Walchand College of Engineering, Sangli

(Government Aided Autonomous Institute)

AY 2022-23

Course Information	
Programme	B.Tech. (Electronics Engineering)
Class, Semester	Second Year B. Tech., Sem III
Course Code	6MA201
Course Name	Probability and Statistics
Desired Requisites:	Mathematics course at Higher Secondary Junior College

Teaching Scheme		**Examination Scheme (Marks)**			
Lecture	2 Hrs/week	**MSE**	**ISE**	**ESE**	**Total**
Tutorial	-	30	20	50	100
		Credits: 02			

Course Objectives	
1	Familiarize the students with techniques in probability and statistics.
2	Design a statistical hypothesis about the real world problem and conduct appropriate test for drawing valid inference about the population characteristics.
3	
4	

Course Outcomes (CO) with Bloom's Taxonomy Level		
At the end of the course, the students will be able to,		
CO1	**Apply** computational tools to solve Mathematical and Statistical problems	Apply
CO2	**Solve** problems in probability, statistics.	Apply
CO3		
CO4		

Module	**Module Contents**	**Hours**
I	**Random Variable** Discrete random variable, Continuous random variable, Probability mass function, Probability density function, Bivariate discrete random variable, Joint probability distribution, Joint distribution function of two dimensional discrete random variable, Examples	4
II	**Probability Distribution** Poisson Distribution, Gaussian Distribution, Exponential Distribution, Examples	4
III	**Sampling Distribution** Population, Sample, Random samples, large sample, small sample, Parameter, statistic, standard error of Statistic, sampling distribution of mean, sampling distribution of proportion, Examples	5
IV	**Testing of Hypothesis I** Hypothesis, null and alternative hypothesis, critical region, level of significance, Types of error, one tailed test, two tailed test, test of significance for large samples, Hypothesis testing for single population proportion, hypothesis testing for single population mean, Examples	5
V	**Testing of Hypothesis II** Test of significance for small samples, degrees of freedom, student t distribution: Definition and its properties, Test the significance of mean of random sample, Examples, Chi-square distribution: Definitions and its properties, chi square test, chi square test of goodness of fit, Examples,	5
VI	**Statistics:** Correlation, Linear regression, Curve fitting (a) straight line (b) logarithmic curve,	5

	Examples.	
Textbooks		
1	Gupta and Kapoor, “Fundamentals of Mathematical Statistics”.	
2	Vijay Rohatgi, “An Introduction to Probability and Statistics”.	
3		
4		
References		
1	Sheldon M. Ross, “Introduction to Probability and Statistics for Engineers and Scientists”, Academic Press, (2009)	
2		
3		
4		
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	2	1												
CO2	1	2												
CO3														
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 2022-23

Course Information	
Programme	B. Tech. (Electronics Engineering)
Class, Semester	Second Year B. Tech., Sem. III
Course Code	6EN201
Course Name	Electronic Circuit Analysis and Design-I
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 **explain** the working of electronic circuits: rectifiers, Zener diode voltage regulator, amplifiers using BJT and MOSFETs and feedback amplifiers.
2	To **illustrate** the small signal models used for analysis of electronic circuits.
3	To **illustrate** the methods of designing the electronic circuits using discrete components.
4	

Course Outcomes (CO) with Bloom's Taxonomy Level

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

CO1	**Analyze** the performance of diode circuits.	Analyze
CO2	**Analyze** the performance of electronic circuits (amplifiers) using small signal models such as hybrid-$\boldsymbol{\pi}$, $\boldsymbol{r_e}$ and ***h***-parameter model.	Analyze
CO3	**Evaluate** the performance of feedback amplifiers, oscillators and power amplifiers.	Evaluate
CO4	**Design** the electronic circuits (amplifiers) for given specifications using discrete components such as BJT, FET and MOSFET.	Create

Module	**Module Contents**	**Hours**
I	**Diode Circuits** Rectifier circuits, RC filter circuit, Zener diode voltage regulator, voltage doubler circuit, diode logic circuits, photodiode and LED circuits.	4
II	**BJT Amplifiers** BJTs and its biasing methods considering stability factor; Basic BJT amplifier: DC and AC load line analysis, small signal hybrid-π model: analysis of common emitter (CE), common collector (emitter follower) amplifier and common base (CB) amplifier.	8
III	**JFET Amplifiers** JFET (Junction Field Effect Transistor): operation, characteristics, biasing methods for JFET: self bias, voltage divider bias; small signal equivalent circuit, JFET common source amplifier, JFET common drain amplifier.	5
IV	**MOSFET Amplifiers** Two terminal MOS structure, enhancement-mode MOSFET, ideal current-voltage characteristics, biasing in MOSFET amplifiers, small-signal equivalent circuit, common source (CS) amplifier, common drain (source follower) amplifier and common gate configuration; MOSFET as a switch.	8
V	**Feedback Amplifiers and Oscillators** Multistage amplifiers, Darlington pair, general feedback structure, amplifiers with negative feedback, properties of negative feedback, four basic feedback topologies; Oscillators: basic principle of oscillation, Phase-Shift oscillator; frequency response of amplifiers.	9

VI	**Power Amplifiers** Classification of power amplifiers: class-A, class-B, class-AB, class-C power amplifiers; transformer-coupled amplifiers, class-AB push-pull complementary output stage.	6

Textbooks	
1	D. A. Neamen, "*Electronic Circuit Design and Analysis*", 3rd Edition, McGraw Hill Education (India) Private Limited, New Delhi, 2007.
2	A. S. Sedra and K. C. Smith, "*Microelectronic Circuits*", 5th Edition, Oxford University Press, 2004.
3	Allen Mottershed , "*Electronic Devices and Cir*cuits", 2nd Edition, PHI, 1979.
4	D. A. Neamen, "*Microelectronics: Circuit Analysis and Design*", 4th Edition, McGraw Hill Education (India) Private Limited, New Delhi, 2021.
References	
1	R. Boylestad and L. Nashelsky, "*Electronic Devices and Circuit Theory*", 9th Edition, PHI, 2009.
2	Millman and Halkias, "*Electronic devices and Circuits*", 1st Edition, Tata McGraw Hill, 1991.
3	Gerald E. Williams, "*Practical Transistor Circuit Design and Analysis*", 1st Edition, Tata McGraw Hill, New Delhi, 1973.
4	
Useful Links	
1	https://nptel.ac.in/courses/108105158
2	https://nptel.ac.in/courses/117101106
3	https://nptel.ac.in/courses/108101091
4	

CO-PO Mapping

	Programme Outcomes (PO)												PSO	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	2	3												
CO2	2	3												
CO3		3	3											
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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AY 2022-23

Course Information	
Programme	B.Tech. (Electronics Engineering)
Class, Semester	Second Year B. Tech., Sem III
Course Code	6EN202
Course Name	Circuit Theory
Desired Requisites:	Engineering Mathematics, Basic Electrical Engineering

Teaching Scheme		**Examination Scheme (Marks)**			
Lecture	3 Hrs/week	**MSE**	**ISE**	**ESE**	**Total**
Tutorial	1 Hrs/week	30	20	50	100
		Credits: 4			

