	Evaluation Scheme and Marks				Credits		
				TH	PR			CCE	TW	PR	Total	TH	PR	Total
III	2302206A	MDM	MDM 1: Privacy and Security in Online Social Media	3		20	60	20			100	3		3
	2302207A	MDM	Lab work in Privacy and Security in Online Social Media		2				25	25	50		1	1
IV	2302216A	MDM	MDM 2: Foundations of Cyber Physical Systems	3		20	60	20			100	3		3
	2302217A	MDM	Lab work in Foundations of Cyber Physical Systems		2				25	25	50		1	1
V	2302309A	MDM	MDM 3: Cyber Security, Tools, Techniques and Counter Measures	3		20	60	20			100	3		3
VI	2302317A	MDM	MDM 4: Cyber Crime Administration	3		20	60	20			100	3		3
			Total	9	4	80	240	80	50	50	500	12	2	14

Minor Offered in 2024 – 2025 (Data Science)

Sem	Course Code	Course Type	Title of Course	Teaching Scheme		Insem	Endsem	Evaluation Scheme and Marks				Credits		
				TH	PR			CCE	TW	PR	Total	TH	PR	Total
III	2302206B	MDM	MDM 1: Data Analytics with Python	3		20	60	20			100	3		3
	2302207B	MDM	Lab work in Data Analytics with Python		2				25	25	50		1	1
IV	2302216B	MDM	MDM 2: Machine Learning for Engineering and science applications	3		20	60	20			100	3		3
	2302217B	MDM	Lab work in Machine Learning for Engineering and science applications		2				25	25	50		1	1
V	2302309B	MDM	MDM3 : Data Science Using Python	3		20	60	20			100	3		3
VI	2302317B	MDM	MDM4 : Deep Learning	3		20	60	20			100	3		3
			Total	9	4	80	240	80	50	50	500	12	2	14

Open Elective: Open Elective courses offered by E&TC Department

Sr. No.	Semester	Course Title	
1	III	OE 1 (2302208)	Industrial Management
2	IV	OE 2 (2302218)	Project Management
3	V	OE 3 (2302308)	Digital Business Management
4	VI	OE 4 (2302318)	Digital Marketing

Electronics and Telecommunication Engineering Exit Courses (To award Certificate)															
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
2302221	EXIT	Internship*	0	0	0	0	0	0	100	0	100	0	2	0	2
2302222	EXIT	Data communication and Networking (Exit Course-1)	2	0	2	20	30	0	50	0	100	2	0	1	3
2302223	EXIT	Electronic Servicing and Maintenance (Exit Course-2)	2	0	2	20	30	0	50	0	100	2	0	1	3
Total			4	0	4	40	60	0	200	0	300	4	2	2	8

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Internship in industry for 2-weeks

→To get certificate student should get following credits

- Internship →2 credits
- Exit course-1 →3 credits
- Exit course-2 →3 credits
- **Total credits** →**8 credits**



K. K. Wagh Institute of Engineering Education and Research, Nashik (Autonomous w.e.f. A.Y.2022-23)
Details of Course Structure: B.Tech (2023 Pattern)

Board of Studies in Electronics & Telecommunication Engineering
B.Tech (E & TC): Hon. with Multidisciplinary Minor (MDM) 2023 Pattern
For B.tech Honours Degree (2023 Pattern): Minor Course in Electronics Engineering (VLSI Design & Technology)

Sem	Course Code	Course Type	Title of Course	Teaching Scheme Hrs./week			Evaluation Scheme and Marks								Credits			
				TH	TU	PR	In Sem	End Sem	CCE	TU	TW	PR	OR	Total	TH	TU	PR	Total
V	2302381	MDM	Digital CMOS Design	04	-	-	20	60	20	-	-	-	-	100	04	-	-	04
	2302382	MDM	Lab work in Digital CMOS Design	-	-	04	-	-	-	-	50	50	-	100	-	-	02	02
VI	2302384	MDM	ASIC Design	04	-	-	20	60	20	-	-	-	-	100	04	-	-	04
	2302385	MDM	Lab Work in ASIC Design	-	-	04	-	-	-	-	50	50	-	100	-	-	02	02
VII	2302481	MDM	Reconfigurable Computing	03	-	-	20	60	20	-	-	-	-	100	03	-	-	03
	2302481	MDM	Introduction to Micro fabrication	03	-	-	20	60	20	-	-	-	-	100	03	-	-	03
Total				14	-	08	80	240	80	-	100	100	-	600	14	-	04	18

Name and Sign of BoS Chairman

Sign of Director



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

T. Y. B. Tech. Pattern 2023 Semester: V			
2302301: 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 magnetostatic 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 to solve the problems related to the electrostatic field.		2 - Understand
CO2	Study magnetostatic field parameters and their distributions in different media and Apply it to solve the problems related to the electrostatic field.		2 - Understand
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 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, Poisson's and Laplace's equation, Application of Poisson's and Laplace's equations, Boundary Condition.			
Unit II	Magnetostatics	(08 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	(06 hrs)	COs Mapped – CO3

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
(Autonomous from Academic Year 2022-23)

T. Y. B. Tech. Pattern 2023 Semester: V 2302302:Digital Signal Processing			
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: - Engineering Mathematics III			
Companion course, if any: Lab work in DSP and CS			
Course Objectives: 1. To understand the mathematical description of continuous and discrete time signals and systems and classify signals into different categories. 2. To analyze Linear Time Invariant (LTI) systems in time and transform domains. 3. To introduce students with transforms for analysis of discrete time signals and systems. 4. To introduce students with transforms for analysis using Fast Fourier Transform 5. To design IIR and FIR filters.			
Course Outcomes: On completion of the course, students will be able to–			
	Course Outcomes		Bloom’s Level
CO1	Understand mathematical description and representation of continuous and discrete time signals and systems.		2-Understand
CO2	Develop input output relationship for linear shift invariant system and understand the convolution operator for continuous and discrete time system		3- Apply
CO3	Analyze discrete time signals and systems using Discrete Fourier transforms.		4 -Analyze
CO4	Develop algorithms for linear filtering of signals.		3- Apply
CO5	Design different types of IIR and FIR digital filters		4 -Analyze
COURSE CONTENTS			
Unit I	Introduction and Classification of signals	(09 hrs + 2 hrs Tutorial)	COs Mapped - CO1
Definition of signal and systems, communication and control systems as examples. Sampling of analog signals, Continuous time and discrete time signal, Classification of signals as even, odd, periodic and non-periodic, deterministic and non-deterministic, energy and power. Elementary signals used for testing: reasons for using standard test signals, exponential, sine, impulse, step and its properties, ramp, rectangular, triangular, signum, sinc. Operations on signals: Amplitude scaling, addition, multiplication, differentiation, integration (Accumulator for DT), time scaling, time shifting and time folding.			
Unit II	Representation of LTI systems in time domain:	(08 hrs+ 2hrsTutorial)	COs Mapped CO2
Systems: Definition, Classification: linear and non-linear, time variant and invariant, causal and non-			

causal, static and dynamic, stable and unstable, invertible.			
System modeling: Input-output relation, definition of impulse response, convolution integral, computation of convolution integral using graphical method for unit step to unit step, unit step to exponential, exponential to exponential, unit step to rectangular and rectangular to rectangular only. Properties of convolution. System properties in terms of impulse response, step response in terms of impulse response.			
Unit III	Basics of DSP and Discrete Fourier Transform	(08 hrs+ 2hrsTutorial)	COs Mapped CO3
Sampling, Basic elements of DSP and its requirements, advantages of Digital over Analog signal processing. mapping between analog frequencies to digital frequency, DTFT, Definition, Frequency domain sampling, DFT, Properties of DFT, circular convolution, linear convolution, Computation of linear convolution using circular convolution, Linear filtering using overlap add and overlap save method.			
Unit IV	Fast Fourier Transform	(08 hrs+ 2hrsTutorial)	COs Mapped CO4,
FFT, decimation in time and decimation in frequency using Radix-2 FFT algorithm, Comparison between finding DFT of signals using direct method and using FFT algorithm. In- place computation and memory requirement. Goertzel and Chirp-Z algorithm.			
Unit V	IIR and FIR filter design	(09 hrs+ 2hrsTutorial)	COs Mapped CO5,
Design of IIR filters from analog filters.IIR filters design by impulse invariance method, Bilinear transformation method, warping effect. Characteristics of Butterworth filters, Chebyshev filters and elliptic filters, Ideal filter requirements, Gibbs phenomenon, windowing techniques, characteristics and comparison of different window functions, Design of linear phase FIR filter using windows..			
TextBooks			
1. Simon Haykins and Barry Van Veen, “Signals and Systems”, Wiley India, 2 nd Edition. 2. John G. Proakis“Digital Signal Processing: Principles”, Pearson publication			
Reference Books			
1. A. Nagoor Kanni ``Signals and Systems”, McGraw Hill, 2. Dr. Shaila Apte, “Digital Signal Processing” Wiley India Publication			

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

Guidelines for Continuous Comprehensive Evaluation of Theory Course		
Sr. No.	Components for Continuous Comprehensive Evaluation	Marks Allotted

1	Assignments on each unit	10
2	Tests on each unit	10



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

T. Y. B. Tech. Pattern 2023 Semester: V 2302303: VLSI Design and Technology			
Teaching Scheme:		Credit Scheme:	Examination Scheme:
Theory :03 hrs/week Practical : 02 hrs/week		03 01	Continuous Comprehensive InSem Exam: 20Marks EndSem Exam: 60Marks Practical Exam : 50 Marks
Prerequisite Courses, if any: - Digital System Design using HDL			
Companion course, if any: Lab work in VLSI Design and Technology			
Course Objectives: 1. To Understand the architecture of PLD 2. To implement combinational and sequential circuits 3. To get the knowledge about properties of CMOS circuits 4. To Understand the concept behind ASIC design 5. To Get an Idea of Testability Approach			
Course Outcomes: On completion of the course, students will be able to–			
	Course Outcomes		Bloom's Level
CO1	Understand the basic architecture of various PLDs		2- Understanding
CO2	Explain the role of Verilog in digital system design		2- Explain
CO3	Develop effective HDL coding for digital design and Model digital circuit with HDL, simulate, synthesis and prototype in PLDs		3,6- Design
CO4	Design CMOS circuits for specified applications and Implement subsystem using CMOS Technology		4 -Analyze
CO5	Apply knowledge of chip level issues , faults and testability in design		3- Apply
COURSE CONTENTS			
Unit I	PLD Architectures and applications	(06hrs)	COs Mapped - CO1
Study of Programmable Logic Devices (PROM, PAL, PLA) and comparison, Complex Programmable Devices: Various families, Features, Specifications, CPLD Architecture Applications, Field Programmable Gate Arrays: Various families, Features, Specifications, FPGA Architecture Applications, Implementing functions in PLA, PAL and FPGA, Study of latest FPGA Devices			
Unit II	Introduction to Verilog HDL	(08hrs)	COs Mapped - CO2
Overview of Digital Design with Verilog HDL, Hierarchical Modelling Concepts, Basic Concepts, Modules and ports, Initial and always block, Modelling Styles: Gate-Level Modelling			

Unit III	Design Elements in Verilog	(08hrs)	COs Mapped – CO3
Dataflow Modelling, Behavioural Modelling, Switch level Modelling. Tasks and functions, Verilog Test bench			
Unit IV	CMOS Logic Design	(07hrs)	COs Mapped – CO4
CMOS Inverter and DC transfer Characteristics, Inverter with capacitive load and its effects, CMOS Logic gates (All gates) and Multiplexer , Combinational circuit design using CMOS , Sequential circuit design using CMOS Transmission gates, example of TG for combinational circuit.			
Unit V	Digital Design Issues and Testability	(07hrs)	COs Mapped - CO5
Metastability and solutions, Timing considerations and Skew, Clock distribution and jitter, Supply and ground bounce, Power distribution techniques and optimization, Need of Design for Testability (DFT), DFT Guideline, Testability, Types of fault and fault models, Hazards, Test pattern generation, Sequential circuit test, Built-in Self-Test, JTAG & Boundary scan, TAP Controller.			
Text Books			
1. Charles H. Roth, “Digital systems design using VHDL”, PWS. 2. Wyane Wolf, “Modern VLSI Design (IP-Based Design)”, 4E, Prentice Hall. 3. Steve Kils “Advanced FPGA Design Architecture, Implementation and Optimization”, Wiley.			
Reference Books			
1. E. Weste, David Money Harris, “CMOS VLSI Design: A Circuit & System Perspective”, Pearson Publication. 2. R. Jacob Baker, “CMOS Circuit Design, Layout, and Simulation”, 3E, Wiley-IEEE Press 3. John F. Wakerly, “Digital Design Principles and Practices” , 3E, Prentice Hall 4. M. Morris Mano , “Digital Design”, 3E , Pearson 5. Cem Unsalan, Bora Tar, “Digital System Design with FPGA: Implementation Using Verilog and VHDL”, McGraw-Hill 6. VHDL Programming by Douglas.L.Perry , McGraw-Hill 4 th 2002			

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

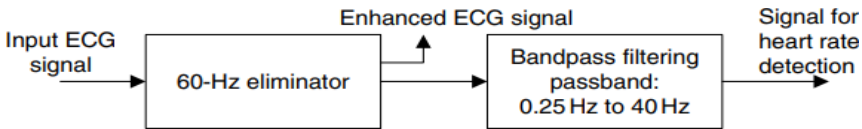
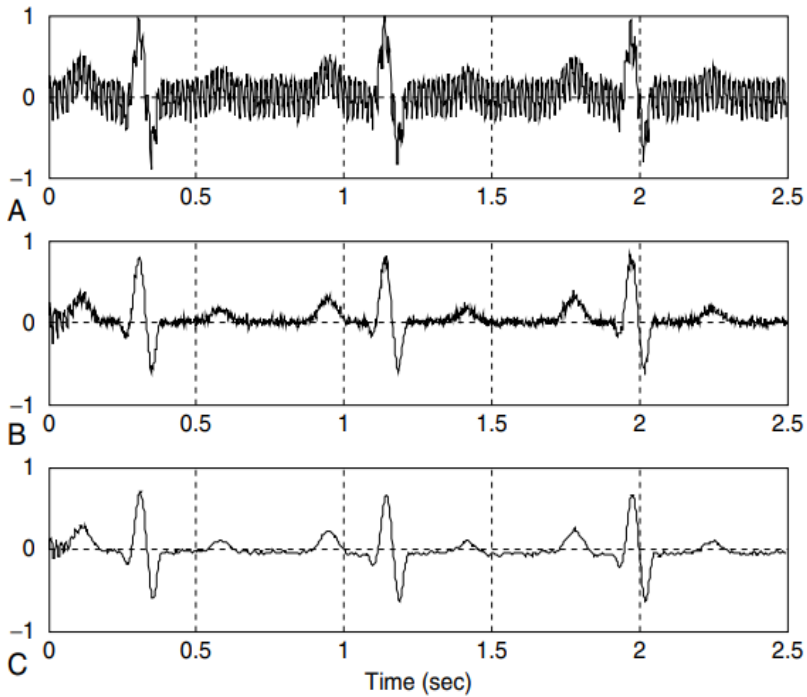
Guidelines for Continuous Comprehensive Evaluation of Theory Course		
Sr. No.	Components for Continuous Comprehensive Evaluation	Marks Allotted
1	Assignments on Unit-1, Unit-2, Unit-3 Unit-4, Unit-5	10
2	LMS Test on Each Unit	10
	Total	20

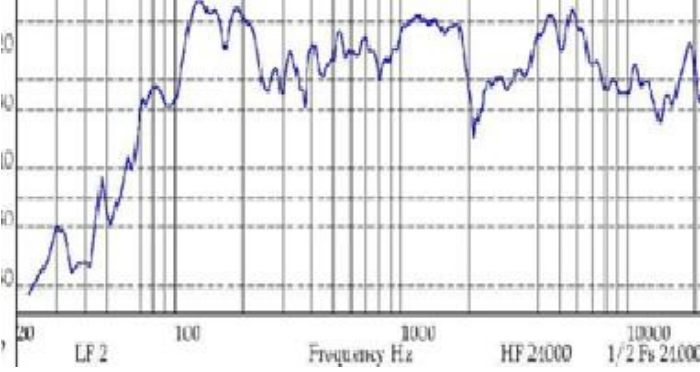


K. K. Wagh Institute of Engineering Education and Research, Nashik
(Autonomous from Academic Year 2022-23)

T Y. B. Tech Pattern 2023 Semester: V			
2302304: Lab work in Digital Signal Processing			
Teaching Scheme:		Credit Scheme:	Examination Scheme:
Practical : 02 hrs/week		01	Continuous Comprehensive Practical Exam: 25 Marks TW: 25 Marks
Prerequisite Courses, if any:			
Course Objectives:			
1. To develop practical skills in signal processing using MATLAB and mobile-based tools, including sampling, system response, spectral analysis, and filter design for real-time signals like audio and ECG.			
2. To design and implement signal processing applications such as equalizers, speech recognition systems, and sensor-based DSP on embedded and mobile platforms, bridging theory with real-world systems.			
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	Students will be able to analyze and process real-world signals using MATLAB and mobile-based tools, demonstrating an understanding of sampling, filtering, and frequency domain analysis.	4-Analyze	3- Mechanism
CO2	Students will be able to design and implement basic DSP applications such as audio equalizers, ECG enhancement systems, and speech recognition interfaces for embedded and mobile platforms.	3-Appply	5-Complex Overt Response

List of Laboratory Experiments / Assignments		
Sr. No.	Laboratory Experiments / Assignments	CO Mapped
1	To verify sampling theorem in MATLAB and Demonstrate the effects of aliasing arising from improper sampling	1
2	Find the response of LTI system for unit step signal $x_1(t)$ and exponential signal	2

	$x_2(t)$	
3	Record or use the recorded music samples of different instruments (at least four) and analyze the major frequency components included in music signal. Also try to solve this using Prats compare and comment on the results.	3
	Design an appropriate filter for ECG signal enhancement and heart rate detection.  ECG signal enhancement system.  Results of ECG signal processing. (a) Initial corrupted ECG data; (b) ECG data enhanced by removing 60 Hz; (c) ECG data with DC blocking and noise removal for heart rate detection.	4
5	Design Loudspeaker Equalizer The objectives of this equalization is to reduce the variations in the overall frequency response, extend the low frequency response, and improve the power handling of low frequency information	4

		
6	Implement a speech recognition algorithm for voice driven system. Use voice commands to drive a digital output, When a user speaks “on”, the device will start to operate; it will stop working when a user speaks “stop”. Try the same for multiple users. Interested students can implement it on hardware.	3,4
7	Android based Plots: Using A-JDSP App, determine the frequency response and pole-zero plot for Kaiser filter. (use achartengine library for Android)	4
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’s 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 assistant. 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 Lab Assessment		
1. Each experiment from lab journal is assessed for thirty marks based on three rubrics. 2. Rubric R-1 for timely completion, R-2 for understanding and R-3 for presentation/journal writing where each rubric carries ten marks.		



