DAYANANDA SAGAR UNIVERSITY

DEVARAKAGGALAHALLI, HAROHALLI, KANAKAPURA ROAD
RAMANAGAR DISTRICT- 562112

SCHOOL OF ENGINEERING

SCHEME & SYLLABUS
FOR
BACHELOR OF TECHNOLOGY (B.Tech) – I YEAR

COMMON TO ALL BRANCHES

(With effect from 2023-27)

PART-B

SCHEME AND SYLLABUS FOR THE FIRST YEAR B.TECH (2023-27) PROGRAMEE

Definitions / Descriptions

Definition of Credit:	
1 Hour Lecture (L) Per Week	01 Credit
1 Hour Tutorial (T) Per Week	0.5 Credit
1 Hour Practical (P) Per Week	0.5 Credit
1 Hour Project (J) Per Week	0.5 Credit

Course code and Definition:	
BSC	Basic Science Courses
ESC	Engineering Science Courses
HSMC	Humanities and Social Sciences including Management Courses
IPCC	Integrated Professional Core Course
PCC	Professional Core Courses
PEC	Professional Elective Courses
OEC	Open Elective Courses
SEC	Skill Enhancement Courses
UHV	Universal Human Value Course
PROJ	Project Work
INT	Internship

Implementation of National Education Policy (NEP) 2020 for the B.Tech. students of Batch 2023-24

The implementation of Curriculum follows NEP 2020 and addresses the following features and categories of courses:

1. Student Centric flexible curriculum.
2. Inter-disciplinary Courses,
3. Multi-disciplinary Courses,
4. Ability Enhancement Courses,
5. Skill Enhancement Courses,
6. Value Added Courses,
7. Product Design and Development,
8. Internship (Rural Internship, Industry Internship, Research/Development Internship), and
9. Multiple Exit and Multiple Entry

    - Certificate in Engineering after completion of first year.
    - Diploma in Engineering after completion of second year.
    - Advanced Diploma in Engineering after completion of third year.
    - Degree in Engineering after completion of fourth year

DAYANANDA SAGAR UNIVERSITY
School of Engineering
Devarakaggalahalli, Harohalli, Bengaluru – 562 112

SCHEME 2023 – 2027 Batch

I SEMESTER (Chemistry Cycle)

S.N	Course Type	Course Name	Teaching Department	Specific to Department	Teaching Hours / Week				Examination				Credits
					Lecture	Tutorial	Practice	Project	Durationin Hours	CIE Marks	SEE Marks	Total Marks	
					L	T	P	J					
1	BSC	Linear Algebra and Differential Equations	MAT	All Depts.	3	0	0	0	03	60	40	100	**3**
2	BSC	Engineering Chemistry	CHEM	All Depts.	2	0	2	0	03	60	40	100	**3**
3	ESC	Introduction to Mechanical Engineering	ME	All Depts.	2	0	2	0	03	60	40	100	**3**
4	ESC	Introduction to Electrical Engineering	EC	All Depts	2	0	0	0	03	60	40	100	**2**
5	ESC	C Programming for Problem Solving	CSE	All Depts.	2	2	2	0	03	60	40	100	**4**
6	ESC	Engineering Mechanics	ME	All Depts.	2	0	0	0	03	60	40	100	**2**
7	HSMC	Technical English	HUM	All Depts.	1	2	0	0	--	100	--	100	**2**
8	AEC	Environmental Science	Biology	All Depts.	1	0	0	0	--	100	--	100	**1**
9	HSMC	Kannada Kali / Manasu	HUM	All Depts.	0	0	0	0	--	100	--	100	**0**
									Total	**600**	**200**	**800**	**20**

DAYANANDA SAGAR UNIVERSITY
School of Engineering
Devarakaggalahalli, Harohalli, Bengaluru – 562 112

SCHEME 2023 – 2027 Batch

II SEMESTER (Physics Cycle)

S.N	Course Type	Course Name	Teaching Department	Specific to Department	Teaching Hours / Week				Examination				Credits
					Lecture	Tutorial	Practice	Project	Duration in Hours	CIE Marks	SEE Marks	Total Marks	
					L	T	P	J					
1	BSC	Single and Multivariate Calculus	MAT	All Depts.	3	0	0	0	03	60	40	100	**3**
2	BSC	Engineering Physics	PHY	All Depts.	3	0	2	0	03	60	40	100	**4**
3	ESC	Introduction to Electronics Engineering	ECE	All Depts.	3	0	0	0	03	60	40	100	**3**
4	ESC	Object Oriented Programming (Python)	CSE	All Depts.	2	2	2	0	03	60	40	100	**4**
5	ESC	Engineering Graphics and Design Thinking	ME	All Depts.	1	0	4	0	03	60	40	100	**3**
6	AEC	Biology for Engineers	Biology	All Depts.	2	0	0	0	--	100	--	100	**2**
7	HSMC	Constitution of India and Professional Ethics	HUM	All Depts.	1	0	0	0	--	100	--	100	**1**
		Total								**500**	**200**	**700**	**20**

DAYANANDA SAGAR UNIVERSITY
School of Engineering
Devarakaggalahalli, Harohalli, Bengaluru – 562 112

SCHEME 2023 – 2027 Batch

I SEMESTER (Physics Cycle)													
S.N	Course Type	Course Name	Teaching Department	Specific to Department	Teaching Hours / Week				Examination				Credits
					Lecture	Tutorial	Practice	Project	Duration in Hours	CIE Marks	SEE Marks	Total Marks	
					L	T	P	J					
1	BSC	Linear Algebra and Differential Equations	MAT	All Depts.	3	0	0	0	03	60	40	100	**3**
2	BSC	Engineering Physics	PHY	All Depts.	3	0	2	0	03	60	40	100	**4**
3	ESC	Introduction to Electronics Engineering	ECE	All Depts.	3	0	0	0	03	60	40	100	**3**
4	ESC	C Programming for Problem Solving	CSE	All Depts.	2	2	2	0	03	60	40	100	**4**
5	ESC	Engineering Graphics and Design Thinking	ME	All Depts.	1	0	4	0	03	60	40	100	**3**
6	AEC	Biology for Engineers	Biology	All Depts.	2	0	0	0	--	100	--	100	**2**
7	HSMC	Constitution of India and Professional Ethics	HUM	All Depts.	1	0	0	0	--	100	--	100	**1**
		Total								**500**	**200**	**700**	**20**

DAYANANDA SAGAR UNIVERSITY
School of Engineering
Devarakaggalahalli, Harohalli, Bengaluru – 562 112

SCHEME 2023 – 2027 Batch

II SEMESTER (Chemistry Cycle)

S.N	Course Type	Course Name	Teaching Department	Specific to Department	Teaching Hours / Week				Examination				
					Lecture	Tutorial	Practice	Project	Duration in Hours	CIE Marks	SEE Marks	Total Marks	Credits
					L	T	P	J					
1	BSC	Single and Multivariate Calculus	MAT	All Depts.	3	0	0	0	03	60	40	100	3
2	BSC	Engineering Chemistry	CHEM	All Depts.	2	0	2	0	03	60	40	100	**3**
3	ESC	Introduction to Mechanical Engineering	ME	All Depts.	2	0	2	0	03	60	40	100	**3**
4	ESC	Introduction to Electrical Engineering	EC	All Depts.	2	0	0	0	03	60	40	100	**2**
5	ESC	Object Oriented Programming (Python)	CSE	All Depts.	2	2	2	0	03	60	40	100	4
6	ESC	Engineering Mechanics	ME	All Depts.	2	0	0	0	03	60	40	100	**2**
7	HSMC	Technical English	HUM	All Depts.	1	2	0	0	--	100	--	100	**2**
8	AEC	Environmental Science	Biology	All Depts.	1	0	0	0	--	100	--	100	**1**
9	HSMC	Kannada Kali / Manasu	HUM	All Depts.	0	0	0	0	--	100	--	100	**0**
		Total								**600**	**200**	**800**	**20**

INTRODUCTION TO ELECTRICAL ENGINEERING

[As per Choice Based Credit System (CBCS) scheme]

SEMESTER – I/II

Subject Code	:		**Credits**	:	02
Hours / Week	:	02 Hours	**Total Hours**	:	26 Hours
L–T–P	:	2–0–0			

Course Learning Objectives:

This course enables students to:

- **Demonstrate** a foundational understanding of electrical quantities, including current, voltage, power, and energy.
- **Apply** fundamental laws of electric circuits, such as Ohm's law and Kirchhoff's laws to evaluate electrical circuits.
- **Explain** fundamental concepts of electro-magnetic circuits.
- **Demonstrate** a foundational understanding of the working principles, construction, and characteristics of DC machines.
- **Illustrate** the construction, operation, and types of transformers, considering their significance in electrical systems.
- **Explain** the structure and components of electrical power system, highlighting their interconnections.
- **Explain** emerging trends of green energy technologies and smart metering.
- **Explain** the importance of earthing, protective devices, and proper wiring for ensuring electrical safety.

Teaching-Learning Process (General Instructions)

These are sample new pedagogical methods, where teacher can use to accelerate the attainment of the various course outcomes.

1. ***Lecture method*** means it includes not only traditional lecture method, but different *type of teaching methods* may be adopted to develop the course outcomes.
2. ***Interactive Teaching:*** *Adopt the* ***Active learning*** that includes brainstorming, discussing, group work, focused listening, formulating questions, notetaking, annotating, and roleplaying.
3. Show ***Video/animation*** films to explain functioning of various concepts.
4. Encourage ***Collaborative*** (Group Learning) Learning in the class.
5. To make ***Critical thinking***, ask at least three Higher order Thinking questions in the class.
6. Adopt ***Problem Based Learning***, which fosters students' Analytical skills, develop thinking skills such as the ability to evaluate, generalize, and analyse information rather than simply recall it.
7. Show the ***different ways to solve*** the same problem and encourage the students to come up with their own creative ways to solve them.
8. Discuss how every ***concept can be applied to the real world*** - and when that's possible, it helps improve the students' understanding.

UNIT – I	10 Hours
Fundamentals laws of Electrical circuit and elements: Electrical charge, potential; current; power and energy; AC and DC current (mathematical treatment); Ohm's law; KCL and KVL in resistive circuits; series and parallel combination of resistors; voltage and current division rule; V-I relationships for inductor and capacitor under AC voltage; impedance and admittance (series RC and RL); Overview of active power, reactive power and power factor; Introduction to 3 phase systems; Simulation using LTspice software to demonstrate voltage division, current division in resistive circuits. Simulation using LTspice software to show voltage and current waveform for RC and RL circuit. ***(TextBook-1: Chapter 1: 1.1 to 1.4, 1.6 to 1.8. Chapter 2: 2.1 to 2.3. Chapter 4: 4.1 to 4.4 Chapter 6: 6.1 to 6.4)***	
UNIT – II	**10 Hours**
Electromagnetic circuits: Magnetic circuits: Basics of magnetic circuits (flux, mmf, permeability, reluctance, B and H); Relation between field theory and circuit theory; Faraday's and lenz's laws, Lorentz force; Self and Mutual inductance. DC machines: Principle of operation of DC generator; generated EMF equation; classification; characteristics and applications. (Introductory treatment only); Principle of operation of DC Motor; back EMF; speed and torque; classification; characteristics and applications. Losses and efficiency in DC machines. Transformers: Construction, working principle, induced emf equation; step-up and step down; losses and efficiency. ***(TextBook-2: Chapter 7: 7.1 to 7.12; Textbook 1: 10.1, 10.2, 10.4, 10.5, 10.8, 10.9, 10.11 and 10.12; Chapter 8: 8.1, 8.2 and 8.9)***	
UNIT – III	**06Hours**
Powers system fundamentals: Power system structure; generations sources; green energy; smart meters; power tariff calculations; Electrical safety and standards (IS: 732-2019, IEC: 60446): Colour code of wires for single phase supply, earthing, fuse and MCB. ***(Textbook 1: , Chapter 16: 16.1 to 16.5; Textbook 2: Chapter 24: 24.1 to 24.6)***	

Course Outcome	Description	Bloom's Taxonomy Level
At the end of the course the student will be able to:		
CO1	**Solve** for voltage, current, power and energy in purely R, series RL and RC circuits under DC and AC voltages.	L3
CO2	**Demonstrate** understanding of principle of operation of DC machines and its applications.	L2
CO3	**Demonstrate** understanding of the working principle of transformers.	L2

CO4	**Demonstrate** understanding of the working principle of transformers, generation sources, the significance of renewable energy sources in electrical engineering, and safety practices.	L2
CO5	Demonstrate proficiency in using simulation software (e.g., LTspice) to simulate and **solve** electrical parametrs.	L3

Table: Mapping Levels of COs to POs / PSOs

COs	Program Outcomes (POs)												PSOs		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	3	2		1	3						1		1		
CO2	3	2									1		1		
CO3	3	2									1		1		
CO4	3					2	3	2			1		1	1	2
CO5	3	3	2	1	3				1	1	2	2	1	1	

3: Substantial (High) **2: Moderate (Medium)** **1: Poor (Low)**

TEXT BOOKS:

1. D.P.Kothari and I.J. Nagrath, "Basic Electrical Engineering", 4th Edition, Tata McGraw Hill, 2019.
2. B.L. Theraja and A.K. Therja, "A textbook of electrical technology, Vol. I (Basic electrical Engineering)", S. Chand Publishing, 23rd Rev Ed, 2006.

REFERENCE BOOKS:

1. Clayton Paul, Syed A Nasar and Louis Unnewehr, "Introduction to Electrical Engineering", 2nd Edition, McGraw-Hill, 1992.
2. William H Hayt and Jack E Kimberly and Steven M Durbin, "Engineering Circuit Analysis" 8th Edition, McGraw-Hill, 2013.

E-Resources:

1. https://nptel.ac.in/courses/108/108/108108076

Activity Based Learning (Suggested Activities in Class):

1. Real world problem solving using group discussion and hands-on activities. E.g., Interfacing different types of sensors using Arduino.
2. Simulation of different electrical circuits. E.g., RL and RC circuits.

****

INTRODUCTION TO ELECTRONICS ENGINEERING

[As per Choice Based Credit System (CBCS) scheme]

SEMESTER – I/II

Subject Code	:		**Credits**	:	03
Hours / Week	:	03 Hours	**Total Hours**	:	39 Hours
L–T–P	:	3–0–0			

Course Learning Objectives:

This course enables students to

1. **Understand** the fundamental principles of diodes and their applications, including the band diagram of insulators, conductors, and semiconductors, diode construction, and V-I characteristics.
2. **Analyze** diode circuits under different biasing conditions and comprehend the behavior of diodes in applications such as AND gates, OR gates, rectifiers, and voltage regulators.
3. **Comprehend** the construction, operation, and characteristics of bipolar junction transistors (BJTs), including input and output characteristics, different biasing techniques, and transistor amplification.
4. **Calculate** common emitter amplifier circuits with voltage divider bias.
5. **Demonstrate** an understanding of operational amplifiers (Op-amps), including their symbols, operation modes, properties, and applications such as amplifiers, comparators, and oscillators.
6. **Demonstrate** an understanding of digital electronics, including binary number systems, Boolean algebra, logic gates, sequential logic circuits, and the application of Flip-Flops.
7. **Verify** digital circuits and components with basic activities on simulators.
8. **Familiarize** themselves with microprocessors and microcontrollers, and understand their architecture and components.
9. **Familiarize** with communication and modulation demodulation.

Teaching-Learning Process (General Instructions)

These are sample new pedagogical methods, where teacher can use to accelerate the attainment of the various course outcomes.

1. ***Lecture method*** means it includes not only traditional lecture method, but different *type of teaching methods* may be adopted to develop the course outcomes.
2. ***Interactive Teaching:*** *Adopt the* ***Active learning*** that includes brainstorming, discussing, group work, focused listening, formulating questions, notetaking, annotating, and roleplaying.
3. Show ***Video/animation*** films to explain functioning of various concepts.
4. Encourage ***Collaborative*** (Group Learning) Learning in the class.
5. To make ***Critical thinking***, ask at least three Higher order Thinking questions in the class.
6. Adopt ***Problem Based Learning***, which fosters students' Analytical skills, develop thinking skills such as the ability to evaluate, generalize, and analyse information rather than simply recall it.
7. Show the ***different ways to solve*** the same problem and encourage the students to come up with their own creative ways to solve them.
8. Discuss how every ***concept can be applied to the real world*** - and when that's possible, it helps improve the students' understanding.

UNIT – I	09 Hours
Diodes and its application: Band diagram of insulators, conductors and semiconductors; semiconductor types: intrinsic and extrinsic (n-type and p-type); diode construction; diode under no-bias, forward bias and reverse bias; V-I characteristics of diode; simplified equivalent circuit of practical diode and ideal diode; diode specifications: peak inverse voltage, reverse leakage current and maximum forward current; numerical on series diode configuration with DC input, Rectifier Circuits: Half wave and full wave, Reservoir and smoothing circuits. (Textbook 1: Chapter 1: 1.1 to 1.7, 1.9, 1.12, 1.15, Chapter 2: 2.3, 2.5, 2.6, 2.7, 2.11)	
UNIT – II	**08 Hours**
Transistors: Construction of npn and pnp BJT transistors; transistor operation; input and output characteristics of CB and CE configurations; significance of different regions of operation: active, cut-off and saturation (transistor as a switch); BJT Amplification; transistor amplifying action; numerical on current relations and amplification; Need for biasing: Q-point; types of biasing: fixed, and voltage divider, Introduction to Field Effect Transistor, Construction and Characteristics of JFET, MOSFET (MOS) (Depletion and Enhancement) Type, Transfer Characteristic. (Textbook 1: Chapter 3: 3.1 to 3.5, Chapter 4: 4.1 to 4.5, Chapter 6.1 and 6.2)	
UNIT – III	**08 Hours**
Operational amplifiers: Op-amp symbols, terminals and operation: single mode, differential mode and common mode; basic properties of ideal and practical Op-amp: input offset voltage, input resistance, output resistance, gain, bandwidth, CMRR, slew rate; basic Op-map applications: inverting amplifier, non-inverting amplifier, summing amplifier, differential amplifier, differentiator and integrator; Op-amp comparator; feedback: positive and negative feedback; criteria for stability and oscillations (Barkhausen criterion); RC phase shift oscillators; (Textbook 1: Chapter 10: 10.1, 10.4 to 10.7, Chapter 14: 14.5 to 14.7)	
UNIT – IV	**08 Hours**
Digital Electronics: Binary number system: conversion and representation; logic levels: high and low; Boolean algebra: operators and DeMorgan's law; Boolean Expression, logic gates with truth-table and representation: AND, OR, NOT, XOR, NAND, NOR; combination of gates and associated numerical; sequential logic circuits: SR latch using NAND/NOR gate, SR FLIP-FLOP, D Flip-Flop, J-K Flip- Flop. (Textbook 2: Chapter 1: 1.1 to 1.3, Chapter 2: 2.1 to 2.5, Chapter 4: 4.1 to 4.3, Chapter 5.1 to 5.5, Chapter 6.1 to 6.4)	
UNIT – V	**06 Hours**
Microprocessor Systems: Overview of microprocessor and microcontroller architecture. **Communications:** Introduction to the communication system, Modulation, Demodulation, a simple CW transmitter, and receiver, Superheterodyne Receiver.	

Course Outcome	Description	Bloom's Taxonomy Level
At the end of the course, the student will be able to:		
1	**Demonstrate** a solid understanding of the fundamental principles underlying electronic components, such as diodes, transistors, operational amplifiers, logic gates, and microcontrollers.	L2

2	**Apply** knowledge of electronic components to **analyze** circuits for various applications, such as rectification, amplification, filtering, and digital logic operations.	L4
3	**Analyze** the performance of operational amplifiers (Op-amps) in various circuit configurations, including amplifiers, comparators, and oscillators, to optimize their functionality and address design requirements.	L4
4	**Demonstrate** comprehension of microprocessor and microcontroller architecture, operation, and their applications.	L2
5	**Identify** the need for modulation and demodulation in signal transmission.	L3

Table: Mapping Levels of COs to POs / PSOs

COs	Program Outcomes (POs)												PSOs		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	3	2	1									2	3		
CO2	3	3	2	1								2	3		
CO3	3	3	2	2								2	3	2	
CO4	3	3	2	2								2	3	2	
CO5	3	3	3	1								3	3	3	

3: Substantial (High) **2: Moderate (Medium)** **1: Poor (Low)**

TEXT BOOKS:

1. R. L. Boylestad and L. Nashelsky, "Electronic Devices and Circuit Theory", 11th Ed, Pearson Education, 2013.
2. M. Moris. Mano and Michael D. Ciletti, "Digital Electronics", 4th Ed, Pearson Education, 2006.
3. Michael Tooley, "Electronic Circuits: Fundamentals and Applications" BA Elsevier Ltd., Third Edition,2006

REFERENCE BOOKS:

1. David A Bell, "Electronic Devices and Circuits", 5th Ed, Oxford university press, 2008.
2. Millman & Halkias, "Electronics Devices and Circuits", 2nd Ed, McGraw Hill, 2010.

E-Resources:

1. NPTEL- https://nptel.ac.in/courses/122/106/122106025
2. Virtual Labs- http://vlabs.iitkgp.ac.in/be/
3. https://nptel.ac.in/courses/117104072

Activity Based Learning (Suggested Activities in Class):

1. Real world problem solving using group discussion and hands-on activities. E.g., Interfacing different types of sensors using Arduino.
2. Simulation of different electronic circuits. E.g., Rectifiers and Amplifiers.

****

DAYANANDA SAGAR UNIVERSITY

DEVARAKAGGALAHALLI, HAROHALLI, KANAKAPURA ROAD
RAMANAGAR DISTRICT- 562112

SCHOOL OF ENGINEERING

SCHEME & SYLLABUS
FOR
BACHELOR OF TECHNOLOGY (B.Tech) – 2023

ELECTRONICS AND COMMUNICATION ENGINEERING

(With effect from 2023-27)

(III, IV, V, VI, VII & VIII SEMESTERS)

Dayananda Sagar University

School of Engineering

Devarakaggalahalli , Harohalli , Kanakapura Road , Ramanagar District- 562112

DEPARTMENT OF ELECTRONICS AND COMMUNICATION ENGINEERING

SCHEME AND SYLLABUS

B.Tech. PROGRAMME– 2023 BATCH

Definitions / Descriptions

Definition of Credit:	
01 Credit	1 Hour Lecture (L) Per Week
01 Credit	1 Hour Tutorial (T) Per Week
0.5 Credit	1 Hour Practical (P) Per Week
0.5 Credit	1 Hour Project (J) Per Week

Course code and Definition:	
BSC	Basic Science Courses
ESC	Engineering Science Courses
HSMC	Humanities and Social Sciences including Management Courses
IPCC	Integrated Professional Core Course
PCC	Professional Core Courses
PEC	Professional Elective Courses
OEC	Open Elective Courses
SEC	Skill Enhancement Courses
INT	Internship
PROJ	Project Work

Dayananda Sagar University

School of Engineering

Devarakaggalahalli , Harohalli , Kanakapura Road , Ramanagar District- 562112

DEPARTMENT OF ELECTRONICS AND COMMUNICATION ENGINEERING

Implementation of National Education Policy (NEP) 2020 for the B.Tech students of Batch 2023-27

The implementation of Curriculum follows NEP 2020 and addresses the following features and categories of courses:

1. Student Centric flexible curriculum.
2. Inter-disciplinary Courses,
3. Multi-disciplinary Courses,
4. Ability Enhancement Courses,
5. Skill Enhancement Courses,
6. Value Added Courses,
7. Product Design and Development
8. Internship (Rural Internship, Industry Internship, Research/Development Internship), and
9. Multiple Exit and Multiple Entry
    - Certificate in Engineering after completion of first year.
    - Diploma in Engineering after completion of second year.
    - Advanced Diploma in Engineering after completion of third year.
    - Degree in Engineering after completion of fourth year

Dayananda Sagar University

School of Engineering

Devarakaggalahalli , Harohalli , Kanakapura Road , Ramanagar District- 562112

DEPARTMENT OF ELECTRONICS AND COMMUNICATION ENGINEERING

SCHEME 2023 – 2027 Batch

Department of ECE

III SEMESTER

Sl.No	Course Code	Course Type	Course Name	Teaching Department	Teaching Hours / Week				Examination				Credits
					Lecture	Tutorial	Practical	Project	Duration in Hours	CIE Marks	SEE Marks	Total Marks	
					L	T	P	J					
1		BSC	Transforms and Numerical Methods	MAT	3	0	0	0	03	60	40	100	**3**
2		IPCC	**CS cluster & ECE** Data Structures	CSE	3	0	2	0	03	60	40	100	**4**
3		IPCC	**CS cluster & ECE** Digital Logic Design	ECE	3	0	2	0	03	60	40	100	**4**
4		PCC	**ECE** Network Analysis	ECE	3	0	0	0	03	60	40	100	**3**
5		PCC	**ECE** Signals & Systems	ECE	3	0	0	0	03	60	40	100	**3**
6		AEC	Liberal Studies – I	Any Dept.	1	0	0	0	01	100	--	100	**1**
7		SEC	Skill Enhancement Course – I	ECE	1	0	2	0	01	100	--	100	**2**
			Total										**20**

Skill Enhancement Course – II

	Introduction to Model-Based Design		XXXXXX
	Microcontroller Programming		XXXXXX

Dayananda Sagar University

School of Engineering

Devarakaggalahalli , Harohalli , Kanakapura Road , Ramanagar District- 562112

DEPARTMENT OF ELECTRONICS AND COMMUNICATION ENGINEERING

IV SEMESTER

Sl.No	Course Code	Course Type	Course Name	Teaching Department	Teaching Hours / Week				Examination				Credits
					Lecture	Tutorial	Practica	Project	Duration in Hours	CIE Marks	SEE Marks	Total Marks	
					L	T	P	J					
1		BSC	Probability and Statistics	MAT	3	0	0	0	03	60	40	100	**3**
2		PCC	**ECE** Electromagnetic Field Theory	ECE	3	1	0	0	03	60	40	100	**4**
3		IPCC	**ECE** Analog Electronic Circuits	ECE	3	0	2	0	03	60	40	100	**4**
4		IPCC	**CS cluster & ECE** Embedded System Design	ECE	3	0	2	0	03	60	40	100	**4**
5		PCC	Control & Instrumentation	ECE	3	0	0	0	03	60	40	100	**3**
6		PCC	**CS cluster & ECE** Computer Organization & Architecture	ECE	3	0	0	0	03	60	40	100	**3**
7		SEC	Skill Enhancement Course – II	ECE	1	0	2	0	--	100	--	100	**2**
			Total										**23**

Skill Enhancement Course – II			
	Introduction to Embedded Machine Learning		XXXXX
	Introduction to PSPICE ORCAD/Multisim-National Instruments/TINA-Texas Instruments		XXXXX

Dayananda Sagar University

School of Engineering

Devarakaggalahalli , Harohalli , Kanakapura Road , Ramanagar District- 562112

DEPARTMENT OF ELECTRONICS AND COMMUNICATION ENGINEERING

V SEMESTER

Sl.No	Course Code	Course Type	Course Name	Teaching Department	Teaching Hours / Week				Examination				Credits
					Lecture	Tutorial	Practica	Project	Duration in Hours	CIE Marks	SEE Marks	Total Marks	
					L	T	P	J					
1		IPCC	Analog and Digital Communication	ECE	3	0	2	0	3	60	40	100	4
2		PCC	Digital Signal Processing	ECE	3	0	0	0	3	60	40	100	**3**
3		PCC	Machine Learning	ECE	3	0	0	0	3	60	40	100	**3**
4		IPCC	Antennas and wave propagation	ECE	3	0	2	0	3	60	40	100	**4**
5		IPCC	CMOS VLSI Design	ECE	3	0	2	0	3	60	40	100	**4**
6		PEC	Professional Elective Course – I / MOOC	ECE	3	0	0	0	3	60	40	100	**3**
8		SEC	Skill Enhancement Course – III	ECE	1	0	2	0	1	100	--	100	**2**
			Total										23

Skill Enhancement Course – III			
	DSP Lab		XXXXX
	PLC Programming		XXXXX
	Electric Vehicle Power Management System		

Dayananda Sagar University

School of Engineering

Devarakaggalahalli , Harohalli , Kanakapura Road , Ramanagar District- 562112

DEPARTMENT OF ELECTRONICS AND COMMUNICATION ENGINEERING

	VI SEMESTER												
Sl.No	Course Code	Course Type	Course Name	Teaching Department	Teaching Hours / Week				Examination				Credits
					Lecture	Tutorial	Practical	Project	Duration in Hours	CIE Marks	SEE Marks	Total Marks	
					L	T	P	J					
1		HMSC	Innovation Management and Entrepreneurship	ECE	2	0	0	0	03	60	40	100	2
2		IPCC	Microwave Engineering	ECE	3	0	2	0	03	60	40	100	4
3		PCC	VLSI Testing &Verification	ECE	3	0	0	0	03	60	40	100	**3**
4		PCC	Networking & Communication	ECE	3	0	0	0	03	60	40	100	**3**
5		OEC	Open Elective – I	ECE	3	0	0	0	03	60	40	100	**3**
6		PEC	Professional Elective Course – II / MOOC	ECE	3	0	0	0	03	60	40	100	**3**
7		PEC	Professional Elective Course – III / MOOC	ECE	3	0	0	0	03	60	40	100	**3**
8		PROJ	Minor Project	ECE	0	0	0	2	01	100	--	100	**2**
			Total										**23**

Dayananda Sagar University

School of Engineering

Devarakaggalahalli , Harohalli , Kanakapura Road , Ramanagar District- 562112

DEPARTMENT OF ELECTRONICS AND COMMUNICATION ENGINEERING

	VII SEMESTER												
Sl.No	**Course Code**	**Course Type**	**Course Name**	**Teaching Department**	**Teaching Hours / Week**				**Examination**				**Credits**
					Lecture	**Tutorial**	**Practical**	**Project**	**Duration in Hours**	**CIE Marks**	**SEE Marks**	**Total Marks**	
					L	**T**	**P**	**J**					
1		PCC	Wireless Communication	ECE	3	0	0	0	03	60	40	100	**3**
2		OEC	Open Elective – II	ECE	3	0	0	0	03	60	40	100	**3**
3		PEC	Professional Elective Course – IV/ MOOC	ECE	3	0	0	0	03	60	40	100	**3**
4		PEC	Professional Elective Course – V / MOOC	ECE	3	0	0	0	03	60	40	100	**3**
5		PROJ	Major Project	ECE	0	0	0	6	03	100	--	100	**3**
			Total										**15**

Dayananda Sagar University

School of Engineering

Devarakaggalahalli , Harohalli , Kanakapura Road , Ramanagar District- 562112

DEPARTMENT OF ELECTRONICS AND COMMUNICATION ENGINEERING

	VIII SEMESTER												
Sl.No	Course Code	Course Type	Course Name	Teaching Department	Teaching Hours / Week				Examination				Credits
					Lecture	Tutorial	Practical	Project	Duration in Hours	CIE Marks	SEE Marks	Total Marks	
					L	T	P	J					
1		PROJ	Capstone Project		0	0	0	22	03	60	40	100	12
2		INT	Research Internship/ Industry Internship – III		0	0	0	0	06	100	--	100	04
			Total										**16**

Dayananda Sagar University

School of Engineering

Devarakaggalahalli , Harohalli , Kanakapura Road , Ramanagar District- 562112

DEPARTMENT OF ELECTRONICS AND COMMUNICATION ENGINEERING

Professional Elective Courses

Sl.No		Verticals		V-1		V-2	V-3	V-4	
		Domain Clusters		Signal Processing and Communication		VLSI	IoT & Embedded Systems	Interdisciplinary/ Emerging Technologies	
				(A)	(B)	(C)	(D)	(E)	(F)
1	PROFESSIONAL ELECTIVE COURSES	PEC-I	5th Sem	Wireless Sensor Networks	Digital Image Processing	Mixed Signal VLSI design	Real Time Operating Systems Design and Programming	Sensors & Transducers	Renewable Energy Technologies
2		PEC-II	6th Sem	Network Security	Advanced Digital Signal Processing	Analog IC Design	Embedded Linux	Mechatronics	Internet of Things & Industry 4.0
3		PEC-III		Satellite Sensing Remote	Digital Speech Processing	Digital IC Design	Design Patterns for Embedded Systems	Industrial Instrumentation	MEMS
				Information Theory and Error Control Coding					Power Electronics
4		PEC-IV	7th Sem	Radar and Navigation	Computer Vision	Electronic Materials Device and Processing	Linux Device Drivers	Electronic Measurement System	Introduction to Nano Electronics
5		PEC-V		Optical Communication	Software Defined Radio	Low Power VLSI	Internet of Things	Industrial Automation	Electric Vehicle Technology

Dayananda Sagar University

School of Engineering

Devarakaggalahalli , Harohalli , Kanakapura Road , Ramanagar District- 562112

DEPARTMENT OF ELECTRONICS AND COMMUNICATION ENGINEERING

OPEN ELECTIVE COURSES

Open Elective I -Courses	Open Elective II-Courses
Renewable Energy Technology	Nanotechnology and its Applications
Fundamentals of Telecommunication	Internet of Things
Electric Vehicle Technology	Reconfigurable system design

Dayananda Sagar University

School of Engineering

Devarakaggalahalli , Harohalli , Kanakapura Road , Ramanagar District- 562112

DEPARTMENT OF ELECTRONICS AND COMMUNICATION ENGINEERING

SEMESTER III

TRANSFORMS AND NUMERIAL METHODS

[As per Choice Based Credit System (CBCS) scheme]

SEMESTER – III

Subject Code	:		**Credits**	:	03
Hours / Week	:	03 Hours	**Total Hours**	:	39 Hours
L–T–P–S	:	3–0–0–0			

Course Learning Objectives:

This Course will enable students to:

1. **Apply** their knowledge of Laplace transforms and inverse Laplace transforms to proficiently solve linear ordinary differential equations with constant coefficients, facilitating the analysis and modelling of complex systems.

2. **Analyze** periodic functions using Fourier series, assessing the convergence properties and precision of the series expansion, thereby enhancing their ability to understand and manipulate periodic phenomena.

3. **Utilize** complex exponential form, Fourier transforms of basic functions, and Fourier sine and cosine transforms to solve problems involving Fourier integrals, developing proficiency in applying these techniques to various mathematical scenarios.

4. **Employ** numerical methods, including Euler's Method, Runge-Kutta 4th order, Adams-Bashforth, and Adams-Moulton Methods, to solve differential equations and effectively analyze dynamic systems, enabling them to model real-world phenomena and make accurate predictions**.**

5. **Apply** finite difference methods, including the Crank-Nicolson method and appropriate techniques for hyperbolic PDEs, to effectively solve different types of partial differential equations (PDEs) such as elliptic, parabolic, and hyperbolic equations, enhancing their problem-solving skills in the context of differential equations and their applications.

Dayananda Sagar University
School of Engineering
Devarakaggalahalli , Harohalli , Kanakapura Road , Ramanagar District- 562112

DEPARTMENT OF ELECTRONICS AND COMMUNICATION ENGINEERING

Teaching-Learning Process (General Instructions)

These are sample new pedagogical methods, where teacher can use to accelerate the attainment of the various course outcomes.

1. ***Lecture method*** means it includes not only traditional lecture method, but different *type of teaching methods* may be adopted to develop the course outcomes.
2. ***Interactive Teaching:*** *Adopt the* ***Active learning*** that includes brainstorming, discussing, group work, focused listening, formulating questions, notetaking, annotating, and roleplaying.
3. Show ***Video/animation*** films to explain functioning of various concepts.
4. Encourage ***Collaborative*** (Group Learning) Learning in the class.
5. To make ***Critical thinking***, ask at least three Higher order Thinking questions in the class.
6. Adopt ***Problem Based Learning***, which fosters students' Analytical skills, develop thinking skills such as the ability to evaluate, generalize, and analyse information rather than simply recall it.
7. Show the ***different ways to solve*** the same problem and encourage the students to come up with their own creative ways to solve them.
8. Discuss how every ***concept can be applied to the real world*** - and when that's possible, it helps improve the students' understanding.

UNIT – I	**09 Hours**
Laplace Transform and Inverse Laplace Transform; Laplace Transforms of Elementary functions (without proof), ***(Text Book-1: Chapter 6: 203 to 207).*** Laplace Transforms of $e^{at}f(t)$, $t^n f(t)$ and $\frac{f(t)}{t}$, Periodic functions, Unit step function and impulse functions ***(Text Book-1: Chapter 6:208-230)***. Inverse Laplace Transforms- By the method of Partial Fractions, Logarithmic and Trigonometric functions, Convolution Theorem, Inverse Laplace transform using Convolution Theorem ***(Text Book-1: Chapter 6: 238)***. Solution to Differential Equations by Laplace Transform. ***(Text Book-1: Chapter 238-242)***.	
UNIT – II	**09 Hours**
Fourier Series: Periodic Functions, Trigonometric Series ***(Text Book-1: Chapter 11: 495).***	

Fourier series Standard function, Functions of any Period 2L, Even and Odd functions, Half-range Expansions. ***(Text Book-1: Chapter 11: 483-492)*** Practical Harmonic analysis (calculate average power and RMS values of periodic waveforms)	
UNIT – III	**06 Hours**
Fourier Transform: Calculation of Fourier integrals using complex exponential form ***(Text Book-1: Chapter 11: 510).*** Fourier transform of basic functions ***(Text Book-1: Chapter 11: 510-516).*** Fourier sine and cosine transforms. ***(Text Book-1: Chapter 11: 518-522).***	
UNIT – IV	**07 Hours**
Numerical Methods for Solving Ordinary Differential Equations: Euler's Method-Basic principles of Euler's method for solving first-order ODEs ***(Text Book-1: Chapter 1:10-12).*** Runge-Kutta 4th order ***(Text Book-1: Chapter 21:904).*** Multistep Methods-Explanation of multistep methods (Adams-Bashforth, Adams–Moulton Methods) ***(Text Book-1: Chapter 21:911-913).*** Second-Order ODE. Mass–Spring System (Euler Method, Runge–Kutta Methods) ***(Text Book-1: Chapter 21:916-918).***	
UNIT – V	**08 Hours**
Numerical Methods for Partial Differential Equations: Classification of PDEs (elliptic, parabolic, hyperbolic), ***(Text Book-1: Chapter 21:922-923).*** Finite Difference Methods (Laplace and Poisson Equations), Derivation of finite difference approximations ***(Text Book-1: Chapter 21:923-927).*** Crank–Nicolson Method ***(Text Book-1: Chapter 21:938-941).*** Method for Hyperbolic PDEs ***(Text Book-1: Chapter 21:943-945).***	

Dayananda Sagar University
School of Engineering
Devarakaggalahalli , Harohalli , Kanakapura Road , Ramanagar District- 562112

DEPARTMENT OF ELECTRONICS AND COMMUNICATION ENGINEERING

Course Outcome	Description	Bloom's Taxonomy Level
At the end of the course the student will be able to:		
1	**Apply** Laplace transforms and inverse Laplace transforms to solve linear ordinary differential equations with constant coefficients, demonstrating proficiency in system analysis and modelling.	L3
2	**Analyze** periodic functions using Fourier series and evaluate the convergence properties and precision of the series expansion.	L2 & L3
3	**Solve** problems involving Fourier integrals by applying complex exponential form, Fourier transforms of basic functions, and Fourier sine and cosine transforms.	L3
4	**Utilize** numerical methods such as Euler's Method, Runge-Kutta 4th order, Adams-Bashforth, and Adams-Moulton Methods to solve differential equations and analyze dynamic systems	L2 & L3
5	**Apply** finite difference methods, including the Crank-Nicolson method and appropriate techniques for hyperbolic PDEs, to solve various types of partial differential equations (PDEs) such as elliptic, parabolic, and hyperbolic equations.	L3

Table: Mapping Levels of COs to POs / PSOs

COs	Program Outcomes (POs)												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	3	2	2	1					1					
CO2	3	2	2						1					
CO3	3	2	2	1					1					
CO4	3	2	2	1					1					
CO5	3	2	2	1					1					

3: Substantial (High) **2: Moderate (Medium)** **1: Poor (Low)**

TEXT BOOKS:

1. Erwin Kreyszig, Advanced Engineering Mathematics, 2015, 10th Edition, Wiley India.

REFERENCE BOOKS:

1. Higher Engineering Mathematics, B.S. Grewal, 2015, 43rd Edition, Khanna Publishers.
2. Higher Engineering Mathematics, John Bird, 2017, 6 th Edition, Elsevier Limited.

E-Resources:

1. https://nptel.ac.in/courses/111106139
2. https://nptel.ac.in/courses/111101164
3. https://nptel.ac.in/courses/111105038

Dayananda Sagar University

School of Engineering

Devarakaggalahalli , Harohalli , Kanakapura Road , Ramanagar District- 562112

DEPARTMENT OF ELECTRONICS AND COMMUNICATION ENGINEERING

DATA STRUCTURES

[As per Choice Based Credit System (CBCS) scheme]

SEMESTER – III

Subject Code	:		**Credits**	:	04
Hours / Week	:	03 Hours	**Total Hours**	:	52 Hours
L–T–P	:	3–0–2			

Prerequisites:

Proficiency in a C programming language.

Course Learning Objectives:

This Course will enable students to:

1. **Understand** the basic approaches for analysing and designing data structures.
2. **To introduce** dynamic memory allocation and C language concepts required for building data structures
3. **Develop** essential skills to construct data structures to store and retrieve data quickly and **efficiently**.
4. **Usage** of different data structures that support different sets of operations which are suitable for various applications.
5. **Implement** how to insert, delete, search and modify data in any data structure- Stack, Queues, Lists, Trees.
6. **Develop** applications using the available data structure as part of the course for mini-project.

Teaching-Learning Process (General Instructions)

These are sample new pedagogical methods, where teachers can use to accelerate the attainment of the various course outcomes.

1. ***Lecture method*** means it includes not only traditional lecture methods, but different *types of teaching methods* may be adopted to develop the course outcomes.
2. ***Interactive Teaching:*** *Adopt the* ***Active learning*** that includes brainstorming, discussing, group work, focused listening, formulating questions, note taking,

annotating, and roleplaying.

3. Show ***Video/Animation*** films to explain functioning of various concepts.
4. Encourage ***Collaborative*** (Group Learning) Learning in the class.
5. To make ***Critical thinking***, ask at least three Higher order Thinking questions in the class.
6. Adopt ***Problem Based Learning***, which fosters students' Analytical skills, develop thinking skills such as the ability to evaluate, generalize, and analyse information rather than simply recall it.
7. Show the ***different ways to solve*** the same problem and encourage the students to come up with their own creative ways to solve them.
8. Discuss how every ***concept can be applied to the real world*** - and when that's possible, it helps improve the students' understanding.

UNIT – I	**08 Hours**

INTRODUCTION:
Introduction to Data Structure, Classification, C Structure and Union, Array Definition, Representation, Operations (Insertion, Deletion, Search and Traversal), Two/Multidimensional Arrays (Text Book-1: Chapter 1: 1.1, 1.2,1.3.1-1.3.4), sparse matrix, (Text Book-2: Chapter 2: 2.5), C Pointers (Text Book-3: Chapter 5: 5.1 – 5.12, Chapter 6: 6.4).

UNIT – II	**09 Hours**

INTRODUCTION TO ADT:
Stack: Definition, Array Representation of Stack, Operations on Stacks.
(Text Book1: Chapter 2: 2.1, 2.2)
Applications of Stack: Expression evaluation, Conversion of Infix to Postfix, Infix to Prefix (Text Book-1: Chapter 2: 2.3) Recursion, Tower of Hanoi (Text Book-1: Chapter 3: 3.2, 3.3)
Queue: Definition, Representation of Queues, Operations of Queues, Circular Queue.
Applications of Queue: Job Scheduling, A Maze Problem
(Text Book2: Chapter 3: 3.3,3.4,3.5).

Dayananda Sagar University

School of Engineering

Devarakaggalahalli , Harohalli , Kanakapura Road , Ramanagar District- 562112

DEPARTMENT OF ELECTRONICS AND COMMUNICATION ENGINEERING

UNIT – III	09 Hours
DYNAMIC DATA STRUCTURES:	
Linked List: Types, Representation of Linked Lists in Memory. Traversing, Searching, Insertion & Deletion from Linked List. Circular List, Doubly Linked List, Operations on Doubly Linked List (Insertion, Deletion, Traversal). **Applications:** Stack & Queue Implementation using Linked Lists. **Case Study**: Josephus problem. (Text Book1: Chapter 4: 4.2,4.3,4.5)	
UNIT – IV	**08 Hours**
TREES: Basic Terminology, Binary Trees and their representation, Complete Binary Trees, Binary Search Trees, Threaded Binary Trees, Operations on Binary Trees (Insertion, Deletion, Search & Traversal). (Text Book2: Chapter 5: 5.1,5.2,5.3,5.5,5.7) **Applications:** Expression Evaluation **Case Study:** Game Tree (Text Book1: Chapter 5: 5.5.3,5.5.4,5.6)	
UNIT – V	**05 Hours**
Efficient Binary Search Trees: Optimal Binary Search Trees, AVL Trees, Red Black Trees, Splay Trees. (Text Book2: Chapter 10: 10.1,10.2,10.3,10.4) **Case Study**: B Trees (Text Book2: Chapter 11: 11.2)	

Dayananda Sagar University

School of Engineering

Devarakaggalahalli , Harohalli , Kanakapura Road , Ramanagar District- 562112

DEPARTMENT OF ELECTRONICS AND COMMUNICATION ENGINEERING

Course Outcome	Description	Bloom's Taxonomy Level
At the end of the course the student will be able to:		
1	**Demonstrate** the key C programming concepts such as pointers, structures, unions and arrays data structures to perform operations such as insertion, deletion, searching, sorting, and traversing.	L3
2	**Utilize** the fundamental concepts of stacks and queues to solve the standard applications like tower of Hanoi, conversion and evaluation of expressions, job scheduling and maze.	L3
3	**Implement** Singly Linked List, Doubly Linked List, Circular Linked Lists, stacks and queues using linked list**.**	L3
4	**Develop** critical thinking and problem-solving skills by designing and implementing efficient algorithms for Non-linear tree data structure and perform insertion, deletion, search and traversal **operations** on it.	L3
5	**Apply** advanced techniques, such as balancing algorithms for AVL trees, Splay trees and Red-Black trees to maintain the balance and efficiency of binary trees.	L3

Table: Mapping Levels of COs to POs / PSOs

COs	Program Outcomes (POs)												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	3	3	3									2		
CO2	3	3	3									2		
CO3	3	3	3									2		
CO4	3	3	3	2								2		
CO5	3	3	3	2								2		

3: Substantial (High) **2: Moderate (Medium)** **1: Poor (Low)**

TEXT BOOKS:

1. A.M. Tannenbaum, Y Langsam, M J Augentien "Data Structures using C", 1st Edition, Pearson, 2019.
2. Ellis Horowitz, Susan Anderson-Freed, and Sartaj Sahni, "Fundamentals of Data structures in C", 2nd Edition, Orient Longman, 2008.
3. Brian. W. Kernighan, Dennis. M. Ritchie, "The C Programming Language", 2nd Edition, Prentice-Hall, 1988.

REFERENCE BOOKS:

1. Gilberg & Forouzan, "Data Structures: A Pseudo-code approach with C", 2nd Edition, Cengage Learning,2014.
2. Jean-Paul Tremblay & Paul G. Sorenson, "An Introduction to Data Structures with Applications", 2nd Edition, McGraw Hill, 2013.
3. R.L. Kruse, B.P. Learly, C.L. Tondo, "Data Structure and Program design in C", 5th Edition, PHI ,2009.

E-Resources:

1. https://nptel.ac.in/courses/106102064
2. https://www.coursera.org/learn/data-structures?specialization=data-structures-algorithms
3. https://www.udemy.com/topic/data-structures/free/
4. https://www.mygreatlearning.com/academy/learn-for-free/courses/data-structures
5. https://cse01-iiith.vlabs.ac.in/
6. https://kremlin.cc/k&r.pdf

Activity Based Learning (Suggested Activities in Class)

1. Real world problem solving using group discussion.
2. Role play E.g., Stack, Queue, etc.,
3. Demonstration of solution to a problem through programming.
4. Flip class activity E.g., arrays, pointers, dynamic memory allocation, etc.,

Dayananda Sagar University

School of Engineering

Devarakaggalahalli , Harohalli , Kanakapura Road , Ramanagar District- 562112

DEPARTMENT OF ELECTRONICS AND COMMUNICATION ENGINEERING

DATA STRUCTURES LABORATORY (Total Contact Hours: 26)

Following are experiments to be carried out using either C programming language

1. To Implement C programs with concepts of pointers, structures.
2. To implement multidimensional array Matrix Multiplication.
3. To search elements in data structure with different search methods.
4. To implement stack, queue and their variations using arrays.
5. To implement stack, queue and their variations using singly linked lists
6. To implement conversion & evaluation of expression using stacks.
7. To Implement doubly circular Linked Lists and variations and use them to store data and perform operations on it.
8. To Implement Addition/multiplication of 2 polynomial using linked lists
9. To implement binary tree traversal techniques.