Course Objectives	
1	The theoretical structure, formal representation, computational methods, notation, and vocabulary of linear models to be able to apply them to the analysis and design of digital and analog communications and control systems.
2	To perform signal analysis with reference to spectrum analysis of deterministic signals
3	
4	

Course Outcomes (CO) with Bloom's Taxonomy Level		
At the end of the course, the students will be able to,		
CO1	Work with basic fundamentals, theorems used in circuit's analysis	Understanding
CO2	Carry out transient and steady state analysis of different circuits	Analyzying
CO3	Do analysis and synthesis of circuit characteristics	Evaluating
CO4	Design a circuit and network	Creating

Module	**Module Contents**	**Hours**
I	**Network Analysis** Review of fundamentals of circuit components, complex numbers and phasors in circuits, applications to networks, graphs and trees, node and mesh analysis, matrix representations dual and inverse networks, admittance and impedance, state variable analysis, T-II transformations, bridged-T and lattice networks, Network Theorems: Superposition, Millman, Norton, Thevenin, Maximum power transfer, AC and DC analysis.	8
II	**Transient Response of Circuits** RL and RC circuits, switching conditions, RLC circuits, Review of Laplace transform, important theorems and properties, application analysis of circuits in time domain, transfer function, Initial Conditions and Solutions to networks.	8
III	**Sinusoidal Steady State Analysis** The Sinusoidal Forcing Function, Phasor Concept, Average and Effective values of Voltage and Current, Instantaneous and Average Power, Complex Power, Steady State Analysis Using Mesh and Nodal Analysis, Application of Network Theorems to AC Circuits.	6

IV	**Resonance and Magnetically Coupled Circuits** U Series resonance, impedance and phase angle of series resonant circuit, voltage and current in series resonant circuit, effect of resistance on frequency response curve, bandwidth, selectivity and quality factor. Parallel resonance, resonant frequency for tankcircuit, and variation of impedance with frequency factor of parallel resonant circuit, reactance curves. Magnetic coupled circuits: Mutual inductance, coefficient of coupling, single tuned anddouble tuned circuits.	6
V	**Two Port Networks** Open and short circuit parameters, transmission parameters, hybrid parameters, matrix form of input output relations, interaction of two four terminal networks, unsymmetrical networks, propagation functions, lattice networks, balanced and unbalanced networks, bisection theorem.	8
VI	**Network Functions** Concept of complex frequency network functions for one port and two port network, poles and zeros of network functions, restrictions on poles and zeros location for driving point function and transfer function. Time domain behavior from poles and zero plot, stability of active network. Characteristics of RLC and LC high pass, low pass, band pass and band stop filter.	6

Textbooks	
1	Van Valkenburg, "Network Analysis", PHI publication.
2	Leonard S. Bobrow, "Fundamentals of Electrical Engineering", Oxford University Press
3	
4	

References	
1	L.P. Huelsman, "Basic Circuit Theory", PHI Publication, 3rd Edition, 2009.
2	C. K. Alexander, M. N. O. Sadiku, "Electrical Circuits", Tata McGraw-Hill, 2008.
3	Ravish R Singh, "Network Analysis and Synthesis", Tata McGraw-Hill, 2013
4	

Useful Links	
1	
2	
3	
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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	1												
CO2		1	2											
CO3		1		2									3	
CO4			1	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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AY 2022-23

Course Information	
Programme	B.Tech. (Electronics Engineering)
Class, Semester	Second Year B. Tech., Sem III
Course Code	6EN203
Course Name	Digital Electronics
Desired Requisites:	Basic 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 develop the fundamental concepts in digital design.
2	To make differences between combinational and sequential circuits evident to students.
3	To motivate students learn implementation of digital circuits using HDL and PLD.
4	To teach students to develop digital design using VHDL code

Course Outcomes (CO) with Bloom's Taxonomy Level		
At the end of the course, the students will be able to,		
CO1	Differentiate between combinational and sequential circuits	Compare
CO2	Design medium scale combinational and sequential digital circuits	Construct
CO3	Explain various issues like static and dynamic hazards with combinational logic and timing issues like metastability with sequential circuits.	Analyze
CO4	Differentiate between PAL, PLA, PLD and their architecture.	Compare

Module	**Module Contents**	**Hours**
I	**Combinational Logic:** Review of Digital circuits, Quine: Mc-cluskey method for logic minimization, Designs using MUX and Demux, Priority Encoder, Priority decoder, Parity Generator and Checker, Carry look ahead adder, ALU , tristate buffers, timing Hazards,. Hazard removal, Code converter	8
II	**Sequential Logic:** Latches & Flip Flop (S-R Latch, D Latch, D FF, J-K FF, T FF, Conversion of any FF to any other FF, , Switch Denouncing, Synchronous Counters, Mod-N Counter,	8
III	**Shift register**: SISO, SIPO, PISO, PIPO, Bidirectional shift resistor, universal shift register, Johnson counter, universal shift resistor, Ring Counter. twisted ring counters, Timing parameters. Clock Skew, Clock jitter, Meta stability	8
IV	**a) Finite state machines:** Mealy and Moore machines, State diagram, State assignment, Clocked Synchronous State Machines Design using J-K, D, T FF (sequence detector, counters, priority resolver) , decoding counter state , **b) Logic Families:** TTL,CMOS, and their characteristics	8
V	**Programmable Logic Devices**: Design Using PLA & PAL, CPLD architectures, Generic, Xilnx 9500 series, Altera MAX 3000A family	3
VI	**VHDL Constructs:** Introduction to VHDL. Data types and objects, Modelling Dataflow, Behavioural and Structural, VHDL concurrent and sequential	4

Textbooks	
1	"Digital Design", John F. Wakerly,Pearson Education Publication,
2	"Fundamentals of Digital Circuits", Anand Kumar, PHI, 2ndEdition, 2016.
3	"Digital Electronics" Mandal S.K , 1st Ediction. Mc-Graw-Hill
4	"VHDL-Programming by Example" Douglas Perry TMH, 4th Edition

References	
1	“Modern Digital Design”, R..P.Jain, Mc-Graw-Hill
2	“Digital Logic and Computer Design”, Morris Manno, PHI
3	
4	
Useful Links	
1	https://nptel.ac.in/courses/108/105/108105113
2	https://nptel.ac.in/courses/117/106/117106086
3	
4	

CO-PO Mapping

	Programme Outcomes (PO)												PSO	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	1	1												
CO2		1	1	2										2
CO3			1	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 2022-23

Course Information	
Programme	B.Tech. (Electronics Engineering)
Class, Semester	Second Year B. Tech., Sem III
Course Code	6EN204
Course Name	Electronic Instrumentation
Desired Requisites:	-

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

Course Objectives	
1	Understand the required sensor and actuator criteria for a mechatronic system.
2	Understand the operation of commonly employed sensors and actuators.
3	Analyse and select the most appropriate sensors or actuator for an application.
4	Understand working and applications of digital storage oscilloscope and spectrum analyser.