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

T Y. B. Tech Pattern 2023 Semester: V			
2302305: Lab work in VLSI Design and Technology			
Teaching Scheme:		Credit Scheme:	Examination Scheme:
Practical : 02hrs/week		01	Continuous Comprehensive Practical Exam: 25 Marks TW: 25 Marks
Prerequisite Courses, if any: DSD with HDL			
Course Objectives: To simulate, test and verify any digital circuit on FPGA			
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	Develop programs using HDL & handle the hardware proficiently by writing & simulating for combinational & sequential circuits in various modeling styles and implementation of programs in PLDs.	4	4 (Mechanism)
CO2	Design CMOS circuits for specified applications and Implement subsystems using CMOS Technology.	4	5 (Complex Overt Response)
CO3	Apply knowledge of chip level issues, faults and testability in design of Digital circuits.	2	3 (Guided Response)

List of Laboratory Experiments / Assignments		
Sr. No.	Laboratory Experiments / Assignments	CO Mapped
1	Implementation of Full Adder using all modeling styles	C01,CO2, CO3
2	Design a lift controller for 4 floors building Assume suitable data. Also write test bench for it.	C01,CO2, CO3
3	Design a washing machine controller Assume suitable data. Also write test bench for it. (Operation: When start is pressed, goes through wash, spin, rinse, spin cycles. If “double rinse” is selected, an extra rinse and spin cycle is added. Details: Must fill the tub with water before washing or rinsing – output the signal “fill tub” to do this. A timer is provided that gives the appropriate amount of time for a wash, rinse, or spin	C01,CO2, CO3

	cycle.)	
4	Design a Traffic Light Controller, assume suitable data. Also write test bench for it. (A busy highway is intersected by a little used farm road. Detectors C sense the presence of cars waiting on the farm road ,with no car on farm road, light remain green in highway direction, if vehicle on farm road, highway lights go from Green to Yellow to Red, allowing the farm road lights to become green, these stay green only as long as a farm road car is detected but never longer than a set interval, when these are met, farm lights transition from Green to Yellow to Red, allowing highway to return to green, even if farm road vehicles are waiting, highway gets at least a set interval as green)	C01,CO2, CO3
5	To simulate Logic Gates using CMOS	C04
6	To simulate Combinational/ Sequential circuit Using Conventional method and Transmission Gates(TG)	C04
7	To simulate CMOS combinational logic for minimum four variable inputs	C04
8	Simulate Stuck at fault model of given function	C05
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's 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 assistant. 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 Lab Assessment		
Each experiment from lab journal is assessed for thirty marks based on three rubrics. Rubric R-1 for timely completion, R-2 for understanding and R-3 for presentation/journal writing where each rubric carries ten marks.		



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

T. Y. B. Tech Pattern 2023 Semester: V 2302306A: Software Defined Radio			
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: Analog and DigitalCommunication			
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 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
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	(06 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	(06 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	(06 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	(06 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	(06 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. Roupheal , “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														
	PO												PSO	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	3	3	3	-	-	-	-	-	-	-	-	-	-	3
CO2	3	3	-	-	-	-	-	-	-	-	-	-	-	3
CO3	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	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 2023 Semester: V		
2302306B : Mechatronics		
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, Mechanical Processes & systems, Control System (Sensors & actuators), Electrical Circuits & Machines, Basics of Microcontrollers		
Companion course, if any: -Lab work in Mechatronics 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	Explain fundamentals of mechatronics.	2	
CO2	Describe the operation of sensors and actuators.	2	
CO3	Explain components of hydraulic circuit and its applications	2	
CO4	Explain components of pneumatic circuit and its applications	2	
CO5	Illustrate applications of mechatronics.	2	
COURSE CONTENTS			
Unit I	Introducing Mechatronics	(08 hrs)	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 gear trains Applications: CNC Machines, Flexible Manufacturing System, Computer Integrated Manufacturing, Humanoid Robot, Advanced Vehicle Control System, etc.			
Unit II	Sensors & Actuators	(08 hrs)	COs Mapped - CO2
Transducers: Types, Characteristics Parameters Displacement Sensors, Position Sensors, Proximity Sensors, Velocity Sensors, Motion Sensors, Force Sensors, Acceleration Sensors,			

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 2023 Semester: V		
2302306C: Interfacing techniques		
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: Microcontrollers		
Companion course, if any: Lab work in Interfacing Techniques		
Course Objectives: 1. To understand the architecture of the PIC microcontroller and develop basic assembly programs using arithmetic, logic instructions, and various addressing modes. 2. To learn PIC microcontroller I/O port programming, timer configurations, and interrupt mechanisms and apply this knowledge to simple interfacing tasks such as LED control. 3. To explore the fundamentals of serial communication and gain familiarity with standard serial communication protocols including RS232, RS485, I2C, and USB. 4. To develop an understanding of peripheral interfacing techniques such as memory vs I/O interfacing, data transfer methods, and interfacing of peripherals like LCD, keypad, ADC, DAC, and stepper motors. 5. To gain hands-on experience with Arduino for sensor interfacing and explore communication technologies like Zigbee and Wi-Fi, including their relevance to cloud-connected IoT systems.		
Course Outcomes: On completion of the course, students will be able to–		
	Course Outcomes	Bloom's Level
CO1	Explain the PIC18 microcontroller architecture, arithmetic and logic assembly instructions and C Data types.	Understand
CO2	Apply I/O port programming using TRIS registers, and configure timers, interrupts, and INTCON register and Demonstrate basic hardware interfacing such as LED control using the PIC microcontroller.	Apply
CO3	Apply serial communication protocols for efficient data handling and peripheral communication using PIC microcontrollers.	Apply
CO4	Apply interfacing techniques for LCD, keypad, ADC, DAC, and stepper motors, and understand memory vs I/O interfacing, buses, and data transfer methods like polling, interrupts, and DMA.	Apply
CO5	Apply interfacing with Arduino for sensors and communication modules, and compare Zigbee and Wi-Fi	Apply

	technologies in IoT systems, including sensor classification and cloud platform integration.	
COURSE CONTENTS		
Unit I	PIC Microcontroller Architecture and Assembly Programming	(07 hrs) COs Mapped - CO1
PIC architecture, Introduction to PIC assembly programming, Arithmetic and logic instructions, Addressing Modes, Oscillator configurations of PIC, Reset circuits of PIC 18, C Data types for PIC 18		
Unit II	PIC I/O & Timers	(07 hrs) COs Mapped - CO2
PIC I/O Port Programming, TRIS Register, Timers basics, Interrupts in PIC, INTCON, Introduction to interfacing, LED Interfacing		
Unit III	Serial Communication	(08 hrs) COs Mapped – CO3
Basics of serial communication, Basics of Serial Communication Protocol: Study of RS232, RS 485, I2C, USB		
Unit IV	Peripheral Interfacing	(07 hrs) COs Mapped – CO4
Memory Interfacing vs I/O Interfacing, Introduction to Parallel and Serial Interfacing, Data Transfer Techniques-Polling, Interrupts, DMA, Block transfer and byte transfer, LCD Interfacing, 4 X 4 Matrix Keypad, ADC, DAC interfacing, Stepper motor interfacing,		
Unit V	Interfacing in Embedded and IoT Systems	(07 hrs) COs Mapped – CO5
Arduino- Interfacing with LEDs, buttons, sensors, Zigbee, Wi-Fi - Comparison. The role of cloud platforms in IoT (Internet of Things), Introduction to sensor types: Analog vs Digital sensors, Active vs Passive sensors, Interfacing of arduino with sensors		
Text Books		
1. Embedded microcomputer systems: real time interfacing (3 rd edition), Jonathan W. Valvano. 2. Embedded system: An integrated approach, Lyla B.Das. 3. Introduction to embedded system: A cyber physical systems approach(2 nd edition), Edward Ashford Lee and Sanjit Arunkumar Seshia		
Reference Books		
1. Embedded Systems Architecture - A Comprehensive Guide- T. Noergaard (Newnes, 2005) 2. 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		

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



K. K. Wagh Institute of Engineering Education and Research, Nashik
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T. Y. B. Tech Pattern 2023 Semester: V		
2302306D : Foundation course in ML		
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 Programming (Python), and Data Structures.		
Companion course, if any: Lab work in Foundation course in ML		
Course Objectives: 1. Introduce core machine learning concepts and various types of learning paradigms. 2. Develop skills in data preprocessing and feature engineering for improved model performance. 3. Enable training and evaluation of ML models using suitable techniques and validation methods. 4. Apply unsupervised learning algorithms for clustering and dimensionality reduction. 5. Interpret model results using standard performance metrics for better decision-making.		

Course Outcomes: On completion of the course, students will be able to–		
	Course Outcomes	Bloom's Level
CO1	Explain core ML concepts and differentiate between supervised, unsupervised, and reinforcement learning problems.	2-Understand
CO2	Preprocess and engineer features from raw data to optimize model performance.	3-Apply
CO3	Train and evaluate models using appropriate loss functions, regularization, and validation techniques.	3-Apply
CO4	Apply unsupervised learning algorithms like k-Means and PCA for clustering and dimensionality reduction.	3-Apply
CO5	Evaluate and interpret model performance using metrics like accuracy, precision, recall, ROC, and AUC.	4-Analyze
COURSE CONTENTS		
Unit I	Introduction to Machine Learning and Types of Learning	COs Mapped - CO1
History and Evolution of Machine Learning Applications of ML in Real-world Domains Machine Learning Lifecycle Types of Learning: Supervised, Unsupervised, Semi-		

supervised, Reinforcement Learning Instance-based vs Model-based learning Batch vs Online Learning, Overview of AI vs ML, Challenges in ML: Overfitting, Underfitting, Bias-Variance Tradeoff Training, Testing, and Validation Sets Cross-validation Techniques (Hold-out, K-Fold)		
Unit II	Data Preprocessing and Feature Engineering	COs Mapped - CO2
Understanding ML Datasets: Attributes, Labels, Features Data Preprocessing: Handling Missing Values Feature Scaling: Normalization & Standardization Encoding: One-Hot, Label Encoding Feature Engineering Basics Feature Selection Techniques Dimensionality Reduction: Concept of Subset Selection Principal Component Analysis (PCA) Entropy, Information Gain, Gini Index		
Unit III	Supervised Learning Techniques	COs Mapped – CO3
Regression: Linear Regression: Hypothesis, Cost Function, Least Squares, Gradient Descent Performance Metrics: MSE, MAE, R ² Classification: Logistic Regression k-Nearest Neighbors (k-NN) Naïve Bayes Classifier Support Vector Machines (SVM): Maximal Margin Classifier, Kernel Trick, Decision Trees for Classification and Regression Introduction to Random Forests Binary vs Multiclass Classification (One-vs-Rest, One-vs-One)		
Unit IV	Unsupervised Learning Techniques	COs Mapped – CO4
Difference Between Supervised and Unsupervised Learning Applications of Unsupervised Learning Clustering Algorithms: k-Means Clustering Hierarchical Clustering, Dimensionality Reduction using PCA and Applications, Use Cases: Market Segmentation, Image Compression, etc.		
Unit V	Model Evaluation and Optimization	COs Mapped – CO5
Model Evaluation Metrics: Accuracy, Precision, Recall, F1-Score Confusion Matrix ROC and AUC Curve Overfitting and Underfitting: Causes and Solutions Regularization Techniques: L1 (Lasso), L2 (Ridge) – Basic Concepts Cross-Validation: K-Fold, Stratified Hyperparameter Tuning: Grid Search – Conceptual Introduction VC Dimension and Generalization (Introductory)		
Text Books		
1. Deep Learning – Ian Goodfellow, Yoshua Bengio, Aaron Courville. 2. Hands-On Machine Learning with Scikit-Learn, Keras, and TensorFlow – Aurélien Géron. 3. . Russell, S. and Norvig, P. 2015. Artificial Intelligence - A Modern Approach, 3rd edition, Prentice Hall 4. J. Gabriel, Artificial Intelligence: Artificial Intelligence for Humans (Artificial Intelligence, Machine Learning), Create Space Independent Publishing Platform, First edition , 2016 5. Peter Flach: Machine Learning: The Art and Science of Algorithms that Make Sense of Data, Cambridge University Press, Edition 2012.		

Reference Books
1. Learning Spark – Jules Damji, Matei Zaharia.
2. Natural Language Processing with Transformers – Lewis Tunstall.
3. .Gareth James, Daniela Witten, Trevor Hastie, Robert Tibshirani, An Introduction to Statistical Learning, Springer, ISBN 978-1-4614-7137-0 2.
4. Giuseppe Bonaccorso, “Machine Learning Algorithms”, Packt Publishing Limited, ISBN10: 1785889621, ISBN-13: 978-1785889622 2.
5. Tom Mitchell “Machine Learning” McGraw Hill Publication, ISBN :0070428077 9780070428072

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	-	3	3
CO4	3	3	-	-	3	-	-	-	-	-	3	-	3	3
CO5	3	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	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
(Autonomous from Academic Year 2022-23)

T Y. B. Tech Pattern 2023 Semester: V			
2302307A: Lab work in Software Defined Radio			
Teaching Scheme:		Credit Scheme:	Examination Scheme:
Practical : 02hrs/week		01	Continuous Comprehensive Practical Exam: 25 Marks TW: 25 Marks
Prerequisite Courses, if any: Analog and Digital Communication			
Course Objectives: - To understand how SDR platform provides easy access to wireless network system - To understand Digital Modulation Techniques for SDR.			
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		
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.		



K. K. Wagh Institute of Engineering Education and Research, Nashik
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T. Y. B. Tech. Pattern 2023 Semester: V		
2302307B : Lab work in Mechatronics		
Teaching Scheme:	Credit Scheme:	Examination Scheme:
Pr.: 2 Hrs / Week	01	Continuous Comprehensive Evaluation Practical : 25 Marks Term work: 25 Marks
Prerequisite Courses, if any: Basic Electronics Engineering, Mechanical Processes & systems, Control System (Sensors & actuators), Electrical Circuits & Machines, Basics of Microcontrollers		
Companion course, if any: --		
Course Objectives: 1. To Apply the fundamental principles of various transducers (resistive, capacitive, optical, thermoelectric) for the measurement of physical quantities 2. To utilize a data acquisition system to measure electrical signals (voltage and current) from sensors and analyze the operation of basic electromechanical and fluid power systems, including position control and pneumatic circuits. 3. Evaluate different measurement techniques for flow and proximity sensing, and design and simulate basic fluid power circuits for specific applications.		

Course Outcomes: On completion of the course, students will be able to–			
	Course Outcomes	Bloom's Level	Bloom's Level (Psychomotor domain)
CO1	Analyze the principles of operation and apply various transducers (strain gauge, capacitive, resistive, optical, thermoelectric) for the measurement of physical parameters like weight, liquid level, displacement, velocity, and temperature.	3- Applying	4- Manipulation
CO2	Design and implement basic data acquisition systems for measuring electrical quantities and understand the principles of flow and position control systems, including pneumatic and hydraulic circuits, and proximity sensors.	3- Applying	4- Manipulation

Sr. No.	List of Experiments
1.	Weight measurement using strain gauge.
2.	Liquid level measurement using capacitive transducer.
3.	Displacement measurement using sliding potentiometer.
4.	Velocity measurement using photo interruptive sensor and photo reflective sensor.
5.	Temperature measurement using thermocouple / RTD.
6.	To use data acquisition system for DC voltage & DC current measurement.
7.	Flow measurement using rotameter & ultrasonic sensor.
8.	Position control using servomechanism with photo electric pickup.
9.	Design of pneumatic circuits.
10.	Verify operation of proximity sensors.
11.	Simulation of hydraulic / pneumatic circuits.
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.	



