Walchand College of Engineering, Sangli

(Government Aided Autonomous Institute)

AY 2024-25

Course Information	
Programme	B.Tech. (Electronics Engineering)
Class, Semester	Final Year B. Tech., Sem VII
Course Code	6EN401
Course Name	Real Time Operating System
Desired Requisites:	C programming, Embedded System Design

Teaching Scheme		**Examination Scheme (Marks)**			
Lecture	3 Hrs/week	**MSE**	**ISE**	**ESE**	**Total**
Tutorial	-	30	20	50	100
		Credits: 3			

Course Objectives	
1	To make students familiar with installation and use of the Linux/ Embedded Linux operating system.
2	To give exposure for Embedded Linux boards as per the industry trends
3	To explain /demonstrate services provided by RTOS and their usage
4	To illustrate/demonstrate how to design of applications using RTOS.(uCOS-II)

Course Outcomes (CO) with Bloom's Taxonomy Level		
At the end of the course, the students will be able to,		
CO1	Illustrate various OS, Linux commands, Embedded Linux Board and concepts of RTOS	Understand
CO2	Write program/ problem/ situation by applying the knowledge acquired in Linux/ RTOS	Apply
CO3	Design the tasks and their interactions by using appropriate RTOS services for multitasking based (RTOS based) embedded system	Create

Module	**Module Contents**	**Hours**
I	**Introduction to Operating System:** Introduction to OS, Types of OS, Comparison of different OS, Linux Distributions, Linux architecture, Linux Kernel, File Systems, Shell utility, Installation and Configuration of Linux, Basic commands of Linux, Application programming in Linux, multifile programming	7
II	**Introduction to Embedded Linux:** Embedded Linux introduction, Why Embedded Linux? Linux vs. Embedded Linux, Components of Embedded Linux Systems, , Embedded Linux Boot flow Process, Embedded Linux Boards- Raspberry Pi /Beagle Bone, Raspberry Pi / Beagle Bone - OS installation and configuration, Facilities in Embedded Linux Boards used in Industry/Market	7
III	**Introduction to Real-time OS and Real Time system contents:** RTOS Introduction, Foreground/Background Systems, Pre-emptive and Non-Pre-emptive Kernels, Priority inversion, Deadlock	6
IV	**Task Management in RTOS:** Task structure, RTOS initialization, Task stack, Task states and task state transitions. Creating and deleting a task, Task priority, Case studies of task-based applications	7
V	**Time and Event management in RTOS:** Clock tick, delaying a task, resuming the delayed task, getting system time, case study of application based on time management	7

VI	**Intertask Communication in RTOS:** Need of Intertask communication, Semaphore, Mailbox, Queues in RTOS. Internals of RTOS for managing tasks and Intertask communication, Case study of RTOSapplications.	6

Textbooks	
1	Chris Simmonds,"Mastering Embedded Linux Programming", Second Edition.
2	Jean J. Labrosse,"MicroC OS II: The Real Time Kernel", CMP books publication ISBN: 978-1578201037
3	Chowdary Venkateswara Amazon,"Simple Real-time Operating System: A Kernel,", ISBN: 978-1425117825
4	Qing Li, Caroline Yao Elsevier "Real-Time Concepts for Embedded Systems," ISBN: 978-1578201242

References	
1	https://www.engineersgarage.com/embedded-linux-tutorial-basics/
2	"Exploring Raspberry Pi: Interfacing to the Real World with Embedded Linux" first Edition, Derek Molloy
3	https://freertos.org/Documentation/161204_Mastering_the_FreeRTOS_Real_Time_Kernel, A_Hands-On_Tutorial_Guide.pdf
4	www.micrium.com for uCOS-II related documents, tutorials, downloads.

Useful Links	
1	https://www.linux.org/
2	www.nxp.com for processor specific documents.
3	www.NPTEL.org for OS and RTOS related video courses

CO-PO Mapping

	Programme Outcomes (PO)												**PSO**	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	3													
CO2		3												2
CO3			2											2
CO4														

The strength of mapping is to be written as 1: Low, 2: Medium, 3: High
Each CO of the course must map to at least one PO.

Assessment

The assessment is based on MSE, ISE and ESE.
MSE shall be typically on modules 1 to 3.
ISE shall be taken throughout the semester in the form of teacher's assessment. Mode of assessment can be field visit, assignments etc. and is expected to map at least one higher order PO.
ESE shall be on all modules with around 40% weightage on modules 1 to 3 and 60% weightage on modules 4 to 6.
For passing a theory course, Min. 40% marks in (MSE+ISE+ESE) are needed and Min. 40% marks in ESE are needed. (ESE shall be a separate head of passing)

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AY 2024-25

Course Information	
Programme	B.Tech. (Electronics Engineering)
Class, Semester	Final Year B. Tech., Sem VII
Course Code	6EN402
Course Name	Microwave Communication Engineering
Desired Requisites:	Communication Engineering

Teaching Scheme		**Examination Scheme (Marks)**			
Lecture	3 Hrs/week	**MSE**	**ISE**	**ESE**	**Total**
Tutorial	-	30	20	50	100
		Credits: 3			

Course Objectives	
1	To understand the theoretical principles underlying microwave devices and networks
2	To introduce the various types of transmission lines and to discuss the losses associate
3	To instill knowledge on the properties of various microwave components
4	To deal with the microwave generation and microwave measurement techniques

Course Outcomes (CO) with Bloom's Taxonomy Level		
At the end of the course, the students will be able to,		
CO1	Classify the microwave frequencies and the waveguides that are used application	II
CO2	Examine the active & passive microwave devices & components used in Microwave communication systems	IV
CO3	Analyze the operation and working of the various tubes or sources for the transmission of the microwave frequencies	IV
CO4	Measure the various microwave parameter using analytical treatment	V

Module	**Module Contents**	**Hours**
I	**Microwave Fundamentals and Electromagnetic field Theory:** Microwave regions and band designations, microwave devices, applications of microwaves, Interaction between electrons and fields, electron motion in electric, magnetic and electromagnetic field, electromagnetic plane waves	5
II	**Microwave Waveguide and Components:** Rectangular and circular waveguide, TE and TM modes, power transmission and power losses in waveguide, excitation modes in waveguide, microwave cavities, Microwave passive components—Tee junctions, magic tee, couplers, circulators, attenuators, phase shifters, bends, twists, corners, irises, windows. Scattering Matrix Parameters of microwave networks, S-matrix for E-plane Tee junction, S-matrix for H-plane Tee junctions, S-matrix for directional coupler	8
III	**Microwave Tubes:** Limitations of conventional tubes, O and M type classification of microwavetubes, re-entrant cavity, velocity modulation. Types of Tubes, Two cavity Klystron, Reflex Klystron, traveling wave tube amplifier, Magnetron	6
IV	**Microwave Solid State Devices:** Tunnel diode, PIN diode, Gunn diode, LSA diode, Read diode, IMPATT diode, TRAPATT diode, BARITT DIODE, Varactor Diode, solid state ruby laser, semiconductor laser	7

V	**Microwave Measurements:** Measurement devices: Slotted line, Tunable detector, VSWR meter, Power Meter, S-parameter measurement, frequency measurements, Power measurement, Attenuation measurement, Phase shift measurement, VSWR measurement, Impedance measurement, Q of cavity resonator measurement	7
VI	**Microwave Strip Lines and Antenna:** Micro-strip line, Slot line, Parallel strip line, advantages, Horn antenna, Dish Antenna, Micro-strip antenna	6

Textbooks	
1	Pozar, D.M., "Microwave Engineering", 4th Edition, 2011, Wiley (ISBSN - 9781118213636)
2	Robert E. Collin, John Wiley & Sons, FOUNDATIONS FOR MICROWAVE ENGINEERING, 2ND ED,2007, (ISBN: 8126515287)
3	Gustrau, F, RF and Microwave Engineering: Fundamentals of Wireless Communications, 2012, Wiley, ISBN - 9781118349571
References	
1	Gottapu Sasibhushana Rao, "Microwave and Radar Engineering", 2014, Pearson Education India, (ISBN: 9789332540637)
2	Das, A., and Das, S.K, "Microwave Engineering", McGraw-Hill, 2000, (ISBN - 9780074635773)
3	S Vasuki and D Helena Margaret, R Rajeswari, "Microwave Engineering", McGraw Hill Education (India) Private Limited, ISBN933921949X, 9789339219499
Useful Links	
1	https://onlinecourses.nptel.ac.in/noc20_ee91/preview

CO-PO Mapping

	Programme Outcomes (PO)												PSO	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	3													
CO2				3										
CO3				3										
CO4				3										

The strength of mapping is to be written as 1: Low, 2: Medium, 3: High
Each CO of the course must map to at least one PO.