Course Outcomes (CO) with Bloom's Taxonomy Level		
At the end of the course, the students will be able to,		
CO1	Explain fundamental physical and technical base of sensors and actuators.	Understand
CO2	Identify the acquired data and measured results.	Apply
CO3	Analyse the applications of digital storage oscilloscope and spectrum analyser.	Analyze

Module	**Module Contents**	**Hours**
I	**Instrumentation of an Engineering System** Instrumentation of an Engineering System: Role of Sensors and Actuators,Human Sensory System, Mechatronic Engineering, Control System Architectures, Instrumentation Process. Component Interconnection and Signal Conditioning: Signal Modification and Conditioning, Impedance Matching Methods, Data Acquisition Hardware, Bridge Circuits, Linearizing Devices, Signal-Modification Hardware.	4
II	**Performance Specification and Instrument Rating Parameters** Performance Specification, Time-Domain Specifications, Frequency-Domain Specifications, Linearity, Instrument Ratings, Bandwidth Analysis, Aliasing Distortion Due to Signal Sampling, Instrument Error Considerations, Estimation from Measurements, Sensing and Estimation, Least-Squares Estimation.	4
III	**Analog Sensors and Transducers** Sensors and Transducers, Sensors for Electromechanical Applications, Potentiometer, Variable-Inductance Transducers, Permanent-Magnet and Eddy Current Transducers, Variable-Capacitance Transducers., Piezoelectric Sensors, Strain Gauges, Torque Sensors, Gyroscopic Sensors, Thermo-Fluid Sensors.	4
IV	**Digital and Innovative Sensing** Innovative Sensor Technologies, Shaft Encoders, Incremental Optical Encoder, Motion Sensing by Encoder, Encoder Data Acquisition and Processing, Absolute Optical Encoders, Encoder Error, Optical Sensors, Lasers, and Cameras, Miscellaneous Sensor Technologies, Tactile Sensing, MEMS Sensors, Sensor Fusion, Wireless Sensors	4

V	**Special Oscilloscopes** Delayed Time Base oscilloscopes, Analog storage oscilloscopes, Sampling oscilloscopes, Digital storage oscilloscopes, DSO Applications	4
VI	**Waveform Analyzing Instruments** Spectrum Analyzer , Digital Spectrum Analyzer	4

Textbooks	
1	B. P. Lathi and Jeff Kennedy, "Modern Digital and Analog Communication Systems", Third edition, Oxford University Press, 1998, ISBN: 12345678
2	Straus, Joseph Nathan, "Elements of Communication", Third edition, Prentice Hall, 2011, ISBN: 12345678
3	
4	

References	
1	Pawlak, Andrzej M.,Sensors and actuators in mechatronics : design and applications, CRC Press, Taylor & Francis Group, 2007.
2	Ranganathan S.," Transducer Engineering", Allied Publishers (P) Ltd., 2003
3	
4	

Useful Links	
1	Onlinecourses.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												
CO2			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 2022-23

Course Information	
Programme	B.Tech. (Electronics Engineering)
Class, Semester	Second Year B. Tech., Sem III
Course Code	6EN255
Course Name	Data Structures and Algorithms Lab
Desired Requisites:	Programming basics, C programming

Teaching Scheme		**Examination Scheme (Marks)**			
Practical	2 Hrs/ Week	**LA1**	**LA2**	**Lab ESE**	**Total**
Interaction	2 Hrs/ Week	30	30	40	100
		Credits: 3			

Course Objectives	
1	An ability to describe basic concepts of Data structures
2	To apply knowledge of engineering, information technology, mathematics, and science
3	An ability to design a system or component, or process to meet stated specifications
4	An ability to identify, formulate and solve engineering problems

Course Outcomes (CO) with Bloom's Taxonomy Level

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

CO1	Demonstrate different data structures and need of searching and sorting techniques.	Understand
CO2	Implement Static and dynamic data structures stack and queue, searching and sorting algorithms.	Apply
CO3	Examine the complexity of data structures, searching and sorting algorithms.	Analyze

List of Experiments / Lab Activities/Topics

List of Topics

Introduction

Basic Concepts: Algorithm, Pseudo code, ADT, Data Structure, Algorithmic Efficiency Recursion: Direct and Indirect recursion, analysis of recursive functions.

Linked Lists

Concept of linked organization, Singly linked list, doubly linked list and dynamic storage management, circular linked list, Operations such as insertion, deletion, inversion, concatenation

Stacks and Queues

Fundamentals stack and queue as ADT, Representation and Implementation of stack and queue Application of stack for expression evaluation and for expression conversion, Backtracking.

Trees & Graphs

Tree: Basic terminology, binary trees and its representation, binary tree traversals (recursive and non-recursive), operations such as copy, equal on binary tree, expression trees, General Trees.

Graphs: Terminology and Representation of graphs using adjacency matrix, adjacency list and adjacency Multilist, Traversals Depth First and Breadth First.

Searching & Sorting:

Search: Importance of searching, Sequential, Binary, Fibonacci search algorithms.

Sorting: Internal and External Sorts, Insertion, Shell, Heap, Quick sort, Mergesort, Radix sort,

List of Lab Activities:

1. Programs to revise arrays, structures and pointers
2. Programs to study different file operations opening files, closing files, writing a file, reading file
3. Program to implement algorithm and observing complexity measures
4. Program to implement singly linked list with all operations
5. Program to implement doubly linked list with all operations
6. Program to implement Stack
7. Program to implement Queue
8. Program to implement applications of Stack (Expression evaluation and string reversing)
9. Programs to Search the data with complexity
10. Implementation of binary search tree

Textbooks	
1	“Fundamentals of Data structures in C++”, S.Sahni and D.Mehta, Galgotia BookSource
2	Richard F. Gilberg, Behrouz A. Forouzan, "Data Structures A pseudo code approach with C".
3	
4	
References	
1	“Data Structures and Algorithm Analysis in C++” M.Weiss, Pearson Education, 2002.
2	N. B. Venkateshwarlu, E. V. Prasad, C and Data Structures, S. Chand and Company, 2010
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			2	2	2				2					
CO2			2	2	2				2					
CO3			2	2	2				2				2	
CO4														
The strength of mapping is to be written as 1,2,3; where, 1: Low, 2: Medium, 3: High Each CO of the course must map to at least one PO, and preferably to only one PO.														

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

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AY 2022-23

Course Information	
Programme	B. Tech. (Electronics Engineering)
Class, Semester	Second Year B. Tech., Sem. III
Course Code	6EN251
Course Name	Electronic Circuit Analysis and Design-I Laboratory
Desired Requisites:	Basic Electronics Engineering

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 **explain** the working of electronic circuits like rectifiers, amplifiers (voltage and current), power amplifiers and feedback amplifiers using BJT, FET and MOSFETs.
2	To **illustrate** the methods of designing the electronic circuits using discrete components.
3	To **explain** the practical ways of **measuring** AC and DC parameters of electronic circuits like amplifiers for their performance analysis.
4	

Course Outcomes (CO) with Bloom's Taxonomy Level

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

CO1	**Demonstrate** the working of electronic circuits: rectifiers, Zener diode voltage regulator, and amplifiers built using BJT, JFET and MOSFET.	Apply
CO2	**Test** and **analyze** the performance of amplifiers built using BJT, JFET and MOSFET.	Analyze
CO3	**Evaluate** the performance of voltage, current, power and feedback amplifiers.	Evaluate
CO4	**Design** the electronic circuits (amplifiers) for given specifications using discrete components such as BJT, FET and MOSFET.	Create

