Walchand College of Engineering, Sangli

(Government Aided Autonomous Institute)

AY 2023-24

Course Information

Programme	B.Tech. (Electronics Engineering)
Class, Semester	Third Year B. Tech., Sem V
Course Code	6EN301
Course Name	Digital Signal Processing
Desired Requisites:	Signals and Systems

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

Course Objectives

1	To illustrate the fundamental concepts of Signal Processing.
2	To explain the different techniques for design of filters and multirate systems.
3	To enable the students for the design and development of DSP systems.

Course Outcomes (CO) with Bloom's Taxonomy Level

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

CO1	Solve Discrete Fourier Transform in efficient manner	Apply
CO2	Analyze the structures for Discrete Time systems	Analyze
CO3	Design the FIR, IIR Digital Filters for given specifications	Create
CO4	Describe the fundamentals of Multirate DSP and Wavelet Transform	Evaluate

Module	**Module Contents**	**Hours**
I	**Discrete Fourier Transform and its Computation** Introduction, The Discrete Fourier Series and its Properties, The Fourier Transformof Periodic signals, Sampling of the Fourier Transform, The Discrete Fourier Transform and its Properties, Efficient Computation of the Discrete Fourier Transform, Decimation-in-Time FFT Algorithms, Decimation-in-Frequency FFT Algorithms, Implementation of FFT Algorithms for IIR Systems.	8
II	**Structures for Discrete-Time Systems** Introduction, Block Diagram Representation of Difference Equations, Signal Flow Graph Representation of Difference Equations, Basic Structures of FIR Systems,Basic Network structures	4
III	**Filter Design Techniques-FIR Filters** Introduction, Design of FIR Filter by Windowing, Properties of commonly used windows, Linear Phase property of FIR Filter, Kaiser Window Filter design, Discrete Time Differentiator	8
IV	**Filter Design Techniques-IIR Filters** Introduction, Design of Discrete-time IIR Filters from Continuous-time Filters, Filter Design by Impulse Invariance, Filter Design by Bilinear Transformation, Frequency Transformations of Low pass IIR Filters	8
V	**Multirate Digital Signal Processing** Introduction, Decimation and interpolation, Sampling rate conversion, Multistage Implementation of Sampling rate conversion, Sampling rate conversion for Bandpass signals, Sampling rate conversion by arbitrary factor, Applications of Multirate DSP	8
VI	**Introduction to Wavelet Transform** STFT, Wavelets representation, Haar Wavelet, Daubachis Wavelet, Filter BankRepresentation	4

SKP, 25/08/2023

25/8/23

Textbooks	
1	Sanjit K. Mitra, "Digital Signal Processing: A Computer Based Approach",4th Edition, Tata McGraw-Hill Publication.
2	Oppenheim & Schafer, "Discrete Time Signal Processing", ,2nd Edition, Pearson education.
3	
4	
References	
1	J. G. Proakis, "Digital Signal Processing", Prentice Hall India
2	
3	
4	
Useful Links	
1	www.nptel.ac.in
2	
3	
4	

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												2
CO3				2										2
CO4	2													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)

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AY 2023-24

Course Information	
Programme	B. Tech. (Electronics Engineering)
Class, Semester	Third Year B. Tech., Sem. V
Course Code	6EN302
Course Name	Embedded System Design
Desired Requisites:	Microcontroller Peripherals and Interfacing theory and lab

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

Course Objectives	
1	To illustrate the features of ARM architecture.
2	To provide the knowledge of different hardware peripherals and programming of different peripherals of ARM7 based controller. Ex. LPC2148 / LPC1768
3	To empower the students for the design and development of embedded system.
4	To encourage students to provide solution for real world problems using embedded systems .

Course Outcomes (CO) with Bloom's Taxonomy Level		
At the end of the course, the students will be able to,		
CO1	**illustrate** architecture and operation of internal peripherals of ARM microcontroller	Apply
CO2	**write** assembly and C program to configure and use internal peripherals ARM microcontroller	Apply
CO3	**analyse** program and find operating parameters of peripheral in ARM microcontroller	Analyze
CO4	**design** and **develop** small embedded system using embedded C programming and ARM microcontroller.	Create

Module	**Module Contents**	**Hours**
I	**Architecture** ARM7 / ARM Cortex M3 Architecture, Memory organization, Programmers model, Pipelining, Memory, Register Structure, Current Program Status Register, Exception Modes, System buses and peripherals, Memory Accelerator module, Compare features / architecture of ARM with 8051	6
II	**Embedded C Programming** Introduction to ARM7 / ARM Cortex M3 programming example, Software documentation method, Development Tools, ARM C Programming, Startup code, microcontroller pin layout, PLL configuration, Pin Connect block, I/O programming, boot-loader, In Application Programming. External Peripheral Interfaces like led, switch, LCD, Motor, Seven Segment Display etc.	8
III	**Interrupt Structure of ARM Microcontroller** Interrupt system in ARM7 / ARM Cortex M3, Interrupt Controller, FIQ, IRQ, Non-vectored interrupt, Software interrupt, Interrupt latency, Nested interrupts, External interrupts, Interrupt configuration and Programming examples.	6
IV	**Peripherals of ARM Microcontroller** Block diagram of Timers, role of prescaler, Capture and Match facility of timer and configuration of it using registers, Pulse Width Modulator, RTC operation and Programming, Watch dog timer, Analog to digital converter, Digital to analog converter and their programming.	8

V	**Communication Protocols** On chip serial ports, Serial port programming, setting baud rate, Using UART buffer, printf for serial data transfer, interrupt based serial port handling, I2C protocol, Using I2C for interfacing external EEPROM, SPI protocol and programming.	7
VI	**Application Development** Finite state machine in designing Embedded Systems, Design considerations for embedded system design, Design of a simple general purpose ARM kit, Case studies of ARM based applications.	4

Textbooks	
1	Andrew Sloss, ARM System Developer's Guide, Elsevier India, 2005
2	Joseph Yiu, "The Definitive Guide to ARM® Cortex®-M3 and Cortex®-M4 Processors", Newnes; 3rd edition
3	"Textbook of EMBEDDED SYSTEM", NA. VIKRAMAN
4	"Introduction to Microprocessor Based Systems Using the ARM Processor" by Kris Schindler

References	
1	ARM inc, ARM Reference Manual, ARM, inc., NA, 2011
2	Technical references, data sheets and user manuals of respective controller
3	Yifeng Zhu, "Embedded Systems with Arm Cortex-M Microcontrollers in Assembly Language and C", E-Man Press LLC
4	Frank Vahid and Tony Givargis, "Embedded System Design", Wiley

Useful Links	
1	https://nptel.ac.in/
2	https://in.coursera.org/
3	https://www.nxp.com/
4	https://www.arm.com/

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			3									
CO4			3											2

1: Low, 2: Medium, 3: High

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 quiz, seminar, assignments or any interactive activity 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 2023-24

Course Information

Programme	B.Tech. (Electronics Engineering)
Class, Semester	Third Year B. Tech., Sem V
Course Code	6EN303
Course Name	Digital Communication Engineering
Desired Requisites:	Analog 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 equip the students with the advanced knowledge of digital communication.
2	To estimate the performance of modern digital communication in presence of noise

Course Outcomes (CO) with Bloom's Taxonomy Level

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

CO1	Understand relevance of probability theory in digital communication	Understand
CO2	Apply channel, source and error control coding techniques effectively	Apply
CO3	Analyze the performance of digital communication system with different environment	Apply

Module	Module Contents	Hours
I	**Random variable and random Processes** Review of Probability concept, Types of Random variable, Uniform, exponential, Poisson, Gaussian Random variable, Expectation, variance, movement generation function, Central limit theorem , Classification of Random Processes, Stationary; Time average; Ergodic Process; Wide sense stationary Process	7
II	**Spread Spectrum Signals for Digital Communication:** Model of spread spectrum digital communication system, Direct sequence spread spectrum signals, Frequency hopped spread spectrum signals, CDMA, Time hopping SS, Synchronization of SS systems.	4
III	**Digital Communication through Fading Multipath Channels:** Characterization of fading multipath channels, The effect of signal characteristics on the choice of a channel model, Frequency nonselective, Slowly fading channel, Diversity techniques for fading multipath channels, Digital signals over a frequency selective, Slowly fading channel.	5
IV	**Communication Link Analysis** What the System Link Budget, the Channel, Received Signal Power and Noise Power, Link Budget Analysis, Noise Figure, Noise Temperature, and System Temperature, Sample Link Analysis	8
V	**Information Theory** Measure of Information, Classification of Source Codes, Source Coding Theorem, Lossless Data Compression, Discrete Memoryless Channels, Channel Coding Theorem, Gaussian Channel Capacity Theorem	8

VI	**Error-Control Coding** Errors, Error-Detection Methods, Automatic Repeat Request (ARQ), Block Codes, Convolutional Codes, Compound Codes	7

Textbooks	
1	T.L. Singal, "Analog and Digital Communication",6th Edition, Mc Graw Hill, 2012
2	Roy Blake , "Electronic Communication System", Thomson Publications, 2nd Edition,2002

References	
1	Simon Hykin, "Communication System", 4th Edition, John Wiley & Sons, 2000
2	B P Lathi, "Modern Digital and Analog Communication System", 4th Edition, Oxford University Press, 2017

Useful Links	
1	www.nptel.ac.in
2	
3	
4	

CO-PO Mapping

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

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AY 2022-23

Course Information

Programme	B.Tech. (Electronics Engineering)
Class, Semester	Third Year B. Tech., Sem I
Course Code	6EN351
Course Name	Digital Signal Processing Lab
Desired Requisites:	Signals and Systems

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

Course Objectives

1	The objective of the course is to work out for the convolution.
2	Correlation, DFT, IDFT, Block convolution.
3	Signal smoothing, filtering of long duration signals.
4	Spectral analysis of signals using MATLAB simulation.

Course Outcomes (CO) with Bloom's Taxonomy Level

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

CO1	Illustrate the basic operations of Signal processing	Apply
CO2	Analyze the spectral parameter of window functions	Understand
CO3	Create IIR, and FIR filters for band pass, band stop, low pass and high pass filters	Create
CO4	Demonstrate multirate DSP and wavelet transform	Evaluate

List of Experiments / Lab Activities/Topics

List of Lab Activities:

1. Generation of different signals using MATLAB.
2. Calculation of DFT and plot Magnitude,Phase response for the same.
3. Calculation of IDFT and plot Magnitude response for the same.
4. Implementation of Median Filter.
5. Implementation of Moving Average Filter.
6. Find Circular Convolution of given sequences.
7. Illustration of Overlap-Add Method.
8. Design of simple filter.
9. Design of FIR filter using different window functions.
10. Design of FIR filter using Kaiser window.
11. To plot frequency response of low pass filter using Kaiser window for differenttuning parameters.
12. Illustration of Up sampling of signal.
13. Illustration of Down sampling of signal.
14. Illustration of Effect of window length.
15. Illustration of Effect of Up sampling in Frequency Domain.

Textbooks

1	Sanjit K. Mitra, "Digital Signal Processing: A Computer Based Approach",4th Edition, Tata McGraw-Hill Publication.
2	Oppenheim & Schafer, "Discrete Time Signal Processing", ,2nd Edition, Pearson education.
3	
4	

References

1	J. G. Proakis, "Digital Signal Processing", Prentice Hall India
2	

3	
4	

Useful Links	
1	www.nptel.ac.in
2	
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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												2
CO3				2										2
CO4	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 2023-24

Course Information	
Programme	B. Tech. (Electronics Engineering)
Class, Semester	Third Year B. Tech., Sem. V
Course Code	6EN352
Course Name	Embedded System Design LAB
Desired Requisites:	Microcontroller Peripherals and Interfacing theory and lab

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

Course Objectives	
1	Write, simulate and debug assembly and C programs for LPC2148 / LPC1768 microcontroller
2	Write, simulate, download and test C programs for microcontroller using development board
3	Develop C program for implementing given or required system operation.