Assessment

The assessment is based on MSE, ISE and ESE.
MSE shall be typically on modules 1 to 3.
ISE shall be taken throughout the semester in the form of teacher's assessment. Mode of assessment canbe field visit, assignments etc. and is expected to map at least one higher order PO.
ESE shall be on all modules with around 40% weightage on modules 1 to 3 and 60% weightage on modules 4 to 6.
For passing a theory course, Min. 40% marks in (MSE+ISE+ESE) are needed and Min. 40% marks in ESE are needed. (ESE shall be a separate head of passing)

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AY 2024-25

Course Information

Programme	B.Tech. (Electronics Engineering)
Class, Semester	Final Year B. Tech., Sem VII
Course Code	6EN451
Course Name	Real Time Operating System Lab
Desired Requisites:	Theory/Lab Courses with C programming, Microcontroller Peripherals and Interfacing, Embedded System Design.

Teaching Scheme		**Examination Scheme (Marks)**			
Practical	2 Hrs/ Week	**LA1**	**LA2**	**Lab ESE**	**Total**
Interaction	-	30	30	40	100
		Credits: 1			

Course Objectives

1	To learn system Architecture, configuration and Programming for Embedded Linux Based System.
2	To facilitate students to gain practical experience of RTOS and services provided by it.
3	To help students to co-relate the RTOS theory with the RTOS implementation.
4	To provide exposure to industry applications and facilitate for writing applications using Linux and RTOS.

Course Outcomes (CO) with Bloom's Taxonomy Level

At the end of the course, the students will be able to,

CO1	Installation of OS Process and write programs / scripts for Embedded Linux Board.	Apply
CO2	Verify the RTOS fundamentals, through illustrative programs and demonstrate usage of task, time, and event management, Intertask communication using a simulator. (Programming skill, Modern Tools)	Analyze
CO3	Implement a given logic as an RTOS based application. Create document of the same and demonstrate using simulation tools. (Programming skill, Independent and teamwork, Modern Tools)	Create

List of Experiments / Lab Activities/Topics

List of Lab Activities:

1. Experiments to revise an Embedded System Design
2. Experiment to study Linux distribution installation, configuration and basic commands of it.
3. Experiment to study configuration for an Embedded Linux Board.
4. Experiment to access GPIO of an Embedded Linux Board to control components / devices interfaced to it.
5. Demonstration of RTOS based application in keil micro vision
6. Writing of RTOS based application.
7. Finding the type of kernel for a given RTOS (Pre-emptive or Non-pre-emptive)
8. Semaphore for managing shared resource and task synchronization
9. Demonstration of Clock tick and its effect of event timing in RTOS based systems.
10. Semaphore for event synchronization
11. Using mailbox facility in RTOS
12. Using queue facility in RTOS
13. Avoiding deadlock in RTOS

Textbooks

1	Chris Simmonds , "Mastering Embedded Linux Programming", Second Edition.
2	Derek Molloy ,"Exploring Raspberry Pi: Interfacing to the Real World with Embedded Linux" first Edition,
3	Jean J. Labrosse, "MicroC OS II: The Real Time Kernel" CMP books publication ISBN: 978-1578201037

4	RTOS Lab Manual
References	
1	https://www.engineersgarage.com/embedded-linux-tutorial-basics/
2	www.micrium.com for uCOS-II related documents, tutorials, downloads.
3	https://www.freertos.org/Documentation/RTOS_book.html
4	Everything You Need to Know about RTOS (pdf book) by Silabs
Useful Links	
1	https://www.linux.org/
2	https://www.raspberrypi.org/
3	www.highintegritysystems.com/rtos for RTOS tutorials
4	https://www.youtube.com/watch?v=ECEvUEkSSLg for videos by Renesas Inc.

CO-PO Mapping

	Programme Outcomes (PO)												PSO	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1		3												
CO2			3										2	
CO3				2					2					2

The strength of mapping is to be written as 1,2,3; where, 1: Low, 2: Medium, 3: High
Each CO of the course must map to at least one PO, and preferably to only one PO.

Assessment

There are three components of lab assessment, LA1, LA2 and Lab ESE.
IMP: Lab ESE is a separate head of passing.(min 40 %), LA1+LA2 should be min 40%

Assessment	Based on	Conducted by	Typical Schedule	Marks
LA1	Lab activities, attendance, journal	Lab Course Faculty	During Week 1 to Week 8 Marks Submission at the end of Week 8	30
LA2	Lab activities, attendance, journal	Lab Course Faculty	During Week 9 to Week 16 Marks Submission at the end of Week 16	30
Lab ESE	Lab activities, journal/ performance	Lab Course Faculty and External Examiner as applicable	During Week 18 to Week 19 Marks Submission at the end of Week 19	40

Week 1 indicates starting week of a semester. Lab activities/Lab performance shall include performing experiments, mini-project, presentations, drawings, programming, and other suitable activities, as per the nature and requirement of the lab course. The experimental lab shall have typically 8-10 experiments and related activities if any.

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AY 2024-25

Course Information

Programme	B.Tech. (Electronics Engineering)
Class, Semester	Final Year B. Tech., Sem VII
Course Code	6EN452
Course Name	Microwave Communication Engineering Lab
Desired Requisites:	Communication

Teaching Scheme		**Examination Scheme (Marks)**			
Practical	2 Hrs/ Week	**LA1**	**LA2**	**Lab ESE**	**Total**
Interaction	-	30	30	40	100
		Credits: 1			

Course Objectives

1	To understand the theoretical principles underlying microwave devices and networks
2	To introduce the various types of transmission lines and to discuss the losses associate
3	To instill knowledge on the properties of various microwave components
4	To deal with the microwave generation and microwave measurement techniques

Course Outcomes (CO) with Bloom's Taxonomy Level

At the end of the course, the students will be able to,

CO1	Classify the microwave frequencies and the waveguides that are used application	II
CO2	Examine the active & passive microwave devices & components used in Microwave communication systems	IV
CO3	Analyze the operation and working of the various tubes or sources for the transmission of the microwave frequencies	IV
CO4	Measure the various microwave parameter using analytical treatment	V

List of Experiments / Lab Activities/Topics

List of Lab Activities:

List of Experiments:

1. Study of Microwave components and equipment
2. Study of V-I Characteristics of Gunn Diode
3. Reflex Klystron as source and plot its various modes
4. Verification of port characteristics of E-plane tee, H-plane tee & Magic tree
5. Verification of port characteristics of Microwave Circulator and isolator, calculation of insertion loss and isolation loss
6. Verification of port characteristics of Directional coupler, calculation of coupling factor, insertion loss and directivity.
7. Power pattern of Horn Antenna
8. Power Patterns of different Antenna like Dipole, Yagi etc.
9. Study of slotted section with probe carriage. Measure the VSWR for various values of terminating impedances (open/short/matched termination).
10. To test and verify Microwave Integrated Circuits using Microstrip trainer kit and finds parameters, and plot the frequency response.