K. K. Wagh Institute of Engineering Education and Research, Nashik
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T. Y. B. Tech. Pattern 2023 Semester: V			
2302307C: Lab work in Interfacing techniques			
Teaching Scheme:		Credit Scheme:	Examination Scheme:
Practical : 02hrs/week		01	Practical: 25 Marks Term work: 25 Marks
Prerequisite Courses, if any: Microcontrollers			
Course Outcomes: On completion of the course, students will be able to–			
	Course Outcomes	Bloom's Level	Psychomotor domain
CO1	Apply knowledge of digital I/O configuration to interface basic components such as LEDs, push buttons, buzzers, relays, and LCDs with PIC18FXXXX microcontroller.	Apply	6. Adaptation
CO2	Apply programming skills to interface peripheral devices like keypads, stepper motors, and analog sensors using internal modules such as ADC and timers in PIC18FXXXX.	Apply	6. Adaptation
CO3	Apply embedded system concepts to interface and control sensors and actuators using Arduino platform.	Apply	6. Adaptation

List of Laboratory Experiments / Assignments		
Sr. No	Laboratory Experiments / Assignments	CO Mapped
1	Write a program to interface multiple LEDs with the PIC18FXXXX microcontroller to create lighting patterns used in applications like status indicators, home automation, and digital displays.	CO1
2	Design a control system using a PIC microcontroller to simulate a basic security or automation alert mechanism. When Button 1 is pressed, it activates a relay (simulating a device), triggers a buzzer for audible alert, and initiates a forward LED chasing sequence to indicate system activation. When Button 2 is pressed, the relay and buzzer turn off, and the LEDs chase in reverse direction, signaling system deactivation. This application demonstrates user-triggered control for safety or automation scenarios.	CO1
3	Develop a program to interface a 16x2 LCD with the PIC18FXXXX microcontroller to display system messages or real-time data.	CO1
4	Develop a user input system by interfacing a 4x4 matrix keypad with the PIC18FXXXX microcontroller to capture numeric or command inputs. This setup is commonly used in applications such as digital door locks, menu-driven embedded systems, and user authentication panels where secure and efficient input handling is required.	CO2

5	Design a waveform generation system using the PIC18FXXXX microcontroller to produce a square wave signal by configuring timers with interrupts. This technique is essential in applications such as tone generation, digital clock signals, pulse generation for motor control, or triggering external circuits in timing-critical embedded systems	CO2
6	Develop a data acquisition system using the PIC18FXXXX microcontroller by interfacing an analog sensor, such as a potentiometer or LM35 temperature sensor, through the built-in ADC module. This forms the core of applications like temperature monitoring systems, smart thermostats, and analog signal-based automation where real-time analog data is converted to digital for processing and control.	CO2
7	Implement a motion control system by interfacing a stepper motor with the PIC18FXXXX microcontroller to achieve precise rotational movement. This application is widely used in CNC machines, 3D printers, robotic arms, and automated positioning systems where accurate control of angular displacement is essential.	CO2
8	Develop an embedded control system using Arduino by interfacing various sensors (e.g., temperature, light, motion) and actuators (e.g., motors, relays, buzzers) to enable real-time monitoring and automated response. This setup is fundamental in smart home automation, environmental monitoring, and robotics applications where sensor data triggers actuator actions for intelligent control.	CO3
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		



K. K. Wagh Institute of Engineering Education and Research, Nashik
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T. Y. B. Tech Pattern 2023 Semester: V		
2302307D: Lab work in Foundation course in ML		
Teaching Scheme:	Credit Scheme:	Examination Scheme:
Practical : 02hrs/week	01	Practical Exam: 25 Marks Term Work: 25Marks
Prerequisite Courses, if any:		
Companion course, if any:		
Course Objectives: 1. Implement and compare core deep learning components 2. Develop and train CNN and RNN models 3. Evaluate model performance.		

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 and implement basic deep learning concepts such as neural networks and activation functions.	L2: Understand	1-Imitation
CO2	Develop and train convolutional and recurrent neural network models for classification and prediction.	L3: Apply	1-Imitation
CO3	Evaluate model performance using appropriate deep learning metrics and tools.	L4: Analyze	1-Imitation

List of Laboratory Experiments		
Sr. No.	Laboratory Experiments	CO Mapped
1	Implement and compare ReLU, Sigmoid, and Tanh on the same dataset; visualize activation outputs and training convergence.	CO1
2	Implement a basic neural network using Keras or PyTorch for a binary classification task (e.g., classifying spam vs. non-spam emails or IRIS dataset).	CO1
3	Train a Convolutional Neural Network on MNIST or CIFAR-10 dataset and evaluate accuracy.	CO2
4	Use VGG16, ResNet50, or MobileNet to classify custom images using	CO2

	transfer learning and fine-tuning.	
5	Implement RNN or LSTM to perform time series prediction (e.g., stock prices) or text classification (e.g., IMDB sentiment analysis).	CO2
6	Experiment with different combinations of optimizers (SGD, Adam, RMSProp) and loss functions; plot and compare convergence curves.	CO3
7	Compute and visualize confusion matrix, precision, recall, F1-score, and ROC curve for a classification model.	CO3
8	Mini Project – Design an integrated project combining big data tools and deep learning models.	CO1,2,3
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 Teamwork 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	2	2	2	3	-	-	-	1	2	-	2	3	2
CO2	3	3	3	2	3	-	-	-	2	2	2	2	3	3
CO3	2	3	2	3	3	-	-	-	1	2	1	3	2	2



K. K. Wagh Institute of Engineering Education and Research, Nashik
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T. Y. B. Tech. Pattern 2023 Semester: V		
2302308: Digital Business Management		
Teaching Scheme:	Credit Scheme:	Examination Scheme:
Theory: 02hrs/week	02	Continuous Comprehensive Evaluation: 50 Marks
Prerequisite Courses, if any: Project Management.		
Companion course, if any: --		
Course Objectives: 1. To familiarize with digital business concept. 2. To acquaint with E-commerce. 3. To give insights into E-business and its strategies.		

Course Outcomes: On completion of the course, students will be able to–			
	Course Outcomes	Bloom’s Level	
CO1	Understand fundamentals of Digital Business.	2-Understand	
CO2	Identify drivers of digital business.	2-Understand	
CO3	Illustrate various approaches and techniques for E-business and management.	2-Understand	
CO4	Identify security threats in e-business.	2-Understand	
CO5	Prepare E-business plan.	3-Apply	
COURSE CONTENTS			
Unit I	Introduction to Digital Business	(04 hrs)	COs Mapped - CO1
Introduction, Background and current status, E-market places, structures, mechanisms, economics and impacts. Difference between physical economy and digital economy.			
Unit II	Drivers of digital business	(04 hrs)	COs Mapped - CO2
Big Data & Analytics, Mobile, Cloud Computing, Social media, BYOD, and Internet of Things (digitally intelligent machines/services), Opportunities and Challenges in Digital Business.			
Unit III	Overview of E-Commerce	(08 hrs)	COs Mapped – CO3
E-Commerce: Meaning, Retailing in e-commerce-products and services, consumer behavior, market research and advertisement, B2B-E-commerce-selling and buying in private e-markets, public B2B exchanges and support services, e-supply chains, Collaborative Commerce, Intra business EC and Corporate portals. Other E-C models and applications, innovative EC System-From E- government and learning to C2C, mobile commerce and			

pervasive computing EC Strategy and Implementation EC strategy and global EC, Economics and Justification of EC, Using Affiliate marketing to promote your e- commerce business, Launching a successful online business and EC project, Legal, Ethics and Societal impacts of EC.			
Unit IV	Managing E-Business	(07 hrs)	COs Mapped – CO4
Managing Knowledge, Management skills for e- business, Managing Risks in e –business. Security Threats to e-business -Security Overview, Electronic Commerce Threats, Encryption, Cryptography, Public Key and Private Key Cryptography, Digital Signatures, Digital Certificates, Security Protocols over Public Networks: HTTP, SSL, Firewall as Security Control, Public Key Infrastructure (PKI) for Security, Prominent Cryptographic Applications.			
Unit V	E-Business Strategy	(07 hrs)	COs Mapped – CO5
E-business Strategic formulation- Analysis of Company’s Internal and external environment, Selection of strategy, E-business strategy into Action, challenges and E-Transition, From Idea to Realization-Business plan, Case Studies.			
Text Books			
1. Urmi Dutta, Neha Somani, “E-Commerce & Business Communication”, Oxford University Press 2. Elias M. Awad, “E-commerce from vision to fulfilment” 3rd Edition, Prentice Hall India 3. Dave Chaffey, “Digital Business and E-Commerce Management”, 6th Edition, Pearson 4. Colin Combe, “Introduction to E-business: Management and Strategy”, 1st Edition , Elsvier 5. Eloise Coupey, “Digital Business Concepts and Strategy”, 2nd Edition , Pearson			
Reference Books			
1. Vinocenzo Morabito, “Trend and Challenges in Digital Business Innovation” Springer 2. Erika Darics, “Digital Business Discourse”, Palgrave Macmillan 3. “E-Governance-Challenges and Opportunities”, Proceedings in 2nd International Conference theory and practice of Electronic Governance 4. “Perspectives the Digital Enterprise –A framework for Transformation”, TCS Consulting Journal Vol. 5			

[illegible]

Guidelines for Continuous Comprehensive Evaluation of Theory Course		
Sr. No.	Components for Continuous Comprehensive Evaluation	Marks Allotted
1	Activity	20
2	Presentation	30
	Total	50

Tut. No.	Title of Tutorial
1	Compare conventional business with e- business based on structure, mechanisms and economics.
2	Discuss the role of Big Data and Data Analytics in Digital Business Management.
3	Review various Opportunities and Challenges in Digital Business.
4	Prepare a report on societal impacts of Digital Business.
5	Review various security aspects of Digital Business.
6	Discuss the various steps for executing the business plan digitally.
7	Develop a strategy for E-Business for selling a product online.
8	Discuss a typical case study of any one Digital Business.



K. K. Wagh Institute of Engineering Education and Research, Nashik
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T. Y. B. Tech Pattern 2023 Semester: V			
2302309A: MDM3: Cyber Security, Tools, Techniques and Counter Measures			
Teaching Scheme:		Credit Scheme:	Examination Scheme:
Theory :03hrs/week		03	Continuous Comprehensive Evaluation: 20Marks InSem Exam: 20Marks EndSem Exam: 60Marks
Prerequisite Courses, if any: Introduction to Computer Science / Programming, Python, C/C++, Introduction to Cyber Security / Information Security Fundamentals			
Companion course, if any: Cybersecurity Laws, Ethics & Policy			
Course Objectives:			
1. Understand core principles of cybersecurity and common threat landscapes.			
2. Identify and analyze various types of cyberattacks and vulnerabilities.			
3. Apply security tools and techniques to protect networks, systems, and data.			
4. Evaluate and implement countermeasures against malware, phishing, and intrusion.			
5. Demonstrate awareness of ethical, legal, and compliance issues in cybersecurity.			
Course Outcomes: On completion of the course, students will be able to–			
	Course Outcomes		Bloom's Level
CO1	Identify common cyber threats and vulnerabilities in information systems.		1- Remember
CO2	Describe key cybersecurity tools and techniques used for system protection.		2- Understand
CO3	Apply appropriate countermeasures to secure networks and devices.		3- Apply
CO4	Analyze security incidents to determine causes and potential impacts.		4-Analyze
CO5	Demonstrate the use of ethical hacking tools in a controlled environment.		3- Apply
COURSE CONTENTS			
Unit I	Introduction to Cyber Security and Threat Dynamics	(07hrs)	COs Mapped CO1
Cyber Security Essentials-What is Cyber Security Essentials, Indian Cyberspace, Security Concept, Basic Cryptography. Attack Vectors, Threat, Risk and Vulnerability. Advance Persistent Threat and cyber kill chain			
Unit II	Cyber Security Frameworks and Network Defense Mechanisms	(08hrs)	COs Mapped – CO2
Cyber Security Framework: Cyber Security Policy, Cyber Security Regulations in INDIA, Cyber Security Regulations in other countries, Cyber Security Policy Framework. Firewall And Packet Filters:			
Firewall, Packet Filtering, IDS, IPS, Security Information and Event Management			

Unit III	Network and Application Security Tools and Techniques	(07hrs)	COs Mapped - CO3
Introduction to Windows Firewall, Introduction to Linux Firewall, Attacks On Wireless Networks: Basics of Wireless Networks, Standards in Wireless Networks, Wireless Networks Attack. Application Inspection Tools : ZAP, SQLMap, DVWA, WebGoat.			
Unit IV	Web-Based Attacks, Cyber Crimes, and Incident Response	(07hrs)	COs Mapped - CO4
Web Attack- Browser Attack, Web Attacks Targeting Users, Obtaining user for website data, Email Attacks. Cyber Crimes – Types of Cyber Crime, Hacking, Cyberspace and Criminal Behaviour, Classification of Terms, Traditional Problems associated with computer crime, Introduction to Incidence Response, Digital Forensic			
Unit V	Foundations of Cyber Law and Computer Crime	(07hrs)	COs Mapped - CO5
Computer language, Network Language, Realms of Cyber World, Internet crime and Act : A brief history of Internet, Recognizing and defining computer crime, Contemporary Crimes, Indian IT Act 2000, Digital Evidences and chain of custody.			
Text Books			
1. Principles of Cyber Security Course Code: PGDCS-101 Published by Dr. Babasaheb Ambedkar 2. Open University Cyber Security Techniques: PGDCS-103 Published by Dr. Babasaheb Ambedkar Open University			
Reference Books			
1. Cyber Security – Understanding Cyber Crimes, Computer Forensics and Legal Perspectives Author: Nina Godbole, Sunit Belapure, Publisher: Wiley India 2. Information Systems Security – Security Management, Metrics, Frameworks and Best Practices Author: Nina Godbole, Publisher: Wiley India.			
NPTEL Link			
https://onlinecourses.swayam2.ac.in/nou24_ge65/preview			

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

Guidelines for Continuous Comprehensive Evaluation of Theory Course		
Sr. No.	Components for Continuous Comprehensive Evaluation	Marks Allotted
1	Assignment: Assignment No. 1 - Unit 1 (10 Marks) Assignment No. 2 - Unit 2 (10 Marks) Assignment No. 3 – Unit 3 (10 Marks) Assignment No. 4 - Unit 4 (10 Marks) Assignment No. 5 - Unit 5 (10 Marks)	10
2	Quiz (Using LMS): 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)	10



K. K. Wagh Institute of Engineering Education and Research, Nashik
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T. Y. B. Tech Pattern 2023 Semester: V			
2302309B: MDM3: Data Science using Python			
Teaching Scheme:		Credit Scheme:	Examination Scheme:
Theory :03hrs/week		03	Continuous Comprehensive Evaluation: 20Marks InSem Exam: 20Marks EndSem Exam: 60Marks
Prerequisite Courses, if any: prior knowledge of programming language would be helpful			
Companion course, if any: understanding of Python, MATLAB			
Course Objectives: 1. To introduce the core concepts and ecosystem of Data Science. 2. To establish a solid foundation in statistical and probabilistic reasoning. 3. To develop proficiency in Python programming. 4. To equip learners with skills in data handling and visualization. 5. To prepare students to build end-to-end data science solutions.			
Course Outcomes: On completion of the course, students will be able to–			
	Course Outcomes	Bloom's Level	
CO1	Utilize Python programming and core data structures to handle and manipulate data for data science applications.	3-Apply	
CO2	Apply statistical analysis, probability theory, hypothesis testing, and exploratory techniques to extract meaningful insights from data.	3-Apply	
CO3	Perform essential data preprocessing, dimensionality reduction, and apply supervised learning algorithms for predictive analytics.	3-Apply & 4-Analysis	
CO4	Implement deep learning and unsupervised learning techniques to solve complex data science problems such as classification, clustering, and anomaly detection.	3-Apply 6-Implementation	
CO5	Design and execute end-to-end data science projects, from data collection to model deployment, using Python and MATLAB.	3-Apply & 5-Evaluation	
COURSE CONTENTS			
Unit I	Introduction to Data Science	(08hrs)	COs Mapped - CO1
Introduction to data science, Difference in AI, Machine Learning and Data Science, Basic introduction of python, Google Colab and their features Python Data Types, Input/Output, Operators: Precedence and Associativity, Decision			