Course Outcomes (CO) with Bloom's Taxonomy Level		
At the end of the course, the students will be able to,		
CO1	**Apply** programming skills to integrate hardware peripherals of ARM microcontroller.	Apply
CO2	**Test** and **debug** programs for ARM microcontroller.	Analyze
CO3	**Develop** and **demonstrate** small embedded systems using ARM C programming and hardware peripherals for ARM microcontroller.	Create

List of Experiments / Lab Activities/Topics

List of Lab Activities:

List of Experiments:
1. Experiment 1: Introduction of the development tools and kit
2. Experiment 2: Simple assembly language, embedded C program and study of startup.s file
3. Experiment 3: GPIO Programming
4. Experiment 4: PLL Programming
5. Experiment 5: Interrupt programming (IRQ and NV-IRQ)
6. Experiment 6: FIQ programming and comparison of FIQ with VIRQ and NVIRQ
7. Experiment 7: Programming Timer as Timer and Timer as Counter
8. Experiment 8: Programming Timer to perform capture operation and match facility of timer
9. Experiment 9: Programming PWM and application of it
10. Experiment 10: Programming ADC and DAC
11. Experiment 11: Programming UART
12. Experiment 12: Programming RTC and WDT
13. Experiment 13: Study of complex algorithm implementation for application development
14. Mini-Project

Textbooks	
1	NXP, LPC 2148 / 1768 data sheet, NXP inc.,
2	NXP, LPC 2148 / 1768 user manual, NXP inc.,
3	Development board / Kit reference manual

References	
1	Sloss Andrew N, Symes Dominic, Wright Chris, "ARM System Developer's Guide: Designing and Optimizing", Morgan Kaufman Publication
2	Joseph Yiu, "The Definitive Guide to ARM® Cortex®-M3 and Cortex®-M4 Processors", Newnes; 3rd edition
3	Technical references and user manuals of respective controller

Useful Links	
1	https://nptel.ac.in/
2	https://in.coursera.org/
3	https://www.nxp.com/
4	https://www.arm.com/

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

Assessment

There are three components of lab assessment, LA1, LA2 and Lab ESE. LA1 and LA2 shall be taken throughout the semester in the form of teacher's assessment. Mode of assessment can be through quizzes, assignments, mini project, lab based activity and submission. Also small weightage is also given to attendance.
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 2022-23

Course Information	
Programme	B.Tech. (Electronics Engineering)
Class, Semester	Third Year B. Tech., Sem V
Course Code	6EN353
Course Name	Digital Communication Engineering Lab
Desired Requisites:	Analog Comunication Engineering

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

Course Objectives	
1	To analyse the significance and different applications of digital communications.
2	
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Course Outcomes (CO) with Bloom's Taxonomy Level		
At the end of the course, the students will be able to,		
CO1	Analyze different Digital Modulation & Demodulation schemes	Analyze
CO2	Evaluate various Source & Channel Coding Techniques	Evaluate
CO3		
CO4		

List of Experiments / Lab Activities/Topics

List of Lab Activities:

1. Introduction to MATLAB
2. To generate uniform and normal random variables, also find the mean and variance of the distribution using MATLAB
3. To generate continuous sine waveform, square waveform, and saw-tooth waveform using MATLAB
4. Generation of Pseudo Noise (PN) random sequence using MATLAB
5. To study Pulse Code Modulation and Demodulation using MATLAB.
6. To study BPSK Modulation and plot BER using MATLAB.
7. To study QPSK/4-QAM Modulation and plot BER using MATLAB.
8. To study the Digital Signal transmission using Quadrature Amplitude Modulation (QAM) using MATLAB.
9. Write a MATLAB based program for encoding and decoding of Huffman code.
10. To generate the line codes for a 10-bit dataset in a MATLAB

Textbooks	
1	T.L. Singal, "Analog and Digital Communication",6th Edition, Mc Graw Hill, 2012
2	Roy Blake , "Electronic Communication System", Thomson Publications, 2nd Edition,2002
3	
4	

References	
1	Simon Hykin, "Communication System", 4th Edition, John Wiley & Sons, 2000
2	Bernard Sklar, "Digital Communications - Fundamentals and Applications", Pearson Publications
3	
4	

Useful Links	
1	www.nptel.ac.in
2	
3	
4	

CO-PO Mapping														
	Programme Outcomes (PO)												PSO	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	3													3
CO2		3												
CO3			3										3	
CO4			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 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 2023-24

Course Information	
Programme	B. Tech. (Electronics Engineering)
Class, Semester	Third Year B. Tech., Sem-V
Course Code	6EN341
Course Name	Mini Project-1
Desired Requisites:	ECAD-I, ECAD-II, Microcontroller Interfacing and Peripherals

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 provide students hands on experience on, troubleshooting, maintenance, fabrication, innovation, record keeping, documentation etc. thereby enhancing the skill and competency part of technical education.
2	To create an Industrial environment and culture within the institution.
3	To inculcate innovative thinking and practice based learning and thereby preparing students for their final year project.
4	To set up self-maintenance cell within departments to ensure optimal usage of infrastructure Facilities.

Course Outcomes (CO) with Bloom's Taxonomy Level

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

CO1	Choose, Initiate and manage a minor project.	Understand
CO2	Propose research problem and present it in a clear and distinct manner through different oral, written and design techniques.	Apply
CO3	Construct the circuit using hardware and/or software.	Create
CO4	Execute the project and comment upon the results of it.	Analyze

List of Experiments / Lab Activities/ Topics

Mini Project Description:

A project group shall consist of normally 3 students per group. The mini project will involve the design, construction, and debugging of an electronic system approved by the department. Each student should conceive, design and develop the idea leading to a project/product. **The theme of the project should be based on courses studied in SY using discrete components/ operational amplifier/ microcontroller/ Arduino/ Raspberry Pi etc.**

Each student must keep a project notebook/logbook. The project notebooks will be checked periodically throughout the semester, as part of in-semester-evaluation. The student should submit a soft bound report at the end of the semester. The final product as a result of mini project should be demonstrated at the time of examination.

Textbooks

1	Electronics Projects For Dummies, by by Earl Boysen and Nancy Muir, Published by Wiley Publishing, Inc., 2006
2	Make: Electronics, by Charles Platt, Published by Maker Media, 2015
3	
4	

References

1	A. E. Ward, J.A.S. Angus, "Electronic Product Design", Stanley Thrones (Publishers) Limited, 1996.
2	Paul Horowitz, Winfield Hill, "The Art of Electronics", Cambridge University Press, 1989
3	

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Useful Links	
1	
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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
CO2			3		2									
CO3			3		2						1		1	1
CO4		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, 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 2023-24

Course Information	
Programme	B.Tech. (Electronics Engineering)
Class, Semester	Third Year B. Tech., Sem V
Course Code	6EN311
Course Name	Professional Elective I -Biomedical Instrumentation
Desired Requisites:	Electronics Measurement and Instrumentation

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

Course Objectives	
1	To explain the basics body cell structure and different types of transducers
2	To explain the different types of patient monitoring system
3	Understand the design concept of different Medical instruments
4	To demonstrate different medical instruments

Course Outcomes (CO) with Bloom's Taxonomy Level		
At the end of the course, the students will be able to,		
CO1	Understand CNS-PNS and Cardio pulmonary system	Understand
CO2	Apply proper sensors for sensing biomedical signals to biomedical instrumentation setup	Apply
CO3	Design ECG,EEG and EMG amplifier	Create
CO4	Explain block diagram of patient monitoring systems, X-ray machine, CT scan and Ultrasonography machine.	Understand

Module	**Module Contents**	**Hours**
I	**Fundamentals of Medical Instrumentation** Physiological Systems of the body, Sources of Biomedical signals, Basic Medical Instrumentation system, Micro-Electro-Mechanical System (Mems), Wireless Connectivity in Medical Instruments, General Constraints in design of Medical Instrumentation Systems	8
II	**The Origin of Bio potentials, Bio potential Electrodes & Biosensors** Electrical activity of Excitable Cells, Functional Organization of the Peripheral NervousSystem,Electrocardiogram(ECG),Electromogram(EMG), Electroencephalogram(EEG), Electroretinogram(ERG) and their recording system, Biomedical signal Analysis and Processing Techniques.	4
III	**Patient Monitoring Systems** System Concepts, Cardiac Monitor, Bedside patient Monitoring Systems, Central Monitors, Measurement of Heart rate, Measurement of Temperature, Measurement of respiration Rate, Biomedical Telemetry Systems	4
IV	**Modern Imaging Systems** X-ray machines And Digital Radiography, X-ray Computed Tomography, Nuclear Medical Imaging Systems, Magnetic Resonance Imaging Systems, Ultrasonic Imaging Systems and Thermal Imaging Systems.	8
V	**Assisting and Therapeutic Equipment's** Cardiac Pacemakers, Defibrillators, Diathermy, Hemodialysis Machines, Ventilators	8
VI	**Laser Application in Biomedical Field** The Laser, Types of Lasers, Laser Application, Laser Safety	7

Textbooks

1	John. G. Webster, “Medical Instrumentation”, John Wiley, 2009
2	Goddes& Baker, “Principles of Applied Biomedical Instrumentation”, John Wiley, 2008
3	Carr & Brown, “Biomedical Instrumentation & Measurement”, Pearson, 2004
4	

References	
1	R.S. Khandpur, “Hand book of Medical instruments”, TMH, New Delhi, 1987.
2	Sanjay Guha,”Medical Electronics and Instrumentation”, University Publication, 200.
3	Edwand J. Bukstein, “Introduction to Biomedical electronics” , Sane and Co. Inc, 1973
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Useful Links	
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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	2							2	
CO3			3										2	
CO4									3				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 2023-24

Course Information

Programme	B.Tech. (Electronics Engineering)
Class, Semester	Third Year B. Tech., Sem. V
Course Code	6EN312
Course Name	Professional Elective-I: Microelectronics
Desired Requisites:	-

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*** students with a sound understanding of existing semiconductor devices to give meaning to their studies of electronic circuits and systems.
2	To ***explain*** carrier transport phenomena in solids on the basis of energy band theory and Boltzmann transport equation which forms the basis of electrical characteristics of semiconductor devices.
3	To ***develop*** capability in students to learn on their own about the new researched devices as they keep emerging in the market in future and lay the foundation for of their a constant career updating and self education.
4	To ***prepare*** the students for GATE in order to motivate them for higher studies.

Course Outcomes (CO) with Bloom's Taxonomy Level

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

CO1	**Explain** the formation of bandgaps in solids, formation of depletion-diffusion layer capacitance in p-n junction diodes and characteristics of illuminated p-n junction, incoherent (LEDs) and coherent light sources (Lasers)	Understand
CO2	**Apply** continuity equation and Poisson's equation to derive time dependence of carrier concentration on electric fields and potentials by considering band diagram of p-n junction in equilibrium.	Apply
CO3	**Model** the operation of bipolar junction transistor in three regions (cut-off, linear and saturation) using Ebers Moll coupled diode model.	Apply
CO4	**Analyze** BJT band diagram and explain current gain, base transport factor, and emitter injection efficiency.	Analyze
CO5	**Interpret** C-V characteristics of MOS capacitor and I-V characteristics of JFET, MOSFET with relevance to their ethical parameters like pinch off voltage, threshold voltage etc.	Evaluate

Module	**Module Contents**	**Hours**
I	**Energy Bands and Charge Carriers in Semiconductors** Bonding forces and energy bands in solids, Charge carriers in semiconductors, Carrier concentration, drift of carriers in electric and magnetic fields, invariance of Fermi level at equilibrium.	6
II	**Excess Carriers in Semiconductors** Diffusion of carriers, Diffusion current, Drift current, Mobility of carriers, Recombination, Continuity equation, Quasi Fermi levels, Gradients in Quasi Fermi levels, resistivity of materials.	6
III	**Junctions** Formation of p-n junctions, Equilibrium conditions, Steady state conditions, Transient and AC conditions, deviations from simple theory, Metal-Semiconductor Junctions.	8
IV	**Field Effect Transistors** JFET (characteristics), MOS capacitor (threshold voltage, C-V characteristics), MOSFET: I-V characteristics, Equivalent circuits for the MOSFET.	7

V	**Bipolar Junction Transistors** Minority carrier distributions and terminal currents, Generalized Biasing: The Coupled-Diode Model, Charge control analysis; switching, drift in base region, base narrowing, avalanche breakdown, thermal effects, Kirk effect.	7
VI	**Optoelectronic Devices** Photodiodes: I-V characteristics in an illuminated junction, Solar Cells, Photodetectors; LEDs, Semiconductor Lasers.	6

Text Books	
1	B.G. Streetman, S. K. Banerjee, " Solid State Electronic Devices ", 7th edition, Pearson India Education Service Pvt. Ltd., 2017.
2	
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References	
1	S. M. Sze, "Physics of Semiconductor Devices", 2nd Edition, PHI, 2005.
2	Donald. A. Neamen, "Semiconductor Physics and Devices: Basic Principles", 3rd Edition, McGraw Hill Higher Education, 2003.