OPEN-ENDED EXPERIMENTS

1. A man in an automobile search for another man who is located at some point of a certain road. He starts at a given point and knows in advance the probability that the second man is at any given point of the road. Since the man being sought might be in either direction from the starting point, the searcher will, in general, must turn around many times before finding his target. How does he search to minimize the expected distance travelled? When can this minimum expectation be achieved?
2. The computing resources of a cloud are pooled and allocated according to customer demand. This has led to increased use of energy on the part of the service providers due to the need to maintain the computing infrastructure. What data structure will you use for allocating resources which addresses the issue of energy saving? Why? Design the solution.
3. Mini-Project on applying suitable data structure to a given real-world problem.

Dayananda Sagar University
School of Engineering
Devarakaggalahalli , Harohalli , Kanakapura Road , Ramanagar District- 562112

DEPARTMENT OF ELECTRONICS AND COMMUNICATION ENGINEERING

DIGITAL LOGIC DESIGN

[As per Choice Based Credit System (CBCS) scheme]

SEMESTER – III

Subject Code	:		**Credits**	:	04
Hours / Week	:	03 Hours	**Total Hours**	:	39 + 26 Hours
L–T–P	:	3–0–2			

Course Learning Objectives:

This Course will enable students to:

1. **Translate** the elements of digital logic functions to digital system abstractions using Verilog.
2. **Illustrate** simplification of Boolean expressions using Karnaugh
3. **Model** combinational logic circuits for arithmetic operations and logical operations
4. **Analyse** and model sequential elements flip-flops, counter, shift registers.
5. **Outline** the concept of Mealy Model, Moore Model and apply FSM to solve a given design problem.

Teaching-Learning Process (General Instructions)

These are sample new pedagogical methods, where teacher can use to accelerate the attainment of the various course outcomes.

1. ***Lecture method*** means it includes not only traditional lecture method, but different *type of teaching methods* may be adopted to develop the course outcomes.
2. ***Interactive Teaching:*** *Adopt the* ***Active learning*** that includes brainstorming, discussing, group work, focused listening, formulating questions, note taking, annotating, and role playing.
3. Show ***Video/animation*** films to explain functioning of various concepts.
4. Encourage ***Collaborative*** (Group Learning) Learning in the class.
5. To make ***Critical thinking***, ask at least three Higher order Thinking questions in the class.
6. Adopt ***Problem Based Learning***, which fosters students' Analytical skills, develop thinking skills such as the ability to evaluate, generalize, and analyse information rather than simply recall it.

7. Show the ***different ways to solve*** the same problem and encourage the students to come up with their own creative ways to solve them.
8. Discuss how every ***concept can be applied to the real world*** - and when that's possible, it helps improve the students' understanding.

UNIT – I	**08 Hours**

INTRODUCTION:
Number System- Binary, Hexa, Decimal, Octal and its conversion, Addition and subtraction using 1's and 2's complement, Canonical Notation - SOP & POS forms, Minimization of SOP and POS forms.
(Text Book-1: Chapter 1: 1.2 to 1.4, Chapter 2: 2.6)

ARITHMETIC CIRCUITS AND VERILOG MODELLING
Adders: Half adder, full adder, Ripple carry adder, parallel adder /subtractor, fast adders- CLA, comparator- 2 bit. Simplification using K-Maps
(Text Book-2: Chapter 5: 5.2, 5.3.3, 5.4,5.5.2, 5.5.3)

Introduction to Verilog, Syntax of Verilog coding, Modelling styles in Verilog, Verilog Operators, Test bench for simulation
(Text Book-3: Chapter 1: 1.1, 1.2.2, 1.3.1, 1.3.2, 1.3.3, 1.4.2, 1.5.1.2, 1.5.2.2, 1.5.3.2, 1.5.4.2, 1.6.2)

UNIT – II	**07 Hours**

Combinational Circuit Building Multiplexers 4:1, 8:1, decoders 3:8, 2:4, demultiplexers 1:4, encoders 8:3, 4:2, code converters- B to G and G to B- Simplification using K-Maps

Verilog for combinational circuits: Behavioural modelling- if else, case-casex, casez, structrual modelling.
(Text Book-2: Chapter 6: 6.1, 6.2, 6.3, 6.4, 6.6)

UNIT – III	**08 Hours**

Sequential Circuits-1
Basic Latch, Gated latches, Flip Flops SR, D, JK, T, Race round condition, master-slave flip-flops JK, 0's and 1's Catching Problem, Conversion of flip-flops SR-JK, JK-T, shift registers- SISO, SIPO, PISO, PIPO, Universal Shift Register, Setup time, Hold time, Propagation delay. ***(Text Book-2: Chapter 7: 7.1, 7.2,7.3, 7.4,7.5,7.6, 7.8)***

UNIT – IV	08 Hours
Sequential Circuits-2 Binary counters– asynchronous and synchronous, mod-n counter, Verilog blocking and non-blocking, Mealy Model, Moore Model, State machine notation, Construction of Finite State Machine. ***(Text Book-2: Chapter 7: 7.9, 7.11, 7.12.3, 7.12.4, 8.1, 8.2, 8.3, 8.4)***	

UNIT – V	08 Hours
Introduction to Electronic Design Automation: FPGA Design Flow, ASIC Design flow, architectural design, logic design, simulation, verification and testing, 3000 Series FPGA architecture. **Applications**: Design 4 Bit ALU, 7 Segment display, Vending Machine, 3 Pipeline. ***(Text Book-4: Chapter 1)***	

List of Laboratory/Practical Experiments activities to be conducted :
Experiments can be conducted using Verilog tool /Kits
1. Introduction to Xilinx tool, FPGA flow
2. Adder – HA, FA using data flow and behavioral modelling styles
3. Adder – HA, FA using structural modelling style
4. Combinational designs – I **a.** Multiplexer: 4:1, 8:1 MUX. **b.** De Multiplexer: 1:4, 1:8 DEMUX.
5. Combinational designs – II **c.** Encoder with and without Priority: 8:3 and 4:2. **d.** Decoder: 3:8 and 2:4.
6. Design of 4 bit ALU
7. Flip Flop: D FF, T FF, JK FF
8. Design of Mod – n Up/Down Counter with Synchronous reset
9. Design of Mod – n Up/Down Counter with Asynchronous reset.
10. Open Ended Experiment.

Dayananda Sagar University

School of Engineering

Devarakaggalahalli , Harohalli , Kanakapura Road , Ramanagar District- 562112

DEPARTMENT OF ELECTRONICS AND COMMUNICATION ENGINEERING

Course Outcome	Description	Bloom's Taxonomy Level
At the end of the course the student will be able to:		
1	**Interpretation** of Boolean Expressions of digital design in simplified form	L2
2	**Build** the various elements of digital logic system with Verilog	L3
3	**Construct** Combinational and Sequential logic circuits	L3
4	**Analyse** the hardware model of a digital system at different levels of abstraction in Verilog	L4
5	**Evaluate** the functionality of digital design by implementing on FPGA kits	L5
6	**Modeling** of digital systems using FSM	L3

Table: Mapping Levels of COs to POs / PSOs

Cos	Program Outcomes (POs)												PSOs		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	3	-	1	-	-	-	-	-	-	-	1	-	1	-	-
CO2	3	2	1	2	3	-	-	-	1	-	1	1	2	1	-
CO3	3	2	3	1	2	-	-	1	1	-	1	1	2	1	-
CO4	3	3	2	3	3	1	-	1	-	1	2	1	2	2	1
CO5	3	3	2	3	3	1	-	-	-	1	-	-	2	2	1
CO6	3	3	3	3	3	2	-	1	2	2	2	2	2	1	2

3: Substantial (High) **2: Moderate (Medium)** **1: Poor (Low)**

TEXT BOOKS:

1. M. Morris Mano Michael D. Ciletti , "Digital Design with an Introduction to the Verilog HDL", 6th Edition, Pearson Education, 2014.
2. Stephen Brown, Zvonko Vranesic, "Fundamentals of Digital Logic with Verilog design", McGraw Hill, 2014.
3. Nazein M. Botros, "HDL programming (VHDL and Verilog)", Dreamtech Press, 2006.
4. Douglas J Smith, "HDL Chip Design", Doone publications 1996.

REFERENCE BOOKS:

1. John M Yarbrough, "Digital Logic Applications and Design", Thomson Learning, 2014.
2. Donald D. Givone, "Digital Principles and Design", McGraw Hill, 2015.
3. Samir Palnitkar, "Verilog HDL: A Guide to Digital Design and Synthesis", Pearson Education, 2016.

E-Resources:

1. https://archive.nptel.ac.in/courses/106/105/106105165/
2. https://nptel.ac.in/courses/117105080

Activity Based Learning (Suggested Activities in Class)

1. Design problem solving and Programming using group discussion. E.g., Traffic light controller, Digital Clock, Elevator.
2. Demonstration of solution to a problem through simulation.

****

Dayananda Sagar University

School of Engineering

Devarakaggalahalli , Harohalli , Kanakapura Road , Ramanagar District- 562112

DEPARTMENT OF ELECTRONICS AND COMMUNICATION ENGINEERING

NETWORK ANALYSIS

[As per Choice Based Credit System (CBCS) scheme]

SEMESTER – III

Subject Code	:		**Credits**	:	03
Hours / Week	:	03 Hours	**Total Hours**	:	39 Hours
L–T–P	:	3–0–0			

Course Learning Objectives:

This course will enable students to:

1. **To understand the fundamental principles of electrical circuits, laws, and theorems, enabling them to analyze simple electrical circuits.**
2. **To analyze direct current (DC) circuits using various methods like nodal analysis, and mesh analysis with passive components.**
3. **To analyze AC circuits and learn impedance concepts, phasor representation, transient and steady-state response and frequency response.**
4. **To apply various network theorems such as Superposition, Thevenin, Norton & maximum power transfer for simplification of complex circuits.**
5. **To calculate Z, Y, H, and ABCD parameters of two-port networks and understand the relationship between different network parameters.**
6. **To understand the fundamentals of filters and analyze constant k low pass and high pass filters**

Teaching-Learning Process (General Instructions)

These are sample new pedagogical methods, where teacher can use to accelerate the attainment of the various course outcomes.

1. ***Interactive Lectures:*** Engage students through discussions, case studies, and real-life examples.
2. ***Hands-on Projects:*** Assign practical projects to students to enhance their understanding and application of concepts.
3. ***Group Discussions:*** Encourage collaborative learning and problem-solving through group discussions and brainstorming sessions.
4. ***Case Studies:*** Understand the significance of time constant, natural frequency, and resonance to analyse its characteristics, behaviors, and outcomes..
5. ***Simulations and Virtual Labs:*** Use simulation tools and virtual labs to provide a virtual hands-on experience in mesh and node analysis.
6. ***Guest Lectures:*** Invite industry experts to share their experiences and provide insights into applications of network theorems in real-world problems.
7. ***Online Forums:*** Establish an online platform for students to discuss and share their ideas and questions related to the course.

8. ***Demonstrations:*** Conduct live demonstrations of network system prototypes to showcase practical implementations.
9. ***Assignments and Assessments:*** Assign regular assignments and assessments to evaluate students' understanding and progress.
10. ***Industry Visits:*** Organize visits to manufacturing companies to expose students to real-world applications.

UNIT – I	09 Hours

BASICS & NETWORK TOPOLOGY

Practical sources, Source transformations, Network reduction using Star-Delta transformation, Kirchhoff's Laws, Mesh Analysis with and without dependent source, Super mesh, Nodal Analysis with and without dependent source, Super node, Graph of a network, Tree, Co-tree, Sub graph, Connected graph and loop, Incidence matrix.

UNIT – II	08 Hours

NETWORK THEOREMS

Superposition, Thevenin's, Norton's, Maximum power transfer, Reciprocity, Tellegen's, Millman's theorems for d.c and a.c sources.

UNIT – III	07 Hours

TRANSIENT ANALYSIS

Transient analysis: Series RL, RC, RLC networks, significance of time constant, natural frequency, Resonance, Q factor. Steady-state sinusoidal analysis of reactive networks

UNIT – IV	08 Hours

NETWORK PARAMETERS

Z parameters, Y parameters, H parameters, ABCD parameters, Symmetry and reciprocity, Relation between two port parameters, Interconnection of two-port networks

UNIT – V	07 Hours

NETWORK FILTERS

Filter fundamentals, Pass and stop bands, Characteristic impedance, Constant K- low pass filter, Constant K-high pass filter, Band pass filter, All pass filter

Dayananda Sagar University
School of Engineering
Devarakaggalahalli , Harohalli , Kanakapura Road , Ramanagar District- 562112

DEPARTMENT OF ELECTRONICS AND COMMUNICATION ENGINEERING

Course Outcome	Description	Bloom's Taxonomy Level
At the end of the course the student will be able to:		
1	**Understand** linear, non-linear components and circuits, **Analyse** electrical circuits involving resistors, capacitors, inductors, and various sources using source transformation, nodal analysis, mesh analysis and graph theory and concept of duality.	L4-Analyze
2	**Analyze** and solve complex DC circuits, calculating voltage, current, and power in various circuit elements using network theorems to simplify complex circuits and calculate equivalent circuit parameters.	L3-Apply
3	**Analyze** AC circuits, including calculating impedance, current, and voltage across different components, analyze and predict the transient behavior of electrical circuits during the switching process.	L4-Analyze
4	**Apply** the concept of network parameters, Z, Y, H and ABCD parameters, Students will be able to represent and analyse electrical application circuits in terms of these parameters using the concept of symmetry and reciprocity to these circuits.	L3-Apply
5	Understand the working of Low pass, high pass, band stop and band pass filters. **Analyse** filter characteristics and Design filter circuits for low pass, high pass, band pass and band reject applications.	L4-Analyse
6	Develop problem-solving skills and apply critical thinking to tackle real-world electrical network challenges. Students will effectively communicate their circuit analysis results, both orally and in written form, to convey technical information clearly and concisely	L4-Analyse

COs	Program Outcomes (POs)											
	1	2	3	4	5	6	7	8	9	10	11	12
	Engineering Knowledge	Problem Analysis	Design	Conduct Investigation of complex	Tool Usage	Engineer & Society	Environment & Stability	Ethics	Team Work	Communication	Life Long Learning	Project Management & Finance

				problems								
CO1	**3**	**3**	**1**	**2**	**2**	**1**	**-**	**-**	**1**	**-**	**2**	**-**
CO2	**3**	3	**1**	**2**	**3**	**1**	**-**	**-**	**1**	**-**	**2**	**-**
CO3	**3**	**2**	**3**	**1**	**2**	**1**	**-**	**-**	**1**	**-**	**2**	**-**
CO4	**3**	**3**	**2**	**3**	**1**	**1**	**-**	**-**	**1**	**-**	**2**	**-**
CO5	**3**	**3**	**3**	**3**	**3**	**1**	**-**	**1**	**1**	**1**	**2**	**-**
CO6	**3**	**3**	**3**	**3**	**3**	**2**	**-**	**1**	**2**	**2**	**2**	**2**

TEXT BOOKS:

1. Hayt W. H., Kemmerly J. E. and Durbin S. M., "Engineering Circuit Analysis", 6th Ed., Tata McGraw-Hill Publishing Company Ltd.,2008.
2. Roy Choudhury, ―Networks and systems, 2nd edition, New Age International Publications, 2006
3. Valkenberg V., "Network Analysis", 3rd Ed., Prentice Hall International Edition., 2007

REFERENCE BOOKS:

1. Network Analysis & Synthesis by Franklin S. KUO, Wiley Publication, 2006
2. Boylestad, Robert L. Introductory circuit analysis. Pearson Education India, 2003.

E-Resources:

For the Blended Learning
https://nptel.ac.in/courses/108/105/108105159/
UNIT 1 : BASICS AND NETWORK TOPOLOGY
https://youtu.be/0pFF1oAYgQ I
https://youtu.be/0BQ2yyC6L c8
UNIT -2 : NETWORK THEOREMS
https://youtu.be/ouQoab7GVRQ
UNIT -3 : SINUSOIDAL STEADY STATE AND TRANSIENT ANALYSIS
https://youtu.be/T90oBR-CtJQ
UNIT – 4 : NETWORK PARAMETRS
https://youtu.be/plv9ovmwHm A
UNIT-5: NETWORK FILTERs
https://www.youtube.com/watch?v=u59IUA6uvjk

Dayananda Sagar University
School of Engineering
Devarakaggalahalli , Harohalli , Kanakapura Road , Ramanagar District- 562112

DEPARTMENT OF ELECTRONICS AND COMMUNICATION ENGINEERING

SIGNALS AND SYSTEMS

[As per Choice Based Credit System (CBCS) scheme]

SEMESTER – III

Subject Code	:	21EC2401	**Credits**	:	03
Hours / Week	:	03 Hours	**Total Hours**	:	39 Hours
L–T–P	:	3–0–0			

Course Learning Objectives:

This Course will enable students to:

1. Understanding of signals, their classification and signal transformations
2. Develop input output relationship for linear time-invariant systems and understand the convolution operator.
3. Knowledge of Fourier series as an important tool to analyze periodic signals for continuous and discrete time signals
4. Knowledge of transform techniques for the frequency domain description of continuous and discrete time signals and systems.
5. Understanding basics of sampling for discretization of continuous time signal and use of software tools for signal processing.
6. Build foundation for advanced courses such as signal processing, control system and communication

Teaching-Learning Process (General Instructions)

These are sample new pedagogical methods, where teacher can use to accelerate the attainment of the various course outcomes.

1. ***Lecture method*** means it includes not only traditional lecture method, but different *type of teaching methods* may be adopted to develop the course outcomes.
2. ***Interactive Teaching:*** *Adopt the* ***Active learning*** that includes brainstorming, discussing, group work, focused listening, formulating questions, notetaking, annotating, and roleplaying.
3. Show ***Video/animation*** films to explain functioning of various concepts.
4. Encourage ***Collaborative*** (Group Learning) Learning in the class.

5. To make ***Critical thinking***, ask at least three Higher order Thinking questions in the class.
6. Adopt ***Problem Based Learning***, which fosters students' Analytical skills, develop thinking skills such as the ability to evaluate, generalize, and analyse information rather than simply recall it.
7. Show the ***different ways to solve*** the same problem and encourage the students to come up with their own creative ways to solve them.
8. Discuss how every ***concept can be applied to the real world*** – and when that's possible, it helps improve the students' understanding.

UNIT – I	**08 Hours**
Introduction to signal: Continuous and discrete time signals: Classification of Signals – Periodic aperiodic even – odd – energy and power signals – Deterministic and random signals – complex exponential and sinusoidal signals – periodicity – unit impulse – unit step – Transformation of the independent variable of signals: time scaling, time shifting.	
UNIT – II	**08 Hours**
Introduction to Systems and Behavior of LTI systems: System properties: system with and without memory, invertibility and inverse system, causality, stability, time invariance, and linearity. Time domain representation of LTI System: Discrete-Time LTI systems: convolution sum, Continuous-Time LTI systems: convolution integral, properties of LTI systems. Causal LTI system representation through differential equations and difference equations.	
UNIT – III	**08 Hours**
Fourier Series and Fourier Transforms: Representation of Fourier series for Continuous time periodic signals, properties of continuous time Fourier series, Exponential Fourier series, Relationship between Exponential Fourier series and trigonometric Fourier series, Complex Fourier spectrum. Fourier transformation of continuous and discrete time signals and their properties. Parseval's theorem.	

UNIT – IV	08 Hours
Laplace transform and Z-Transform: Laplace transform, ROC, inverse Laplace transform, properties of Laplace transform, analysis, and characterization of LTI systems using Laplace transform, unilateral Laplace transform. Z-transform, region of convergence – properties of ROC – Properties of z-transform– inverse z-transform.	
UNIT – V	**07 Hours**
Sampling and Reconstruction: The Sampling Theorem, Reconstruction of a signal by using interpolation, Effects of under-sampling: Aliasing. Introduction to digital computer simulation using MATLAB/ Scilab.	

Course Outcome	Description	Bloom's Taxonomy Level
At the end of the course the student will be able to:		
1	**Classify** the signals and perform basic operations on signals and systems.	L2
2	**Differentiate** systems based on their properties and determine the response of the LTI system using convolution.	L3
3	**Analyze** the spectral characteristics of continuous-time periodic and aperiodic signals using Fourier analysis.	L4
4	**Apply** Laplace transform and Z-transform for analyzing continuous-time and discrete-time signals and systems.	L3
5	**Understand** the process of sampling, effects of under-sampling, and software simulation tools for signal processing.	L2

Table: Mapping Levels of COs to POs / PSOs														
COs	**Program Outcomes (POs)**												**PSOs**	
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**
CO1	2	1											1	
CO2	3	3											2	
CO3	3	3										1	1	2
CO4	3	3										1	1	2
CO5	3	2			3								1	1

3: Substantial (High) **2: Moderate (Medium)** **1: Poor (Low)**

TEXT BOOKS:

1. Alan V Oppenheim, Alan S, Willsky and A Hamid Nawab, —Signals and Systems Pearson Education Asia / PHI, 2nd edition, 1997. Indian Reprint 2002.
2. Simon Haykins and Barry Van Veen, —Signals and Systems, 2nd Edition, 2004

REFERENCE BOOKS:

1. Michael Roberts, —Fundamentals of Signals & Systems, 2nd edition,Tata McGraw-Hill, 2010, ISBN 978-0-07-070221-9.

2. H. P Hsu, R. Ranjan, —Signals and Systems||, Scham's outlines, TMH

2. B. P. Lathi, —Linear Systems and Signals||, Oxford University Press, 2005.

4. Ganesh Rao and Satish Tunga, —Signals and Systems, Pearson/SanguineTechnical

Publishers, 2004.

E-Resources:

1. https://nptel.ac.in/courses/108104100
2. https://nptel.ac.in/courses/117104074
3. https://www.edx.org/course/signals-and-systems-part-1

Activity Based Learning (Suggested Activities in Class)

1. Student seminars or presentations on Current research trends by referring to IEEE Journal on Selected Areas in Communications, IEEE Transactions on Signal Processing, IEEE Transactions on Audio, Speech, and Language Processing, etc.
2. Demonstration of solution to a problem through Matlab programming.

****

Dayananda Sagar University

School of Engineering

Devarakaggalahalli , Harohalli , Kanakapura Road , Ramanagar District- 562112

DEPARTMENT OF ELECTRONICS AND COMMUNICATION ENGINEERING

SEMESTER – IV

PROBABILITY AND STATISTICS

[As per Choice Based Credit System (CBCS) scheme]

SEMESTER – IV

Subject Code	:		**Credits**	:	03
Hours / Week	:	03 Hours	**Total Hours**	:	39 Hours
L–T–P–S	:	3–0–0–0			

Course Learning Objectives:

This Course will enable students to:

1. **Apply** statistical principles and probability concepts to solve complex problems in real-world scenarios involving uncertainty and randomness.
2. **Evaluate** and select appropriate probability distributions and statistical techniques to analyze and interpret data accurately in various applications.
3. **Justify** the use of estimation methods and hypothesis testing techniques for drawing meaningful inferences about population parameters.
4. **Analyze** and interpret sample test results for different statistical relationships, such as means, variances, correlation coefficients, regression coefficients, goodness of fit, and independence, to make informed decisions.
5. **Identify** sample tests using appropriate statistical procedures to investigate the significance of observed data and communicate findings effectively.

Dayananda Sagar University
School of Engineering
Devarakaggalahalli , Harohalli , Kanakapura Road , Ramanagar District- 562112

DEPARTMENT OF ELECTRONICS AND COMMUNICATION ENGINEERING

Teaching-Learning Process (General Instructions)

These are sample new pedagogical methods, where teacher can use to accelerate the attainment of the various course outcomes.

1. ***Lecture method*** means it includes not only traditional lecture method, but different *type of teaching methods* may be adopted to develop the course outcomes.
2. ***Interactive Teaching:*** *Adopt the* ***Active learning*** that includes brainstorming, discussing, group work, focused listening, formulating questions, notetaking, annotating, and roleplaying.
3. Show ***Video/animation*** films to explain functioning of various concepts.
4. Encourage ***Collaborative*** (Group Learning) Learning in the class.
5. To make ***Critical thinking***, ask at least three Higher order Thinking questions in the class.
6. Adopt ***Problem Based Learning***, which fosters students' Analytical skills, develop thinking skills such as the ability to evaluate, generalize, and analyse information rather than simply recall it.
7. Show the ***different ways to solve*** the same problem and encourage the students to come up with their own creative ways to solve them.
8. Discuss how every ***concept can be applied to the real world*** - and when that's possible, it helps improve the students' understanding.

UNIT - I	**09 Hours**
Probability: Definitions of Probability, Addition Theorem, Conditional Probability, Multiplication Theorem, Bayes' Theorem of Probability	
UNIT – II	**09 Hours**
Random Variables and their Properties and Probability Distributions: Discrete Random Variable, Continuous Random Variable, Joint Probability Distributions Their Properties, Probability Distributions: Discrete Distributions: Binomial, Poisson Distributions and their Properties; Continuous Distributions: Exponential ,Normal, Distributions and their Properties.	
UNIT – III	**06 Hours**
Estimation and testing of hypothesis: Sample, Populations, Statistic, Parameter, Sampling Distribution, Standard Error, Un- Biasedness, Efficiency, Maximum Likelihood Estimator, Notion & Interval Estimation.	

Dayananda Sagar University
School of Engineering
Devarakaggalahalli , Harohalli , Kanakapura Road , Ramanagar District- 562112

DEPARTMENT OF ELECTRONICS AND COMMUNICATION ENGINEERING

UNIT – IV	07 Hours
Sample Tests-1: Large Sample Tests Based on Normal Distribution , Small Sample Tests : Testing Equality of Means, Testing Equality of Variances, Test of Correlation Coefficient	
UNIT – V	**08 Hours**
Sample Tests-2: Test for Regression Coefficient; Coefficient of Association, 2 – Test for Goodness of Fit, Test for Independence.	

Course Outcome	Description	Bloom's Taxonomy Level
At the end of the course the student will be able to:		
1	**Apply** the principles of probability to solve complex problems in various real-world scenarios.	L2 & L3
2	**Solve** and **compare** different probability distributions, including discrete and continuous random variables, in order to make informed decisions and predictions.	L2 & L3
3	**Apply** statistical estimation techniques, such as maximum likelihood estimation and interval estimation, to draw meaningful inferences about population parameters from sample data.	L3
4	**Examine** hypothesis testing methods, including large and small sample tests, to assess the significance of observed data and draw valid conclusions.	L4
5	**Analyze** statistical relationships and perform sample tests to assess the Equality of means in different populations, Correlation coefficients between variables to determine the strength and direction of the relationship. Independence of variables using appropriate statistical tests to assess the absence of any relationship.	L4

Table: Mapping Levels of COs to POs / PSOs														
COs	**Program Outcomes (POs)**												**PSOs**	
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**
CO1	3	2	2		2				1					
CO2	3	2	2		2				1					
CO3	3	2	2						1					
CO4	3	2	2		2				1					
CO5	3	2	2		2				1					

3: Substantial (High) **2: Moderate (Medium)** **1: Poor (Low)**

TEXT BOOKS:

1. Probability & Statistics for Engineers and Scientists, Walpole, Myers, Myers, Ye. Pearson Education.

REFERENCE BOOKS:

3. Probability, Statistics and Random Processes T. Veerarajan Tata McGraw – Hill
4. Probability & Statistics with Reliability, Queuing and Computer Applications, Kishor S. Trivedi, Prentice Hall of India ,1999

E-Resources:

1. https://nptel.ac.in/courses/106104233
2. https://nptel.ac.in/courses/117103067
3. https://nptel.ac.in/courses/103106120
4. https://www.coursera.org/learn/probability-intro#syllabus
5. https://nptel.ac.in/courses/111104073

Activity Based Learning (Suggested Activities in Class)

1. Tools like Python programming, R programming can be used which helps student to develop a skill to analyze the problem and providing solution.
2. Regular Chapter wise assignments/ Activity/Case studies can help students to have critical thinking, developing an expert mind set, problem-solving and teamwork.

****

Dayananda Sagar University

School of Engineering

Devarakaggalahalli , Harohalli , Kanakapura Road , Ramanagar District- 562112

DEPARTMENT OF ELECTRONICS AND COMMUNICATION ENGINEERING

Following are Activities Can carried out in place of Assignments using either R programming language or Python Programming or excel solver.

1. There are n people gathered in a room. What is the probability that at least 2 of them will have the same birthday? (Use excel solver, R Programming, Python Programming)
   a. Use simulation to estimate this for various n., and Produce Simulation Graph.
   b. Find the smallest value of n for which the probability of a match is greater than 0.5.
   c. Explore how the number of trials in the simulation affects the variability of our estimates.
2. **Case Study 1: Customer Arrivals at a Coffee Shop**
   a. Background: A coffee shop wants to analyze the number of customer arrivals during its morning rush hour (7:00 AM to 9:00 AM). The shop has been recording the number of customer arrivals every 15 minutes for the past month.
   b. Data: The data consists of the number of customer arrivals recorded at the coffee shop during each 15-minute interval for the past month.
   c. Here is a sample of the data:

Time Interval	Customer Arrivals
7:00 AM - 7:15 AM	**6**
7:15 AM - 7:30 AM	**4**
7:30 AM - 7:45 AM	**9**
7:45 AM - 8:00 AM	**7**
8:00 AM - 8:15 AM	**5**
8:15 AM - 8:30 AM	**8**
8:30 AM - 8:45 AM	**10**
8:45 AM - 9:00 AM	**6**

   analyze the customer arrivals and determine the probability distribution that best fits the data. Specifically, explore both discrete and continuous probability distributions,including the binomial, Poisson, exponential, and normal distributions.
3. **Case Study 2: Comparing the Performance of Two Groups**
   a. Suppose you are a data analyst working for a company that manufactures a new energy drink. The marketing team conducted a promotional campaign in two different cities (City A and City B) to determine the effectiveness of the campaign in increasing sales. The sales data for a random sample of customers in each city was collected over a week. Your task is to compare the average sales between the two cities and test whether there is a significant difference in the variance of sales.
   b. Data: Let's assume the following sample data for the number of energy drinks sold in each city:

   City A: [30, 28, 32, 29, 31, 33, 34, 28, 30, 32]
   City B: [25, 24, 26, 23, 22, 27, 29, 30, 26, 24]
   perform a two-sample t-test to test the equality of means and a test for equality of variances using Python's SciPy library.
4. **case study 3:** testing independence between two categorical variables.

   a. Data: Sample of 100 employees, and each employee is classified as either Male or Female. They were asked to rate their job satisfaction on a scale of 1 to 5, where 1 represents low satisfaction and 5 represents high satisfaction. The data is as follow

5.

Employee	Gender	Job Satisfaction
1	Male	4
2	Female	3
3	Male	2
4	Female	5
...	...	...
100	Female	4

a. Test for independence between gender and job satisfaction, use the chi-squared test in R.

****

Dayananda Sagar University

School of Engineering

Devarakaggalahalli , Harohalli , Kanakapura Road , Ramanagar District- 562112

DEPARTMENT OF ELECTRONICS AND COMMUNICATION ENGINEERING

ELECTROMAGNETIC FIELD THEORY

[As per Choice Based Credit System (CBCS) scheme]

SEMESTER – IV

Course Code	:	**Credits**	: 04
Hours / Week	: 04 Hours	**Total Hours**	: 39+13 Hours
L–T–P–J	: 3–1–0–0		

Course Learning Objectives:

This Course will enable students to:

1. **Understand** the applications of Coulomb's law and Gauss law to different charge distributions
2. **Apply** the knowledge of Laplace's and Poisson's Equations to solve real time problems on capacitance of different charge distributions.
3. **Understand** the significance of Biot-Savart's and Ampere's Law for different current distributions.
4. **Study** the significance of Divergence, Curl and Gradient
5. **Understand** the interpretation of Maxwell' equations for time varying conditions
6. **Analyse** for uniform Plane waves for their characteristic's features.
7. **Acquire** knowledge of Poynting Theorem and its application of Power flow.

Dayananda Sagar University
School of Engineering
Devarakaggalahalli , Harohalli , Kanakapura Road , Ramanagar District- 562112

DEPARTMENT OF ELECTRONICS AND COMMUNICATION ENGINEERING

Teaching-Learning Process (General Instructions)

These are sample new pedagogical methods, where teacher can use to accelerate the attainment of the various course outcomes.

1. ***Lecture method*** means it includes not only traditional lecture method, but different *type of teaching methods* may be adopted to develop the course outcomes.
2. ***Interactive Teaching:*** *Adopt the* ***Active learning*** that includes brainstorming, discussing, group work, focused listening, formulating questions, notetaking, annotating, and roleplaying.
3. Show ***Video/animation*** films to explain functioning of various concepts.
4. Encourage ***Collaborative*** (Group Learning) Learning in the class.
5. To make ***Critical thinking***, ask at least three Higher order Thinking questions in the class.
6. Adopt ***Problem Based Learning***, which fosters students' Analytical skills, develop thinking skills such as the ability to evaluate, generalize, and analyse information rather than simply recall it.
7. Show the ***different ways to solve*** the same problem and encourage the students to come up with their own creative ways to solve them.
8. Discuss how every ***concept can be applied to the real world*** - and when that's possible, it helps improve the students' understanding.

UNIT – I	08 Hours

Electrostatics -1: Coulomb's Law and Electric Field Intensity, Electric Field due to line charge, volume Charge and Sheet Charge, Related Problems.
(Text Book-1: Chapter 2: 26 to 43).
Gauss' Law: Electric flux, Electric Flux Density, Gauss' Law, Applications of Gauss' Law, Maxwell's first equation, Introduction to 'del' operator and Divergence Theorem, Related Problems
(Text Book-1: Chapter3: 48-69).

UNIT – II	09 Hours

Electrostatics – 2
Energy and Potential: Energy and potential in a moving point charge in an Electric Field, Line Integral, Definition of Potential Difference, Potential field of a moving charge,

Potential Gradient, conductor properties and boundary conditions, boundary conditions for perfect dielectric materials. Related Problems.
(Text Book-1: Chapter 4: 75 to 94, 100-104, Chapter 5: 110-113, 119-123).
Poisson's and Laplace's Equations: Poisson's and Laplace's Equations, Uniqueness Theorem, Applications of Laplace's and Poisson's Equations, Related Problems.
(Text Book-1: Chapter 6: 143-168)

UNIT – III	**08 Hours**

The Steady Magnetic Field: Biot-Savart Law, Applications of Biot-Savart's law, Ampere's Circuital Law, Curl, Stokes' Theorem, Magnetic Flux and Flux Density, Scalar and Vector Magnetic Potentials,
Magnetic Boundary Conditions, Energy in Magnetic Field Related Problems
(Text Book-1: Chapter 7: 180-216).

UNIT – IV	**07 Hours**

Time Varying Magnetic Field: Faraday's Law of e.m.f, Inconsistency of Ampere's law, Displacement Current, Maxwell's Equation in Point and Integral Form of different media, The retarded potential,
Boundary Conditions: Dielectric –Dielectric boundary. Related Problems
(Text Book-1: Chapter 9: 277-297).

UNIT – V	**07 Hours**

Uniform Plane Waves: Wave propagation in free space and dielectrics, Propagation in Conductors: Skin Effect, The Poynting Vector and Power Considerations, Power loss in plane conductor, Wave Polarization, Reflection of uniform plane waves at normal Incidence, for perfect conductor-dielectric boundary & dielectric-dielectric boundary, Standing Wave Ratio,
Introduction to transmission lines and waveguide
(Text Book-1: Chapter 11: 367-390, Chapter12: 406-425).

Dayananda Sagar University
School of Engineering
Devarakaggalahalli , Harohalli , Kanakapura Road , Ramanagar District- 562112

DEPARTMENT OF ELECTRONICS AND COMMUNICATION ENGINEERING

Course Outcome	Description	Bloom's Taxonomy Level
At the end of the course the student will be able to:		
1	**Analyse** the various charge distributions with respect to various Electrostatic theorems and principles	L4
2	**Analyse** the various current distributions with respect to various Magnetostatic theorems and principles	L4
3	**Apply** the Maxwell's equation for time varying conditions.	L3
4	**Apply** Maxwell's equations to describe the plane waves and their propagation in different Media.	L3
5	**Analyse** the power concept associated with EM with Poynting Theorem and evaluate power associated withPlane waves.	L4

Table: Mapping Levels of COs to POs / PSOs

Cos	Program Outcomes (POs)												PSOs		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	3	2	1	1	-	1	-	1	-	-	-	-	1	-	-
CO2	3	2	1	-	-	1	-	1	-	-	-	-	1	-	-
CO3	3	2	-	-	-	-	-	1	-	-	-	-	1	**1**	-
CO4	3	2	1	-	-	-	-	-	-	-	-	1	1	**1**	-
CO5	3	2	-	-	-	-	-	-	-	-	-	1	1	**1**	-

3: Substantial (High) **2: Moderate (Medium)** **1: Poor (Low)**

TEXT BOOKS:

1. Engineering Electromagnetics-William H. Hayt Jr. and John A. Buck, Tata McGraw Hill, 6th Edition, 2001
2. Electromagnetic Waves and Radiating systems – E. C. Jordan and K.G. Balman, PHI, 2nd Edition.

REFERENCE BOOKS:

1. Electromagnetics- Joseph Edminister, Schaum Outline Series, McGraw Hill.
2. Field and Wave Electromagnetics- David K. Cheng, Pearson Education Asia II Editionn.- 1989, Indian Reprint 2001.

E-Resources:

1. https://onlinecourses.nptel.ac.in/noc21_ee83/preview
2. https://archive.nptel.ac.in/courses/108/104/108104087/

****

Dayananda Sagar University

School of Engineering

Devarakaggalahalli , Harohalli , Kanakapura Road , Ramanagar District- 562112

DEPARTMENT OF ELECTRONICS AND COMMUNICATION ENGINEERING

Analog Electronic Circuits

[As per Choice Based Credit System (CBCS) scheme]

SEMESTER – IV

Subject Code	:		**Credits**	:	04
Hours / Week	:	03 Hours	**Total Hours**	:	39 + 26 Hours
L–T–P	:	3–0–2			

Course Learning Objectives:

This Course will enable students to:

1. Understand BJT biasing and determine various gains of BJT amplifiercircuit using hybrid parameters.
2. Explain the structure and operation of MOSFET and its application.
3. Relate theinternal structure of op-amp, frequency response andcompensation techniques.
4. Apply the knowledge of op-amps in various linear and non linearapplications.

Teaching-Learning Process (General Instructions)

These are sample new pedagogical methods, where teacher can use to accelerate the attainment of the various course outcomes.

1. ***Lecture method*** means it includes not only traditional lecture method, but different *type of teaching methods* may be adopted to develop the course outcomes.
2. ***Interactive Teaching:*** *Adopt the* ***Active learning*** that includes brainstorming, discussing, group work, focused listening, formulating questions, note taking, annotating, and roleplaying.
3. Show ***Video/animation*** films to explain functioning of various concepts.
4. Encourage ***Collaborative*** (Group Learning) Learning in the class.
5. To make ***Critical thinking***, ask at least three Higher order Thinking questions in the class.
6. Adopt ***Problem Based Learning***, which fosters students' Analytical skills, develop thinking skills such as the ability to evaluate, generalize, and analyse information rather than simply recall it.

Dayananda Sagar University

School of Engineering

Devarakaggalahalli , Harohalli , Kanakapura Road , Ramanagar District- 562112

DEPARTMENT OF ELECTRONICS AND COMMUNICATION ENGINEERING

UNIT – I	04Hours
Diode Applications	
Diode clipper and clamper circuits, Performance Analysis of Half Wave Rectifier, Full wave Centre Tap and Bridge rectifier.	
UNIT – II	**11 Hours**
Transistors- BJT	
DC Load Line, Q Point, Biasing Circuits- Fixed, Emitter Bias and Voltage Divider Bias. Transistor small signal model and analysis of a transistor amplifier circuit using h- parameter for CE configuration, RC coupled Single stage Amplifier, Concept of Feedback, Introduction to power amplifiers.	
UNIT – III	**9 Hours**
Operational Amplifier:	
IC Operational Amplifier, Voltage Follower Circuit, Non-Inverting and Inverting Amplifier, Op-Amp as DC Amplifiers – Direct coupled - voltage follower, Inverting Amplifier, Non-Inverting Amplifier, Capacitor coupled voltage follower OP-Amp Frequency Response and Compensation: Op-Amp circuit stability, Internally Compensated Op-Amps- frequency and phase response	
UNIT – IV	**08 Hours**
Switching and Oscillator Circuits	
Op-amp as switching circuits: Zero Crossing Detector, Comparator, Inverting Schmitt trigger, Sample and Hold circuit. Oscillators circuits: Wien bridge, phase shift, Hartley and Colpitts oscillators, Triangular waveform generator, 555 timer monostable, Astable and Bistable Multivibrator.	
UNIT – V	**07 Hours**
Filter and Data Converters	
Frequency Analysis, Active Filters: First order and second order active Low pass and high pass filters. DAC and ADC convertor: DAC using R-2R, ADC-Successive approximation. Flash ADC, Binary weighted DAC	

Dayananda Sagar University
School of Engineering
Devarakaggalahalli , Harohalli , Kanakapura Road , Ramanagar District- 562112

DEPARTMENT OF ELECTRONICS AND COMMUNICATION ENGINEERING

Course Outcome	Description	Bloom's Taxonomy Level
At the end of the course the student will be able to:		
1	**Understand** bias stability and small signal behavior of BJT.	Understanding - Level 2
2	**Understand** types and structure of Mosfet and its application.	Understanding- Level 2
3	**Analyze** the design of dc operational amplifiers, frequency response and compensation techniques of op-amp.	Analysis - Level 4
4	**Apply** the knowledge of op-amp for various switching circuits, oscillators and signal generators.	Application - Level 3
5	**Evaluate** the performance of OpAmp in linear, nonlinear circuits, data convertors and active filters.	Evaluation - Level 5

Table: Mapping Levels of COs to POs / PSOs

COs	Program Outcomes (POs)												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	3	2	1		2	1			1		1	2	3	3
CO2	3	2	1			1				1	1	2	3	3
CO3	3	2	2		2			1				2	3	2
CO4	3	2	2		2	1			1	1	1	2	3	3
CO5	3	3	3		2				1			2	2	2

3: Substantial (High) **2: Moderate (Medium)** **1: Poor (Low)**

TEXT BOOKS:

1. Millman.J. and Halkias C.C, "Electronic Devices and Circuits", Mc Graw Hill, 2007
2. David A.,Bell "Electronic Devices and Circuits", Oxford Higher Education Press, 5th Edition, 2010
3. David A. Bell "Operational Amplifiers and Linear ICs", 3rd edition, PHI/Pearson,200

REFERENCE BOOKS:

1. A.S. Sedra and K. C. Smith, " Microelectronic Circuits", 5th edition oxford university press 2004.
2. Donald .A. Neamen, Electronic Circuit Analysis and Design –2nd Edition, Tata Mc Graw Hill, 2009.
3. Robert L.Boylestad and Louis Nashelesky,"Electronic Devices and Circuit Theory", 10 th Edition, Pearson Education/PHI, 2008
4. Linear Integrated Circuits", D. Roy Choudhury and Shail B. Jain, 4nd edition, Reprint 2006.
5. Ramakant A Gayakwad, "Op-Amps and Linear Integrated Circuits," Pearson, 4th Ed, 2015

E-Resources:

1. https://www.youtube.com/watch?v=pkIxCmaxWFg&list=PLbRMhDVUMngehqNF2w_UbAi94qIycZOTG
2. https://www.youtube.com/watch?v=lpXNCwsnxjM&list=PLuv3GM6-gsE3npYPJJDnEF3pdiHZT6Kj3

Activity Based Learning (Suggested Activities in Class)

1. **Project-based Learning:** Assign a semester-long project where students design and implement an electronic based system for a specific application.
2. **Guest Speaker Series:** Invite professionals from the industry to share their experiences and projects related to electronic circuits.
3. **Prototyping Sessions:** Conduct hands-on sessions where students build and test small electronic circuit

Dayananda Sagar University

School of Engineering

Devarakaggalahalli , Harohalli , Kanakapura Road , Ramanagar District- 562112

DEPARTMENT OF ELECTRONICS AND COMMUNICATION ENGINEERING

ANALOG ELECTRONIC CIRCUITS LABORATORY

List of Laboratory/Practical Experiments activities to be conducted (if any) :
1. Design of Diode clipping and Clamping circuits.
2. RC coupled Single stage BJT amplifier - Determination of the gain-frequency response, input and output impedances.
3. Design of Summing Amplifier using Op-Amp
4. Design of Integrator and Differentiator, using Op-Amp.
5. Design of Comparators and Zero crossing detector using Op-Amp.
6. Design of Schmitt Trigger using Op-Amp.
7. IC 555 timer as Multivibrator
8. Design of Active Filters - LPF, HPF for given frequency range
9. Design of Phase shift and Wein Bridge oscillator using Op-Amp.
10. 4- bit DAC using Op-Amp.
11. Open ended experiment

Total Contact Hours: 26

****

Dayananda Sagar University

School of Engineering

Devarakaggalahalli , Harohalli , Kanakapura Road , Ramanagar District- 562112

DEPARTMENT OF ELECTRONICS AND COMMUNICATION ENGINEERING

EMBEDDED SYSTEM DESIGN

[As per Choice Based Credit System (CBCS) scheme]

SEMESTER – IV

Subject Code	:		**Credits**	:	04
Hours / Week	:	04 Hours	**Total Hours**	:	39 + 26 Hours
L–T–P	:	3–0–2			

Course Learning Objectives:

This Course will enable students to:

1. **Understand** the fundamental concepts of embedded system design.
2. Gain **knowledge** of various hardware and software components used in embedded systems.
3. **Develop** skills to design and implement embedded systems for different applications.
4. Learn to **analyze** and optimize the performance of embedded systems.
5. **Enhance** problem-solving and critical thinking abilities in the context of embedded system design.

Teaching-Learning Process (General Instructions)

These are sample new pedagogical methods, where teacher can use to accelerate the attainment of the various course outcomes.

1. ***Interactive Lectures:*** Engage students through discussions, case studies, and real-life examples.
2. ***Hands-on Projects:*** Assign practical projects to students to enhance their understanding and application of concepts.
3. ***Group Discussions:*** Encourage collaborative learning and problem-solving through group discussions and brainstorming sessions.
4. ***Case Studies:*** Analyze real-world embedded system designs to understand their challenges and solutions.
5. ***Simulations and Virtual Labs:*** Use simulation tools and virtual labs to provide a virtual hands-on experience.
6. ***Guest Lectures:*** Invite industry experts to share their experiences and provide insights into real-world embedded system design practices.

7. ***Online Forums:*** Establish an online platform for students to discuss and share their ideas and questions related to the course.
8. ***Demonstrations:*** Conduct live demonstrations of embedded system prototypes to showcase practical implementations.
9. ***Assignments and Assessments:*** Assign regular assignments and assessments to evaluate students' understanding and progress.
10. ***Industry Visits:*** Organize visits to embedded system manufacturing companies to expose students to real-world applications.