Making and Looping, Function and its syntax, Positional arguments, Keyword arguments etc, Exercises on Loops, decision making and functions, String: Operations & Functions, List: Accessing List, Slicing, Cloning/Copy etc, Set and Tuple: Accessing, Slicing, Operations & Functions, Dictionary: Properties, Accessing Dictionary, Problems on Dictionary, Exercises on String, Set, Tuple and Dictionary			
Unit II	Statistics, Probability & Data Exploration	(07hrs)	COs Mapped - CO2
Measures of centrality, dispersion, skewness, and kurtosis , Data distributions and estimation, Exploratory Data Analysis (EDA): visualization, outliers, correlation, Hypothesis testing: t-tests, chi-square, ANOVA, p-values, Probability theory fundamentals, Hands-on exercises using Python (NumPy, Pandas, Seaborn/Matplotlib, SciPy)			
Unit III	Data Pre-processing and Supervised learning	(07hrs)	COs Mapped - CO3
Data Preprocessing, Handling missing values, Class Imbalance and its remedies, Feature Scaling, Transformation, Discretization, Image and Text Preprocessing, Dimensionality Reduction, Feature Ranking, Feature Selection and Feature Extraction, Exercises on Data Preprocessing and Dimensionality Reduction Performance measures: Error, Accuracy, Precision, Recall, Confusion Matrix and AUC Score Exercises on supervised learning algorithms: Linear Regression – Predict Housing Prices, Logistic Regression – Binary Classification, KNN Classifier – Handwritten Digit Recognition, Decision Tree Classifier – Play Tennis Dataset, Random Forest – Customer Churn Prediction Project 1: Student Performance Prediction, Project 2: Email Spam Classifier, Project 3: Multi-Class Classification – Iris Dataset			
Unit IV	Advanced Neural Networks & Unsupervised Learning	(07hrs)	COs Mapped - CO4
Overview of modern Deep Learning frameworks: TensorFlow, Keras, PyTorch Applications of Unsupervised Learning: Clustering, anomaly detection, dimensionality reduction Deep Learning: Image Classification and Convolutional Neural Networks, Text Classification and Recurrent Neural Networks, Exercises using deep learning models: Convolutional Neural Networks (CNNs) for Image Classification, Recurrent Neural Networks (RNNs) for Text Classification, Sentiment analysis or SMS spam classification using RNN			
Unit V	End to End project using Python and MATLAB	(07hrs)	COs Mapped – CO5
Steps for end to end machine learning project, End-to-end implementation of various real-life projects using python: Sentiment Analysis using LSTM, Real-Time Object Detection, Image Classification on CIFAR-10			

End-to-end implementation of various real-life projects using MATLAB: ECG Signal Classification using ML, Image Segmentation using K-Means
Text Books
1. Grus, J. (2019). Data science from scratch: first principles with python. O'Reilly Media
Reference Books
1. Kroese, D. P., Botev, Z., Taimre, T., & Vaisman, R. (2019). Data science and machine learning: mathematical and statistical methods. CRC Press. 2. Thareja, R. (2022) Data Science and Machine Learning using Python. McGraw Hill.
NPTEL Link
https://onlinecourses.nptel.ac.in/noc24_cs59/preview https://www.youtube.com/watch?v=tA42nHmEKw&list=PLyqSpQzTE6M_fEg1zZmeGIkenMDgXKGYi

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	2	2	2	-	-	-	-	-	-	-	-	-
CO2	3	2	2	2	2	-	-	-	-	-	-	-	-	-
CO3	3	3	3	2	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	Assignment: Assignment No. 1 - Unit 1 (10 Marks) Assignment No. 2 - Unit 2 (10 Marks) Assignment No. 3 – Unit 3(10 Marks) Assignment No. 4 - Unit 4(10 Marks) Assignment No. 5 - Unit 5(10 Marks)	10
2	Quiz (Using LMS): 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)	10



K. K. Wagh Institute of Engineering Education and Research, Nashik
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T. Y. B. Tech.Pattern 2023 Semester: V			
2302310: Intellectual Property Rights (IPR)			
(Branch: E&TC)			
Teaching Scheme:	Credit Scheme:	Examination Scheme:	
Tutorial: 01hr/week Practical : 02hrs/week	01	Tutorial: 25 Marks Term work: 25 Marks	
Prerequisite Courses, if any: NA			
Course Objectives: 1. To provide a comprehensive understanding of the patent system and its importance in protecting inventions. 2. To equip students with the knowledge and skills necessary to analyze inventions for patentability. 3. To teach students the principles and techniques of drafting clear, concise, and legally sound patent applications			
Course Outcomes: On completion of the course, students will be able to–			
	Course Outcomes	Bloom’s Level	
CO1	Explain the patent system and its requirements.	2-Understand	
CO2	Determine if an invention can be patented.	2-Understand	
CO3	Draft a patent application.	2-Understand	
COURSE CONTENTS			
Unit I	Indian Patent System & Patentability Basics	(04 hrs)	COs Mapped - CO1
Overview of the Indian Patent System, Structure and Scope of the Patents Act, 1970 ,Key Provisions of the Patents Rules, 2003 (incl. Amendments)			
Patentability Criteria: Novelty, Inventive Step, Industrial Applicability, Statutory Exceptions			
Unit II	Patent Drafting & Filing Procedure	(04 hrs)	COs Mapped – CO2
Types of Patent Applications: Ordinary, Convention, PCT, Provisional vs. Complete Specification, Structure of a Patent, Document: Title, Abstract, Description, Claims , Basics of Patent Drafting Patent Filing Process: Filing, Publication, Request for Examination (RFE), First Examination Report (FER), Responses & Amendments			
Unit III	Grant, Opposition & Global Aspects	(04 hrs)	COs Mapped – CO3
Powers of Controller & FER Decisions, Pre-Grant and Post-Grant Opposition , Patent Grant and Rights, Compulsory Licensing , Patent Enforcement and Infringement , PCT &Convention Applications , International Filing and Timelines			

Text Books	
1. Kalyan C. Kankanala, A.K. Narasani, V. Radhakrishnan, “Indian Patent Law and Practice”, Oxford Press.	
Reference Books	
1. David Bainbridge, “Intellectual Property”, Pearson. 2. NPTEL Course on Intellectual Property NPTEL Course on “Patent Law for Scientists and Engineers” by Prof. Feroz Ali IIT Madras Link of the Course: https://onlinecourses.nptel.ac.in/noc20_hs55/preview	

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	2	-	-	-	-	2	2	-	-	-	-	-	-	2
CO2	-	3	-	2	-	-	-	-	-	-	-	-	2	-
CO3	-	-	3	-	2	-	-	-	2	2	-	2	2	-

Guidelines for Tutorial & Teamwork Allocation		
Sr. No.	Components	Marks Allotted
1	Tutorials	25
2	Performance in Lab	25

List of Tutorials (25 Marks)

1. To write a patent draft.
2. To write a Copyright Registration Draft
3. To Draft a Trademark Application
4. To Prepare an Invention Disclosure Form (IDF)
5. To write a Software Copyright Draft



K. K. Wagh Institute of Engineering Education and Research, Nashik
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T. Y. B. Tech. Pattern 2023 Semester: V 2302310: Lab work in Intellectual Property Rights (IPR)			
Teaching Scheme:		Credit Scheme:	Examination Scheme:
Tutorial: 01hr/week Practical : 02hrs/week		01	Tutorial: 25 Marks Term work: 25 Marks
Prerequisite Courses, if any: NA			
Companion course, if any: Intellectual Property Rights			
Course Objectives: 1. Understand the Indian Patent System and key legal provisions. 2. Analyze patentability through prior art and trademark searches. 3. Draft provisional and complete patent specifications.			
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	Navigate the Indian Patent Office (IPO) portal and interpret key sections of the Patents Act and Rules.	2- Understand	1-Imitation
CO2	Evaluate the patentability of inventions through novelty, inventive step, and prior art/trademark searches.	5- Evaluate	2- Manipulation
CO3	Draft provisional and complete patent specifications for a given technical idea.	6- Create	3- Precision

List of Laboratory Experiments		
Sr. No.	Laboratory Experiments	CO Mapped
1	Introduction to Patent System : Practical overview of Indian Patent Office (IPO) website	CO1
2	Understanding Patent Acts & Rules: Identify major sections and amendments	CO1
3	Patentability Analysis (Novelty, Inventive Step, etc.) and Copyright - Compare two similar patents - Identify novelty and inventive step	CO2
4	Prior Product / circuit Design Search Activity (Trademark , etc)	CO2

5	Understanding Patent Specifications - Dissect a sample patent (Title, Abstract, Claims, Description)	CO3
6	Patent Drafting Exercise – Part 1 - Draft a Provisional Specification for a given project idea	CO3
7	Patent Drafting Exercise – Part 2 - Convert the provisional into a Complete Specification	CO3
8	Evaluation & Presentation	CO3
Guidelines for Laboratory Conduction		
1. Teacher will brief the given experiment to students, its procedure, observations, calculation, and outcome of this experiment. 2. Lab assistants will provide access to patent databases, project ideas, templates, and required tools. 3. Students will perform the activity (e.g., draft a patent, compare patents, dissect a sample patent) in groups under supervision. 4. Submit your work (search results/drafts/comparisons) to the faculty for review and feedback. 5. Based on feedback, write a brief conclusion summarizing your understanding and final outcome.		
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	
	PO												PSO	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	2	-	-	-	2	-	2	-	2	-	2	-	-	-
CO2	2	3	-	2	2	-	-	-	2	-	2	2	2	2
CO3	2	2	3	-	2	-	2	2	3	3	2	2	2	3

SEMESTER VI



K. K. Wagh Institute of Engineering Education and Research, Nashik
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T. Y. B. Tech. Pattern 2023 Semester: VI			
2302311: Embedded Systems			
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: Microcontrollers			
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 basic 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	Explain the basics of embedded system	2- Understand	
CO2	Apply different peripherals of ARM 7 based microcontrollers	3-Apply	
CO3	Interface different real time devices ARM 7 based microcontrollers	3-Apply	
CO4	Select software architecture for embedded system	3-Apply	
CO5	Implement embedded system using 32 bit microcontroller	3-Apply	
COURSE CONTENTS			
Unit I	Embedded System Overview	(06 hrs)	COs Mapped - CO1
Embedded System Introduction, Hardware and software architectures of Embedded System, Classification and Characteristics of Embedded System ,Design metrics(technical and techno- economical), Embedded processor technology, Selection of microcontroller and memory , Embedded system life cycle			
Unit II	ARM 7 based Microcontroller	(07 hrs)	COs Mapped - CO2
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			
Unit III	ARM Peripheral	(07 hrs)	COs Mapped – CO3
LPC 2148 Interfacing with LED, Switches and RelayLPC 2148 interface with LCD , on-chip DAC for waveform generation, Interfacing with ARM 7 with DHT 11 sensor and servomotor, on-chip ADC, Vector Interrupt Controller(VIC)			
Unit IV	Software aspects of embedded systems	(07 hrs)	COs Mapped – CO4
Programming Embedded C, OS used in embedded system, Real time OS: Usage of Shared resources and related issues, Concept of RTOS, Types of RTOS, differences from GPOS, real time scheduling			
Unit V	Latest trend in embedded system and Case Studies	(06 hrs)	COs Mapped – CO5
Latest trend in embedded system, Vending Machine, Digital Camera, Robotics Arm Control			
Text Books			
1.K.V. Shibu, “Introduction to Embedded Systems”, McGraw Hill Education India Private Limited, 2nd Edition 2. Lyla B Das “Embedded Systems” Pearson publication 3. Andrew Sloss, Dominic Symes, Chris Wright, “ARM System Developer’s Guide – Designing and Optimizing System Software”, Elsevier, 1st Edition			
Reference Books			
1.UM10139 LPC214x User manual, NXP Semiconductor			

Strength of CO-PO Mapping														
	PO													
	1	2	3	4	5	6	7	8	9	10	11	12	PSO1	PSO2
CO1	3	3	-	-	-	-	-	-	-	-	-	-	2	3
CO2	3	2	-	-	3	-	-	-	-	-	-	3	2	3
CO3	3	2	3	-	3	-	-	-	-	-	-	3	3	3
CO4	3	2	3	-	3	-	-	-	-	-	-	3	2	2
CO5	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	Five Assignments on Unit-1, Unit-2, Unit-3, Unit-4 and Unit-5	10
2	5 Quiz	10
	Total	20



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

T. Y. B. Tech. Pattern 2023 Semester: VI		
2302312: Power Electronics		
Teaching Scheme:	Credit Scheme:	Examination Scheme:
Theory :03 hrs/week	02	Continuous Comprehensive Evaluation: 20 Marks InSem Exam: 20 Marks EndSem Exam: 60 Marks
Prerequisite Courses, if any: Basic Electronics		
1. To introduce different power devices viz. SCR, GTO, MOSFET and IGBT with construction, characteristics, repetitive and non-repetitive ratings and typical triggering/driver circuits. 2. To understand working, design and performance analysis and applications of various power converter circuits such as ac to dc converters, inverter and chopper To know various protection circuit requirements of power electronic devices.		

	Course Outcomes	Bloom's Level	
CO1	Select power devices for different power power conversion applications. Design & Implement gate drive circuits for power devices	3- Apply 2- Understand	
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”, CRC Press, 1st Edition, 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 Wiley & 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. 6. L. Ashok Kumar, S. Albert Alexander and Madhuvanthani Rajendran, “Power Electronic Converters for Solar Photovoltaic Systems”, Elsevier, 1st Edition, 2020			

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	2
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	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 2023 Semester: VI			
2302313: Lab work in Embedded Systems and Power Electronics			
Teaching Scheme:	Credit Scheme:	Examination Scheme:	
Practical :02hrs/week	01	Practical : 25 Marks Term work: 25 Marks	
Prerequisite Courses, if any: Microcontrollers			
Course Outcomes: On completion of the course, students will be able to–			
	Course Outcomes	Bloom’s Level	Psychomotor domain
CO1	Apply knowledge of digital I/O configuration to interface basic components with LPC2148 microcontroller.	Apply	Adaptation
CO2	Apply programming skills to initialize peripherals and interface sensors and actuators using LPC 2148.	Apply	Adaptation
CO3	Apply serial communication to communicate with outside world.	Apply	Adaptation
CO1	Understand the operating principles of various power electronic devices	Understand	Imitation
CO2	Use power electronic simulation packages & hardware to develop the power converters.	Apply	Adaptation
CO3	Analyze and choose the appropriate converters for various applications	Apply	Adaptation

PART A

List of Laboratory Experiments / Assignments		
Sr. No	Laboratory Experiments / Assignments	CO Mapped
1	Write a program to interface button, LED, relay and buzzer to LPC 2148	CO1
2	Write a program to interface GLCD to LPC 2148	CO1
3	Generate square wave, triangular and Sawtooth using DAC.	CO2
4	ADC (Analog-to-Digital Converter) Interface using LPC2148: Read data from Temperature Sensor (e.g., LM35) and LDR sensor	CO2
5	Write a program to interface servo motor to LPC2148	CO2
6	Transmit and receive data using serial communication to another Board or PC	CO3
7	Interface a GSM module to LPC2148 and write a program to Send and receive messages using GSM to another user.	CO3
8	Interface a GSM module to LPC2148 and write a program to track the location using GPS.	CO3

PART B

List of Laboratory Experiments / Assignments		
Sr. No.	Laboratory Experiments / Assignments	CO Mapped
1	Study static characteristics of SCR and decide in which region it gets turn on.	CO1
2	Plot V-I characteristics of Power MOSFET & understand its application as a Switch.	CO1
3	Study the static characteristics of IGBT and compare it with MOSFET.	CO1
4	Implement the design for single phase full converter using IGBT / SCR with R & R-L load and observe the effect of firing angle on the load.(Bulb)	CO2
5	Implement Step down / step up chopper using power MOSFET and observe the effect of ON time period on the Output.	CO2
6	To study the design for 5V battery charger using IC TPS40200.	CO3
7	Single-Phase PWM bridge inverter.	CO2
8	To 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. 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/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)

[illegible]



K. K. Wagh Institute of Engineering Education and Research, Nashik
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T. Y. B. Tech. Pattern 2023 Semester: VI		
2302314A: Microwave 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: Electromagnetic fields, wave propagation, and network theory		
Companion course, if any: --		
Course Objectives: 1. To introduce the fundamental principles of microwave engineering, including microwave transmission lines. 2. To familiarize students with waveguides, impedance matching techniques, and microwave network analysis. 3. To explore microwave components, semiconductor devices, and integrated circuits used in communication and radar systems.		