Textbooks

1	Microwave Engineering, 4th Edition, Pozar, D.M., 2011, Wiley (ISBSN - 9781118213636)
2	FOUNDATIONS FOR MICROWAVE ENGINEERING, 2ND ED, By Robert E. Collin, John Wiley & Sons, 2007, (ISBN: 8126515287)
3	RF and Microwave Engineering: Fundamentals of Wireless Communications, Gustrau, F, 2012, Wiley, ISBN - 9781118349571

References	
1	Microwave and Radar Engineering, By Gottapu Sasibhushana Rao · 2014, Pearson Education India, (ISBN: 9789332540637)
2	Microwave Engineering, Das, A., and Das, S.K., McGraw-Hill, 2000, (ISBN - 9780074635773)
3	Microwave Engineering, S Vasuki and D Helena Margaret, R Rajeswari, McGraw Hill Education (India) Private Limited, ISBN933921949X, 9789339219499
Useful Links	
1	https://onlinecourses.nptel.ac.in/noc20_ee91/preview

CO-PO Mapping

	Programme Outcomes (PO)												PSO	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	3													
CO2				3										
CO3				3										
CO4				3										

The strength of mapping is to be written as 1,2,3; where, 1: Low, 2: Medium, 3: High
Each CO of the course must map to at least one PO, and preferably to only one PO.

Assessment

There are three components of lab assessment, LA1, LA2 and Lab ESE.
IMP: Lab ESE is a separate head of passing.(min 40 %), LA1+LA2 should be min 40%

Assessment	Based on	Conducted by	Typical Schedule	Marks
LA1	Lab activities, attendance, journal	Lab Course Faculty	During Week 1 to Week 8 Marks Submission at the end of Week 8	30
LA2	Lab activities, attendance, journal	Lab Course Faculty	During Week 9 to Week 16 Marks Submission at the end of Week 16	30
Lab ESE	Lab activities, journal/ performance	Lab Course Faculty and External Examiner as applicable	During Week 18 to Week 19 Marks Submission at the end of Week 19	40

Week 1 indicates starting week of a semester. Lab activities/Lab performance shall include performing experiments, mini-project, presentations, drawings, programming, and other suitable activities, as per the nature and requirement of the lab course. The experimental lab shall have typically 8-10 experiments and related activities if any.

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AY 2024-25

Course Information	
Programme	B. Tech. (Electronics Engineering)
Class, Semester	Final Year B. Tech. Sem. VII
Course Code	6EN491
Course Name	Project-I
Desired Requisites:	Mini-Project

Teaching Scheme		**Examination Scheme (Marks)**			
Practical	6 Hrs/Week	**LA1**	**LA2**	**Lab ESE**	**Total**
Interaction	-	30	30	40	100
		Credits: 3			

Course Objectives	
1	**Explain** to survey and study the published literature on the assigned/ selected topic. The topicmay be chosen from the problem assigned by the industry. The chosen topic may provide a solution to the electronics industry problem/ solution to societal needs.
2	**Explain** the use of methods/ methodology/ procedures/ software tools to carry out preliminary **Analysis**/ **Modelling**/ **Simulation**/ Experiment/ Design. It is expected to find out the feasibility of the project.
3	**Illustrate** the guidelines to write and **organize** the project report based on the study conducted for presentation to the department.

Course Outcomes (CO) with Bloom's Taxonomy Level		
At the end of the course, the students will be able to,		
CO1	**Explain** the purpose of the project and conceptual idea behind the project.	Understand
CO2	**Analyze** the journal/ conference/ research papers/ magazine articles and present the comparative study of similar work done by others.	Analyze
CO3	**Propose** a research problem/ problem undertaken as project-work and present it in a clear and distinct manner through different **design techniques** which meets the desired objectives of the project-work.	Create
CO4	Prepare **and Organize** written report on the study conducted/part of project-work (simulations/ technical design) completed for presentation before the department committee.	Apply

List of Experiments / Lab Activities/ Topics

The objective of Project-I is to enable the student to take up investigative study in the broad field of Electronics Engineering, either fully theoretical/practical or involving both theoretical and practical work to be assigned by the Department on an individual basis or three/five students in a group, under the guidance of a Supervisor from the Department alone or jointly with a Supervisor/ Mentor from Industry. This is expected to provide a good initiation for the student(s) in R&D work.

The Projects may be chosen from the following areas/domains, but not limited to:

- Embedded Systems/ VLSI Design
- Electronic Communication Systems
- Biomedical Electronics
- Power Electronics/ Electric Vehicles
- Robotics and Mechatronic Systems
- Artificial Intelligence and Machine Learning
- Applications of Electronics to Agriculture

Assessment: A demonstration and oral examination on the Project-I shall be conducted at the end of the semester.

Text Books	
1	Journal/ Conference papers/ Magazine Articles/ Handbooks with reference to topic selected for the project-work.

References	
1	Journal/ Conference papers/ Magazine Articles/ Handbooks with reference to topic selected for the project-work.

Useful Links	
1	https://ieeexplore.ieee.org
2	https://www.sciencedirect.com
3	https://www.elsevier.com

CO-PO Mapping

	Programme Outcomes (PO)												PSO	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	3					3	2			2			2	2
CO2		3		3									3	3
CO3			3		2								3	3
CO4								2	3	3	3	2	2	2

The strength of mapping is to be written as 1,2,3; where, 1: Low, 2: Medium, 3: High
Each CO of the course must map to at least one PO, and preferably to only one PO.

Assessment

There are three components of lab assessment, LA1, LA2 and Lab ESE.
IMP: Lab ESE is a separate head of passing (min 40 %). LA1, LA2 together is treated as In-Semester Evaluation, LA1+LA2 should be min 40%.

Assessment	Based on	Conducted by	Typical Schedule	Marks
LA1	Lab activities, attendance, journal	Lab Course Faculty	During Week 1 to Week 8 Marks Submission at the end of Week 8	30
LA2	Lab activities, attendance, journal	Lab Course Faculty	During Week 9 to Week 16 Marks Submission at the end of Week 16	30
Lab ESE	Lab activities, journal/ performance	Lab Course Faculty and External Examiner as applicable	During Week 18 to Week 19 Marks Submission at the end of Week 19	40

Week 1 indicates starting week of a semester. Lab activities/Lab performance shall include performing experiments, mini-project, presentations, drawings, programming, and other suitable activities, as per the nature and requirement of the lab course. The experimental lab shall have typically 8-10 experiments and related activities if any.

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AY 2024-25

Course Information	
Programme	B.Tech. (Electronics Engineering)
Class, Semester	Final Year B. Tech., Sem VII
Course Code	6EN411
Course Name	Professional Elective V - RF Circuit Design
Desired Requisites:	ECAD

Teaching Scheme		**Examination Scheme (Marks)**			
Lecture	3 Hrs/week	**MSE**	**ISE**	**ESE**	**Total**
Tutorial	-	30	20	50	100
		Credits: 3			

Course Objectives	
1	To learn the radio frequency communication electronics and integrated circuit design
2	Understand the RF device modeling to RF circuit building blocks
3	Study the RF transceiver architecture

Course Outcomes (CO) with Bloom's Taxonomy Level		
At the end of the course, the students will be able to,		
CO1	Illustrate the concept of lumped elements with transmission line	II
CO2	Categorize the passive devices and CMOS transistor for RF IC Design	IV
CO3	Choose the various components for design amplifier and switches	VI

Module	**Module Contents**	**Hours**
I	**Lumped Elements**: Fundamentals Of Electromagnetics, Wave Equation, Skin Depth, Surface Impedance, Fundamentals of Lumped Elements, Modeling of Lumped Elements, Inductors, Inductor Configurations, Loss in Inductors, Lumped-Element Capacitors, Lumped Element Resistors	7
II	**Transmission Lines**: Printed-Circuit Transmission Lines, TransmissionLines in RFICs, Multi-Conductor Transmission Lines RESONATORS, Fundamentals of Resonators, Quality Factor, Distributed Resonators, Impedance Matching, Design of Impedance-Matching Networks	7
III	**Scattering Parameters**: Rf Passive Components, Characteristics of Multiport RF Passive Components, Directional Couplers, Hybrids, PowerDividers, Filters Design.	7
IV	**Fundamentals Of Cmos Transistors For Rfic Design:** MOSFET Basics, MOSFET Models, Important MOSFET Frquencies, Parameters, Varactor Diodes, Fundamentals of Stability, Determination of Stable and Unstable Regions, Stability Consideration for N-Port Circuits	6
V	**Fundamentals of Amplifier Design:** Low Noise Amplifiers, Power Amplifiers, Balanced Amplifiers, Broadband Amplifiers, Current Mirrors, Fundamentals of Oscillator Design, Phase Noise, Fundamentals of Mixers, Mixer Types, Mixer Analysis and Design, Sampling Mixer	6
VI	**Fundamentals of Switches**: Analysis of Switching MOSFET, SPST Switches,SPDT Switches, Ultra-Wideband Switches, Ultra-High-Isolation Switches, Filter Switches RFIC Simulation, RFIC Layout, RFIC Measurement,Fundamentals of Systems, System Type	6