UNIT – I	**05 Hours**

INTRODUCTION TO EMBEDDED SYSTEMS

Introduction: What is an Embedded System, Embedded Systems VS. General Computing Systems, History of Embedded Systems, Classification of Embedded Systems, Major Application Areas of Embedded Systems, Purpose of Embedded Systems, Wearable Devices—The Innovative Bonding of Lifestyle with Embedded Technologies ***(Text Book-3: Chapter 1)***

Characteristics and Quality Attributes of Embedded Systems: Characteristics of an Embedded System, Quality Attributes of Embedded Systems ***(Text Book-3: Chapter 3)***

Embedded Systems—Application- and Domain-Specific: Washing Machine—Application-Specific Embedded System, Automotive–Domain Specific Examples of Embedded System ***(Text Book-3: Chapter 4)***

UNIT – II	**10 Hours**

EMBEDDED SYSTEM HARDWARE DESIGN

Embedded System Core: General Purpose and Domain Specific Processors, Application Specific Integrated Circuits (ASICs), Programmable Logic Devices (PLDs), Commercial off-the-shelf Components (COTS) ***(Text Book 3: Chapter 2.1)***

Memory: Overview on Various Types of memory sub systems used in Embedded systems and their selection ***(Text Book 3: Chapter 2.2)***

Sensors and Actuators: interfacing of LEDs, 7-segment LED Displays, Piezo Buzzer, Stepper Motor, Relays, Optocouplers, Matrix keyboard, Push button switches, Programmable Peripheral Interface Device (e.g. 8255 PPI), etc. with the I/O subsystem of the embedded system ***(Text Book 3: Chapter 2.3)***

Communication Interface: I2C, SPI, CAN, UART,1-wire, parallel bus, etc. RS-232C, RS-485, Parallel Port, USB, IEEE 1394, Infrared (IrDA), Bluetooth, Wi-Fi, ZigBee, GPRS, etc. ***(Text Book 3: Chapter 2.4)***

Other System Components: Reset Circuit, Brown-out protection circuit, Oscillator Unit, Real-Time Clock (RTC), Analog to Digital Converter (ADC), Timers and Watchdog Timer unit ***(Text Book 3: Chapter 2.6)***

Arm Cortex Mx Processor family Overview: Features, Architecture, Memory System, Exception and Interrupts, Low Power Features ***(Text Book 1: Chapter 3)***

UNIT – III	10 Hours
EMBEDDED SYSTEM SOFTWARE DESIGN	
Programming Concepts and Embedded Programming in C: High -Level Language C programming, C program elements (compiler build stages, macros, functions, Bitwise Operations, Looping constructs, Pointers and AAPCS) ***(Reference Book 2: Chapter 5.1 to 5.6)*** **Embedded Firmware Design and Development:** Embedded Firmware Design Approaches ***(Text Book 3: Chapter 9.1)***	
UNIT – IV	**10 Hours**
REAL-TIME OPERATING SYSTEMS	
Operating System Basics: The Kernel, Types of Operating Systems, Tasks, Process and Threads ***(Text Book 3: Chapter 10.1, 10.2, 10.3)*** **Thread Management:** Introduction to RTOS, Function pointers, Thread Management, Semaphores, Thread Synchronization, Process Management, Dynamic loading and linking ***(Text Book 2: Chapter 3)*** **Time Management:** Cooperation, blocking semaphores, First In First Out Queue, Thread sleeping, Deadlocks, Monitors, Fixed Scheduling ***(Text Book 2: Chapter 4)*** **Real-time Systems:** Data Acquisition Systems, Priority scheduler, Debouncing a switch, Running event threads as high priority main threads, Available RTOS ***(Text Book 2: Chapter 5)***	
UNIT – V	**04 Hours**
EMBEDDED SYSTEM TESTING AND DEBUGGING **Integration and Testing of Embedded Hardware and Firmware:** Integration of Hardware and Firmware, Board Bring up ***(Text Book 3: Chapter 12),*** Tools used for testing and debugging**:**. ***(Text Book 3: Chapter 13)***	

Dayananda Sagar University
School of Engineering
Devarakaggalahalli , Harohalli , Kanakapura Road , Ramanagar District- 562112

DEPARTMENT OF ELECTRONICS AND COMMUNICATION ENGINEERING

Course Outcome	Description	Bloom's Taxonomy Level
At the end of the course the student will be able to:		
1	**Apply** knowledge of embedded system design principles to solve real-world problems.	Application - Level 4
2	**Design** and implement embedded systems using appropriate hardware and software components.	Synthesis - Level 5
3	**Analyze** and evaluate the performance of embedded systems through testing and debugging techniques.	Analysis - Level 4
4	**Demonstrate** effective teamwork and communication skills in the development of embedded system projects.	Application - Level 4
5	**Critically assess** the ethical and societal implications of embedded system design.	Evaluation - Level 6

Table: Mapping Levels of COs to POs / PSOs

COs	Program Outcomes (POs)												PSOs		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	3	3	3	3							2	2	3	3	
CO2	3	3	3	3	3	2	2	1	3			2	3	3	
CO3	3	3	1	3	3							2	3	2	
CO4	3	3	3	3	3	2							3	3	
CO5						3	3	3							3

3: Substantial (High) **2: Moderate (Medium)** **1: Poor (Low)**

TEXT BOOKS:

1. Joseph Yiu," The Definitive Guide to ARM® Cortex®-M3 and Cortex®-M4 Processors", 3rd Edition, Newnes, 2013
2. Jonathan Valvano," Embedded Systems: Real-Time Operating Systems for ARM Cortex-M Microcontrollers", 2nd Edition, CreateSpace Independent Pub, 2012.
3. K.V. Shibu," Introduction to Embedded Systems", 2nd Edition, McGraw Hill Education, 2017.

REFERENCE BOOKS:

1. James K. Peckol, "Embedded Systems: A Contemporary Design Tool", Wiley, 2009.
2. Raj Kamal, "Embedded Systems- Architecture, Programming and Design", 3rd Edition, McGraw Hill Education, 2017.

E-Resources:

1. MOOC Course: "Introduction to Embedded Systems" by University of California, Irvine (Link: [www.coursera.org/embedded-systems])
2. Website: Embedded.com (Link: [www.embedded.com])
3. Online Tutorial: "Embedded Systems Tutorial" by Tutorials point (Link: [www.tutorialspoint.com/embedded_system])
4. ARM Procedure Call Standard (AAPCS) Standard documentation (Link: https://developer.arm.com/documentation/dui0041/c/ARM-Procedure-Call-Standard)

Activity Based Learning (Suggested Activities in Class)

1. **Project-based Learning:** Assign a semester-long project where students design and implement an embedded system for a specific application.
2. **Hackathons:** Organize hackathons where students work in teams to solve a given problem using embedded system design techniques.
3. **Guest Speaker Series:** Invite professionals from the industry to share their experiences and projects related to embedded system design.
4. **Case Studies:** Provide students with real-world case studies of successful embedded system designs and ask them to analyze and present their findings.
5. **Prototyping Sessions:** Conduct hands-on sessions where students build and test small-scale embedded system prototypes using development boards and sensors.

Dayananda Sagar University

School of Engineering

Devarakaggalahalli , Harohalli , Kanakapura Road , Ramanagar District- 562112

DEPARTMENT OF ELECTRONICS AND COMMUNICATION ENGINEERING

EMBEDDED SYSTEM DESIGN LABORATORY

Total Contact Hours: 26

1. Introduction to Microcontrollers: Familiarize students with microcontroller architecture and programming.
2. C as implemented in Assembly: Modify and compile a C program and observe the assembly listing and the map file. (*Note: Mapped to **module 5** of **Efficient Embedded Systems Design and Programming Lab** conducted by **ARM University program**)
3. General purpose I/O Lab: Implement a simple C program to read from and write to IO pins in the microcontroller. (*Note: Mapped to **module 7** of **Efficient Embedded Systems Design and Programming Lab** conducted by **ARM University program**)
4. Interrupt Handling: Understand interrupt handling and implement interrupt-driven tasks. (*Note: Mapped to **module 6** of **Efficient Embedded Systems Design and Programming Lab** conducted by **ARM University program**)
5. Analog-to-Digital Conversion: Learn how to perform analog-to-digital conversion using microcontrollers. (*Note: Mapped to **module 8** of **Efficient Embedded Systems Design and Programming Lab** conducted by **ARM University program**)
6. Timer Lab Exercise: Signal Generator with precision Timing and Buffering (*Note: Mapped to **module 9** of **Efficient Embedded Systems Design and Programming Lab** conducted by **ARM University program**)
7. PWM Generation: Generate Pulse Width Modulation signals for controlling motor speed.
8. Communication Protocols: Implement I2C or SPI communication protocols between microcontrollers. (*Note: Mapped to **module 10** of **Efficient Embedded Systems Design and Programming Lab** conducted by **ARM University program**)
9. Wireless Communication: Implement wireless communication between two or more embedded systems.
10. Power Management Techniques: Design power-efficient embedded systems using sleep modes and power management techniques
11. Real-Time Operating Systems: Implement a simple real-time task scheduler on a microcontroller.
12. System Debugging and Testing: Learn techniques for debugging and testing embedded systems.
13. Embedded System Project: Design and implement a complete embedded system project, integrating various hardware and software components.

****

Dayananda Sagar University
School of Engineering
Devarakaggalahalli , Harohalli , Kanakapura Road , Ramanagar District- 562112

DEPARTMENT OF ELECTRONICS AND COMMUNICATION ENGINEERING

CONTROL SYSTEMS

[As per Choice Based Credit System (CBCS) scheme]

SEMESTER – IV

Subject Code	:		**Credits**	:	03
Hours / Week	:	03 Hours	**Total Hours**	:	39 Hours
L–T–P	:	3–0–0			

Course Learning Objectives:

This Course will enable students to:

1. **Understand** the principles of various types of control systems, to derive transfer function and state space models of various physical systems.
2. **Analyse** the behaviour of a control system in time and frequency domains.
3. **Familiarising** different compensation methods in time/frequency domain.
4. **Analyse** the stability of a control system using time and frequency domain.

Teaching-Learning Process (General Instructions)

These are sample new pedagogical methods, where teacher can use to accelerate the attainment of the various course outcomes.

1. ***Lecture method*** means it includes not only traditional lecture method, but different *type of teaching methods* may be adopted to develop the course outcomes.
2. ***Interactive Teaching:*** *Adopt the* ***Active learning*** that includes brainstorming, discussing, group work, focused listening, formulating questions, notetaking, annotating, and roleplaying.
3. Show ***Video/animation*** films to explain functioning of various concepts.
4. Encourage ***Collaborative*** (Group Learning) Learning in the class.
5. To make ***Critical thinking***, ask at least three Higher order Thinking questions in the class.
6. Adopt ***Problem Based Learning***, which fosters students' Analytical skills, develop thinking skills such as the ability to evaluate, generalize, and analyse information rather than simply recall it.
7. Show the ***different ways to solve*** the same problem and encourage the students to come up with their own creative ways to solve them.
8. Discuss how every ***concept can be applied to the real world*** - and when that's possible, it helps improve the students' understanding.

Dayananda Sagar University

School of Engineering

Devarakaggalahalli , Harohalli , Kanakapura Road , Ramanagar District- 562112

DEPARTMENT OF ELECTRONICS AND COMMUNICATION ENGINEERING

UNIT – I	08 Hours
MATHEMATICAL MODELS OF PHYSICAL SYSTEMS: Concepts of Control Systems- Open Loop and closed-loop control systems, Classification of control systems, Mathematical models –Transfer functions and Impulse Response-Simple electrical and mechanical systems, Feedback Characteristics-Effects of feedback, Block diagram representation of systems, Block diagram algebra, Signal flow graph, Mason's gain formula.	
UNIT – II	**06 Hours**
TIME DOMAIN ANALYSIS Standard test signals, Time responses of first-order and second-order systems, Time domain specifications, characteristic Equation, the concept of stability, Routh-Hurwitz stability criterion.	
UNIT – III	**08 Hours**
TIME DOMAIN STABILITY ANALYSIS Root locus concept, construction of root loci, Stability analysis using root locus, Effects of addition of poles and zeros on root locus plot technique, Polar Plot.	
UNIT – IV	**08 Hours**
FREQUENCY DOMAIN STABILITY ANALYSIS: Frequency response characteristics, Frequency domain specifications, Bode plot, Transfer function from the Bode plot, Stability Analysis using Bode Plot, Lag compensation, Lead compensation, Lag-Lead compensation using Bode Plot.	
UNIT – V	**09 Hours**
STATE SPACE ANALYSIS Concepts of state, state-space modeling for continues physical systems, Representation of state space model in different canonical forms, Transfer function. Eigen values, Eigen vectors, State Transition Matrix and its Properties, Solution of state equations, Controllability and Observability.	

Dayananda Sagar University
School of Engineering
Devarakaggalahalli , Harohalli , Kanakapura Road , Ramanagar District- 562112

DEPARTMENT OF ELECTRONICS AND COMMUNICATION ENGINEERING

Course Outcome	Description	Bloom's Taxonomy Level
At the end of the course the student will be able to:		
1	**Simplification** of any linear control system using block reduction and signal flow graph techniques	L2
2	**Analyze** the transient and steady state performance parameters of control systems for various error signals.	L4
3	**Evaluate** the stability of a system using time domain and frequency domain techniques.	L5
4	**Design** different compensators in the time/frequency domain	L3
5	**Examine** the controllability and observability of control systems using the state space method.	L4

Table: Mapping Levels of COs to POs / PSOs

Cos	Program Outcomes (POs)												PSOs		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	3	2	1	1	-	-	-	-	-	-	-	-	**1**	-	-
CO2	3	2	1	1	-	-	-	-	-	-	-	1	**1**	-	-
CO3	3	2	2	2	1	1	-	-	-	-	-	1	**1**	**1**	-
CO4	3	2	2	1	1	1	-	-	1	-	-	1	**1**	**1**	-
CO5	3	2	2	2	-	1	-	-	-	-	-	1	**1**	**1**	-

3: Substantial (High) **2: Moderate (Medium)** **1: Poor (Low)**

TEXT BOOKS:

1. I.J. Nagrath and M. Gopal, "Control Systems Engineering", New Age International (P) Limited, Publishers, 2nd edition. 2004
2. Katsuhiko Ogata, "Modern Control Engineering", Prentice Hall of India Pvt. Ltd., 3rd edition, 1998.
3. A. Anand Kumar, "Control Systems", 2/e, PHI, 2014.

REFERENCE BOOKS:

1. B. C. Kuo, "Automatic Control Systems", John wiley and sons, 8th edition, 2003.
2. Norman. S. Nise, "Control Systems Engineering", John wiley & Sons, 3rd Edition.

Dayananda Sagar University
School of Engineering
Devarakaggalahalli , Harohalli , Kanakapura Road , Ramanagar District- 562112

DEPARTMENT OF ELECTRONICS AND COMMUNICATION ENGINEERING

COMPUTER ORGANIZATION AND ARCHITECTURE

[As per Choice Based Credit System (CBCS) scheme]

SEMESTER – IV

Subject Code	:		**Credits**	:	03
Hours / Week	:	03 Hours	**Total Hours**	:	39 Hours
L–T–P	:	3–0–0			

Course Learning Objectives:

This Course will enable students to:

1. **Understand** the Architecture and programming of ARM microprocessor.
2. **Develop** program using Arm instruction set and appreciate the advanced features provided in the ARM
3. **Understand** the exception handling techniques.
4. **Study in** detail the concept of instruction level parallelism and concepts of pipelining.
5. **Understand** various cache memory mapping techniques and memory Organization.

Teaching-Learning Process

1. ***Lecture method*** along with traditional lecture method, different *type of teaching methods* may be adopted to develop the course outcomes.
2. ***Interactive Teaching:*** *incorporating* brainstorming, discussing, group work, focused listening, formulating questions, notetaking, annotating, and roleplaying.
3. Showing ***Video/animation*** films to explain functioning of various concepts.
4. Encourage ***Collaborative*** (Group Learning) Learning in the class.
5. To make ***Critical thinking***, asking Higher order Thinking questions in the class in the form of Quiz and writing programs with complex solutions.
6. Showing the ***different ways to solve*** the same problem and encourage the students to come up with their own creative ways to solve them.

UNIT – I	**05 Hours**

An Overview of Computing Systems:

History of Computers, The Computing Device, ***(Text Book-1: Chapter 1: 1.1 to 1.3)***

The ARM7TDMI Programmers' Model:

Introduction, Data types, Processor Modes, Registers, Program Status Registers, The vector Table. ***(Text Book-1: Chapter 2: 2.1 to 2.6)***

Assembler Rules and Directives: Structure of Assembly Language Modules, Registers, Directives and Macros. ***(Text Book-1: Chapter 4)***

Loads, Stores and Addressing: LODS and STORES instructions, Operand Addressing , ENDIANNES ***(Text Book-1: Chapter 5: 5.3, 5.4, 5.5)***

UNIT – II	**05 Hours**

Constants and Literal Pools: The ARM Rotation Scheme, Loading Constants and address into Registers ***(Text Book-1: Chapter 6: 6.1 to 6.4)***

Logic and Arithmetic : Flags and their Use, Compare instructions, Data Processing Instructions ***(Text Book-1: Chapter 7: 7.1 to 7.4)***

Loops and Branches: Branching, Looping, Conditional Execution, Straight-Line Coding ***(Text Book-1: Chapter 8: 812 to 8.6)***

Subroutines and Stacks: Stack, Subroutines, Passing parameters to subroutines, The ARM APCS. ***(Text Book-1: Chapter 10: 10.1 to 10.5)***

UNIT – III	**05 Hours**

Mixing C and Assembly Language: Inline Assembler Embedded Assembler, Calling Between C and Assembly. ***(Text Book-1: Chapter 14: 14.1 to 14.4)***

Exception Handling: Interrupts, Error Conditions, Processor Exception Sequence, The Vector Table, Exception Handlers, Exception Priorities, Procedures for Handling Exceptions. ***(Text Book-1: Chapter 11: 11.1 to 11.8)***

UNIT – IV	**12 Hours**

Pipelining: Basic and Intermediate Concepts
Introduction, The Major Hurdle of Pipelining, How Pipelining Implemented, What makes Pipelining hard to Implement, Extending the MIPS Pipeline to Handle Multicycle Operations, The MIPS R4000 Pipeline, Crosscutting Issues. ***(Text Book-2: C.1 to C.7).***

UNIT – V	**12 Hours**

Memory Hierarchy:
Introduction, Cache Performance, Six basic cache Optimizations, Virtual Memory, Protection and examples of Virtual Memory, Fallacies and Pitfalls.
(***Text Book-2: B.1 to B.6***)

Dayananda Sagar University
School of Engineering
Devarakaggalahalli , Harohalli , Kanakapura Road , Ramanagar District- 562112

DEPARTMENT OF ELECTRONICS AND COMMUNICATION ENGINEERING

Course Outcome	Description	Bloom's Taxonomy Level
At the end of the course the student will be able to:		
1	**Apply** knowledge of the internal architecture and organization of ARM microprocessors to utilize their components and functionalities.	L3
2	**Apply** the instruction set of ARM Microprocessor by writing Assembly language programs.	L3
3	**Analyze and compare** the various exception handling techniques.	L4
4	**Examine** the concept of instruction-level parallelism and **analyze** the principles of Pipelining techniques.	L4
5	**Compare** and **contrast** memory hierarchy and its impact on computer cost/performance.	L4

Table: Mapping Levels of COs to POs / PSOs

COs	Program Outcomes (POs)												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	3	3	2									1		2
CO2	3	3	2		1							1		2
CO3	3	3	1									0		2
CO4	3	3	1									0		2
CO5	3	3	1									0		2

3: Substantial (High) 2: Moderate (Medium) 1: Poor (Low)

TEXT BOOKS:

1. William Hohl, "ARM Assembly Language", 2nd Edition, CRC Press, 2009.
2. John L Hennessy, David A Patterson, "Computer Architecture, A Quantitative Approach", 5th Edition, Morgan Kaufmann publishers, 2012.

REFERENCE BOOKS:

1. David A Patterson, John L Hennessy, "Computer Organization and Design", 4th Edition, Morgan Kaufmann publishers, 2010.
2. Steve Furber, "ARM System-on-chip Architecture", 2nd Edition, Pearson Publications, 2000.
3. Carl Hamacher, Zvonko Vranesic, Safwat Zaky, "Computer Organization", 5th Edition, Tata McGraw Hill, 2002.

E-Resources:

1. https://www.udemy.com/topic/arm-cortex-m/
2. https://www.edx.org/school/armeducation
3. https://onlinecourses.nptel.ac.in/noc22_cs93/preview

Activity Based Learning (Suggested Activities in Class)

1. Mini project implementation using Assembly Language Programming.
2. Demonstration of solution to a problem through programming.

****

Dayananda Sagar University

School of Engineering

Devarakaggalahalli , Harohalli , Kanakapura Road , Ramanagar District- 562112

DEPARTMENT OF ELECTRONICS AND COMMUNICATION ENGINEERING

SEMESTER V

ANALOG AND DIGITAL COMMUNICATION

[As per Choice Based Credit System (CBCS) scheme]

SEMESTER V

Course Code	:		Credits	:	04
Hours / Week	:	3 Hours	Total Hours	:	39 Hours
L T P	:	3-0-2			
Pre-requisite	:	Probability, Signals and Systems			

Course Learning Objectives:

By the end of the course, students will be proficient in:

1. Compare the various modulation and demodulation techniques.
2. Understand the trans receiver design and the effect of noise in communication system.
3. Understand the process of digitization through Sampling and Quantization.
4. Determine the performance of line codes and methods to reduce inter symbol interference.
5. Interpret the detection process using analytical methods.
6. Compute the probability of error of digital communication systems.

Teaching-Learning Process (General Instructions)

These are sample new pedagogical methods, where teacher can use to accelerate the attainment of the various course outcomes.

1. Lecture method means it includes not only traditional lecture method, but also different type of teaching methods may be adopted to develop the course outcomes.
2. Interactive Teaching: Adopt the Active learning that includes brainstorming, discussing, group work, focused listening, formulating questions, notetaking, annotating, and roleplaying.
3. Show Video/animation films to explain functioning of various concepts.
4. Encourage Collaborative (Group Learning) Learning in the class.
5. To make Critical thinking, ask at least three Higher order Thinking questions in the class.
6. Adopt Problem Based Learning analytical thinkingskillssuchastheabilitytoevaluate, generalize, andanalyzeinformationrather than simply recallit.
7. Show the different ways to solve the same problem and encourage the students to come up with their own creative ways to solve them.
8. Discuss how every concept can be applied to the real world - and when that's possible,it helps improve the students' understanding.

Dayananda Sagar University

School of Engineering

Devarakaggalahalli , Harohalli , Kanakapura Road , Ramanagar District- 562112

DEPARTMENT OF ELECTRONICS AND COMMUNICATION ENGINEERING

UNIT I	08 Hours

INTRODUCTION TO COMMUNICATION SYSTEM AND AMPLITUDE MODULATION:

Elements of Communication System, Need for Modulation, Amplitude Modulation-Conventional AM, DSB-SC, SSB, VSB, Time and Frequency Domain representation of AM, Modulation Index and Transmission Power Calculation. Generation of Conventional AM signals - Square Law Modulator, Detection of AM signals - Envelope detector. Generation of DSBSC signals - Balanced Modulator, Coherent detection of DSB-SC Modulated signals. Generation of SSB signals - Phase discrimination method. Demodulation of SSB Signals - Coherent detection, Frequency Division Multiplexing

UNIT II	08 Hours

ANGLE MODULATION:

Introduction - FM, NBFM, WBFM and PM, Modulation Index of FM and PM, Transmission bandwidth of FM signals, Relation between FM and PM. Generation of FM signals - Indirect FM, Direct FM. Demodulation of FM signals - Balanced frequency discriminator, Zero-crossing detector.

TRANSMITTER, RECEIVER AND NOISE:

AM Transmitter, FM Transmitter, Tuned radio frequency receiver, Superheterodyne receiver, Comparison of FM receiver with AM Receiver, Source of noise, Noise in AM, Noise in FM, Pre-emphasis & de-emphasis in FM.

UNIT III	08 Hours

SAMPLING AND QUANTIZATION:

Block diagram of Digital communication system, Sampling theorem, Practical aspects of sampling and signal recovery, Quantization, Quantization noise, Quadrature sampling of bandpass signals, Pulse Code Modulation (PCM) system, Differential PCM system, Delta modulation (DM) and its drawbacks, Adaptive Delta Modulation. Time Division Multiplexing

UNIT IV	07 Hours

BASEBAND SHAPING FOR DATA TRANSMISSION:

Introduction, Line Coding, Characteristics of Line coding, Discrete PAM signals, Power spectra of discrete PAM signals, Inter symbol Interference, Nyquist criterion for distortion less baseband binary transmission, Correlative coding, Eye pattern.

DETECTION OF SIGNALS - Orthogonal signals, Geometric interpretation of signals, Correlation receiver, Matched filter, Properties of matched filter, ML detector.

UNIT V	08 Hours

DIGITAL PASS BAND TRANSMISSION:

Introduction, Pass band transmission model, Coherent modulation techniques - ASK, FSK, PSK, QPSK, M-ary PSK, QAM, M-ary QAM, Constellation diagram, Deriving probability of error for coherent ASK, FSK, PSK, QPSK, Non coherent modulation techniques.

Dayananda Sagar University
School of Engineering
Devarakaggalahalli , Harohalli , Kanakapura Road , Ramanagar District- 562112

DEPARTMENT OF ELECTRONICS AND COMMUNICATION ENGINEERING

List of Laboratory/Practical Experiments activities to be conducted (if any) :

1. Design and testing of AM modulator and demodulator circuit and analysis spectrum using spectrum analyzer.
2. Design and testing FM modulator and demodulator circuit and analysis spectrum using spectrum analyzer.
3. Design and testing DSBSC modulator and demodulator circuit.
4. Spectrum analysis of modulated signal using spectrum analyse
5. To study and observe the effect on input signal using pre-emphasis and de-emphasis circuit.
6. Verification of sampling theorem, demonstrate over sampling and under sampling.
7. To study the Pulse Amplitude Modulation & demodulation.
8. To study Pulse width modulation, Pulse Position modulation and demodulation.
9. To study Phase lock loop (PLL) and calculate its capture range, lock range and free running VCO.
10. To analyse an ASK & FSK modulation systems and interpret the modulated & demodulated waveform
11. Using Linear block codes-the error received through a noisy channel can be removed/minimized by error detection and correction code.
12. To study Cyclic encoding & decoding of BCD bit sequence and error detection & correction of bits' sequence.
13. To employ one of the convolution codes and observe its error correcting performance and decode-ability.
14. Verify the Encoding and Decoding process of Delta Modulator
15. To implement of μ-law companding and A-law companding for compression and expanding of a signal.

Course Outcome	Description	**Bloom's** Taxonomy Level
At the end of the course the student will be able to:		
CO1	**Illustrate** and explain the basic elements of a communication system.	L3
CO2	**Analyze** baseband signals in time domain and frequency domain.	L4
CO3	**Interpret** and explain AM, DSB-SC, SSB, FM, PCM, ASK, FSK, PSK, QAM modulation and demodulation techniques.	L3
CO4	**Analyze** the behavior of a communication system in the presence of noise.	L4
CO5	**Estimate** the performance of a communication system using analytical methods.	L5
CO6	**Determine** the probability of error for FSK, PSK, QPSK, M-ary PSK, QAM, M-ary QAM.	L5

	Table: Mapping Levelsof COsto POs/ PSOs													
Cos	Program Outcomes (POs)												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	3	2	-	-	2	2	-	-	-	-	-	2	3	2
CO2	3	2	-	-	2	2	-	-	-	-	-	2	3	2
CO3	3	2	-	-	2	2	-	-	-	-	-	2	3	2
CO4	3	2	-	-	2	2	-	-	-	-	-	2	3	2
CO5	3	2	-	-	2	2	-	-	-	-	-	2	3	2
CO6	3	2	-	-	2	2	-	-	-	-	-	2	3	2

3: Substantial (High) 2: Moderate (Medium) 1: Poor (Low)

TEXT BOOKS:

1. Simon Haykin, Michael Moher, Introduction to Analog and Digital Communication 4th edition, John and Wiley & Sons
2. B. P. Lathi, Z. Ding "Modern Digital and Analog Communication Systems", Oxford University Press, 2010.

REFERENCE BOOKS:

1. Principles of Communication Systems–Taub & Schilling, Gautam Sahe, TMH, 3rdEd
2. Communication Systems Second Edition – R.P. Singh, SP Sapre, TMH, 2007.
3. Modern Analog and Digital Communication Systems, 3rd Edition, Oxford University – B.P. Lathi,
4. Electronics & Communication System – George Kennedy and Bernard Davis, TMH

NPTEL LECTURE LINKS:

1. https://onlinecourses.nptel.ac.in/noc21_ee74/preview
2. https://www.digimat.in/nptel/courses/video/108102096/L04.html
3. https://nptel.ac.in/courses/117101051

Dayananda Sagar University

School of Engineering

Devarakaggalahalli , Harohalli , Kanakapura Road , Ramanagar District- 562112

DEPARTMENT OF ELECTRONICS AND COMMUNICATION ENGINEERING

Digital Signal Processing

[As per Choice Based Credit System (CBCS) scheme]

SEMESTER – V

Subject Code	:		**Credits**	:	03
Hours / Week	:	03 Hours	**Total Hours**	:	39 Hours
L–T–P–S	:	3–0–0–0			

Course Learning Objectives:

This Course will enable students to:

1. Understand the theory and application of Discrete Fourier Transforms (DFT) in signal processing, including its properties and relationships with other transforms.
2. Master the implementation of Fast Fourier Transform (FFT) algorithms for efficient computation of DFT, utilizing both decimation-in-time and decimation-in-frequency techniques.
3. Design Finite Impulse Response (FIR) filters using various window methods and frequency sampling techniques, for desired filter characteristics and specifications.
4. Develop proficiency in designing Infinite Impulse Response (IIR) filters by transforming analog filter designs (Butterworth and Chebyshev) to digital using techniques like impulse invariance and matched z transforms.
5. Gain practical skills in implementing FIR and IIR filters on digital signal processors (DSPs), understanding their architectures, instruction sets, and fixed-point arithmetic formats.
6. Apply theoretical knowledge to real-world signal processing scenarios, analyzing and optimizing signal processing systems using DFT, FFT, FIR, and IIR filters for various applications

Dayananda Sagar University

School of Engineering

Devarakaggalahalli , Harohalli , Kanakapura Road , Ramanagar District- 562112

DEPARTMENT OF ELECTRONICS AND COMMUNICATION ENGINEERING

Teaching-Learning Process (General Instructions)

These are sample new pedagogical methods, where teacher can use to accelerate the attainment of the various course outcomes.

1. ***Lecture method*** means it includes not only traditional lecture method, but different *type of teaching methods* may be adopted to develop the course outcomes.
2. ***Interactive Teaching:*** *Adopt the* ***Active learning*** that includes brainstorming, discussing, group work, focused listening, formulating questions, notetaking, annotating, and roleplaying.
3. Show ***Video/animation*** films to explain functioning of various concepts.
4. Encourage ***Collaborative*** (Group Learning) Learning in the class.
5. To make ***Critical thinking***, ask at least three Higher order Thinking questions in the class.
6. Adopt ***Problem Based Learning***, which fosters students' Analytical skills, develop thinking skills such as the ability to evaluate, generalize, and analyse information rather than simply recall it.
7. Show the ***different ways to solve*** the same problem and encourage the students to come up with their own creative ways to solve them.
8. Discuss how every ***concept can be applied to the real world*** - and when that's possible, it helps improve the students' understanding.

Dayananda Sagar University

School of Engineering

Devarakaggalahalli , Harohalli , Kanakapura Road , Ramanagar District- 562112

DEPARTMENT OF ELECTRONICS AND COMMUNICATION ENGINEERING

UNIT 1	08 Hours
Discrete Fourier Transforms: Frequency domain sampling and reconstruction of discrete time signals. DFT as a linear transformation, its relationship with other transforms. Properties of DFT, multiplication of two DFTs- the circular convolution, Additional DFT properties.	
UNIT - II	**08 Hours**
FFT Algorithms: Use of DFT in linear filtering, overlap-save and overlap-add method. Direct computation of DFT, need for efficient computation of the DFT (FFT algorithms) Radix-2 FFT algorithm for the computation of DFT and IDFT–decimation-in-time and decimation-in-frequency algorithms. Goertzel algorithm, and chirp-z transform.	
UNIT - III	**08 Hours**
FIR Filter Design: Introduction to FIR filters, design of FIR filters using - Rectangular, Hamming, Bartlet and Kaiser Windows, FIR filter design using frequency sampling technique.	
UNIT - IV	**08 Hours**
IIR Filter Design: Characteristics of commonly used analog filters –Butterworth and Chebyshev filters, analog to analog frequency transformations. Design of digital IIR filters from analog filters (Butterworth and Chebyshev) - impulse invariance method. Mapping of transfer functions: Approximation of derivative (backward difference and bilinear transformation) method, Matched Z transforms.	
UNIT - V	**07 Hours**
Digital Signal Processor: Elementary idea about the architecture and important instruction sets of TMS320C6XXX processor, fixed point and floating-point formats. FIR and IIR filter implementation in fixed point system.	

Dayananda Sagar University
School of Engineering
Devarakaggalahalli , Harohalli , Kanakapura Road , Ramanagar District- 562112

DEPARTMENT OF ELECTRONICS AND COMMUNICATION ENGINEERING

Course Outcome	Description	Bloom's Taxonomy Level
At the end of the course the student will be able to:		
1	Able to analyze discrete-time signals in the frequency domain, understanding the properties and applications of the Discrete Fourier Transform (DFT), and its relevance in signal processing.	Analyze L4
2	Able to apply Discrete Fourier Transform (DFT) and Fast Fourier Transform (FFT) algorithms in various signal processing tasks, including linear filtering and spectrum analysis.	Applying L3
3	Able to design Finite Impulse Response (FIR) filters using different windowing techniques and frequency sampling methods, enabling precise control over filter characteristics and performance.	Applying L3
4	Able to design and implement Infinite Impulse Response (IIR) filters by understanding analog filter characteristics, digital filter design methods, and mapping analog filters to digital domains, ensuring optimal filtering performance in practical applications.	Applying L3
5	Able to understand digital signal processor architectures, instruction sets, and numerical formats, and apply this knowledge to efficiently implement FIR and IIR filters for real-time signal processing tasks on digital signal processors.	Understanding L2

Table: Mapping Levels of COs to POs / PSOs

COs	Program Outcomes (POs)												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	3	3		2	2							2	3	2
CO2	3	3	3	2						2			3	2
CO3	3	3		2	2	2						2	3	2
CO4	3	3	2	2	2				2			2	3	2
CO5	3	2		2	2							2	3	2

3: Substantial (High) **2: Moderate (Medium)** **1: Poor (Low)**

TEXT BOOKS:

1. Digital Signal Processing - Principles, Algorithms, and Applications by Proakis & Monalakis, Pearson Education, 4th Edition, 2017.
2. Li Tan, Jean Jiang, "Digital Signal processing- Fundamentals and Applications", Academic Press, 2013, ISBN: 978-0-12-415893. 97
3. Digital Signal Processing, S.Salivahanan, A.Vallabraj & C. Gnanapriya, TMH Publishing Co.
4. Digital Signal Processing using MATLAB, Vinak K. Ingle, III Edition, Cengage Learning.

REFERENCE BOOKS:

1. Digital Signal Processing, P. Rameshbabu, Scitech Publications (India).
2. Digital Signal Processing-A Computer Based Approach, S.K Mitra, TMH Publishing Co.
3. Digital Signal Processing; A Hands on Approach, C. Schuler & M.Chugani, TMH Publishing Co.
4. Texas Instruments DSP Processor user manuals and application notes
5. D.Ganesh Rao and Vineeth P Gejji, "Digital Signal Processing" Cengage India Private Limited, 2017, ISBN: 9386858231

E-Resources:

1. https://nptel.ac.in/courses/117102060
2. https://onlinecourses.nptel.ac.in/noc19_ee50/preview

Activity Based Learning (Suggested Activities in Class)

1. Signal Processing Simulation Software: MATLAB
2. Peer Teaching and Collaborative Learning

Dayananda Sagar University

School of Engineering

Devarakaggalahalli , Harohalli , Kanakapura Road , Ramanagar District- 562112

DEPARTMENT OF ELECTRONICS AND COMMUNICATION ENGINEERING

MACHINE LEARNING

[As per Choice Based Credit System (CBCS) scheme]

SEMESTER V

Course Code	:		Credits	:	03
Hours / Week	:	03 Hours	Total Hours	:	39 Hours
L-T-P	:	3-0-0			

Course Learning Objectives:

This Course will enable students to:

1. **Explain** the machine learning landscape, including types of machine learning systems, trade-offs, challenges, and validation methods.
2. **Apply** various supervised machine learning algorithms, such as linear regression, logistic regression, support vector machines, decision trees, and K-nearest neighbors, to solve prediction problems.
3. **Analyse** different unsupervised learning algorithms, including clustering techniques and dimensionality reduction methods, to uncover patterns and structures in data.
4. **Implement** ensemble learning techniques, such as bagging and boosting algorithms, to enhance model performance and robustness.
5. **Develop** and train artificial neural networks, including perceptron and multilayer networks, using techniques like backpropagation, regularization, and stochastic gradient descent.

Teaching-Learning Process (General Instructions)

These are sample new pedagogical methods, where teacher can use to accelerate the attainment of the various course outcomes.

1. Flipped Classroom

- **Method:** Provide pre-recorded lectures and reading materials for students to review at home. Use class time for hands-on activities, discussions, and problem-solving.
- **Result:** Enhances understanding through active learning and allows students to engage more deeply with the material.

2. Project-Based Learning

- **Method:** Assign real-world projects that require students to apply machine learning algorithms to solve problems. Projects can range from data analysis tasks to developing predictive models.
- **Result:** Develops practical skills and critical thinking, reinforcing theoretical knowledge through application.

3. Peer Teaching and Collaboration

- **Method:** Organize group activities where students explain concepts to each other, work on collaborative projects, and provide peer feedback.
- **Result:** Encourages deeper understanding, improves communication skills, and fosters a collaborative learning environment.

4. Case Studies and Real-World Examples

- **Method:** Integrate case studies and examples from industry to demonstrate the practical applications of machine learning algorithms.
- **Result:** Bridges the gap between theory and practice, making learning more relevant and engaging.

5. Interactive Simulations and Tools

- **Method:** Use interactive tools and simulations to visualize machine learning concepts and algorithms. Tools like TensorFlow Playground can help students understand neural networks and other complex models.
- **Result:** Enhances comprehension through visual learning and interactive experimentation.

6. Gamification

- **Method:** Incorporate game elements such as quizzes, competitions, and leaderboards to motivate students and make learning more enjoyable.
- **Result:** Increases engagement and motivation, encouraging students to actively participate and strive for improvement.

7. Hands-On Coding Labs

- **Method:** Conduct coding labs where students can implement machine learning algorithms using programming languages like Python and tools like Jupyter Notebooks.
- **Result:** Builds coding proficiency and practical implementation skills, reinforcing theoretical concepts.

8. Guest Lectures and Industry Talks

- **Method:** Invite industry experts and guest lecturers to share their experiences and insights on the application of machine learning in various fields.
- **Result:** Provides real-world perspectives and inspiration, connecting classroom learning with industry practices.

.10. Online Discussion Forums and Communities

- **Method:** Create online forums or use platforms like Slack, Discord, or Piazza for students to discuss topics, ask questions, and share resources.
- **Result:** Encourages continuous learning and collaboration outside the classroom, providing a platform for peer support and knowledge exchange.

11. Formative Assessments and Feedback

- **Method:** Use regular quizzes, mini-projects, and formative assessments to gauge understanding and provide timely feedback.
- **Result:** Helps identify areas where students need improvement and provides opportunities for them to refine their knowledge and skills.

12. Blended Learning

- **Method:** Combine traditional in-class teaching with online resources and activities. Use a learning management system (LMS) to track progress and provide additional materials.
- **Result:** Offers flexibility and personalized learning paths, catering to different learning styles and paces.

UNIT I	07 Hours
INTRODUCTION Machine learning landscape, Trade-off between Prediction Accuracy and Model Interpretability, Types of Machine learning System (Supervised v/s Unsupervised Learning, Regression v/s Classification), Challenges of Machine Learning, Testing and validation methods.	
UNIT II	**08 Hours**
SUPERVISED MACHINE LEARNING ALGORITHMS Linear Regression (Simple Linear Regression, Multiple Linear Regression, Linear model selection and Regularization algorithms (Ridge, Lasso & Elastic net), Logistic Regression, Support Vector Machines, Decision Tree, K-Nearest Neighbour (KNN)	
UNIT III	**08 Hours**
UNSUPERVISED MACHINE LEARNING ALROTITHMS Challenges of Unsupervised Learning, K-Means Clustering, Hierarchical Clustering, DBSCAN (Density-Based Spatial Clustering of Applications with Noise), Dimensionality Reduction Algorithms (Principal Components Analysis (PCA), Linear Discriminant Analysis (LDA))	
UNIT IV	**7 Hours**
ENSEMBLE LEARNING Bagging Algorithms (Random Forest), Boosting Algorithms (AdaBoost (Adaptive Boosting), Gradient Boosting Machines (GBM), XGBoost (Extreme Gradient Boosting))	
UNIT V	**06 Hours**

Dayananda Sagar University

School of Engineering

Devarakaggalahalli , Harohalli , Kanakapura Road , Ramanagar District- 562112

DEPARTMENT OF ELECTRONICS AND COMMUNICATION ENGINEERING

ARTIFCIAL NEURAL NETWORKS

Introduction, Neural Network Representations, Perceptron, Single Neural Network, Multi-layered Networks, Fitting a Neural Network (Back Propagation Algorithms, Regularization & stochastic Gradient Descent, Dropout Learning, Network Learning)

Dayananda Sagar University
School of Engineering
Devarakaggalahalli , Harohalli , Kanakapura Road , Ramanagar District- 562112

DEPARTMENT OF ELECTRONICS AND COMMUNICATION ENGINEERING

Course Outcome	Description	Bloom's Taxonomy Level
At the end of the course the student will be able to:		
CO1	**Identify** types and challenges of machine learning systems.	L3
CO2	**Apply** supervised learning algorithms to prediction problems.	L3
CO3	**Analyse** unsupervised learning algorithms for pattern recognition.	L4
CO4	**Apply** ensemble methods to improve model performance.	L3
CO5	**Develop** and train neural networks using various techniques.	L3

Table: Mapping Levelsof COstoPOs/ PSOs

Cos	Program Outcomes (POs)												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	2	3	1		-	-	-	-	-	-	-	-	1	-
CO2	2	3	1		-	-	-	-	-	-	-	1	1	-
CO3	1	3	1				-	-	-	-	-		1	1
CO4	1	3					-	-		-	-		1	1
CO5	1	1	3		2		-	-	-	-	-	2	1	1

3: Substantial (High) **2: Moderate (Medium)** **1: Poor (Low)**

TEXT BOOKS:

1. Mitchell, Tom M. Machine learning. Vol. 1. , bk. 9. : McGraw-hill New York, 1997.
2. Géron, A. "Hands-On machine learning with scikit-learn, keras & tensorflow farnham." Canada: O'Reilly (2019).

.

REFERENCE BOOKS:

1. James, Gareth, Daniela Witten, Trevor Hastie, Robert Tibshirani, and Jonathan Taylor. An introduction to statistical learning: With applications in python. Springer Nature, 2023.

E-Resources:

1. **Coursera - Machine Learning by Andrew Ng:**
   - **Description:** This is one of the most popular and comprehensive machine learning courses available online. Taught by Andrew Ng, a pioneer in the field, it covers a wide range of topics including supervised learning, unsupervised learning, and neural networks.
   - **Link:** Coursera Machine Learning
2. **Fast.ai - Practical Deep Learning for Coders:**

- **Description**: Fast.ai offers practical and hands-on courses focused on deep learning and machine learning. The course is designed to get you up and running quickly, even if you don't have a strong mathematical background.
- **Link: Fast.ai Course**

3. **Google's Machine Learning Crash Course:**
   - **Description:** This is a free, self-study guide for aspiring machine learning practitioners. It includes video lectures, real-world case studies, and hands-on practice exercises.
   - **Link: Google Machine Learning Crash Course**
4. **Kaggle Learn - Micro-Courses:**
   - **Description:** Kaggle offers a variety of short, interactive lessons that cover fundamental and advanced machine learning concepts. It's especially useful for those who enjoy learning by doing.
   - **Link: Kaggle Learn**

1. Implementation of machine learning algorithm using PYTHON/MATLAB.

Dayananda Sagar University

School of Engineering

Devarakaggalahalli , Harohalli , Kanakapura Road , Ramanagar District- 562112

DEPARTMENT OF ELECTRONICS AND COMMUNICATION ENGINEERING

ANTENNA AND WAVE PROPAGATION

[As per Choice Based Credit System (CBCS) scheme]

SEMESTER – V

Course Code	:		**Credits**	:	04
Hours /Week	:	03+02	**Total Hours**	:	39 Hours
L–T–P–J	:	3–0–2			

Prerequisites: Electromagnetic Field Theory

Course Learning Objectives:

This Course will enable students to:

1. **Understand** the basic antenna parameters and radiation mechanism from an antenna.
2. **Understand** the array concepts in antennas, and their applications.
3. **Understand** the concepts of Reflector Antennas and their applications.
4. **Study** the properties of different types of antennas, and special antennas.
5. **Understand** the methods of measuring various antenna parameters.
6. **Study** the wave propagation concepts in ground, sky and troposphere regions.

Teaching-Learning Process (General Instructions)

These are sample new pedagogical methods, where teacher can use to accelerate the attainment of the various course outcomes.

1. ***Lecture method*** means it includes not only traditional lecture method, but different *type of teaching methods* may be adopted to develop the course outcomes.
2. ***Interactive Teaching:*** *Adopt the* ***Active learning*** that includes brainstorming, discussing, group work, focused listening, formulating questions, notetaking, annotating, and roleplaying.
3. Show ***Video/animation*** films to explain functioning of various concepts.
4. Encourage ***Collaborative*** (Group Learning) Learning in the class.
5. To make ***Critical thinking***, ask at least three Higher order Thinking questions in the class.
6. Adopt ***Problem Based Learning***, which fosters students' Analytical skills, develop thinking skills such as the ability to evaluate, generalize, and analyse information rather than simply recall it.
7. Show the ***different ways to solve*** the same problem and encourage the students to come up with their own creative ways to solve them.
8. Discuss how every ***concept can be applied to the real world*** - and when that's possible, it helps improve the students' understanding.

Dayananda Sagar University

School of Engineering

Devarakaggalahalli , Harohalli , Kanakapura Road , Ramanagar District- 562112

DEPARTMENT OF ELECTRONICS AND COMMUNICATION ENGINEERING

UNIT 1	08 Hours
ANTENNA FUNDAMENTALS: Introduction, Radiation Mechanism. Antenna Parameters- Radiation Patterns, Main Lobe and Side Lobes, Beam-width, Beam Area, Radiation Intensity, Beam Efficiency, Directivity, Gain and Antenna Apertures, Aperture Efficiency, Polarization, Antenna regions, Friis Transmission equation -Path loss.	
UNIT 2	**08 Hours**
WIRE ANTENNAS: Introduction to Dipoles, Short and Half wave Dipole – Current Distributions, Evaluation of Field Components, Power Radiated, Radiation Resistance - only equations. Introduction to Loop Antennas.	
UNIT 3	**08 Hours**
ANTENNA ARRAYS: Two element Arrays – different cases, Principle of Pattern Multiplication, N element Uniform Linear Arrays – Broadside, End-fire Arrays, EFA with Increased Directivity; Binomial Arrays, Effects of Uniform and Non-uniform Amplitude Distributions, Related Problems, Yagi - Uda Arrays. Flat Sheet and Corner Reflectors. Paraboloidal Reflectors – types of feeds.	
UNIT 4	**08 Hours**
SPECIAL ANTENNAS & ANTENNA MEASUREMENTS: Helical Antennas – Significance, Geometry, Design considerations for monofilar helical antennas in Axial Mode and Normal Modes (Qualitative Treatment), Introduction to Microstrip patch antenna, MIMO and Smart antennas, Horn Antennas – Types, Design Characteristics of Pyramidal Horns. Antenna measurement: Measurement of antenna ranges, directivity measurement, Anechoic chamber, CATR	
UNIT 5	**07 Hours**
WAVE PROPAGATION: Concepts of Propagation – frequency ranges and types of propagations. Ground Wave Propagation, Sky Wave Propagation – Formation of Ionospheric Layers and their Characteristics, Critical Frequency, MUF & Skip Distance, Optimum working Frequency, Virtual Height. Space Wave Propagation – Mechanism, LOS. Tropospheric Wave Propagation – Radius of Curvature of path, Field Strength Calculations, Duct Propagation, Related problems.	

Dayananda Sagar University

School of Engineering

Devarakaggalahalli , Harohalli , Kanakapura Road , Ramanagar District- 562112

DEPARTMENT OF ELECTRONICS AND COMMUNICATION ENGINEERING

List of Experiments:

Expt. No.	TITLE OF THE EXPERMENT	REMARKS
1	Testing of Rectangular and Circular Patch Antenna	Hardware
2	Characterizing Pyramidal Horn at 9.6 GHz	Hardware
3	Design and Simulation of Wire Antennas	Software
4	Design and simulation of Printed Antennas	Software
5	Design and Simulation of Horn Antennas	Software
6	Design and Simulation of Reflector Antennas	Software
7	Wave Propagation Simulation	Software

Course Outcome	Description	Bloom's Taxonomy Level
At the end of the course the student will be able to:		
CO1	Explain the antenna radiation mechanism with its fundamental parameters and **make use of** Friis transmission equation to compute received power and field components of a dipole antenna.	**3-Apply**
CO2	**Develop** array of antennas to enhance directivity for isotropic and non-isotropic radiation distributions.	**3-Apply**
CO3	**Apply** the design characteristics to measure the dimensions of horn antenna and outline the features of helical antennas, reflector antennas and smart antennas for various applications .	**3-Apply**
CO4	**Examine** the directivity , radiation aptterns and gain performance of antennas using MATLAB tool..	**4-Analyze**
CO5	**Analyze** the impact of atmospheric layers on wave propagation, paraphrase the method of antenna measurement in controlled environment.	**4-Analyze**

Table: Mapping Levels of COs to POs / PSOs														
COs	**Program Outcomes (POs)**												**PSOs**	
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**
CO1	3	3	-	3	3	3	3	-	2	2	3	3	2	0
CO2	3	2	1	-	-	1	2	-	-	-	-	3	1	0
CO3	3	2	2	2	-	1	1	-	-	-	2	3	3	2
CO4	3	3	3	3	2	1	3	3	2	3	1	3	1	2
CO5	3	2	2	-	3	3	3	2	-	-	3	3	1	1

3: Substantial (High) **2: Moderate (Medium)** **1: Poor (Low)**

Text Books:

1. John D Krauss, Ronald J Marhefka, Ahmad S Khan, “Antennas for all Applications”, 3rd edition, Mc Graw-Hill, 2006
2. C.A Balanis, “Antenna Theory”, John Wiley & Sons, 2nd ed., 2001.
3. A R Harish and M Sachidananda, “Antenna and Wave Propagation” Oxford University Press, 2007.