List of Experiments / Lab Activities/Topics

List of Topics(Applicable for Interaction mode):

List of Lab Activities: (Minimum 8 experiments)

1. Analyze the performance rectifier circuits.
2. Zener diode I-V characteristics and design a Zener diode voltage regulator.
3. Design and analysis of single stage common emitter BJT amplifier. Plot the frequency response of amplifier.
4. Design and analysis of single stage common collector (emitter follower) amplifier.
5. Analyze the performance of common source JFET amplifier.
6. Biasing methods for MOSFET and MOSFET as a switch.
7. Design and analysis of common source MOSFET amplifier.
8. Design and analysis of common drain (source follower) MOSFET amplifier.
9. Study of performance of Darlington pair.
10. Design and analysis of two stage BJT amplifier with negative feedback.
11. Design and analysis of class-A power amplifier using BJT/MOSFET.
12. Design and analysis of class-AB power amplifier.
13. Analyze the performance RC Phase-Shift Oscillator.

Textbooks

1	D. A. Neamen, "*Electronic Circuit Design and Analysis*", 3rd Edition, McGraw Hill Education (India) Private Limited, New Delhi, 2007.
2	A. S. Sedra and K. C. Smith, "*Microelectronic Circuits*", 5th Edition, Oxford University Press, 2004.
3	Allen Mottershed , "*Electronic Devices and Cir*cuits", 2nd Edition, PHI, 1979.
4	D. A. Neamen, "*Microelectronics: Circuit Analysis and Design*", 4th Edition, McGraw Hill Education (India) Private Limited, New Delhi, 2021.

References	
1	R. Boylestad and L. Nashelsky, "*Electronic Devices and Circuit Theory*", 9th Edition, PHI, 2009.
2	Millman and Halkias, "*Electronic devices and Circuits*", 1st Edition, Tata McGraw Hill, 1991.
3	Gerald E. Williams, "*Practical Transistor Circuit Design and Analysis*", 1st Edition, Tata McGraw Hill, New Delhi, 1973.
4	

Useful Links	
1	https://nptel.ac.in/courses/122106025
2	https://nptel.ac.in/courses/108105158
3	https://nptel.ac.in/courses/117101106
4	

CO-PO Mapping

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

Walchand College of Engineering, Sangli

(Government Aided Autonomous Institute)

AY 2022-23

Course Information

Programme	B.Tech. (Electronics Engineering)
Class, Semester	Second Year B. Tech., Sem III
Course Code	6EN252
Course Name	Digital Electronics Lab
Desired Requisites:	Basic Electronics Engineering

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 explain the importance of the HDL for Digital Design
2	To demonstrate the complete flow of EDA tool for implementing digital designs
3	To explain the concepts involved in simulation and synthesis of digital circuits using EDA tool
4	

Course Outcomes (CO) with Bloom's Taxonomy Level

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

CO1	Able to write & debug the VHDL code	Understand
CO2	Able to implement on kits	Apply

List of Experiments / Lab Activities/Topics

List of Topics(Applicable for Interaction mode):
List of Experiments:

1. Experiment 1: Introduction to Xilinx
2. Experiment 2: 1 bit full adder using 1 bit half adder as a component
3. Experiment 3: 4 bit full adder using 1 bit full adder as a component
4. Experiment 4: 1 bit full adder using 8:1 multiplexer as component
5. Experiment 5: 1 bit full adder using 1:8 demux as component
6. Experiment 6: Implementation of 4:1 mux using 2:1 mux as a component
7. Experiment 7: Implementation of demultiplexer IC 74138
8. Experiment 8: 4 bit comparator
9. Experiment 9: Implementation of flip flops
10. Experiment 10: UP counter and DOWN counter
11. Experiment 11: MODN counter
12. Experiment 12: UP-DOWN counter
13. Experiment 13: Shift registers
14. Experiment 14: Universal shift register
15. Experiment 15: Parallel loading shift register
16. Experiment 16: Sequence detector
17. Experiment 17: Creation of project in Quartus-II & download

Textbooks

1	John F. Wakerly, "Digital Design", Pearson Education Publication, 5th edition, 2018.
2	Anand Kumar, "Fundamentals of Digital Circuits", PHI, 2ndEdition, 2009
3	Mandal S.K , "Digital Electronics" Mc-Graw-Hill, 1stEdiction., 2009
4	Douglas Perry, "VHDL-Programming by Example" TMH, 4th Edition, 2012

References

1	R.P.Jain, “Modern Digital Design”, Mc-Graw-Hill, 4th edition, 2010
2	Morris Manno, “Digital Logic and Computer Design”, Prentice-Hall India, 1st edition 2011
3	
4	
Useful Links	
1	https://nptel.ac.in/courses/108/105/108105113
2	https://nptel.ac.in/courses/117/106/117106086
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		2	2									1
CO2		1	1											1

The strength of mapping is to be written as 1,2,3; where, 1: Low, 2: Medium, 3: High
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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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(Government Aided Autonomous Institute)

AY 2022-23

Course Information

Programme	B. Tech. (Electronics Engineering)
Class, Semester	Second Year B. Tech., Sem. III
Course Code	6EN253
Course Name	Python Programming
Desired Requisites:	Programming for Problem Solving

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

Course Objectives

1	To define the significance of Python in programming.
2	To demonstrate use of computer language constructs and principles such as: conditional branching loops, block structures, functions, and input/output for implementing programs to Solve problems.
3	To make use of the different libraries of Python

Course Outcomes (CO) with Bloom's Taxonomy Level

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

CO1	**Illustrate** the features of Python programming.	**Apply**
CO2	**Implement** programs using Python language in a programming environment/using programming tool to solve problems.	**Apply**
CO3	**Examine** a given program to identify its output.	**Analyze**
CO4	**Demonstration** applications implemented using Embedded Systems and Python.	**Create**

List of Experiments / Lab Activities/Topics

List of Topics:

1) Installing and Using Python
2) Variables, operators, expressions and statements Using Python
3) Conditional statements Using Python
4) Functions Using Python
5) Loops and Iteration Using Python
6) String and string operations Using Python
7) File handling Using Python
8) Lists and Dictionaries in Python
9) Tuples in Python
10) Python Libraries
11) Data structure application example using Python
12) Web based application demonstration Using Python

List of Lab Activities:

1) Python IDE installation and first python program.
2) Programs to implement expressions using Python.
3) Programs to study different conditional statements using Python.
4) Programs to study functions using Python.
5) Programs to study loops and iterations using Python.
6) Programs to study string and string operations using Python.
7) Programs to study file handling using Python.
8) Programs to study lists and dictionaries in Python.
9) Programs to study tuples in Python.
10) Programs based on NumPy library.
11) Programs to demonstrate data structure example.
12) Programs to demonstrate web based application.
13) Mini Project