Textbooks	
1	Radio-frequency integrated-circuit engineering / Cam Nguyen, Wiley series in microwave and optical engineering, ISBN 978-1-118-93648-1, 2015
2	High-Frequency Integrated Circuits, Sorin Voinigescu, Cambridge University, ISBN-13: 978-0521873024
References	
1	The Design of CMOS Radio-Frequency Integrated Circuits, by Thomas H. Lee, ISBN: 978-0521835398
2	RF Microelectronics, 2nd Edition, by Behzad Razavi, Prentice Hall, ISBN: 978-0137134731
Useful Links	
1	-

CO-PO Mapping

	Programme Outcomes (PO)												PSO	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1				3										
CO2				3										
CO3				3										
CO4														

The strength of mapping is to be written as 1: Low, 2: Medium, 3: High
Each CO of the course must map to at least one PO.

Assessment

The assessment is based on MSE, ISE and ESE.
MSE shall be typically on modules 1 to 3.
ISE shall be taken throughout the semester in the form of teacher's assessment. Mode of assessment can be field visit, assignments etc. and is expected to map at least one higher order PO.
ESE shall be on all modules with around 40% weightage on modules 1 to 3 and 60% weightage on modules 4 to 6.
For passing a theory course, Min. 40% marks in (MSE+ISE+ESE) are needed and Min. 40% marks in ESE are needed. (ESE shall be a separate head of passing)

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AY 2024-25

Course Information	
Programme	B.Tech. (Electronics Engineering)
Class, Semester	Final Year B. Tech., Sem. VII
Course Code	6EN412
Course Name	Professional Elective V- Pattern Recognition and Applications.
Desired Requisites:	Basics of linear Algebra, Image processing/ Computer Vision.

Teaching Scheme		**Examination Scheme (Marks)**			
Lecture	3 Hrs/week	**MSE**	**ISE**	**ESE**	**Total**
Tutorial	-	30	20	50	100
		Credits: 3			

Course Objectives	
1	To the fundamental concepts and principles of pattern recognition.
2	To Learn about different classification algorithms and their applications in pattern recognition.
3	To Explore advanced topics in pattern recognition, such as deep learning and neural networks.
4	Understand the concept of statistical pattern recognition and its applications.

Course Outcomes (CO) with Bloom's Taxonomy Level		
At the end of the course, the students will be able to,		
CO1	To **Identify** the key components and processes involved in pattern recognition systems.	Understand
CO2	**Apply** feature extraction and selection methods to effectively represent and describe patterns in datasets.	Apply
CO3	**Analyze** and **interpret** the results of pattern recognition algorithms and models.	Analyze

Module	**Module Contents**	**Hours**
I	**Introduction to Pattern Recognition:** Image Fundamentals required for Pattern Recognition, Definition and scope of pattern recognition, Components of Pattern Recognition Systems, Overview of the pattern recognition process, Evaluation metrics for pattern recognition systems, Applications of pattern recognition in various fields.	7
II	**Feature Extraction and Selection:** Feature representation and feature vectors, Feature extraction techniques (e.g., statistical, frequency domain, transform-based), Dimensionality reduction techniques (e.g., Principal Component Analysis (PCA), Linear Discriminant Analysis (LDA)), Feature selection methods (e.g., Sequential Forward Selection (SFS), Genetic Algorithms).	7
III	**Bayesian Decision Theory:** Introduction to Bayes' theorem, Bayes decision rule and decision boundaries Minimum error rate classification, Classifiers based on Gaussian distributions (e.g., Naive Bayes, Gaussian Mixture Models).	6
IV	**Supervised Learning Algorithms:** Linear classifiers (e.g., Perceptron, Support Vector Machines (SVM)), k-Nearest Neighbors (k-NN) algorithm, Decision tree classifiers. **Unsupervised Learning and Clustering** Clustering algorithms (e.g., k-means, hierarchical clustering), Self-Organizing Maps (SOM).	7

V	**Neural Networks for Pattern Recognition:** Introduction to artificial neural networks (ANNs), Perceptrons and multilayer perceptrons (MLPs), Backpropagation algorithm for training ANNs, Convolutional Neural Networks (CNNs) for image recognition, Recurrent Neural Networks (RNNs) for sequence data.	6
VI	**Statistical Pattern Recognition:** Maximum Likelihood Estimation (MLE) and Maximum a Posteriori (MAP) estimation, Hidden Markov Models (HMMs) for sequential data, Gaussian Mixture Models (GMMs), Expectation-Maximization (EM) algorithm.	6

Textbooks	
1	Milan Sonka, Vaclav Hlavac, and Roger Boyle, "Image Processing, Analysis, and Machine Vision"
2	Christopher M. Bishop, "Pattern Recognition and Machine Learning",2006
3	Sergios Theodoridis and Konstantinos Koutroumbas, "Introduction to Pattern Recognition: A MATLAB Approach"
4	Richard O. Duda, Peter E. Hart, and David G. Stork ,"Pattern Classification"
References	
1	R. Schalkoff, Pattern Recognition - Statistiucal, Structural and Neural Approaches, John Wiley, 1992.
2	J.I. Tou & R.C. Gonzalez, Pattern Recognition Priciples, Addition-Wesley.
Useful Links	
1	https://www.coursera.org/learn/pattern-recognition-machine-learning
2	https://www.springer.com/gp/book/9780387310732
3	https://www.journals.elsevier.com/pattern-recognition
4	https://github.com/

CO-PO Mapping

	Programme Outcomes (PO)												PSO	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	2													
CO2		2												
CO3												2		

The strength of mapping is to be written as 1: Low, 2: Medium, 3: High
Each CO of the course must map to at least one PO.

Assessment

The assessment is based on MSE, ISE and ESE.
MSE shall be typically on modules 1 to 3.
ISE shall be taken throughout the semester in the form of teacher's assessment. Mode of assessment can be field visit, assignments etc. and is expected to map at least one higher order PO.
ESE shall be on all modules with around 40% weightage on modules 1 to 3 and 60% weightage on modules 4 to 6.
For passing a theory course, Min. 40% marks in (MSE+ISE+ESE) are needed and Min. 40% marks in ESE are needed. (ESE shall be a separate head of passing)

Walchand College of Engineering, Sangli

(Government Aided Autonomous Institute)

AY 2024-25

Course Information	
Programme	B.Tech. (Electronics Engineering)
Class, Semester	Final Year B. Tech., Sem. VII
Course Code	6EN413
Course Name	Professional Elective V - Advanced Control Systems
Desired Requisites:	Embedded System Design, FPGA Based System Design

Teaching Scheme		**Examination Scheme (Marks)**			
Lecture	3 Hrs/week	**MSE**	**ISE**	**ESE**	**Total**
Tutorial	-	30	20	50	100
		Credits: 3			

Course Objectives	
1	This subject deals with state space, describing function, and stability analysis. Including controllability and observability.
2	It also deals with digital control devices, systems and algorithms.