References:

4. K D Prasad, SatyaPrakashan, “Antennas & Wave Propagation”, Tech India Publications, New Delhi, 2001

E-Resources:

1. Antennas - Course (nptel.ac.in)
2. Analysis And Design Principles Of Microwave Antennas - Course (nptel.ac.in)

****

Dayananda Sagar University
School of Engineering
Devarakaggalahalli , Harohalli , Kanakapura Road , Ramanagar District- 562112

DEPARTMENT OF ELECTRONICS AND COMMUNICATION ENGINEERING

CMOS VLSI DESIGN

[As per Choice Based Credit System (CBCS) scheme]

SEMESTER – V

Subject Code	:		**Credits**	:	03
Hours / Week	:	03 Hours	**Total Hours**	:	39 Hours
L–T–P	:	3–0–0			

Course Learning Objectives:

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

- **Familiarize** themselves with fabrication techniques and scaling applied to various MOS parameters, used in modern semiconductor manufacturing techniques.
- **Comprehend** the construction, operation, and characteristics of a nMOS considering both ideal and non-ideal characteristics and their impact on device performance.
- **Demonstrate** and **Build** various combinational logic circuits using CMOS design and its families for optimized digital circuit performance.
- **Analyz**e bistable elements and memory cells using CMOS technology, understanding their operational principles and performance characteristics.
- **Explain** delay elements in CMOS circuits, RC delay models, Elmore delay, and logical effort.
- **Draw** and **Simulate** combinational and sequential circuits using schematic and layouts.
- **Understand** emerging semiconductor devices such as FINFETs, memristors and HEMT, exploring their unique properties and potential applications.

Teaching-Learning Process (General Instructions)

These are sample new pedagogical methods, where teacher can use to accelerate the attainment of the various course outcomes.

1. ***Lecture method*** means it includes not only traditional lecture method, but different *type of teaching methods* may be adopted to develop the course outcomes.
2. ***Interactive Teaching:*** *Adopt the* ***Active learning*** that includes brainstorming, discussing, group work, focused listening, formulating questions, notetaking, annotating, and roleplaying.
3. Show ***Video/animation*** films to explain functioning of various concepts.
4. Encourage ***Collaborative*** (Group Learning) Learning in the class.

5. To make ***Critical thinking***, ask at least three Higher order Thinking questions in the class.
6. Adopt ***Problem Based Learning***, which fosters students' Analytical skills, develop thinking skills such as the ability to evaluate, generalize, and analyse information rather than simply recall it.
7. Show the ***different ways to solve*** the same problem and encourage the students to come up with their own creative ways to solve them.
8. Discuss how every ***concept can be applied to the real world*** - and when that's possible, it helps improve the students' understanding.

UNIT – I	**08 Hours**

CMOS Technologies: Wafer Formation, Photolithography, Well and Channel Formation, Silicon Dioxide (SiO_2), Isolation, Gate Oxide, Gate and Source/Drain Formations, Contacts and Metallization, Passivation, Metrology

MOS layers, Stick diagrams- NMOS and CMOS Design Rules and Layout, Fabrication- NWELL, PWELL, Twin-Tub, BiCMOS.

(Textbook 1: Chapter 3: 3.2
Textbook 2: Chapter 1: 1.7,1.8,1.10, Chapter 3: 3.1 – 3.4, 3.7, Chapter 5: 5.1)

UNIT – II	**08 Hours**

MOS Transistor: Introduction, Long Channel I-V characteristics, C-V Characteristics, Simple MOS Capacitance Models, Detailed MOS Gate Capacitance Model, Non-ideal I-V Effects, Mobility Degradation and Velocity Saturation, Channel Length Modulation, Threshold Voltage Effects, Leakage, Temperature Dependence, Body effect, Tunnelling.

Scaling Of MOS Circuits: Scaling models and factors.

(Textbook 1: Chapter 2: 2.1,2.2, 2.3.1,2.3.2,2.4,2.5, Chapter 4: 4.1 to 4.3, 4.4, 4.4.1- 4.4.3, 4.5.1,
Textbook 3: Chapter 7: 7.2, 7.3)

UNIT – III	**08 Hours**

Static CMOS Inverter DC and Transient Characteristics, Beta Ratio Effect, Noise Margin, Pass Transistor DC Characteristics, NAND NOR DC characteristics

Delay: Introduction, Transient Response, RC Delay Model, Elmore Delay, Linear Delay Model, Logical effort, Parasitic Delay, Logical effort of paths, Delay in multistage logic networks

UNIT – IV	**08 Hours**

Combinational Circuit Design: Circuit families, CMOS Logic with Schematic and Layout, Static CMOS, Skewed gates, Ratioed Circuits, Pseudo nMOS, Ganged CMOS, CVSL, Dynamic Circuits, Domino Logic, Pass Transistor Circuits, Transmission Gates, BICMOS Circuits, Ex-Inverter, NAND Gate, NOR Gate, Combinational Logic, Tristates, Multiplexers

(Textbook 1: Chapter 1: 1.3, 1.4.1-1.4.8,
Textbook 2: Chapter 6: 6.2,6.3,6.4)

Dayananda Sagar University
School of Engineering
Devarakaggalahalli , Harohalli , Kanakapura Road , Ramanagar District- 562112

DEPARTMENT OF ELECTRONICS AND COMMUNICATION ENGINEERING

UNIT – V	07 Hours
Sequential Circuit Design: Circuit Design of Latches and Flipflops, Conventional CMOS Latches, Flip flops, Resettable Latches and Flip Flops, Enabled Latches and Flip Flops, Behaviour of Bistable Elements, Sequential Circuits, CMOS D-latch and Edge Triggered Flipflop, JK Flip Flop Circuits **Semiconductor Memories:** DRAM Cells -1T, 4T, nMOS and CMOS pseudostatic DRAM cell, 6T SRAM (Textbook 1: Chapter 1: 1.4.9 Chapter 10: 10.3.1, 10.3.2, 10.3.4, 10.3. (Textbook 2: Chapter 9: 9.2.3, 9.2.4,9.2.5,9.2.6)	

VLSI LAB

List of Experiments

Use VLSI design tools(Cadence Tool Suite) to carry out the experiments, use library files and technology files of atleast 180 nm.

l) Capture the schematic of CMOS inverter. Record the observations.

2) Draw the layout of inverter and Verify for DRC and LVS, extract parasitic.

3) Capture the schematic of 2-input CMOS NAND and NOR gate.

4) Draw layout of NAND and NOR and verify for DRC and LVS, extract parasitic and perform post layout simulations. Record the observations.

5) Capture the schematic of 2-input CMOS AND and OR.

6) Capture the schematic of 2-input CMOS EXOR and EXNOR.

7) Capture the schematic of basic gates using Transmission Gate and record the observations.

8) Capture the schematic of SR latch, SR Flip Flop, D Flip Flop and record the observations.

9) Capture the schematic of 1T DRAM cell and record results of read and write access with BL/BLB.

10) Capture the schematic of 6T SRAM cell and record results of read and write access with BL/BLB.

11) Open Ended Experiment.

Dayananda Sagar University

School of Engineering

Devarakaggalahalli , Harohalli , Kanakapura Road , Ramanagar District- 562112

DEPARTMENT OF ELECTRONICS AND COMMUNICATION ENGINEERING

Course Outcome	Description	Bloom's Taxonomy Level
At the end of the course the student will be able to:		
1	**Explain** the key steps involved in fabrication such as wafer formation, photolithography, and metallization and outline the nMOS, pMOS using pwell, nwell; twintub and BiCMOS fabrication processes.	L1, L2
2	**Analyze** and **Model** the electrical behavior of nMOS/pMOS transistors, including I-V and C-V characteristics, delay elements, and study the effects of non-ideal factors such as mobility degradation, velocity saturation, threshold voltage effects, and channel length modulation.	L3
3	**Analyze** the DC and transient response characteristics of CMOS inverter discussing the beta ratio effect, noise margins**,** and DC Characteristics of NAND and NOR gate and C**onstruct** combinational logic circuits like multiplexers, and tristate buffers using CMOS technology and its families.	L3, L6
4	**Build** various bistable elements such as SR latches, clocked latches, and edge-triggered flip-flops using CMOS technology, and study 1T, 4T DRAM cells and 6T SRAM cells.	L3, L6
5	Describe the structure, operating principles, and advantages of FINFETs, memristors and HEMT, **explain**ing how these devices differ from traditional MOSFETs and their potential applications in modern electronics.	L2

Table: Mapping Levels of COs to POs / PSOs														
COs	**Program Outcomes (POs)**												**PSOs**	
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**
CO1	3	2	1	-	3	-	-	1	1	1	-	2	3	2
CO2	3	2	2	-	3	-	-	1	1	1	-	2	3	2
CO3	3	3	2	-	3	-	-	1	1	1	-	2	3	2
CO4	3	3	3	2	3	-	-	1	1	1	-	2	3	3
CO5	3	-	-	-	3	-	-	1	1	1	-	2	1	2

3: Substantial (High) **2: Moderate (Medium)** **1: Poor (Low)**

TEXT BOOKS:

1. Neil Weste and David M Harris , "Principles of CMOS VLSI Design: A Circuit and System Perspective," Pearson Education (Asia) Pvt.. Ltd., 4th Edition, 2023.
2. Douglas A Pucknell & Kamran Eshragian , "Basic VLSI Design" PHI 3rd Edition
3. J. P. Uyemura "Introduction to VLSI Circuits and Systems", Wiley Publications, 3rd Edition.

REFERENCE BOOKS:

1. Wayne, Wolf, "Modern VLSI design: System on Silicon" Pearson Education, 2nd Edition
2. Eugene D Fabricius "Introduction to VLSI Design", McGraw-Hill International publications.
3. Sung Mo Kang & Yosuf Lederabic Law, "CMOS Digital Integrated Circuits: Analysis and Design", McGraw-Hill, 3rd Edition

E-Resources:

1. CMOS VLSI IIT- https://www.cdeep.iitb.ac.in/vod/vodCloud/course_intra.php?ccode=296&referSrc=57dc9eb7be985a0e14aaa07846b0b9b4 https://www.ee.iitm.ac.in/vlsi/courses/ee5311_2020
2. SWAYAM- https://onlinecourses.nptel.ac.in/noc22_ee08/preview
3. NPTEL- https://archive.nptel.ac.in/courses/108/107/108107129/
4. Virtual Labs- http://vlabs.iitkgp.ac.in/mvlsi/
5. https://www.ee.iitb.ac.in/student/~vharihar/EEs801Seminar_FinFETs_vharihar.doc
6. https://www.sciencedirect.com/topics/physics-and-astronomy/memristor
7. https://www.d.umn.edu/~sburns/EE4611Spring2017/Seminar%20Presentations/HighElectronMobilityTransistors-ByAndrewRidderman.pptx

Activity Based Learning (Suggested Activities in Class) using group discussion and hands-on activities.

1. Solutions for digital subsystems/ systems demonstrating the trade-offs between power, performance, and area in CMOS design. Ex- Adders, MAC etc
2. Design and Implementation of a sequential circuits performing timing analysis.
   Ex- CMOS-Based Digital Clock, Counters
3. Implementing Combinational/Sequential circuits using Memristors/ FINFETs and study the behaviour.

****

SCHOOL OF ENGINEERING

DEPARTMENT OF ELECTRONICS AND COMMUNICATION ENGINEERING

PROFESSIONAL ELECTIVE COURSES -I

Dayananda Sagar University
School of Engineering
Devarakaggalahalli , Harohalli , Kanakapura Road , Ramanagar District- 562112

DEPARTMENT OF ELECTRONICS AND COMMUNICATION ENGINEERING

WIRELESS SENSOR NETWORKS

[As per Choice Based Credit System (CBCS) scheme]

SEMESTER – V

Subject Code	:		**Credits**	:	03
Hours / Week	:	03 Hours	**Total Hours**	:	39 Hours
L–T–P	:	3-0-0			

Course Learning Objectives:

The broad objective of the course is to provide students with the following.

1. To understand the fundamentals of wireless sensor networks and their application to critical real-time scenarios.
2. To study the protocols at various layers and their differences with traditional protocols.
3. To understand the issues of sensor networks.
4. To learn the challenges involved in managing a sensor network.

Teaching-Learning Process (General Instructions)

These are sample new pedagogical methods, where teachers can use to accelerate the attainment of the various course outcomes.

1. ***Lecture method*** means it includes not only traditional lecture method, but different *type of teaching methods* may be adopted to develop the course outcomes.
2. ***Interactive Teaching:*** *Adopt the* ***Active learning*** that includes brainstorming, discussing, group work, focused listening, formulating questions, note taking, annotating, and role playing.
3. Show ***Video/animation*** films to explain functioning of various concepts.
4. Encourage ***Collaborative*** (Group Learning) Learning in the class.
5. To make ***Critical thinking***, ask at least three Higher order Thinking questions in the class.
6. Adopt ***Problem Based Learning***, which fosters students' Analytical skills, develop thinking skills such as the ability to evaluate, generalize, and analyse information rather than simply recall it.
7. Show the ***different ways to solve*** the same problem and encourage the students to come up with their own creative ways to solve them.
8. Discuss how every ***concept can be applied to the real world*** - and when that's possible, it helps improve the students' understanding.

Dayananda Sagar University

School of Engineering

Devarakaggalahalli , Harohalli , Kanakapura Road , Ramanagar District- 562112

DEPARTMENT OF ELECTRONICS AND COMMUNICATION ENGINEERING

UNIT 1: OVERVIEW OF WIRELESS SENSOR NETWORKS	**08 Hours**
Introduction, Sensor network applications – Habitat Monitoring –Tracking chemical plumes – Smart transportation. Advantages of sensor networks. Challenges for Wireless Sensor Networks, Enabling Technologies for Wireless Sensor Networks.	
Assignments followed by Viva-voce	
UNIT 2: WIRELESS SENSOR ARCHITECTURES	**08 Hours**
Single-Node Architecture - Hardware Components, Energy Consumption of Sensor Nodes, Operating Systems and Execution Environments, Network Architecture - Sensor Network Scenarios, Optimization Goals and Figures of Merit, Gateway Concepts.	
Assignments followed by Viva-voce	
UNIT 3: NETWORKING SENSORS	**08 Hours**
Physical Layer and Transceiver Design Considerations, MAC Protocols for Wireless Sensor Networks, Low Duty Cycle Protocols, and Wakeup Concepts - S-MAC, The Mediation Device Protocol, Wakeup Radio Concepts, Address and Name Management, Assignment of MAC Addresses, Routing Protocols- Energy-Efficient Routing, Geographic Routing.	
Troubleshooting of problems, Logical reasoning of concept working	
UNIT 4: INFRASTRUCTURE ESTABLISHMENT	**08 Hours**
Topology Control, Clustering, Time Synchronization, Localization and Positioning, Sensor Tasking and Control.	
Assignments followed by Viva-voce	
UNIT 5: SENSOR NETWORK PLATFORMS AND TOOLS	**07 Hours**
Sensor Node Hardware – Berkeley Motes, Programming Challenges, Node-level software Platforms, Node-level Simulators, State-centric programming.	
Expert lectures followed by reflection notes	

Dayananda Sagar University
School of Engineering
Devarakaggalahalli , Harohalli , Kanakapura Road , Ramanagar District- 562112

DEPARTMENT OF ELECTRONICS AND COMMUNICATION ENGINEERING

Course Outcome	Description	Bloom's Taxonomy Level
At the end of the course the student will be able to:		
CO 1	**Analyze** the structure of sensor networks with WSN architectures and their applications.	L4
CO 2	**Examine** the communication protocols used in WSNs, such as MAC and routing protocols.	L4
CO 3	**Apply** the technical knowledge in building the infrastructure topologies for a WSN	L3
CO 4	**Experiment with** the sensor nodes using simulation software to assess critical parameters in deploying a WSN	L3
CO 5	**Determine** the solutions to the issues in real-time application development based on WSN	L5

Table: Mapping Levels of COs to POs / PSOs

Cos	Program Outcomes (POs)												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	3	-	1	-	-	-	-	-	-	-	-	-	3	-
CO2	3	3	1	2	-	2	-	-	2	3	-	-	3	-
CO3	3	2	2	3	-	2	-	-	-	3	-	-	3	-
CO4	3	3	3	3	3	-	-	3	3	3	2	3	3	3
CO5	3	3	3	3	3	3	-	3	3	3	-	-	3	3

3: Substantial (High) **2: Moderate (Medium)** **1: Poor (Low)**

TEXT BOOKS:

1. Holger Karl and Andreas Willig, "Protocols and Architectures for Wireless Sensor Networks", John Wiley, 2005.
2. Feng Zhao and Leonidas J. Guibas, "Wireless Sensor Networks- An Information Processing Approach", Elsevier, 2007.

REFERENCE BOOKS:

1. Kazem Sohraby, Daniel Minoli, and Taieb Znati, "Wireless Sensor Networks - Technology, Protocols and Applications", John Wiley, 2007.
2. Anna Hac, "Wireless Sensor Network Designs", John Wiley, 2003.

Activity-Based Learning (Suggested Activities in Class)

1. Use simulation software and tools to solve real-time issues and scenarios in WS

****

Dayananda Sagar University
School of Engineering
Devarakaggalahalli , Harohalli , Kanakapura Road , Ramanagar District- 562112

DEPARTMENT OF ELECTRONICS AND COMMUNICATION ENGINEERING

DIGITAL IMAGE PROCESSING

[As per Choice Based Credit System (CBCS) scheme]

SEMESTER – V

Subject Code	:		**Credits**	:	03
Hours / Week	:	03 Hours	**Total Hours**	:	39 Hours
L–T–P	:	3–0–0			

Course Learning Objectives:

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

- **Familiarize** themselves with the core concepts and fundamental steps of digital image processing, components of an image processing system, visual perception, image sensing, acquisition, sampling, and quantization.
- Equip themselves with **knowledge** of various image transform techniques, including two-dimensional orthogonal and unitary transforms, discrete Fourier transform, discrete cosine transform, sine transform, Hadamard transform, and Haar transform.
- Develop practical skills by **apply**ing techniques of image enhancement in both spatial and frequency domains including gray level transformations, histogram processing, arithmetic/logic operations, spatial filtering, smoothing, sharpening, and homomorphic filtering.
- **Explain** image segmentation with point, line, and edge detection, thresholding, edge/region-based segmentation. and different compression models.
- **Comprehend** the fundamentals of image compression, and practical techniques like Huffman coding.
- **Understand** the principles and techniques of image restoration, image degradation/restoration process, various noise models, and advanced filtering techniques to enhance degraded images.

Teaching-Learning Process (General Instructions)

These are sample new pedagogical methods, where teacher can use to accelerate the attainment of the various course outcomes.

1. ***Lecture method*** means it includes not only traditional lecture method, but different *type of teaching methods* may be adopted to develop the course outcomes.
2. ***Interactive Teaching:*** *Adopt the* ***Active learning*** that includes brainstorming, discussing, group work, focused listening, formulating questions, notetaking, annotating, and roleplaying.
3. Show ***Video/animation*** films to explain functioning of various concepts.
4. Encourage ***Collaborative*** (Group Learning) Learning in the class.

5. To make ***Critical thinking***, ask at least three Higher order Thinking questions in the class.
6. Adopt ***Problem Based Learning***, which fosters students' Analytical skills, develop thinking skills such as the ability to evaluate, generalize, and analyse information rather than simply recall it.
7. Show the ***different ways to solve*** the same problem and encourage the students to come up with their own creative ways to solve them.
8. Discuss how every ***concept can be applied to the real world*** - and when that's possible, it helps improve the students' understanding.

UNIT – I	**08 Hours**

Digital Image Fundamentals: Fundamental Steps in Digital Image Processing, Components of an Image processing system, Light and electromagnetic Spectrum, Image sensing and acquisition, Image sampling and quantization, some basic relationships between pixels., introduction to mathematical tools in digital image processing.
Color Image Processing: Color Fundamentals, Color Models, Pseudo color Image Processing.
(Textbook 1: Chapter 1: 1.4,1.5, Chapter 2: 2.1 to 2.6, Chapter 6: 6.1 to 6.3)

UNIT – II	**09 Hours**

Image Transforms: Two-dimensional orthogonal & unitary transforms, properties of unitary transforms, two dimensional discrete Fourier transform, Discrete cosine transform, sine transform, Hadamard transform, Haar transform, Problems.
(Textbook 2: Chapter 5: 5.2, 5.3, 5.5 to 5.9)

UNIT – III	**08 Hours**

Intensity Transformations and Spatial Filtering: Basics of Intensity Transformations and Spatial Filter, Some Basic Gray Level Transformations, Histogram Processing, Fundamentals of Spatial Filtering, Smoothing Spatial Filters, Sharpening Spatial Filters, Problems
(Textbook 1: Chapter 3: 3.1-3.6)

UNIT – IV	**08 Hours**

Image Segmentation: Fundamentals, point, Line and Edge detection, Canny edge Detection, Marr-Hidreth Detection, Hough Transform, Thresholding upto Otsus Method.

Compression: Fundamentals, Image Compression Models, Huffman Coding

(Textbook 1: Chapter 10: 10.1,10.2,10.3, Chapter 8: 8.1,8.2)

UNIT – V	**06 Hours**

Image Restoration: A Model of the Image Degradation/Restoration Process, Noise Models, Linear-Position Invariant Degradations, Inverse Filtering, Minimum Mean Square Error (Wiener) Filtering, Constrained Least Squares Filtering. Geometric Mean Filter

(Textbook 1: Chapter 5: 5.1, 5.2, 5.5, 5.7 – 5.10)

Dayananda Sagar University
School of Engineering
Devarakaggalahalli , Harohalli , Kanakapura Road , Ramanagar District- 562112

DEPARTMENT OF ELECTRONICS AND COMMUNICATION ENGINEERING

Course Outcome	Description	Bloom's Taxonomy Level
At the end of the course the student will be able to:		
1	**Explain** the fundamental principles of image acquisition, sampling, and quantization, colour models and mathematical tools to process and analyse them.	L1, L2
2	**Analyse** and **make use of** two-dimensional orthogonal and unitary transforms, discrete Fourier, cosine, sine, Hadamard, and Haar transforms, to solve problems for digital image processing.	L3, L4
3	**Illustrate** intensity transformations and spatial filtering techniques, grey level transformations, histogram processing, smoothing, and sharpening filters, for enhancing digital images.	L3
4	**Demonstrate** an understanding of image segmentation methods , for point, line, and edge detection, **discuss** Canny edge detection, Marr-Hildreth detection, Hough transform, Otsu's method, and Huffman coding for image compression model.	L2
5	**Outline** image degradation and restoration process, noise models, linear-position invariant degradations and apply inverse filtering, Wiener filtering, and constrained least squares filtering for image restoration.	L2, L3

Table: Mapping Levels of COs to POs / PSOs

COs	Program Outcomes (POs)												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	3							1	1	1		2	2	
CO2	3	3	2					1	1	1		2	2	1
CO3	3	3	2					1	1	1		2	2	1
CO4	3	2	1					1	1	1		2	2	1
CO5	3	1	1					1	1	1		2	2	1

3: Substantial (High) **2: Moderate (Medium)** **1: Poor (Low)**

TEXT BOOKS:

1. Rafel C. Gonzalez and Richard E. Woods, "Digital Image Processing", Pearson Education, 3rd Edition 2020.
2. Anil Jain K. "Fundamentals of Digital Image Processing, PHI Learning Pvt. Ltd., 2011.

REFERENCE BOOKS:

1. Rafel C.Gonzalez, Richard E.Woods, S.L. Eddins , "Digital Image Processing using Matlab", Pearson Education, 3rd Edition, 2020.
2. Sandipen Dey, " Hands on Image Processing with Python", Packt Publising Ltd, 2023.

E-Resources:

1. Digital image Processing IIT-
   https://www.iitmandi.ac.in/pdf/senate_courses/EE608.pdf
   https://www.cse.iitd.ac.in/~pkalra/col783/
2. SWAYAM- https://onlinecourses.swayam2.ac.in/nou23_cs15/preview
3. NPTEL- https://nptel.ac.in/courses/117105135

Activity Based Learning (Suggested Activities in Class) using group discussion and hands-on activities.

1. Apply different enhancement techniques such as contrast stretching, histogram equalization, and spatial filtering, and present the results, explaining the rationale behind the chosen techniques.
2. Develop a real-time system for analyzing medical images (e.g., X-rays, MRIs) to assist in the diagnosis of diseases such as cancer or fractures.
3. Create a system for real-time enhancement of surveillance camera footage to improve visibility and object recognition in low-light conditions or adverse weather.

****

Dayananda Sagar University

School of Engineering

Devarakaggalahalli , Harohalli , Kanakapura Road , Ramanagar District- 562112

DEPARTMENT OF ELECTRONICS AND COMMUNICATION ENGINEERING

MIXED SIGNAL VLSI DESIGN

[As per Choice Based Credit System (CBCS) scheme]

SEMESTER – V

Subject Code :	**Credits : 03**
Hours / Week : 03 Hours	**Total Hours: 39 Hours**
L-T-P :	

COURSE OBJECTIVES:

This Course will enable students to:

1. Analyse small signal and large signal model of MOSFETS
2. Analyse the characteristics of single stage amplifier and differential amplifier.
3. Understand and Analyze Op-Amp parameters
4. Study analog comparators
5. Infer VCO and PLL characteristics.
6. Understanding the working of different data converters: ADC and DAC.

Teaching-Learning Process (General Instructions)

These are sample new pedagogical methods, where teacher can use to accelerate the attainment of the various course outcomes.

1. Lecture method means it includes not only traditional lecture method, but also different type of teaching methods may be adopted to develop the course outcomes.
2. Interactive Teaching: Adopt the Active learning that includes brainstorming, discussing, group work, focused listening, formulating questions, notetaking, annotating, and roleplaying.
3. Show Video/animation films to explain functioning of various concepts.
4. Encourage Collaborative (Group Learning) Learning in the class.
5. To make Critical thinking, ask at least three Higher order Thinking questions in the class.
6. Adopt Problem Based Learning analytical thinking skills such as the ability to evaluate, generalize, andanalyzeinformation rather than simply recallit.
7. Show the different ways to solve the same problem and encourage the students to come up with their own creative ways to solve them.
8. Discuss how every concept can be applied to the real world - and when that's possible,it helps improve the students' understanding.

Dayananda Sagar University
School of Engineering
Devarakaggalahalli , Harohalli , Kanakapura Road , Ramanagar District- 562112

DEPARTMENT OF ELECTRONICS AND COMMUNICATION ENGINEERING

Unit - I	7 Hrs
CMOS Device Modelling and Single Stage Amplifier: Small Signal Model. Analog CMOS Subcircuits: MOS Switch, MOS Diode, Current Sinks and Sources, Basic Current Mirror Common Source with Resistive load. Source follower. **Textbook 1 – Sections (2.4.3, 3.1 - 3.5)**	
Unit - II	**8Hrs**
Differential Amplifier and OPAMPs: Differential Amplifiers and Operational Amplifiers: Single Ended Differential operation, Basic differential Pair. OP- AMPS: General Consideration and Performance Parameters, One/Single Stage OP-AMP, Two stage Op-amp. Comparators, Characterization of a Comparator, Two Stage Open Loop Comparator. **Textbook 1 – sections (4.1- 4.4)**	
Unit - III	**8Hrs**
VCO and PLL: Basic Concepts, Phase Detector, Type-I PLLs, Simple PLL, Frequency Multiplication, Drawbacks of Simple PLL, Phase/Frequency Detectors, Charge Pumps, Charge- Pump PLLs Integer-N Frequency Synthesizers- General Considerations, Basic Integer-N Synthesizer **Textbook 1 – Sections (4.1- 4.4)**	
Unit - IV	**9Hrs**
Digital to Analog Converters: Analog Versus Discrete Time Signals, Converting Analog Signals to Digital Signals, Sample-and-Hold (S/H) Characteristics, DAC specifications : INL, DNL, Offset, Gain Error, DAC Architectures, Digital Input Code, Resistors String, R- 2R Ladder Networks, Current Steering, Cyclic DAC, Pipeline DAC, Delta Sigma DAC **Textbook 2 – Sections (28.1, 28.2, 28.3, 28.4)** **Textbook 2 – Sections (29.1, 29.2, 29.6)**	
Unit - V	**7 hrs**
Analog to Digital Converters: ADC Architectures, Flash, Pipeline ADC, Integrating ADC, Successive Approximation ADC, Sigma Delta ADC, INL, DNL, Offset, Gain Error **Textbook 2- Sections (28.5)** **Textbook 2 – Sections (29.2, 29.2.1,29.2.2,29.2.3,29.2.4,29.2.5)**	

Dayananda Sagar University
School of Engineering
Devarakaggalahalli , Harohalli , Kanakapura Road , Ramanagar District- 562112

DEPARTMENT OF ELECTRONICS AND COMMUNICATION ENGINEERING

COURSE OUTCOMES:

CO No.	Outcomes	Bloom's Taxonomy Level
CO1	**Explain** basic concepts of CMOS device, single stage and differential amplifiers.	**L2**
CO2	Given all specifications, **design** single stage OPAMP, two stage OPAMP and comparator.	**L3**
CO3	**Apply** basic concepts of PLL and Synthesizers for frequency multiplication.	**L3**
CO4	Explain data converter specifications and **analyze** performance of different types of DAC and ADC.	**L4**
CO5	**Model** analog and mixed signal circuits using advanced simulation tool.	**L3**

Strength of CO Mapping to POs:

	Table: Mapping LevelsofCOsto POs/ PSOs													
Cos	Program Outcomes (POs)												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	**1**	**1**	**1**	**-**	**-**	**-**	**-**	**-**	**1**	**-**	**1**	**-**	**1**	**2**
CO2	**2**	**2**	**1**	**1**	**1**	**-**	**-**	**-**	**1**	**-**	**1**	**-**	**1**	**3**
CO3	**2**	**2**	**1**	**1**	**1**	**-**	**-**	**-**	**1**	**-**	**1**	**-**	**1**	**3**
CO4	**2**	**1**	**1**	**1**	**1**	**-**	**-**	**-**	**1**	**1**	**1**	**-**	**1**	**3**
CO5	**2**	**3**	**3**	**2**	**3**	**-**	**-**	**1**	**2**	**2**	**2**	**-**	**2**	**3**

1: Slight (Low), 2: Moderate (Medium), 3: Substantial (High)

TEXT BOOKS

. 1. Design of Analog CMOS Integrated Circuits, Behzad Razavi, 3rd Edition, 2002, Tata McGrawHill.
2. CMOS-Mixed Signal Circuit Design, R. Jacaob Baker, (Vol ll of CMOS: Circuit Design, Layout and Stimulation), IEEE Press and Wiley Interscience, 2002.
3. CMOS Analog Circuit Design, Phillip E Allen, Douglas R Holberg, 2rd Edition, 2006, Oxford University Press.

REFERENCE TEXT BOOKS

1. Analysis and Design of Analog Integrated Circuits, Gray, Hurst, Lewis, and Meyer, John Wiley & Sons, 5th edition, 2009
2. Analog Integrated Circuit Design, Carusone, Johns, and Martin, 2nd edition, John Wiley, 2012.
3. Analog Design for CMOS VLSI Systems, Franco Maloberti, Kluwer Academic Publishers, 2001

NPTEL LECTURE LINKS:

1. CMOS Digital VLSI Design - Course (nptel.ac.in)

****

Dayananda Sagar University
School of Engineering
Devarakaggalahalli , Harohalli , Kanakapura Road , Ramanagar District- 562112

DEPARTMENT OF ELECTRONICS AND COMMUNICATION ENGINEERING

REAL TIME OPERATING SYSTEMS DESIGN AND PROGRAMMING

[As per Choice Based Credit System (CBCS) scheme]

SEMESTER – V

Subject Code	:		**Credits**	:	03
Hours / Week	:	03 Hours	**Total Hours**	:	39 Hours
L–T–P	:	3–0–0			

Course Learning Objectives:

This Course will enable students to:

1. **Understand** the differences between general purpose and real time operating systems.
2. **Understand** multithreading in real-time environment.
3. **Understand** task and thread scheduling in real-time operating systems.
4. **Understand** memory management in real-time system.
5. **program** using system proved timers, signals, mutual exclusion, semaphores, message queues and exception handlers.
6. **program** real-time applications to run in a realistic operating environment.

Teaching-Learning Process (General Instructions)

These are sample new pedagogical methods, where teacher can use to accelerate the attainment of the various course outcomes.

1. **Interactive Simulations:** Use interactive simulations or virtual labs that emulate real-time operating system environments. Students can experiment with task scheduling, interrupt handling, and resource management in a simulated RTOS environment.
2. **Problem-Based Learning (PBL):** Present students with real-world problems or scenarios that require the design and implementation of real-time systems using RTOS. Guide students through the problem-solving process, encouraging them to apply RTOS concepts to develop solutions.
3. **Flipped Classroom:** Flip the traditional classroom model by assigning pre-recorded lectures and instructional materials for students to review before class. Use class time for interactive discussions, hands-on activities, and problem-solving exercises related to RTOS design and programming.
4. **Collaborative Learning Projects:** Assign collaborative learning projects where students work in teams to design and implement real-time systems using RTOS. Encourage collaboration, communication, and peer learning as students collaborate on project tasks and share knowledge and insights.
5. **Peer Teaching:** Implement peer teaching sessions where students take turns teaching RTOS concepts to their peers. Assign each student or group a specific topic related to RTOS design and programming, and have them prepare and deliver presentations or tutorials to the class.
6. **Gamification:** Gamify the learning experience by incorporating game elements, such as challenges, quests, and leader boards, into RTOS-related learning activities. Design educational games or simulations that engage students and motivate them to master RTOS concepts and skills.
7. **Problem-Solving Workshops:** Organize problem-solving workshops where students work together to solve challenging real-time computing problems using RTOS. Provide guidance and support as students collaborate to develop innovative solutions and overcome obstacles.

8. **Role-Playing Exercises:** Conduct role-playing exercises where students assume different roles, such as system designers, embedded software developers, and quality assurance engineers, in a simulated RTOS development project. Role-playing helps students gain a deeper understanding of the diverse perspectives and responsibilities involved in real-time system development.
9. **Industry Partnerships and Guest Lectures:** Foster partnerships with industry professionals and invite guest speakers from companies that develop or use real-time operating systems in their products. Guest lectures provide insights into industry trends, best practices, and real-world applications of RTOS design and programming.
10. **Multimedia Resources:** Utilize multimedia resources, such as videos, animations, and interactive tutorials, to supplement traditional lectures and readings. Engaging multimedia content can help reinforce RTOS concepts and provide visual representations of complex ideas, enhancing student comprehension and retention.

UNIT – I	08 Hours
Introduction to Real-Time Systems and Operating Systems Real Time Applications V/S Non-Real Time Applications, Real-Time Systems V/S Non-Real-Time Systems, Characteristics And Requirements Of Real-Time Systems, Introduction To Operating Systems, Real-Time Operating System (RTOS) V/S General Purpose Operating System (GPOS)	
UNIT – II	**08 Hours**
Thread Management in RTOS Introduction to RTOS, Function pointers, Thread Management, Semaphores, Thread Synchronization, Process Management, Dynamic Loading and Linking	
UNIT – III	**07 Hours**
Time Management in RTOS Cooperation, Blocking Semaphores, FIFO Queue, Thread Sleeping, Deadlocks, Monitors, Fixed Scheduling	
UNIT – IV	**09 Hours**
RTOS Application Design Task Decomposition techniques- Feature Based Decomposition, The Outside-In Approach to Task Decomposition (The Seven-Step Process – Use Case: Decomposing an IoT Thermostat), Setting Task Priorities (Task Scheduling Algorithms, Verifying CPU Utilization Using Rate Monotonic Analysis (RMA), Measuring Execution Time of the Tasks), RTOS Application Design Patterns (Publish and Subscribe Models, Low-Power Application Design Patterns)	
UNIT – V	**07 Hours**
Case Study: Free RTOS Creating tasks and starting the scheduler, deleting tasks, Trying out the code, Task memory allocation, Understanding FreeRTOS task states, Troubleshooting start-up problems.	

Dayananda Sagar University
School of Engineering
Devarakaggalahalli , Harohalli , Kanakapura Road , Ramanagar District- 562112

DEPARTMENT OF ELECTRONICS AND COMMUNICATION ENGINEERING

Course Outcome	Description	Bloom's Taxonomy Level
At the end of the course the student will be able to:		
CO1	Apply knowledge of operating systems to develop real-time operating system applications	L3
CO2	Examine the principles of thread management and time management in RTOS for implementing RTOS applications	L4
CO3	Design RTOS applications using decomposition techniques and task prioritization methods.	L6
CO4	Develop problem-solving skills by applying RTOS concepts to practical scenarios in real-time systems.	L3
CO5	Analyze the case studies on RTOS and evaluate the practical exercises on FreeRTOS	L4

Table: Mapping Levels of COs to POs / PSOs

COs	Program Outcomes (POs)												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	3	2		1				3				3	3	
CO2	3	2						3				3	3	
CO3	3	2	3					3		2		3	3	
CO4	3	3	3	1				3		2		3	3	
CO5	3	3	3	2	3			3	3	3	2	3	3	3

3: Substantial (High) **2: Moderate (Medium)** **1: Poor (Low)**

TEXT BOOKS:

1. Jonathan Valvano," Embedded Systems: Real-Time Operating Systems for ARM Cortex-M Microcontrollers", 2nd Edition, CreateSpace Independent Pub, 2012.
2. Jacob Beningo," Embedded Software Design – A Practical Approach to Architecture, Processes, and Coding Techniques", 1st Edition, APress, 2022.
3. Brian Amos, "Hands-On RTOS with Microcontroller", 1st Edition, Packt Publishing Ltd., 2020.

REFERENCE BOOKS:

1. Sam Siewert, "Real-Time Embedded Components And System with Linux and RTOS", Mercury Learning And Information LLC, 2016.
2. Jiacun Wang, "Real-Time Embedded Systems", 3rd Edition, Wiley, 2017.
3. Jane W. S Liu, "Real-Time Systems", 1st Edition, Pearson Education India, 2002.

E-Resources:

1. **Udemy - Mastering RTOS: Hands-on with FreeRTOS, Arduino and STM32Fx**: This course covers RTOS concepts and hands-on implementation using FreeRTOS, Arduino, and STM32 microcontrollers.
2. **edX - Embedded Systems - Shape the World: Real-Time Interactions**: This course by the University of Texas at Austin covers real-time systems design principles and hands-on labs using the ARM Cortex-M microcontroller.
3. **Coursera - Real-Time Systems with ARM Cortex-M Microcontrollers in Assembly Language**: This course from the University of Colorado Boulder focuses on real-time systems programming using ARM Cortex-M microcontrollers in assembly language.
4. **LinkedIn Learning - Embedded and Real-Time Systems**: This course provides an overview of embedded systems and real-time operating systems, covering topics like interrupts, tasks, and scheduling.
5. **Skillshare - Introduction to Real-Time Operating Systems (RTOS)**: This course offers a beginner-friendly introduction to real-time operating systems, covering basic concepts and practical examples.

Activity Based Learning (Suggested Activities in Class)

1. **RTOS Simulation Exercises:** Use simulation tools or development boards with RTOS support to simulate real-time scenarios. Students can write simple RTOS-based programs and simulate their execution to understand task scheduling, context switching, and resource management.

2. **RTOS Task Scheduling Game:** Divide students into groups and assign each group a task scheduling algorithm (e.g., round-robin, priority-based). Provide them with scenarios (tasks with different priorities and deadlines) and have them compete to schedule tasks efficiently using their assigned algorithm. This helps reinforce understanding of scheduling concepts.

3. **RTOS Kernel Configuration Workshop:** Provide students with a basic RTOS kernel (e.g., FreeRTOS) and guide them through the process of configuring it for different applications. Students can experiment with task priorities, stack sizes, and other parameters to understand their impact on system behavior.

4. **RTOS Debugging Challenge:** Present students with buggy RTOS-based code and challenge them to identify and fix the issues. This activity helps develop problem-solving skills and reinforces understanding of RTOS concepts such as task synchronization, deadlock avoidance, and memory management.

5. **RTOS Project Showcase:** Encourage students to work on RTOS-based projects throughout the course. At the end of the semester, organize a project showcase where students demonstrate their projects to their peers and instructors. This not only provides practical experience but also fosters creativity and collaboration.

6. **RTOS Performance Analysis Lab:** Provide students with benchmarking tools and real-world applications running on an RTOS. Have them analyze the performance metrics (e.g., response time, throughput) under different workloads and system configurations. This activity helps students understand the trade-offs involved in RTOS design and configuration.
7. **RTOS Case Studies:** Present case studies of real-world applications that rely on RTOS, such as automotive systems, medical devices, or industrial control systems. Discuss the challenges faced in designing and implementing these systems, and encourage students to brainstorm solutions based on their understanding of RTOS concepts.
8. **RTOS Coding Challenges:** Organize coding challenges where students are given specific real-time requirements (e.g., periodic tasks, event-driven tasks) and are tasked with implementing them using an RTOS. This helps reinforce programming skills and solidify understanding of RTOS concepts in a practical context.

Dayananda Sagar University
School of Engineering
Devarakaggalahalli , Harohalli , Kanakapura Road , Ramanagar District- 562112

DEPARTMENT OF ELECTRONICS AND COMMUNICATION ENGINEERING

SENSORS AND TRANSDUCERS

[As per Choice Based Credit System (CBCS) scheme]

SEMESTER – V

Subject Code	:	XXECXXXX	**Credits**	:	03
Hours / Week	:	03 Hours	**Total Hours**	:	39 Hours
L–T–P	:	3–0–0			

Course Learning Objectives:

This course will enable students to:

1. Understand the types of sensors and transducers
2. Learn about the role of signal conditioning in amplifiers
3. Understand data acquisition systems and data conversion
4. Understand the data transmission and telemetry techniques

Teaching-Learning Process (General Instructions)

These are sample new pedagogical methods, that teachers can use to accelerate the attainment of the various course outcomes.

1. ***Lecture method*** means it includes not only traditional lecture methods but also different types of teaching methods that may be adopted to develop the course outcomes.
2. ***Interactive Teaching:*** *Adopt* ***Active learning*** that includes brainstorming, discussing, group work, focused listening, formulating questions, note-taking, annotating, and role-playing.
3. Show ***Video/animation*** films to explain the functioning of various concepts.
4. Encourage ***Collaborative*** (Group Learning) Learning in the class.
5. To make ***Critical thinking***, ask at least three Higher-order thinking questions in the class.
6. Adopt ***Problem-based Learning***, which fosters students' Analytical skills, and develops thinking skills such as the ability to evaluate, generalize, and analyze information rather than simply recall it.

UNIT – I	**08 Hours**

Sensors

Stain Gages, Load Cells, Proximity Sensors, Pneumatic Sensors, Light Sensors, Tactile Sensors, Fiber Optic Transducers, Digital Transducers, Recent Trends – Smart Pressure Transmitters, Selection of Sensors, Rotary – Variable Differential Transformer, Synchros and Resolvers, Induction Potentiometers, Micro Electromechanical Systems.

Assignment followed by Viva-voce

UNIT – II	**08 Hours**

Transducers

Introduction, Classification of Transducers, Advantages and Disadvantages of Electrical Transducers, Transducers Actuating Mechanisms, Resistance Transducers, Variable Inductance Transducers, Capacitive Transducers, Piezoelectric Transducers, Hall Effect Transducers, Thermoelectric Transducers, Photoelectric Transducers

Assignment followed by Viva-voce

UNIT – III	07 Hours
Signal Condition Introduction, Functions of Signal Conditioning Equipment, Amplification, Types of Amplifiers, Mechanical Amplifiers Fluid Amplifiers, Optical Amplifiers, Electrical and electronic Amplifiers	
Case study	
UNIT – IV	**09 Hours**
Data Acquisition Systems and Conversion Introduction, Objectives and Configuration of Data Acquisition System, Data Acquisition Systems, Data Conversion.	
Assignment followed by Viva-voce	
UNIT – V	**07 Hours**
Data/Signal Transmission, Telemetry Data/Signal Transmission, Telemetry, Measurement of Non – Electrical Quantities, Pressure Measurement.	
Expert lectures followed by reflection notes	

Course Outcome	Description	Bloom's Taxonomy Level
At the end of the course, the student will be able to:		
CO1	Apply the knowledge of the working of sensors and transducers to build an application	L3
CO2	Develop a signal conditioning circuit for electronic amplifiers	L3
CO3	Analyze data acquisition systems and develop a case study for real-world applications	L4
CO4	Identify the techniques used in data transmission and telemetry for data processing and measurement of signals	L3

	Mapping Levels of COs to POs / PSOs													
Cos	**Program Outcomes (POs)**												**PSOs**	
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**
CO1	3	-	1	-	-	-	-	-	-	-	-	-	2	-
CO2	3	1	1	-	-	-	-	-	-	-	-	-	2	-
CO3	3	2	2	1	-	1	-	1	-	-	-	1	2	2
CO4	3	2	2	1	-	1	1	1	-	-	-	1	2	2

3: Substantial (High) **2: Moderate (Medium)** **1: Poor (Low)**

TEXT BOOKS:

1. Electrical and Electronic Measurements and instrumentation R.K Rajput S. Chand 3rd Edition, 2013.
2. Patranabis.D, "Sensors and Transducers", Wheeler publisher, 1994.

REFERENCE BOOKS:

1. A Course in Electronics and Electrical Measurements and Instruments J.B. Gupta Katson Books 13th Edition, 2008
2. A Course in Electrical and Electronic Measurements and Instrumentation A. K. Sawheny DhanpatRai 2015

E-Resource:

1. **Nptel - https://onlinecourses.nptel.ac.in/noc23_ee105/preview**

Activity-Based Learning (Suggested Activities in Class):

1. **Case Studies:** Analyze case studies of real-world applications using sensors and transducers. Discuss the challenges faced during the implementation.

Dayananda Sagar University
School of Engineering
Devarakaggalahalli , Harohalli , Kanakapura Road , Ramanagar District- 562112

DEPARTMENT OF ELECTRONICS AND COMMUNICATION ENGINEERING

RENEWABLE ENERGY TECHNOLOGY

[As per Choice Based Credit System (CBCS) scheme]

SEMESTER V

Course Code	:		Credits	:	03
Hours / Week	:	03 Hours	Total Hours	:	39 Hours
L-T-P	:	3-0-0			

CourseLearningObjectives:

This Course will enable students to:

1. Understand energy scenario, availability of non-conventional energy sources and its future prospects.
2. Study the fundamentals of solar energy and solar photovoltaics
3. Study the fundamentals of wind energy conversion and its applications
4. Understand the different possible ways of extracting energy from ocean, know about Biomass energy and geothermal energy system.

Teaching-Learning Process (General Instructions)

These are sample new pedagogical methods, where teacher can use to accelerate the attainment of the various course outcomes.

1. Lecture method means it includes not only traditional lecture method, but also different type of teaching methods may be adopted to develop the course outcomes.
2. Interactive Teaching: Adopt the Active learning that includes brainstorming, discussing, group work, focused listening, formulating questions, notetaking, annotating, and roleplaying.
3. Show Video/animation films to explain functioning of various concepts.
4. Encourage Collaborative (Group Learning) Learning in the class.
5. To make Critical thinking, ask at least three Higher order Thinking questions in the class.
6. Adopt Problem Based Learning, analytical thinkingskillssuchastheabilitytoevaluate, generalize, andanalyzeinformationrather than simply recallit.
7. Show the different ways to solve the same problem and encourage the students to come up with their own creative ways to solve them.
8. Discuss how every concept can be applied to the real world - and when that's possible,it helps improve the students' understanding.