Textbooks	
1	R. Nageswara Rao, "Core Python Programming", Dreamtech Press, 2nd Edition, 2017
2	Eric Matthes, "Python Crash Course – A Hands-on, Project-Based Introduction to Programming", No Starch Press, 2nd Edition, 2019
3	Kenneth Lambert, "Fundamentals of Python: First Programs" Course Technology, Cengage Learning.2nd edition, 2017
References	
1	Barry, Paul, Head First Python, O Rielly,2nd Edition, 2010
2	2 Lutz, Mark, Learning Python, O Rielly, 4th Edition, 2009
Useful Links	
1	https://swayam.gov.in/
2	https://in.coursera.org/
3	https://www.tutorialspoint.com/
4	https://www.javatpoint.com/

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				2									
CO3		2			2									
CO4			2		2									
1: Low, 2: Medium, 3: High														

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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(Government Aided Autonomous Institute)

AY 2022-23

Course Information

Programme	B.Tech. (Electronics Engineering)
Class, Semester	Second Year B. Tech., Sem IV
Course Code	6EN221
Course Name	Electronic Circuit Analysis and Design - II
Desired Requisites:	Electronic Circuit Analysis and Design - I

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 working of differential amplifier and operational amplifier.
2	To **illustrate** the methods used for analysis of op-amp based circuits.
3	To **explain** the use of op-amp in linear and non-linear industrial circuits.
4	To **explain** the working of and **design methods** for voltage regulators.

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 Descriptor
CO1	**Apply** the fundamentals of OpAmp to calculate the circuit conditions, and illustrate functioning of various linear and nonlinear application circuits, such as amplifiers, waveform generators, precision rectifiers, PLL etc.	III	Applying
CO2	**Analyze** the OpAmp based circuits considering ideal OpAmp and also with effect of practical limitations of OpAmp on the circuit output.	IV	Analysing
CO3	**Evaluate** the performance of OpAmp based electronic circuits (Amplifiers, Waveform generators, active filters)	V	Evaluating
CO4	**Design** OpAmp based circuits considering practical limitations and as per given specifications.	VI	Creating

Module	Module Contents	Hours
I	**Operational Amplifier** Amplifier fundamentals, differential amplifier, basic op-amp configuration, op-amp powering, feedback in op-amp circuits, ideal op-amp circuit analysis.	5
II	**Basic OpAmp Circuits** Inverting and Non-inverting amplifiers, adder, subtractor, voltage to current converters, current to voltage converters, instrumentation amplifier, transducer bridge amplifier, Log/Antilog amplifier. Design process of opamp based circuits considering ideal opamp.	8
III	**OpAmp Practical Limitations** Simplified op-amp circuit diagram, input bias and offset current, input offset voltage, input offset error compensation, low input bias op-amp, open loop response, closed loop response, transient response; sources of noise, stability in op-amp circuits, frequency compensation. Design of opamp circuits (studied) considering practical limitations, including output swing and power supply. How to read the data sheet.	6
IV	**OpAmp based filter Circuits** Opamp as Integrator and Differentiator, Advantage of active filter, First order active filter, standard second order active filters. Design of simple active filters.	4

V	**Comparator and Waveform Generators** Voltage Comparator, Schmitt triggers and applications, peak detector, sample and hold circuit, Sine wave generators, multi-vibrators, triangular wave generators, saw tooth wave generators, monolithic waveform generators, V to F and F to V converter. Design of comparator and waveform generator circuits.	8
VI	**Voltage Regulator and PLL** Precision rectifier, Linear regulators, Linear regulator applications, . Design of OpAmp based linear voltage regulator. Principle of Switching regulator, Phase locked loop, Analog and digital phase detector, Monolithic PLLs: NE565, CD4046.	8

Textbooks	
1	Sergio Franco, "*Design with op-amp and analog integrated circuits*", Tata McGraw Hill, New Delhi.
2	Robert F. Coughlin and Frederick F. Driscoll, "*Operational amplifiers and linear integrated circuits*", PHI.

References	
1	Ramakant Gaikwad,"*Op-amp and Linear Integrated Circuits*", Pearson Education India, ISBN: 9789332549913
2	Tobey and Gramme, "*Operational Amplifiers*", McGraw-Hill; First Edition, ISBN: 978-0070649170
3	D. Roy Choudhury and S. B. Jain, "*Linear Integrated Circuits*", New Age International Publishers, 4th Edition, 2017, ISBN: 9788122430981

Useful Links	
1	https://www.tutorialspoint.com/semiconductor_devices/semiconductor_devices_operational_amplifiers.htm
2	https://www.allaboutcircuits.com/video-tutorials/op-amp-basics-introduction-to-the-operational-amplifier/
3	https://web.mit.edu/6.101/www/reference/op_amps_everyone.pdf
4	https://www.ti.com/amplifier-circuit/op-amps/products.html

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											3	
CO3		3											3	2
CO4			3							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)

Walchand College of Engineering, Sangli

(Government Aided Autonomous Institute)

AY 2022-23

Course Information	
Programme	B.Tech. (Electronics Engineering)
Class, Semester	Second Year B. Tech., Sem IV
Course Code	6EN222
Course Name	Signals and Systems
Desired Requisites:	Engineering Mathematics, Basic Electrical Engineering

Teaching Scheme		**Examination Scheme (Marks)**			
Lecture	3 Hrs/week	**MSE**	**ISE**	**ESE**	**Total**
Tutorial	1 Hrs/week	30	20	50	100
		Credits: 4			

Course Objectives	
1	On completion of the course, students should be sufficiently familiar with the theoretical structure, formal representation, computational methods, notation, and vocabulary of linear models to be able to apply them to the analysis and design of digital and analog communications and control systems. The students will be able to perform signal analysis with reference to spectrum analysis of deterministic signals.
2	
3	
4	

Course Outcomes (CO) with Bloom's Taxonomy Level

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

CO1	Demonstrate the concept of signals and systems.	Understand
CO2	Examine the response of linear systems in the time domain.	Analyze
CO3	Evaluate systems in the frequency domains.	Evaluate
CO4	Use frequency domain techniques to solve input/output problems for linear time invariant systems.	Create

Module	**Module Contents**	**Hours**
I	**Introduction to Signals and Systems – Continuous and Discrete** Introduction, standard signals, signal representation, classification of signals, systems – representation, classification, Linear, Time invariant, causal, BIBO stable, Static, dynamic.	8
II	**Time Domain Analysis of Continuous and Discrete Time Systems** Zero state and Zero input response, Impulse response, Convolution integral and convolution sum, graphical representation of convolution.	7
III	**Fourier Domain Analysis of Continuous Time Signal** Trigonometric Fourier series, Compact Trigonometric Fourier series, Exponential form, Dirichlet Conditions, Frequency domain representation of periodic signals, Fourier Transform representation of aperiodic signals, Properties of CFT duality, time reversal, Convolution – time and frequency domain, etc.	6
IV	**Laplace Transform Analysis of Signals and System** Definition, Properties, Solution of differential equation. Transfer function, Poles and Zeroes, System analysis using Laplace Transform, min-max phase systems	4