Useful Links	
1	https://nptel.ac.in/courses/108/107/108107142/
2	https://www.youtube.com/playlist?list=PLF178600D851B098F
3	https://www.youtube.com/playlist?list=PLgMDNELGJ1CaNcuuQv9xN07ZWkXE-wCGP
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CO- PO Mapping

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

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 2023-24

Course Information

Programme	B.Tech. (Electronics Engineering)
Class, Semester	Third Year B. Tech., Sem V
Course Code	6EN313
Course Name	Professional Elective 1 - Linear Algebra
Desired Requisites:	Applied Mathematics I & II

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

Course Objectives

1	To provide the students understanding of Linear transformations, Matrix algebra, Vector space, Inner product of vector space..
2	To prepare students to solve systems of linear equations and counting problems,
3	To illustrate applications of Linear Algebra in Electrical networks, Control systems and computer graphics.
4	

Course Outcomes (CO) with Bloom's Taxonomy Level

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

CO1	**Describe** vector and matrix algebra rules, vector space, inner product space, Eigen values and Eigen vectors.	Understand
CO2	**Solve** systems of linear equations, inner product space problems, problems of Eigen values and Eigen vectors.	Apply
CO3	**Examine** linear algebra techniques to electrical and electronics circuits and data smoothing, Linear Transformations to Computer Graphics.	Apply
CO4		

Module	**Module Contents**	**Hours**
I	**Systems of Linear Equations** Vectors and Linear combinations, Solving systems of linear equations, Echelon and reduced echelon form, Matrices, Elimination using matrices, rules for matrixoperations, the inverse of a matrix, characterization of invertible matrix, partitioned matrix, matrix factorization	4
II	**Vector Spaces** Vector spaces and subspaces, null space, Column and row spaces, Dual space, transformations, linearly independent sets, bases and dimension, coordinate systems, applications to Electrical circuits and data smoothing	8
III	**Inner product of Vector Spaces** Length and dot product in R^n, Inner product Spaces Orthonormal Bases: Gram-Schmidt Process, Mathematical models and Least squares analysis, Applications of Inner product spaces	8
IV	**Linear Transformations** The Idea of a Linear Transformation, The Matrix of a Linear Transformation, Diagonalization and the Pseudo-inverse	8
V	**Eigen values and Eigen vectors** Eigen values and eigen vectors, characteristic equations, linear transformations,digonilzations, Applications to differential equations, complex Eigen values, orthgonality	7

VI	**Applications** Matrices in engineering, ,single value decomposition, Computer Graphics, Leastsquares approximation.	4

Textbooks	
1	Gilbert Strang, Wellesley-Cambridge, "Introduction to Linear Algebra"5th edition, Press, 2016
2	Jim Defranza and Daniel Gagliardi,"Introduction to Linear Algebra with Applications" McGraw Hill Education (India) Edition 2012
3	Stephen Boyd and Lieven Vandenberghe, "Introduction to Applied Linear Algebra", CambridgeUniversity Press, 2018
4	
References	
1	Ward Cheney and David Kincaid, Jones, "Linear Algebra Theory and Applications and Bartlett", Publishers, Indian Edition 2010
2	David C. Lay, Steven R. Lay, and Judi J., "Linear Algebra and its Applications" McDonald, Pearson, 5 edition, 2015
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Useful Links	
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CO-PO Mapping

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

Walchand College of Engineering, Sangli

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AY 2023-24

Course Information	
Programme	B.Tech. (Electronics Engineering)
Class, Semester	Third Year B. Tech., Sem V
Course Code	6EN314
Course Name	Automotive Electronics
Desired Requisites:	

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 basic control system and sensor required Engine control
2	To learn basic of signal conversion circuit in Automotive system
3	To enhance skill of communication in automotive vehicle
4	

Course Outcomes (CO) with Bloom's Taxonomy Level		
At the end of the course, the students will be able to,		
CO1	Use various sensor system to control engine and its devices	Understand
CO2	Apply knowledge of communication to device for controlling devices	Apply
CO3	Analyse a problem and identify the computing requirements for engine control instrumentation	Analyze

Module	**Module Contents**	**Hours**
I	**The Basics of Electronic Engine Control:** Motivation for Electronic Engine Control. Exhaust Emissions, Fuel Economy, Federal Government Test Procedures, Concept of an Electronic Engine Control System, Definition of Engine Performance Terms, Exhaust Catalytic Converters, Electronic Fuel Control System, Analysis of Intake Manifold Pressure, Idle Speed Control, Electronic Ignition	8
II	**Sensors and Actuators** Automotive Control System Applications of Sensors and Actuators, Throttle Angle Sensor, Temperature Sensors, Typical Coolant Sensor, Sensors for Feedback Control, Knock Sensors, Angular Rate Sensor, LIDAR, Digital Video Camera, Flex-Fuel Sensor, Automotive Engine Control Actuators, Variable Valve Timing, Electric Motor Actuators, Stepper Motors, Ignition System	8
III	**Digital Powertrain Control Systems** Digital Engine Control, Control Modes for Fuel Control, Discrete Time Idle Speed Control, EGR Control, Variable Valve Timing Control, Turbocharging, Direct Fuel Injection, Flex Fuel, Electronic Ignition Control, Integrated Engine Control System, Summary of Control Modes	7

IV	**Vehicle Motion Controls** Representative Cruise Control System, Cruise Control Electronics, Antilock Braking System, Electronic Suspension System, Electronic Suspension Control System, Four-Wheel Steering CAR	4
V	**Automotive Instrumentation** Modern Automotive Instrumentation, Input and Output Signal Conversion, Display Devices, Fuel Quantity Measurement, Coolant Temperature Measurement, Oil Pressure Measurement, Vehicle Speed Measurement,	4
VI	**Vehicle Communications** IVN, CAN, Local Interconnect Network (LIN), FlexRay IVN, MOST IVN, Vehicle to Infrastructure Communication, Vehicle-to-Cellular Infrastructure, Short-Range Wireless Communications, Satellite Vehicle Communication, GPS Navigation, Safety Aspects of Vehicle-to-Infrastructure Communication	8

Textbooks	
1	William Ribbens, "Understanding Automotive Electronics An Engineering Perspective" Elsevier
2	Bosch Automotive, Robert Bosch GmbH "Electrics and Automotive Electronics: Systems and Components, Networking and Hybrid Drive", Springer Science & Business Media, 2013
3	
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References	
1	Najamuz Zaman, "Automotive Electronics Design Fundamentals", Springer Cham, October 2016
2	Ronald K. Jurgen ,"Automotive Electronics Handbook", McGraw Hill Professional, 1999
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Useful Links	
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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 2023-24

Course Information

Programme	B.Tech. (Electronics Engineering)
Class, Semester	Third Year B. Tech., Sem V
Course Code	6EN315
Course Name	Professional Elective II - Object Oriented Programming
Desired Requisites:	C Programming

Teaching Scheme		**Examination Scheme (Marks)**			
Lecture	2 Hrs/week	**MSE**	**ISE**	**ESE**	**Total**
Tutorial	1 Hr/week	30	20	50	100
		Credits: 3			

Course Objectives

1	To introduce the students the concepts of object oriented programming
2	To explain and illustrate the fundamental concepts of classes, objects, facilities in OOP etc.
3	To explain and illustrate the concepts of operator overloading, pointers etc.
4	To explain and illustrate the concepts of inheritance and polymorphism etc.

Course Outcomes (CO) with Bloom's Taxonomy Level

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

CO1	Apply the understanding (of OOP) to identify how the problem can be solved using OOP approach (for a given situation).	Apply
CO2	Apply the knowledge of OOP to illustrate the functioning of OOP facilities through related programs.	Apply
CO3	Analyze the given OOP program and identify the functionality.	Analyze
CO4	Evaluate a OOP based library for electronic peripherals	Evaluate

Module	**Module Contents**	**Hours**
I	**OOP Programming Fundamentals** Need of Object oriented programming, Differences between procedural and OOP approach, input output, directives, data types, type conversion, library and headerfiles, Revision of C type constructs in CPP	5
II	**Objects and Classes** Need of class, real life examples of class, class and objects, class and data types, access specifiers, objects as function arguments, constructor, destructor, defaultconstructor, copy constructor, scope resolution, UML diagram of class	4
III	**Operator Overloading** Need of Operator overloading, Overloading unary operators, Overloading binary operators, data conversion between objects and basic types, Pitfalls of operator overloading and conversion	4
IV	**Inheritance and Polymorphism** Base class and derived class, derived class constructor, overriding member functions, abstract base class, class hierarchy, public and private inheritance, avoiding ambiguity of multiple inheritance, polymorphism	5
V	**Pointers and Virtual Functions** Address and pointers, Pointers and arrays, pointers and functions, strings, memory management using new and delete, applications of pointers, Virtual functions,friend functions, static functions, this pointer,	4
VI	**Using OOP for embedded electronic systems** Using OOP for Arduino library. Need of OOP for electronic systems, Developing a library for electronic peripherals.	4

Textbooks

1	Robert Lafore, " Object Oriented Programming in C++", SAMS publishing, Fourth Edition, ISBN: 0-672-32308-7. (If needed the relevant language book will be referred)
2	Arduino Library related Internet resources
3	
4	
References	
1	Bjorne Stroustrup, "The C++ programming language", 4th Edition, Addison-Wesley Professional, ISBN: 978-0321563842
2	Web tutorials C++ and Object Oriented Programming
3	NPTEL lectures, Object-Oriented Programming by IITBx (free audit course)
4	Arduino Library related Internet resources
Useful Links	
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CO-PO Mapping

	Programme Outcomes (PO)												PSO	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	3												3	
CO2			2											2
CO3		3											3	
CO4			3											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 can be field visit, assignments etc. and is expected to map at least one higher order PO.
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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 2023-24

Course Information	
Programme	B.Tech. (Electronics Engineering)
Class, Semester	Final Year B. Tech., Sem-V
Course Code	6EN316
Course Name	Data Analytics
Desired Requisites:	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	Develop in depth understanding of the key technologies in data science and business analytics:
2	Use quantitative modeling and data analysis techniques to the solution of real world business problems, communicate findings, and effectively present results using data visualization techniques
3	
4	

Course Outcomes (CO) with Bloom's Taxonomy Level		
At the end of the course, the students will be able to,		
CO1	Describe various concepts of data analytics pipeline	
CO2	Apply classification, regression, mining techniques on streaming data	
CO3	Compare different clustering and frequent pattern mining algorithms	
CO4	Describe the concept of R programming and implement analytics on Big data using R	

Module	**Module Contents**	**Hours**
I	**Introduction to Data Analytics**: Sources and nature of data, classification of data (structured, semi-structured, unstructured), characteristics of data, introduction to Big Data platform, need of data analytics, evolution of analytic scalability, analytic process and tools, analysis vs reporting, modern data analytic tools, applications of data analytics. **Data Analytics Lifecycle**: Need, key roles for successful analytic projects, various phases of data analytics lifecycle – discovery, data preparation, model planning, model building, communicating results, operationalization.	5
II	**Data Analysis** Regression modeling, multivariate analysis, Bayesian modeling, inference and Bayesian networks, support vector and kernel methods, analysis of time series: linear systems analysis & nonlinear dynamics, rule induction, neural networks: learning and generalisation, competitive learning, principal component analysis and neural networks, fuzzy logic: extracting fuzzy models from data, fuzzy decision trees, stochastic search methods.	8
III	**Mining Data Streams** Introduction to streams concepts, stream data model and architecture, stream computing, sampling data in a stream, filtering streams, counting distinct elements in a stream, estimating moments, counting oneness in a window, decaying window, Real-time Analytics Platform (RTAP) applications, Case studies – real time sentiment analysis, stock market predictions	8

IV	**Frequent Itemsets and Clustering** Mining frequent itemsets, market based modelling, Apriori algorithm, handling large data sets in main memory, limited pass algorithm, counting frequent itemsets in a stream, clustering techniques: hierarchical, K-means, clustering high dimensional data, CLIQUE and ProCLUS, frequent pattern based clustering methods, clustering in non-euclidean space, clustering for streams and parallelism.	7
V	**Frame Works and Visualization** MapReduce, Hadoop, Pig, Hive, HBase, MapR, Sharding, NoSQL Databases, S3, Hadoop Distributed File Systems, Visualization: visual data analysis techniques, interaction techniques, systems and applications	7
VI	**Introduction to R** R graphical user interfaces, data import and export, attribute and data types, descriptive statistics, exploratory data analysis, visualization before analysis, analytics for unstructured data	5

Textbooks	
1	Rechard Dosey, "Data Analytics: Become A Master In Data Analytics Paperback"
2	Mark Gardner, "Beginning R: The Statistical Programming Language", Wrox Publication
3	
4	

References	
1	David Dietrich, Barry Heller, Beibei Yang, "Data Science and Big Data Analytics", EMC Education Series, John Wiley
2	Michael Berthold, David J. Hand, Intelligent Data Analysis, Springer
3	Anand Rajaraman and Jeffrey David Ullman, Mining of Massive Datasets, Cambridge University Press
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Useful Links	
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CO-PO Mapping

	Programme Outcomes (PO)												**PSO**	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	3		3											
CO2														
CO3				3										3
CO4	3				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 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 2023-24

Course Information	
Programme	B.Tech. (Electronics Engineering)
Class, Semester	Third Year B. Tech., Sem V
Course Code	6EN317
Course Name	Optical Communication
Desired Requisites:	Communication Engg

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

Course Objectives	
1	Understand the basics of signal propagation through optical fibers, fiber impairments, components and devices.
2	Classify the various sources and detector for Optical link budget
3	Interpret various types of amplifier used in the optical link.
4	Understand the system performance for long link communication.