Course Outcomes (CO) with Bloom's Taxonomy Level		
At the end of the course, the students will be able to,		
CO1	**understand** state space, describing function, and stability analysis. Including controllability and observability.	Understand
CO2	**Apply and Analyze** concepts of digital control devices, systems and algorithms.	Apply, Analyze
CO3	Stability Analysis using different techniques.	Analyze

Module	**Module Contents**	**Hours**
I	**State Space Analysis:** Multivariable systems, State Space Representation of systems, Solution of State Equation, State Transition Matrix, Transfer function from state variablemodel, Eigenvalues and Eigenvectors, Concepts of controllability and observability, Tests for controllability and observability for continuous time systems – Time varying case, minimum energy control, time invariant case, Principle of Duality, Controllability and observability form Jordan canonicalform and other canonical forms.	5
II	**Describing Function Analysis:** Definition, limitations, use of describing function for stability analysis, Introduction to nonlinear systems, Types of nonlinearities, describing function analysis of nonlinear control systems, describing function of idealrelay, relay with hysteresis & dead zone, saturation/coulomb friction & backlash.	7
III	**Stability Analysis:** Stability in the sense of Lyapunov., Lyapunov's stability and Lypanov's instability theorems. Direct method of Lypanov for the Linear and Nonlinear continuous time autonomous systems.	7

IV	**Digital Control Introduction:** Why Use Digital Control, Configuration of the Basic Digital Control Scheme, Principles of Signal Conversion, Basic Discrete – Time signals, Time –Domain models for discrete – time systems, Transfer function models, Stability on the Z-plane and the Jury stability criterion, Sampling as Impulse Modulation, Sampled Spectra and Aliasing, Filtering Practical Aspects of thechoice of sampling rate, Principle of discretization, The Routh stability criterion on the r- plane.	7
V	**Digital Control Devices and Systems and Algorithms:** Introduction, z-Domain description of sampled continuous – time plants, z-Domain description of systems with Dead – Time, Implementation of Digital Controllers, Digital temperature control system, Digital position control system, Stepping motors and their control. z- plane specifications of control system design, Digital compensator Design using frequency response plots, Digital compensator Design using root Locus plots, z- plane Synthesis.	7
VI	**Pole-placement Design and State observers:** Introduction, Stability improvement by state feedback, Necessary and sufficient conditions of arbitrary pole-placement, State regulator design, Design of State Observers, Compensator Design by the separation principle, Servo design: Introduction of the reference input by feed forward control, StateFeedback with Integral Control, Digital Control systems with state feedback, Deadbeat control by state feedback and Dead beat observers.	6

Textbooks	
1	Modern Control System Theory – by M. Gopal, New Age International Publishers, 2nd edition, 1996.
References	
1	"*Modern Control Engineering"* – by K. Ogata, Prentice Hall of India, 3rd edition, 1998
2	"Control Systems Engineering" by I.J. Nagarath and M.Gopal, New Age International (P) Ltd.
3	"Digital Control and State Variable Methods" – by M. Gopal, Tata Mc Graw-Hill Companies, 1997.
4	"*Systems and Control by Stainslaw"* H. Zak , Oxford Press, 2003

CO-PO Mapping														
	Programme Outcomes (PO)												**PSO**	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	2													
CO2		2												2
CO3		2												
1: Low, 2: Medium, 3: High														

Walchand College of Engineering, Sangli

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AY 2024-25

Course Information

Programme	B.Tech. (Electronics Engineering)
Class, Semester	Final Year B. Tech. Sem. VII
Course Code	6EN414
Course Name	Professional Elective VI- Internet of Things
Desired Requisites:	Sensors and Instrumentation, Embedded System

Teaching Scheme		**Examination Scheme (Marks)**			
Lecture	3 Hrs/week	**MSE**	**ISE**	**ESE**	**Total**
Tutorial	-	30	20	50	100
Practical	-				
Interaction	-	**Credits: 3**			

Course Objectives

1	To provide understanding of the Internet of Things concepts.
2	To demonstrate various IoT communication protocols.
3	To understand applications of Internet of Things and its usefulness for society.

Course Outcomes (CO) with Bloom's Taxonomy Level

At the end of the course, the students will be able to,

CO1	Explain IoT building blocks	Understand
CO2	Compare various IoT connectivity and communication technologies	Analyze
CO3	Design applications for solution building in IoT domain	Apply

Module	**Module Contents**	**Hours**
I	**IoT Fundamentals and Overview:** Definition and Characteristics of IoT, Physical Design of IoT, IoT enabled Technologies , IoT Applications : Smart cities, Smart Homes, Smart Agriculture, Smart Energy, Smart vehicles	6
II	**IoT Physical Devices and Endpoints**: Mobile Ad hoc Network, Stationary and Mobile Wireless Sensor Networks, Hardware and software architecture of sensor node ,type of sinks, gateway, Operating system for WSN	8
III	**MAC and network layer for sensor network**: IEEE standard Protocols for sensor network communication, low duty cycle protocols and wake up concepts for energy conservation	8
IV	**IoT Communication Technologies**: M2M protocols for IoT- 6LowPAN, RFID, Wireless HART, MQTT, CoAP, XMPP, AMQP	6

V	**Cloud and SDN**: cloud computing and virtualization concepts, Cloud Architecture , Cloud computing, benefits , challenges, risksCloud services , introduction to software defined network	6
VI	**IoT Security and Authentication**: Implementing basic security measures for IoT devices (e.g., encryption, authentication), IoT Data Analytics :basic data analytics on IoT sensor data.	5

Text Books	
1	Sudip Misra, Chandana Roy, Anandarup Mukherjee, "Introduction to Industrial Internet of Things and Industry 4.0" 2021
References	
1	D.E. Comer "Internetworking with TCP/IP", Vol. I (4th Edition), II, III (PHI)
2	Olivier Hersent, David Boswarthick "Internet of Things Applications and Protocols ", Wiely publication 2nd Ed.
3	William Stallings "Foundations of Modern Networking : SDN, NFV, QoE, IoT and Cloud" Pearson Education
Useful Links	
1	https://onlinecourses.nptel.ac.in/noc21_cs17/preview

CO-PO Mapping

	Programme Outcomes (PO)												PSO	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1			3						3				2	
CO2			3											2
CO3	2													3
CO4														

The strength of mapping is to be written as 1,2,3; Where, 1:Low, 2:Medium, 3:High
Each CO of the course must map to at least one PO.

Assessment

The assessment is based on MSE, ISE and ESE.
MSE shall be typically on modules 1 to 3.
ISE shall be taken throughout the semester in the form of teacher's assessment. Mode of assessment can be field visit, assignments etc. and is expected to map at least one higher order PO.
ESE shall be on all modules with around 40% weightage on modules 1 to 3 and 60% weightage on modules 4 to 6.
For passing a theory course, Min. 40% marks in (MSE+ISE+ESE) are needed and Min. 40% marks in ESE are needed. (ESE shall be a separate head of passing)

Walchand College of Engineering, Sangli

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AY 2024-25

Course Information	
Programme	B.Tech. (Electronics Engineering)
Class, Semester	Final Year B. Tech., Sem. VII
Course Code	6EN415
Course Name	Professional Elective VI- Machine Learning
Desired Requisites:	Basics of linear algebra, Probability and statistics

Teaching Scheme		**Examination Scheme (Marks)**			
Lecture	3 Hrs/week	**MSE**	**ISE**	**ESE**	**Total**
Tutorial	-	30	20	50	100
		Credits: 3			

Course Objectives	
1	To understand the basics of Machine Learning (ML).
2	To understand the techniques and Learning algorithms.
3	To know about the implementation aspects of machine learning.
4	To explore and analyse Advanced Topics in Machine Learning.