V	**Fourier Domain Analysis of Discrete Time Signal** Representation of CT signals using Samples, Nyquist Sampling Theorem Discrete time Fourier Transform, Representation of aperiodic sequence, Properties of DTFT: time reversal, Linear Convolution – time and frequency domain, conjugate symmetry. Discrete Fourier Transform: Definition and Properties	8
VI	**Z Transform Analysis of Discrete Time Signals and Systems** Definition, Properties, Solution of difference equation. Transfer function, Poles and Zeroes, System analysis using Z-Transform, Minimum phase – maximum phase system, FIR, IIR systems, All pass systems, Zero phase systems, Chirp-Z Transform	7

Textbooks	
1	A.V. Oppenheim, A.S. Willsky, S.H. Nawab, Signals and Systems, Prentice Hall,1997.
2	Ashok Ambardar, Analog and Digital Signal Processing, CL Engineering, 1999
3	
4	
References	
1	B. P. Lathi, Linear systems and signals ,Oxford University press, 2005
2	M. J. Roberts , Signals and Systems, Tata McGraw-Hill, 2005
3	Simon Haykin, Barry Van Veen, Signals and systems ,Wiley, 2003
4	Hwei P Hsu, Schaum's Outline Signals and Systems, Tata McGraw-Hill, 1995
Useful Links	
1	
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	1	1												1
CO2		1	1											1
CO3					2									1
CO4		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 2022-23

Course Information	
Programme	B.Tech. (Electronics Engineering)
Class, Semester	Second Year B. Tech., Sem IV
Course Code	6EN223
Course Name	Communication Engineering I
Desired Requisites:	Basic Electronics Engineering, Engineering Mathematics

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

Course Objectives	
1	To introduce the techniques of transmitting and receiving information signals using analog carrier modulation techniques and evaluate their performance levels (SNR) in the presence of channel noise.
2	To establish foundation for understanding the relationship among various technical factors useful for designing communication system.
3	
4	

Course Outcomes (CO) with Bloom's Taxonomy Level		
At the end of the course, the students will be able to,		
CO1	Analyze different components of analog communication	Analyze
CO2	Systems such as modulator, demodulator, mixer, receiver etc. in time and frequency domain.	Understand
CO3	Compare analog and digital communication systems on the basis of bandwidth, power requirement and the performance in the presence of	Understand
CO4		

Module	**Module Contents**	**Hours**
I	**Amplitude Modulation and Demodulation** DSB-FC, DSB-SC, SSB, VSB and ISB transmissions: mathematical Analysis-time and frequency domain analysis, modulation index, generation and detection methods, power requirement of these systems, Comparison of AM modulation schemes, Quadrature Carrier Multiplexing(QAM), frequency division Multiplexing, AM detection : envelope detection, Demodulation of DSBSC : synchronous detection.	9
II	**Frequency Modulation and Demodulation** Frequency Modulation (FM),: Single Tone Frequency Modulation, Spectrum Analysis, Narrowband FM, Wideband FM, Transmission Bandwidth of FM Waves, Generation of FM waves: Direct and Indirect Methods, Demodulation of FM, Phase Locked Loops, Limiting of FM waves, comparison between AM & FM, Phase Modulation, Relation between FM and PM.	9
III	**Sampling theorem and Pulse Modulation Techniques** Sampling theorem, Types of sampling, Inter symbol interferences, Modulation & Demodulation of PAM, PWM, PPM, merits & demerits, Introduction to PCM system, quantization of signals, Differential PCM, Delta Modulation, Adaptive Delta Modulation.	4
IV	**Digital Data Transmission** Definition of Line Coding, various line codes, unipolar, bipolar RZ and NRZ techniques, split phase manchester formats	5

V	**Digital Modulation Techniques** Coherent Quadrature Modulation Techniques, Non Coherent Binary Modulation Techniques, Comparison of Binary and Quaternary Modulation Techniques; M array modulation Techniques, Power spectra, Bandwidth efficiency, M array Modulation formats Viewed in the light of channel Capacity theorem, Effect of inters symbol interference.	6
VI	**Noise** Classification and sources of noise, signal to noise ratio (SNR), noise analysis and measurements, equivalent noise bandwidth, noise figure, noise temperature, AWGN.	6

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	Taub Schilling, "Principle of communication system", TMH publication, 4th Edition, 2013
4	

References	
1	Simon Hykin, "Communication System", 4th Edition, John Wiley & Sons, 2000
2	B. P. Lathi, "Modern Digital and Analog Communication Systems", Oxford Publications, 3rd Edition, 1998
3	George Kennedy, "Electronic Communication System", McGraw Hill, 4th Edition, 2009
4	

Useful Links	
1	
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		2	2										3	
CO3			2										2	
CO4														

The strength of mapping is to be written as 1: Low, 2: Medium, 3: High
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Assessment

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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 2022-23

Course Information	
Programme	B. Tech. (Electronics Engineering)
Class, Semester	Second Year B. Tech., Sem. IV
Course Code	6EN224
Course Name	Microcontroller and Peripheral Interfacing
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 difference between Intel 8085 microprocessor and Intel 8051 microcontroller.
2	To explain Intel 8051 microcontroller and its programming in assembly and 8051 C language.
3	To explain interfacing of external devices with Intel 8051 and 8051 C programming.
4	To explain design and development of microcontroller based system.

Course Outcomes (CO) with Bloom's Taxonomy Level

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

CO1	**Illustrate** the architecture of 8051 Microcontroller in comparison with 8085 Microprocessor.	**Apply**
CO2	**Demonstrate** situation-based interfacing of external devices with Intel 8085.	**Apply**
CO3	**Write** assembly and C language programs for Intel 8051 to meet given system requirements.	**Analyze**
CO4	**Design** 8051 microcontroller based system.	**Create**

Module	**Module Contents**	**Hours**
I	**Microprocessor vs. Microcontroller** Introduction of Microprocessor and Microcontroller; Block diagram of 8085 and 8051; function of each pin of 8085 and 8051; Architectural difference between 8085 and 8051; features and applications of 8085 and 8051.	4
II	**Microcontroller Programming** Microcontroller Programming basics; 8051 assembly language programming; Instruction set; Instruction types; Addressing modes; 8051 C programming; Features and advantages of 8051 C programming; Programming examples for both; Use of Development tools for Intel 8051.	8
III	**External Peripheral Interfacing** Port structure of 8051; Interfacing led and switch with 8051; Interfacing devices like relay, DC motor, Stepper motor, seven segment display, character LCD, DAC0808, digital sensors, analogue sensors through ADC0808; External memory interface; Writing algorithm and C program for interfaces.	8
IV	**Internal Peripherals** 8051 Timer and its working, Timer modes, Programming timer as timer in C, Programming timer as counter in C; 8051 UART and its working, Serial communication modes, Programming UART in C; 8051 Interrupts sources, Interrupt flags, Vector addresses, Interrupt structure, Interrupt blocking conditions, Interrupt priorities, Interrupt latency, Interrupt configuration, Writing an Interrupt Service Routine in C.	8
V	**Microcontroller Based System Design** System requirements; Selection of components; Interface design; Flow chart design; Writing Algorithm; Writing C program for system; Design examples like Temperature controller etc.	8

VI	**RISC Microcontrollers** Introduction to RISC architecture; Block diagram of PIC microcontroller; Architectural difference between PIC controller and 8051; PIC microcontroller features.	3