Course Outcomes: On completion of the course, students will be able to–		
	Course Outcomes	Bloom's Level
CO1	Understand the fundamentals of microwave technology and the principles governing transmission lines and wave propagation.	2
CO2	Analyse wave propagation in different waveguide structures and understand the application of Smith charts. utilize scattering matrix representations for N-port microwave network analysis.	3
CO3	Analyse scattering matrix representations for microwave networks, design impedance matching circuits, evaluate microwave components, and apply the knowledge in system design.	3
CO4	Study the characteristics and applications of microwave semiconductor devices, including transistors and diodes, design single-stage transistor amplifier and evaluate RF and microwave oscillators	3
CO5	Understand the principles and operation of microwave tubes, ferrite-based components, and microwave integrated circuits, and apply this knowledge to real-world applications in radar, satellite, and communication systems	3

COURSE CONTENTS			
Unit I:	Fundamentals of Microwave Engineering and Transmission Line Theory	(07 hrs)	COs Mapped - CO1
Brief history of microwaves, microwave frequency bands, different applications of microwaves, microwave transmission lines, wave propagation in transmission lines, lossy and distortionless transmission lines.			
Unit II:	Microwave Network Analysis and Waveguide Fundamentals	(07 hrs)	COs Mapped - CO2
Smith chart - fundamentals and applications, introduction to waveguides and wave types - TE, TM, TEM, TE & TM modes in circular and rectangular waveguides, cutoff frequency, attenuation in waveguides, waveguide impedance and equivalent circuits, N-port microwave networks, impedance, admittance and scattering matrix representations.			
Unit III:	Microwave Network Theory, Impedance Matching, Resonators, and Passive Components	(8 hrs)	COs Mapped – CO3
S-parameters and network analysis, properties of S matrix, impedance matching techniques, QWT and applications, microwave resonators, waveguide resonators, resonant frequency, microwave power dividers, T-junction power divider, microwave directional coupler, microwave filter design process.			
Unit IV:	Microwave Semiconductor Devices, Amplifier Design, and Oscillator Principle	(07 hrs)	COs Mapped – CO4
Microwave semiconductor devices - PIN, schottky, tunnel and varactor diodes, PIN Diode-Based Microwave Switching and Phase Control, Negative Resistance Devices and Gunn Diode, Avalanche Transit-Time Devices, Microwave Amplifier Design			
Unit V:	Microwave Tubes, Ferrite Devices, Integrated Circuits, and Practical Applications	(07 hrs)	COs Mapped – CO5
Microwave vacuum electron devices, Microwave Propagation and Non-Reciprocal Components, Microwave Integrated Circuits (MICs) and Planar Technologies, Microwave applications and system relevance.			
Text Books			
1. R. E. Collin, Foundations for microwave engineering, second edition, Jan. 2001, Wiley IEEE Press, ISBN: 978-078-03-6031-0 2. David M. Pozar, Microwave Engineering, fourth edition, Jan. 2013, Wiley, ISBN: 978-812-65-4190-4			
Reference Books			
1. R.S. Rao, Microwave Engineering, second edition, Oct. 2015, PHI Learning Pvt. Ltd, ISBN: 978-812-03-5159-2 2. Ahmad Shahid Khan, Microwave Engineering: Concepts and Fundamentals, 2014, CRC press, ISBN: 978-113-80-7242-8 3. Michael Steer, Fundamentals of microwave and RF design, 2019, North Carolina State University Library, ISBN: 9781469656892 4. Prakash Kumar Chaturvedi, Microwave, Radar and RF engineering, 2018, Springer, ISBN: 978-981-10-7964-1			

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



K. K. Wagh Institute of Engineering Education and Research, Nashik
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T. Y. B. Tech. Pattern 2023 Semester: VI		
2302314B : Process Instrumentation		
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, Mechatronics,		
Companion course, if any: --		
Course Objectives: 1. To Make the students familiar with fundamentals of process control and controls schemes 2. To Fundamentals of PLC(Programmable logic controller) and PLC Programming techniques 3. To discuss role of SCADA(Supervisory Control and Data Acquisition), HMI (Human Machine Interface) interfacing with PLC to provide solutions for Process Industries		

Course Outcomes: On completion of the course, students will be able to–			
	Course Outcomes		Bloom’s Level
CO1	Explain fundamentals of process control and control schemes.		2
CO2	Explain concepts of PLC, its uses for industrial applications.		2
CO3	Discuss basics of SCADA, HMI and communication with PLC		2
CO4	Make use of knowledge of Installation, troubleshooting & maintenance of PLC to provide solutions for industrial automation problems.		3
CO5	Apply basic and advanced PLC instructions to implement control logic for various industrial applications		3
COURSE CONTENTS			
Unit I	Process control & control schemes	(06 hrs)	COs Mapped - CO1
Introduction to process control, objectives and benefits, types of processes, characteristics, and selection of control action for them. Necessity of process modeling Study of flow control, pressure control, liquid level, temperature, Scaling, Feedback, feedforward, cascade, ratio, split range, selective control, adaptive control, and model based control, Multivariable control, discrete state control.			

Unit II	Fundamentals of PLC (Programmable Logic controller)	(06 hrs)	COs Mapped - CO2
PLC Fundamentals - Block diagram of PLC's, Selection of PLC components(Power supply, CPU, I/Os List , Communication bus Various ranges available in PLC's), I/O list selection /li>, Open-Circuit and Short-Circuit Tests, Types of Inputs & outputs / Source Sink Concepts, Wiring of the I/O devices, Architectural Evolution of PLC, PLC advantages & Disadvantages, PLC vs Computers, Introduction to the field devices, Concept of flags and Scan cycle execution.Overview of Conventional ladders vs PLC Ladder logic, Hardwired Logic vs Programmed logic, Programming word level logic instructions, Relation of digital gate logic to contact/coil logic, Relay logic, Relay Sequencers			
Unit III	SCADA, HMI & Communication between PLC & SCADA	(6 hrs)	COs Mapped – CO3
Fundamentals, Comparison of SCADA, DCS, PLC and smart instruments, Remote Terminal Unit (RTU) structure, MTU (Main terminal unit), functions of MTU, Components of a SCADA system, HMI (Human Machine Interface, Interfacing technique of PLC with HMI. Communication between PLC & SCADA system : Industrial Ethernet, TCP/IP,, Fieldbus, Modbus, LAN connectivity: bridges, routers and switches, SCADA network security, P&ID's fundamentals			
Unit IV	PLC Installation, troubleshooting and Maintenance	(06 hrs)	COs Mapped – CO4
Installation : Consideration of operating environment, Receiving test, check & assembly, Electrical Noise, Leaky inputs & outputs, Grounding, voltage variations & surges, Circuit protections & wiring, Program Editing & Commissioning. Troubleshooting: Processor module, Input & Output malfunctions, Ladder logic program. PLC Maintenance.			
Unit V	PLC Programming	(06 hrs)	COs Mapped – CO5
Processor memory organization, PLC Programming languages, Ladder diagrams, Relays, contactors, switches, sensors, output control devices, latching relays, ladder diagram elements. Instructions: Relay type instructions, Instruction addressing, Branch Instructions, Internal Relay Instructions, Basic Functions : PLC Timer & Counter functions, Timer & Counter Industrial applications, Arithmetic functions, Comparison functions, Jump functions, Data handling functions, Digital Bit functions, PLC matrix Functions, Advanced PLC Functions: Analog PLC operation, PID control of Continuous processes.			
Text Books			
“Programmable Logic Controllers” Frank D. Petruzella McGraw-Hill Education Fourth Edition, Optimization of Industrial Unit Processes - Bela G. Liptak “Programmable Logic Controllers”, W. Bolton, Elsevier, Fourth Edition,2015			
Reference Books			
Process Control Instrumentation Technology, C. D. Johnson “Programmable Logic Controllers, Principles & Applications” John W. Wobb, Ronald, A. Rais, PHI publishing, Fifth Edition E-Material : Virtual lab : https://plc-coep.vlabs.ac.in/ PLC manual : http://www.plcmanual.com/			

Learning PLC basics : https://www.youtube.com/watch?v=iF_vvp2kXWg
 PLC Handbook (practical guide to programming PLC) : www.automationdirect.com

	Strength of CO-PO/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	-	-	-	-	-	-	-	-	-	-	2	2
CO4	3	3	-	-	-	-	-	-	-	-	-	-	-	2
CO5	3	3	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



K. K. Wagh Institute of Engineering Education and Research, Nashik
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T. Y. B. Tech. Pattern 2023 Semester: VI			
2302314C: Advanced 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	Explain the architectures of ARM Cortex		2-Understand
CO2	Explain different peripherals interface of STM32F4xx		
CO3	Implement the real world interfacing external peripherals and programming of ARM cortex based microcontroller		2-Understand
CO4	Implement serial interface using ARM cortex based microcontroller		3-Apply
CO5	Program ARM cortex using CUBE IDE and embedded C		3-Apply,
COURSE CONTENTS			
Unit I	Embedded Processor Fundamentals	(06 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	STM32F4xx Peripherals	(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	(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	(07 hrs)	COs Mapped – CO4
STM32F4xx Interfacing with accelerometer MPU 6050, Ultrasonic Sensor HC-SR04, PWM: Controlling speed and direction of DC Motor, STM32 interfacing with TFT			
Unit V	CUBE IDE software and CAN bus	(06 hrs)	COs Mapped – CO5
CUBE IDE software , Different STM 32 board, sequence of transmitting and receiving data on CAN Bus, Raspberry PI board and interfacing for different 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. Joseph Yiu, “The Definitive Guide to ARM® Cortex®-M3 and Cortex®-M4 Processors”, Newnes, 3 rd 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	-	-	3	-	-	-	-	-	-	3	3	3
CO3	3	3	-	-	3	-	-	-	-	-	-	3	3	3
CO4	3	3	-	-	3	-	-	-	-	-	-	3	3	3
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 (5 tests, one on each unit)	10
	Total	20



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

T. Y. B. Tech. Pattern 2023 Semester: VI			
23022314D: Neural Network and Fuzzy Control			
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: NA			
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	Describe the concept of fuzziness involved in various systems Apply the knowledge of fuzzy set theory.		L2
CO2	Understand the difference between learning and programming, Explore different neural network architectures		L2
CO3	Explore practical applications of Neural Networks (NN).		L2
CO4	Explain the fundamental principles of competitive learning in neural networks.		L2
CO5	Describe the basics of genetic algorithms, the use of GA operators, and their applications.		L2
COURSE CONTENTS			
Unit I	Fundamentals of Fuzzy Logic	(06 hrs)	COs Mapped - CO1
Basic concepts: fuzzy set theory- basic concept of crisp sets and fuzzy sets- complements-union intersection- 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 functions Basic learning rules- Mcculloch-Pitts neuron-Architecture, algorithm, applications-single layer net for pattern classification- Biases and thresholds, linear separability - Hebb's rule- 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 rules-number 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	(06 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. Kliryan- Fuzzy System & Fuzzy logic Prentice Hall of India, First Edition. 2. Lawrence Fussett- fundamental of Neural network Prentice Hall , First Edition.			
Reference Books			
1. Bart Kosko, —Neural network and Fuzzy System— Prentice Hall-1994. 2. J.Klin and T.A.Folger, —Fuzzy sets— University and information- Prentice Hall -1996. J.M.Zurada, —Introduction to artificial neural systems—Jaico Publication house,Delhi 1994. 3. VallusuRao and HayagynaRao , —C++ Neural network and fuzzy logic—BPB and Publication, New Delhi,1996. 4. Intelligent Systems and Control- http://nptel.ac.in/courses/108104049/16			

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

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	-	-	-	-	-	-	-	-	3	-	-
CO2	3	2	2	-	-	-	-	-	-	-	-	3	-	-
CO3	3	3	2	1	-	-	-	-	-	-	-	3	-	2
CO4	3	2	2	-	-	-	-	-	-	-	-	3	-	-
CO5	3	3	2	1	-	-	-	-	-	-	-	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 2023 Semester: VI			
2302315A: Advanced DSP (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: NA			
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.		L6
CO2	Understand theory of wavelets and capable of Designing wavelet filters.		L6
CO3	Implement adaptive filters for given applications.		L3
CO4	Estimate power spectrum of signals using different methods.		L4
CO5	Apply signal processing tools to Biomedical and Telecommunication Applications		L2
COURSE CONTENTS			
Unit I	Multirate DSP	(06 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	(08 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	(07 hrs)	COs Mapped – CO2
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	(06 hrs)	COs Mapped – CO3
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 – CO4
1. Biomedical Applications 2. Audio Applications 3. Telecommunication Applications (Radar) 4. Applications to astronomy			
Text Books			
1. K. Deerga 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/PSO Mapping														
	PO												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	3
CO3	3	3	3	3	3								3	3
CO4	3	3	3	3	3								3	3
CO5	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	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 2023 Semester: VI		
2302315B: 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 to System Design	(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, Eigenvalue. 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 Field	(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			
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”, Pearson Publication.			

													CO-PSO Mapping	
	PSO												PSO	
	1	1	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 LMS 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. E&TC Pattern 2023			
2302315C: Circular Economy (Elective 3)			
Teaching Scheme:		Credit Scheme:	Examination Scheme:
Theory :03hrs/week		03	Continuous Comprehensive Evaluation: 20Marks InSem Exam: 20Marks EndSem Exam: 60Marks
Prerequisite Courses, if any: None			
Companion course, if any:			
Course Objectives:			
1. To provide students with exposure to real-time industrial environments, enabling them to understand current technologies, tools, and practices that are beyond classroom simulation.			
2. To develop and enhance students’ technical and managerial skills through hands-on experience,making them industry-ready professionals.			
3. To foster the ability to apply academic knowledge to practical problems, including exposure toengineering ethics, responsibilities, and professional conduct.			
4. To improve students’ communication skills and documentation abilities through writing technicalreports and project summaries based on industrial experiences.			
5. To create an understanding of organizational structures, socio-economic factors, quality controlprocesses, and worker psychology in industrial setups.			
Course Outcomes: On completion of the course, students will be able to–			
	Course Outcomes		Bloom’s Level
CO1	Describe the key characteristics of a circular economy		1-Remember
CO2	Comprehend the concept of circularity and conduct relevant research		2- Understand
CO3	Use the principles of circularity for application to sustainable development		3-Apply
CO4	Apply complexity aspects of circular economy for creating circular business models		3-Apply
CO5	Apply the concept of circular economy to environmental engineering problems		3-Apply
COURSE CONTENTS			
Unit I	Introduction to Circular Economy	(04hrs)	COs Mapped – CO2
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	(04hrs)	COs Mapped - CO2

Material recovery, Waste Reduction, reducing negative externalities, Explaining Butterfly diagram, Concept of Loops			
Unit III	Circular design, innovation and Assessment	(08hrs)	COs Mapped – CO1
Zero waste: Waste Management in context of Circular Economy, Circular design, Research and innovation, LCA, Circular Business Models			
Unit IV	Case Studies	(09hrs)	COs Mapped – CO3,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	(05hrs)	COs Mapped – CO3,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. The Circular Economy Handbook: Realizing The Circular Advantage Peter Lacy, Jessica Long, Wesley Spindler Palgrave Macmillan UK 4. Waste to Wealth: The Circular Economy Advantage Peter Lacy, Jakob Rutqvist Palgrave Macmillan			
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://www.oecd.org/cfe/regionaldevelopment/Ekins-2019-Circular-Economy-WhatWhy-How-Where.pdf>
6. <https://ic-ce.com/product/principles-of-circular-economy/>
7. <https://ic-ce.com/product/circular-business-management/>
8. <https://ic-ce.com/product/bootcamp/> 9. <http://ic-ce.com/journal-on-circular-economy/>

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	2	2	1	-	-	2	2	1	-	-	-	2	-	1
CO2	3	3	-	3	-	-	2	1	-	-	--	3	-	-
CO3	3	2	3	-	2	2	3	-	-	-	-	2	1	1
CO4	3	3	3	2	1	1	3	1	2	2	2	2	1	-
CO5	3	3	2	2	-	-	3	1	-	1	-	3	-	1

Sr. No.	Components for Continuous Comprehensive Evaluation	Marks Allotted
1	Assignment: Assignment No. 1 - Unit 1 (10 Marks) Assignment No. 2 - Unit 2 (10 Marks) Assignment No. 3 – Unit 3(10 Marks) Assignment No. 4 - Unit 4(10 Marks) Assignment No. 5 - Unit 5(10 Marks)	10
2	Quiz (Using LMS): 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)	10



K. K. Wagh Institute of Engineering Education and Research, Nashik
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T. Y. B. Tech. Pattern 2023 Semester: VI			
2302315D: Automotive Electronics (Elective 3)			
Teaching Scheme:		Credit Scheme:	Examination Scheme:
Theory :03 hrs/week Practical : NA		03	Continuous Comprehensive Evaluation: 20 Marks In Sem Exam: 20 Marks End Sem 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 & invehicle 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.		2-Understand
CO4	Recognize need of telematics and infotainment systems in automotive applications.		2-Understand
CO5	Explain the concept of ECU and design application of automotive electronics using model base development.		3-Apply
COURSE CONTENTS			
Unit I	Batteries & Charging systems	(06 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	(06 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	(06 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	Telematics & Infotainment systems	(06 hrs)	COs Mapped – CO4
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.)			
Unit V	ECU & Automotive communication systems	(06 hrs)	COs Mapped – CO5
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, Model Base Development using MATLAB			
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. Intra & inter vehicle communication, Gilbert Held, CRC Press, 2007			

Strength of CO-PO Mapping														
	PO												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	-	-
CO4	3	3	-	-	-	-	-	-	-	-	-	3	-	-
CO5	3	3	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



K. K. Wagh Institute of Engineering Education and Research, Nashik
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T Y. B. Tech. Pattern 2023 Semester: VI			
2302316A: Lab work in Microwave Engineering			
Teaching Scheme:		Credit Scheme:	Examination Scheme:
Practical : 02hrs/week		01	Practical Exam: 25 Marks TW: 25 Marks
Prerequisite Courses, if any: Mechatronics			
Course Objectives:			
1. An understanding of microwave waveguides, passive & active devices, tubes and network analysis.			
2. To understand and handle microwave equipment.			
3. To understand microwave measurements			
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	Operate microwave devices and components.	Apply (L3)	Mechanism (P4)
CO2	Analyze and evaluate microwave characteristics and parameters.	Analyze (L4), Evaluate (L5)	Complex Overt Response (P5)

List of Laboratory Experiments		
Sr. No.	Laboratory Experiments	CO Mapped
1	Familiarization with the Microwave Laboratory Apparatus	1
2	To Study the Characteristics of Reflex Klystron	2
3	To Plot the V-I Characteristics of Gunn Diode	2
4	To Study the Basic Properties of E-plane Tee, H-plane Tee and Magic Tee	2
5	To Measure the Scattering Parameters of Circulator	2
6	To study the characteristics of multi-hole directional coupler by measuring the following parameters: coupling factor and directivity of coupler	2
7	To Study the Properties of Magic Tee and Determining the Scattering Parameters of Magic Tee	2
8	To plot the Radiation pattern and Determining Gain of a Pyramidal Horn Antenna	2
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.