Dayananda Sagar University
School of Engineering
Devarakaggalahalli , Harohalli , Kanakapura Road , Ramanagar District- 562112

DEPARTMENT OF ELECTRONICS AND COMMUNICATION ENGINEERING

UNIT I	08 Hours
INTRODUCTION TO ENERGY SCIENCE AND RENEWABLE ENERGY TECHNOLOGIES: Energy, economy and social development, classification of energy sources, consumption trends of primary energy resources, importance of non-conventional energy sources, advantages and disadvantages of conventional energy sources, Salient features of non-conventional energy sources, world energy status, energy scenario in India, summary of renewable energy sources: solar, wind, biomass, tidal, geothermal, Ocean Energy. Prospects of renewal energy sources. (Text book-1 (1.2,1.4,1.5,1.6,1.9,1.10,1.15,1.16) (Text book – II (1.6, 1.7,1.15)	
UNIT II	**08 Hours**
SOLAR ENERGY: **Solar Radiation:** Basics of solar radiation spectrum, Measurement of solar radiation (Pyranometer and Pyrheliometer), Solar radiation geometry, Solar radiation on horizontal and inclined surface. Solar thermal**:** Solar collectors. Solar photovoltaic**:** Fundamentals of solar cell, solar cell characteristic, solar module, solar array, solar applications. **(Text book-I (4.4,4.5,4.6,4.8,4.14,4.15)) (Text book-I (5.2.2, 5.2.3,5.2.4))** **(Reference book -2 (4.4.2,4.4.3,4.4.4) (Text book-I (6.6.1,6.6.2,6.6.3, 6. 11.1,6.11.2,6.11.3))**	
UNIT III	**06 Hours**
WIND ENERGY: Basic principles of wind energy collection, site selection consideration, Basic components of wind energy conversion system, classification of wind energy conversion system, advantages and disadvantage of wind energy conversion system, Energy storage, Applications of wind energy systems **(Text book-II : 6.2,6.4,6.5,6.6,6.7,6.12,6.13)**	
UNIT IV	**08 Hours**
BIOMASS ENERGY: Introduction; Photosynthesis Process; Biofuels; Biomass Resources; Biomass conversion technologies; Urban waste to energy conversion; Biomass Gasification-Downdraft type **(Text book-I : 8.1, 8.2,8.3, 8.4,8.5,8.6,8.7.1)**	
UNIT V	**09 Hours**
OTHER ENERGY SOURCES: Geothermal Energy: Introduction, Applications, Resources of geothermal energy. **(Text Book I: 9.1, 9.2, 9.4)** Ocean Thermal Energy: Introduction, Ocean Thermal Energy Conversion (OTEC), Principle of OTEC system, Methods of OTEC power generation- open and closed cycle. Tidal Energy: Principle of Tidal Power, Components of Tidal Power Plant, Operation methods of utilization of Tidal Energy, Advantages and limitations. **(Text Book II: 9.1,9.2.1, 9.2.2, 9.2.3, 9.2.4, 9.3.1, 9.3.2, 9.3.3, 9.3.4, 9.3.9)** **Fuel cell:** Design and principle of operation of a fuel cell **(Text Book II: 10.2.2)**	

Dayananda Sagar University
School of Engineering
Devarakaggalahalli , Harohalli , Kanakapura Road , Ramanagar District- 562112

DEPARTMENT OF ELECTRONICS AND COMMUNICATION ENGINEERING

Course Outcome	Description	**Bloom's** Taxonomy Level
At the end of the course the student will be able to:		
1	Describe need for renewable energy, its future prospects.	L2
2	Apply the basic knowledge of solar radiation, to the working of solar thermal and solar photovoltaics as well as its applications	L3
3	Apply the basics of wind energy conversion principles and its classifications to its applications	L3
4	Apply the knowledge of biomass energy resources and technologies for conversion of raw biomass into useful forms of	L3
5	Apply the fundamentals of geothermal energy, ocean thermal, tidal energy and design of fuel cells as different renewable energy sources.	L3 & L4

Table: Mapping Levelsof COsto POs/ PSOs

COs	Program Outcomes (POs)												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	3	2	-	-	-	-	-	3	-	-	-	3	1	-
CO2	3	2	-	-	-	-	-	3	-	-	-	3	1	-
CO3	3	2	-	-	-	-	-	3	-	-	-	3	1	1
CO4	3	2	-	-	-	-	-	3	-	--	-	3	1	-
CO5	3	2	-	-	-	-	--	3	-	-	-	3	1	-

3: Substantial (High) 2: Moderate (Medium) 1: Poor (Low)

TEXT BOOK

1. B. H. Khan, "Non-Conventional Energy Resources".
2. Nonconventional Energy sources, G D Rai, Khanna Publication, Fourth Edition,

REFERENCE BOOKS:

1. . S. P. Sukhatme and J. K. Nayak, "Solar Energy: Principles of Thermal Collection and Storage"
2. Chetan Singh Solanki, "Solar Photovoltaics: Fundamentals, technologies and Applications" PHI learning Pvt Ltd,2nd edition.

E-RESOURCES:

1. https://youtube.com/playlist?list=PLwdnzlV3ogoXUifhvYB65lLJCZ74o_fAk&si=iXbsMvVkZCK5dDe9

Activity Based Learning(Suggested ActivitiesinClass)

1. Project showcasing an application of any of the above renewable energy sources studied.

Dayananda Sagar University
School of Engineering
Devarakaggalahalli , Harohalli , Kanakapura Road , Ramanagar District- 562112

DEPARTMENT OF ELECTRONICS AND COMMUNICATION ENGINEERING

INNOVATION MANAGEMENT AND ENTREPRENEURSHIP

[As per Choice Based Credit System (CBCS) scheme]

SEMESTER VI

Course Code	:		Credits	:	02
Hours / Week	:	02 Hours	Total Hours	:	26 Hours
L T P	:	3 0 0			

Course Learning Objectives:

This Course will enable students to:

1. Understand basic skills of Management
2. Understand the need for Entrepreneurs and their skills
3. Identify the Management functions and social responsibilities.
4. Understand the identification of Business, drafting the Business plan and sources of funding.

Teaching-Learning Process (General Instructions)

These are sample new pedagogical methods, where teacher can use to accelerate the attainment of the various course outcomes.

1. ***Lecture method*** means it includes not only traditional lecture method, but different *type of teaching methods* may be adopted to develop the course outcomes.
2. ***Interactive Teaching:*** *Adopt the* ***Active learning*** that includes brainstorming, discussing, group work, focused listening, formulating questions, note taking, annotating, and role playing.
3. Show ***Video/animation*** films to explain functioning of various concepts.
4. Encourage ***Collaborative*** (Group Learning) Learning in the class.
5. To make ***Critical thinking***, ask at least three Higher order Thinking questions in the class.
6. Adopt ***Problem Based Learning***, which fosters students' Analytical skills, develop thinking skills such as the ability to evaluate, generalize, and analyze information rather than simply recall it.
7. Show the ***different ways to solve*** the same problem and encourage the students to come up with their own creative ways to solve them.
8. Discuss how every ***concept can be applied to the real world*** - and when that's possible, it helps improve the students' understanding.

Dayananda Sagar University

School of Engineering

Devarakaggalahalli , Harohalli , Kanakapura Road , Ramanagar District- 562112

DEPARTMENT OF ELECTRONICS AND COMMUNICATION ENGINEERING

UNIT I	07 Hours
Management: Nature and Functions of Management – Importance, Definition, Management Functions, Levels of Management, Roles of Manager, Managerial Skills, Management & Administration, Management as a Science, Art & Profession (Selected topics of Chapter 1, Text 1). **Planning:** Planning-Nature, Importance, Types, Steps and Limitations of Planning; Decision Making – Meaning, Types and Steps in Decision Making (Text 1).	
UNIT II	**07 Hours**
Organizing and Staffing: Organization-Meaning, Characteristics, Process of Organizing, Principles of Organizing, Span of Management (meaning and importance only), Departmentalization-Process Departmentalization, Purpose Departmentalization, Committees– Meaning, Types of Committees. **Staffing-**Need and Importance, Recruitment and Selection Process.	
UNIT III	**06 Hours**
Entrepreneurship: Introduction, Evolution of the concept of Entrepreneurship, Entrepreneurship today, Types of Entrepreneurs, Intrapreneurship, Entrepreneurial competencies, Capacity Building for Entrepreneurs. **Identification of Business Opportunities:** Introduction, Mobility of Entrepreneurs, Business opportunities in India, Models for Opportunity Evaluation.	
UNIT IV	**06 Hours**
Business plans: Introduction, purpose of a Business plan, contents of a Business plan, presenting a Business plan, why do some Business plan fail? Procedure for setting up an Enterprise.	

Course Outcome	Description	**Bloom's** Taxonomy Level
At the end of the course the student will be able to:		
1	Understand the fundamental concepts of Management and its functions.	L2
2	Understand the different functions to be performed by managers/Entrepreneur.	L1, L2
3	Understand the social responsibilities of a Business.	L3
4	Understand the Concepts of Entrepreneurship and to identify Business opportunities.	L2
5	Understand the components in developing a business plan.	L2

Table: Mapping Levels of COs to POs / PSOs

Cos	Program Outcomes (POs)												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	3	2	-	-	-	1	-	-	1	-	-	1	3	2
CO2	3	3	2	-	1	1	-	2	2	-	-	1	3	2
CO3	2	2	1	-	1	1	-	-	1	-	-	1	3	2
CO4	2	2	2	-	-	1	-	-	2	-	-	2	3	2
CO5	2	2	2	-	1	1	-	1	1	-	-	2	3	2

3: Substantial (High) 2: Moderate (Medium) 1: Poor (Low)

TEXT BOOKS:

1. Principles of Management – P.C Tripathi, P.N Reddy, McGraw Hill Education, 6th Edition, 2017. ISBN 13:978-93-5260-535-4.

2. Entrepreneurship Development Small Business Enterprises- Poornima M Charantimath,2nd Edition, Pearson Education 2018, ISBN 978-81-317-6226-4.

REFERENCE BOOK:

1. Essentials of Management: An International, Innovation and Leadership perspective by Harold Koontz, Heinz Weihrich McGraw Hill Education, 10th Edition 2016. ISBN- 978-93-392-2286-4.

Web links and Video Lectures (e-Resources):

1. https://nptel.ac.in/courses/110107094
2. https://nptel.ac.in/courses/110106141
3. https://nptel.ac.in/courses/122106031

Dayananda Sagar University

School of Engineering

Devarakaggalahalli , Harohalli , Kanakapura Road , Ramanagar District- 562112

DEPARTMENT OF ELECTRONICS AND COMMUNICATION ENGINEERING

MICROWAVE ENGINEERING

[As per Choice Based Credit System (CBCS) scheme]

SEMESTER – VI

Course Code	: 22EC35XX	**Credits**	: 04
Hours / Week	: 03+02 Hours	**Total Hours**	: 39 Hours
L–T–P–J	: 3–0–1–0		

Course Learning Objectives:

This Course will enable students to:

1. To familiarize students with the importance of Microwaves in the present scenario.
2. To use the concept of Electromagnetic field theory and network analysis to analyse the microwave transmission line and waveguides.
3. To make the students learn about microwave passive and active devices, SWR and Impedance Matching
4. To design an impedance matching circuit at microwave frequency using transmission lines.
5. Make the students to know S-matrix and S-parameters
6. To familiarize students with the various network parameters and analyse microwave networks

Teaching-Learning Process (General Instructions)

These are sample new pedagogical methods, where teachers can use to accelerate the attainment of the various course outcomes.

1. ***Lecture method*** means it includes not only traditional lecture methods, but different types of teaching methods may be adopted to develop the course outcomes.
2. ***Interactive Teaching:*** Adopt the ***Active learning*** that includes brainstorming, discussing, group work, focused listening, formulating questions, note taking, annotating, and roleplaying.
3. Show ***Video/animation*** films to explain functioning of various concepts.
4. Encourage ***Collaborative*** (Group Learning) Learning in the class.
5. To make ***Critical thinking***, ask at least three Higher order Thinking questions in the class.
6. Adopt ***Problem Based Learning***, which fosters students' Analytical skills, develop thinking skills such as the ability to evaluate, generalize, and analyse information rather than simply recall it.
7. Show the ***different ways to solve*** the same problem and encourage the students to come up with their own creative ways to solve them.
8. Discuss how every ***concept can be applied to the real world*** - and when that's possible, it helps improve the students' understanding.

Dayananda Sagar University

School of Engineering

Devarakaggalahalli , Harohalli , Kanakapura Road , Ramanagar District- 562112

DEPARTMENT OF ELECTRONICS AND COMMUNICATION ENGINEERING

UNIT – I	08 Hours
Introduction to Transmission Line Theory: Microwave frequencies, Microwave devices and Microwave Systems, Transmission Line Equations and Solutions, Reflection Coefficient and Transmission Coefficient, standing wave and standing-wave ratio, Line Impedance and Admittance, Smith Chart and Impedance Matching. **(TEXT BOOK 1 - CHAPTER 0 : 0.0-0.3; CHAPTER 3 : 3.0-3.5)**	
UNIT – II	**09 Hours**
Microwave Network Characterization And Passive Devices: The scattering Matrix – Reciprocity Theorem- Lossless networks and unitary conditions- ABCD parameters- Cascaded networks-Relations between S- Y and ABCD parameters. Properties and s-matrices for typical network such as section of uniform transmission line, 3-port networks (reciprocal and nonreciprocal), T-junctions directional coupler, magic tee, ferrite devices, isolator, circulators. **(TEXT BOOK 2 - CHAPTER 6 : 6.1-6.4)**	
UNIT – III	**08 Hours**
Microwave Tubes and semiconductor Devices: Klystron, Multi-cavity Klystron, Reflex klystron, velocity modulation, transit time, density modulation, beam spreading/ de-bunching, power output and efficiency, Travelling Wave Tube, Magnetron. Gunn diode and its applications, PIN diode, Schottky barrier diodes. (For all the devices: only constructions, operation, definition with explanation and end equations are included. Derivations are excluded). **(TEXT BOOK 2 - CHAPTER 9 & 10)**	
UNIT – IV	**07 Hours**
Microwave Measurements: Introduction, tunable detector, Slotted line carriage, VSWR meter, Spectrum Analyzer, Power Measurements, Insertion loss and attenuation measurements, VSWR Measurements, Return loss measurements by reflectometer, Impedance measurement, frequency measurements. **(TEXT BOOK 2 - CHAPTER 13 & 10)**	
UNIT – V	**07 Hours**
Planar Transmission Lines: Planar transmission lines such as strip line, micro-strip line, slot line and coplanar waveguides. Characteristics of planar transmission lines. Losses in Micro-strip Lines- Quality Factor Q of Micro-strip Lines: - Properties of materials (Substrate, Conductor, Dielectric and Resistive). Introduction to MIC's:- Technology of hybrid MICs, monolithic MICs, comparison of both MICs. **(TEXT BOOK 2 - CHAPTER 3 : 3.8, CHAPTER4; TEXT BOOK 1 - CHAPTER 11 & 12)**	

Dayananda Sagar University
School of Engineering
Devarakaggalahalli , Harohalli , Kanakapura Road , Ramanagar District- 562112

DEPARTMENT OF ELECTRONICS AND COMMUNICATION ENGINEERING

List of Experiments

1. Study of Reflex Klystron Oscillator Mode Characteristics / Gunn diode characteristics.
2. Study of Circulator/Isolator. Extraction of S-Parameters. (Waveguide/stripline component)
3. Study of E-plane, H-plane & Magic Tee. Extraction of S-Parameters. (Waveguide Tees)
4. Measurement of Frequency and wavelength measurement using slotted Line Assembly.
5. Measurement of Reflection coefficient using Smith chart (Magnitude and phase)
6. Measurement of input impedance of the line using smith chart.

Course Outcome	Description	Bloom's Taxonomy Level
At the end of the course the student will be able to:		
1	**Demonstrate** comprehension of transmission line theory at microwave frequencies, including the analysis of microwave devices and systems, transmission line equations, reflection coefficients, standing waves, and impedance matching, enabling effective design and implementation of microwave systems.	L4
2	**Apply** advanced concepts in microwave network characterization and passive devices, such as scattering parameters, reciprocity theorem, ABCD parameters, and S-Y parameter relationships, to analyze and design complex microwave circuits and components.	L3
3	**Evaluate** the construction, operation, and characteristics of microwave tubes and semiconductor devices, including klystrons, magnetrons, Gunn diodes, and PIN diodes, for diverse microwave applications, ensuring efficient utilization of these devices in practical scenarios.	L5
4	**Utilize** various techniques and instruments for microwave measurements, including tunable detectors, VSWR meters, spectrum analyzers, and reflectometers, to accurately characterize microwave systems and components, ensuring optimal performance and reliability.	L4

5	**Analyze** the properties and performance characteristics of planar transmission lines such as strip lines, microstrip lines, and coplanar waveguides, and understand the technology of microwave integrated circuits (MICs), enabling the design and development of advanced microwave communication systems and devices.	L4

Table: Mapping Levels of COs to POs / PSOs

COs	Program Outcomes (POs)												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	3	3	2	2	2	-	-	2	2	1	2	1	2	-
CO2	3	2	2	2	-	-	-	-	2	2	2	1	2	-
CO3	3	2	2	2	-	-	-	2	-	1	2	2	1	2
CO4	3	2	1	-	-	-	-	-	-	-	2	2	-	1
CO5	3	2	1	-	2	-	-	1	2	-	2	2	-	2

3: Substantial (High) **2: Moderate (Medium)** **1: Poor (Low)**

TEXT BOOKS:

1. Samuel Y. Liao: Microwave devices and Circuits", Prentice Hall of India, New Delhi, 3rd Ed. 2006.
2. Annapurna Das and Sisir K.Das: Microwave Engineering - Tata Tata-McGraw Hill, New Delhi, 2008

REFERENCE BOOKS:

1. R.E. Collin : Foundations for Microwave Engg. - IEEE Press Second Edition (2002).
2. David M. POZAR : Microwave Engg. - John Wiley & Sons - 2nd Edition (2003).
3. Rizzi P.A, "Microwave Engineering, Passive Circuits" Prentice Hall of India.

E-Resources:

1. NPTEL :: Electrical Engineering - NOC:Microwave Theory and Techniques
2. NPTEL :: Electrical Engineering - NOC:RF and Microwave Networks
3. Microwave Integrated Circuits - Course (nptel.ac.in)

****

Dayananda Sagar University
School of Engineering
Devarakaggalahalli , Harohalli , Kanakapura Road , Ramanagar District- 562112

DEPARTMENT OF ELECTRONICS AND COMMUNICATION ENGINEERING

VLSI TESTING & VERIFICATION

[As per Choice Based Credit System (CBCS) scheme]

SEMESTER – VI

Subject Code	:		**Credits**	:	03
Hours / Week	:	03 Hours	**Total Hours**	:	39 Hours
L–T–P–S	:	3–0–0–0			

COURSE LEARNING OBJECTIVES:

This course will enable students to:

1) Know about the various test Generation Algorithms and Fault Simulation Techniques.
2) Understand Test generation for combinational logic circuits, Testable combinational logic circuit design
3) Infer Built-In Self-Test analysis, Test pattern generation for BIST
4) Apply Fault Diagnosis Logic Level Diagnosis, Diagnosis by UUT reduction and Fault Diagnosis for Combinational Circuits.

Teaching-Learning Process (General Instructions)

These are sample new pedagogical methods, where teacher can use to accelerate the attainment of the various course outcomes.

1. ***Lecture method*** means it includes not only traditional lecture method, but different *type of teaching methods* may be adopted to develop the course outcomes.
2. ***Interactive Teaching:*** *Adopt the* ***Active learning*** that includes brainstorming, discussing, group work, focused listening, formulating questions, notetaking, annotating, and roleplaying.
3. Show ***Video/animation*** films to explain functioning of various concepts.
4. Encourage ***Collaborative*** (Group Learning) Learning in the class.
5. To make ***Critical thinking***, ask at least three Higher order Thinking questions in the class.
6. Adopt ***Problem Based Learning***, which fosters students' Analytical skills, develop thinking skills such as the ability to evaluate, generalize, and analyse information rather than simply recall it.
7. Show the ***different ways to solve*** the same problem and encourage the students to come up with their own creative ways to solve them.
8. Discuss how every ***concept can be applied to the real world*** - and when that's possible, it helps improve the students' understanding.

Dayananda Sagar University

School of Engineering

Devarakaggalahalli , Harohalli , Kanakapura Road , Ramanagar District- 562112

DEPARTMENT OF ELECTRONICS AND COMMUNICATION ENGINEERING

UNIT - I	08 Hours
BASICS OF TESTING AND FAULT MODELING: Introduction to Testing - Faults in digital circuits -Modeling of faults - Logical Fault Models - Fault detection - Fault location -Fault dominance -Logic Simulation - Types of simulation - Delay models - Gate level Event-driven simulation.	
UNIT - II	**08 Hours**
TEST GENERATION FOR COMBINATIONAL AND SEQUENTIAL CIRCUITS: Test generation for combinational logic circuits - Testable combinational logic circuit design -Test generation for sequential circuits - design of testable sequential circuits.	
UNIT - III	**08 Hours**
DESIGN FOR TESTABILITY: Design for Testability - Ad-hoc design - Generic scan-based design - Classical scan-based design - System level DFT approaches.	
UNIT - IV	**08 Hours**
SELF TEST AND TEST ALGORITHMS: Built-In Self-Test - Test pattern generation for BIST - Circular BIST - BIST Architectures - Testable Memory Design - Test algorithms - Test generation for Embedded RAMs.	
UNIT - V	**07 Hours**
FAULT DIAGNOSIS LOGIC: Level Diagnosis -Diagnosis by UUT reduction - Fault Diagnosis for Combinational Circuits - Self- checking design - System Level Diagnosis.	

Dayananda Sagar University

School of Engineering

Devarakaggalahalli , Harohalli , Kanakapura Road , Ramanagar District- 562112

DEPARTMENT OF ELECTRONICS AND COMMUNICATION ENGINEERING

Course Outcome	Description	Bloom's Taxonomy Level
At the end of the course the student will be able to:		
1	Analyze concepts and techniques of VLSI (Very Large-Scale Integration) design verification and testing.	Analyze L4
2	Apply fault modeling techniques to detect and correct faults in VLSI circuits	Applying L3
3	Understand test economy, fault modeling and simulation, defects, Automatic Test Pattern Generation (ATPG),	Applying L3
4	Conceptualize design for testability, and built-in self-test (BIST).	Applying L3

Table: Mapping Levels of COs to POs / PSOs

COs	Program Outcomes (POs)												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	3	3		2									3	2
CO2	3	3	3	2						2			3	2
CO3	3	3		2		2							3	2
CO4	3	3	2	2					2				3	2
CO5	3	2		2	2							2	3	2

3: Substantial (High) **2: Moderate (Medium)** **1: Poor (Low)**

TEXT BOOKS:

1. "Digital Circuit Testing and Testability", P.K.Lala. Academic Press, 2002.
2. "Logic Design Theory", N.N. Biswas, PHI publication
3. "Switching & Finite Automata Theory", Z. Kohavi, TMH

REFERENCE BOOKS:

1. A.L. Crouch, "Design Test for Digital IC's and Embedded Core Systems", Prentice Hall International.
2. M. Abramovici, M.A. Breuer and A.D. Friedman, "Digital Systems and Testable Design", Jaico Publishing House.

E-Resources:

1. https://nptel.ac.in/courses/117105137

Dayananda Sagar University
School of Engineering
Devarakaggalahalli , Harohalli , Kanakapura Road , Ramanagar District- 562112

DEPARTMENT OF ELECTRONICS AND COMMUNICATION ENGINEERING

NETWORKING AND COMMUNICATION

[As per Choice Based Credit System (CBCS) scheme]

SEMESTER – VI

Subject Code	:		**Credits**	:	03
Hours / Week	:	03 Hours	**Total Hours**	:	39 Hours
L–T–P	:	3–0–0			

Course Learning Objectives:

This course enables students to

1. Understand and Contrast the concept of Signals, OSI & TCP/IP reference models and discuss the functionalities of each layer in these models.
2. Analyse flow control and error control mechanisms and apply them using standard data link layer protocols
3. To design subnets and calculate the IP addresses to fulfill network requirements of an organization. Analyze and apply various routing algorithms to find shortest paths for packet delivery.
4. To familiarize the function of Transport Layer Protocols (UDP, TCP) and suggest appropriate protocol in reliable/unreliable communication.
5. Analyze the features and operations of various application layer protocols such as HTTP, DNS and SMTP.

Teaching-Learning Process (General Instructions)

These are sample new pedagogical methods, where teacher can use to accelerate the attainment of the various course outcomes.

1. ***Lecture method*** means it includes not only traditional lecture method, but different *type of teaching methods* may be adopted to develop the course outcomes.
2. ***Interactive Teaching:*** *Adopt the* ***Active learning*** that includes brainstorming, discussing, group work, focused listening, formulating questions, notetaking, annotating, and roleplaying.
3. Show ***Video/animation*** films to explain functioning of various concepts.
4. Encourage ***Collaborative*** (Group Learning) Learning in the class.
5. To make ***Critical thinking***, ask at least three Higher order Thinking questions in the class.
6. Adopt ***Problem Based Learning***, which fosters students' Analytical skills, develop thinking skills such as the ability to evaluate, generalize, and analyse information rather than simply recall it.
7. Show the ***different ways to solve*** the same problem and encourage the students to come up with their own creative ways to solve them.
8. Discuss how every ***concept can be applied to the real world*** - and when that's possible, it helps improve the students' understanding.

Dayananda Sagar University

School of Engineering

Devarakaggalahalli , Harohalli , Kanakapura Road , Ramanagar District- 562112

DEPARTMENT OF ELECTRONICS AND COMMUNICATION ENGINEERING

UNIT – I	08 Hours
Introduction: Data communications (Components, Data Representation, and Dataflow), Networks (Distributed Processing, Network Criteria, Physical Structures, Network Models, and Categories of Networks), Reference Models: OSI, TCP/IP **Physical Layer**: Transmission media: Magnetic Media, Twisted pair, Base band Coaxial Cable, Fiber optics, Wireless Transmission: Electromagnetic Spectrum, Radio Transmission, Microwave Transmission	
UNIT – II	**07Hours**
Data Link Layer: Data link layer: Design issues: framing, error detection and correction, Elementary Data link Protocols: Stop and wait, Sliding Window protocols: Go-back-N, Selective Repeat, **Medium Access sub layer:** Channel allocation methods, Multiple Access protocols: ALOHA,CSMA, Ethernet and Wireless LAN.	
UNIT – III	**08 Hours**
Network Layer: Network Layer design issues, Virtual circuit and Datagram subnets, Routing algorithms: Shortest path routing, Flooding, Distance vector routing, Hierarchical routing, Broad cast and Multi cast routing, Congestion Control: Congestion prevention policies. The Network layer in the internet: The IP Protocol, IP Addresses, and Internet Control Protocols, IPv6.	
UNIT – IV	**08 Hours**
Transport Layer: Transport Services, Elements of Transport Protocols: Addressing, Connection establishment, Connection Release, Flow control and Buffering, InternetTransport Protocols: UDP and TCP. Session layer: Dialog Control and Synchronization.	
UNIT – V	**08 Hours**
Application Layer: Presentation Layer: Translation, Encryption and Compression DomainName System, Electronic Mail, World Wide Web, Hyper Text Transfer Protocol, Network Security: Cryptography, Symmetric key algorithms, Public key algorithms, Digital signatures.	

Course Outcome	Description	Bloom's Taxonomy Level
At the end of the course the student will be able to:		
1	**Interpret** the basics of data communication, networks, transmission media and the services provided by each layer of OSI and TCP/IP models and **examine** the address for specific layers of TCP/IP Protocol.	L2, L4
2	**Demonstrate** the protocols of data link layer, Medium Access sub layer and concepts of flow control and error control.	L3
3	**Analyse and apply** the routing algorithms for packet delivery and **discuss** the congestion control, Internet protocols for a network layer.	L4
4	**Illustrate** the function of addressing, connection management and protocols of the transport layer.	L3
5	**Outline** the function of the application layer protocols like DNS, SMTP, HTTP, WWW and **illustrate** the network securitymechanism.	L2, L3

Table: Mapping Levels of COs to POs / PSOs

COs	Program Outcomes (POs)												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	2	2	1	1								2	3	
CO2	3	2	2	1								2	3	
CO3	3	3	2	2								2	3	2
CO4	3	2	2	2								2	3	2
CO5	2	1	1									2	3	3

3: Substantial (High) **2: Moderate (Medium)** **1: Poor (Low)**

TEXT BOOKS:

1. Data Communications and Networking – Behrouz A. Forouzan, Fourth Edition TMH, 2006.
2. Computer Networks -- Andrew S Tanenbaum, 4th Edition, Pearson Education.

REFERENCE BOOKS:

1. Understanding communications and Networks, 3rd Edition, W.A. Shay, Thomson

E-Resources:

1. NPTEL- https://archive.nptel.ac.in/courses/106/105/106105082/

SCHOOL OF ENGINEERING

DEPARTMENT OF ELECTRONICS AND COMMUNICATION ENGINEERING

PROFESSIONAL ELECTIVE COURSES -II

Dayananda Sagar University
School of Engineering
Devarakaggalahalli , Harohalli , Kanakapura Road , Ramanagar District- 562112

DEPARTMENT OF ELECTRONICS AND COMMUNICATION ENGINEERING

NETWORK SECURITY

[As per Choice Based Credit System (CBCS) scheme]

SEMESTER- VI

Course Code	:		Credits	:	03
Hours / Week	:	03 Hours	Total Hours	:	39 Hours
L-T-P	:	3-0-0			

CourseLearningObjectives:

This Course will enable students to:

1. To acquire the knowledge on basic need for the information security, art of secret writing, network security services and service mechanisms, the classical encryption techniques and a popular DES algorithm.
2. To study the mathematics of public key cryptography, principles, applications and their requirements, key management and representative algorithms.
3. To study the basics of message authentication and cryptographic hash functions, digital signatures and authentication protocols.
4. To study authentication applications, services and encryption techniques.
5. To study the concepts of security measures such as E-mail, Firewalls and IP security in network-based applications.

Teaching-Learning Process (General Instructions)

These are sample new pedagogical methods, where teacher can use to accelerate the attainment of the various course outcomes.

1. Lecture method means it includes not only traditional lecture method, but different type of teaching methods may be adopted to develop the course outcomes.
2. Interactive Teaching: Adopt the Active learning that includes brainstorming, discussing, group work, focused listening, formulating questions, notetaking, annotating, and roleplaying.
3. Show Video/animation films to explain functioning of various concepts.
4. Encourage Collaborative (Group Learning) Learning in the class.
5. To make Critical thinking, ask at least three Higher order Thinking questions in the class.
6. Adopt Problem Based Learning skillssuch as theabilitytoevaluate, generalize, and analyseinformationrather than simply recallit.
7. Show the different ways to solve the same problem and encourage the students to come up with their own creative ways to solve them.
8. Discuss how every concept can be applied to the real world - and when that's possible, it helps improve the students' understanding.

Dayananda Sagar University

School of Engineering

Devarakaggalahalli , Harohalli , Kanakapura Road , Ramanagar District- 562112

DEPARTMENT OF ELECTRONICS AND COMMUNICATION ENGINEERING

UNIT-I	09 Hours
CLASSICAL ENCRYPTION TECHNIQUES AND DATA ENCRYPTION STANDARD (DES) ALGORITHM OVERVIEW: Need for information security, Services, Mechanisms and Attacks, Model for network security, Cryptography, Cryptanalysis. Symmetric Cipher Model, Substitution Techniques, Caesar Cipher, Mono alphabetic Cipher, Play Fair Cipher, Hill Cipher. Traditional Block and Stream Cipher structures, Feistel Cipher, The Data Encryption Standard (DES) algorithm, Avalanche effect, Strength and Weaknesses of DES.	
UNIT II	**08 Hours**
PUBLIC-KEY (ASYMMETRIC KEY) CRYPTOGRAPHY AND RSA ALGORITHM: Mathematics of Asymmetric Key Cryptography. Principles, Applications and Requirements of Public-Key Cryptosystems, Public-key cryptanalysis. Description of RSA algorithm, Computational aspects, and Security of RSA. Diffie-Hellman key exchange algorithm.	
UNIT III	**08 Hours**
MESSAGE AUTHENTICATION AND CRYPTOGRAPHIC HASH FUNCTIONS: Authentication Requirements and Functions, Message Authentication Codes, Hash Functions, Security of Hash Functions and MACs. Digital Signature Schemes and Authentication Protocols, Digital Signature Standard (DSS).	
UNIT IV	**08 Hours**
AUTHENTICATION APPLICATIONS: Entity/Message Authentication, Kerberos, Kerberos versions 4, X.509 authentication service, Kerberos Encryption techniques.	
UNIT V	**06 Hours**
SECURITY IN NETWORK BASED APPLICATIONS AND IP SECURITY: Pretty Good Privacy (PGP), Data Compression using ZIP. Overview, IP security architecture, Authentication header, Encapsulating Security Pay Load (ESP). Firewalls: Design principles, Trusted systems.	

Dayananda Sagar University
School of Engineering
Devarakaggalahalli , Harohalli , Kanakapura Road , Ramanagar District- 562112

DEPARTMENT OF ELECTRONICS AND COMMUNICATION ENGINEERING

Course Outcomes	Description	Bloom's Taxonomy Level
At the end of the course the student will be able to:		
1	Understand and implement conventional encryption techniques.	L2
2	Implementation of public key cryptographic techniques.	L4
3	Analyze Hash functions and Digital signature schemes.	L5
4	Analyze authentication services and its applications.	L3
5	Analyze network security protocols	L4

Table: Mapping Levels of COs to POs / PSOs

COs	Program Outcomes (POs)												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	2	2	1	1							2	2	3	1
CO2	3	2	2	1	2				2			2	3	
CO3	3	3	2	2		2						2	3	2
CO4	3	2	2	2					2		1	2	3	2
CO5	2	1	1								1	2	3	3

3: Substantial (High) 2: Moderate (Medium) 1: Poor (Low)

TEXT BOOKS:

1. Cryptography and Network Security-Principles and Practice: William Stallings, Pearson 6th edition.

REFERENCE BOOKS:

1. V.K.Jain, "Cryptography and Network Security",Khanna Publishers.
2. Fundamentals of Network Security-Eric Maiwald, 2009 Edition, Information Security Series

E-Resources:

1. NPTEL- Computer Science and Engineering - Cryptography and Network Security
2. Virtual Labs- Advanced Network Technologies Virtual Lab — IIT Kharagpur (iitkgp.ac.in)

Dayananda Sagar University

School of Engineering

Devarakaggalahalli , Harohalli , Kanakapura Road , Ramanagar District- 562112

DEPARTMENT OF ELECTRONICS AND COMMUNICATION ENGINEERING

Advanced Digital Signal Processing

[As per Choice Based Credit System (CBCS) scheme]

SEMESTER – VI

Subject Code	:		**Credits**	:	03
Hours / Week	:	03 Hours	**Total Hours**	:	39 Hours
L–T–P–S	:	3–0–0–0			

Course Learning Objectives:

This Course will enable students to:

1. To understand and apply techniques for designing FIR and IIR digital filters.
2. To gain knowledge of multirate signal processing and its applications.
3. To explore the properties and estimation methods of random signals and power spectra.
4. To learn and implement various algorithms for adaptive filtering and their applications in real-world scenarios.
5. To comprehend parametric methods for power spectrum estimation and their practical implementations.

Teaching-Learning Process (General Instructions)

These are sample new pedagogical methods, where teacher can use to accelerate the attainment of the various course outcomes.

1. ***Lecture method*** means it includes not only traditional lecture method, but different *type of teaching methods* may be adopted to develop the course outcomes.
2. ***Interactive Teaching:*** *Adopt the* ***Active learning*** that includes brainstorming, discussing, group work, focused listening, formulating questions, notetaking, annotating, and roleplaying.
3. Show ***Video/animation*** films to explain functioning of various concepts.
4. Encourage ***Collaborative*** (Group Learning) Learning in the class.
5. To make ***Critical thinking***, ask at least three Higher order Thinking questions in the class.
6. Adopt ***Problem Based Learning***, which fosters students' Analytical skills, develop thinking skills such as the ability to evaluate, generalize, and analyse information rather than simply recall it.
7. Show the ***different ways to solve*** the same problem and encourage the students to come up with their own creative ways to solve them.
8. Discuss how every ***concept can be applied to the real world*** - and when that's possible, it helps improve the students' understanding.

Dayananda Sagar University

School of Engineering

Devarakaggalahalli , Harohalli , Kanakapura Road , Ramanagar District- 562112

DEPARTMENT OF ELECTRONICS AND COMMUNICATION ENGINEERING

UNIT - I	08 Hours
Design of Digital Filters: Design of FIR Filters, Design of Linear-Phase FIR Filters using Windows, Design of Linear-Phase FIR Filters by frequency sampling method, Design of IIR Filters from Analog filters, IIR Filter design by Impulse Invariance, IIR Filter Design by the Bilinear Transformation, Frequency Transformations. **(Chapter 10: 10.2, 10.2.2,10.2.3,10.3,10.3.2, 10.3.3,10.4)**	
UNIT - II	**08 Hours**
Multirate Digital Signal Processing: Introduction, Decimation by a factor D, Interpolation by a factor I, Sampling rate conversion by a rational factor I/D, Multistage implementation of sampling rate conversion, Applications of Multirate Signal Processing, Digital filter banks, two channel quadrature mirror filter banks, M-channel QMF bank. **(Chapter 11: 11.1 to 11.6, 11.9 to 11.12)**	
UNIT - III	**08 Hours**
Linear prediction and Optimum Linear Filters: Random signals, Correlation Functions and Power Spectra, Innovations Representation of a Stationary Random Process. Forward and Backward Linear Prediction. Solution of the Normal Equations. The Levinson-Durbin Algorithm, The Schur Algorithm. Properties of the Linear Prediction-Error Filters. **(Chapter 12: 12.1 to 12.5)**	
UNIT - IV	**07 Hours**
Adaptive filters: **Applications of Adaptive Filters** -System Identification, Adaptive Channel Equalization, Adaptive noise cancellation, Linear Predictive coding of Speech Signals, Adaptive direct form FIR filters-The LMS algorithm, Properties of LMS algorithm. Adaptive direct form filters- RLS algorithm. **(Chapter 13: 13.1,13.1.1, 13.1.2, 13.1.6,13.1.7,13.2,13.3, 13.3.1,13.3.2)**	
UNIT - V	**08 Hours**
Power Spectrum Estimation: Parametric Methods for Power Spectrum Estimation: Relationship between the auto correlation and the model parameters, Yule and Walker methods for the AR Model Parameters, Burg Method for the AR Model parameters, Unconstrained least-squares method for the AR Model parameters, Sequential estimation methods for the AR Model parameters, Selection of AR Model Order, MA Model for Power Spectrum Estimation, ARMA Model for Power Spectrum Estimation. **(Chapter 14: 14.3.1 to 14.3.8)**	

Dayananda Sagar University

School of Engineering

Devarakaggalahalli , Harohalli , Kanakapura Road , Ramanagar District- 562112

DEPARTMENT OF ELECTRONICS AND COMMUNICATION ENGINEERING

Course Outcome	Description	Bloom's Taxonomy Level
At the end of the course the student will be able to:		
1	Able to design FIR filters using windows and frequency sampling methods, and IIR filters using impulse invariance and bilinear transformation techniques.	Applying L3
2	Able to perform decimation, interpolation, and sampling rate conversion, and understand the implementation and applications of multirate signal processing	Understanding L2
3	Able to understand random signals, correlation functions, and power spectra, and will be able to apply linear prediction techniques using algorithms like Levinson-Durbin and Schur.	Understanding L2
4	Able to design and implement adaptive filters using LMS and RLS algorithms for applications such as system identification, channel equalization, noise cancellation, and speech coding.	Applying L3
5	Able to analyze parametric methods for power spectrum estimation, including AR, MA, and ARMA models, and will be able to estimate model parameters using methods like Yule-Walker, Burg, and least-squares.	Analyze L4

Table: Mapping Levels of COs to POs / PSOs

COs	Program Outcomes (POs)												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	3	2	3						1			1	3	2
CO2	2	2	2		2							1	3	2
CO3	3	2	1		2							1	3	2
CO4	3	2	3							2		1	3	2
CO5	3	2	3	1	2							1	3	2

3: Substantial (High) **2: Moderate (Medium)** **1: Poor (Low)**

TEXT BOOKS:

1. Digital Signal Processing Principles, Algorithms, and Applications by John G. Proakis, Prentice-Hall International Inc., 4th Edition, 2012.

REFERENCE BOOKS:

1. Oppenheim, Alan V. Discrete-time signal processing. Pearson Education India, 1999.
2. Mitra, Sanjit Kumar, and Yonghong Kuo. Digital signal processing: a computer-based approach. Volume New York: McGraw-Hill Higher Education, 2006.

E-Resources:

1. https://nptel.ac.in/courses/111106139
2. https://nptel.ac.in/courses/111101164
3. https://nptel.ac.in/courses/111105038

Dayananda Sagar University
School of Engineering
Devarakaggalahalli , Harohalli , Kanakapura Road , Ramanagar District- 562112

DEPARTMENT OF ELECTRONICS AND COMMUNICATION ENGINEERING

ANALOG IC DESIGN

[As per Choice Based Credit System (CBCS) scheme]

SEMESTER VI

Course Code	:		Credits	:	03
Hours / Week	:	03 Hours	Total Hours	:	39 Hours
L T P	:	3 0 0			

Course Learning Objectives:

This Course will enable students to:

1. Understanding MOS Transistors and Small Signal Models
2. Analyzing Single Stage Amplifiers
3. Designing and Analyzing Current Mirrors and Differential Amplifier
4. Understanding Noise and Feedback in Circuits
5. Analyzing Stability, Frequency Compensation, and Advanced Circuit Techniques

Teaching-Learning Process (General Instructions)

These are sample new pedagogical methods, where teacher can use to accelerate the attainment of the various course outcomes.

1. Lecture method means it includes not only traditional lecture method, but also different type of teaching methods may be adopted to develop the course outcomes.
2. Interactive Teaching: Adopt the Active learning that includes brainstorming, discussing, group work, focused listening, formulating questions, notetaking, annotating, and roleplaying.
3. Show Video/animation films to explain functioning of various concepts.
4. Encourage Collaborative (Group Learning) Learning in the class.
5. To make Critical thinking, ask at least three Higher order Thinking questions in the class.
6. Adopt Problem Based Learning analytical thinking skills such as the ability to evaluate, generalize, andanalyzeinformationrather than simply recallit.
7. Show the different ways to solve the same problem and encourage the students to come up with their own creative ways to solve them.
8. Discuss how every concept can be applied to the real world - and when that's possible, it helps improve the students' understanding.

Dayananda Sagar University
School of Engineering
Devarakaggalahalli , Harohalli , Kanakapura Road , Ramanagar District- 562112

DEPARTMENT OF ELECTRONICS AND COMMUNICATION ENGINEERING

UNIT I	08 Hours

MOS and Single stage amplifiers

MOS Device Physics: MOS as switch, MOS small signal model, Noise: Statistical Characteristics of Noise – Noise Spectrum, Amplitude distribution, Correlated and uncorrelated sources, Signal to Noise ratio, Noise analysis procedure, Types of Noise, Thermal Noise, Flicker Noise.

Single stage Amplifiers: General Considerations, Common source stage with resistive and diode load, problems, Source follower, Common gate, Cascode stage, Folded Cascode.

UNIT II	08 Hours

Differential and Operations Amplifiers

Current Mirror: Basic Current Mirrors, Cascode current Mirrors, Active current mirror
Differential Amplifiers: Single ended and differential operation, Common mode response, differential pair with active loads, Gilbert cell
Operational Amplifier: One stage op-amp, two stage op-amp

UNIT III	08 Hours

Feedback: General considerations, Properties of feedback circuit- Gain desensitization, Thermal impedance modification, bandwidth modification, no-linearity reduction, Sense and return mechanism.
Feedback Topologies-VV, VI, IV, II, effect of feedback on noise, Feedback analysis.

UNIT IV	08 Hours

Frequency Response of Amplifiers
General considerations, Millers Approximation for Common Source (direct Analysis), Source follower- High frequency equivalent, Bootstrapping, Common gate stage- High frequency, Gain bandwidth trade-offs, Basic frequency Compensation, compensation of two-stage OPAMP.
Band gap reference: Supply independent biasing, temperature independent references, Band gap reference.

UNIT V	07 Hours

Analog Layout techniques
Device fabrication, active devices, passive devices, resistors, interconnects, General layout considerations – antenna effect,
layout techniques- multi finger transistors, symmetry, STI, reference distribution, passive devices, interconnects, Pads and Electro static discharge (ESD) protection, substrate coupling, packaging.

Dayananda Sagar University
School of Engineering
Devarakaggalahalli , Harohalli , Kanakapura Road , Ramanagar District- 562112

DEPARTMENT OF ELECTRONICS AND COMMUNICATION ENGINEERING

Course Outcome	Description	**Bloom's** Taxonomy Level
At the end of the course the student will be able to:		
1	Comprehend CMOS Process Components and MOS Models	Understanding
2	Analyze and Design Single Stage Amplifiers	Analyzing
3	Design and Analyze Current Mirrors and Differential Amplifiers	Applying
4	Evaluate Noise and Feedback in Electronic Circuits	Evaluating
5	Assess Stability and Frequency Compensation Techniques	Evaluating

Table: Mapping Levels of COs to POs / PSOs

Cos	Program Outcomes (POs)												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	3	2			2							1	2	
CO2	3	3	2		1							1		1
CO3	3	3	3		1							1	2	
CO4	3	3			3						1	1	1	
CO5	3	3	2		1				1		2	1		2

3: Substantial (High) 2: Moderate (Medium) 1: Poor (Low)

TEXT BOOKS:

1. Design of Analog CMOS Integrated Circuits,BehzadRazavi, McGrawHill Edition, 2002, ISBN: 0-07 238032-2
2. CMOS Circuit Design, Layout and Simulation, R. Jacob Baker, Harry W. Li and David E. Boyce, IEEE Press, 2002, ISBN: 81-203-1682-7

REFERENCE BOOKS:

1. Analysis and design of Analog Integrated Circuits,Gray, Hurst, Lewis, and Meyer: 4th Edition, John Wiley & Sons, ISBN-10: 0470245999
2. CMOS Analog Circuit Design, Phillip E. Allen and Douglas R. Holberg, 2nd Edition Oxford University Press, February 2002, ISBN: 9780199765072

E-Resources:

1. https://nptel.ac.in/courses/117106030

Dayananda Sagar University
School of Engineering
Devarakaggalahalli , Harohalli , Kanakapura Road , Ramanagar District- 562112

DEPARTMENT OF ELECTRONICS AND COMMUNICATION ENGINEERING

EMBEDDED LINUX

[As per Choice Based Credit System (CBCS) scheme]

SEMESTER VI

Course Code	:		Credits	:	03
Hours / Week	:	3 Hours	Total Hours	:	39 Hours
L T P	:	3-0-0			

Course Learning Objectives:

This Course will enable students to:

1. To understand transition roadmap from a traditional RTOS to Embedded Linux.
2. To learn architecture of the Embedded Linux OS, steps involved in building a GNU cross-platform tool chain and system emulators.
3. To understand the use of Linux kernel in an embedded system, building rootfile system structure.
4. To understand the Interaction between kernel space and user space, debugging and profiling of the system.
5. To learn the Yocto Project for easier development of Linux-based systems for embedded products and build toolchains, bootloaders, kernels, root filesystems, Linux Distribution containing binary packages.

Teaching-Learning Process (General Instructions)

These are sample new pedagogical methods, where teacher can use to accelerate the attainment of the various course outcomes.

1. Lecture method means it includes not only traditional lecture method, but also different type of teaching methods may be adopted to develop the course outcomes.
2. Interactive Teaching: Adopt the Active learning that includes brainstorming, discussing, group work, focused listening, formulating questions, notetaking, annotating, and roleplaying.
3. Show Video/animation films to explain functioning of various concepts.
4. Encourage Collaborative (Group Learning) Learning in the class.
5. To make Critical thinking, ask at least three Higher order Thinking questions in the class.
6. Adopt Problem Based Learning analytical thinkingskillssuchastheabilitytoevaluate, generalize, andanalyzeinformationrather than simply recallit.
7. Show the different ways to solve the same problem and encourage the students to come up with their own creative ways to solve them.
8. Discuss how every concept can be applied to the real world - and when that's possible,it helps improve the students' understanding.

Dayananda Sagar University

School of Engineering

Devarakaggalahalli , Harohalli , Kanakapura Road , Ramanagar District- 562112

DEPARTMENT OF ELECTRONICS AND COMMUNICATION ENGINEERING

UNIT I	08 Hours
INTRODUCTION TO EMBEDDED LINUX: History of Embedded Linux, Embedded Linux versus desktop Linux, different hardware and software support for embedded Linux, Linux-based embedded system components, Reference hardware model, Reference hardware model implementations, CPU memory map, The role of the bootloader, Possible scenarios, An example of bootloader operations, Linux kernel, Device tree, System programs, Application, Typical layout of the root filesystem.	
UNIT II	**08 Hours**
HARDWARE SUPPORT AND SOFTWARE DEVELOPMENT TOOLS FOR EMBEDDED LINUX: Processor Architectures, Buses and interfaces, I/O, Storage, General-Purpose Networking, Industrial-Grade Networking, System Monitoring, GNU Cross-Platform Development Toolchain, Emulators	
UNIT III	**06 Hours**
KERNEL CONSIDERATIONS AND ROOT FILES SYSTEM: Selecting a Kernel, Configuring the Kernel, Compiling the Kernel, Installing the Kernel, Libraries, Kernel Modules, Kernel Images, Device Files	
UNIT IV	**08 Hours**
KERNEL DEBUGGING TECHNIQUES: GNU Debugger (GDB), Challenges to Kernel Debugging, Using KGDB for Kernel Debugging, Kernel Debugging Techniques, Hardware Assisted Debugging.	
UNIT V	**09 Hours**
THE YOCTO PROJECT: Yocto project Building, Yocto project Family, Yocto project Terms, Bit Bake Build Engine	

Course Outcomes	Description	Bloom's Taxonomy Level
At the end of the course the student will be able to:		
CO1	Apply Knowledge and understand the important elements of Embedded Linux Operating System architecture	L2,L3
CO2	Understand the architecture and build process of. Linux based system	L2, L4
CO3	Create and use a cross-development environment, write the Kernel modules, evaluate system operation.	L6, L5
CO4	Evaluate debugging issues encountered in devolving software for Embedded Linux System	L4, L5
CO5	Apply knowledge to produce tools and processes that enable the creation of Linux distributions for embedded and related software.	L2,L3

Table: Mapping Levelsof COstoPOs/ PSOs

Cos	Program Outcomes (POs)												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	3	2	2	-	3	-	-	-	-	-	-	3	2	1
CO2	3	2	2	1	3	-	-	-	-	-	-	1	2	1
CO3	3	2	3	2	3	1	-	-	-	-	-	1	2	1
CO4	3	3	2	2	3							1	2	1
CO5	3	3	2	2	3							3	2	1
CO6	3	2	2	-	3	-	-	-	-	-	-	3	2	1

3: Substantial (High) 2: Moderate (Medium) 1: Poor (Low)

TEXT BOOKS:

1. Karim Yaghmour, Jon Masters, Gilad Ben-Yossef, Philippe Gerum, "Building Embedded LinuxSystems", O'Reilly Media,2008.
2. Rudolf J. Streif, "Embedded Linux Systems with the Yocto Project", Pearson Education, Inc.,2016.