Course Outcomes (CO) with Bloom's Taxonomy Level		
At the end of the course, the students will be able to,		
CO1	**Understand** fundamental and basics of Machine Learning algorithms	Understand
CO2	**Discuss and Develop** Practical Skills with hands on experience in implementing and applying machine learning algorithms using popular programming libraries and frameworks	Apply
CO3	**Gain** experience in applying machine learning techniques to real-world datasets and problems.	Apply
CO4	Stay Updated with Recent Developments and advancements in machine learning.	Analyse

Module	**Module Contents**	**Hours**
I	**Introduction to Machine Learning:** Definition and scope of machine learning, Types of machine learning algorithms (supervised, unsupervised, reinforcement learning), Key applications of machine learning, Overview of the machine learning process, Linearity and Non linearity – Early trends in Machine learning – Data Understanding Representation and visualization.	6
II	**Supervised Learning Algorithms:** Linear regression and regularization techniques, Logistic regression for classification, k-Nearest Neighbors (k-NN) algorithm, Decision trees and ensemble methods (random forests, gradient boosting), Support Vector Machines (SVM), Evaluation metrics for classification and regression tasks	7
III	**Unsupervised Learning Algorithms:** Clustering algorithms (k-means, hierarchical clustering), Dimensionality reduction techniques (Principal Component Analysis (PCA), Anomaly detection, Evaluation metrics for unsupervised learning tasks.	7
IV	**Neural Networks and Deep Learning:** Introduction to artificial neural networks, Activation functions and gradient descent, Feedforward neural networks and backpropagation, Convolutional Neural Networks (CNN) for image recognition, Recurrent Neural Networks (RNN) for sequence data, Introduction to deep learning frameworks (e.g., TensorFlow, PyTorch).	7

V	**Model Evaluation and Selection:** Training set, validation set, and test set, Cross-validation techniques, Bias-variance trade off, Overfitting and underfitting, Hyperparameter tuning and model selection, Model interpretation. Optimization Methods: Optimization Methods: Gradient descent, stochastic gradient descent (SGD) and extensions to SGD, regularization	7
VI	**Advanced Topics in Machine Learning:** Ensemble methods (e.g., bagging, boosting), Reinforcement learning basics Introduction to natural language processing (NLP), Time series analysis and forecasting, Transfer learning and domain adaptation	5

Textbooks	
1	Christopher M. Bishop , "Pattern Recognition and Machine Learning",2006
2	Tom Mitchell, "Machine Learning", McGraw Hill, 1997
3	Shai Shalev-Shwartz and Shai Ben-David. Understanding Machine Learning: From Theory to Algorithms. Cambridge University Press. 2014.
4	Ian Goodfellow, "Deep Learning", Yoshua Bengio, and Aaron Courville

References	
1	Trevor Hastie, Robert Tibshirani, and Jerome Friedman, “The Elements of Statistical Learning”
2	Kevin P. Murphy, "Machine Learning: A Probabilistic Perspective"
3	Aurélien Géron ,"Hands-On Machine Learning with Scikit-Learn, Keras, and TensorFlow"

Useful Links	
1	https://www.kaggle.com/
2	https://scikit-learn.org/stable/documentation.html
3	https://www.tensorflow.org/learn
4	https://www.coursera.org/

CO-PO Mapping

	Programme Outcomes (PO)												**PSO**	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	2													
CO2		2												
CO3				2										
CO4												2		

The strength of mapping is to be written as 1: Low, 2: Medium, 3: High
Each CO of the course must map to at least one PO.

Assessment

The assessment is based on MSE, ISE and ESE.
MSE shall be typically on modules 1 to 3.
ISE shall be taken throughout the semester in the form of teacher’s assessment. Mode of assessment can be field visit, assignments etc. and is expected to map at least one higher order PO.
ESE shall be on all modules with around 40% weightage on modules 1 to 3 and 60% weightage on modules 4 to 6.
For passing a theory course, Min. 40% marks in (MSE+ISE+ESE) are needed and Min. 40% marks in ESE are needed. (ESE shall be a separate head of passing)

Walchand College of Engineering, Sangli

(Government Aided Autonomous Institute)

AY 2024-25

Course Information

Programme	B. Tech. (Electronics Engineering)
Class, Semester	Final Year B. Tech., Sem. VII
Course Code	6EN416
Course Name	Professional Elective VI - Analog CMOS IC Design
Desired Requisites:	Digital Electronics, Digital CMOS IC Design

Teaching Scheme		**Examination Scheme (Marks)**			
Lecture	3 Hrs/week	**MSE**	**ISE**	**ESE**	**Total**
Tutorial	-	30	20	50	100
Practical	-				
Interaction	-	**Credits: 3**			

Course Objectives

1	To **explain** the analog circuit concepts based on MOS devices in such a way to develop in students the insight and intuition towards MOS circuits.
2	To **organize** guest lectures and practical sessions with the help of industry persons.
3	To **deliver** the tips (or thumb rules) related with design of analog circuits throughout the course.
4	To **motivate** the students to develop lifelong/ self-learning attitude.

Course Outcomes (CO) with Bloom's Taxonomy Level

At the end of the course, the students will be able to,

CO1	**Analyze** MOS device circuits to derive the dependence of various electrical parameters analytically and graphically. (M1)	Analyze
CO2	**Develop** large signal and small signal models for single stage amplifiers and differential amplifiers using MOS transistors and derive the gain relationships. (M2, M3)	Apply
CO3	**Design** common source, common gate, common drain amplifier for given specifications. Further recognize their application under various typical situations. (M2, M3)	Design
CO4	**Analyze** large signal and small signal behaviour of differential amplifiers and compute the differential gain, common mode gain and CMRR. (M3)	Analyze
CO5	**Analyze** active current mirrors and explain the properties of differential pairs using such circuits as loads. (M5)	Analyze
CO6	**Design** 2-stage Op-Amp for given specifications. **Compute** the poles and zeros in the frequency response of the single stage amplifiers using time-constant method (M6)	Design

Module	**Module Contents**	**Hours**
I	**MOS Device Physics:** MOS IV Characteristics, Second Order Effects, MOS device models (MOS device capacitance, MOS small signal model) MOS model parameters	8
II	**Single Stage Amplifier:** Part I CS stage with resistance load, diode connected load, current source load, CS stage with source, degeneration,	6
III	**Single Stage Amplifier:** Part II source follower, common-gate stage, Cascade stage, folded cascade, choice of device models.	6
IV	**Differential Amplifiers:** Basic difference pair, differential mode response, common mode response, Differential pair with MOS loads	6
V	**Passive and Active Current mirrors:** Basic current mirrors, Cascade mirrors, active current mirrors.	7
VI	**Frequency Response:** CS stage, Source follower, Common gate stage, Cascade stage and Difference pair. Design of 2-stage operational amplifier	7

Text Books	
1	Behzad Razavi, "*Design of Analog CMOS Integrated Circuits"*, Second Edition, Tata McGraw-Hill Publishing Company Limited, New Delhi, 2017.
References	
1	R. Jacob Baker, "*CMOS: Circuit Design, Layout and Simulation*", Wiley-Inter- science, (2008)
2	Allen, P.E. and Holberg, D.R., "*CMOS Analog Circuit Design*", Oxford University Press (2002)
Useful Links	
1	www.vlsi-expert.com,
2	www.testbench.in
3	www.asic-world.com
4	https://nptel.ac.in/courses/117/101/117101105/

CO-PO Mapping

	Programme Outcomes (PO)												PSO	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	2	3												3
CO2	2	3												3
CO3			3											3
CO4	2	3												3
CO5	2	3												3
CO6		2	3											3

The strength of mapping is to be written as 1,2,3; Where, 1: Low, 2:Medium, 3:High
Each CO of the course must map to at least one PO.

Assessment

The assessment is based on MSE, ISE and ESE.
MSE shall be typically on modules 1 to 3.
ISE shall be taken throughout the semester in the form of teacher's assessment. Mode of assessment can be field visit, assignments etc. and is expected to map at least one higher order PO.
ESE shall be on all modules with around 40% weightage on modules 1 to 3 and 60% weightage on modules 4 to 6.
For passing a theory course, Min. 40% marks in (MSE+ISE+ESE) are needed and Min. 40% marks in ESE are needed. (ESE shall be a separate head of passing)

Walchand College of Engineering, Sangli

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AY 2024-25

Course Information

Programme	B.Tech. (Electronics Engineering)
Class, Semester	Final Year B. Tech., Sem. VII
Course Code	6EN453
Course Name	Professional Elective V -Internet of Things Lab
Desired Requisites:	Sensors and Instrumentation, Embedded System

Teaching Scheme		**Examination Scheme (Marks)**			
Practical	2 Hrs/ Week	**LA1**	**LA2**	**Lab ESE**	**Total**
Interaction	- Hrs/ Week	30	30	40	100
		Credits: 1			

Course Objectives

1	To provide understanding of the Internet of Things concepts.
2	To demonstrate sensor node architecture and communication.
3	To understand applications of Internet of Things and its usefulness for society.