Textbooks	
1	Kenneth J. Ayala,The 8051 Microcontroller Architecture, Programming and Applications, 2nd Edition, Penram International Publication, revised edition 2009
2	Mohammad Ali Mazidi, The 8051 Microcontroller and Embedded Systems, Pearson Education, 2nd edition, 2010.
3	John B. Peatman, Design with PIC microcontrollers, Pearson Education, 1st edition, 2003
4	Ramesh Gaonkar, Fundamentals of Microcontrollers and Applications in Embedded Systems, Penram International Publication(India), 2010
References	
1	Intel 8085 and 8051 datasheet (www.intel.com)
2	Keil A51 and C51 manuals
3	PIC16F877A datasheet (www.microchip.com)
4	Hi-Tech C Compiler manual
Useful Links	
1	https://nptel.ac.in/
2	https://in.coursera.org/
3	https://www.tutorialspoint.com/
4	https://www.javatpoint.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											1
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 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 2022-23

Course Information

Programme	B.Tech. (Electronics Engineering)
Class, Semester	Second Year B. Tech., Sem IV
Course Code	6EN225
Course Name	Control Systems
Desired Requisites:	Basic Electronics

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

Course Objectives

1	To provide fundamentals of Control systems such as open loop and closed loop systems,Block diagram, Signal flow graph etc.
2	To introduce fundamentals of time and frequency domain analysis.
3	To develop concept of stability in time and frequency domain.
4	

Course Outcomes (CO) with Bloom's Taxonomy Level

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

CO1	**Compare** open and closed loop systems, first, second and higher order systems.	Understanding
CO2	**Apply** Block diagram and signal flow graph techniques and compensating networks	Applying
CO3	**Draw and Examine** systems using Routh-Hurwitz criteria, Root locus, Bode plots, and state space model.	Analyzing

Module	**Module Contents**	**Hours**
I	**Introduction:** Mathematical models of physical system , Open and Closed loop systems, regenerative feedback, Transfer function, Block diagram and reduction techniques, signal flow graph, Transfer function of physical systems, control system components	6
II	**Time response Analysis** Standard test signals, time response of second order system, steady state errors and error constants, design specifications of second order system. Preliminary design considerations of Compensators need of compensation, lead compensations, lag compensation, lag-lead compensation.	7
III	**Stability Analysis in Time Domain** Concept of stability, condition of stability, characteristic equation, relative stability, Routh-Hurwitz criterion, special cases for determining relative stability.	7
IV	**Root locus techniques** Basic concept, rules of root locus, application of root locus technique for control systems.	7
V	**Frequency Response Analysis** Polar plots, Bode plots, Nyquist stability criterion, gain margin, phase margin, effect of addition of poles and zeros on bode plots.	7
VI	**Analysis of Control Systems in State – Space** Basic concepts of state, state variable and state models, transfer matrix, Controllability, observability, obtaining state space equations in canonical form.	6

Textbooks

1	*"*Modern Control Engineering*",* Katsuhiko Ogata, 5th Edition, Prentice Hall, 2015.
2	"Control System Engineering", I.J. Nagrath, M. Gopal, 5th Edition, New Age International Publications, 2008.
3	"Modern Control System", Dorf, Bishop, 12th Edition, Prentice Hall, 2013.
4	

References	
1	"Electronic Measurement and Instrumentation", Oliver Cage, Tata McGraw Hill Publication.
2	"Modern Control System", Dorf, Bishop, 12th Edition, Prentice Hall, 2013
3	"Feedback and Control Systems", Schaum's Outlines Series book, 2nd Edition, McGrawHill Education, 2012.
4	

Useful Links	
1	https://swayam.gov.in/
2	https://in.coursera.org/
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												
CO3		3	3											2
CO4														

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

Assessment

The assessment is based on MSE, ISE and ESE.
MSE shall be typically on modules 1 to 3.
ISE shall be taken throughout the semester in the form of teacher's assessment. Mode of assessment can be field visit, assignments etc. and is expected to map at least one higher order PO.
ESE shall be on all modules with around 40% weightage on modules 1 to 3 and 60% weightage on modules 4 to 6.
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AY 2022-23

Course Information

Programme	B.Tech. (Electronics Engineering)
Class, Semester	Second Year B. Tech., Sem IV
Course Code	6EN271
Course Name	Electronic Circuit Analysis and Design – II Lab
Desired Requisites:	Electronic Circuit Analysis and Design – I Lab

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 **illustrate demonstrate,** proper use of instruments and simulator software.
2	To **explain** the process of constructing a circuit and verifying working of circuits mentioned in the experiment list.
3	To **illustrate** the methods used for analysis and design of OpAmp based circuits.
4	To **Illustrate** how to perform the experiment and how to document the results.

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 Descriptor
CO1	**Use** the required instruments, with proper theoretical understanding of the instruments and modern tools such as circuit simulation software. (Skills of using Conventional as well as Modern Tools)	III	Applying
CO2	**Examine practically** the performance of a given OpAmp based circuit, do correct calculations, draw correct inference and properly write the conclusions. (experiential learning)	IV	Analysing
CO3	**Design** simple OpAmp based applications using the circuits studied in related theory course, and as per given problems. (independent thinking, experiential learning)	VI	Creating
CO4	**Prepare the documentation** of proper observations, neat graphs, writing conclusion in grammatically and technically correct language, explain orally the circuit operation and process of performing the experiments in correct technical language. (Present and defend, measure, assess, interpret and conclude, communication skills)	VI	Creating

List of Experiments / Lab Activities/Topics

List of lab Activities:

Activities 1 to 10 shall involve performing the analysis and design various circuits and verifying the performance practically using actual hardware (in person lab) or using simulation tools (in case of online lab), documenting the results and performing related activities (as given in lab manual, as home-work)

1. Course Info, Analysis and Design of Transistorized difference amplifier
2. Analysis and Design of Inverting, Non-inverting amplifier,
3. Analysis and Design of Adder Circuits
4. Analysis and Design of Subtractor and Instrumentation Amplifier
5. Designing with Practical Limitations of OpAmp
6. How to read Datasheet of OpAmp
7. Analysis and Design of Active Filters
8. Analysis and Design of Schmitt trigger and Square-Triangular Generator
9. Analysis and Design of Precision rectifier
10. Analysis and Design of Linear Regulated Power Supply
11. Demonstration of Phase Locked Loop

Textbooks	
1	Sergio Franco, "*Design with op-amp and analog integrated circuits*", Tata McGraw Hill, New Delhi.
2	Robert F. Coughlin and Frederick F. Driscoll, "*Operational amplifiers and linear integrated circuits*", PHI.
3	Lab Manual of this course
References	
1	Ramakant Gaikwad,"*Op-amp and Linear Integrated Circuits*", Pearson Education India, ISBN: 9789332549913, Fourth Edition, 2015.
2	Tobey and Gramme, "*Operational Amplifiers*", McGraw-Hill; First Edition, ISBN: 978-0070649170, 1971 (Classic book)
3	D. Roy Choudhury and S. B. Jain, "*Linear Integrated Circuits*", New Age International Publishers, 4th Edition, 2017, ISBN: 9788122430981, 2017.
4	
Useful Links	
1	https://www.allaboutcircuits.com/video-tutorials/op-amp-basics-introduction-to-the-operational-amplifier/
2	https://web.mit.edu/6.101/www/reference/op_amps_everyone.pdf
3	https://www.ti.com/amplifier-circuit/op-amps/products.html