Course Outcomes (CO) with Bloom's Taxonomy Level		
At the end of the course, the students will be able to,		
CO1	Demonstrate the basic elements of optical fiber transmission link, fiber modes configurations and structures.	II
CO2	Identify the different kind of losses, signal distortion in optical wave guides and other signal Degradation factors. Design optimization of SM fibers, RI profile and cut-off wave length	III
CO3	Classify fiber slicing and connectors, noise effects on system performance, operational principles WDM and solutions	IV
CO4	Choose the various optical source materials, LED structures, quantum efficiency, Laser diodes and different fiber amplifiers, optical receivers such as PIN APD diodes, noise performance in photo detector, receiver operation and configuration	V

Module	**Module Contents**	**Hours**
I	**Introduction** Introduction**,** Ray theory transmission, Total internal reflection, Acceptance angle, Numerical aperture, Skew rays, Electromagnetic mode theory of optical propagation, EM waves, modes in Planar guide, phase and group velocity, cylindrical fibers, SM fibers.	7
II	**Transmission Characteristics of Optical Fibres** Attenuation, Material absorption losses in silica glass fibers, Linear and Nonl inear Scattering losses, Fiber Bend losses, Midband and farband infra red transmission, Intra and inter Modal Dispersion, Over all Fiber Dispersion, Polarization, non linear Phenomena. Optical fiber connectors**,** Fiber alignment and Joint Losses, Fiber Splices, Fiber connectors, Expanded Beam Connectors	7

III	**Sources and Detectors** Optical Sources : Semiconductor Physics background, Light emitting diode (LEDs)- structures, materials, Figure of merits, characteristics & Modulation. Laser Diodes -Modes & threshold conditions, Diode Rate equations, resonant frequencies, structures, characteristics and figure of merits, single mode lasers, Modulation of laser diodes, Spectral width , temperature effects, and Light source linearity. Optical Detectors: PIN Photo detectors, Avalanche photo diodes, construction, characteristics and properties, Comparison of performance, Photo detector noise - Noise sources , Signal to Noise ratio , Detector response time	7
IV	**Coupling and Receiver operation** Power Launching and Coupling: Source to fiber power launching, Lensing schemes, fiber-to-fiber joints, LED coupling to single mode fibers, fiber splicing, Optical fiber connectors. Optical Receiver Operation : Receiver operation, Preamplifier types, receiver performance and sensitivity, Eye diagrams, Coherent detection, Specification of receivers	6
V	**Optical Transmission System** Transmission Systems : Point –to-point link –system considerations, Link power budget and rise time budget methods for design of optical link, BER calculation Optical Amplifiers : Semiconductor optical Amplifier, EDFA, Raman Amplifier, Wideband Optical Amplifiers	6
VI	**Measurements and Advances in Optical Fiber Systems** Fiber Attenuation measurements- Dispersion measurements – Fiber Refractive index profile measurements – Fiber cut- off Wave length Measurements – Fiber Numerical Aperture Measurements – Fiber diameter measurements Principles of WDM, DWDM, Telecommunications & broadband application, SONET/SDH, MUX, Analog & Digital broadband, optical switching	6

Textbooks	
1	Keiser, G, “Optical Fiber Communications”, ISBN - 9780071164689, by McGraw-Hill, 5th Edition, 2000.
2	John M. Senior, M. Yousif Jamro, “Optical Fiber Communications: Principles and Practice”, ISBN - 9780130326812, Prentice Hall Internacional series in optoelectronics, 2009
3	
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References	
1	Singal, T.L, “Optical Fiber Communications: Principles and Applications”. ISBN - 9781316870532, 2017, Cambridge University Press
2	Rogers, A.J, “Understanding Optical Fiber Communications”, ISBN - 9780890064788, Artech House optoelectronics library, 2001
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Useful Links	
1	https://archive.nptel.ac.in/courses/108/106/108106167/
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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 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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Course Information	
Programme	B.Tech. (Electronics Engineering)
Class, Semester	Third Year B. Tech., Sem V
Course Code	6OE357
Course Name	Introduction to Electronic Systems
Desired Requisites:	Basic Electronics 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 illustrate the concept behind electronics systems and its application.
2	
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Course Outcomes (CO) with Bloom's Taxonomy Level

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

CO1	Explain the working of components used in the electronic systems.	Understand
CO2	Develop a digital circuit for a given logic and build circuit for given specifications.	Apply
CO3	Analyze the performance of Data Acquisition System and Power Electronics Circuits.	Analyze
CO4	Test embedded system applications using Arduino board.	Apply

Module	**Module Contents**	**Hours**
I	**Electronic System Components** Transducers-Types, Classification, Characteristics: Signal Conditioning of inputs, Instrumentation Amplifiers, Capacitive type, Inductive type sensors, Limit switches, Temperature sensors:RTD, thermistor, Thermocouple, semiconductor diode sensor, piezoelectric transducer photovoltaic cell, LDR, Speed measurement using magnetic photoelectric pickup. Distance measurement: LVDT, capacitive transducers, Resistive, Glass scales, Magnetic scales. Concept of Quadrature output and index pulse.PH Sensors, ProximitySensors, Motion Sensors.	7
II	**Operational Amplifier** Differential amplifier, Basic op-Amp configuration, Ideal op-amp analysis, Op-amp characteristics, Inverting and Non inverting amplifiers, Adder, Subtractor, voltage to current converters, current to voltage converters, instrumentation amplifiers, Active filters. Voltage comparator, Comparator application, waveform generators: multivibrators, oscillators.	8
III	**Digital Systems** Flip-flops, Counters, Up-counters, Down Counters, Mod-N counters, State diagram.	5
IV	**Data Acquisitions System** Digital to Analog Converter (DAC), Analog to Digital converter (ADC), Data Acquisition System (DAS): introduction, objectives of DAS, single and multichannel, data conversion, sample and hold circuit, elements of DAS, interfacing of transducers-multiplexing.	7
V	**Power Semiconductor Devices and its Applications** SCR, TRIAC, DIAC, UJT, AC voltage regulator, Controlled rectifiers, Inverters, Speed control of AC and DC motors, SMPS,UPS, Electronics lamp ballast.	5

VI	**Embedded Systems** Introduction to microcontroller based system: Arduino board, Arduino based systems, Simple Arduino program, interfacing display board to Arduino, Speed control of DC motor, motor driver IC: L293D.	8

Textbooks	
1	R. Boylestad and L. Nashelsky, “Electronics Devices and Circuits”, 8th Edition, Prentice Hall International, 2005.
2	Anand Kumar, "Fundamentals of Digital circuits", 2nd Edition, PHI, 2009.
3	A. K. Sawhney, “Measurements and Instrumentation”, Dhanpat Rai and Sons, 2013
4	
References	
1	R. P. Jain, "Modern Digital Design", Mc-Graw-Hill, 2008
2	Ramakant Gaikwad, “Op-amps and Linear Integrated Circuits”, Pearson Education, 2011.
3	M.D. Singh and KB Khanchandani, “Power Electronics”, 2nd Edition, McGraw-Hill, 2007.
4	
Useful Links	
1	www.spoken-tutorial.org ---IIT Bombay.
2	
3	
4	

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		2											2
CO3		3												3
CO4	3		2											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 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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Course Information	
Programme	B.Tech. (Electronics Engineering)
Class, Semester	Third Year B. Tech., Sem V
Course Code	6OE358
Course Name	Open Elective – Signals and Systems
Desired Requisites:	-

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

Course Objectives	
1	Develop the mathematical skills to solve problems involving signals and systems in various areas of appllications
2	To Understand signals and systems in terms of both the time and transform domains with , complementary insights into tools for analysis
3	
4	

Course Outcomes (CO) with Bloom's Taxonomy Level		
At the end of the course, the students will be able to,		
CO1	Classify the different signals and systems	Understand
CO2	Characterize LTI systems in the time domain and frequency domain	Apply
CO3	Use MATLAB software to implement the signal processing and system analysis for different applications	Apply

Module	**Module Contents**	**Hours**
I	**Classification of Signals and Systems:** Standard signals- Step, Ramp, Pulse, Impulse, Real and complex exponentials and Sinusoids, Classification of signals – Continuous time (CT) and Discrete Time (DT) signals, Periodic & Aperiodic signals, Deterministic & Random signals, Energy & Power signals, Classification of systems- CT systems and DT systems, Linear & Nonlinear, Time-variant & Time-invariant, Causal & Noncausal, Stable & Unstable.	6
II	**Analysis of CT and DT signals** Fourier series for periodic signals - Fourier Transform – properties- Laplace Transforms and properties.	8
III	**Analysis of DT signals** Baseband signal Sampling – Fourier Transform of discrete time signals (DTFT) – Properties of DTFT - Z Transform & Properties	6
IV	**Linear Time Invariant DT Systems** Impulse response – Difference equations-Convolution sum- Discrete Fourier Transform and Z Transform Analysis of Recursive & Non-Recursive systems- DT systems connected in series and parallel.	8
V	**Application areas of Signals and Systems** Overview of applications of Signals and Systems in the fields of Speech and audio processing.Multimedia processing (image and video),Underwater acoustic, Biological signal analysis, Biometrics, control applications	7
VI	**Analysis of Signals and Systems using Simulation Tools** Introduction to MATLAB, Use MATLAB software to implement the signal processing and system analysis.	4

Textbooks	
1	B.P. Lathi, “Signals, Systems & Communications”- BS Publications, 2003.
2	A.V. Oppenheim, A.S. Willsky and S.H. Nawab,”Signals and Systems”- PHI, 2nd Edn.
3	
4	
References	
1	Simon Haykin and Van Veen,”Signals & Systems” -,Wiley, 2nd Edition.
2	
3	
4	
Useful Links	
1	NPTEL lectures
2	https://www.mathworks.com
3	
4	

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												
CO3					3								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)

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Course Information

Programme	B.Tech. (Electronics Engineering)
Class, Semester	Third Year B. Tech., Sem-V
Course Code	6EN354
Course Name	Project Management
Desired Requisites:	

Teaching Scheme		**Examination Scheme (Marks)**			
Lecture	-	**LA1**	**LA2**	**Lab ESE**	**Total**
Interaction	2 Hour/week	30	30	40	100
		Credits: 2			

Course Objectives

1	To prepare the students to manage projects by exploring both technical and managerial challenges and preparing the budget.
2	To make aware the students about leadership and ethical qualities in dealing with real life project
3	To induce qualities for working in interdisciplinary and cross functional teams with effective communication skills, economical and managerial challenges and commercial management.

Course Outcomes (CO) with Bloom's Taxonomy Level

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

CO	**Course Outcome Statement/s**	**Bloom's Taxonomy Level**	**Bloom's Taxonomy Description**
CO1	Grasp and perceive the project activities with respect to resources and constraints of feasibility or completion time	II	Understanding
CO2	Estimate and prepare budget for project completion and commercial management	IV	Analyzing
CO3	Figure out and schedule the project and assess for controlling critical path networks	V	Evaluating

Contents

1	**Introduction to Project Management.** Phases in the life cycle of projects and their significance, characteristics of projects from conventional organizations, objectives of the project and interdependence of cost on schedules	4
2	**Project Cost, Planning, feasibility, risk.** Controlling Schedules, Cost, specifications or quality, Monitoring both the cost and schedule of a project in financial terms, Baseline Cost Curves and their significance in the overall project cost impact	4

3	**Critical Path Networks - Principles of Resource Scheduling.** Numeric Models of Project, Non-Numeric Models of Project, Scoring Models of Project, Project Network and CPM, Gantt Charts, Resource allocation and Controlling phases of a project	4
4	**Executing and Controlling.** Audit schedules and auditing a project and identifying deviations, quality needs in a project, applying relevant quality tools in a project and interpreting the results of the tools to monitor the quality **Commercial Management and various regulations.** Potential risks in a project, Categorizing of project risks, and defining the strategies for managing the project risks	4
5	**Study and use of software related to Project Management System.**	3
6	**Human Values and Professional Ethics** Need, basic guidelines, content & process for value education, understanding harmony in the human being- harmony in myself, understanding harmony in the family & society- harmony in human relationship, understanding harmony in the nature & existence, implications of the above holistic understanding of harmony on professional ethics.	7

Text Books	
1	Dennis Lock ," Project Management ", Gower Publishing Limited, 2013
2	Samuel J. Mantel, Jr., Jack R. Meredith, Scott M. Shafer, Margaret M. Sutton, "Project Management in Practice " JOHN WILEY & SONS, INC., 2011
3	Horald Kerzner, "Project Management: A systems approach to planning, scheduling and controlling", John Wiley & Sons Inc., 2009

References	
1	K. Nagarajan, Project Management, New Age Int., 2nd ed. 2004.
2	B.M.Naik, "Project Management-Scheduling and Monitoring", PERT/CPM, 1984
3	William R Duncan, "A guide to the project management body of knowledge", PMI Publications, 1996
4	The factories act 1948 – Government of India 6. Meri Williams , "The Principles of Project Management ", By – Site point Pvt Ltd., 2008

Useful Links	
1	https://www.apm.org.uk/resources/what-is-project-management/
2	https://www.projectmanager.com/project-management

CO-PO Mapping														
	Programme Outcomes (PO)												**PSO**	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1								1					1	1
CO2									2					2
CO3							1						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				
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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Course Information	
Programme	B.Tech. (Electronics Engineering)
Class, Semester	Third Year B. Tech., Sem VI
Course Code	6EN321
Course Name	Electromagnetic Engineering
Desired Requisites:	

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

Course Objectives	
1	To **understand** the electric fields, electric energy and potential.
2	To **understand** the magnetic flux and forces, energy stored in magnetic field.
3	To **develop** in-depth understanding of time-varying fields and electromagnetic waves.
4	To **study** the electromagnetic wave transmission methods like transmission lines, antennas and waveguides.