Course Outcomes (CO) with Bloom's Taxonomy Level

At the end of the course, the students will be able to,

CO1	Design sensor node	Apply
CO2	Compare various connectivity and communication technologies	Analyze
CO3	Simulate/Design applications for solution building in IoT domain	Create

List of Experiments / Lab Activities/Topics

List of Lab Activities:

1. Introduction to IoT Devices: Arduino, Raspberry Pi, Node-MCU, etc.
2. Sensor Interfacing:

   Different sensors with IoT devices.

   Collecting sensor data and displaying it on the device
3. Actuator Control:

   Controlling actuators using IoT devices.
4. Data Logging and Visualization:

   Logging sensor data on IoT devices or cloud platforms. sensor data using graphs or web interfaces
5. IoT Security and Authentication:
6. IoT Energy Management: Optimizing power consumption through sleep modes, duty cycling, and low-power components, Implementing basic security measures for IoT devices
7. Use of IoT public cloud for data storage and processing
8. All above experiments design and simulate using appropriate tools.

Textbooks

1	"Introduction to Industrial Internet of Things and Industry 4.0" Sudip Misra, Chandana Roy, Anandarup Mukherjee 2021

References

1	“Internet of Things Applications and Protocols ”, Wiely publication 2nd Ed.
2	William Stallings “Foundations of Modern Networking : SDN, NFV, QoE, IoT and Cloud” Pearson Education
Useful Links	
1	-

CO-PO Mapping														
	Programme Outcomes (PO)												**PSO**	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1			3											2
CO2				3										
CO3					3				3				2	
CO4														
The strength of mapping is to be written as 1,2,3; where, 1: Low, 2: Medium, 3: High Each CO of the course must map to at least one PO, and preferably to only one PO.														

Assessment				
There are three components of lab assessment, LA1, LA2 and Lab ESE. IMP: Lab ESE is a separate head of passing.(min 40 %), LA1+LA2 should be min 40%				
Assessment	**Based on**	**Conducted by**	**Typical Schedule**	**Marks**
LA1	Lab activities, attendance, journal	Lab Course Faculty	During Week 1 to Week 8 Marks Submission at the end of Week 8	30
LA2	Lab activities, attendance, journal	Lab Course Faculty	During Week 9 to Week 16 Marks Submission at the end of Week 16	30
Lab ESE	Lab activities, journal/ performance	Lab Course Faculty and External Examiner as applicable	During Week 18 to Week 19 Marks Submission at the end of Week 19	40
Week 1 indicates starting week of a semester. Lab activities/Lab performance shall include performing experiments, mini-project, presentations, drawings, programming, and other suitable activities, as per the nature and requirement of the lab course. The experimental lab shall have typically 8-10 experiments and related activities if any.				

Walchand College of Engineering, Sangli

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AY 2022-23

Course Information	
Programme	B.Tech. (Electronics Engineering)
Class, Semester	Final Year B. Tech., Sem. VII
Course Code	6EN454
Course Name	Professional Elective VI-Machine Learning lab
Desired Requisites:	Python Programming

Teaching Scheme		**Examination Scheme (Marks)**			
Practical	2 Hrs/ Week	**LA1**	**LA2**	**Lab ESE**	**Total**
Interaction	-	30	30	40	100
		Credits: 1			

Course Objectives

1	To make students do practical implementation of the different ML concepts and techniques.
2	To make students familiar with steps involved in applying machine learning algorithms to real-life Problems
3	Make use of Data sets in implementing the machine learning algorithms.
4	To develop research interest towards this field.

Course Outcomes (CO) with Bloom's Taxonomy Level

At the end of the course, the students will be able to,

CO 1	**Apply** ML algorithms to **solve** real world problems and **analyze** the results.	Apply, Analyze
CO 2	**Design** and **provide** best solution to ML problems by **measuring** the performance of different algorithms/tools, and **comparing** them.	Evaluate, Create

List of Experiments / Lab Activities/Topics

List of Lab Activities:

1. Implement a classification algorithm, such as logistic regression or a decision tree with suitable data set from real world problem and classify the data set to produce new sample.
2. Build a linear regression model on any dataset with appropriate features and targets.
3. Build an SVM model to classify a dataset with multiple classes.
4. Implement character recognition using Multilayer Perceptron.
5. Implement backpropagation Algorithm for X-OR function.
6. Use convolutional neural networks (CNNs) to classify images from suitable dataset.
7. Apply clustering algorithms like k-means or hierarchical clustering on appropriate dataset.
8. Build an anomaly detection model to identify unusual patterns.

Mini-project: students work in team on any socially relevant problem that needs a machine learning based solution, and evaluate the model performance.

Textbooks

1	"Hands-On Machine Learning with Scikit-Learn, Keras, and TensorFlow" by Aurélien Géron
2	"Python Machine Learning" by Sebastian Raschka and Vahid Mirjalili
3	"Machine Learning: A Hands-On Approach" by Thomas Dehaene
4	"Machine Learning for Dummies" by John Paul Mueller and Luca Massaron:

References	
1	Practical Machine Learning for Computer Vision" by Martin Görner, Ryan Gillard, and Valliappa Lakshmanan
	"Applied Machine Learning: Algorithms and Labs with Python" by Kelleher, Mac Namee, and D'Arcy

Useful Links	
1	https://www.kaggle.com/kernels
2	https://scikit-learn.org/stable/auto_examples/index.html
3	https://www.tensorflow.org/tutorials
4	https://www.coursera.org/

CO-PO Mapping

	Programme Outcomes (PO)												PSO	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	3													
CO2		2	2		2									

The strength of mapping is to be written as 1,2,3; where, 1: Low, 2: Medium, 3: High
Each CO of the course must map to at least one PO, and preferably to only one PO.

Assessment

There are three components of lab assessment, LA1, LA2 and Lab ESE.
IMP: Lab ESE is a separate head of passing.(min 40 %), LA1+LA2 should be min 40%

Assessment	Based on	Conducted by	Typical Schedule	Marks
LA1	Lab activities, attendance, journal	Lab Course Faculty	During Week 1 to Week 8 Marks Submission at the end of Week 8	30
LA2	Lab activities, attendance, journal	Lab Course Faculty	During Week 9 to Week 16 Marks Submission at the end of Week 16	30
Lab ESE	Lab activities, journal/ performance	Lab Course Faculty and External Examiner as applicable	During Week 18 to Week 19 Marks Submission at the end of Week 19	40

Week 1 indicates starting week of a semester. Lab activities/Lab performance shall include performing experiments, mini-project, presentations, drawings, programming, and other suitable activities, as per the nature and requirement of the lab course. The experimental lab shall have typically 8-10 experiments and related activities if any.

Walchand College of Engineering, Sangli

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AY 2024-25

Course Information

Programme	B. Tech. (Electronics Engineering)
Class, Semester	Final Year B. Tech., Sem. VII
Course Code	6EN455
Course Name	Professional Elective VI - Analog CMOS IC Design Lab
Desired Requisites:	Digital Electronics, Digital CMOS IC Design

Teaching Scheme		**Examination Scheme (Marks)**			
Practical	2 Hrs/Week	**LA1**	**LA2**	**Lab ESE**	**Total**
Interaction	-	30	30	40	100
		Credits: 1			

Course Objectives

1	**Demonstrate** the flow of Cadence EDA tools for designing and simulating analog CMOS circuits.
2	**Develop** an insight into CMOS analog circuits and design single stage CS, CG, CD, differential amplifiers and 2-stsge Operational amplifier for given specifications.
3	**Explain** how to characterize the transistors for the voltage conditions seen by the circuit with goal of optimizing dimensions for given ID or trans-conductance.
4	**Prepare** the students for good documentation discipline.