REFERENCE BOOKS:

1. P. Raghavan, Amol Lad, Sriram Neelakandan, "Embedded Linux System Design and Development", Auerbach Publications, Taylor & Francis Group, LLC, 2006.
2. Derek Molloy, "Exploring Raspberry Pi- Interfacing to the Real World with Embedded Linux",John Wiley & Sons, Inc.
3. Chris Simmonds, "Mastering Embedded Linux Programming", Second edition, Packt PublishingLtd. Birmingham, UK, 2017.

Activity Based Learning (Suggested Activities in Class)

1. Project Showcasing Linux Based Embedded System

NPTEL LECTURE LINKS:

1. Embedded Linux – Batch 2 – NPTEL+

Dayananda Sagar University

School of Engineering

Devarakaggalahalli , Harohalli , Kanakapura Road , Ramanagar District- 562112

DEPARTMENT OF ELECTRONICS AND COMMUNICATION ENGINEERING

MECHATRONICS

[As per Choice Based Credit System (CBCS) scheme]

SEMESTER VI

Course Code :		Credits :	03
Hours / Week: 3 Hours		Total Hours :	39
L T P : 3-0-0			
Perquisite Courses: Basics of Engineering Physics and chemistry			

COURSE OBJECTIVES:

1. Student gain clarity on what Mechatronics entails and how it integrates mechanical, electrical, and computer engineering principles.
2. Develop expertise in sensor principles, interfacing, and signal conditioning for effective application in Mechatronics system design and implementation.
3. Acquire comprehensive skills in control system principles, including open-loop vs. closed-loop control, PID controllers, stability analysis, and tuning techniques, to successfully apply advanced control theory in Mechatronic design projects for optimized performance and stability.
4. Students will gain a clear understanding of advanced microcontroller systems, communication protocols, and optimization strategies for designing efficient embedded systems in Mechatronics.
5. Students will gain a comprehensive understanding of Mechatronic system design methodology, including electronics integration, system modeling and simulation using MATLAB/Simulink, reliability and safety considerations, and hands-on project implementation for practical learning.
6. Enhance problem-solving abilities by applying Mechatronics principles to solve engineering challenges effectively.

Teaching-Learning Process (General Instructions)

These are sample new pedagogical methods, where teacher can use to accelerate the attainment of the various course outcomes.

1. Lecture method means it includes not only traditional lecture method, but also different type of teaching methods may be adopted to develop the course outcomes.
2. Interactive Teaching: Adopt the Active learning that includes brainstorming, discussing, group work, focused listening, formulating questions, notetaking, annotating, and roleplaying.
3. Show Video/animation films to explain functioning of various concepts.
4. Encourage Collaborative (Group Learning) Learning in the class.
5. To make Critical thinking, ask at least three Higher order Thinking questions in the class.
6. Adopt Problem Based Learning analytical thinking skills such as the ability to evaluate, generalize, andanalyzeinformationrather than simply recallit.
7. Show the different ways to solve the same problem and encourage the students to come up with their own creative ways to solve them.
8. Discuss how every concept can be applied to the real world - and when that's possible,it helps improve the students' understanding.

Dayananda Sagar University

School of Engineering

Devarakaggalahalli , Harohalli , Kanakapura Road , Ramanagar District- 562112

DEPARTMENT OF ELECTRONICS AND COMMUNICATION ENGINEERING

COURSE CONTENT:	
UNIT 1	**07Hrs**
Introduction to Mechatronics: Overview of Mechatronics: Definition, scope, and interdisciplinary nature, History and evolution of Mechatronics, Mechatronic systems and their components, Role of sensors, actuators, and controllers in Mechatronic systems, Introduction to microcontrollers and embedded systems.	
UNIT 2	**09Hrs**
Sensors, Actuators and Signal Processing: Introduction to sensors and transducers, Classification of sensors based on physical principles (e.g., resistive, capacitive, optical, magnetic), Sensor interfacing and signal conditioning techniques, Actuators and their types (e.g., electric motors, pneumatic actuators, hydraulic actuators), Sensor fusion techniques: Kalman filtering, Signal processing for sensor data: Filtering, feature extraction, and pattern recognition.	
UNIT 3	**08Hrs**
Control Systems in Mechatronics: Basics of control systems: Open-loop vs. closed-loop control, PID controllers and other control algorithms, Control system design for Mechatronic applications, Introduction to feedback systems Stability analysis and control tuning techniques, Application of control theory in Mechatronic design projects.	
UNIT 4	**08Hrs**
Embedded Systems Design and Optimization: Advanced microcontroller architectures and system-on-chip (SoC) platforms, High-speed interfacing and communication protocols (e.g., SPI, I2C, CAN), Design considerations for embedded systems: Power efficiency, reliability, and security, Optimization techniques for embedded software and hardware co-design.	
UNIT 5	**07Hrs**
Mechatronic System Design Design methodology for Mechatronic systems emphasizing electronics integration, System modeling and simulation using software tools (e.g., MATLAB/Simulink), Design considerations for reliability, safety, and performance in Mechatronic systems, Project- based learning: Design, implementation, and testing of a Mechatronic system.	

Dayananda Sagar University
School of Engineering
Devarakaggalahalli , Harohalli , Kanakapura Road , Ramanagar District- 562112

DEPARTMENT OF ELECTRONICS AND COMMUNICATION ENGINEERING

COURSE OUTCOMES

Course Outcome	Description	Bloom's Taxonomy
At the end of the course the student will be able to:		
CO1	**Analyze** the interdisciplinary nature of Mechatronics and its applications across engineering domains.	4-**Analyze**
CO2	**Incorporate** understanding of sensors, actuators, and signal processing techniques into the design and implementation of Mechatronic systems.	5-**Incorporate**
CO3	**Apply control** theory principles learned to design and implement control strategies for Mechatronic projects, demonstrating proficiency in real-world applications.	4-**Apply**
CO4	**Evaluate** the performance characteristics, applications and trade-offs of different types of sensor like acoustic, vibratory, resonant	5-**Evaluate**
CO5	**Analyze** design considerations including power efficiency, reliability, and security in the development of embedded systems for Mechatronic applications.	**3- Analyze**
CO6	**Interpret** the process of project-based learning involving the design, implementation, and testing using modern engineering tool and software of a Mechatronic system, applying theoretical knowledge to practical engineering challenges.	**4- Interpret**

Table: Mapping Levels of COs to POs / PSOs

COs	Program Outcomes (POs)												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	3	-	3	-	-	3	-	-	3	-	-	1	3	2
CO2	3	2	3	2	3	-	-	-	3	-	-	1	3	2
CO3	3	2	-	3	-	-	-	-	2	-	3	1	3	2
CO4	3	-	-	3	2	-	3	-	-	2	0	1	3	2
CO5	3	-	3	3	3	-	3	2	-	-	-	-	3	2
CO6	3	-	3	2	3	2	-	-	-	-	3	1	2	2

TEXT BOOKS:

1. Mechatronics: Principles and Applications" by Godfrey C. Onwubolu
2. Mechatronics: Principles, Technologies and Applications" by Robert H. Bishop
3. Mechatronics: A Foundation Course" by Clarence W. de Silva
4. Mechatronics: An Integrated Approach" by Edward Carryer, Matthew Ohline, and Thomas Kenny.

REFERENCES:

1. Embedded Systems: Architecture, Programming and Design" by Raj Kamal
2. Mechatronics System Design" by Devdas Shetty and Richard A. Kolk
3. Modern Control Engineering" by Katsuhiko Ogata

NPTEL LECTURE LINKS:

1. Mechatronics - Course (nptel.ac.in)

Dayananda Sagar University

School of Engineering

Devarakaggalahalli , Harohalli , Kanakapura Road , Ramanagar District- 562112

DEPARTMENT OF ELECTRONICS AND COMMUNICATION ENGINEERING

Industrial Internet of Things

[As per Choice Based Credit System (CBCS) scheme]

SEMESTER - VI

Course Code	:	Credits	: 3
Hours / Week	: Hours	Total Hours	: 39 Hours
L T P	: 3-0-0		

Course Learning Objectives:

This Course will enable students to:

1. Remembering: Recall the foundational concepts and historical evolution of Industry 4.0 and the Industrial Internet of Things, including key terminologies, principles, and technological advancements.

2. Understanding: Interpret the significance and implications of Industry 4.0 and IIoT within the context of modern industrial systems, explaining how these technologies enable digital transformation, enhance operational efficiency, and drive innovation.

3. Applying: Apply knowledge of IoT technologies and protocols to design and implement solutions for specific industrial scenarios, demonstrating proficiency in configuring sensor networks, selecting appropriate communication protocols, and deploying edge computing solutions.

4. Analyzing: Analyze data generated by IoT-enabled industrial systems to identify patterns, trends, and anomalies, utilizing data analytics techniques such as descriptive statistics, data visualization, and regression analysis to derive actionable insights for process optimization and decision-making.

5. Evaluating: Evaluate the effectiveness and suitability of Industry 4.0 and IIoT solutions in addressing industrial challenges and opportunities, considering factors such as scalability, interoperability, security, and return on investment (ROI), and proposing recommendations for improvement or optimization.

Dayananda Sagar University
School of Engineering
Devarakaggalahalli , Harohalli , Kanakapura Road , Ramanagar District- 562112

DEPARTMENT OF ELECTRONICS AND COMMUNICATION ENGINEERING

Teaching-Learning Process (General Instructions)

These are sample new pedagogical methods, where teacher can use to accelerate the attainment of the various course outcomes.

1. Lecture method means it includes not only traditional lecture method, but also different type of teaching methods may be adopted to develop the course outcomes.
2. Interactive Teaching: Adopt the Active learning that includes brainstorming, discussing, group work, focused listening, formulating questions, notetaking, annotating, and roleplaying.
3. Show Video/animation films to explain functioning of various concepts.
4. Encourage Collaborative (Group Learning) Learning in the class.
5. To make Critical thinking, ask at least three Higher order Thinking questions in the class.
6. Adopt Problem Based Learning analytical thinking skills such as the ability to evaluate, generalize, andanalyzeinformationrather than simply recallit.
7. Show the different ways to solve the same problem and encourage the students to come up with their own creative ways to solve them.
8. Discuss how every concept can be applied to the real world - and when that's possible,it helps improve the students' understanding.

UNIT I	8 Hours
Introduction to Industry 4.0: Sensing & actuation, Communication Protocols, Networking Protocols , Industry 4.0: Globalization and Emerging Issues, The Fourth Revolution, LEAN Production Systems, Smart and Connected Business Perspective, Smart Factories.	
UNIT II	**8 Hours**
Industrial Internet Technologies Cyber Physical Systems and Next Generation Sensors and Product Lifecycle Management, Augmented Reality and Virtual Reality, Artificial Intelligence, Big Data, Cybersecurity in Industry 4.0, Basics of Industrial IoT: Data Transmission and Data Acquisition.	
UNIT III	**8 Hours**
(IIoT-Business Models) Introduction of Business Model, Reference Architecture, Business models of IIOT: Business opportunity, categorization, Reference architecture of IIOT, IIRA frame works, study of key performance indicators.	
UNIT IV	**8 Hours**
Analytics for Industy 4.0 Introduction, Machine Learning and Data Science in Industrial IoT: Big Data Analytics and Software Defined Networks: IIoT Machine Learning and Data Science Data Management with Hadoop Data Center, Industrial IoT Security and Fog Computing - Fog Computing in IIoT, Industrial IoT overview, IS-95- CDMA-One.	
UNIT V	**7 Hours**
Healthcare, Power Plants Industrial IoT- Application Domains: Oil, chemical and pharmaceutical industry, Applications of UAVs in Industries, Real case studies	

Course Outcome	Description	**Bloom's** Taxonomy Level
At the end of the course the student will be able to:		
CO1	Understand the basic concept of sensing and actuation and Networking and communication protocol, introduction to basic concepts of industry 4.0	L2
CO2	Understand key technologies applied like Cyber Physical Systems, AR,VR, AI, Big data , Cybersecurity, Cloud computing , Data Transmission, Data Acquisition in Industry 4.0	L2
CO3	Apply the Knowledge of IIoT in designing a Business Models	L3
CO4	Implement analytics technologies like ML, DS, Big data, SDN, Data Management Fog Computing.	L2
CO5	Implement the industry 4.0 in various engineering domains	L3

Table: Mapping LevelsofCOsto POs/ PSOs

Cos	Program Outcomes (POs)												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	3	2				2						3	3	2
CO2	3	2				2						3	3	2
CO3	3	2				2						3	3	2
CO4	3	2				2						3	3	2
CO5	3	2				2						3	3	2

3: Substantial (High) 2: Moderate (Medium) 1: Poor (Low)

TEXT BOOKS:

1. Introduction to industrial internet of things and industry 4.0 by Sudip misra, Chandan roy, Anandarup Mukarjee, 1st edition , CRC Press publisher,2021, ISBN 9781003020905

REFERENCES:

1. Industry 4.0 the industrial Internet of Things , Alasdair Gilchrist, 1st edition, Apress Publisher,2017, ISBN-13: 978-1-4842-2046-7
2. Industry 4.0: Managing The Digital Transformation, Alp Ustundag, EmreCevikcan, 1st edition, Springer, 2018, ISBN 978-3-319-57869-9.
3. Designing the Industry - Internet of things connecting the physical, digital and virtual worlds, OvidiuVermesan and Peer Friess,1st edition, Rivers Publishers, 2016, ISBN 978-87-93379-81-7

Alternative NPTEL/SWAYAM Course:

1. Introduction to Industry 4.0 and Industrial Internet of Things - Course (nptel.ac.in)

SCHOOL OF ENGINEERING

DEPARTMENT OF ELECTRONICS AND COMMUNICATION ENGINEERING

PROFESSIONAL ELECTIVE COURSES -III

Dayananda Sagar University
School of Engineering
Devarakaggalahalli , Harohalli , Kanakapura Road , Ramanagar District- 562112

DEPARTMENT OF ELECTRONICS AND COMMUNICATION ENGINEERING

Satellite Remote Sensing

[As per Choice Based Credit System (CBCS) scheme]

SEMESTER VI

Course Code	:		Credits	:	03
Hours / Week	:	03 Hours	Total Hours	:	39 Hours
L T P	:	3 0 0			

Course Learning Objectives:

This Course will enable students to:

1. To understand satellite orbital laws, parameters and launching procedure.
2. To explain physical principles of remote sensing including atmospheric and thermal effects.
3. To understand the sensor system in satellite required for remote sensing.
4. To analyze and represent the images captured by earth observation satellites.

Teaching-Learning Process (General Instructions)

These are sample new pedagogical methods, where teacher can use to accelerate the attainment of the various course outcomes.

1. Lecture method means it includes not only traditional lecture method, but also different type of teaching methods may be adopted to develop the course outcomes.
2. Interactive Teaching: Adopt the Active learning that includes brainstorming, discussing, group work, focused listening, formulating questions, notetaking, annotating, and roleplaying.
3. Show Video/animation films to explain functioning of various concepts.
4. Encourage Collaborative (Group Learning) Learning in the class.
5. To make Critical thinking, ask at least three Higher order Thinking questions in the class.
6. Adopt Problem Based Learning analytical thinking skills such as the ability to evaluate, generalize, andanalyzeinformationrather than simply recallit.
7. Show the different ways to solve the same problem and encourage the students to come up with their own creative ways to solve them.
8. Discuss how every concept can be applied to the real world - and when that's possible, it helps improve the students' understanding.

Dayananda Sagar University
School of Engineering
Devarakaggalahalli , Harohalli , Kanakapura Road , Ramanagar District- 562112

DEPARTMENT OF ELECTRONICS AND COMMUNICATION ENGINEERING

UNIT - I	07 Hours
SATELLITE ORBITS: Kepler's Laws, Newton's law, orbital parameters, orbital perturbations, station keeping, geo stationary and non-Geo-stationary orbits – Look Angle Determination- Limits of visibility – eclipse-Sub satellite point –Sun transit outage-Launching Procedures - launch vehicles and propulsion.	
UNIT - II	**08 Hours**
PHYSICAL PRINCIPLES OF REMOTE SENSING: Fundamentals of Remote Sensing Signals, Electromagnetic Radiation Laws, Spectral Signatures in the Solar Spectrum, Brief introduction of Vegetation Reflectance, Soil Reflectance Properties, Water in the Solar spectrum ,The Thermal Infrared Domain, Characteristics of EM Radiation in the Thermal Infrared, Thermal Properties of Vegetation, Soils in the Thermal Domain, Thermal Signature of Water and Snow, The Microwave Region ,Characteristics of Electromagnetic Radiation in the, Atmospheric Interactions Atmospheric Absorption, Atmospheric Scattering, Atmospheric Emission	
UNIT - III	**08 Hours**
SENSORS AND REMOTE SENSING SATELLITES: Resolution of a Sensor System and types, Passive and active sensors: Photographic Cameras, Across-Track Scanners,Along-Track (Push-Broom) Scanners, Video Cameras, Microwave Radiometers, RADAR, LIDAR Satellite remote sensing mission: The Landsat Program, The SPOT Satellites	
UNIT - IV	**08 Hours**
BASIS FOR ANALYZING EO SATELLITE IMAGES: Constraints in Using Remote Sensing Data, Costs of Data Acquisition, End-User Requirements, Types of Interpretation, Thematic Classification, Generation of Biophysical Variables , Change Detection, Spatial Patterns, Organization of Remote Sensing Project, Description of Objectives, Scale and Resolution, Classification Typology, Selection of Imagery, Image Formats and Media.	
UNIT - V	**08 Hours**
VISUAL ANALYSIS OF SATELLITE IMAGES: Characteristics of Photographic Images, Feature Identification, Criteria for Visual Interpretation, Brightness, Color, Texture, Spatial Context, Shape and Size, Shadow, Spatial Pattern,Period of Acquisition, Elements of Visual Analysis, Geometric Characteristics of a Satellite Image, Effect of Spatial and spectral Resolution in Visual Analysis, Effect of Spectral Resolution in Visual Analysis, Structure of a Digital Image, Media and Data Organization, Data Storage, Image File Formats, Digital Image Processing Systems, General File Operations: File Management, Display Utilities, Image Statistics and Histograms	

Course Outcome	Description	Bloom's Taxonomy Level
At the end of the course the student will be able to:		
1	Illustrate satellite launching procedure by understanding orbital laws and parameters.	L3
2	Apply physical principles of energy transmission and image acquisition; optical, thermal, and microwave radiant energy interactions on the Earth's surface to aid remote sensing.	L3
3	Employ principal characteristics of sensors to understand Satellite observation systems	L3
4	Analyze earth observation satellite images by considering the constraint in remote sensing.	L4
5	Implement image processing on the satellite image by performing acquisition, feature identification, organization.	L3

Table: Mapping Levels of COs to POs / PSOs

Cos	Program Outcomes (POs)												PSOs		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	3	3	-	3	-	3	3	2	-	-	-	3	2	-	-
CO2	3	2	1	1	-	-	3	2	-	-	-	3	2	-	-
CO3	3	2	2	2	-	-	-	21	-	-	-	-	2	2	3
CO4	3	2	2	1	1	-	-	2	2	-	3	-	2	2	-
CO5	3	2	2	2	3	-	-	-	-	-	3	-	2	2	3

3: Substantial (High) 2: Moderate (Medium) 1: Poor (Low)

TEXT BOOKS:

1. Dennis Roddy, 'Satellite Communication', McGraw Hill International, 4th Edition, 2006.
2. Emilio Chuvieco ,Fundamentals of Satellite Remote Sensing, An Environmental Approach , Taylor and Francis, Third Edition

REFERENCE BOOKS:

1. Satellite Communications- Timothy Pratt, Charles Bostian and Jeremy Allnutt, WSE, Wiley Publications, 2nd Edition, 2003, John Wiley & Sons.
2. Satellite Communication Engineering- Wilbur L. Pritchand, Robert A Nelson and Henri G.Suyderhoud, 2nd Edition, Pearson Publications.

E-Resources:

1. **Coursera course: Introduction to Satellite communication - https://www.coursera.org/learn/satellite-communications**
2. Swayam course: Global Navigation Satellite Systems and Applications **https://onlinecourses.nptel.ac.in/noc21_ce77/preview**
3. **NPTEL videos: https://www.youtube.com/watch?v=dt4Ce8gQPns&list=PLAnjLC20C-XQnoowCtt-67WmyxoQPu2Fi**

Activity Based Learning (Suggested Activities in Class)

1. Handson experience on BHUVAN website of ISRO

Dayananda Sagar University
School of Engineering
Devarakaggalahalli , Harohalli , Kanakapura Road , Ramanagar District- 562112

DEPARTMENT OF ELECTRONICS AND COMMUNICATION ENGINEERING

INFORMATION THEORY & ERROR CONTROL CODING

[As per Choice Based Credit System (CBCS) scheme]

SEMESTER VI

Course Code	:		Credits	:	03
Hours / Week	:	03 Hours	Total Hours	:	39 Hours
L T P	:	3 0 0			

CourseLearningObjectives:

This Course will enable students to:

1. Understand the principles of various types of control systems, to derive transfer function and state space models of various physical systems.
2. Analyse the behavior of a control system in time and frequency domains.
3. Familiarizing different compensation methods in time/frequency domain.
4. Analyse the stability of a control system using time and frequency domain.

Teaching-Learning Process (General Instructions)

These are sample new pedagogical methods, where teacher can use to accelerate the attainment of the various course outcomes.

1. Lecture method means it includes not only traditional lecture method, but also different type of teaching methods may be adopted to develop the course outcomes.
2. Interactive Teaching: Adopt the Active learning that includes brainstorming, discussing, group work, focused listening, formulating questions, notetaking, annotating, and roleplaying.
3. Show Video/animation films to explain functioning of various concepts.
4. Encourage Collaborative (Group Learning) Learning in the class.
5. To make Critical thinking, ask at least three Higher order Thinking questions in the class.
6. Adopt Problem Based Learning analytical thinkingskillssuchastheabilitytoevaluate, generalize, andanalyzeinformationrather than simply recallit.
7. Show the different ways to solve the same problem and encourage the students to come up with their own creative ways to solve them.
8. Discuss how every concept can be applied to the real world - and when that's possible,it helps improve the students' understanding

Dayananda Sagar University

School of Engineering

Devarakaggalahalli , Harohalli , Kanakapura Road , Ramanagar District- 562112

DEPARTMENT OF ELECTRONICS AND COMMUNICATION ENGINEERING

UNIT I	08 Hours
INFORMATION THEORY: Introduction, Measure of information, Average information content of symbols in long independent sequences, Average information content of symbols in long dependent sequences. Mark-off statistical model for information source, Entropy and information rate of mark-off source	
UNIT II	**08 Hours**
SOURCE CODING: Encoding of the source output, properties of codes, Kraft inequality, construction of instantaneous codes, code efficiency and redundancy, Shannon's encoding algorithm, Shannon-Fano Coding, Huffman minimum redundancy code, Extended Huffman coding, Arithmetic Coding	
UNIT III	**08 Hours**
INFORMATION CHANNELS: Communication Channels: Channel Models, Channel Matrix, Joint probability Matrix, System Entropies, Mutual Information, Properties of Mutual information, Channel Capacity, Special Channels, Channel Capacity of: Binary Symmetric Channel, Binary Erasure Channel, Muroga,s Theorem, Continuous Channels: Maximization of entropy Mutual information of continuous noisy channels, Shannon-Hartley law and its implications Joint and Conditional Entropies, Shannon Limit.	
UNIT IV	**08 Hours**
ERROR CONTROL CODING: Introduction, Examples of error control coding, Methods of controlling errors, types of codes, types of errors, Linear block codes matrix description of, minimum distance consideration Error detection and correction capabilities, single error correcting Block codes, single error correcting Hamming codes Table lookup for decoding using Standard array.	
UNIT V	**07 Hours**
TYPES OF CODING: Binary cyclic code's Algebraic structure of cyclic codes Encoding using (n-k) bit shift register Syndrome calculation, Error detection and correction Convolution Codes, Time domain approach. Transform domain approach, State Diagram, tree diagram, Trellis diagram. Encoders and Decoders using Viterbi's algorithm for (n,k,l) convolutional codes	

Dayananda Sagar University
School of Engineering
Devarakaggalahalli , Harohalli , Kanakapura Road , Ramanagar District- 562112

DEPARTMENT OF ELECTRONICS AND COMMUNICATION ENGINEERING

Course Outcome	Description	**Bloom's** Taxonomy Level
At the end of the course the student will be able to:		
1	**Comprehensive Understanding of Information Theory**: Students will grasp fundamental concepts like entropy and information rates for different sources.	L2
2	**Proficiency in Source Coding**: They'll learn techniques like Huffman and Arithmetic coding, constructing efficient codes	L4
3	**Knowledge of Information Channels**: Students will understand communication channels, capacities, and mutual information calculations for various scenarios	L5
4	**Expertise in Error Control Coding**: They'll gain skills in error detection, correction, and decoding techniques for different types of codes including cyclic and convolutional codes.	L3
5	**Application Skills**: Students will be able to apply coding techniques effectively in practical scenarios, developing problem-solving abilities and critical analysis skills.	L4

Table: Mapping Levelsof COstoPOs/ PSOs

Cos	Program Outcomes (POs)												PSOs		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	
CO1	3	2	1	1	-	-	-	-	-	-	-	-	1	-	
CO2	3	2	1	1	-	-	-	-	-	-	-	1	1	-	
CO3	3	2	2	2	1	1	-	-	-	-	-	1	1	1	
CO4	3	2	2	1	1	1	-	-	1	-	-	1	1	1	
CO5	3	2	2	2	-	1	-	-	-	-	-	1	1	1	

3: Substantial (High) 2: Moderate (Medium) 1: Poor (Low)

TEXT BOOKS:

1. Digital and analog communication systems, K.SamShanmugam, John Wiley India Pvt. Ltd,20011. 4.
2. Digital Communication, Simon Haykin, John Wiley India Pvt. Ltd,2012. 5.
3. Information Theory and Coding, Muralidhar Kulkarni, K.S. Shivaprakash, Wiley India Pvt. Ltd, 2015, ISBN:978-81-265- 5305-1

REFERENCE BOOKS:

1. ITC and Cryptography, Ranjan Bose, TMH, 2 ndedition,2012
2. Digital Communications - Glover and Grant; Pearson Ed. 2nd edition2010.
3. Digital Communications: Fundamentals & Applications, 2nd edition, Sklar, Pearson Education India.
4. Error Control Coding-Fundamentals & Applications, Shulin, Daniel J. Costello, 2ndEdition, Prentice Hall Inc. Eagle wood Cliffs

E-Resources:

1. https://nptel.ac.in/courses/117101053
2. https://nptel.ac.in/courses/108102117

Activity Based Learning(Suggested ActivitiesinClass)

1. Stability analysis in time and frequency using MATLAB

Dayananda Sagar University

School of Engineering

Devarakaggalahalli , Harohalli , Kanakapura Road , Ramanagar District- 562112

DEPARTMENT OF ELECTRONICS AND COMMUNICATION ENGINEERING

Digital Speech Processing

[As per Choice Based Credit System (CBCS) scheme]

SEMESTER – VI

Subject Code	:		**Credits**	:	03
Hours / Week	:	03 Hours	**Total Hours**	:	39 Hours
L–T–P–S	:	3–0–0–0			

Course Learning Objectives:

This Course will enable students to:

1. To understand the fundamentals of digital speech processing and production of speech.
2. To analyze time domain models for speech signals and to analyze speech signals in frequency domain.
3. To analyze linear predictive coding techniques.
4. To illustrate the homomorphic speech processing.
5. To analyze the speech enhancement techniques and application of speech signal processing.

Teaching-Learning Process (General Instructions)

These are sample new pedagogical methods, where teacher can use to accelerate the attainment of the various course outcomes.

1. Lecture method means it includes not only traditional lecture method, but also different type of teaching methods may be adopted to develop the course outcomes.
2. Interactive Teaching: Adopt the Active learning that includes brainstorming, discussing, group work, focused listening, formulating questions, notetaking, annotating, and roleplaying.
3. Show Video/animation films to explain functioning of various concepts.
4. Encourage Collaborative (Group Learning) Learning in the class.
5. To make Critical thinking, ask at least three Higher order Thinking questions in the class.
6. Adopt Problem Based Learning analytical thinkingskillssuch as theabilitytoevaluate, generalize, andanalyzeinformationrather than simply recallit.
7. Show the different ways to solve the same problem and encourage the students to come up with their own creative ways to solve them.
8. Discuss how every concept can be applied to the real world - and when that's possible,it helps improve the students' understanding

Dayananda Sagar University

School of Engineering

Devarakaggalahalli , Harohalli , Kanakapura Road , Ramanagar District- 562112

DEPARTMENT OF ELECTRONICS AND COMMUNICATION ENGINEERING

UNIT - I	08 Hours
Fundamentals of Digital Speech Processing: Anatomy and Physiology of Speech Organs, The process of Speech Production, Acoustic Phonetics, Articulatory Phonetics, The Acoustic Theory of Speech Production- Uniform lossless tube model, effect of losses in vocal tract, effect of radiation at lips, Digital models for speech signals. **Textbook 1 – Chapter 3 (Section 3, 3.1, 3.2,3.3,3.4)**	
UNIT - II	**08 Hours**
Short-Time Analysis of Speech: Short-Time Analysis of Speech, Short-Time Energy and Zero-Crossing Rate, Short-Time Autocorrelation Function (STACF), Short-Time Fourier Transform (STFT), Sampling the STFT in Time and Frequency, The Speech Spectrogram, Relation of STFT to STACF, Short-Time Fourier Synthesis. **Textbook 1 – Chapter 4 (Sections 4.1, 4.2, 4.6) and Textbook 1 – Chapter 6 (Section 6.1)**	
UNIT - III	**08 Hours**
Linear Predictive Coding (LPC) Analysis: Basic principles of Linear Predictive Analysis: The Autocorrelation Method, The Covariance Method, Solution of LPC Equations: Cholesky Decomposition Solution for Covariance Method, Durbin's Recursive Solution for the Autocorrelation Equations, Comparison between the Methods of Solution of the LPC Analysis Equations, Applications of LPC Parameters: Pitch Detection using LPC Parameters, Formant Analysis using LPC Parameters. **Textbook 1- Chapter 8 (8.1,8.3,8.3.1,8.3.2, 8.4, 8.10.1,8.10.2)**	
UNIT - IV	**08 Hours**
Homomorphic Speech Processing: Introduction, Homomorphic Systems for Convolution: Properties of the Complex Cepstrum, Computational Considerations, The Complex Cepstrum of Speech, Pitch Detection, Formant Estimation, The Homomorphic Vocoder. **Textbook 1- Chapter 7 (Sections 7.1,7.2,7.3,7.4.7.5)**	
UNIT - V	**07 Hours**
Speech Enhancement: Nature of interfering sounds, Speech enhancement techniques: Single Microphone Approach: spectral subtraction, Enhancement by re-synthesis, Comb filter, Wiener filter, Multi microphone Approach. **Applications of Speech Processing:** Speech recognition systems, Text-to-Speech system and Speaker recognition systems: speaker verification systems, speaker identification systems. **Textbook 2- Chapter 8 (Sections 8.1,8.2,8.3,8.4,8.5,8.6,8.7)** **Reference Book 1- Chapter 9, Chapter 8, Reference Book 2- Chapter 14**	

Dayananda Sagar University
School of Engineering
Devarakaggalahalli , Harohalli , Kanakapura Road , Ramanagar District- 562112

DEPARTMENT OF ELECTRONICS AND COMMUNICATION ENGINEERING

Course Outcome	Description	Bloom's Taxonomy Level
At the end of the course the student will be able to:		
1	**Explain** the fundamental concepts of production of speech signal and digital speech signal processing.	Understanding L2
2	**Apply** short time Fourier transform (STFT) and short time autocorrelation function (STAF) to analyze speech signals.	Applying L3
3	**Analyze** the digital speech signals by applying linear predictive coding (LPC) technique or homomorphic speech processing techniques.	Analyze L4
4	**Apply** speech enhancement techniques like spectral subtraction, filtering techniques etc. to improve the quality of speech signal.	Applying L3
5	Given a speech signal, **develop** a software program using Python or Matlab to acquire, analyze, and to enhance it.	Create L5

Table: Mapping Levels of COs to POs / PSOs

COs	Program Outcomes (POs)												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	2	1	1	1	-	-	-	-	1	-	1	-	3	2
CO2	3	1	1	1	1	-	-	-	1	-	1	-	3	2
CO3	1	3	1	1	1	-	-	-	1	-	1	-	3	2
CO4	3	1	1	1	1			-	2	1	1	-	3	2
CO5	2	2	3	2	3			1	2	2	2	-	3	2

3: Substantial (High) **2: Moderate (Medium)** **1: Poor (Low)**

TEXT BOOKS:

1. L.R. Rabiner and S. W. Schafer, Digital Processing of Speech Signals, Pearson Education, 2008.
2. Human & Machine, Douglas O'Shaughnessy, Speech Communications, 2nd Edition., Wiley India, 2000.

REFERENCE TEXT BOOKS

1. Lawrence R. Rabiner and Ronald W. Schafer, "Introduction to Digital Speech Processing", Foundations and Trends® in Signal Processing 1:1-2 (2007)
2. Thomas F Quatieri, "Discrete-Time Speech Signal Processing – Principles and Practice", Pearson Education.
3. Lawrence R. Rabiner and Biing Hwang Juang, "Fundamentals of Speech Recognition", Prentice Hall; 1st edition (1 May 1993)
4. Vinay K. Ingle John G. Proakis, Digital Signal Processing Using MATLAB® Third Edition, CENGAGE Learning

E-Resources:

1. Digital Speech Processing - Course (nptel.ac.in)

Activity Based Learning (Suggested Activities in Class)

1. Speech Processing Simulation Software: MATLAB
2. Peer Teaching and Collaborative Learning

Dayananda Sagar University

School of Engineering

Devarakaggalahalli , Harohalli , Kanakapura Road , Ramanagar District- 562112

DEPARTMENT OF ELECTRONICS AND COMMUNICATION ENGINEERING

DIGITAL IC DESIGN

[As per Choice Based Credit System (CBCS) scheme]

SEMESTER VI

Course Code	:	Credits	: 04
Hours / Week : 3 Hours		Total Hours	: 39 Hours
L T P	: 3-0-2		
Pre-requisite	: Digital Logic Design		

CourseLearningObjectives:

This Course will enable students to:

1. To understand the basic concepts of digital IC design.
2. To understand different implementation strategies of ICs.
3. To understand the concept of different fast adders and their performances
4. To understand the concept of different fast multipliers and their performances
5. To analyze different kinds of timing issues that occur in digital ICs.
6. To know different techniques for memory design and their performances.

Teaching-Learning Process (General Instructions)

These are sample new pedagogical methods, where teacher can use to accelerate the attainment of the various course outcomes.

1. Lecture method means it includes not only traditional lecture method, but also different type of teaching methods may be adopted to develop the course outcomes.
2. Interactive Teaching: Adopt the Active learning that includes brainstorming, discussing, group work, focused listening, formulating questions, notetaking, annotating, and roleplaying.
3. Show Video/animation films to explain functioning of various concepts.
4. Encourage Collaborative (Group Learning) Learning in the class.
5. To make Critical thinking, ask at least three Higher order Thinking questions in the class.
6. Adopt Problem Based Learning analytical thinking skills such as the ability to evaluate, generalize, andanalyzeinformationrather than simply recallit.
7. Show the different ways to solve the same problem and encourage the students to come up with their own creative ways to solve them.
8. Discuss how every concept can be applied to the real world - and when that's possible,it helps improve the students' understanding.

UNIT-I	07 Hours
Implementation Strategies For Digital ICs: Introduction, From Custom to Semi custom and Structured Array Design Approaches, Custom Circuit Design, Cell-Based Design, Methodology Standard Cell, Compiled Cells, Macrocells, Megacells and Intellectual Property, Semi-Custom Design Flow, Array-Based Implementation Approaches, Pre-diffused (or Mask-Programmable) Arrays, Pre-wired Arrays.	
UNIT-II	**08 Hours**
Timing Issues In Digital Circuits Introduction, Timing Classification of Digital Systems, Synchronous Interconnect, Mesochronous interconnect, Plesiochronous Interconnect, Asynchronous Interconnect, Synchronous Design An In-depth Perspective, Synchronous Timing Basics Sources of Skew and Jitter, Clock-Distribution Techniques, Latch-Based Clocking, Self-Timed Circuit Design, Self-Timed Logic - An Asynchronous Technique , Completion-Signal Generation, Self-Timed Signaling, Practical Examples of Self-Timed Logic, Synchronizers and Arbiters, Synchronizers Concept and Implementation, Arbiters, Metastability.	
UNIT-III	**08 Hours**
Design of Fast Adders: Introduction, Data-paths in Digital Processor Architectures, Analysis of Ripple carry adders, carry look-ahead, conditional sum adder, prefix adders: Brent-kung and Kogge-stone adder, carry select adders, carry skip adders, carry-save adders, Barrel Shifter, Logarithmic Shifter.	
UNIT-IV	**08 Hours**
Design of Fast Multipliers Array multiplier design, Fast multipliers: Reducing partial products, Booth's multiplier, implementing bigger multipliers using smaller ones, accumulation of partial products using carry save adders, 4:2 compressor implementation, Wallace tree multipliers, Balance tree multiplier.	
UNIT-V	**08 Hours**
Designing Memory and Array Structures Introduction, Memory Classification, Memory Architectures and Building Blocks, The Memory Core, Read-Only Memories, Nonvolatile, Read-Write Memories, Read-Write Memories (RAM), Contents-Addressable or Associative Memory (CAM), Memory Peripheral Circuitry, The Address Decoders, Sense Amplifiers, Voltage References Drivers/Buffers, Timing and Control, Memory Reliability and Yield, Signal-To-Noise Ratio, Memory yield.	

Dayananda Sagar University
School of Engineering
Devarakaggalahalli , Harohalli , Kanakapura Road , Ramanagar District- 562112

DEPARTMENT OF ELECTRONICS AND COMMUNICATION ENGINEERING

COURSE OUTCOMES:

CO No.	Outcomes	Bloom's Taxonomy Level
CO1	**Explain** basic implementation strategies for digital ICs.	**L3**
CO2	**Investigate** different timing issues that occur in digital ICs and find solutions to mitigate them.	**L4**
CO3	**Analyze** the performance of fast adders and multipliers and compare their design performance.	**L3**
CO4	**Analyze** the techniques to design different types of memory and array structures and **compare** their performances.	**L5**
CO5	Given all the specifications, **design** a digital IC by applying any EDA tool and find its design performance.	**L3**

Table: Mapping Levelsof COstoPOs/ PSOs

Cos	Program Outcomes (POs)												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	**1**	**1**	**1**	**-**	**-**	**-**	**-**	**-**	**1**	**-**	**1**	**-**	**1**	**2**
CO2	**2**	**2**	**2**	**1**	**2**	**-**	**-**	**-**	**1**	**-**	**1**	**2**	**1**	**3**
CO3	**2**	**2**	**2**	**1**	**2**	**-**	**-**	**-**	**1**	**-**	**1**	**2**	**1**	**3**
CO4	**2**	**1**	**1**	**1**	**2**	**-**	**-**	**-**	**1**	**1**	**1**	**-**	**1**	**3**
CO5	**2**	**3**	**3**	**2**	**3**	**-**	**-**	**1**	**2**	**2**	**2**	**2**	**2**	**3**

Strength of CO Mapping to POs:

1: Slight (Low), 2: Moderate (Medium), 3: Substantial (High)

TEXT BOOKS:

1. Jan M Rabaey, Digital Integrated Circuites – A design perspective',
2. Israel Koren, Computer arithmetic algorithms, 2nd Edition, A K Peters, Natick, Massachusetts

REFERENCE TEXT BOOKS:

1. Neil H.E. Weste, David Money Harris, Ayan Banerjee CMOS VLSI Design: A Circuits and Systems Perspective.

Dayananda Sagar University

School of Engineering

Devarakaggalahalli , Harohalli , Kanakapura Road , Ramanagar District- 562112

DEPARTMENT OF ELECTRONICS AND COMMUNICATION ENGINEERING

NPTEL LECTURE LINKS:

1. NPTEL
2. NPTEL :: Electrical Engineering - NOC:Digital IC Design

Dayananda Sagar University
School of Engineering
Devarakaggalahalli , Harohalli , Kanakapura Road , Ramanagar District- 562112

DEPARTMENT OF ELECTRONICS AND COMMUNICATION ENGINEERING

DESIGN PATTERNS FOR EMBEDDED SYSTEMS

[As per Choice Based Credit System (CBCS) scheme]

SEMESTER – VI

Subject Code	:		**Credits**	:	03
Hours / Week	:	03 Hours	**Total Hours**	:	39 Hours
L–T–P	:	3–0–0			

Course Learning Objectives:

This Course will enable students to:

1. **Identify** and recall common design patterns used in embedded systems.
2. **Explain** the principles behind each design pattern and how they apply to embedded systems.
3. **Implement** different design patterns in practical embedded system scenarios.
4. **Evaluate** the trade-offs involved in choosing one design pattern over another in embedded system development.
5. **Design** and **develop** novel embedded systems solutions using a combination of design patterns.

Teaching-Learning Process (General Instructions)

These are sample new pedagogical methods, where teacher can use to accelerate the attainment of the various course outcomes.

1. **Cross-Disciplinary Collaboration:**
   Facilitate collaboration between students from different disciplines, such as computer science, electrical engineering, and mechanical engineering, to work on embedded systems projects together. This interdisciplinary approach encourages diverse perspectives and skillsets.
2. **Interactive Whiteboard Sessions:**
   Conduct interactive whiteboard sessions where students collectively solve problems related to embedded systems design patterns. This dynamic approach allows for visual representation and encourages active participation.
3. **Live Coding Demos:**
   Demonstrate the implementation of design patterns in real-time through live coding sessions. Students can follow along, ask questions, and interact with the instructor, promoting active learning and immediate feedback.
4. **Real-Time Data Analysis Projects:**
   Assign projects that involve real-time data analysis in embedded systems, such as sensor data processing or signal processing. Students apply design patterns to optimize system performance and responsiveness.
5. **Collaborative Documentation Projects:**
   Task students with collaboratively creating documentation or tutorials on different design patterns in embedded systems. This project-based approach reinforces understanding while also producing valuable resources for future learners.
6. **Field Trips to Embedded Systems Facilities:**
   Organize field trips to companies or research facilities specializing in embedded systems development. Students observe first-hand how design patterns are applied in professional settings and engage in discussions with industry professionals.

7. **Multimedia Case Studies:**
   Develop multimedia case studies that combine text, images, videos, and interactive elements to explore real-world applications of design patterns in embedded systems. This multimedia approach caters to diverse learning styles.

8. **Peer Review Workshops:**
   Conduct peer review workshops where students provide feedback on each other's design pattern implementations. This promotes critical thinking, communication skills, and a deeper understanding of design principles.
9. **Embedded Systems Hackathons:**
   Host hackathons specifically focused on embedded systems development, where students collaborate to solve challenges using design patterns. Mentors can provide guidance and support throughout the event.
10. **Design Pattern Mapping Exercises:**
    Engage students in mapping design patterns to specific embedded systems architectures or use cases. This activity encourages critical thinking and helps students understand the applicability of different patterns in various contexts.
11. **Storyboarding Sessions:**
    Facilitate storyboard sessions where students visually depict the application of design patterns in the context of real-world scenarios. Storyboarding helps students think through system interactions and design decisions before implementation.

UNIT – I	**08 Hours**
INTRODUCTION Embedded Programming (Object Oriented V/S Structured Programming) – Design Pattern Introduction (Overview of Development Workflow) – Basic Structure Of Embedded System – Design Patterns In Development	
	08 Hours
DESIGN PATTERNS FOR ACCESSING HARDWARE Basic Hardware Access Concepts - Hardware Proxy Pattern - Hardware Adapter Pattern - Mediator Pattern - Observer Pattern - Debouncing Pattern - Interrupt Pattern - Polling Pattern	
UNIT – III	**08 Hours**
DESIGN PATTERNS FOR EMBEDDING CONCURRENCY AND RESOURCE MANAGEMENT Basic Concurrency Concepts - Cyclic Executive Pattern - Static Priority Pattern - Critical Region Pattern - Guarded Call Pattern - Queuing Pattern - Rendezvous Pattern - Simultaneous Locking Pattern - Ordered Locking	
UNIT – IV	**08 Hours**
DESIGN PATTERNS FOR STATE MACHINES Basic State Machine Concepts - Single Event Receptor Pattern - Multiple Event Receptor Pattern - State Table Pattern - State Pattern -Decomposed AND-State Pattern -	
UNIT – V	**07 Hours**
SAFETY AND RELIABILITY PATTERNS Basics About Safety and Reliability - One's Complement Pattern - CRC Pattern - Smart Data Pattern - Channel Pattern - Protected Single Channel Pattern - Dual Channel Pattern	

Course Outcome	Description	Bloom's Taxonomy Level
At the end of the course, the student will be able to:		
CO1	Apply the knowledge of object-oriented programming and structured programming for developing embedded systems.	L3
CO2	Analyze and apply appropriate design patterns for accessing hardware for embedded system development.	L4
CO3	Design embedded systems with concurrency and resource management capability.	L6
CO4	Examine and experiment with the design patterns using simulation software and development boards.	L4
CO5	Evaluate design approaches, and optimize system performance and reliability using safety and reliability patterns.	L5

Table: Mapping Levels of COs to POs / PSOs

COs	Program Outcomes (POs)												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	3	2		1				3				3	3	
CO2	3	3	3	1				3		2		3	3	
CO3	3	2	3					3		2		3	3	
CO4	3	2	3	1	3			3		2		3	3	3
CO5	3	2	3	1	3			3		2		3	3	

3: Substantial (High) **2: Moderate (Medium)** **1: Poor (Low)**

TEXT BOOKS:

1. Bruce Powel Douglass, "Design Patterns for Embedded Systems in C: An Embedded Software Engineering Toolkit", 1st Edition, Newnes, 2011.
2. Arnold Berger, Embedded systems design: an introduction to processes, tools, and techniques. CRC Press, 2001.
3. Michael J Pont, Patterns for Time-Triggered Embedded Systems: Building reliable applications with the 8051 family of microcontrollers,

REFERENCE BOOKS:

1. Erich Gamma, Richard Helm, Ralph Johnson, and John Vlissides, "Design Patterns: Elements of Reusable Object-Oriented Software", Pearson Deutschland GmbH, 1995.
2. Frank Buschmann, Regine Meunier, Hans Rohnert, Peter Sommerlad, and Michael Stal, "Pattern-Oriented Software Architecture: A System of Patterns", COOTS 96, 1996.

E-Resources:

1. **Udemy - Embedded C Programming Design Patterns :**
   In this Couse Students will get an understanding about
   a. **Clean and maintainable:** design patterns help us write clean, robust and maintainable code.
   b. **Enhanced code reuse:** patterns help you decouple dependencies and keep your code organized.
   c. **Being proactive about bug prevention:** design patterns give clear expectations and enable us to review and reason about large quantities of code more easily.
   d. **Removes ambiguity:** using the same patterns consistently removes ambiguity about code structure and behaviour.
   e. **Essential for effective DevOps:** code that applies well known and understandable patterns is easy to review.
   f. **Make details fall into place:** design patterns help organize the code and make small implementation details fall into place more easily.

Activity Based Learning (Suggested Activities in Class)

1. **Pattern Identification Exercise:**

   Provide students with code snippets or diagrams representing different embedded systems scenarios. Ask them to identify which design patterns are being used and justify their choices. This exercise enhances pattern recognition skills and understanding of pattern applicability.

2. **Pattern Implementation Projects:**

   Assign projects where students design and implement embedded systems solutions using specific design patterns. For example, students could develop a traffic light controller using the State pattern or implement a communication protocol using the Observer pattern. This allows students to apply design patterns in real-world scenarios and gain practical experience.

3. **Pattern Refactoring Workshop:**

   Present students with existing embedded systems code that could benefit from refactoring to incorporate design patterns. In small groups, students analyze the code, identify areas for improvement, and refactor the code to use appropriate design patterns. This exercise reinforces understanding of design principles and encourages critical thinking.

4. **Pattern Simulation Activities:**

   Use simulation software or development boards to create interactive activities where students can experiment with different design patterns in embedded systems. For example, students could simulate the behavior of a sensor network using the Observer pattern or implement task scheduling using the Strategy pattern. This allows for exploration and experimentation in a controlled environment.

5. **Pattern Comparison Discussions:**

   Facilitate group discussions where students compare and contrast different design patterns in terms of their strengths, weaknesses, and suitability for various embedded systems scenarios. Encourage students to analyze trade-offs and make informed decisions about pattern selection. This activity promotes critical thinking and deeper understanding of design pattern principles.

6. **Pattern Documentation Analysis:**

   Provide students with documentation or case studies of embedded systems projects that utilize design patterns. In small groups, students analyze the documentation to identify which design patterns were used, how they were implemented, and the impact on the overall system design. This exercise reinforces understanding of pattern application in real-world contexts.