Course Outcomes (CO) with Bloom's Taxonomy Level

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

CO1	**Explain** the principles of static and time-varying electric and magnetic fields.	Understand
CO2	**Compare** the behaviour of electromagnetic waves in free space and guided medium like two-wire transmission line.	Understand
CO3	**Solve** the problems on static and time-varying electromagnetic fields.	Apply
CO4	**Analyze** the effects of electromagnetic radiation and electromagnetic interference.	Analyze

Module	**Module Contents**	**Hours**
I	**Electrostatics** Review of vector analysis and coordinate systems. Coulomb's Law, electric fieldintensity, field due to line charge, sheet charge; electric flux density, Gauss's Law and it's applications, divergence theorem; energy and potential, potentialgradient, electric dipole; energy density in electrostatic field	4
II	**Conductors, Dielectrics and Capacitance** Current and current density, continuity of current, conductor properties and boundary conditions; boundary conditions for perfect dielectric materials, Poisson's and Laplace's equations; Capacitance.	8
III	**Steady Magnetic Field** Magnetic field intensity, Biot-Savart Law, Ampere's circuital Law, Stokes' theorem, magnetic flux and magnetic flux density; scalar and vector magnetic potential; Force on a moving charge, force between differential current elements,properties of magnetic materials, energy stored in magnetic field, forces on magnetic materials, inductance, magnetic boundary conditions.	8
IV	**Time Varying Fields and Maxwell's Equations** Faraday's Law, displacement current, Maxwell's equations in point (differential) form and integral form, time varying potentials, time-harmonic fields	8
V	**Uniform Plane Electromagnetic Waves** Wave propagation in free space and dielectrics, Power flow in uniform plane wave, Poynting's theorem, wave propagation in conductors: skin depth, reflection of plane waves, standing wave ratio, polarization of uniform plane waves.	7

VI	**Transmission Lines** Types of two-conductor transmission lines, equivalent circuit, transmission line parameters, transmission line equations, lossless propagation, wave reflection, standing waves and voltage standing wave ratio, reflection coefficient, Smith Chart.	4

Textbooks	
1	William H. Hayt and John A. Buck, "Engineering Electromagnetics", 7th Edition, Tata McGraw- Hill, 2007.
2	Matthew N. O. Sadiku, "Elements of Electromagnetics", 3rd Edition, Oxford University Press, 2007.
3	S. C. Mahapatra and Sudipta Mahapatra, "Principles of Electromagnetics", Tata McGraw-Hill, 2011.
4	
References	
1	E. C. Jordan & K. Balman, "Electromagnetic Waves and Radiating Systems", 2nd Edition, PHI, 2007.
2	David K. Cheng, "Field and Wave Electromagnetics", Pearson Education, 2015.
3	
4	
Useful Links	
1	https://nptel.ac.in/courses/108/106/108106073/
2	https://nptel.ac.in/courses/108/104/108104087/
3	
4	

CO-PO Mapping

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

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Course Information	
Programme	B.Tech. (Electronics Engineering)
Class, Semester	Third Year B. Tech., Sem VI
Course Code	6EN322
Course Name	Digital System Architecture
Desired Requisites:	Digital Electronics

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

Course Objectives	
1	To explain the designs of building blocks of digital system viz. data path design, control unit design, memory units to finally design the microprocessor 2. 3. 4. 5.
2	To illustrate the concepts behind designing the robust digital systems.
3	To unfold the architectures of DACs and ADCs using various approaches motivating students to compare their performance.
4	To assign medium complexity digital system design related problems in batches as a self study exercise.
	To illustrate HDL implementation of digital designs in FPGA

Course Outcomes (CO) with Bloom's Taxonomy Level		
At the end of the course, the students will be able to,		
CO1	Explain the architectures of FPGAs and the concept behind programmable devices	Understand
CO2	Apply FSM approach to develop sequential digital circuits, and floating point and fixed point arithmetic to develop architectures of floating/fixed pointdata-path blocks.	Apply
CO3	Analyze digital circuits and their architectures for functionality, and memory units for timing performance using timing diagrams.	Analyze
CO4	Compare various approaches of designing memory blocks, DACs and ADCs with references to their merits and demerits and performance parameters respectively	Evaluate
CO5	Develop architectures of digital blocks (Data-path, Control units) with knowledge of functionality extending further to 4-bit/8-bit microprocessor with defined set of instructions.	Create

Module	**Module Contents**	**Hours**
I	**Designing Datapath Blocks** Number representation (fixed point and floating point), Fixed Pont arithmetic, floating point arithmetic, High speed adders/ Multipliers (Robertson's algorithm and Booth's algorithm), pipeline processing.	8
II	**Designing Control units** Concepts, Hardwired Control, Examples on hardwired control (Multiplier control unit), CPU control unit, Microprogrammed Control Unit, Example based on micro-programmed control unit, Concepts in Pipeline control	6

III	**Designing Memory Blocks** ROM, Internal Structure, Rom control inputs and timing, Static RAM, Internal Structure, Timing, Dynamic RAM, Timing, Memory Systems (Multilevel memories, Address translation, replacement policies), Caches (Address mapping, Associative, Direct and set-associative mapping), Cache performance	7
IV	**Processor Design** Introduction, Microcomputer Organization, Microprocessor Organization, Set of Instructions, Addressing Modes, Designing instruction, stack, subroutines and interrupt, Input-Output interface, Serial and parallel communication with processor, Direct Memory Access	6
V	**PLDs and Their Architectures** Introduction to Programmable Logic Devices, Field Programmable Gate Arrays, FPGA Architectures (Xilinx Spartan Series, Altera Stratix Series) involving Configurable Logic Blocks, I/O blocks, Programmable interconnects.	4
VI	**Data Converters**: **DAC** Binary weighted Resistor , R/2R ladder, Performance metrics of DAC (Resolution, Settling time, linearity, speed and Errors) **ADC** – Flash ADC, Successive Approximation ADC, Single slope ADC, Dual Slop ADC, ADC specifications (Quantization error, Intergral non-linearity error, Gain and Offset Error, Signal to Noise Ratio, Dynamic Range, Effective number of bits, Bit Error Rate, Figure of Merit)	9

Textbooks	
1	*Morris Mano, "Digital Logic and Microprocessoor Design", PHI, 2001*
2	John Wakerley, "Digital Design , Principles and Practices", PHI, 2005 3.
3	Hayes, "Computer Architecture and Organization", McGraw Hill, 3rd Edition, 2012

References	
1	Frank Vahid "Digital Electronics" Wiley Publication. 2012
2	Enoch O. Hwang, "Digital Logic and Microprocessoor Design with VHDL", Thomson Publication, 2007 Reprint

Useful Links	
1	www.xilinx.com
2	www.altera.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	3													
CO3		3												
CO4		3												
CO5			3			1	1							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 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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Course Information

Programme	B. Tech. (Electronics Engineering)
Class, Semester	Third Year B. Tech., Sem.VI
Course Code	6EN323
Course Name	Power Electronics
Desired Requisites:	Basic Electrical Engineering, Circuit Theory

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	**Explain** the working of modern power semiconductor devices and their applications.
2	**Explain** the working of power converter circuits like controlled rectifier, inverter, AC voltage controller and chopper and provide the knowledge of performance parameters of converters in the analysis of their performance.
3	**Explain** the use of different power control techniques like converters, choppers, inverters and cycloconverters to control the speed of DC motors and Induction motors.
4	**Illustrate** to choose an appropriate power electronic circuit and a power semiconductor device while designing an electrical power control system.

Course Outcomes (CO) with Bloom's Taxonomy Level

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

CO1	**Explain** the working of power semiconductor devices such as SCR, GTO, Power MOSFET and IGBT.	Understand
CO2	**Analyze** the performance of controlled rectifiers, DC to DC converters, Inverters, AC to AC converter.	Analyze
CO3	**Evaluate the** performance parameters of controlled rectifier, DC to DC converter, DC to AC converter and AC to AC converter.	Evaluate
CO4	**Analyze** the speed control techniques/ methods for AC and DC motors.	Analyze

Module	**Module Contents**	**Hours**
I	**Power Semiconductor Devices** SCR (Silicon Controlled Rectifier): two transistor model, protection circuits, series and parallel operation of SCR, triggering and commutation circuits; GTO, TRIAC, DIAC, Power Diode, Power BJT, Power MOSFET, IGBT.	7
II	**Phase Controlled Rectifiers** Single phase half and full wave controlled rectifier with R and RL load, Single phase half controlled (semiconverter) and fully controlled bridge rectifier. Three phase half wave controlled rectifier with resistive load, three phase half controlled and fully controlled bridge rectifier with R and RL load; Calculation of performance parameters of line commutated converters: Fourier analysis; effect of source impedance on the performance of controlled rectifiers.	9
III	**Inverters and AC voltage Controllers** Single phase half and full bridge inverter using transistor/MOSFET/IGBT, performance parameters, Fourier analysis of inverter output voltage; Three phase bridge inverter-120^0 and 180^0 conduction mode; PWM inverters; Series and Parallel resonant inverter. AC voltage controllers: single phase and three phase AC voltage controllers, AC power control using TRIAC; Cycloconverters: single phase to single phase, three phase to single phase, three phase to three phase cycloconverter.	8
IV	**DC to DC converters** Choppers: principles of operation, control strategies: TRC, current limit control; types of chopper, step up chopper, multiphase chopper; SMPS.	4

V	**D.C. Motor Control** Equivalent circuit, speed torque characteristics (separately excited and series motor), operating modes, single phase and three phase controlled rectifier fed drives; four quadrant drive-single phase and three phase dual converter; Chopper-fed DC drive.	6
VI	**A.C. Motor Control** Equivalent circuit, speed torque characteristics, speed control methods-stator voltage control, rotor voltage control, frequency control, stator voltage and frequency control (V/F); Vector Control.	6

Text Books	
1	M. D. Singh & K. B. Khanchandani, "*Power Electronics*", Second Edition, Tata McGraw-Hill Publishing Company Ltd., New Delhi, 2007.
2	M.H. Rashid, "*Power Electronics: Circuits, Devices & Applications*", Third Edition, PHI, New Delhi, 2008.
3	P. S. Bimbhra, "*Power Electronics*", Third Edition, Khanna Publishers, 2004.
4	

References	
1	P. C. Sen, "*Power Electronics*", First Edition, Tata McGraw Hill Publishing Company Ltd, 2008.
2	V. R. Moorthi, "*Power Electronics-Devices, Circuits and Industrial Applications*", Oxford University Press, 2010.
3	Ned Mohan, T. M. Undeland, W. P. Robbins, "*Power electronics-Converters, Applications and Design*", Third Edition, John Wiley and Sons Inc., 2003.
4	

Useful Links	
1	https://nptel.ac.in/courses/108/105/108105066/#
2	https://nptel.ac.in/courses/108/108/108108077/
3	https://nptel.ac.in/courses/108/102/108102145/
4	

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	3	1											2
CO3	2	3												
CO4		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.

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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Course Information

Programme	B.Tech. (Electronics Engineering)
Class, Semester	Third Year B. Tech., Sem -VI
Course Code	6EN371
Course Name	Digital System Architecture Lab
Desired Requisites:	Digital Electronics Lab

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

Course Objectives

1	To know the HDL language for Digital Design
2	To understand the difference in HDL and other high level programming language
3	To understand the concept in simulation and synthesis

Course Outcomes (CO) with Bloom's Taxonomy Level

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

CO1	The students will be able to design the basic digital circuits and test them.	Understand
CO2	Able to develop designed circuit using VHDL	Apply
CO3	Able to implement the control unit using VHDL	Analyse

List of Experiments / Lab Activities/Topics

VERILOG: Introduction to VERILOG, Program structure, Attributes, Functions and Procedures, Types of VERILOG architectures(Structural, Data flow, Behavioral), VERILOG concurrent and sequential constructs, Combinational and Sequential logic design using Verilog

List of Lab Activities:

1 Introduction to Xilinx with sample experiment in Verilog
2 1 bit full adder using 1 bit half adder as a component
3 4 bit full adder using 1 bit full adder as a component.
4 1 bit full adder using 8:1 multiplexer as component
5 1 bit full adder using 1:8 demux as component
6 Implementation of 4:1 mux using 2:1 mux as a component
7 Implementation of demultiplexer IC 74138
8 4 bit comparator
9 Implementation of flip flops
10 4-bit Counter using D-f/f
11 Counter using operators
12 UP counter and DOWN counter
13 Shift registers
14 Universal Shift register

Textbooks

1	Douglas Perry , "VERILOG", , Tata McGraw-Hill,
2	Charles H Roth, "Digital System Design Using VHDL", Cengage Learning India

References

1	Steafan,"Fundamentals of Digital Logic Using VERILOG ", McGraw Hill
2	Manjita Srivastava ,"Digital Design: HDL-Based Approach",,Cengage Learning India

Useful Links	
1	www.xilinx.com
2	www.altra.com

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						1	1							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

(Government Aided Autonomous Institute)

AY 2023-24

Course Information

Programme	B. Tech. (Electronics Engineering)
Class, Semester	Third Year B. Tech., Sem. VI
Course Code	6EN372
Course Name	Power Electronics Lab
Desired Requisites:	Basic Electrical Engineering, Circuit Theory

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

Course Objectives

1	Explain the V-I characteristics of power semiconductor devices and their use as a switch.
2	Demonstrate the operating and handling procedure (i.e. safety measures) of power electronic experimental set ups.
3	Explain the need of isolating power circuit ground and control circuit ground (use of Powerscope or isolation transformer) during observation of waveforms and measurement of input and output voltage of a power electronic circuit i.e. controlled rectifier, inverter and chopper.
4	Demonstrate the use of simulation software (PSIM, MATLAB, PSPICE) in the analysis and design of power electronic circuits /systems.