K. K. Wagh Institute of Engineering Education and Research, Nashik
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T Y. B. Tech. Pattern 2023 Semester: VI			
2302316B: Lab work in Process Instrumentation			
Teaching Scheme:	Credit Scheme:	Examination Scheme:	
Practical : 02hrs/week	01	Continuous Comprehensive Practical Exam: 25 Marks TW: 25 Marks	
Prerequisite Courses, if any: Mechatronics			
Course Objectives:			
1. To define and explain the role of Programmable Logic Controllers (PLCs) within process instrumentation systems, including their function in data acquisition, control, and automation of industrial processes			
2. To gain practical experience in designing and simulating ladder logic diagrams for implementing fundamental logic gates and basic motor control circuits using Programmable Logic Controllers (PLCs).			
3. To develop proficiency in utilizing PLC timer functions (On-delay, Off-delay, Retentive) within ladder logic to create sequential control programs for automation tasks.			
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	Design and implement basic and combinational logic functions using PLC ladder diagrams, including fundamental logic gates and motor control circuits.	3- Apply	4-Manipulation
CO2	Develop and analyze PLC ladder logic programs utilizing timers to implement sequential control for industrial automation applications.	4- Analyzing	4-Manipulation

List of Laboratory Experiments		
Sr. No.	Laboratory Experiments	CO Mapped
1	Design and simulate PLC ladder logic circuits that effectively implement the fundamental Boolean logic gates: NOT, AND, and OR. Demonstrate the truth table behavior of each gate using the PLC simulation environment. https://plc-coep.vlabs.ac.in/	CO1
2	Develop and simulate a PLC ladder logic program to control an output device (e.g., a motor or indicator light) using two momentary pushbuttons: one for starting the device and another for stopping it. The	CO1

	output should remain active after the start button is released until the stop button is pressed. Verify the correct start/stop operation through PLC simulation. https://plc-coep.vlabs.ac.in/	
3	Design and simulate a PLC ladder logic program that uses a single momentary push button to toggle the state of an output device (e.g., a light). Each press of the button should switch the output from its current state (ON to OFF, or OFF to ON). Demonstrate the toggling functionality through PLC simulation. https://plc-coep.vlabs.ac.in/	CO1
4	Develop and simulate a PLC ladder logic program where an output device (e.g., a conveyor belt) turns ON a specified time delay after an input signal (e.g., a sensor activation) becomes active. Demonstrate and verify the programmed time delay using the PLC simulation environment. https://plc-coep.vlabs.ac.in/	CO2
5	Design and simulate a PLC ladder logic program where an output device (e.g., a cooling fan) remains ON for a specific duration after the input signal (e.g., a process completion signal) becomes inactive. Demonstrate and verify the programmed off-delay using the PLC simulation environment. <u>(Virtual lab simulation)</u>	CO2
6	Develop and simulate a PLC ladder logic program that utilizes a retentive timer to accumulate the duration for which an input signal is active. The accumulated time should be retained even if the input signal becomes inactive and should only reset upon a separate reset condition. Demonstrate the retentive timing functionality and the reset operation using the PLC simulation environment. https://plc-coep.vlabs.ac.in/	CO2
7	Design and simulate a PLC ladder logic diagram for a Direct-On-Line (DOL) starter for a three-phase induction motor. The circuit should include a start pushbutton, a stop pushbutton, a motor contactor, and overload protection. Demonstrate the starting and stopping of the motor, as well as the response to an overload condition, within the PLC simulation environment. https://plc-coep.vlabs.ac.in/	CO2
8	Design and simulate a PLC ladder logic diagram to control a simplified traffic light system for a single intersection. The traffic light sequence should follow a standard pattern: Green for a set duration, followed by Yellow for a shorter duration, and then Red for a specific duration. Implement this cycle continuously in the PLC simulation environment. You should clearly define the time durations for each light. <u>(Virtual lab simulation)</u>	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
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.



K. K. Wagh Institute of Engineering Education and Research, Nashik
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T. Y. B. Tech. Pattern 2023 Semester: VI 2302316C: Lab Work in Advanced Processor		
Teaching Scheme:	Credit Scheme:	Examination Scheme:
Practical :02hrs/week	01	Practical: 25 MarksTerm work: 25 Marks
Prerequisite Courses, if any: Microcontroller 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	



K. K. Wagh Institute of Engineering Education and Research, Nashik
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T. Y. B. Tech. Pattern 2023 Semester: VI		
2302316D: Lab work in Neural Network and Fuzzy Control		
Teaching Scheme:	Credit Scheme:	Examination Scheme:
Practical : 02hrs/week	01	Practical : 25 Marks Term work: 25 Marks
Prerequisite Courses, if any: Fundamental of Computing		
Course Outcomes: On completion of the course, students will be able to–		
	Course Outcomes	Bloom's Level
CO1	Describe the concept of fuzziness involved in various systems Apply the knowledge of fuzzy set theory.	L2
CO2	Understand the difference between learning and programming, Explore different neural network architectures	L2
CO3	Explore practical applications of Neural Networks (NN).	L2
CO4	Explain the fundamental principles of competitive learning in neural networks.	L2
CO5	Describe the basics of genetic algorithms, the use of GA operators, and their applications.	L2

List of Laboratory Experiments / Assignments		
Sr. No.	Laboratory Experiments / Assignments	CO Mapped
1	A university wants to analyze the enrolment of students on two courses, Course A and Course B, to identify: Students enrolled in both courses. Students enrolled in either course. Students enrolled only in Course A. Students not enrolled in Course A. Students enrolled only in Course B. Students did not enroll in Course B.	CO1
2	To design and implement models the tipping behaviour of a customer based on the quality of service and food at a restaurant. The system will determine the appropriate tip percentage, considering the subjective and imprecise nature of human decision-making in evaluating service and food quality. Service Quality: A fuzzy input variable representing the quality of service, categorized as "Poor," "Good," or "Excellent." Food Quality: A fuzzy input variable representing the quality of food, categorized as "Bad," "Decent," or "Delicious". "Tip Percentage: representing the recommended tip percentage, categorized as "Low," "Medium," or "High."	CO1

3	To design and implement a system for controlling the temperature in a room. The system will adjust the heating or cooling based on the current room temperature and user preferences. The goal is to maintain a comfortable indoor environment while demonstrating scenarios. IF the Current Temperature is Cold AND User Preference is Warm THEN Increase Heating. IF Current Temperature is Hot AND User Preference is Cool THEN Increase Cooling. IF the Current Temperature is Comfortable THEN Maintain Settings.	CO3
4	A company wants to allocate employees to projects based on their skills (fuzzy relation R) and project requirements (fuzzy relation S). However, there are constraints such as limited working hours, budget restrictions, and employee availability. The goal is to determine the best employee-project assignments that maximize skill utilization while satisfying the constraints.	CO2
5	Traditional washing machines lack intelligent control mechanisms to optimize washing cycles based on fabric type and dirt levels. This results in inefficient use of resources such as water, electricity, and detergent, and may also lead to suboptimal cleaning or potential damage to delicate fabrics. The aim is to design a controller that can intelligently adjust the washing cycle parameters (e.g., wash time, water temperature, agitator speed, and spin speed) based on the type of fabric and the level of dirt detected. Fabric Type: Categorize fabrics into types such as Delicate, Normal, and Heavy-duty. Dirt Level: Measure the dirt level as Low, Medium, or High. Wash Time: Adjust the duration of the wash cycle. Water Temperature: Control the temperature of the water (Cold, Warm, Hot). Agitator Speed: Adjust the speed of the agitator (Low, Medium, High). Spin Speed: Control the speed of the spin cycle (Low, Medium, High).	CO2
6	To design and implement a network that simulates a digital circuit capable of performing the XOR (exclusive OR) operation on two binary inputs. The XOR operation is a fundamental logic gate in digital electronics and simulating it using a network will help in understanding the underlying principles of digital logic and network-based implementations. Two binary inputs, A and B, each of which can be either 0 or 1. A single binary output, Y, which represents the result of the XOR operation on inputs A and B. The XOR operation yields 1 if the inputs are different (A=0, B=1 or A=1, B=0) and 0 if the inputs are the same (A=0, B=0 or A=1, B=1).	CO3
7	To design and implement a network that simulates a digital circuit capable of performing the AND operation on two binary inputs. The AND operation is one of the basic logic gates in digital electronics and simulating it using a network will help in understanding the foundational principles of digital logic and	CO3

	network-based implementations. Two binary inputs, A and B, each of which can be either 0 or 1. A single binary output, Y, which represents the result of the AND operation on inputs A and B. The AND operation yields 1 only if both inputs are 1 (A=1, B=1); otherwise, the output is 0.	
8	To design and implement an unsupervised learning algorithm that simulates associative memory, a type of neural network capable of storing and recalling patterns based on similarity. Associative memory is a fundamental concept in neural networks and cognitive computing, and its implementation will help in understanding how unsupervised learning can be used for pattern recognition and retrieval tasks.	CO3
9	To design and implement a system that accurately identifies the closest matching word from a predefined dictionary when given a misspelled or incorrect word. The system should handle various types of errors, such as insertion, deletion, substitution, and transposition of characters, and efficiently return the most likely correct word. The solution should be robust, scalable, and capable of processing inputs with different levels of distortion or incompleteness.	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.		



K. K. Wagh Institute of Engineering Education and Research, Nashik
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T. Y. B. Tech. Pattern 2023 Semester VI			
2302377A: MDM4: Cyber Crime Administration			
Teaching Scheme:		Credit Scheme:	Examination Scheme:
Theory :03hrs/week		03	Continuous Comprehensive Evaluation: 20Marks InSem Exam: 20Marks EndSem Exam: 60Marks
Prerequisite Courses, if any: Introduction to Computer Science / Programming, Python, C/C++, Introduction to Cyber Security / Information Security Fundamentals			
Companion course, if any: Cybersecurity Laws, Ethics & Policy			
Course Objectives: 1. Understand the basic concepts and types of cyber-crimes. 2. Learn about cyber laws and the legal framework related to cyber-crimes. 3. Explore investigation processes and tools used in cyber-crime cases. 4. Promote cyber safety and preventive measures among users. 5. Develop awareness of the role of cyber-crime administration and career opportunities. .			
Course Outcomes: On completion of the course, students will be able to–			
	Course Outcomes		Bloom’s Level
CO1	Define and describe the nature, types, and motives behind cyber-crimes.		1- Remember, 2- Understand
CO2	Identify and explain the key sections of the IT Act and legal procedures.		2- Understand, 3- Apply
CO3	Apply basic cyber investigation techniques and use common forensic tools.		3- Apply
CO4	Analyze common cyber threats and suggest appropriate safety practices.		4-Analyze
CO5	Examine administrative roles and preventive strategies in cyber-crime management.		2- Understand, 4-Analyze
COURSE CONTENTS			
Unit I	Introduction to Cyber Crime	(07hrs)	COs Mapped CO1
What is Cyber Crime, Types of Cyber Crimes, Cyber Criminals and Their Motives, History and Evolution of Cyber Crime, Difference between Traditional Crime and Cyber Crime, Common Cyber Crime Terminologies, Introduction to Cyber Laws, Importance of Cyber Crime Awareness.			
Unit II	Types of Cyber Crimes	(08hrs)	COs Mapped – CO2
Hacking, Phishing and Email Scams, Identity Theft, Cyber Bullying and Harassment, Online Fraud and Financial Scams, Child Exploitation and Pornography, Cyber Terrorism, Cyber Crimes Against Women.			

Unit III	Cyber Laws and Legal Framework	(07hrs)	COs Mapped - CO3											
Introduction to IT Act 2000, Key Sections of the IT Act, Role of Law Enforcement Agencies, Cyber Forensics and Legal Evidence, Arrest and Investigation Procedures, Rights of the Accused, Cyber Crime Courts and Jurisdiction, Limitations of Existing Laws.														
Unit IV	Cyber Crime Investigation and Tools	(07hrs)	COs Mapped - CO4											
Steps in Cyber Crime Investigation, Role of Police and Cyber Cells, Collecting Digital Evidence, Email and IP Tracking, Social Media Investigations, Tools for Cyber Forensics, Writing an FIR in Cyber Crime, Case Study: Simple Cyber Crime Case.														
Unit V	Cyber Safety and Administration	(07hrs)	COs Mapped - CO5											
Safe Browsing Practices, Using Strong Passwords, Social Media Safety, Reporting a Cyber Crime, Role of Government in Cyber Safety, Awareness Campaigns, Cyber Crime Prevention Tips, Career Roles in Cyber Crime Administration														
Text Books														
1. Cyber Laws by Pawan Duggal 2. Cyber Crime in India by Dr. M. Dasgupta 3. Prevention of Cyber Crime and Fraud Management by Indian Institute of Banking and Finance/ M.K Geeta and Mr. Swapna Raman														
Reference Books														
1. Cyber Security Understanding Cyber Crimes, Computer Forensics and Legal Perspectives by Sumit Belapure and Nina Godbole, Wiley India Pvt. Ltd. 2. Information Warfare and Security by Dorothy F. Denning, Addison Wesley 3. Security in the Digital Age: Social Media Security Threats and Vulnerabilities by Henry A. Oliver, Create Space Independent Publishing Platform. 4. Information Security Governance, Guidance for Information Security Managers by W. KragBrothy, 1st Edition, Wiley Publication.														
NPTEL Link														
Cyber Crime Administration - Course (swayam2.ac.in)														
Strength of CO-PO Mapping													PO-PSO mapping	
	PSO												PSO	
	1	2	3	4	5	6	7	8	9	10	11	12	-	-
CO1	3	2	-	-	-	-	-	1	-	-	-	1	-	-
CO2	3	2	-	-	-	3	-	3	-	1	-	-	-	-
CO3	3	2	3	3	3	-	-	-	1	1	-	2	-	-
CO4	3	2	2	2	2	2	2	-	-	-	-	3	-	-
CO5	2	2	2	2	-	3	2	2	2	2	1	2	-	-

Guidelines for Continuous Comprehensive Evaluation of Theory Course		
Sr. No.	Components for Continuous Comprehensive Evaluation	Marks Allotted
1	Assignment: Assignment No. 1 - Unit 1 (10 Marks) Assignment No. 2 - Unit 2 (10 Marks) Assignment No. 3 – Unit 3 (10 Marks) Assignment No. 4 - Unit 4 (10 Marks) Assignment No. 5 - Unit 5 (10 Marks)	10
2	Quiz (Using LMS): 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)	10



K. K. Wagh Institute of Engineering Education and Research, Nashik
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T. Y. B. Tech. Pattern 2023 Semester: VI		
2302317B: MDM4: Deep Learning		
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: Machine Learning for Engineering and Science Applications.		
Companion course, if any: NA		
Course Objectives: - To explain neural network theory, algorithms, and methodologies. - To design and develop deep learning applications, and analyze their complexity and limitations. - To Analyze deep learning case studies.		

Course Outcomes: On completion of the course, students will be able to–			
	Course Outcomes		Bloom’s Level
CO1	Explain the concepts of deep learning and its frameworks.		2-Understand
CO2	Describe various deep learning architectures, including activation functions, batch normalization, and methods to prevent overfitting.		2-Understand
CO3	Identify and apply deep learning architectures, specifically Convolutional Neural Networks, to computer vision applications.		3-Apply
CO4	Explain and apply Recurrent Neural Networks (RNNs) and related architectures like LSTMs and GRUs for Natural Language Processing (NLP).		3-Apply
CO5	Apply deep learning methodologies to relevant case studies and applications in computer vision and natural language processing.		3-Apply
COURSE CONTENTS			
Unit I	Introduction to Deep Learning and Frameworks	(07 hrs)	COs Mapped - CO1
Deep Learning Basics: Intro, History, capabilities, the perceptron, Multi-Layer Perceptron, ANN architecture. Tensor Flow, Creating and Manipulating Tensor Flow Variables, Tensor Flow Operations, Placeholder Tensors, Managing Models over the CPU and GPU, Specifying the Logistic Regression Model in Tensor Flow, Logging and Training the Logistic Regression, Introduction to Keras, PyTorch.			