7. **Pattern Design Challenges:**

   Present students with design challenges or constraints and ask them to devise solutions using design patterns. For example, students could be tasked with designing a power management system for a battery-operated device using the Strategy pattern to support different power-saving modes. This encourages creativity and problem-solving skills.

8. **Pattern Role-Playing Scenarios:**

   Create role-playing scenarios where students take on different roles within an embedded systems development team. Each role requires applying specific design patterns to solve challenges, such as the Architect selecting appropriate patterns and the Developer implementing them. This activity fosters collaboration and teamwork while reinforcing pattern application skills.

9. **Pattern Presentation and Demonstration:**

   Have students research a specific design pattern used in embedded systems and prepare a presentation or demonstration for the class. They should explain the purpose of the pattern, its implementation details, and provide examples of its usage in real-world applications. This encourages independent learning and knowledge sharing among peers.

10. **Pattern Case Study Projects:**

    Assign case study projects where students analyze real-world embedded systems applications and identify the design patterns used. They should then evaluate the effectiveness of these patterns in addressing system requirements and constraints. This promotes critical analysis and application of theoretical concepts to practical scenarios.

These activity-based learning approaches engage students actively in the learning process, fostering deeper understanding and retention of design patterns for embedded systems. By combining theoretical knowledge with hands-on experience, students develop practical skills that are essential for success in embedded systems development.

Dayananda Sagar University

School of Engineering

Devarakaggalahalli , Harohalli , Kanakapura Road , Ramanagar District- 562112

DEPARTMENT OF ELECTRONICS AND COMMUNICATION ENGINEERING

INDUSTRIAL INSTRUMENTATION

[As per Choice Based Credit System (CBCS) scheme]

SEMESTER VI

Course Code	:		Credits	:	03
Hours / Week	:	03 Hours	Total Hours	:	39 Hours
L T P	:	3 0 0			

Course Learning Objectives:

This Course will enable students to:

1. To understand the fundamentals of industrial instrumentation.
2. To learn about various sensors and transducers used in industry.
3. To study signal conditioning techniques.
4. To explore data acquisition systems and their applications.
5. To understand the control systems and their role in instrumentation

Teaching-Learning Process (General Instructions)

These are sample new pedagogical methods, where teacher can use to accelerate the attainment of the various course outcomes.

1. Lecture method means it includes not only traditional lecture method, but also different type of teaching methods may be adopted to develop the course outcomes.
2. Interactive Teaching: Adopt the Active learning that includes brainstorming, discussing, group work, focused listening, formulating questions, notetaking, annotating, and roleplaying.
3. Show Video/animation films to explain functioning of various concepts.
4. Encourage Collaborative (Group Learning) Learning in the class.
5. To make Critical thinking, ask at least three Higher order Thinking questions in the class.
6. Adopt Problem Based Learning analytical thinking skills such as the ability to evaluate, generalize, andanalyzeinformationrather than simply recallit.
7. Show the different ways to solve the same problem and encourage the students to come up with their own creative ways to solve them.
8. Discuss how every concept can be applied to the real world - and when that's possible, it helps improve the students' understanding.

Dayananda Sagar University
School of Engineering
Devarakaggalahalli , Harohalli , Kanakapura Road , Ramanagar District- 562112

DEPARTMENT OF ELECTRONICS AND COMMUNICATION ENGINEERING

UNIT I	07 Hours
Introduction to Industrial Instrumentation Fundamentals of measurement and instrumentation, Standards and calibration Static and dynamic characteristics of instruments, Error analysis	
UNIT II	**08 Hours**
Types of sensors and transducers Displacement, velocity, and acceleration sensors, Temperature, pressure, and flow sensors Level and humidity sensors	
UNIT III	**08 Hours**
Signal Conditioning: Signal conditioning circuits: amplifiers, filters, and converters, Analog-to-digital and digital-to- analog converters, Isolation and protection circuits, Noise reduction techniques	
UNIT IV	**08 Hours**
Data Acquisition Systems Components of data acquisition systems (DAQ), Interfacing sensors with DAQ systems Communication protocols (RS232, RS485, Modbus, etc.), PC-based data acquisition	
UNIT V	**08 Hours**
Control Systems and Applications Fundamentals of control systems, PID controllers and tuning, PLCs and SCADA systems Industrial automation and case studies	

Course Outcome	Description	**Bloom's** Taxonomy Level
At the end of the course the student will be able to:		
1	Understand the fundamental principles of measurement and instrumentation, including various standards, calibration techniques, and error analysis.	L1
2	Identify and select appropriate sensors and transducers for measuring physical quantities like displacement, velocity, temperature, pressure, flow, level, and humidity in industrial applications.	L1, L2
3	Design and implement signal conditioning circuits, including amplifiers, filters, and converters, and apply noise reduction techniques to ensure accurate measurements	L4
4	Develop, interface, and troubleshoot data acquisition systems (DAQ), and understand the various communication protocols used in industrial settings.	L4
5	Apply control system principles, including the use of PID controllers, PLCs, and SCADA systems, to industrial automation scenarios.	L3

Table: Mapping Levels of COs to POs / PSOs

Cos	Program Outcomes (POs)												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	3	2	-	-	-	1	-	-	-	-	-	3	3	2
CO2	3	2	-	-	-	1	-	-	-	-	-	3	3	2
CO3	3	2	-	-	3	1	-	-	-	-	-	3	3	2
CO4	3	2	-	-	-	1	-	-	-	-	-	3	3	2
CO5	3	2	-	-	3	1	-	-	-	-	-	3	3	2

3: Substantial (High) 2: Moderate (Medium) 1: Poor (Low)

TEXT BOOKS:

1. Singh, S.K., 2009. Industrial instrumentation and control. (No Title).
2. Murty, D.V.S., 2010. Transducers and instrumentation. PHI Learning Pvt. Ltd.
3. D Patranabis, 2017 "Principles of Industrial Instrumentation"

REFERENCE BOOKS:

1. S. Mukhopadhyay,2012 "Industrial Instrumentation, Control and Automation"
2. Bentley, J.P., 2005. Principles of measurement systems. Pearson education.

Alternative NPTEL/SWAYAM Course:

S. No.	NPTEL Course Name	Instructor	Host Institute
1	Industrial Instrumentation	Prof. Alok Barua	IIT Kharagpur

Dayananda Sagar University
School of Engineering
Devarakaggalahalli , Harohalli , Kanakapura Road , Ramanagar District- 562112

DEPARTMENT OF ELECTRONICS AND COMMUNICATION ENGINEERING

MEMS

[As per Choice Based Credit System (CBCS) scheme]

SEMESTER VI

Course Code	:		Credits	:	03
Hours / Week	:	03 Hours	Total Hours	:	39 Hours
L T P	:	3 0 0			

Course Learning Objectives:

This Course will enable students to:

1. Understand the definitions, development, and fundamentals of MEMS (Micro-Electro-Mechanical Systems), microfluidics, microelectronics, and microsystems.
2. Acquire knowledge about different materials used in MEMS fabrication, including silicon, gallium arsenide, polymers, and shape memory alloys.
3. To understand various lithography techniques such as photolithography, electron beam lithography, and their role in MEMS fabrication.
4. Students will explore real-world scenarios where integrated and smartsensors play a crucial role.
5. Students will understand how microvalves, micropumps, and micro motorsare integrated into micro actuator systems.
6. Discover the interdisciplinary nature of MEMS technology in multi-disciplinary applications.

Teaching-Learning Process (General Instructions)

These are sample new pedagogical methods, where teacher can use to accelerate the attainment of the various course outcomes.

1. Lecture method means it includes not only traditional lecture method, but different type of teaching methods may be adopted to develop the course outcomes.
2. Interactive Teaching: Adopt the Active learning that includes brainstorming, discussing, group work, focused listening, formulating questions, notetaking, annotating, and roleplaying.
3. Show Video/animation films to explain functioning of various concepts.
4. Encourage Collaborative (Group Learning) Learning in the class.
5. To make Critical thinking, ask at least three Higher order Thinking questions in the class.
6. Adopt Problem Based Learning, which fosters students' Analytical skills, develop thinking skills such as the ability to evaluate, generalize, and analyse information rather than simply recall it.
7. Show the different ways to solve the same problem and encourage the students to come up with their own creative ways to solve them.
8. Discuss how every concept can be applied to the real world - and when that's possible, it helps improve the students' understanding.

Dayananda Sagar University

School of Engineering

Devarakaggalahalli , Harohalli , Kanakapura Road , Ramanagar District- 562112

DEPARTMENT OF ELECTRONICS AND COMMUNICATION ENGINEERING

UNIT-I	07 Hours
FUNDAMENTALS OF MICROFABRICATION Definition - development- fundamentals of MEMS, Micro fluidics, microelectronics, micro systems- design and fabrication, working principles and applications. Integrated circuit processes, potential of MEMS in industry.	
UNIT-II	**07 Hours**
MEMS MATERIALS Materials substrates and wafers, silicon substrate- properties of silicon, silicon compounds, silicon piezo resistors. Galium Arsenide, quartz, polymer for MEMS, conductive polymer. Shape memory alloys.	
UNIT III	**10 Hours**
MEMS FABRICATION TECHNOLOGIES Photolithography, photo resist applications, light sources, X-ray lithography, electron beam lithography, ion implantation, thin film deposition, diffusion process, Chemical and physical vapor deposition, bulk and surface machining, LIGA, DRIE, RIE, laser ablation process, Microsterio lithography for 3D fabrication and nanolithography.	
UNIT IV	**08 Hours**
MICROSENSORS Micro sensors, classification of physical sensors, integrated, intelligent or smart sensors, sensors principle, thermal sensors, electrical sensors, mechanical sensors, chemical and biosensors.	
UNIT V	**07 Hours**
MICROACTUATORS Electromagnetic and thermal microactuation, mechanical design of micro actuators, microactuator, micro valves, micro pumps, micro motors. Microactuator systems: Ink jet printers, micro-mirror TV projectors. Micro-opto-electromechanical systems, multi-disciplinary applications.	

Dayananda Sagar University
School of Engineering
Devarakaggalahalli , Harohalli , Kanakapura Road , Ramanagar District- 562112

DEPARTMENT OF ELECTRONICS AND COMMUNICATION ENGINEERING

Course Outcome	**Description**	**Bloom's** Taxonomy
At the end of the course the student will be able to:		
1	**Demonstrate** comprehensive understanding of MEMS and microsystems fundamentals, including their development, design principles, fabrication processes, and working applications in various industries.	L2
2	**Dissect** the properties of substrate materials to understand their influence on the mechanical and electrical behavior of MEMS devices.	L4
3	**Develop** and **utilize** advanced lithography and etching techniques to create high-resolution microsystems, integrating ion implantation and thin film deposition.	L3
4	**Analyze** and classify physical sensors based on intricate working principles, considering complex phenomena such as noise, non-linearity, and environmental influences.	L3
5	**Distinguish** between different fabrication techniques for microactuators and their influence on deviceperformance and reliability.	L4
6	**Interpret** the interdisciplinary applications of microsensor and microactuators in various fields such as biotechnology, aerospace, automotive, and consumer electronics, assessing their impact and potential advancements.	L5

Table: Mapping Levels of COs to POs/ PSOs

Cos	Program Outcomes (POs)												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	3	2	3	-	3	2	-	-	-	3	-	1	3	2
CO2	3	2	3	-	-	-	3	-	-	3	-	1	3	2
CO3	3	-	3	-	-	-	-	-	2	-	-	1	3	2
CO4	3	3	-	2	-	-	-	-	-	-	-	1	3	2
CO5	3	2	3	-	3	-	-	-	3	-	-	1	3	2
CO6	3	2	-	-	3	3	3	-	1	-	-	1	2	2

3: Substantial (High) 2: Moderate (Medium) 1: Poor (Low)

TEXT BOOKS:

1. Tai-Ran Hsu, MEMS and Microsystems Design and Manufacture, Tata McGraw Hill, New Delhi, 2002.
2. Nitaigour Premchand Mahalik, Micro Electro Mechanical Systems, Tata McGraw Hill, New Delhi, 2007.
3. Mohamed Gad-El-Hak, The Micro Electro Mechanical Systems, Handbook, CRC Press, New York, 2002.

REFERENCES:

1. Kalpakjian, Manufacturing Engineering and Technology, 4'edition, Addison Wesley Congmen Pvt. Ltd., Singapore, 2009.
2. Mark Madou, Fundamentald of Microfabrication, CRC Press, New York, 1997. Maluf.N, An Introduction to Microelectro mechanical Sytems Engineering, Artech House, Boston, 2000.
3. Rai Choudhury, Micro Electro Mechanical Systems and _ Micro-opto-electromechanical systems Technology and Applications, PHI Learning, 2009.

E-Resources:

1. Nptel course: https://onlinecourses.nptel.ac.in/noc22_ee36/preview
2. Nptel course: https://onlinecourses.nptel.ac.in/noc19_ee40/preview

Activity Based Learning (Suggested Activities in Class)

1. MEMS device 2-D layout designing using CAD or Ledit software
2. Case study using MATLAB/Simulink

Dayananda Sagar University
School of Engineering
Devarakaggalahalli , Harohalli , Kanakapura Road , Ramanagar District- 562112

DEPARTMENT OF ELECTRONICS AND COMMUNICATION ENGINEERING

POWER ELECTRONICS

[As per Choice Based Credit System (CBCS) scheme]

SEMESTER VI

Course Code	:	22EC36XX	Credits	:	03
Hours / Week	:	03 Hours	Total Hours	:	39 Hours
L T P	:	3 0 0			

CourseLearningObjectives:

This Course will enable students to:

1. Study the semiconductors devices as switches suitable for power circuits.
2. Select and design the converters for various forms of power conversions.
3. Understand the operations of various motor drives
4. Design and implement the control circuits for various power electronics Applications

Teaching-Learning Process (General Instructions)

These are sample new pedagogical methods, where teacher can use to accelerate the attainment of the various course outcomes.

1. Lecture method means it includes not only traditional lecture method, but also different type of teaching methods may be adopted to develop the course outcomes.
2. Interactive Teaching: Adopt the Active learning that includes brainstorming, discussing, group work, focused listening, formulating questions, notetaking, annotating, and roleplaying.
3. Show Video/animation films to explain functioning of various concepts.
4. Encourage Collaborative (Group Learning) Learning in the class.
5. To make Critical thinking, ask at least three Higher order Thinking questions in the class.
6. Adopt Problem Based Learning analytical thinkingskillssuchastheabilitytoevaluate, generalize, andanalyzeinformationrather than simply recallit.
7. Show the different ways to solve the same problem and encourage the students to come up with their own creative ways to solve them.
8. Discuss how every concept can be applied to the real world - and when that's possible,it helps improve the students' understanding.

Dayananda Sagar University
School of Engineering
Devarakaggalahalli , Harohalli , Kanakapura Road , Ramanagar District- 562112

DEPARTMENT OF ELECTRONICS AND COMMUNICATION ENGINEERING

UNIT - I	06 Hours
INTRODUCTION TO POWER ELECTRONICS: Need for power electronics, power semiconductor devices, Types of power electronic circuits. Power BJTs: construction & switching –characteristics, Power IGBTs: Construction, switching characteristics, latch-up in IGBT, gate and base drive circuits.	
UNIT - II	**08 Hours**
THYRISTORS: Construction, VI characteristics, two transistor model, switching characteristics, di/dt and dv/dt protection, thyristor types, series and parallel operation of thyristors, thyristor firing circuits. COMMUTATION TECHNIQUES: Natural commutation, Forced commutation: self-commutation, impulse commutation, resonant pulse commutation and complementary commutation.	
UNIT - III	**08 Hours**
CONTROLLED RECTIFIERS AND CONTROLLERS: Introduction, Principle of phase- controlled converter, Operation of single-phase semi converters, full converters and dual converters with parameter analysis. Principle of Three phase half wave converter. **AC VOLTAGE CONTROLLERS**: Introduction, principle of ON-OFF and phase control, Operation of single phase, Bi-directional controllers with resistive and inductive loads. Single phase Cyclo converters.	
UNIT - IV	**08 Hours**
DC CHOPPERS: Introduction, principle of step-down operation, step-down chopper with RL loads, Principle of step-up operation, step-up chopper with Resistive load, performance parameters, Chopper classification (Class A to Class E). **DC DRIVES**: Introduction, Basic Characteristics of DC Motors, Operating modes, Single phase Drives. Stepper motor characteristics, Permanent Magnet stepper motors (bipolar and unipolar motor drive sequence), Stepper Motor Drives	
UNIT - V	**09 Hours**
INVERTERS: Introduction, principle of operation, performance parameters, single phase bridge inverters, three phase inverters, voltage control of single-phase inverters, current source inverter, variable DC link inverter. Introduction to Hybrid Electric Vehicles, Basics of Conventional Vehicles.	

Dayananda Sagar University
School of Engineering
Devarakaggalahalli , Harohalli , Kanakapura Road , Ramanagar District- 562112

DEPARTMENT OF ELECTRONICS AND COMMUNICATION ENGINEERING

	Description	Bloom's Taxonomy Level
At the end of the course the student will be able to:		
1	**Compare** the different semiconductors devices and their behaviour as switches and **select** suitably for various power circuits.	**2-Understanding 4-Analyze 5-Evaluate**
2	**Select** and **design** suitable converters for various forms of power conversions.	**1-Remember 4-Analyze**
3	**Analyse** various drive circuits suitable for different motors.	**4-Analyze**
4	**Design** control circuits for power electronics applications like EV applications.	**6-Create**

Table: Mapping Levelsof COstoPOs/ PSOs

Cos	Program Outcomes (POs)												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	**3**	**2**	**2**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**1**	**-**	**3**	**-**
CO2	**3**	**2**	**2**	**2**	**-**	**-**	**-**	**-**	**1**	**-**	**1**	**1**	**3**	**2**
CO3	**3**	**2**	**3**	**2**	**-**	**-**	**2**	**1**	**1**	**-**	**1**	**1**	**3**	**2**
CO4	**3**	**3**	**2**	**3**	**2**	**1**	**2**	**1**	**1**	**1**	**2**	**1**	**3**	**3**

3: **Substantial (High)** **2: Moderate (Medium)** **1: Poor (Low)**

TEXT BOOKS:

1. Power Electronics - M. H. Rashid, Prentice Hall of India Pvt. Ltd., (Pearson (Singapore–Asia)) New Delhi, 2002.
2. Modern Power Electronics – P.C. Sen, 2nd Edition S. Chand, 2000.
3. Mehrdad Ehsani, Yimi Gao, Sebastian E. Gay, Ali Emadi, Modern Electric, Hybrid Electric and Fuel Cell Vehicles: Fundamentals, Theory and Design, CRC Press, 200

REFERENCES:

1. Power Electronics- M. D. Sing and Khanchandani K. B., Tata McGraw Hill Publishing Company Limited, Reprint 2001.
2. Power Electronics - Cyril W. Lander, 3rd Edition, McGraw Hill, 1993.
3. Power Electronics, Converters, Applications and Design – Ned Mohan, Undeland, Riobbins
4. Chris Mi, M. Abul Masrur, David Wenzhong Gao, Hybrid Electric Vehicles: Principles and Applications with Practical Perspectives, John Wiley & Sons Ltd., 2011

E-Resources:

1. https://nptel.ac.in/courses/108105066
2. Power Electronics – Engineering Funda
3. NPTEL :: Electrical Engineering - NOC:Power Electronics
4. Hybrid Car VS Electric Car: Benefits, Working & Types Explained (cars24.com)

Activity Based Learning(Suggested ActivitiesinClass)

- Practically working on finding the characteristics of the given switching devices.
- Study of behaviour of various converters and practically comparing for driving various types of motors.

Dayananda Sagar University
School of Engineering
Devarakaggalahalli , Harohalli , Kanakapura Road , Ramanagar District- 562112

DEPARTMENT OF ELECTRONICS AND COMMUNICATION ENGINEERING

WIRELESS COMMUNICATION

[As per Choice Based Credit System (CBCS) scheme]

SEMESTER VII

Course Code	:		Credits	:	03
Hours / Week	:	03 Hours	Total Hours	:	39 Hours
L T P	:	3 0 0			

CourseLearningObjectives:

This Course will enable students to:

1. Understand the functioning of various wireless communication systems, their revolution and standards.
2. Analyze on cellular communication system, architecture, functioning, various standards
3. Visualize signal propagation in cellular environment
4. Develop skills on multiple access techniques for Wireless Communication
5. Evaluate the functioning of architecture, protocols, capabilities and application of various wireless communication networks.

Teaching-Learning Process (General Instructions)

These are sample new pedagogical methods, where teacher can use to accelerate the attainment of the various course outcomes.

1. Lecture method means it includes not only traditional lecture method, but also different type of teaching methods may be adopted to develop the course outcomes.
2. Interactive Teaching: Adopt the Active learning that includes brainstorming, discussing, group work, focused listening, formulating questions, notetaking, annotating, and roleplaying.
3. Show Video/animation films to explain functioning of various concepts.
4. Encourage Collaborative (Group Learning) Learning in the class.
5. To make Critical thinking, ask at least three Higher order Thinking questions in the class.
6. Adopt Problem Based Learning analytical thinkingskillssuchastheabilitytoevaluate, generalize, andanalyzeinformationrather than simply recallit.
7. Show the different ways to solve the same problem and encourage the students to come up with their own creative ways to solve them.
8. Discuss how every concept can be applied to the real world - and when that's possible,it helps improve the students' understanding.

Dayananda Sagar University
School of Engineering
Devarakaggalahalli , Harohalli , Kanakapura Road , Ramanagar District- 562112

DEPARTMENT OF ELECTRONICS AND COMMUNICATION ENGINEERING

UNIT-I	08 Hours
Evolution of mobile radio communication fundamentals 1G, 2G. 2.5G, 3G and beyond), General Model of Wireless Communication Link, Types of Signals, Cellular Infrastructure, Cellular System Components, Antennas for Cellular Systems, Operation of Cellular Systems, Channel Assignment, Channel Assignment strategies, Handoff Strategies Cellular Interferences, Sectorization; Wireless Channel and Radio Communication, Free Space Propagation Model, Channel Noise and Losses, Fading in Land Mobile Systems, Multipath Fading, Fading Effects on Signal and Frequency, Shadowing ***(Text Book-1: Chapter 1: 1.1 to 2.4.)***	

UNIT-II	08Hours
The cellular fundamentals: cellular communication and frequency reuse, general architecture of a cellular system, channel assignment strategies, hand-off in a cellular system. Interference and cellular system capacity: co-channel interference and adjacent channel interference, power, typical cellular standards (AMPS, GSM, GPRS, WCDMA, LTE, concept of LTE-advanced), 4G features and challenges, 5G vision. ***(Text Book-1: Chapter 3: 3.1 to 3.6)***	

UNIT III	08 Hours
Signal propagation in mobile communication: mobile cellular environment, multipath propagation and fading, free space propagation model, propagation path loss, outdoor propagation models (Okumura model & Hata model), indoor propagation models, power delay profile, channel parameters (delay spread, doppler spread, coherence bandwidth, coherence time). ***(Text Book-1: Chapter 4.1 to 4.11)***	

UNIT IV	08 Hours
Wireless Communication Networks: Wireless Personal Area Networks (Bluetooth, UWB and ZigBee), Wireless Local Area Networks (IEEE 802.11, network architecture, medium access methods, WLAN standards), Wireless Metropolitan Area Networks (WiMAX), Ad-hoc Wireless Networks, ***(Text Book-2: Chapter14)***	

UNIT V	07 Hours
Multiple access schemes: duplexing schemes, FDMA, TDMA, SDMA, spread spectrum technique and CDMA, OFDMA, ALOHA and CSMA. Survey of Cutting-edge technologies on 5G and 6G such as millimeter wave systems ***(Text Book-2: Chapter 9) Pg No 308 to 320***	

Dayananda Sagar University
School of Engineering
Devarakaggalahalli , Harohalli , Kanakapura Road , Ramanagar District- 562112

DEPARTMENT OF ELECTRONICS AND COMMUNICATION ENGINEERING

Course Outcome	Description	Bloom's Taxonomy Level
At the end of the course the student will be able to:		
1	Examine the functions and services of cellular networks.	L3
2	Analyze a wireless cellular system	L3
3	Develop indoor and outdoor prorogation models in mobile communication such as Okumura HATA model.	L4
4	Analyze different wireless standards and Bluetooth communication	L3
5	Analyze multiple access technologies like CDMA, TDMA, FDMA	L3

Table: Mapping Levelsof COstoPOs/ PSOs

Cos	Program Outcomes (POs)												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	**3**	**2**	**2**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**1**	**-**	**3**	**-**
CO2	**3**	**2**	**2**	**2**	**-**	**-**	**-**	**-**	**1**	**-**	**1**	**1**	**3**	**2**
CO3	**3**	**2**	**3**	**2**	**-**	**-**	**2**	**1**	**1**	**-**	**1**	**1**	**3**	**2**
CO4	**3**	**3**	**2**	**3**	**2**	**1**	**2**	**1**	**1**	**1**	**2**	**1**	**3**	**3**
CO5	**3**	**2**	**2**	**3**	**-**	**1**	**2**	**1**	**1**	**1**	**2**	**1**	**3**	**3**

3:Substantial (High) 2: Moderate (Medium) 1: Poor (Low)

TEXT BOOKS:

1. **Wireless Communications: Principles & Practice,** T. S. Rappaport, 2nd Ed., Prentice Hall, 2002
2. **Wireless Communications & Networks**, W. Stallings, 2nd Ed., Prentice-Hall, 2005.

REFERENCE BOOKS:

1. Vijay K Garg, "Wireless Communications and Networks", Morgan Kaufmann Publishers an Imprint of Elsevier, USA 2009 (Indian reprint)
2. J. Schiller, "Mobile Communication" 2/e, Pearson Education, 2012.
3. Iti Saha Misra, "Wireless Communication and Networks : 3G and Beyond", 2/e, McGraw Hill Education (india) Private Ltd, New Delhi, 2013.
4. Wireless Communications by Andrea Goldsmith Cambridge University press

NPTEL LECTURE LINKS:

1. NPTEL :: Electronics & Communication Engineering - Wireless Communication

SCHOOL OF ENGINEERING

DEPARTMENT OF ELECTRONICS AND COMMUNICATION ENGINEERING

PROFESSIONAL ELECTIVE COURSES -IV

Dayananda Sagar University

School of Engineering

Devarakaggalahalli , Harohalli , Kanakapura Road , Ramanagar District- 562112

DEPARTMENT OF ELECTRONICS AND COMMUNICATION ENGINEERING

RADAR AND NAVIGATION

[As per Choice Based Credit System (CBCS) scheme]

SEMESTER – VII

Course Code	:		Credits	: 3
Hours / Week	:	3 Hours	Total Hours	: 39 Hours
L–T–P	:	3–0–0		

Course Learning Objectives:

This Course will enable students to:

1. Develop the knowledge on fundamentals of radar and parameters of general radar equation.
2. Demonstrate the Doppler Effect and the concepts of continuous wave radars, MTI radars and delay line cancellers.
3. Analyze the performance of tracking radar systems.
4. Identify the various navigational aids.

Teaching-Learning Process (General Instructions)

These are sample new pedagogical methods, where teacher can use to accelerate the attainment of the various course outcomes.

1. Lecture method means it includes not only traditional lecture method, but also different type of teaching methods may be adopted to develop the course outcomes.
2. Interactive Teaching: Adopt the Active learning that includes brainstorming, discussing, group work, focused listening, formulating questions, notetaking, annotating, and roleplaying.
3. Show Video/animation films to explain functioning of various concepts.
4. Encourage Collaborative (Group Learning) Learning in the class.
5. To make Critical thinking, ask at least three Higher order Thinking questions in the class.
6. Adopt Problem Based Learning analytical thinkingskillssuchastheabilitytoevaluate, generalize, andanalyzeinformationrather than simply recallit.
7. Show the different ways to solve the same problem and encourage the students to come up with their own creative ways to solve them.
8. Discuss how every concept can be applied to the real world - and when that's possible,it helps improve the students' understanding.

Dayananda Sagar University

School of Engineering

Devarakaggalahalli , Harohalli , Kanakapura Road , Ramanagar District- 562112

DEPARTMENT OF ELECTRONICS AND COMMUNICATION ENGINEERING

UNIT - I	8 Hours
Introduction to RADAR: Simple form of RADAR equation, Radar block Diagram and Operation, Applications of RADAR, The Radar Equation: Prediction of Range Performance, minimum Detectable Signal , Receiver Noise, Probability-density Functions, Signal-to-noise Ratio, Integration of Radar Pulses, Power Pulse Repetition Frequency and Range Ambiguities, Antenna parameters, System Losses, Propagation Effect.	
UNIT - II	**8 Hours**
Types of Radar: CW and Frequency-Modulated Radar, The Doppler Effect, Frequency-modulated CW Radar, Airborne Doppler Navigation, Introduction to MTI RADAR: - delay line cancelers - MTI Signal Processor and pulse doppler RADAR, Range and Doppler Measurement, Block Diagram and Characteristics (Approaching/ Receding Targets) Tracking with RADAR	
UNIT - III	**8 Hours**
Tracking Radar: Tracking with Radar, Sequential Lobing, Conical Scan, Monopulse Tracking Radar, Target-Reflection Characteristics and Angular Accuracy, Tracking in Range, Acquisition, Comparison of Trackers, Tracking with Surveillance Radar	
UNIT - IV	**8 Hours**
Radio Navigation: Navigation - methods of navigation - Radio direction finder - loop antenna – goniometer - Radio Navigation systems - ADF / NDB – Radio compass ADF, VHF phase comparison using ADF - Hyperbolic navigation systems – basic principle - LORAN, Omega, DECCA - Radio ranges – VOR – ground equipment – VOR receiver - Doppler VOR – DME	
UNIT - V	**7 Hours**
Navigation Aids: Approach and landing aids Instrument Landing System (ILS) – elements – localizer - glide slope – marker beacons -lighting systems – operation – limitation - Microwave Landing System (MLS) – operation – advantages – disadvantages - Navigation systems – INS – DNS - Satellite Navigation systems – GPS – DGPS – GNSS – COMPASS – DORIS – GALILEO – IRNSS – QZSS	

Dayananda Sagar University

School of Engineering

Devarakaggalahalli , Harohalli , Kanakapura Road , Ramanagar District- 562112

DEPARTMENT OF ELECTRONICS AND COMMUNICATION ENGINEERING

Course Outcome	Description	Bloom's Taxonomy Level
At the end of the course the student will be able to:		
1	Understand and evaluate the impact of various factors on RADAR performance, such as noise, signal-to-noise ratio, and propagation effects.	L3
2	Examine the characteristics and performance of CW and MTI Radars	L3
3	Compare and analyze the performance of tracking techniques such as Sequential Lobing, Conical Scan, Monopulse Tracking Radar,	L3
4	Evaluate the performance and characteristics of radio navigation systems	L3
5	Analyze the operation and characteristics of the navigational landing aids such as Instrument Landing System, Microwave Landing System and satellite navigational systems.	L3

Table: Mapping Levels of COs to POs / PSOs

Cos	Program Outcomes (POs)												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	3	3	2	-	-	3	-	2	-	-	-	3	3	2
CO2	3	3	2	-	-	-	-	2	-	-	-	3	3	2
CO3	3	-	3	-	-	-	-	2	-	-	-	3	3	-
CO4	3	-	3	-	-	2	-	2	-	-	-	3	3	-
CO5	3	-	-	-	-	2	-	3	-	-	-	3	3	-

3: Substantial (High) **2: Moderate (Medium)** **1: Poor (Low)**

TEXT BOOKS:

1. Introduction to Radar Systems – Merrill I. Skolnik – McGraw Hill

REFERENCE BOOKS:

1. Radar Systems and Radio Aids to Navigation – Dr. A. K. Sen, Dr. A. B. Bhattacharya Khanna Publishers
2. Elements of Electronic Navigation – N. S. Nagaraja – Tata McGraw Hill

E-Resources:

1. https://archive.nptel.ac.in/courses/108/105/108105154/

Dayananda Sagar University
School of Engineering
Devarakaggalahalli , Harohalli , Kanakapura Road , Ramanagar District- 562112

DEPARTMENT OF ELECTRONICS AND COMMUNICATION ENGINEERING

INTRODUCTION TO COMPUTER VISION

[As per Choice Based Credit System (CBCS) scheme]

SEMESTER – VII

Subject Code	:		**Credits**	:	03
Hours / Week	:	03 Hours	**Total Hours**	:	39 Hours
L–T–P–S	:	3–0–0–0			

Course Learning Objectives:

This Course will enable students to:

1. Understand principles of image formation, calibration, and geometric transformations.
2. Implement feature detection, description, and calibration algorithms effectively.
3. Explore stereo vision principles and multi-view geometry for scene analysis.
4. Analyze and optimize camera systems and stereo vision algorithms for robust performance.

   Integrate multi-camera systems with 3D reconstruction pipelines for diverse applications.

Teaching-Learning Process (General Instructions)

These are sample new pedagogical methods, where teacher can use to accelerate the attainment of the various course outcomes.

1. ***Lecture method*** means it includes not only traditional lecture method, but different *type of teaching methods* may be adopted to develop the course outcomes.
2. ***Interactive Teaching:*** *Adopt the* ***Active learning*** that includes brainstorming, discussing, group work, focused listening, formulating questions, notetaking, annotating, and roleplaying.
3. Show ***Video/animation*** films to explain functioning of various concepts.
4. Encourage ***Collaborative*** (Group Learning) Learning in the class.
5. To make ***Critical thinking***, ask at least three Higher order Thinking questions in the class.
6. Adopt ***Problem Based Learning***, which fosters students' Analytical skills, develop thinking skills such as the ability to evaluate, generalize, and analyse information rather than simply recall it.
7. Show the ***different ways to solve*** the same problem and encourage the students to come up with their own creative ways to solve them.
8. Discuss how every ***concept can be applied to the real world*** - and when that's possible, it helps improve the students' understanding.

Dayananda Sagar University

School of Engineering

Devarakaggalahalli , Harohalli , Kanakapura Road , Ramanagar District- 562112

DEPARTMENT OF ELECTRONICS AND COMMUNICATION ENGINEERING

UNIT - I	**08 Hours**
Image Formation: Geometric image formation, Photometric image formation - Camera Models and Calibration: Camera Projection Models – Orthographic, Affine, Perspective, Projective models. Projective Geometry	
UNIT - II	**06 Hours**
Transformation of 2D and 3D, Internal Parameters, Lens Distortion Models- Local Feature, Detectors and Descriptors: Hessian corner detector, Harris Corner Detector, LOG detector, DOG detector.	
UNIT - III	**08 Hours**
SIFT, PCA-SIFT, GLOH, SURF, HOG, Pyramidal HOG, PHOW, Calibration Methods: Linear, Direct, Indirect and Multiplane methods, Pose Estimation. Stereo.	
UNIT - IV	**08 Hours**
Multi-view Geometry: Epipolar Geometry, Rectification and Issues related to Stereo, General Stereo with E Matrix Estimation. (Textbook 1- 11.1 -11.3)	
UNIT - V	**09 Hours**
Stratification for 2 Cameras, Extensions to Multiple Cameras, Self-Calibration with Multiple Cameras, 3D reconstruction of cameras and structures, Three View Geometry.	

Dayananda Sagar University
School of Engineering
Devarakaggalahalli , Harohalli , Kanakapura Road , Ramanagar District- 562112

DEPARTMENT OF ELECTRONICS AND COMMUNICATION ENGINEERING

Course Outcome	Description	Bloom's Taxonomy Level
At the end of the course the student will be able to:		
1	**Comprehensive** study of fundamental principles in image formation, camera models, and geometric transformations for accurate representation and analysis of digital imagery	Understanding L2
2	**Applying** feature detection, description, and calibration techniques, essential for extracting meaningful information and ensuring precise geometric reconstruction.	Applying L3
3	**Understanding and application** of stereo vision principles, multi-view geometry, and 3D reconstruction methods for robust scene perception and visualization.	Analyze L4
4	**Ability** to implement and optimize computer vision algorithms, considering factors such as computational efficiency, accuracy, and real-world applicability.	Create L5
5	**Competence** in integrating multi-camera systems with 3D reconstruction pipelines, enabling the development of innovative solutions in diverse fields like robotics, augmented reality, and virtual reality.	Analyze L4

Table: Mapping Levels of COs to POs / PSOs

COs	Program Outcomes (POs)												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	3	2			3							1	3	2
CO2		3	2		3							1	3	2
CO3	3	3	3		3							1	3	2
CO4	3	3			3						1	1	3	2
CO5	3		2		3				1		2	1	3	2

3: Substantial (High) **2: Moderate (Medium)** **1: Poor (Low)**

TEXT BOOKS:

1. Forsyth and Ponce, "*Computer Vision – A Modern Approach*", Second Edition, Prentice Hall, 2011
2. Emanuele Trucco and Alessandro Verri, "*Introductory Techniques for 3-D Computer Vision*", Prentice Hall, 1998

REFERENCE TEXT BOOKS:

1. Olivier Faugeras, "*Three Dimensional Computer Vision*", MIT Press, 1993.
2. Richard Szeliski, "*Computer Vision: Algorithms and Applications*", Springer, 2011.
3. Milan Sonka, Vaclav Hlavac and Roger Boyle, "*Image Processing, Analysis and Machine Vision*", Third Edition, CL Engineering, 2013.

E-Resources:

1. https://onlinecourses.nptel.ac.in/noc19_cs58/preview
2. https://onlinecourses.nptel.ac.in/noc23_ee39/preview

Activity Based Learning (Suggested Activities in Class)

1) Image Processing Challenges
2) Image Annotation and Labeling

Dayananda Sagar University
School of Engineering
Devarakaggalahalli , Harohalli , Kanakapura Road , Ramanagar District- 562112

DEPARTMENT OF ELECTRONICS AND COMMUNICATION ENGINEERING

ELECTRONIC MATERIALS, DEVICES AND PROCESSING

[As per Choice Based Credit System (CBCS) scheme]

SEMESTER – VII

Subject Code	:		**Credits**	:	03
Hours / Week	:	03 Hours	**Total Hours**	:	39
L–T–P	:	3–0–0			

Course Learning Objectives:

This Course will enable students to:

1. **Evaluate** the impact of miniaturization on MOSFET performance and explore alternative device structures like Silicon-On-Insulator (SOI) to address scaling challenges.
2. **Analyze** advanced modeling techniques to account for quantum effects in MOSFETs and **Understand** high-frequency noise considerations in compound semiconductor devices like HEMTs.
3. **Compare** and highlight the operational principles of emerging transistor technologies like Tunnel FETs (TFETs) and Light-Emitting Diodes (LEDs) based on compound semiconductors.
4. **Explain** the limitations of traditional scaling approaches and explore the concept of band engineering in compound semiconductors for device performance optimization.
5. **Discuss** the potential of polymeric semiconductors in applications like solar cells and understand novel device concepts like memristors.

Teaching-Learning Process (General Instructions)

This course utilizes a variety of engaging pedagogical methods to help students achieve the outlined learning objectives. These methods aim to accelerate your understanding and mastery of the course objectives outlined above.

1. **Interactive Lectures:** While traditional lectures will provide core concepts, the focus will be on active learning techniques like brainstorming, group discussions, and focused listening exercises.
2. **Group Problem-Solving:** Present problems related to MOSFET scaling limitations or high-frequency noise in HEMTs. Students work in groups to discuss, analyze, and propose solutions using their knowledge of advanced modeling techniques.
3. **Peer Review:** Implement peer review activities for projects or presentations throughout the course. Students provide constructive feedback on project reports or presentations related to emerging device concepts or applications of polymeric semiconductors
4. Show ***Video/animation*** films to explain functioning of various concepts of scaling challenges and alternative device structures.
5. **Case Studies:** Present real-world case studies related to the design of low-power mobile devices or the development of high-efficiency solar cells using polymeric

materials. Students analyze the case studies and discuss the engineering decisions made based on the course concepts.

6. **Guest Lectures:** Invite industry professionals working on advanced device research or development to give guest lectures. This allows students to gain insights into real-world applications, challenges, and career opportunities in the field.

Throughout the course, emphasize the real-world applications of these advanced concepts to enhance student motivation and understanding. Encourage active participation through questioning, brainstorming, group work, and peer-to-peer learning.

UNIT – I	**08 Hours**
MOSFET SCALING: Short history of Semiconductor Devices, More Moore, More than Moore, Short-Channel Effect in MOSFETs, Constant-Field scaling, Generalized Scaling, Non Scaling Effects, Threshold-Voltage Requirement, Channel Profile Design, Non-Uniform Doping, Quantum Effect on Threshold Voltage, Discrete Dopant Effects on Threshold Voltage, MOSFET Channel Length.	
UNIT – II	**08 Hours**
QUANTUM PHENOMENA IN MOS TRANSISTORS: Carrier Energy Quantization in MOS capacitor, 2-D Density of States, Electron Concentration Distribution, Approximate Methods, Quantization Correction in Compact MOSFET Models, Quantum Tunnelling, Gate Current Density, Compact Gate Current Models, Gate Induced Drain Leakage (GIDL)	
UNIT – III	**09 Hours**
NON - CLASSICAL MOSFET STRUCTURES: Silicon-On-Insulator Devices, SOI CMOS, Partially Depleted SOI MOSFETs, Fully Depleted SOI MOSFETs, Dual Material Gate MOSFETs, Surrounding Gate MOSFETs, Multigate MOSFETs, FINFETs, TFETs, HEMTs, Silicon Nanowires, Junction less FETs.	
UNIT – IV	**08 Hours**
COMPOUND SEMICONDUCTORS PHYSICS AND TECHNOLOGY: Deposition Techniques, Band Engineering, Heterojunctions (Type I, II, III), Band Bending, P N Heterojunction, Lattice Mismatch, Polar Semiconductors, 2DEG at Heterointerfaces, Quantum Well, LED (Blue, IR), Laser Diode, GaAs HEMT, GaN HFET, MESFET, High Frequency Noise.	
UNIT – V	**06 Hours**
POLYMERIC SEMICONDUCTORS: Materials, Polymer Solar Cell, OLED, Pressure Sensors, Printed Electronics, Perovskite Solar Cells **NOVEL DEVICE PLATFORMS:** Spintronic Devices, Resistive Switching Memories - Concept of Memristors.	

Dayananda Sagar University
School of Engineering
Devarakaggalahalli , Harohalli , Kanakapura Road , Ramanagar District- 562112

DEPARTMENT OF ELECTRONICS AND COMMUNICATION ENGINEERING

Course Outcome	Description	Bloom's Taxonomy Level
At the end of the course the student will be able to:		
1	**Analyze and Evaluate** the impact of miniaturization on MOSFET performance. Critically assess the limitations of traditional scaling approaches and explore alternative device structures like Silicon-On-Insulator (SOI) to address these challenges.	L2 & L3
2	**Demonstrate** the ability to utilize appropriate modeling tools to understand the impact of quantum phenomena on transistor behavior. **Analyze** the quantum effects in MOSFETs and their influence on device characteristics.	L2 & L3
3	**Compare** the operational principles of emerging transistor technologies (e.g., Tunnel FETs, HEMTs) and Light-Emitting Diodes (LEDs) based on compound semiconductors. **Understand** the functionalities and key differences between these advanced devices.	L2 & L3
4	**Explain** the concept of bandgap engineering in compound semiconductors and its role in overcoming limitations of traditional scaling approaches for device performance optimization. **Analyze** how band engineering strategies can be leveraged to design next-generation devices with improved performance characteristics.	L2 & L3
5	**Evaluate** the potential of polymeric semiconductors in applications like solar cells and critically **Analyze** novel device concepts like memristors, considering their advantages and limitations.	L2

Table: Mapping Levels of COs to POs / PSOs

COs	Program Outcomes (POs)												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	3	3		2	3							2		3
CO2	3	3	2	3	3							2		3
CO3	3	3		3	3							1		3
CO4	3	3	2	2	3							2		3
CO5	3	3			2							1		3

3: Substantial (High) **2: Moderate (Medium)** **1: Poor (Low)**

TEXT BOOKS:

1. Y. Taur and T. H. Ning, "Fundamentals of Modern VLSI Devices", Cambridge University Press, Cambridge, United Kingdom, 2nd Edition, 2009.
2. Snowden C. M., "Introduction to Semiconductor Device Modeling", World Scientific Press, Singapore, 1986
3. J.P.Colinge "FinFETs and other Multigate Transistors", 2008.

REFERENCE BOOKS:

1. Donald A. Neamen, Semiconductor Physics and Devices Basic Principles", 3rd Edition,

E-Resources:

1. https://onlinelibrary.wiley.com/journal/15214095

****

Dayananda Sagar University
School of Engineering
Devarakaggalahalli , Harohalli , Kanakapura Road , Ramanagar District- 562112

DEPARTMENT OF ELECTRONICS AND COMMUNICATION ENGINEERING

Linux Device Drivers

[As per Choice Based Credit System (CBCS) scheme]

SEMESTER – VII

Subject Code	:		**Credits**	:	03
Hours / Week	:	03 Hours	**Total Hours**	:	39 Hours
L–T–P	:	3–0–0			

Course Learning Objectives:

This Course will enable students to:

1. **Understand** the fundamental concepts and architecture of Linux Device Drivers, including the role and interaction of kernel modules, to explain the operation of hardware-software interfaces.
2. **Analyze** the source code of existing Linux Device Drivers to identify key components and their interactions, thereby determining the drivers' functionality and performance characteristics.
3. **Design** and **Develop** a custom Linux Device Driver by applying principles of kernel programming and device driver interfaces, ensuring robust and efficient communication between hardware and software.
4. **Evaluate** the performance and reliability of Linux Device Drivers through systematic testing and debugging techniques, ensuring compliance with specified requirements and industry standards.
5. **Apply** advanced troubleshooting and optimization techniques to resolve issues in Linux Device Drivers, enhancing their functionality and compatibility with different hardware configurations.

Teaching-Learning Process (General Instructions)

These are sample new pedagogical methods, where teacher can use to accelerate the attainment of the various course outcomes.

Lectures and Presentations:

- **Content Delivery**: Use lectures to introduce fundamental concepts, architecture, and key components of Linux Device Drivers.
- **Visual Aids**: Incorporate slides with diagrams, flowcharts, and code snippets to illustrate complex topics clearly.

Hands-on Labs:

- **Practical Application**: Design lab sessions where students write, compile, and test their own device drivers.
- **Real Hardware**: Provide access to physical hardware for students to interact with, such as development boards or peripheral devices.

Interactive Tutorials:

- **Guided Learning**: Use step-by-step tutorials to walk students through the process of creating basic drivers, gradually increasing complexity.

- **Sandbox Environment**: Offer a safe, controlled environment where students can experiment without the risk of damaging hardware or the system.

Project-Based Learning:

- **Long-term Projects**: Assign semester-long projects that require students to develop a complete device driver, encouraging deep learning and application of concepts.
- **Collaborative Projects**: Promote teamwork by assigning group projects, fostering collaboration and peer learning.

Flipped Classroom:

- **Pre-class Preparation**: Provide video lectures and reading materials for students to study before class.
- **In-class Activities**: Use class time for discussions, problem-solving sessions, and hands-on exercises based on pre-class materials.

Code Reviews and Peer Assessment:

- **Collaborative Learning**: Encourage students to review each other's code, providing constructive feedback and learning from peers.
- **Critical Thinking**: Teach students to critically evaluate code for efficiency, reliability, and adherence to best practices.

Guest Lectures and Industry Insights:

- **Expert Talks**: Invite industry professionals to share real-world experiences and current trends in device driver development.
- **Case Studies**: Discuss real-world case studies to illustrate practical challenges and solutions in the field.

Simulation and Emulation:

- **Virtual Hardware**: Use simulators and emulators to allow students to develop and test drivers in a virtual environment, making it easier to experiment without needing extensive physical hardware.

Problem-Based Learning (PBL):

- **Real-World Problems**: Present students with real-world problems that require writing or debugging device drivers, fostering analytical and problem-solving skills.
- **Independent Research**: Encourage students to research and find solutions independently or in groups, promoting self-directed learning.

Assessment and Feedback:

- **Formative Assessments**: Use quizzes, short assignments, and in-class exercises to regularly assess understanding and provide immediate feedback.
- **Summative Assessments**: Evaluate students through comprehensive exams, project presentations, and final reports to gauge overall learning outcomes.