Course Outcomes (CO) with Bloom's Taxonomy Level

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

CO1	Experiment with power semiconductor devices and plot its V-I characteristics.	Understand
CO2	Build and test power electronic circuits (controlled rectifiers, inverters, choppers)	Apply
CO3	Analyze the performance power electronic circuits (controlled rectifiers, inverters, choppers)	Analyze
CO4	Examine and compare speed control techniques/ methods for AC and DC motors.	Analyze

List of Experiments / Lab Activities/ Topics

The primary objective of this laboratory is to impart the practical knowledge of power electronic circuits for the conversion and control of electrical energy. This laboratory course develops a basic foundation for analysis, design, test, and control of power electronics converters by experimentation and simulation.

List of Experiments: (Minimum 8 experiments)

1. Study of power semiconductor devices: SCR, Power MOSFET, IGBT.
2. SCR triggering circuits: R, RC, and UJT
3. Single phase half controlled bridge rectifier.
4. Single phase fully controlled bridge rectifier.
5. Single phase transistorized inverter.
6. Single phase to Single phase Cycloconverter.
7. Design and implementation of a Type-A chopper (Power MOSFET based) circuit.
8. AC power control using TRIAC.
9. Single/ Three phase controlled rectifier fed DC drive.
10. Chopper fed DC drive.
11. Three phase induction motor drive.
12. Four quadrant DC drive (Dual converter).
13. Speed control of brushless DC motor.
14. Simulation of Controlled Rectifier and Three Phase Inverter Circuit using MATLAB/ PSIM.

Text Books

1	M.H. Rashid, "*Power Electronics: Circuits, Devices & Applications*", Third Edition, PHI, New Delhi, 2008.

2	M. D. Singh & K. B. Khanchandani, "*Power Electronics*", Second Edition, Tata McGraw-Hill Publishing Company Ltd., New Delhi, 2007.
3	V. R. Moorthi, "*Power Electronics: Devices, Circuits and Industrial Applications*", Oxford University Press, 2010.
4	

References	
1	D. R. Grafham, J. C. Hey, "*SCR Manual*", Fifth Edition, General Electric, New York, 1972.
2	https://www.powersimtech.com/wp-content/uploads/2021/01/PSIM-User-Manual.pdf
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Useful Links	
1	https://powersimtech.com/products/psim/capabilities-applications/
2	https://in.mathworks.com/solutions/power-electronics-control/power-electronics-simulation.html
3	https://www.plexim.com/products/plecs
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CO-PO Mapping

	Programme Outcomes (PO)												**PSO**	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	1			3										
CO2				3	3									2
CO3		1		3	3									2
CO4	1			3	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 6 Marks Submission at the end of Week 6	30
LA2	Lab activities, attendance, journal	Lab Course Faculty	During Week 7 to Week 12 Marks Submission at the end of Week 12	30
Lab ESE	Lab activities, attendance, journal	Lab Course Faculty	During Week 15 to Week 18 Marks Submission at the end of Week 18	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 2023-24

Course Information

Programme	B. Tech. (Electronics Engineering)
Class, Semester	Third Year B. Tech., Sem-VI
Course Code	6EN342
Course Name	Mini Project-2
Desired Requisites:	ECAD-I, ECAD-II, Digital Signal Processing, Embedded System Design, Digital Signal Processing

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 provide students hands on experience on, troubleshooting, maintenance, fabrication, innovation, record keeping, documentation etc. thereby enhancing the skill and competency part of technical education.
2	To create an Industrial environment and culture within the institution.
3	To inculcate innovative thinking and practice based learning and thereby preparing students for their final year project.
4	To set up self-maintenance cell within departments to ensure optimal usage of infrastructure Facilities.

Course Outcomes (CO) with Bloom's Taxonomy Level

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

CO1	Choose, Initiate and manage a minor project.	Understand
CO2	Propose research problem and present it in a clear and distinct manner through different oral, written and design techniques.	Apply
CO3	Construct the circuit using hardware and/or software.	Create
CO4	Execute the project and comment upon the results of it.	Analyze

List of Experiments / Lab Activities/ Topics

Mini Project Description:

A project group shall consist of normally 3 students per group. The mini project will involve the design, construction, and debugging of an electronic system approved by the department. Each student should conceive, design and develop the idea leading to a project/product. **The theme of the project should be related to electronics engineering discipline to be decided by the students based on the societal needs after an exhaustive survey.**

Each student must keep a project notebook/logbook. The project notebooks will be checked periodically throughout the semester, as part of in-semester-evaluation. The student should submit a soft bound report at the end of the semester. The final product as a result of mini project should be demonstrated at the time of examination.

Textbooks

1	Electronics Projects For Dummies, by by Earl Boysen and Nancy Muir, Published by Wiley Publishing, Inc., 2006
2	Make: Electronics, by Charles Platt, Published by Maker Media, 2015
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References

1	A. E. Ward, J.A.S. Angus, "Electronic Product Design", Stanley Thrones (Publishers) Limited, 1996.
2	Paul Horowitz, Winfield Hill, "The Art of Electronics", Cambridge University Press, 1989

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Useful Links	
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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
CO2			3		2									
CO3			3		2						1		1	1
CO4		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, 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 2023-24

Course Information	
Programme	B.Tech. (Electronics Engineering)
Class, Semester	Third Year B. Tech., Sem VI
Course Code	6EN331
Course Name	Mobile Communication Engineering
Desired Requisites:	Probability Theory and statistics, Digital Communication Engineering

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

Course Objectives	
1	To introduce the concepts and techniques associated with Wireless Cellular Communication systems
2	To familiarize with state of art standards used in wireless cellular systems

Course Outcomes (CO) with Bloom's Taxonomy Level		
At the end of the course, the students will be able to,		
CO1	Apply fundamentals of cellular system design to improve performance of cellular network	Apply
CO2	Distinguish between different multiple access technology	Analyze
CO3	Study evolution of mobile communication generation standards	Analyze

Module	**Module Contents**	**Hours**
I	**Mobile Radio Propagation** Large Scale Path Loss - Free Space Propagation Model, Relating Power to Electric Field, Three Basic Propagation Mechanisms -Reflection (Ground Reflection) , Wave Propagation and its types: Ground wave, space wave and sky wave propagation, Diffraction, Scattering, Practical Link Budget, Fading and Multipath.	6
II	**Basics of Antenna** Basic Antenna Parameters – Patterns, Beam Area, Radiation Intensity, Beam Efficiency, Directivity-Gain-Resolution, Antenna Apertures, Effective Height. Fields from Oscillating Dipole, Field Zones, Front - to-back Ratio, Antenna Theorems, Radiation, Retarded Potentials – Helmholtz Theorem	6
III	**The Cellular Concept – System Design Fundamentals** Introduction of Cells, Channel Reuse, SIR Calculations, Traffic Handling Capacity: Erlang Performance, Cellular system design, Cochannel interference ratio, Co channel interference reduction techniques and methods to improve cell coverage, Frequency management and channel assignment, concepts of cell splitting, handover in cellular system.	9
IV	**Multiple Access Technologies** Frequency Division Multiple access (FDMA), Time Division Multiple access (TDMA), Code Division Multiple access (CDMA), Orthogonal Frequency Division, spectral efficiency calculations, comparison of T/F/CDMA technologies based on their signal separation techniques, advantages, disadvantages and application areas.	4
V	**Fundamentals of GSM** GSM standard. The basic architecture of a GSM network, Interfaces in a GSM network. Air interface in GSM, logical and physical channels. Radio Network GSM system functions TRAU, BSC, BTS and MS. The central network functions VLR, HLR, AUC and EIR.	8

VI	**5G Technology** HSPA and LTE – Architecture – Radio interface and channels – Resource mapping – Session, mobility and security procedures – LTE Advanced – Heterogeneous Networks – Internetworking, IP based coupling Architecture - Multimode terminals and intersystem handover	7

Textbooks	
1	T.S.Rappaport, "*Wireless Communications Principles and Practice*", II Ed. PHI, Publications, 2010
2	Prashant Kumar Patra, Sanjit Kumar Dash, "*Mobile Computing*", 2nd Edition, Scitech, 2014
3	V.K.Garg, J.E.Wilkes, "*Principle and Application of GSM*" Pearson Education, 1999
4	
References	
1	William C. Y. Lee, "*Mobile Communication Engineering: Theory and Applications*",2nd Edition, McGraw Hill Publication, 1997
2	Iti Saha Misra, "*Wireless Communication and Networks – 3G and Beyond*", Mc Graw Hill Education, Second Edition, 2013
3	Mischa Schwartz, "*Mobile Wireless Communication*", 1st Edition, Cambridge University Press, 2009.
4	Antenna Theory - C.A. Balanis, John Wiley & Sons, 3rd Ed., 2005.
Useful Links	
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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										3	
CO3		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 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 2023-24

Course Information	
Programme	B.Tech. (Electronics Engineering)
Class, Semester	Final Year B. Tech., Sem VII
Course Code	6EN332
Course Name	Digtal System Engineering
Desired Requisites:	

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 understand the fundamental issues such as power, noise, signaling and timing associated with high speed digital systems.
2	To analyze the effect of parasitic of wires/interconnects in restricting the high speed performance of digital circuits and design the approaches to tackle this associate problem by using their engineering models
3	To comprehend the different sources of interference (noise) in digital systems and apply engineering/statistical models of these to compute and compare bit error rates
4	Understand the significance of signaling & timing issues and apply the knowledge of encoding a signal for error-free transfer of information (bits) from one location to another

Course Outcomes (CO) with Bloom's Taxonomy Level

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

CO1	Understand Interconnects as design objects, Noise in digital systems and its impact to system operation	II
CO2	Analyze Timing and synchronization for functional operations and signalling	IV
CO3	Distinguish Power distribution schemes for low noise	IV
CO4	Explain Signal and signalling conventions for on-chip and off-chip communication	II

Module	**Module Contents**	**Hours**
I	**Wires:** Geometry and Electrical properties, Electrical models of wires (Ideal wire, Transmission line), Simple transmission lines (RC, lossless LC, lossy LRC transmission lines, Dielectric absorption), Special transmission lines (Multi drop buses, Balanced Transmission lines, Common and differential mode impedance, Isolated lines)	7

II	**Noise in Digital System:** Noise sources in a digital system, Power Supply Noise, Cross-talk, Inter-symbol Interference, Noise due to other sources (Alpha particles, Electro-magnetic Interference, Process variation, Thermal Noise, Shot Noise, Flicker or 1/f Noise), Managing noise.	7
III	**Signaling Conventions:** CMOS and Low swing current mode signaling system, Considerations in transmission system design, Signaling modes for transmission lines, Transmitter signaling methods, Receiver signal detection, Source termination, Under-terminated Drivers, Differential Signaling, Signaling over capacitive transmission medium, Signal encoding	7
IV	**Timing Convention:** Conventional Synchronous system and closed loop pipelined system, considerations in timing design, Timing fundamentals, Timing properties of combinational logic and clock storage elements, Eye diagram, Encoding Timing (Signals and Events), Open loop synchronous timing, Closed loop timing, Phase locked loops, Clock Distribution	6
V	**Synchronization:** Synchronization Fundamentals, Applications of synchronization (Arbitration of asynchronous signals, Sampling asynchronous signals, Crossing clock domains), Synchronization failure and meta-stability, Synchronizer Design (Mesochronous, Plesiochronous, Periodic Asynchronous)	6
VI	**Power Distribution:** The power supply network (Local loads, Signal loads), Local Regulation, Logic loads and on-chip power supply distribution (Logic current profile, IR drops, Area Bonding, On-chip by-pass capacitor), Power supply isolation (Supply-supply isolation, Signal-supply isolation), Bypass capacitors, Power Distribution system	6
Textbooks		
1	*Digital System Engineering,* William Dally and John Poulton, Cambridge University Press, Reprint 2007	
2		
3		
4		

References	
1	*High Speed Digital Design, A Handbook of Black Magic,* Howard W. Johnson, Martin Graham, Prentice Hall PTR, Englewood Cliffs, NJ 0763.
2	*High Speed Digital System Design: Interconnect Theory and Design Practices"* Stephen H. Hall, Garrett W. Hall, James A. McCall, Wiley-IEEE Press (ISBN: 978-0-471-36090-2
3	
4	

Useful Links	
1	http://cva.stanford.edu/books/dig_sys_engr/
2	
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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 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 2023-24

Course Information	
Programme	B.Tech. (Electronics Engineering)
Class, Semester	Third Year B. Tech., Sem VI
Course Code	6EN333
Course Name	Professional Elective 3- Design and Analysis of Algorithm
Desired Requisites:	Data Structure and Algorithms

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

Course Objectives	
1	To provide different algorithm approaches like static, dynamic, iterative and recursive techniques.
2	To explain Comparative features of algorithms on the basis of space, time computational complexities,
3	To explain the selection criteria for identifying, formulating and applying a typical algorithm for given problem.
4	