Unit II	Deep Learning Architecture	(07 hrs)	COs Mapped - CO2
Width and Depth of Neural Networks, Different Activation Functions, Batch-normalization, types of loss, Overfitting and generalization., Dropout, regularization Unsupervised Training of Neural Networks, Restricted Boltzmann Machines, Auto Encoders, Deep Learning Applications.			
Unit III	Computer Vision	(08 hrs)	COs Mapped – CO3
Types of optimizations (ADAM, SGDM, RMS prop etc.), Architectural Overview, Motivation, Layers, Filters, Parameter sharing, Regularization, Convolution neural networks (CNNs), convolution, pooling and its variations, different deep CNN architectures - LeNet, AlexNet, VGG, PlacesNet, DenseNet, training a CNNs: weights initialization, batch normalization, hyperparameter tuning . Popular CNN Architectures: ResNet, AlexNet – Applications.			
Unit IV	Natural Language Processing	(07 hrs)	COs Mapped – CO4
recurrent Neural Networks, Bidirectional RNNs, Encoder-decoder sequence to sequence architectures - BPTT for training RNN, Long Short-Term Memory Networks. Advanced RNN: LSTM, GRU, introduction to Generative Adversarial Networks (GANs).			
Unit V	Case Study and Applications	(07 hrs)	COs Mapped – CO5
Computer Vision: Image Classification, Image net- Detection-Audio Wave Net. Natural Language Processing: Sentimental Analysis, Text preprocessing and chatBot			
Text Books			
1. Nikhil Buduma, “Fundamentals of Deep Learning Designing Next-Generation Machine Intelligence Algorithms”, 1st Edition, O’REILLY. 2. Michael Nielsen, “Neural Networks and Deep Learning”, Determination Press. 3. Ian Goodfellow, YoshuaBengio and Aaron Courville, “Deep Learning”, MIT Press. 4. Josh Patterson, Adam Gibson "Deep Learning: A Practitioner's Approach", O'Reilly Media. 5. Kevin P. Murphy "Machine Learning: A Probabilistic Perspective", The MIT Press. 6. Ethem Alpaydin, "Introduction to Machine Learning", 3rd Edition, Prentice Hall of India. 7. Umberto Michelucci “Applied Deep Learning. A Case-based Approach to Understanding”, Deep Neural Networks” Apress, 2018.			
Reference Books			
1. Goodfellow. I., Bengio.Y., and Courville, A., “Deep Learning”, MIT Press. 2. Bishop, C.M., “Pattern Recognition and Machine Learning”, Springer. 3. Satish Kumar, “Neural Networks: A Classroom Approach”, Tata McGraw-Hill Education.			
MOOC / NPTEL Courses:			
1. NPTEL Course on “Deep Learning”, by Prof. Prabir Kumar Bhiswas, IIT Kharagpur. Link of the Course: https://nptel.ac.in/courses/106105215 2. NPTEL Course on “Deep Learning - Part I”, by Prof. Sudarshan Iyengar, Prof Sanatan Sukhija IIT Ropar Link of the Course: https://nptel.ac.in/courses/106106184			

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	2	-	2	-	-	-	-	-	-	-	-	-
CO4	3	3	2	-	2	-	-	-	-	-	-	-	-	2
CO5	3	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 2023 Semester:VI			
2302318 : OEC: Digital Marketing			
Teaching Scheme:		Credit Scheme:	Examination Scheme:
Theory :02 hrs/week		02	Continuous Comprehensive Evaluation: 50 Marks
Abstract: This course provides a comprehensive introduction to digital marketing, emphasizing its importance in the modern era. The course explores social media strategies, including the use of platforms like Facebook, Instagram, and LinkedIn for marketing campaigns. Emphasis is placed on understanding emerging trends in digital marketing, such as voice search and chatbots. Through case studies and practical activities, students will gain hands-on experience in creating and executing digital marketing strategies.			
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	Explain the importance of Digital marketing in upcoming era.		2-Understand
CO2	Design websites using free tools like Wordpress and explore it fordigital marketing.		3-Apply
CO3	Apply various keywords for a website & to perform SEO.		3-Apply
CO4	Explain various SEM Tools and Illustrate use of Facebook,Instagram, YouTube and LinkedIn for Digital Marketing in real life.		2-Understand
CO5	Explain 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	(05 hrs)	COs Mapped – 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	
	PO												PSO	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	-	-	-	-	-	-	-	-	3	3	-	3	-	-
CO2	2	2	2	-	3	-	-	2	3	-	-	3	-	-
CO3	2	-	-	-	-	-	-	-	3	3	-	3	-	-
CO4	2	-	-	-	-	-	-	2	3	-	-	3	-	-
CO5	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	25
2	Five Activities on Unit-1, Unit-2, Unit-3, Unit-4 and Unit-5	25
	Total	50



K. K. Wagh Institute of Engineering Education and Research, Nashik
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T. Y. B. Tech. Pattern 2023 Semester: VI			
2302319: Web Design			
Teaching Scheme:		Credit Scheme:	Examination Scheme:
Tutorial :01 hrs/week		01	--
Prerequisite Courses, if any: Basics of Internet			
Companion course, if any: NA			
Course Objectives: 1. To learn basic principles of CSS and HTML. 2. To learn dynamic web pages creation using JAVA script in HTML forms. 3. To introduce the fundamental concepts of UI and UX, to explain their principles, and to familiarize students with commonly used UI/UX design tools and software.			
Course Outcomes: On completion of the course, students will be able to–			
	Course Outcomes		Bloom's Level
CO1	Explain HTML and CSS Fundamentals.		Understand
CO2	Explain Java script fundamentals.		Understand
CO3	Apply the basic principles of UI and UX design, and explore standard tools used for designing user interfaces and experiences.		Apply
COURSE CONTENTS			
Unit I	Introduction to HTML & CSS	(05hrs)	COs Mapped - 1
Introduction to HTML: What is HTML,HTML Documents, Basic structure of an HTML document ,Creating an HTML document , Mark up Tags , Heading-Paragraphs , Line Breaks ,HTML Tags, Introduction to Cascading Style Sheets: Concept of CSS , Creating Style Sheet , CSS Properties ,CSS Styling(Background, Text Format, Controlling Fonts) ,Working with Lists and Tables ,CSS Id and Class , Box Model(Introduction, Border properties, Padding Properties, Margin properties)			
Unit II	Introduction to Java Script	(04hrs)	COs Mapped - 2
Java script engines, Variables and operators, objects, java script conditionals, java scripts arrays, methods of adding interactivity to web pages, concept of java scripting the forms			
Unit III	Introduction to UI/UX Design	(03 hrs)	COs Mapped - 3
Definition and differences between UI and UX, UX Design Principles, I Design Principles, Design Tools and Software			

Text Books	
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1. Kogent Learning Solutions, “HTML, JavaScript, PHP, Java, JSP, XML and AJAX” Black Book, Dreamtech Press
2. Thomas Powell and Fritz Schneider, “JavaScript 2.0: The Complete Reference”, 2nd Edition, McGraw Hill

Reference Books

1. Jon Duckett, "JavaScript & J Query: Interactive Front-End Web Development", John Wiley & Sons.
2. David Flanagan, "JavaScript: The Definitive Guide", 7 th Edition, O'Reilly Media.
3. Mike Mackgrath, "Javascrpts in Easy Steps" Dreamtech Press

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)

[illegible]



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

TY B. Tech. Pattern 2023 Semester VI

Project Phase 1

Project Phase 1 (2302320)-Credits: 01
Teaching Scheme: Practical 2 Hrs/week
Examination Scheme: TW: 50Marks

Project Phase 2(ETC224009): Credits: 04
Teaching Scheme: Practical 8 Hrs/week
Examination Scheme: OR: 50Marks,
TW: 100 Marks

Prerequisites for the course: Based on knowledge of all subjects

Learning objective for CO1 Students will be able to:	
1	Identify specification of the problem.
2	Structure the problem.
3	Identify the appropriate methodology to solve the problem.
4	Define the methodology to solve the problem.
Learning objective for CO2 Students will be able to:	
1	Adapt the vital skills of compromise and collaboration.
2	Construct , analyzes and approach problem solution as a team
3	Fully understand the role of each individual in a group to accomplish the goal.
4	Develop leadership skills by aligning with the objective of the project and lead the team towards its goal.
Learning objective for CO3 Students will be able to	
1	Plan, co-ordinate and control the complex and diverse activities in project
2	Predict any problems and find solution for it
3	Plan the progress to result in total completion of the project.
Learning objective for CO4 Students will be able to	
1	Design appropriately using a modular construction approach to solve the problem as per specifications.
2	Implement the selected methodology to solve the problem.
3	Select the correct hardware according to specifications.
4	Select the correct software for simulation and programming.
5	Validate the result and draw conclusion.
Learning objective for CO5 Students will be able to	
1	Present the work done by proper documentation
2	Present paper in national / international conferences, project exhibitions & competitions
Learning objective for CO6 Students will	

1	Develop professional practice.
2	Recognize how <i>to do the project to its best</i> .
3	Develop ethical Practices.

Course Outcome	After successful completion of course students will be able to
CO1	Define, analyze and solve complex real life problem.
CO2	Work in collaborative team as a member or leader.
CO3	Apply project management techniques.
CO4	Identify and apply appropriate tools.
CO5	Communicate effectively in verbal and written form.
CO6	Imbibe ethical practices.

Course context, Relevance, Practical Significance:

Course Content: (Syllabus)

1. **Group Size** The student will carry the project work individually or by a group of students. Optimum group size is in 3 students. However, if project complexity demands a maximum group size of 4 students, the committee should be convinced about such complexity and scope of the work.
2. **Selection and approval of topic:**
 - Topic should be related to real life application in the field of Electronics and Telecommunication OR Investigation of the latest development in a specific field of Electronics or Communication or Signal Processing OR The investigation of practical problem in manufacture and / or testing of electronics or communication equipment OR The Microprocessor / Microcontroller based applications project is preferable. OR Software development project related to VHDL, Communication, Instrumentation, Signal Processing and Agriculture Engineering with the justification for techniques used / implemented is accepted. OR Interdisciplinary projects should be encouraged.
 - Each project group interacts and discusses their project idea with Head of Department, Academic coordinator and Project Coordinator. (Project Monitoring committee)
 - Students are asked to submit the synopsis on more than one topic according to their area of interest to project coordinator
 - Students give presentation to Project Monitoring committee on Topics they have submitted the synopsis.

- These synopses are discussed among the committee of project guides (Project Committee)
 - After the presentation committee members select one project topic for each group
 - Project guides are allocated according to area of project
 - There is also an external guide from industry for industry sponsored projects
 - The scope of project is finalized after discussion with the guide
 - Each group presents “project introductory seminar” to project guide and Project Monitoring committee members.
3. The examination is conducted by two examiners (internal and external) appointed by the university. The examiners appointed must have minimum 5 years of experience with UG qualification or 2 years with PG qualification.
 4. The assessment is based on Innovative Idea, Depth of understanding, Applications, Individual contributions, presentation, and the grade given by the internal guide based on the work carried out in a semester.
 5. A log book/Project book of Work carried out during the semester will be maintained with monthly review remarks by the guide and HoD. It should have entries related to the work done, problems faced, solution evolved etc., duly signed by internal and external guides.
 6. Project report must be submitted in the prescribed format only
 7. Project Seminar assessment is based on the project topic. It consists of Literature Survey and basic project work during 7th semester
 8. The report consists of the Literature Survey, basic project work and the size of the report should be maximum of 30 pages.
 9. Project Work assessment is based Hardware and /or software designed and prototyping of the problem statement
 10. The report consists of the Literature Survey, basic project work, Hardware and software design, Testing and conclusion and the size of the report should be maximum of 50 pages during 8th semester
 11. A certified copy of both the reports is required to be presented to external examiner at the time of final examination.

Relevance of the projects and their contribution towards attainments of POs and PSOs:

- Projects done by final year students are classified into application (for societal, educational, interdisciplinary), product and research type
- Modern tools and technology are used by the students for implementation of their projects
- Each project is evaluated according to rubrics designed
- Each project topic has contribution towards attainment of most of the POs and PSOs

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/PSO Mapping													
	PO												PSO	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	3	3	3	3	-	*	*	-	-	-	-	-	*	*
CO2	-	-	-	-	-	-	-	-	3	-	-	-	-	-
CO3	-	-	-	-	-	-	-	-	-	-	3	-	-	-
CO4	3	3	-	3	3	-	-	-	-	-	-	3	-	-
CO5	-	-	-	-	-	-	-	-	-	3	-	-	-	-
CO6	-	-	-	-	-	-	-	3	-	-	-	-	-	-



K.K.Wagh Institute of Engineering Education and Research, Nasik
Electronics & Telecommunication B. Tech.
(Autonomous Honors Syllabus 2023 Pattern)

Course Code	ETC223024						
Course Name	Digital CMOS Design (Honors Course)						
Type of Course	MDM						
Teaching Scheme and Credits	TH(Hrs.)	TU(Hrs.)		PR(Hrs.)		Total Credits	
Weekly Working Hrs	04	-		-		4	
Assessment Scheme	CCE	TW	PR	OR	ISE	ESE	Total (Marks)
(Marks)	20	-	-	-	20	60	100

Prerequisites for the Course:

1. Digital Design with HDL

The course aims to:

Course Objectives	Description
1	To learn MOSFET Models and layout fundamentals
2	To nurture students understanding in performance parameters of digital CMOS Design
3	To understand the advanced trends in CMOS design
4	To understand the advanced trends in CMOS design

On completion of the course, learner will be able to–

Course Outcomes	Description	Bloom's Level
CO1	Understand the fundamentals of CMOS Technology in Digital Domain	2-Understand
CO2	Design digital VLSI circuits	6-Design
CO3	Demonstrate the ability of using EDA tools in IC Design	3-Apply

Course context, Relevance, Practical Significance:

Course Contents:

Unit	Contents	Lecture Hours	Cos Mapped
1	MOSFET Models and Layout: MOSFET equivalent circuits and analysis, Parasitic; Technology scaling; Lambda parameter; CMOS layout techniques; Layout Design Rules CMOS Process Enhancements: Transistors, Interconnect, Circuit Elements, Beyond Conventional CMOS. CMOS Fabrication and Layout: Inverter Cross-section, Fabrication Process, Stick Diagrams.	(08 hrs)	CO1
2	Performance parameters: Static, dynamic and short circuit power dissipations, Propagation delay, Power delay product, Fan in, fan out and dependencies. Delay Estimation: RC Delay Models, Linear Delay Model, Logical Effort, Parasitic Delay. Logical Effort and	(08 hrs)	CO1

3	Logic design-Part 1: Transistor Sizing: Delay in a Logic Gate, Delay in Multistage Logic Networks, Interconnect: Resistance, Capacitance, Delay, Crosstalk. Design Margin. Static CMOS Logic : Inverter, NAND Gate, Combinational Logic, NOR Gate, Compound Gates, Pass Transistors and Transmission Gates, Tristates, Multiplexers, Latches and FlipFlops,	(08 hrs)	CO2
4	Logic design-Part 2: Design calculations for combinational logic and active area on chip; Hazards, sources and mitigation techniques, case study; HDL codes for FSM, Meta-stability and solutions; Transmission gate, utility and Limitations.	(08 hrs)	CO2
5	Advanced trends: Circuit Families: Static CMOS, Ratioed Circuits, Cascode Voltage Switch Logic, Dynamic Circuits, Domino logic, NORA logic, Differential Circuits, Sense Amplifier Circuits, BiCMOS Circuits, Low Power Logic Design, Comparison of Circuit Families, Materials for performance improvement, Techniques for Low power, High speed designs.	(08 hrs)	CO3

References Books

1. Charls Roth, "Digital System Design using VHDL", Tata McGraw Hill.
2. S-M. Kang and Y. Leblebici, CMOS Digital Integrated Circuits : Analysis and Design, Third Edition, McGraw-Hill
3. Samir Palnitkar, "Verilog HDL – A Guide to Digital Design and Synthesis", PHI

Text Books

1. Neil Weste and Kamaran, "Principles of CMOS VLSI Design", Education Asia.
2. M. Rabaey, A. Chandrakasan and B. Nikolic, Digital Integrated Circuits : A Design Perspective, Pearson (Low Price Edition)

e Resources: **NPTEL Video Course : NOC:CMOS Digital VLSI Design**

Useful websites / Video

1. <https://www.youtube.com/watch?v=aCOyq4YzBtY>

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/PSO Mapping														
Strength of COs	PO												PSO	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO 1	3	3	-	-	-	-	-	-	-	-	-	-	-	-
CO 2	3	3	-	-	-	-	-	-	-	-	-	-	-	3
CO 3	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	Unit Tests 1 and 2	10
	Total	20