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											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 2022-23

Course Information	
Programme	B.Tech. (Electronics Engineering)
Class, Semester	Second Year B. Tech., Sem IV
Course Code	6EN273
Course Name	Communication Engineering I Lab
Desired Requisites:	Basic Electronics Engineering, Engineering Mathematics

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

Course Objectives

1	To illustrate different components of analog communication systems such as modulation, demodulation, sampling, antenna etc
2	To enable the students for design and development of applications of communication system
3	
4	

Course Outcomes (CO) with Bloom's Taxonomy Level

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

CO1	Analyze the performance of different modulation and demodulation schemes in terms of bandwidth, power requirement presence of noise.	Analyze
CO2	Compare the performance of different sampling methods, antenna.	Understand
CO3	Demonstrate a small communication system using software packages (MATLAB, Emona Datex board)	Apply
CO4		

List of Experiments / Lab Activities/Topics

List of Topics(Applicable for Interaction mode):-

List of Lab Activities:

1. Spectrum analyzer
2. AM Transmitter/ Receiver

a. DSB-FC system

b. DSB – SC system

3. FM Transmitter/ Receiver

a. Reactance and varactor modulator

b. PLL, quadrature, Foster- Seeley and detuned resonance detectors

4. Sampling theorem and reconstruction
5. Pulse Modulation and demodulation

a. PAM, PWM,PPM techniques

6. PCM Modulation and Demodulation
7. Digital Data Transmission Techniques
8. Digital Modulation Techniques
9. Experiments on MATLAB
10. Experiments on National Instrument's Emona Datex Board

Textbooks

1	George Kennedy , "Electronic Communication System", McGraw Hill, 4th Edition, 2009
2	Roy Blake , "Electronic Communication System", Thomson Publications, 2nd Edition,2002

3	Taub Schilling, "Principle of communication system", TMH publication, 4th Edition, 2013
4	
References	
1	Wayne Tomasi ,"Adavnced Electronic Communications Systems", Pearson education, 5th Edition,2014
2	Simon Hykin, "Communication System", 4th Edition, John Wiley & Sons, 2000
3	B. P. Lathi, "Modern Digital and Analog Communication Systems", Oxford Publications, 3rd Edition, 1998
4	
Useful Links	
1	
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					2									2
CO3					3				2				2	
CO4														

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

Assessment

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

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

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AY 2022-23

Course Information	
Programme	B. Tech. (Electronics Engineering)
Class, Semester	Second Year B. Tech., Sem. IV
Course Code	6EN274
Course Name	Microcontroller and Peripheral Interfacing Lab
Desired Requisites:	Digital Electronics Lab, Data Structures and Algorithm Lab

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 explain debugging of an assembly and 8051 C program for 8051 microcontroller in keil micro-vision C51IDE
2	To show downloading and testing of 8051 C program for 8051 microcontroller using development board.
3	To explain development of 8051 C program for implementing given system requirements using 8051 microcontroller

Course Outcomes (CO) with Bloom's Taxonomy Level

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

CO1	**Use** keil micro-vision C51 IDE to debug an assembly and C programs for 8051 microcontroller.	**Apply**
CO2	**Write** a program for on chip peripheral configuration and external peripheral interfacings.	**Apply**
CO3	**Test** C programs written for 8051 microcontroller using development board.	**Analyze**
CO4	**Design** of an 8051 microcontroller based application.	**Create**

List of Experiments / Lab Activities/Topics

List of Lab Activities:

1. Introduction to software tool and hardware of 8051
2. Assembly language programs to perform different operations, implement if else, for loop, while loop, logic gates and to study block transfer
3. 8051 C program for LED blinking and operating LED using SWITCH
4. Interfacing Motor with 8051 microcontroller
5. Interfacing 4 digits Multiplexed Display with 8051 microcontroller
6. Interfacing 16x2 characters LCD with 8051 microcontroller
7. Interfacing 4x4 Matrix Keyboard with 8051 microcontroller
8. Interfacing DAC0800 with 8051 microcontroller
9. Interfacing ADC0809 with 8051 microcontroller
10. Using Timer as Timer and Timer as Counter
11. Interrupts configuration and handling
12. Serial communication programming
13. Multiprocessor communication (Using Proteus)
14. Design and demonstration of microcontroller based applications

Textbooks

1	Kenneth J. Ayala,The 8051 Microcontroller Architecture, Programming and Applications, 2nd Edition, Penram International Publication, revised edition 2009
2	Mohammad Ali Mazidi, The 8051 Microcontroller and Embedded Systems, Pearson Education, 2nd edition, 2010.
3	John B. Peatman, Design with PIC microcontrollers, Pearson Education, 1st edition, 2003
4	Ramesh Gaonkar, Fundamentals of Microcontrollers and Applications in Embedded Systems, Penram International Publication(India), 2010

References	
1	Intel 8085 and 8051 datasheet (www.intel.com)
2	Keil A51 and C51 manuals
3	PIC16F877A datasheet (www.microchip.com)
4	Hi-Tech C Compiler manual

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

1: Low, 2: Medium, 3: High

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AY 2022-23

Course Information	
Programme	B.Tech. (Electronics Engineering)
Class, Semester	Second Year B. Tech., Sem IV
Course Code	6EN275
Course Name	Control Systems Lab
Desired Requisites:	

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 introduce open and closed loop systems.
2	To provide the concept of compensating networks
3	To provide fundamentals of time and frequency domain analysis.
4	

Course Outcomes (CO) with Bloom's Taxonomy Level		
At the end of the course, the students will be able to,		
CO1	Analyze Open and closed loop DC Motor control system and its response	Analyzing
CO2	**Solve** PD, PI and PID controllers using Matlab	Applying
CO3	Analyze systems using Routh-Hurwitz criteria, Root locus, Bode plots using Matlab	Analyzing
CO4		

List of Experiments / Lab Activities/Topics

List of Topics(Applicable for Interaction mode): -

List of Lab Activities:

1. Potentiometer as transducer and error detector.
2. Synchros as transmitter and error detector.
3. Effect of negative feedback and Speed control of DC motor.
4. DC position Control system (P, PI controller)
5. Time response of second order system.
6. Selection of kp, ki and kd in PID controller
7. To draw Root locus and comment on stability.
8. To draw Bode plots and comment on stability.
9. Conversion of TF model to state space model

Textbooks	
1	"Control System Engineering", I.J. Nagrath, M. Gopal, 5th Edition, New Age International Publications, 2008.
2	"Modern Control Engineering", Katsuhiko Ogata, 5th Edition, Prentice Hall, 2015.
3	"Modern Control System", Dorf, Bishop, 12th Edition, Prentice Hall, 2013.
4	

References	
1	"Feedback and Control Systems", Schaum's Outlines Series book, 2nd Edition, McGraw Hill Education, 2012.
2	"Automatic Control Systems", Bejamin C. Kuo, 7th Edition, Wiley Publications, 1995.
3	
4	

Useful Links	
1	
2	
3	
4	

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