Course Outcomes (CO) with Bloom's Taxonomy Level		
At the end of the course, the students will be able to,		
CO1	Interpret different algorithm approaches like static, dynamic, iterative and recursive techniques.	Apply
CO2	Compare the different algorithms on the basis of space, time computational complexities	Analyze
CO3	Identify the optimum algorithm for given problem.	Analyze
CO4		

Module	**Module Contents**	**Hours**
I	**Introduction** Static and dynamic structures, stacks, queues, dynamic memory allocation and pointers, linked stacks and queues, trees and recursion, Hashing:- Sparse-table, hash function, collision resolution with open addressing and collision resolution by chaining	4
II	**Searching and Sorting Algorithms** Sequential search, Binary search, Comparison of trees, Insertion sort, Selection sort(Heap sort), Shell sort. Computational Complexity, lower bound, & comparison of searching and sorting algorithm	8
III	**Divide and Conquer** Merge sort, quick sort (portioning), Matrix multiplication algorithm, Limitation of divide and conquer. Computational complexity of divide and conquer algorithms.	8
IV	**Dynamic Programming & Greedy Approach** Binomial Coefficients, Floyd's algorithm for shortest path, Chain matrix multiplication, optimal binary search trees and the traveling salesperson problem, Dynamic programming approach to 0-1 knapsack problem, Minimum spanning traces algorithms and their Comparison.	8

V	**Back Tracking & Branch and Bound** Back tracking techniques, the n-queens problem, Back tracking algorithm's efficiency using Monte Carlo algorithm. Graph coloring, the Hamiltomnian circuits' problem. Backtracking Algorithm for 0-1 Knapsack problem and its comparison	7
VI	**Theory of NP** The three general categories of problems. The sets P & NP. NP complete problems,NP-Hard, NP-easy, NP – Equivalent problems, NP Hard problems	4

Textbooks	
1	Ellis Horowitz, Sartaj Sahani, Sangutherar "Fundamentals of Computer Algorithms", Rajasekaran., Galgotia Pubication Ltd, 2010
2	I. Chandra Mohan, "Design and Analysis of Algorithms", PHI Publication, 2012.
3	Horowitz and Sahni, "Analysis of Computer Algorithms", Galgotia Publishers., 2007
4	

References	
1	Richard E. Neapolita & Kumarss Naimipour, "Foundation of Algorithms", (Northeastern Illinois University), D.C. Heath and Company, Publication, 1996.
2	Robert L. Kruse & Brunce P. Leung et. Al, "Data Structures and Program Design" *C*PHI Publication, 1984.
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Useful Links	
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CO-PO Mapping

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

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 2023-24

Course Information	
Programme	B.Tech. (Electronics Engineering)
Class, Semester	Third Year B. Tech., Sem VI
Course Code	6EN334
Course Name	Communication Network Protocols
Desired Requisites:	Digital Communication, Data Communication

Teaching Scheme		**Examination Scheme (Marks)**			
Lecture	2 Hrs/week	**MSE**	**ISE**	**ESE**	**Total**
Tutorial	1 Hrs/week	30	20	50	100
		Credits: 3			

Course Objectives	
1	To develop an understanding of computer networking basics
2	To be exposed to the TCP/IP protocol suite
3	To develop an understanding of different components of computer networks, various protocols, modern technologies and their applications.
4	To gain conceptual understanding of Software Defined Networks (SDN)

Course Outcomes (CO) with Bloom's Taxonomy Level		
At the end of the course, the students will be able to,		
CO1	Design a small TCP/IP Network	Apply
CO2	Identify security issues and suggest suitable solution	Analyze
CO3	Explain concept of cloud and its models.	Understand
CO4	Explain OpenFlow challenges in SDN, and developments in SDN	Understand

Module	**Module Contents**	**Hours**
I	**Introduction to Network and Data Link Layer** Introduction to Network, Transmission media, Topology, Switching techniques. OSI Model, TCP/IP Model Data Link layer design issues, Logical Link Control, Medium Access Control, Elementary Data link layer protocols, Sliding window protocol , Medium access sub layer- Multiple access protocols.	7
II	**Internet Protocol : IPv4 :** IP Datagram Formats - Data and Fragmentation - Address Masks- Prefixes- and Subnetworks - Network Address Translation (NAT) - IP Switching and Routing - Local Delivery and Loopbacks - Address Resolution Protocol ICMP.	8
III	**Transport layer protocols** UDP and TCP segments, comparison, TCP state flow diagram, TCP flow control, congestion control, error control. TCP Timers.	7
IV	**Application layer protocols:** Audio video streaming over IP (RTP,RTCP, SCTP), Application layer protocols, HTTP, SMTP, SNMP, FTP.	6
V	**Security:** The Need of Security, Security Approaches, Principal of Security, Types of Attacks. Network Security: Brief Introduction to Firewalls, IP Security, Virtual Private Networks (VPN)	6

VI	**Cloud Computing and Software Defined Networking(SDN)**: Business Drivers - Technology Innovations - Basic Concepts and Terminology Cloud Characteristics - Cloud Delivery Models - Cloud Deployment Models, Basics and Open flow, SDN Controller, SDN challenges, SDN and virtualization.	6

Textbooks	
1	B A Forouzan," Computer Networks", McGraw Hill Education 2016
2	Chuck Black, "Software defined Networking", Elsevier 2014
3	
4	
References	
1	Wayne Tomasi, "Introduction to Data Communication and Networking", 1/e, Pearson Education .
2	Greg Tomsho, Ed Tittel, David Johnson. "Guide to Networking Essentials", fifth edition, Thomson India Learning, 2007.
3	
4	
Useful Links	
1	https://www.cloudflare.com/en-in/learning/ddos/glossary/tcp-ip/
2	https://networkengineering.stackexchange.com/questions/63278/what-layers-of-the-tcp-ip-model- does-an-sdn-involve
3	
4	

CO-PO Mapping

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

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

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Course Information

Programme	B.Tech. (Electronics Engineering)
Class, Semester	Third Year B. Tech., Sem. VI
Course Code	6EN335
Course Name	Professional Elective-IV: CMOS Digital VLSI Design
Desired Requisites:	Digital Electronics, Electronic Circuits Analysis and Design, Microelectronics

Teaching Scheme		**Examination Scheme (Marks)**			
Lecture	2 Hrs/week	**MSE**	**ISE**	**ESE**	**Total**
Tutorial	1 Hr/week	30	20	50	100
Practical	-				
Interaction	-	**Credits: 3**			

Course Objectives

1	***Explain*** the long and short channel MOS transistor models with emphasis on unified model.
2	***Explain*** the steps involved in manufacturing process of MOS devices.
3	***Explain*** the considerations in optimizing the physical dimensions of MOS transistors in obtaining the trade-off between area, speed and power requirements of CMOS based systems.
4	***Develop*** the logical and design skills of CMOS combinational and sequential logic circuits.

Course Outcomes (CO) with Bloom's Taxonomy Level

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

CO1	**Explain** the basic steps with theoretical principles involved in the process of manufacturing of CMOS devices.	Understand
CO2	**Model** sub-micron, deep submicron MOS transistors and Interconnects.	Apply
CO3	**Analyze** the fundamental principles involved with MOS devices to **design** CMOS inverter to meet the area, speed and power requirements.	Analyze
CO4	**Design** static and dynamic CMOS Combinational Logic circuits and Sequential Logic Circuits by considering the performance parameters like area, speed and power.	Create

Module	**Module Contents**	**Hours**
I	**MOS Transistor Theory** MOS Transistor under Static Conditions, Dynamic Behaviour, Secondary Effects, SPICE Models for MOS Transistor, Technology Scaling.	3
II	**Manufacturing Process for CMOS ICs** Photolithography, Design Rules, Packaging Integrated Circuits, Thermal Considerations in Packaging.	2
III	**CMOS Inverter** Static and Dynamic Behaviour of CMOS Inverter, Power and Energy-Delay, Impact of Technology Scaling on Inverter Metrics.	6
IV	**CMOS Combinational Logic Circuits** Static CMOS Logic Design, Dynamic CMOS Logic Design, Comparison between the two Design Styles.	6
V	**CMOS Sequential Logic Circuits** Static Latches and Registers, Dynamic Latches and Registers, Pulse Registers, Non-Bistable Sequential Circuits: Schmitt Trigger Circuit, Ring Oscillator, Voltage Controlled Oscillator.	5

VI	**Interconnect and Semiconductor Memories** Electrical Models of Wires, Lumped RC Model, Distributed rc line, Transmission Line; Memory Classification, Memory Architectures and Building Blocks, Memory Core: ROM, RAM.	4

Text Books	
1	Jan M. Rabaey, Anantha Chandrakasan, Borivoje Nikolic, "Digital Integrated Circuits-A Design Perspective", 2nd Edition, Prentice-Hall India Learning Pvt. Limited/ Pearson Education, 2014.
2	Sung-Mo Kang, Yusuf Leblebici, "CMOS Digital Integrated Circuits: Analysis and Design", 3rd Edition, McGraw-Hill Education (India) Pvt. Ltd., 2015.
3	
4	
References	
1	Neil Weste, Kamran Eshraghian, "Principles of CMOS VLSI Design: Analysis and Design", Addison Wesley/Pearson Education, 2008
2	William Dally and John Poulton, "Digital System Engineering", Cambridge University Press, Reprint 2007.
3	
4	
Useful Links	
1	https://nptel.ac.in/courses/108/107/108107129/
2	https://ocw.mit.edu/courses/electrical-engineering-and-computer-science/6-374-analysis-and-design-of-digital-integrated-circuits-fall-2003/index.htm
3	
4	

CO-PO Mapping

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

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Course Information	
Programme	B.Tech. (Electronics Engineering)
Class, Semester	Third Year B. Tech., Sem VI
Course Code	6EN336
Course Name	Professional Elective IV: Digital Image Processing
Desired Requisites:	Digital Signal Processing

Teaching Scheme		**Examination Scheme (Marks)**			
Lecture	2 Hrs/week	**MSE**	**ISE**	**ESE**	**Total**
Tutorial	1 Hr/ week	30	20	50	100
		Credits: 3			

Course Objectives	
1	To develop an overview of the field of image processing.
2	To illustrate the fundamental algorithms and their implementation.
3	To apply image processing algorithms for real problems.

Course Outcomes (CO) with Bloom's Taxonomy Level		
At the end of the course, the students will be able to,		
CO1	Apply digital image enhancement techniques for gray scale images and colour images	Apply
CO2	Analyze various image segmentation techniques	Analyze
CO3	Explain image restoration, de noising and image compression techniques	Evaluate
CO4	Identify image representation and description techniques	Understand

Module	**Module Contents**	**Hours**
I	**Introduction to Digital Image Processing** Fundamental steps in digital image processing- Components of Image processing system Image sensing and acquisition - Image sampling and Quantization - relationship between pixels. Image file formats	5
II	**Image Enhancement Techniques** Spatial Domain: Gray level transformation - Histogram processing, Spatial filtering - smoothing filters , sharpening filters ; Frequency Domain: Fourier transform – smoothing frequency domain filters , sharpening filters , Homographic filtering.	5
III	**Image Restoration, Denoising and Image Compression Techniques** Model of Image degradation/ restoration process Types of image blur- Noise models , Classification of Image restoration techniques, Blind de convolution, Image de noising, Median filtering, Inverse filtering, Weiner, least square, Geometric mean filters; Classification of compression techniques, Fundamentals of Information Theory, Shannon Fano coding, Huffman coding, Transform based compression.	7
IV	**Color Image Processing** Color fundamentals, color models, pseudo color image processing, basics offull–color image processing, color transforms, smoothing and sharpening, color segmentation.	7
V	**Image Segmentation** Classification of Image segmentation Techniques, Region approach to Imagesegmentation, Edge based segmentation, Classification of edges, edge detection, edge linking, Hough Transform, Clustering Techniques, WatershedTransformation.	7

VI	**Representation & Description** Chain codes - Polygonal Approximations – signatures - Boundary segments - Skeletons; Boundary Descriptors - Regional descriptors.	7

Textbooks	
1	R.C. Gonzalez and R.E. Woods, "Digital Image Processing", 3rd Edition, Prentice-Hall,
2	Pratt, W.K., "Digital Image Processing", John Wiley and Sons, New York, 1978.
3	
4	
References	
1	A.K. Jain , "Fundamentals of Digital Image Processing"
2	M Sonka, V Hlavac and R Boyle, "Image Processing, Analysis and Machine Vision", PWS 1999
3	
4	
Useful Links	
1	www.nptel.com
2	
3	
4	

CO-PO Mapping

	Programme Outcomes (PO)												PSO	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	3												2	3
CO2		3											2	
CO3	3												2	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 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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Course Information	
Programme	B.Tech. (Electronics Engineering)
Class, Semester	Third Year B. Tech., Sem VI
Course Code	6OE364
Course Name	Cyber Physical System
Desired Requisites:	

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

Course Objectives	
1	To illustrate the fundamental concepts of Cyber Physical Systems
2	To explain design of Cyber Physical Systems.
3	To enable the students for the design and development of CPS
4	