K.K.Wagh Institute of Engineering Education and Research, Nasik
B. Tech. (Autonomous Honors Syllabus 2023 Pattern)

Course Code	ETC223025						
Course Name	Lab work in Digital CMOS Design (Honors Course)						
Type of Course	MDM						
Teaching Scheme and Credits	TH(Hrs.)	TU(Hrs.)		PR(Hrs.)		Total Credits	
Weekly Working Hrs	-	-		4 Hrs/week		2	
Assessment Scheme	CCE	TW	PR	OR	ISE	ESE	Total (Marks)
(Marks)	-	50	50	-	-	-	100

Prerequisites for the Course:

1. Digital Design with HDL

On completion of the course, learner will be able to–

Course Outcomes	Description	Bloom's Level
CO1	Design and simulate CMOS Layout for digital circuits	4- Articulating
CO2	Design and simulate FSM	4- Articulating
CO3	Demonstrate the digital design issues	2- Manipulation

Course context, Relevance, Practical Significance:

List of Laboratory Experiments / Assignments

Sr. No.	Laboratory Experiments / Assignments	Cos Mapped
1	To design, prepare layout and simulate CMOS Inverter for the given specifications of load capacitance, propagation delay, power dissipation and foundry	CO1
2	To design logic for ATM machine password and access functionality. Assume suitable I/Os such as card sense, 4 digit PIN number, type of account, amount and other facilities needed.	CO2
3	To design CMOS logic for $F = A + B(C + D) + EFG$ and prepare layout. Assume suitable capacitive load & foundry. Measure TR, TF & TPD	CO1
4	To draw FSM diagram, write HDL code, synthesis, simulate, place & route for Tea/Coffee vending machine. Generalized I/Os of the machine are coin sense, cup sense, option sense, pour valve, timer count, alarm etc. You may assume additional I/Os too.	CO2
5	To design and simulate combinational logic to demonstrate hazards. Also, simulate the same logic redesigned for removal of hazards.	CO3

Guidelines for Laboratory Conduction

Software's required:

Microwind for experiment 1, 3 and 5

and Xilinx for experiment 2 and 4

Guidelines for Student's Lab Journal

Student's lab journal should contain following related things -

Title, Objectives, Hardware/ Software requirement, theory, code and simulation results																																																																																																							
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 50 marks of term work.																																																																																																							
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CO 2	3	3	2	2	3	-	-	-	-	-	-	3	2	-																																																																																									
CO 3	3	3	2	2	-	-	-	-	-	-	-	3	-	-																																																																																									

Name and Sign of Academic Coordinator

Name and Sign of BoS Chairperson



K. Wagh Institute of Engineering Education and Research, Nasik
B. Tech. (Autonomous Honors Syllabus 2023 Pattern)

Course Code	ETC224024						
Course Name	ASIC Design (Honors Course)						
Type of Course	MDM						
Teaching Scheme and Credits	TH(Hrs.)	TU(Hrs.)		PR(Hrs.)		Total Credits	
Weekly Working Hrs	04	-		-		4	
Assessment Scheme	CCE	TW	PR	OR	ISE	ESE	Total (Marks)
(Marks)	20	-	-	-	20	60	100

Prerequisites for the Course:

1. Semiconductor Theory, Mathematics

The course aims to:

Course Objectives	Description
1	To prepare the student to be an entry-level industrial standard ASIC or FPGA designer.
2	To give the student an understanding of issues and tools related to ASIC/FPGA design and Implementation.
3	To give the student an understanding of basics of System on Chip and Platform based design.

On completion of the course, learner will be able to–

Course Outcomes	Description	Bloom's Level
CO1	Explain the types of ASICs, VLSI design flow, and programmable ASIC architectures using simulation tools.	2-Understand
CO2	Analyze system-level trade-offs in speed, area, and power for ASIC design using partitioning and optimization techniques.	4
CO3	Implement and simulate ASIC/SoC design concepts, including floor planning, placement, routing, and bus-based communication architectures.	6

Course context, Relevance, Practical Significance:

Course Contents:

Unit	Contents	Lecture Hours	Cos Mapped
1	Introduction to ASICs: Types of ASICs, VLSI Design flow, Programmable ASICs - Antifuse, SRAM, EPROM, EEPROM based ASICs. Programmable ASIC logic cells and I/O cells. Programmable interconnects. Latest Version - FPGAs and CPLDs and Soft-core processors.	(08 hrs)	CO1
2	Trade off issues at System Level: Trade off issues at System Level: Optimization with regard to speed, area and power, asynchronous and low power system design. ASIC physical design issues, System Partitioning, Power Dissipation, Partitioning Methods.	(08 hrs)	CO1
3	ASIC Construction: ASIC floor planning, Placement and Routing.	(08 hrs)	CO2
4	System-On-Chip Design: System-On-Chip Design - SoC Design	(08 hrs)	CO2

	Flow, Platform-based and IP based SoC Designs, Basic Concepts of Bus-Based Communication Architectures, On-Chip Communication Architecture Standards, Low-Power SoC Design		
5	High performance algorithms for ASICs/ SoCs: High performance algorithms for ASICs/ SoCs as case studies – Canonic Signed Digit Arithmetic, KCM, Distributed Arithmetic, High performance digital filters for sigma-delta ADC, USB controllers, OMAP.	(08 hrs)	CO3

References Books

1. H.Gerez, “Algorithms for VLSI Design Automation”, John Wiley, 1999
2. J..M.Rabaey, A. Chandrakasan, and B.Nikolic, ”Digital Integrated Circuit Design Perspective (2/e)”, PHI 2003
3. A.Hodges, “Analysis and Design of Digital Integrated Circuits (3/e)”, MGH 2004
4. Hoi-Jun Yoo, Kangmin Lee and Jun Kyong Kim, “Low-Power NoC for High-Performance SoC Design”, CRC Press, 2008
5. S.Pasricha and N.Dutt,” On-Chip Communication Architectures System on Chip Interconnect, Elsevier”, 2008

Text Books

1. “Application specific Integrated Circuits”, J.S. Smith, Addison Wesley.
2. “Principles of CMOS VLSI Design : A System Perspective”, N. Westle & K. Eshraghian, Addison – Wesley Pub.Co.1985.

e Resources:

Useful websites / Video

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/PSO Mapping														
Strength of COs	PO												PSO	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO 1	3	3	-	-	3	-	-	-	-	-	-	-	-	-
CO 2	3	3	-	-	2	-	-	-	-	-	-	-	2	-
CO 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	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)	10
	Total	20

Name and Sign of Academic Coordinator

Name and Sign of BoS Chairperson



K.K.Wagh Institute of Engineering Education and Research, Nasik
B. Tech. (Autonomous Honors Syllabus 2023 Pattern)

Course Code	ETC224024						
Course Name	Lab work in ASIC Design (Honors Course)						
Type of Course	MDM						
Teaching Scheme and Credits	TH(Hrs.)	TU(Hrs.)		PR(Hrs.)		Total Credits	
Weekly Working Hrs	-	-		4 hrs/week		2	
Assessment Scheme	CCE	TW	PR	OR	ISE	ESE	Total (Marks)
(Marks)	-	50	50	-	-	-	100

Prerequisites for the Course:

1. Semiconductor Theory, Mathematics

On completion of the course, learner will be able to–

Course Outcomes	Description	Bloom's Level
CO1	Design and Implement Basic Digital Circuits using VHDL and FPGA	3
CO2	Design and Analyze Analog and Digital Circuits	2
CO3	Simulate, Verify, and Optimize of VLSI Designs	3

Course context, Relevance, Practical Significance:

List of Laboratory Experiments / Assignments

Sr. No.	Laboratory Experiments / Assignments	Cos Mapped
1	Design a 4-bit ALU performing AND, OR, and ADD operations using VHDL.	CO1
2	Implement a real-time digital clock using an FPGA.	CO1
3	Create a 7-segment display controller using FPGA.	CO1
4	Implement 2:1 and 4:1 multiplexers using transmission gates.	CO1
5	Implement a 4-stage ring oscillator and analyze frequency characteristics.	CO2
6	Implement a current mirror and analyze its characteristics.	CO2
7	Design and Simulation of a Low-Power SRAM Cell (6T SRAM Design).	CO3
8	Design and Characterization of a 3-bit Flash ADC.	CO3

Guidelines for Laboratory Conduction

Software's required:

Microwind for experiment 1, 3 and 5

and Xilinx for experiment 2 and 4

Guidelines for Student's Lab Journal

Student's lab journal should contain following related things -
 Title, Objectives, Hardware/ Software requirement, theory, code and simulation results

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 50 marks of term work.

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

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Strength of CO-PO/PSO Mapping														
Strength of COs	PO												PSO	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO 1	3	-	3	-	3	-	-	-	-	-	-	-	-	-
CO 2	2	3	3	-	2	-	-	-	-	-	-	-	-	-
CO 3	3	2	3	2	3	-	-	-	-	-	-	2	-	-

Name and Sign of Academic Coordinator

Name and Sign of BoS Chairperson



K.K.Wagh Institute of Engineering Education and Research, Nasik
B. Tech. (Autonomous Honors Syllabus 2023 Pattern)

Course Code	ETC224026						
Course Name	Reconfigurable Computing						
Type of Course	MDM						
Teaching Scheme and Credits	TH(Hrs.)	TU(Hrs.)		PR(Hrs.)		Total Credits	
Weekly Working Hrs	04	-		-		4	
Assessment Scheme (Marks)	CCE	TW	PR	OR	ISE	ESE	Total (Marks)
	20	-	-	-	20	60	100

Prerequisites for the Course:

1. Digital Design, Optimization Algorithms, Computer Architecture.

The course aims to:

Course Objectives	Description
1	To introduce fundamental concepts of Reconfigurable Computing.
2	To understand the architecture and components of FPGA-based systems.
3	To study various design methodologies for implementing reconfigurable hardware.
4	To learn high-level synthesis techniques and mapping designs to FPGAs.
5	To explore applications of Reconfigurable Computing.

On completion of the course, learner will be able to–

Course Outcomes	Description	Bloom's Level
CO1	Explain the basic concepts, terminologies, and architectures of Reconfigurable Computing.	2-Understand
CO2	Describe FPGA-based architectures and their components.	2-Understand
CO3	Apply various logic design techniques for implementing circuits on FPGA.	3-Apply

Course context, Relevance, Practical Significance:

Course Contents:

Unit	Contents	Lecture Hours	Cos Mapped
1	Introduction to Reconfigurable Computing : Introduction to computing paradigms: General Purpose Computing, Domain-Specific Computing, Application-Specific Computing, Introduction to Reconfigurable Computing: Definitions & Characteristics, Applications of Reconfigurable Computing Basics of FPGA programming	(08 hrs)	CO1
2	FPGA Architecture & Hardware Components : VLSI Basics for FPGA, Wires and vias, Gate delay vs. wire delay, Registers and RAM, Programmable Logic Devices (PLDs), PLA, PAL, SPLD, CPLD, Introduction to Hardware Description Languages (HDLs), Basics of Verilog/VHDL	(08 hrs)	CO2
3	FPGA Design Flow & Programming Reconfigurable Systems: FPGA Design Flow: Design, Synthesis, Integration,	(08 hrs)	CO2

	Implementation, Reconfiguration Techniques: Run-Time Reconfiguration (RTR), Partial Reconfiguration (PR)		
4	Logic Implementation and Mapping on FPGA: Logic Synthesis Techniques, Two-Level Logic Synthesis, Multi-Level Logic Synthesis, LUT- Based Technology Mapping, High-Level Synthesis (HLS) for Reconfigurable Computing, Modeling with Data Flow Graph (DFG) and Control Flow Graph (CFG), Temporal Partitioning (ASAP, ALAP Scheduling).	(08 hrs)	CO3
5	Applications of Reconfigurable Computing: Real-World Applications of FPGA-based Reconfigurable Computing: Image Processing, Signal Processing, Pattern Matching, Cryptography, AI and Machine Learning on FPGA.	(08 hrs)	CO3

References Books

1. Christoph Bobda, Introduction to Reconfigurable Computing: Architectures, Algorithms, and Applications, Springer, 2007.
2. R. Vaidyanathan, Trahan Jerry, Dynamic Reconfiguration: Architectures and Algorithms, Kluwer Academic, 2003.
3. Uwe Meyer-Baese, DSP with FPGAs, Springer-Verilog, 2003.

Text Books

1. Wayne Wolf, FPGA Based System Design, Pearson Education, 2004.
2. Scott Hauck, André DeHon, Reconfigurable Computing - The Theory and Practice of FPGA-Based Computation, Morgan Kaufmann, 2007.

e Resources:

Useful websites / Video

2. <https://www.youtube.com/watch?v=aCOyq4YzBtY>

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

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Strength of CO-PO/PSO Mapping														
Strength of COs	PO												PSO	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO 1	3	-	3	-	3	-	-	-	-	-	-	2	-	-
CO 2	3	2	-	-	3	-	-	-	-	-	-	-	-	-
CO 3	3	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	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)	10
	Total	20

Name and Sign of Academic Coordinator

Name and Sign of BoS Chairperson



K.K.Wagh Institute of Engineering Education and Research, Nasik
B. Tech. (Autonomous Honors Syllabus 2023 Pattern)

Course Code	ETC224027						
Course Name	Introduction to Microfabrication (Honors Course)						
Type of Course	MDM						
Teaching Scheme and Credits	TH(Hrs.)	TU(Hrs.)		PR(Hrs.)		Total Credits	
Weekly Working Hrs	04	-		-		4	
Assessment Scheme	CCE	TW	PR	OR	ISE	ESE	Total (Marks)
(Marks)	20	-	-	-	20	60	100

Prerequisites for the Course:

1. Solid State Physics, VLSI Design

The course aims to:

Course Objectives	Description
1	To understand microfabrication fundamentals, cleanroom technology, and contamination control.
2	Learn semiconductor materials and substrate fabrication techniques.
3	Explain oxidation, CVD, and PVD processes in microfabrication.
4	Study lithography techniques and mask fabrication methods.
5	Analyze layer structuring, etching, doping, and CMP processes.

On completion of the course, learner will be able to–

Course Outcomes	Description	Bloom's Level
CO1	Describe microfabrication principles, cleanroom technology, and semiconductor materials.	2-Understand
CO2	Explain oxidation, CVD, PVD, and lithography techniques in semiconductor processing.	2-Understand
CO3	Analyze theoretical aspects of layer structuring, etching, doping, and CMP in device fabrication.	4- Analyze

Course context, Relevance, Practical Significance:

Course Contents:

Unit	Contents	Lecture Hours	Cos Mapped
1	Introduction & Cleanroom technology: Introduction Definitions, MEMS impact, dimensions, market development, driving forces, application fields, Microfabrication principles, comparison of technologies, processes, fabrication phases Impact of particle contamination of production yield, contamination sources, cleanroom classes, cleanroom concepts, Particle measurement (purpose, methods), DI water (properties, fabrication, control), cleanroom chemistry	(08 hrs)	CO1
2	Substrate Fabrication & Materials: Si: Poly, single crystal, CZ, FZ, dicing, lapping, polishing/CMP, flats, wafer geometry (ttv, bow, etc.) Properties of solid state materials, crystal structure (Si, GaAs), semiconductor effects, comparison of materials	(07 hrs)	CO1

3	Oxidation, CVD & PVD: Dry oxidation, wet oxidation, oxidation kinetics (deal grove model), oxide properties CVD: LPCVD, PECVD, processes (SiO ₂ , Si ₃ N ₄ , LTO,...), reactors PVD : E-beam evaporation, sputtering, HF, magnetron sputtering	(07 hrs)	CO2
4	Lithography: Process steps, +/- resist, coating, developing, removing, contact and proximity exposure, projection/stepper, alignment and marks, light sources, Excimer laser, double sided lithography, mask fabrication, quartz reticles, dark-/lightfield, transmission, phase shift masks	(07 hrs)	CO2
5	Layer Structuring & Modification: Structuring fabrication principles, dry/wet etch, isotropic etching, anisotropic etching, wafer drying (e.g. Marangoni), selectivity, lift-off process, Chemo-mechanical polishing (CMP), Doping, diffusion processes	(07 hrs)	CO3

References Books

1. The Science and Engineering of Microelectronic Fabrication by Stephen A. Campbell
2. Introduction to Microelectronic Fabrication by Richard C. Jaeger
3. Materials Science of Thin Films by Milton Ohring
4. Fundamental Principles of Optical Lithography by Chris Mack
5. Electronic Materials by Prof. Dr. Helmut Föll

Text Books

1. Fundamentals of Microfabrication and Nanotechnology, by Marc J. Madou
2. VLSI Fabrication Principles: Silicon and Gallium Arsenide by Sorab K. Gandhi

e Resources:

Useful websites / Video

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/PSO Mapping														
Strength of COs	PO												PSO	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
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CO 2	3	-	-	-	3	-	-	-	-	-	-	-	-	-
CO 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	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)	10
	Total	20

Name and Sign of Academic Coordinator

Name and Sign of BoS Chairperson