Course Outcomes (CO) with Bloom's Taxonomy Level

At the end of the course, the students will be able to,

CO1	**Analyze** MOS transistors for targeted value of g_m or drain current for designing the physical dimensions and the required gate bias using Cadence EDA tools.	Analyze
CO2	**Demonstrate** the complete flow of Cadence tools from schematic to symbol generation to simulation for CS, CG, CD and differential amplifiers	Understand
CO3	**Build** and **simulate** the single stage amplifier circuits (CS, Source Follower, Cascode stage, differential pair etc.) using MOSFETs schematic design entry for various loads and relate the gain values with theoretical expressions.	Apply
CO4	**Design** differential pair circuits with active current mirror load for given gain and UGB.	Create
CO5	**Design**, **build** and **simulate** 2-stage operational amplifier for given pole frequencies and UGB with and without pole splitting and pole-zero compensation.	Create

List of Experiments / Lab Activities/ Topics

List of Experiments:

1. Characterize nMOS transistors from schematic using Cadence tools.
2. Design, build and simulate single stage Common Source amplifier using resistive load and nMOS diode connected load (Gain and Frequency response). Compare the performance with pMOS diode connected load.
3. Design, build and simulate Common Source amplifiers with current source load. Compare the performance with already studied loads.
4. Design, build and simulate Common Source stage with source degeneration. (gain and frequency response) Compare the performance with and without source degeneration.
5. Design, build and simulate Source follower /Common Gate stage. Crosscheck the results of output impedance, gain, power dissipation against theoretical expectations.
6. Design, build and simulate cascode stage with different loads for the specified voltage gain and maximum power dissipation.
7. Design, build and simulate differential pair with specified tail current source and maximum full swing differential gain using, a)resistive load and b) pMOS current source load and compare the gain values. Cross-confirm the results against theoretical expectations.

8. Demonstrate the design of differential pair with active tail current source (replace the tail current source in Expt. 8 by a nMOS current source biased in saturation). Simulate for evaluating differential gain, common mode gain and CMRR.
9. Design, build and simulate differential amplifier (single ended output) with active current mirror load for the given specifications. Evaluate for CMRR, DC gain etc.
10. Demonstrate design of 2-stage operational amplifier for given UGB.

Text Books	
1	Behzad Razavi, "*Design of Analog CMOS Integrated Circuits"*, Second Edition, Tata McGraw-Hill Publishing Company Limited, New Delhi, 2017.
References	
1	R. Jacob Baker, "*CMOS: Circuit Design, Layout and Simulation*", Wiley-Inter- science, 2008.
2	Allen, P.E. and Holberg, D.R., "*CMOS Analog Circuit Design*", Second Edition, Oxford University Press, 2002.
Useful Links	
1	www.vlsi-expert.com
2	www.testbench.in
3	www.asic-world.com
4	https://nptel.ac.in/courses/117/101/117101105/

CO-PO Mapping

	Programme Outcomes (PO)												PSO	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	1			2	3									3
CO2				2	3									3
CO3			2	2	3									3
CO4				3	3									3
CO5				3	3									3

The strength of mapping is to be written as 1,2,3; where, 1: Low, 2: Medium, 3: High
Each CO of the course must map to at least one PO, and preferably to only one PO.

Assessment

There are three components of lab assessment, LA1, LA2 and Lab ESE.
IMP: Lab ESE is a separate head of passing (min 40 %). LA1, LA2 together is treated as In-Semester Evaluation, LA1+LA2 should be min 40%.

Assessment	Based on	Conducted by	Typical Schedule	Marks
LA1	Lab activities, attendance, journal	Lab Course Faculty	During Week 1 to Week 8 Marks Submission at the end of Week 8	30
LA2	Lab activities, attendance, journal	Lab Course Faculty	During Week 9 to Week 16 Marks Submission at the end of Week 16	30
Lab ESE	Lab activities, journal/ performance	Lab Course Faculty and External Examiner as applicable	During Week 18 to Week 19 Marks Submission at the end of Week 19	40

Week 1 indicates starting week of a semester. Lab activities/Lab performance shall include performing experiments, mini-project, presentations, drawings, programming, and other suitable activities, as per the nature and requirement of the lab course. The experimental lab shall have typically 8-10 experiments and related activities if any.

Walchand College of Engineering, Sangli

(Government Aided Autonomous Institute)

AY 2024-25

Course Information	
Programme	B.Tech. (Electronics Engineering)
Class, Semester	Final Year B. Tech., Sem. VII
Course Code	6OE457
Course Name	Open Elective III-Medical Image Processing
Desired Requisites:	Signal Processing

Teaching Scheme		**Examination Scheme (Marks)**			
Lecture	3 Hrs/week	**MSE**	**ISE**	**ESE**	**Total**
Tutorial	0 Hrs/week	30	20	50	100
		Credits: 3			

Course Objectives	
1	To learn facts about medical imaging sources and study various formats.
2	To study various segmentation and filtering technique of medical image.
3	To learn spatial transformation of medical image

Course Outcomes (CO) with Bloom's Taxonomy Level		
At the end of the course, the students will be able to,		
CO1	Demonstrate various image sources, there representation and various formats of image.	II
CO2	Apply segmentation, filtering and transformation on medical image.	IV
CO3	Analyze various facts of image registration and CT reconstructed image.	IV

Module	**Module Contents**	**Hours**
I	**Basics of Medical Image Sources:** Radiology, the electromagnetic spectrum, basic x-ray physics, attenuation and imaging, computed tomography, magnetic resonance tomography, ultrasound, nuclear medicine and molecular imaging, other imaging techniques, radiation protection and dosimetry	7
II	**Image Representation:** Pixels and voxels, gray scale and color representation, image file formats, DICOM, other formats, image quality, and the signal-to-noise ratio, the intensity transform function and the, dynamic range, windowing, histograms and histogram operations, dithering and depth	7
III	**Image segmentation:** Region growing, k-means clustering, snakes, introduction to level sets,speed functions, multi-atlas fusion-based segmentation	7
IV	**Image enhancement:** contrast enhancement, denoising, deblurring, edge detection, derivativesand Fourier theory, anisotropic diffusion;	6

V	**Image registration:** correlation, least squares, transform based registration, joint entropy, mutual information, binning discontinuities, registration optimization, registration by clustering, ensemble registration, gaussian mixture models.	6
VI	**Medical image reconstruction:** Theory of MRI reconstruction, MRI motion, compensation, algebraic CT reconstruction, CT filtered back-projection.	6

Textbooks	
1	Prince J L and Links J M, *Medical Imaging Signals and Systems*, Pearson (2015).
2	Suetens P, *Fundamentals of Medical Imaging*, Cambridge University Press (2009).

References	
1	Birkfellner W, *Applied Medical Image Processing: A Basic Course*, CRC Press (2014).
2	Nishimura D, *Principles of Magnetic Resonance Imaging*, Stanford University Press (2010).

Useful Links	
1	https://onlinecourses.nptel.ac.in/noc22_ee64/preview

CO-PO Mapping

	Programme Outcomes (PO)												PSO	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	3													
CO2	3													
CO3				3										
CO4				3										

The strength of mapping is to be written as 1: Low, 2: Medium, 3: High
Each CO of the course must map to at least one PO.

Assessment

The assessment is based on MSE, ISE and ESE.
MSE shall be typically on modules 1 to 3.
ISE shall be taken throughout the semester in the form of teacher's assessment. Mode of assessment canbe field visit, assignments etc. and is expected to map at least one higher order PO.
ESE shall be on all modules with around 40% weightage on modules 1 to 3 and 60% weightage on modules 4 to 6.
For passing a theory course, Min. 40% marks in (MSE+ISE+ESE) are needed and Min. 40% marks in ESE are needed. (ESE shall be a separate head of passing)