Course Outcomes (CO) with Bloom's Taxonomy Level		
At the end of the course, the students will be able to,		
CO1	Explain fundamentals and components of CPS	Understand
CO2	Analyze the components of CPS	Analyze
CO3	Design the CPS Systems for given Applications	Create
CO4		

Module	**Module Contents**	**Hours**
I	**Introduction** Introduction of Cyber Physical Systems, various components of CPS, Applications of Cyber Physical System, Design aspects of Cyber Physical system, Introduction to Real Time System	7
II	**Sensing** Types of sensors, Classifications of sensors, Different selection criteria of sensors, Sensor Instrumentation, Concept of Smart sensors, Wireless sensors	8
III	**Sensor Network and Protocol** Sensor Network, Wireless Sensor Network, working of WSN, routing in wireless sensor network, Gateway functions, Data Aggregations, design issues of WSN Short distance protocols : Bluetooth, BLE (Bluetooth Smart), Zigbee, and Industrial protocol Modbus, Mbus, 6LoWPAN, IEC68XX	5
IV	**Embedded system computing** Introduction to Embedded system, Architecture, Programming aspects, peripherals and system design	7
V	**CPS Security** CPS security, Holistic Approach to Security, Overview of Security Technologies Principal security requirements,Security Issues, Types of attacks to CPS.	5
VI	**CASE Study** Industry Automation, Smart Grid, SCADA, general case study of any CPS.	8

Textbooks	
1	Olivier Hersent, David B. Omer Elloumi, "The Internet of Things key applications and Protocols", Wiley publications
2	
3	

4	
References	
1	Lars T Berger K Iniewski, “Smart Grid Applications, Communications, and Security”, Wiley Publications
2	
3	
4	
Useful Links	
1	http://www.cyphylab.ee.ucla.edu
2	
3	
4	

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				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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Course Information	
Programme	B.Tech. (Electronics Engineering)
Class, Semester	Third Year B. Tech., Sem-VI
Course Code	6OE365
Course Name	Biomedical Engineering
Desired Requisites:	Electronics Measurement and Instrumentation

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

Course Objectives

1	To explain the basics body cell structure and different types of transducers
2	To explain the different types of patient monitoring system
3	Understand the design concept of different Medical instruments
4	To demonstrate different medical instruments

Course Outcomes (CO) with Bloom's Taxonomy Level

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

CO1	Understand CNS-PNS and Cardio pulmonary system	Understand
CO2	Apply proper sensors for sensing biomedical signals to biomedical instrumentation setup	Apply
CO3	Design ECG,EEG and EMG amplifier	Create
CO4	Explain block diagram of patient monitoring systems, X-ray machine, CT scan and Ultrasonography machine.	Understand

Module	**Module Contents**	**Hours**
I	**Fundamentals of Medical Instrumentation** Physiological Systems of the body, Sources of Biomedical signals, Basic Medical Instrumentation system, Micro-Electro-Mechanical System (Mems), Wireless Connectivity in Medical Instruments, General Constraints in design of Medical Instrumentation Systems	8
II	**The Origin of Bio potentials, Bio potential Electrodes & Biosensors** Electrical activity of Excitable Cells, Functional Organization of the Peripheral NervousSystem,Electrocardiogram(ECG),Electromogram(EMG), Electroencephalogram(EEG), Electroretinogram(ERG) and their recording system, Biomedical signal Analysis and Processing Techniques.	4
III	**Patient Monitoring Systems** System Concepts, Cardiac Monitor, Bedside patient Monitoring Systems, Central Monitors, Measurement of Heart rate, Measurement of Temperature, Measurement of respiration Rate, Biomedical Telemetry Systems	4
IV	**Modern Imaging Systems** X-ray machines And Digital Radiography, X-ray Computed Tomography, Nuclear Medical Imaging Systems, Magnetic Resonance Imaging Systems, Ultrasonic Imaging Systems and Thermal Imaging Systems.	8
V	**Assisting and Therapeutic Equipment's** Cardiac Pacemakers, Defibrillators, Diathermy, Hemodialysis Machines, Ventilators	8
VI	**Laser Application in Biomedical Field** The Laser, Types of Lasers, Laser Application, Laser Safety	7

Textbooks

1	John. G. Webster, “Medical Instrumentation”, John Wiley, 2009
2	Goddes& Baker, “Principles of Applied Biomedical Instrumentation”, John Wiley, 2008
3	Carr & Brown, “Biomedical Instrumentation & Measurement”, Pearson, 2004
4	

References	
1	R.S. Khandpur, “Hand book of Medical instruments”, TMH, New Delhi, 1987.
2	Sanjay Guha,”Medical Electronics and Instrumentation”, University Publication, 200.
3	Edwand J. Bukstein, “Introduction to Biomedical electronics” , Sane and Co. Inc, 1973
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Useful Links	
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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	2							2	
CO3			3										2	
CO4									3				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)

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Course Information

Programme	B.Tech. (Electronics Engineering)
Class, Semester	Third Year B. Tech., Sem-VI
Course Code	6HS306
Course Name	Introduction to Entrepreneurship
Desired Requisites:	

Teaching Scheme		**Examination Scheme (Marks)**			
Lecture	2 Hrs/week	**LA1**	**LA1**	**ESE**	**Total**
Tutorial	-	30	30	40	100
Practical	-				
Interaction	1 Hr/week	**Credits: 2**			

Course Objectives

1	To explore the entrepreneurial mindset and culture that has been developing in companies of all sizes and industries.
2	To examine the entrepreneurial process from the generation of creative ideas to exploring feasibility to creation of an enterprise for implementation of the ideas.
3	To create and present a business plan for a technology idea.
4	To provide the background, tools, and life skills to participate in the entrepreneurial process within a large company, in a new venture, or as an investor.

Course Outcomes (CO) with Bloom's Taxonomy Level

CO1	**Exploit** the concept, meaning and features of entrepreneurship.	Apply
CO2	**Analyse** the business environment in order to identify business opportunities	Analyse
CO3	**Evaluate** the legal and financial conditions for starting a business venture.	Evaluate
CO4	**Interpret** the business plan, pitch to the investor and build the enterprise.	Create

Module	**Module Contents**	**Hours**
I	**The entrepreneurial perspective** The Entrepreneurial Mind-Set , Corporate Entrepreneurship , Generatingand Exploiting New Entries	5
II	**From idea to the opportunity** Creativity and the Business Idea , Identifying and Analyzing Domestic and International Opportunities , Protecting the Idea and Other Legal Issues forthe Entrepreneur	6
III	**From the opportunity to the business plan** The Business Plan: Creating and Starting the Venture , The Marketing Plan , The Organizational Plan , The Financial Plan	8
IV	**From the business plan to funding the venture** Sources of Capital , Informal Risk Capital, Venture Capital, and Going Public	4

V	**From funding the venture to launching, growing, and ending the new venture** Strategies for Growth and Managing the Implications of Growth , Accessing Resources for Growth from External Sources , Succession Planning and Strategies for Harvesting and Ending the Venture	7
VI	**Case Study** Case study of 3 to 4 successful entrepreneurs covering above theory. Case study of 2 to 3 failure entrepreneurs.	6

Text Books	
1	Robert D. Hisrich, Michael P. Peters, Dean A. Shepherd , "ENTREPRENEURSHIP" MGH 10th Edition.
2	Howard , Allan , Donald "Entrepreneurship : Theory / Process / Practice" Cengage Learning 4th Edition
3	William Bygrave , Andrew Zacharakis "Entrepreneurship" Wiley 2nd Edition

References	
1	Lee A. Swanson "Entrepreneurship and Innovation Toolkit" 3rd Edition
2	Lee A. Swanson "BUSINESS PLAN DEVELOPMENT GUIDE" 8th Edition
3	Hitesh Jhanji "ENTREPRENEURSHIP AND SMALL BUSINESS MANAGEMENT" Lovely Professional University, India

Useful Links	
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CO-PO Mapping

	Programme Outcomes (PO)												**PSO**		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1															
CO2															
CO3															
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 in-semester examinations in the form of online quiz and group activity of 30 marks each as LA1 and LA2. There shall be 1 End-Sem examination (ESE) of 40 marks. LA1 shall be typically on modules 1,2 and 3, and LA2 shall be typically on modules 4,5 and 6. ESE shall be on all modules.

Assessment Plan based on Bloom's Taxonomy Level (Marks)

Bloom's Taxonomy Level		**T1**	**T2**	**ESE**	**Total**
1	Remember				

2	Understand				
3	Apply	5	5	12	22
4	Analyze	5	5	12	22
5	Evaluate	4	4	11	19
6	Create	6	6	25	37
Total		**30**	**30**	**40**	**100**

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Course Information	
Programme	B.Tech. (Electronics Engineering)
Class, Semester	Third Year B. Tech., Sem.-VI
Course Code	6HS303
Course Name	Humanities II- German Language
Desired Requisites:	10+2 level English

Teaching Scheme		**Examination Scheme (Marks)**			
Lecture		**LA1**	**LA2**	**ESE**	**Total**
Tutorial		30	30	40	100
Practical	-				
Interaction	2 Hrs/week	**Credits: 2**			

Course Objectives	
1	To acquire German language skills both written and spoken
2	Enable students to communicate in German language in day to day situations

Course Outcomes (CO) with Bloom's Taxonomy Level		
CO1	Communicate clearly in German in different scenario	Apply
CO2	Handle oral and written communications in German language confidently	Understand

Module	**Module Contents**	**Hours**
I	**Module 1 : Greetings** 1. To introduce oneself and others 2. Greeting people/colleagues at office/work-place etc. 3. Exchanging information about country of origin 4. Place of residence, professions 5. Things that we eat and drink	4
II	**Module 2 : Days, Numbers and languages** 1. Date and Days of Week 2. Names of months 3. Numbers 1 to 1000 4. Names of Continents, Countries and their Capitals 5. Languages and Nationalities, main cultural festivals 6. Health and Parts of body	5
III	**Module 3 : Sentence Structure and Vocabulary Building** 1. Alphabet, 2.Personal Pronouns 3.German Articles 4.Genders 5.Plural Forms 6. Nouns	2
IV	**Module 4 :Grammar** 1.Forming questions, 2.Prepositions, 3. Conjunctions, 4.Verbs 5.Dative and Accusative forms with examples, 6. Opposites	6

V	**Module 5 : Oral Communication** 1. Asking for and telling telephone numbers with dial code numbers 2. Making request 3. Word order in sentences/statements and full question 4. Speak on given topic 5. Asking questions (Forming Question)	5
VI	**Module 6 : Written Communication : Basic Writing Skills** 1. Paragraph Writing 2. Comprehension 3. Short Essay Writing 4. Filling in Personal Information	4

Text Books	
1	.Hartmut Auf der strasse, Heiko Bock, Mechthild Gerdes, Jutta Mueller, Helmut Mueller,"Themen Aktuell1- Deutsch als Fremdsprache-Kursbuch",Max Hueber Verlag,Munich,Germany and Langers International Pvt.Ltd.,New Delhi ,ISBN: 3-19-0001690-9,Reprint 2014
2	.Hartmut Auf der strasse, Heiko Bock, Mechthild Gerdes, Jutta Mueller,Helmut Mueller,"Themen Aktuell1- Deutsch als Fremdsprache-Arbeitsbuch",Max Hueber Verlag,Munich,Germany and Langers International Pvt.Ltd.,New Delhi ,ISBN: 3-19-011690-3,Reprint 201
3	Alan B, Jones A."Themen Aktuell 1- Deutsch als Fremdsprache - Glossar",Max Hueber Verlag, Munich,Germany and Langers International Pvt.Ltd.,New Delhi ,ISBN: 3-19-0001690-9,Reprint 2014
References	
1	Archana Gogate, "German Workbook", Shubhasha Publications,Pune, Reprint July 2016
2	Stefanie Dengler,Paul Rusch,Helen Schmitz,Tanja Sieber, "Netzwerk A1- Deutsch als FremdspracheKursbuch ",Klett Langenscheidt, Munich,Germany and GOYAL Publishers Pvt. Ltd.,New Delhi, First Indian edition-2015
3	Stefanie Dengler,Paul Rusch,Helen Schmitz,Tanja Sieber, "Netzwerk A1- Deutsch alsFremdspracheArbeitsbuch ",Klett Langenscheidt,Munich,Germany and GOYAL Publishers Pvt.Ltd.,New Delhi, First Indian edition-2015
4	Stefanie Dengler,Paul Rusch,Helen Schmitz,Tanja Sieber, Gavin Schalliol"Netzwerk A1- Deutsch alsFremdsprache- Glossar ",Klett Langenscheidt, Munich, Germany and GOYAL Publishers Pvt.Ltd.,New Delhi, First Indian edition-2015
Useful Links	
1	www.klett-sprachen.de/netzwerk
2	www.cornelsen.de/studio-d
3	
4	

CO-PO Mapping															
	Programme Outcomes (PO)												**PSO**		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1										1					
CO2										1					
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 2 in-semester evaluations (LA) of 30 marks each, end-sem examination (ESE) of 40 marks. LA1 and LA2 are based on the modules taught (typically Module 1-3) and ESE is based on all modules with 30-40% weightage on modules before LA1 and 60-70% weightage on modules LA2.