Dayananda Sagar University
School of Engineering
Devarakaggalahalli , Harohalli , Kanakapura Road , Ramanagar District- 562112

DEPARTMENT OF ELECTRONICS AND COMMUNICATION ENGINEERING

UNIT – I	08 Hours
INTRODUCTION TO LINUX DEVICE DRIVERS Overview of Linux Device Drivers: The Role of the Device Driver, Splitting the Kernel, Classes of Devices and Modules, Security Issues, Version Numbering, Building and Running Modules (Setting up the Test System, Creating the Hello World Linux Kernel Module, Compiling and Loading the Linux Kernel Module) ***Text Book 1: Chapter 1 and chapter 2***	
UNIT - II	**08 Hours**
CHARACTER DEVICE DRIVERS Fundamentals of Character Drivers: Major and Minor Numbers, Associated Data Structures, Char Device Registration, File Operation, writing a basic character driver (implementing open, close, read & write functions) ***Text Book 1: Chapter 3***	
UNIT – III	**08 Hours**
BLOCK DEVICE DRIVERS Block driver architecture, Registration, The Block Device Operations, Request Processing, writing a simple block device driver, implementing essential operations ***Text Book 1: Chapter 16***	
UNIT – IV	**08 Hours**
USB DEVICE DRIVERS USB Device Basics, USB subsystem, USB core APIs, Writing a basic USB driver, handling device enumeration ***Text Book 1: Chapter 13***	
UNIT – V	**07 Hours**
DEBUGGING TECHNIQUES Debugging Support in the Kernel, Debugging by Printing, Debugging by Querying, Debugging by Watching, Debugging System Faults, Debuggers and Related Tools ***Text Book 1: Chapter 4***	

Course Outcome	Description	Bloom's Taxonomy Level
At the end of the course the student will be able to:		
CO1	**Understand and Describe** the fundamental concepts and architecture of Linux Device Drivers, including the role of the device driver, security issues, and the process of building and running kernel modules.	L2
CO2	**Analyze and Implement** the key components of character device drivers by registering character devices and writing basic driver functions such as open, close, read, and write operations.	L3
CO3	**Design and Develop** a simple block device driver by understanding block driver architecture, registration, and essential operations, including request processing.	L3
CO4	**Create and Evaluate** a basic USB device driver by utilizing USB core APIs and handling device enumeration within the USB subsystem.	L3
CO5	**Apply and Demonstrate** various debugging techniques supported by the Linux kernel, including printing, querying, watching, and using debugging tools to identify and resolve system faults.	L3

Table: Mapping Levels of COs to POs / PSOs

COs	Program Outcomes (POs)												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	3	2	1	-	3	-	-	3	-	-	-	2	2	1
CO2	3	3	2	-	3	-	-	3	-	-	-	2	2	1
CO3	3	2	3	2	3	-	-	3	-	-	-	2	2	2
CO4	3	2	2	2	3	-	-	3	-	-	-	2	2	2
CO5	3	2	2	1	3	-	-	3	-	-	-	2	2	2

3: Substantial (High) **2: Moderate (Medium)** **1: Poor (Low)**

TEXT BOOKS:

1. Corbet, Jonathan, Alessandro Rubini, and Greg Kroah-Hartman. *Linux device drivers*. " O'Reilly Media, Inc.", 2005.

REFERENCE BOOKS:

1. Madieu, John. *Linux Device Drivers Development: Develop Customized Drivers for Embedded Linux*. Packt Publishing Ltd, 2017.
2. Giometti, Rodolfo. *Linux Device Driver Development Cookbook: Develop Custom Drivers for Your Embedded Linux Applications*. Packt Publishing Ltd, 2019.

E-Resources:

Paid Courses

1. **Udemy: "Linux Device Drivers Programming"**
   - **Instructor: Dmitry Frank**
   - **Description: Covers basic to advanced concepts of Linux device driver programming.**
   - **Link: Udemy**
2. **Coursera: "Linux Kernel Programming"**
   - **Provider: University of Colorado System**
   - **Description: Offers a comprehensive look into Linux kernel programming, including device drivers.**
   - **Link: Coursera**
3. **Linux Foundation Training: "Linux Kernel Internals and Development (LFD420)"**
   - **Provider: Linux Foundation**
   - **Description: In-depth course on Linux kernel internals, focusing on development and device drivers.**
   - **Link: Linux Foundation**

Free Courses and Resources

4. **Embedded Linux Wiki: "Linux Device Drivers Development"**
   - **Description: A free resource offering various articles and tutorials on Linux device driver development.**
   - **Link: ELinux**
5. **LWN.net: "Kernel documentation"**
   - **Description: Extensive documentation and articles on Linux kernel and device drivers.**
   - **Link: LWN.net**
6. **The Linux Documentation Project**
   - **Description: Offers various guides and HOWTOs, including those on kernel and device driver development.**
   - **Link: TLDP**

Books (for Structured Learning)

7. **"Linux Device Drivers" by Jonathan Corbet, Alessandro Rubini, and Greg Kroah-Hartman**
   - **Description: A comprehensive book often considered the standard reference for learning Linux device drivers.**
   - **Link: O'Reilly**
8. **"Essential Linux Device Drivers" by Sreekrishnan Venkateswaran**
   - **Description: Another excellent resource for both beginners and experienced developers.**
   - **Link: Amazon**

MOOCs and University Courses

9. **edX: "Introduction to Linux"**
   - **Provider: Linux Foundation**
   - **Description: While more general, it provides a solid foundation that will be beneficial for learning device drivers.**
   - **Link: edX**

10. **FutureLearn: "Embedded Linux: Using the Yocto Project"**
    - **Provider: The Linux Foundation**
    - **Description: Focuses on embedded Linux development, which includes device drivers.**
    - **Link: Future Learn**

Activity Based Learning (Suggested Activities in Class)

- **Pair Programming**: Encourage students to work in pairs to foster collaboration.
- **Code Reviews**: Conduct code review sessions to discuss best practices and improvements.
- **Guest Lectures**: Invite industry experts to give talks or workshops.
- **Hackathons**: Organize hackathons focused on driver development.
- **Quizzes and Challenges**: Use quizzes to reinforce theoretical knowledge and coding challenges to test practical skills.

These activity-based learning approaches engage students actively in the learning process, fostering deeper understanding and retention of design patterns for embedded systems. By combining theoretical knowledge with hands-on experience, students develop practical skills that are essential for success in embedded systems development.

Dayananda Sagar University
School of Engineering
Devarakaggalahalli , Harohalli , Kanakapura Road , Ramanagar District- 562112

DEPARTMENT OF ELECTRONICS AND COMMUNICATION ENGINEERING

ELECTRONIC MEASUREMENT SYSTEM

[As per Choice Based Credit System (CBCS) scheme]

OPEN ELECTIVE COURSE

Subject Code	:	**Credits**	:
Hours / Week	:	**Total Hours**	: Hours
L–T–P	:		

Course Learning Objectives:

This Course will enable students to:

1. Understand the fundamental principles and concepts of electronic measurements, including accuracy, precision, sensitivity, and error analysis, to effectively measure various electrical parameters.
2. Understand the construction and operation of AC & DC voltmeters and ammeters, oscilloscopes, signal generators, signal analyzers, transducers and LCR meters
3. Gain proficiency in operating electronic measurement instruments such as oscilloscopes, multimeters, function generators, and frequency counters, and analyze the measured data to extract meaningful information.
4. Explore the applications of measuring instrument in electronic signals monitoring and analysis

Teaching-Learning Process (General Instructions)

These are sample new pedagogical methods, where teacher can use to accelerate the attainment of the various course outcomes.

1. Lecture method means it includes not only traditional lecture method, but also different type of teaching methods may be adopted to develop the course outcomes.
2. Interactive Teaching: Adopt the Active learning that includes brainstorming, discussing, group work, focused listening, formulating questions, notetaking, annotating, and roleplaying.
3. Show Video/animation films to explain functioning of various concepts.
4. Encourage Collaborative (Group Learning) Learning in the class.
5. To make Critical thinking, ask at least three Higher order Thinking questions in the class.
6. Adopt Problem Based Learning analytical thinking skills such as theability toevaluate, generalize, andanalyzeinformationrather than simply recallit.
7. Show the different ways to solve the same problem and encourage the students to come up with their own creative ways to solve them.
8. Discuss how every concept can be applied to the real world - and when that's possible,it helps improve the students' understanding.

Dayananda Sagar University

School of Engineering

Devarakaggalahalli , Harohalli , Kanakapura Road , Ramanagar District- 562112

DEPARTMENT OF ELECTRONICS AND COMMUNICATION ENGINEERING

UNIT – I	06 Hours
INTRODUCTION TO MEASUREMENT SYSTEMS: Introduction, Characteristics of Instruments and measurement systems (Static &Dynamic) Error analysis and combinations: Sources, types and statistical analysis. Instrument Calibration: Comparison Method. Types of instruments, classification of instruments based on type of measurement and principle of working (PMMC, MI, Dynamometer, Induction and Electrostatic),	
UNIT – II	**08 Hours**
MEASURING INSTRUMENTS: DC and AC Ammeter, Voltmeter- Chopper type and solid state, AC voltmeter using Rectifier. Average, RMS, Peak responding voltmeters, Multi-meter, frequency meters Analog measuring instruments: D' Arsonval movement, ohmmeters, multimeters, meter protection, extension of range, Advantages of Digital Instrument over Analog Instrument, Digital voltmeters: Ramp type, staircase, dual slope integrating type, successive approximation type, specifications of instruments	
UNIT – II	**10 Hours**
Display devices, Signal Analyzers and Working of CROs: Digital display system and indicators, Classification of Displays, Display devices: Light Emitting diodes (LED) and Liquid Crystal Display (LCD). CRO: Different parts of CRO, Block diagram, Electrostatic focusing, Electrostatic deflection, Post deflection acceleration. Screen for CRTs, Vertical and Horizontal deflection system, Time base circuit, Delay lines Special purpose CROs- Multi input, Dual trace, Dual beam, Sampling, Storage (Analog and Digital) Oscilloscope. Lissajous figures, frequency measurement, phase measurement, CRO probes. Signal Analyzers: AF, HF wave analyzers, heterodyne wave analyzers, harmonic distortion, spectrum analyzers, power analyzers	
UNIT – IV	**09 Hours**
FUNCTION GENERATORS & BRIDGES: Signal and Function Generators, Sweep Frequency Generator, Pulse and Square Wave Generator, Beat Frequency Oscillator, Measurements using DC and AC bridges: Wheat stone bridge, Kelvin bridge, AC bridges, Wein Bridge, Anderson bridges, Wagner & ground connection. Maxwell's bridge (Inductance and Inductance-Capacitance), Hay's bridge, Schering bridge (High voltage and Relative permittivity). Impedance measurement by Q-meter	

Dayananda Sagar University
School of Engineering
Devarakaggalahalli , Harohalli , Kanakapura Road , Ramanagar District- 562112

DEPARTMENT OF ELECTRONICS AND COMMUNICATION ENGINEERING

UNIT – V	06 Hours
TRANSDUCERS: Classification of Transducers, Strain gauge, Displacement Transducer Linear Variable Differential Transformer (LVDT) and Rotary Variable Differential Transformer (RVDT), Temperature Transducer- Resistance Temperature Detector (RTD), Thermistor, Thermocouple, Piezo-electric transducer, Optical Transducer- Photo emissive, Photo conductive, Photo voltaic, Photo-diode, Photo Transistor	

Course Outcome	Description	Bloom's Taxonomy Level
At the end of the course the student will be able to:		
1	Understand about various measurement devices, their characteristics, their operation and their limitations	L2
2	Understand digital instruments, including digital multimeters, frequency counters, and logic analyzers, and their applications in measurement systems.	L2
3	Acquire proficiency in operating Cathode Ray Oscilloscopes (CROs) and understanding the working of signal analysers	L3
4	Develop skills in configuring and analyzing function generators and bridge circuits.	L3
5	Select, configure, and integrate transducers into measurement systems for converting physical quantities into electrical signals	L2

Table: Mapping LevelsofCOsto POs/ PSOs

Cos	Program Outcomes (POs)												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	**3**	-	-	-	-	**1**	**2**	-	-	-	-	**2**	**1**	-
CO2	**3**	-	-	-	**2**	-	**2**	-	-	-	-	**2**	**2**	**1**
CO3	**3**	-	-	-	**2**	-	-	-	-	-	-	**2**	**2**	-
CO4	**3**	-	**2**	-	**2**	-	-	-	-	-	-	**2**	**1**	**1**
CO5	**3**	-	**2**	-	**3**	-	-	-	-	-	-	**2**	**2**	**1**
CO6	**3**	-	-	-	-	**1**	**2**	-	-	-	-	**2**	**1**	-

3: Substantial (High) **2: Moderate (Medium)** **1: Poor (Low)**

TEXT BOOKS:

1. 1. A.K. Sawhney, "A Course in Electrical and Electronic Measurements and Instrumentation", Dhanpat Rai.
2. MMS Anand, "Electronic Instruments & Instrumentation Technology", PHI Pvt. Ltd., New Delhi Ed. 2005
3. David A. Bell, "Electronic Instrumentation and Measurements", 2nd Ed., PHI, New Delhi 2008.

REFERENCE TEXT BOOKS:

1. H.S. Kalsi, "Electronics Instrumentation", TMH Ed. 2004
2. Albert D. Helfrick, William David Cooper, "Modern electronic instrumentation and measurement techniques", TMH 2008.
3. Oliver Cage, "Electronic Measurements and Instrumentation", TMH, 2009.
4. Alan S. Morris, "Measurement and Instrumentation Principles", Elsevier (Buterworth Heinmann), 2008

E-Resources:

1. https://edurev.in/courses/24749_Electrical-and-Electronic-Measurements
2. https://freevideolectures.com/course/4111/nptel-electrical-measurement-electronic-instruments
3. https://kp.kiit.ac.in/pdf_files/06/3rd-Sem_ETC_Electronics-Meaurement-Instrumentation_SM-1.pdf

****

Dayananda Sagar University

School of Engineering

Devarakaggalahalli , Harohalli , Kanakapura Road , Ramanagar District- 562112

DEPARTMENT OF ELECTRONICS AND COMMUNICATION ENGINEERING

INTRODUCTION TO NANOELECTRONICS

[As per Choice Based Credit System (CBCS) scheme]

SEMESTER VII

Course Code	:		Credits	:	03
Hours / Week	:	03 Hours	Total Hours	:	39 Hours
L T P	:	3 0 0			

Course Learning Objectives:

This Course will enable students to:

1. Understand the behavior of electrons at the nanoscale and their role in electronic devices.
2. Analyze and differentiate between ballistic and diffusive conductance in nanoelectronic systems.
3. Calculate conductance using relevant formulas such as the Drude formula and Landauer formulas.
4. Interpret the relationship between electron energy and momentum and its significance in nanoelectronics.
5. Apply thermoelectric principles, including Seebeck coefficient and heat current, to nanoelectronic devices

Teaching-Learning Process (General Instructions)

These are sample new pedagogical methods, where teacher can use to accelerate the attainment of the various course outcomes.

1. Lecture method means it includes not only traditional lecture method, but also different type of teaching methods may be adopted to develop the course outcomes.
2. Interactive Teaching: Adopt the Active learning that includes brainstorming, discussing, group work, focused listening, formulating questions, notetaking, annotating, and roleplaying.
3. Show Video/animation films to explain functioning of various concepts.
4. Encourage Collaborative (Group Learning) Learning in the class.
5. To make Critical thinking, ask at least three Higher order Thinking questions in the class.
6. Adopt Problem Based Learning analytical thinkingskillssuchastheabilitytoevaluate, generalize, andanalyzeinformationrather than simply recallit.
7. Show the different ways to solve the same problem and encourage the students to come up with their own creative ways to solve them.
8. Discuss how every concept can be applied to the real world - and when that's possible,it helps improve the students' understanding.

Dayananda Sagar University

School of Engineering

Devarakaggalahalli , Harohalli , Kanakapura Road , Ramanagar District- 562112

DEPARTMENT OF ELECTRONICS AND COMMUNICATION ENGINEERING

UNIT I	10 Hours
ELECTRON TRANSPORT: Introduction, Fermi energy and density of states, Electron Flow models, Conductance Formula, Ballistic (B) Conductance, Diffusive (D) Conductance, Connecting Ballistic (B) to Diffusive (D), Angular Averaging, Drude Formula.	
UNIT II	**09 Hours**
ENERGY BAND MODEL: E(p) or E(k) Relation, Counting States, Density of States, Number of Modes, Electron Density (n), Conductivity vs. Electron Density (n), Quantum Capacitance and Nanotransistor.	
UNIT III	**10 Hours**
VOLTAGE LEVELS: Boundary Condition, Quasi-Fermi Levels (QFL's), Current from QFL's, Landauer Formulas, What a Probe Measures, Electrostatic Potential, Boltzmann Equation, Spin Voltages	
UNIT IV	**10 Hours**
HEAT AND ENERGY: Seebeck Coefficient, Heat Current, One-level Device, Second Law, Entropy, Law of Equilibrium, Shannon Entropy and Fuel Value of Information	

Course Outcome	Description	Bloom's Taxonomy Level
At the end of the course the student will be able to:		
1	Analyze the behavior of electrons at the nanoscale and differentiate between ballistic and diffusive conductance in nanoelectronics systems	L4
2	Apply relevant formulas such as the Drude formula and Landauer formulas to calculate conductance in nanoelectronics devices.	L3
3	Evaluate the significance of the relationship between electron energy and momentum (E(p) or E(k) relation) in nanoelectronics and its implications for device design and performance.	L5
4	Interpret the thermoelectric principles, including the See beck coefficient and heat current, to assess the performance of nanoelectronics devices and propose improvements for specific applications.	L4

	Table: Mapping Levels of COs to POs / PSOs													
Cos	Program Outcomes (POs)												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	3	3	-	1	2	2	2	-	-	-	-	-	2	-
CO2	3	3	-	1	2	2	2	-	-	-	-	-	2	-
CO3	3	3	1	1	2	2	2	-	-	-	-	-	2	-
CO4	3	2	-	1	-	2	2	-		-	-	-	2	2

3: Substantial (High) 2: Moderate (Medium) 1: Poor (Low)

TEXT BOOK:

1. Supriyo Datta, "Lessons from Nanoelectronics A New Perspective on Transport — Part A: Basic Concepts", World Scientific Publishing Co. Pte. Ltd, 2017.

REFERENCE BOOKS:

1. Marco Baldo, "Introduction to NanoElectronics", MIT OpenCourseWare Publication May 2011.
2. Vladamir, Viatcheslav and Micheal, "Introduction to Nanoelectronics", Cambridge University Press, 2008.

E-Resources:

1. https://nptel.ac.in/courses/117108047

Activity Based Learning (Suggested Activities in Class)

1. MATLAB based analysis of conduction models.

SCHOOL OF ENGINEERING

DEPARTMENT OF ELECTRONICS AND COMMUNICATION ENGINEERING

PROFESSIONAL ELECTIVE COURSES -V

Dayananda Sagar University

School of Engineering

Devarakaggalahalli , Harohalli , Kanakapura Road , Ramanagar District- 562112

DEPARTMENT OF ELECTRONICS AND COMMUNICATION ENGINEERING

OPTICAL COMMUNICATION

[As per Choice Based Credit System (CBCS) scheme]

SEMESTER VII

Course Code	:		Credits	:	03
Hours / Week	:	03 Hours	Total Hours	:	39 Hours
L T P	:	3 0 0			
Pre-requisite: Optical Communication .					

CourseLearningObjectives:

This Course will enable students to:

1. To learn the basic elements of optical fiber transmission link, fiber modes configurations and structures.
2. To understand the different kind of losses, signal distortion in optical wave guides and other signal degradation factors.
3. To learn the various optical source materials, LED structures, quantum efficiency, Laser diodes
4. To learn the fiber optical receivers such as PIN APD diodes, noise performance in photo detector, receiver operation and configuration.
5. To learn the fiber optical network components, variety of networking aspects, FDDI, SONET/SDH and operational principles WDM.

Teaching-Learning Process (General Instructions)

These are sample new pedagogical methods, where teacher can use to accelerate the attainment of the various course outcomes.

1. Lecture method means it includes not only traditional lecture method, but also different type of teaching methods may be adopted to develop the course outcomes.
2. Interactive Teaching: Adopt the Active learning that includes brainstorming, discussing, group work, focused listening, formulating questions, notetaking, annotating, and roleplaying.
3. Show Video/animation films to explain functioning of various concepts.
4. Encourage Collaborative (Group Learning) Learning in the class.
5. To make Critical thinking, ask at least three Higher order Thinking questions in the class.
6. Adopt Problem Based Learning analytical thinkingskillssuchastheabilitytoevaluate, generalize, andanalyzeinformationrather than simply recallit.
7. Show the different ways to solve the same problem and encourage the students to come up with their own creative ways to solve them.
8. Discuss how every concept can be applied to the real world - and when that's possible,it helps improve the students' understanding.

Dayananda Sagar University
School of Engineering
Devarakaggalahalli , Harohalli , Kanakapura Road , Ramanagar District- 562112

DEPARTMENT OF ELECTRONICS AND COMMUNICATION ENGINEERING

UNIT I	08 Hours
INTRODUCTION TO OPTICAL FIBERS: Elements of Optical Fiber communication, applications of optical fiber communication, optical fiber waveguides, Optical Spectral bands, Optical fiber structure, Light Propagation in Optical fibers: Ray theory, Total Internal reflection, Skew rays, Overview of Modes: Cut-off wavelength, V number, Fiber types: SI, GI, MM, SM, Special Fibers: Polarization Maintaining fibers, Photonic Crystal fibers, Dispersion compensated Fiber.	
UNIT II	**08 Hours**
TRANSMISSION CHARACTERISTICS OF OPTICAL FIBERS: Introduction, Difference between bounded and free space optical communication, Propagation characteristics of IR, Visible, UV in Atmosphere and space, Attenuation: Material Absorption, Scattering, bending and core cladding losses, Overview of Signal dispersion in Fibers, its limitations, Intermodal dispersion, Intra-Modal dispersion, Nonlinear effects: Nonlinear scattering, Kerr effects, Fiber alignment and Joint Loss, Fiber Splices Optical Fiber connectors, Expanded Beam Connectors, Lensing schemes for coupling, Fiber couplers.	
UNIT III	**08 Hours**
OPTICAL SOURCES, DETECTOR, RECEIVER AND OPTICAL LINK DESIGN: Optical Sources: Light source materials, LED Structures; LED Characteristics; Semiconductor Laser Diode, LASER Characteristics, Photo detectors, Photo detector noise, Response time, double hetero junction structure, Photo diodes, comparison of photo detectors, Optical receiver operation, Receiver design, Receiver Noise; Receiver sensitivity, Eye diagrams, Optical Link Design: Point-to point links - System considerations; Link Power budget, Rise time budget.	
UNIT IV	**08 Hours**
WDM CONCEPTS AND NETWORK COMPONENTS: WDM concepts, overview of WDM operation principles, WDM standards, Principle and Operation of couplers; Isolators; Circulators; Fabry Perot Filters; Mach-Zehnder Interferometer, EDFA; Semiconductor Optical Amplifiers and Transceivers; Multiplexers, direct thin film filters, active optical components, MEMS technology, Optical MEMS switches, variable optical attenuators, tunable optical fibers, dynamic gain equalizers, optical drop multiplexers, polarization controllers, chromatic dispersion components, tunable light sources.	
UNIT V	**07 Hours**
OPTICAL NETWORKS: Network Topologies; FDDI Networks: -Frame and Token formats; Network operation, SONET/SDH-optical specifications; SONET frame structure - SONET layers- SONET/SDH networks; Optical interfaces, SONET/SDH rings; optical ethernet , introduction to optical transport networks.FTTxs.	

Course Outcome	Description	**Bloom's** Taxonomy Level
At the end of the course the student will be able to:		
1	Illustrate Optical Fiber Communication System, its components and parameters	L3
2	Examine the Transmission characteristics of optical fibers by understanding Attenuation, Signal dispersion in Fibers Intermodal dispersion, Intra-Modal dispersion, Nonlinear effects, Fiber alignment and Joint Loss.	L4
3	Calculate Link budget, by studying characteristics and properties of optical sources, detectors and receivers.	L3
4	Demonstrate the characteristics of active and passive devices of Optical components networks.	L4
5	Model optical networks using SONET/SDH and understand optical transport networks	L3

Table: Mapping LevelsofCOsto POs/ PSOs

Cos	Program Outcomes (POs)												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	3	2			-	2	3	-	2	3	-	3	2	2
CO2	3	2			-	2	3	3	2	3	-	3	2	2
CO3	3	2	2				-		2	3	-		2	2
CO4	3	2	3				-	-	2	3	-		2	2
CO5	3	2	2		-		-	-	2	3	-		2	2

3: Substantial (High) 2: Moderate (Medium) 1: Poor (Low) (P)

TEXT BOOKS

1. Keiser G, "Optical Fiber Communication Systems", 5th Edition, 6th Reprint, McGraw Hill Education (India), 2015.
2. Rajiv Ramaswami, Kumar N. Sivaranjan, Galen H.Sasaki "Optical Networks A practical perspective", 3nd edition, 2013

REFERENCE BOOKS:

1. John M. Senior, "Optical fiber Communications: Principles and Practice", Pearson Education, 3rd Edition, 2009 2.
2. Vivekanand Mishra, Sunita P. Ugale, "Fiber Optic Communication: Systems and Components", Wiley-India, 1st edition, 2013 3.
3. Djafar.K. Mynbaev and Lowell and Scheiner, "Fiber Optic Communication Technology", Pearson Education Asia, 9th impression, 2013 4.
4. Partha Pratim Sahu, Fundamentals of Optical Networks and Components, 1st Edition, ISBN 9780367265458, July 10, 2020 by CRC Press, Taylor and Francis e book.

E-Resources:

1. https://youtu.be/oIurmHsRFSc?si=zjcUpP_QIPbF9CQmhttps://archive.nptel.ac.in/courses/107/106/107106081/

Activity Based Learning(Suggested ActivitiesinClass)

1. Poster presentations on topics of interest
2. Simulation of basic optical fiber communication system using software simulation tools.

Dayananda Sagar University
School of Engineering
Devarakaggalahalli , Harohalli , Kanakapura Road , Ramanagar District- 562112

DEPARTMENT OF ELECTRONICS AND COMMUNICATION ENGINEERING

SOFTWARE DEFINED RADIO

[As per Choice Based Credit System (CBCS) scheme]

SEMESTER – VII

Subject Code	:		**Credits**	:	03
Hours / Week	:	03	**Total Hours**	:	39 Hours
L–T–P	:	3-0-0			

Course Learning Objectives:

By the end of the course, students will be proficient in:

1) Understanding how SDRs work.
2) Making changes to hardware design of SDRs and modifying the host-side software.
3) Transmitting and receiving wireless signals using SDRs.
4) Wireless networking physical layer techniques.
5) Wireless networking MAC, link, and network layer techniques.

Teaching-Learning Process (General Instructions)

These are sample new pedagogical methods, where teacher can use to accelerate the attainment of the various course outcomes.

1. ***Lecture method*** means it includes not only traditional lecture method, but different *type of teaching methods* may be adopted to develop the course outcomes.
2. ***Interactive Teaching:*** *Adopt the* ***Active learning*** that includes brainstorming, discussing, group work, focused listening, formulating questions, note taking, annotating, and role playing.
3. Show ***Video/animation*** films to explain functioning of various concepts.
4. Encourage ***Collaborative*** (Group Learning) Learning in the class.
5. To make ***Critical thinking***, ask at least three Higher order Thinking questions in the class.
6. Adopt ***Problem Based Learning***, which fosters students' Analytical skills, develop thinking skills such as the ability to evaluate, generalize, and analyze information rather than simply recall it.
7. Show the ***different ways to solve*** the same problem and encourage the students to come up with their own creative ways to solve them
8. Discuss how every ***concept can be applied to the real world*** - and when that's possible, it helps improve the students' understanding.

Dayananda Sagar University

School of Engineering

Devarakaggalahalli , Harohalli , Kanakapura Road , Ramanagar District- 562112

DEPARTMENT OF ELECTRONICS AND COMMUNICATION ENGINEERING

MODULE – I	08 Hours
INTRODUCTION: The requirement for software defined radio, the benefits of multi-standard terminals, operational requirements, business models for software defined radio, new base station and network architectures, smart antenna systems.	
MODULE – II	**07 Hours**
BASIC ARCHITECTURE OF A SOFTWARE DEFINED RADIO: Software defined radio architectures; Ideal Software defined radio architectures, Required hardware specifications, Digital aspects of a Software Defined radio, Current technology limitations.	
MODULE – III	**08 Hours**
FLEXIBLE RF RECEIVER ARCHITECTURES: Receiver architecture options, implementation of a digital receiver: frequency up conversion using under sampling, achieving processing gain using oversampling, Noise figure, Receiver sensitivity, ADC spurious signals.	
MODULE – IV	**08 Hours**
MULTI-BAND AND GENERAL COVERAGE SYSTEMS: Multiband Flexible receiver design, the problem of the Diplexer, Achieving Image rejection, Dynamic range enhancement, feedback and feed forward techniques.	
MODULE – V	**08 Hours**
FLEXIBLE TRANSMITTERS AND POWER AMPLIFIERS: Analog quadrature up conversion, quadrature up conversion with interpolation, Interpolated band pass up conversion, PLL based transmitters, Active All-pass filter, Use of high pass and low pass filters, Polyphase filtering.	

Dayananda Sagar University
School of Engineering
Devarakaggalahalli , Harohalli , Kanakapura Road , Ramanagar District- 562112

DEPARTMENT OF ELECTRONICS AND COMMUNICATION ENGINEERING

Course Outcome	Description	Bloom's Taxonomy Level
At the end of the course the student will be able to:		
1	Understand requirements, benefits and different models for Software Defined Radio.	L2
2	Demonstrate about Software Defined Radio Architecture for performance optimization.	L2
3	Make use of timing, frequency, and frame synchronization.	L3
4	Analyze functioning of different blocks associated with Software Defined Radio.	L4
5	Examine circuits at different multi rate signaling technique for frequency conversion and sampling issues.	L4

Table: Mapping Levels of COs to POs / PSOs

Cos	Program Outcomes (POs)												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
O1	3	3			3	2				1				2
CO2	2	3	3	2	3	2				1		1	2	2
CO3	3	2	2	3	3	2				1		1		
CO4	3	3	3	3	3	2				1		1		
CO5	2	2	3	3	2	2				1		1	1	

3: Substantial (High) **2: Moderate (Medium)** **1: Poor (Low)**

TEXTBOOK(S):

1. P Kenington, "RF and Baseband Techniques for Software Defined Radio", Artec House,2005.

REFERENCE(S):

1. Jouko Vanakka, "Digital Synthesizers and Transmitter for Software Radio", Springer,2005
2. Wally H. W. Tuttlebee, "Software Defined Radio: Baseband Technologies for 3G Handsets and Base stations", John Wiley & sons, 2003.

E-Resources:

1. https://en.wikipedia.org/wiki/Software-defined_radio
2. https://www.wiley.com/en
3. us/Software+Defined+Radio%3A+Architectures%2C+Systems+and+Functions-p9780470851647

Dayananda Sagar University
School of Engineering
Devarakaggalahalli , Harohalli , Kanakapura Road , Ramanagar District- 562112

DEPARTMENT OF ELECTRONICS AND COMMUNICATION ENGINEERING

LOW POWER VLSI

[As per Choice Based Credit System (CBCS) scheme]

SEMESTER VII

Course Code	:		Credits	:	03
Hours / Week	:	03 Hours	Total Hours	:	39 Hours
L T P	:	3 0 0			

Course Learning Objectives:

This Course will enable students to:

1. Understand the concept of power dissipation in CMOS devices
2. Learn the basic principles of low power design and power optimization
3. Propose and formulate computer arithmetic techniques for low power system
4. Develop and design software for low power.

Teaching-Learning Process (General Instructions)

These are sample new pedagogical methods, where teacher can use to accelerate the attainment of the various course outcomes.

1. Lecture method means it includes not only traditional lecture method, but also different type of teaching methods may be adopted to develop the course outcomes.
2. Interactive Teaching: Adopt the Active learning that includes brainstorming, discussing, group work, focused listening, formulating questions, notetaking, annotating, and roleplaying.
3. Show Video/animation films to explain functioning of various concepts.
4. Encourage Collaborative (Group Learning) Learning in the class.
5. To make Critical thinking, ask at least three Higher order Thinking questions in the class.
6. Adopt Problem Based Learning analytical thinking skills such as the ability to evaluate, generalize, andanalyzeinformationrather than simply recallit.
7. Show the different ways to solve the same problem and encourage the students to come up with their own creative ways to solve them.
8. Discuss how every concept can be applied to the real world - and when that's possible, it helps improve the students' understanding.

Dayananda Sagar University
School of Engineering
Devarakaggalahalli , Harohalli , Kanakapura Road , Ramanagar District- 562112

DEPARTMENT OF ELECTRONICS AND COMMUNICATION ENGINEERING

UNIT I	06 Hours
SOURCES OF POWER DISSIPATION Introduction, Sources of power dissipation, designing for low power. Physics of power dissipation in MOSFET devices – MIS Structure, Long channel and sub-micron MOSFET, Gate induced Drain leakage.	
UNIT II	**08 Hours**
POWER DISSIPATION IN CMOS Power dissipation in CMOS – Short circuit dissipation, dynamic dissipation, Load capacitance. Low power design limits - Principles of low power design, Hierarchy of limits, fundamental limits, Material, device, circuit and system limits.	
UNIT III	**09 Hours**
SYNTHESIS FOR LOW POWER Behavioral, Logic and Circuit level approaches, Algorithm level transforms, Power-constrained Least squares optimization for adaptive and non-adaptive filters, Circuit activity driven architectural transformations, voltage scaling, operation reduction and substitution	
UNIT IV	**08 Hours**
LOW ENERGY COMPUTING Energy dissipation in transistor channel, Energy recovery circuit design, designs with reversible and partially reversible logic, energy recovery in adiabatic logic and SRAM core, Design of peripheral circuits – address decoder, level shifter and I/O Buffer, supply clock generation.	
UNIT V	**08 Hours**
DESIGN AND TEST OF LOW-VOLTAGE CMOS CIRCUITS Design style, Leakage current in Deep sub-micron transistors, device design issues, minimizing short channel effect, Low voltage design techniques using reverse Vgs, steep sub threshold swing and multiple threshold voltages,	

Course Outcome	Description	**Bloom's** Taxonomy Level
At the end of the course the student will be able to:		
1	Determine various methods to find the power dissipation of MOS circuits.	L5
2	Design and analyze various MOS logic circuits.	L6
3	Evaluate low power techniques for low power dissipation	L5
4	Able to estimate the power dissipation of ICs	L5
5	Formulate different algorithms to reduce power dissipation by software.	L6

Table: Mapping Levels of COs to POs / PSOs

Cos	Program Outcomes (POs)												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	3	2			3							1	2	
CO2		3	2		3							1		1
CO3	3	3	3		3							1	2	
CO4	3	3			3						1	1	1	
CO5	3		2		3				1		2	1		2

3: Substantial (High) 2: Moderate (Medium) 1: Poor (Low)

TEXT BOOKS:

1. Kaushik Roy and S.C.Prasad, **"Low power CMOS VLSI circuit design"** Wiley January 2009.
2. J.Rabaey, **"Low Power Design Essentials (Integrated Circuits and Systems)"**, Springer, 2009.
3. J.B.Kulo and J.H Lou, **"Low voltage CMOS VLSI Circuits",** Wiley 1999.

REFERENCE BOOKS:

1. A.P.Chandrasekaran and R.W.Broadersen, **"Low power digital CMOS design",** Kluwer, October 2012.
2. Gary Yeap, **"Practical low power digital VLSI design",** Kluwer, October 2012.
3. Abdelatif Belaouar, Mohamed.I.Elmasry, **"Low power digital VLSI design",** Kluwer, September 2012.
4. James B.Kulo, Shih-Chia Lin, **"Low voltage SOI CMOS VLSI devices and Circuits",** John Wiley and sons,inc. 2001.

Dayananda Sagar University
School of Engineering
Devarakaggalahalli , Harohalli , Kanakapura Road , Ramanagar District- 562112

DEPARTMENT OF ELECTRONICS AND COMMUNICATION ENGINEERING

INTERNET OF THINGS
[As per Choice Based Credit System (CBCS) scheme]

SEMESTER – VII

Subject Code	:	**Credits**	: 03
Hours / Week	: 3 Hours	**Total Hours**	: 39 Hours
L–T–P	: 3-0-0		

Course Learning Objectives:

This Course will enable students to:

1. Understand about the fundamentals of Internet of Things and its building blocks along with their characteristics.
2. Understand the recent application domains of IoT in everyday life.
3. Learn about IoT sensors, communication protocols, and data analytics techniques
4. Understanding of the technologies and the standards relating to the Internet of Things.
5. Analyze real-world case studies, design and implement IoT solutions

Teaching-Learning Process (General Instructions)

These are sample new pedagogical methods, where teacher can use to accelerate the attainment of the various course outcomes.

1. ***Lecture method*** means it includes not only traditional lecture method, but different *type of teaching methods* may be adopted to develop the course outcomes.
2. ***Interactive Teaching:*** *Adopt the* ***Active learning*** that includes brainstorming, discussing, group work, focused listening, formulating questions, note taking, annotating, and role playing.
3. Show ***Video/animation*** films to explain functioning of various concepts.
4. Encourage ***Collaborative*** (Group Learning) Learning in the class.
5. To make ***Critical thinking***, ask at least three Higher order Thinking questions in the class.
6. Adopt ***Problem Based Learning***, which fosters students' Analytical skills, develop thinking skills such as the ability to evaluate, generalize, and analyze information rather than simply recall it.
7. Show the ***different ways to solve*** the same problem and encourage the students to come up with their own creative ways to solve them.
8. Discuss how every ***concept can be applied to the real world*** - and when that's possible, it helps improve the students' understanding.

Dayananda Sagar University

School of Engineering

Devarakaggalahalli , Harohalli , Kanakapura Road , Ramanagar District- 562112

DEPARTMENT OF ELECTRONICS AND COMMUNICATION ENGINEERING

UNIT – I	08 Hours
INTRODUCTION TO IoT, IoT Ecosystem: Introduction, Enabling IoT and the Complex Interdependence of Technologies, IoT architectural View, Technology behind IoT, Sources of IoT, Drivers behind New Network Architectures, Comparing Architectures, M2M Communication, M2M Architecture, Core IoT Functional Stack, Data Management and Compute stack Examples of IoT **Textbook 1: Chapter 1- 1.1 to 1.3 Chapter 4 – 4.1 to 4.4**	
UNIT – II	**08 Hours**
IOT SENSING, ACTUATION, INTERFACING: Introduction to sensors & transducers: characteristics and specifications of sensors Sensor Technology and sensors used in typical IoT applications, Signal condition in modules of IoT system, Sensor Data Communication Protocols, RFID Technology, Introduction to actuators, Different types of actuators APIs and Interfacing in IoT **Textbook 1: Chapter 5 – 5.1 to 5.9**	
UNIT – III	**08 Hours**
IOT PROCESSING TOPOLOGIES, NETWORKING & COMMUNICATION: IoT Processing Topologies: Data Collection and preprocessing, IoT network: Common Positioning topologies for IoT infrastructure, Star, mesh, and hybrid network, Communication criteria, IoT Access technologies: Wired and Wireless Communication protocols for IoT: Zigbee, Bluetooth Low Energy (BLE), MQTT, CoAP, HTTP, and WebSocket, Wi-Fi, LoRa, and NB-IoT, (IEEE 802.15.4, IEEE1901.2a, LoRaWAN, NB-IoT and other LTE variations: Introduction and comparison) Data Enrichment, Data Consolidation and Device Management at Gateway. IoT Network Layer, IoT Vulnerabilities, Security requirements and threat analysis, Use Cases, Security Models **Textbook 1: Chapter 6 – 6.1 to 6.5**	
UNIT – IV	**08 Hours**
SOCIATED IOT TECHNOLOGIES: Different categories of data, structured versus unstructured data, Motion Data- Rest Data, Data Analytics Overview, Machine Learning – Overview, Requirements of Prototype designing, Embedded Computing Basics: Embedded Software, IDE, Hardware Units, Embedded Platforms for prototyping **Textbook 1: Chapter 10– 10.1 to 10.6; Chapter 12- 12.1-12.2**	

Dayananda Sagar University

School of Engineering

Devarakaggalahalli , Harohalli , Kanakapura Road , Ramanagar District- 562112

DEPARTMENT OF ELECTRONICS AND COMMUNICATION ENGINEERING

UNIT – V	07 Hours
IoT DESIGN, CASE STUDIES Design Layers, Design complexity levels, Product development and deployment Design using Cloud PaaS, Example IoT Applications: Connected ATM premises, Smart City, Smart Grid, Smart Transportation, Smart Manufacturing, Smart Healthcare, Home Automation, Precision Agriculture, Smart vehicles, Streetlights control, Supply Chain monitoring. **Textbook 1: Chapter 13– 13.1; Chapter 14- 14.1-14.2; Chapter 17- 17.1**	

Course Outcome	Description	Bloom's Taxonomy Level
At the end of the course the student will be able to:		
1	**Demonstrate** an understanding of the Internet of Things (IoT) and its ecosystem, including the components, architecture, and evolution of IoT technologies and interaction of IoT device with the physical world environment	L2
2	**Acquire** proficiency in selecting, configuring, and integrating sensors and actuators into IoT systems to collect and act upon real-world data effectively.	L2
3	**Analyze** and select networking and communication techniques used in IoT applications, including wireless communication technologies, network architectures, and communication protocols ensuring acquired sensor data to be reliably collected and transmitted for analysis.	L3
4	**Utilize** associated IOT Technologies and data analytics techniques to derive insights and make informed decisions in IoT implementations	L4
5	**Understand** real-world IoT implementations across different domains, analyzing their implementation, challenges, and impact on society and industries and realize the importance of sensor integration, networking, and data analytics in real-world applications.	L3

Dayananda Sagar University
School of Engineering
Devarakaggalahalli , Harohalli , Kanakapura Road , Ramanagar District- 562112

DEPARTMENT OF ELECTRONICS AND COMMUNICATION ENGINEERING

	Table: Mapping Levels of COs to POs / PSOs													
Cos	**Program Outcomes (POs)**												**PSOs**	
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**
CO1	3	2	1		-	1			-	-		2	2	2
CO2	3	2	2	1	-	1		1	-	-		2	2	2
CO3	3	2	3	2	-	1		1	-	-		2	2	1
CO4	3	2	2	1	2	2		1	-	-		2	2	1
CO5	3	3	2	2	-	2		1	2	2		2	2	1

3: Substantial (High) **2: Moderate (Medium)** **1: Poor (Low)**

TEXTBOOK(S):

1. Sudip Misra, Anandarup Mukherjee, Arijit Roy, "Introduction to IoT", Cambridge University Press 2021.
2. D. Hanes, G. Salgueiro, P. Grossetete, R. Barton, J. Henry; IoT Fundamentals: Networking Technologies, Protocols, and Use Cases for the Internet of Things, 1st Edition, Pearson India Pvt. Ltd., 2018.
3. Raj Kamal, Internet of Things, Architecture and Design Principles,

REFERENCE(S):

1. S. Misra, C. Roy, and A. Mukherjee, 2020. Introduction to Industrial Internet of Things and Industry 4.0. CRC Press.
2. Vijay Madisetti and Arshdeep Bahga, "Internet of Things (A Hands-on-Approach)",1st Edition, VPT, 2014.
3. Cuno Pfister, "Getting Started with the Internet of Things", Shroff Publisher/Maker Media. Internet of Things, Shriram K Vasudevan, Abhishek S Nagarajan, RMD Sundaram, John Wiley & Sons.

E-Resources:

1. https://nptel.ac.in/noc/courses/noc19/SEM1/noc19-cs31/
2. https://www.udemy.com/course/internet-of-things-iot-fundamental-course-iot-101-level/?couponCode=IND21PM

Activity Based Learning (Suggested Activities in Class):

- Switch on an LED if a button is pressed.
- Demonstrate a sensor-based application.

****

Dayananda Sagar University

School of Engineering

Devarakaggalahalli , Harohalli , Kanakapura Road , Ramanagar District- 562112

DEPARTMENT OF ELECTRONICS AND COMMUNICATION ENGINEERING

INDUSTRIAL AUTOMATION

[As per Choice Based Credit System (CBCS) scheme]

SEMESTER VII

Course Code	:		Credits	:	03
Hours / Week	:	03 Hours	Total Hours	:	39 Hours
L T P	:	3 0 0			

Course Learning Objectives:

This Course will enable students to:

1. Understand the basic principles and concepts of industrial automation.
2. Analyze and design control systems for industrial processes.
3. Apply programmable logic controllers (PLCs) in industrial automation.
4. Integrate sensors and actuators into automated systems.
5. Adapt to new technologies and advancements in industrial automation.

Teaching-Learning Process (General Instructions)

These are sample new pedagogical methods, where teacher can use to accelerate the attainment of the various course outcomes.

1. Lecture method means it includes not only traditional lecture method, but also different type of teaching methods may be adopted to develop the course outcomes.
2. Interactive Teaching: Adopt the Active learning that includes brainstorming, discussing, group work, focused listening, formulating questions, notetaking, annotating, and roleplaying.
3. Show Video/animation films to explain functioning of various concepts.
4. Encourage Collaborative (Group Learning) Learning in the class.
5. To make Critical thinking, ask at least three Higher order Thinking questions in the class.
6. Adopt Problem Based Learning analytical thinkingskillssuchastheabilitytoevaluate, generalize, andanalyzeinformationrather than simply recallit.
7. Show the different ways to solve the same problem and encourage the students to come up with their own creative ways to solve them.
8. Discuss how every concept can be applied to the real world - and when that's possible,it helps improve the students' understanding.

Dayananda Sagar University

School of Engineering

Devarakaggalahalli , Harohalli , Kanakapura Road , Ramanagar District- 562112

DEPARTMENT OF ELECTRONICS AND COMMUNICATION ENGINEERING

COURSE CONTENT:	
UNIT-I	**07 Hours**
Introduction to Industrial Automation: Introduction, Architecture of Industrial Automation Systems, Types of Automation, levels of Automation Terminologies- Measurements and control, positioning concept of Automation, Applications	
UNIT-II	**08 Hours**
Automation Sensory Devices: General Characteristic of sensor, Angular and Linear Position sensor, Velocity and Acceleration Sensors Contact sensor, Distance and Velocity Sensor	
UNIT-III	**08 Hours**
MEMS Fabrication Technologies: Introduction to Automatic Control, P-I-D Control, Introduction to sequence control, PLC, PLC Hardware Environment, PLC Programming Languages, PLC Program.	
UNIT-IV	**08 Hours**
Mechanical and Actuation Mechanism Components and Modelling: Elementary Mechanical Concepts, Motion Conversion, Modeling of Mechanical System,Define the End Effectors, control method of actuators	
UNIT-V	**08 Hours**
COMMUNICATION IN AUTOMATION: The Field bus Networks, DCS, SCADA Systems, Higher Level of Automation	

Course Outcome	Description	Bloom's Taxonomy Level
At the end of the course the student will be able to:		
CO1	Define industrial automation and explain its significance in modern industries	L2
CO2	Selection of appropriate sensors and actuators for different industrial applications.	L2
CO3	Design control systems using various control strategies -Program PLCs using ladder logic, function block diagrams,	L3
CO4	**Incorporate** mechanical and actuator mechanism like motion conversion modeling mechanical system, actuation control	L3
CO5	**Interpret** communication technologies used to develop SCADA System and DCS	L2

Dayananda Sagar University
School of Engineering
Devarakaggalahalli , Harohalli , Kanakapura Road , Ramanagar District- 562112

DEPARTMENT OF ELECTRONICS AND COMMUNICATION ENGINEERING

Table: Mapping Levels of COs to POs / PSOs														
COs	**Program Outcomes (POs)**												**PSOs**	
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**
CO1	3	2	-	-	-	1	-	-	-	-	-	3	3	2
CO2	3	2	-	-	-	1	-	-	-	-	-	3	3	2
CO3	3	2	-	-	3	1	-	-	-	-	-	3	3	2
CO4	3	2	-	-	-	1	-	-	-	-	-	3	3	2
CO5	3	2	-	-	3	1	-	-	-	-	-	3	3	2

TEXT BOOKS:

1. Groover, M. P., Automation, Production System & Computer Integrated Manufacturing, Pearson Education Asia (2009).
2. Garry Dunning Programmable Logic Controller.
3. Programmable Logic Controllers by Frank Petruzella.
4. JM 608 Industrial Automation, An Engineering Approach Politeknik Port Dickson, 2013, word press.

REFERENCES:

1. Industrial Instrumentation, Control and Automation, S. Mukhopadhyay, S.Sen and A.K. Deb,Jaico Publishing House, 2013
2. 2. Electric Motor Drives, Modelling, Analysis and Control, R.Krishnan, Prentice Hall India, 2002
3. Majumdar, S. R., Pneumatic Systems, McGraw Hill (2005).
4. Nakra, B. C., Theory and Applications of Automatic Controls, Revised 2nd Edition, New Age International Publishers (2014).

ALTERNATIVE NPTEL/SWAYAM COURSE:

S. No.	NPTEL Course Name	Instructor	Host Institute
1	Industrial Automation & control	Prof. S. Mukhopadhyay	IIT Kharagpur

Dayananda Sagar University

School of Engineering

Devarakaggalahalli , Harohalli , Kanakapura Road , Ramanagar District- 562112

DEPARTMENT OF ELECTRONICS AND COMMUNICATION ENGINEERING

ELECTRIC VEHICLE TECHNOLOGY

[As per Choice Based Credit System (CBCS) scheme]

SEMESTER VII

Course Code	:		Credits	:	03
Hours / Week	:	3 Hours	Total Hours	:	39 Hours
L T P	:	3-0-2			
Pre-requisite	:				

Course Learning Objectives:

By the end of the course, students will be proficient in:

1. To provide a comprehensive understanding of electric vehicle (EV) technologies, including the principles of operation, components, and different types of EVs.
2. To explore the science behind battery technologies used in EVs, including types of batteries, charging methods, and battery management systems.
3. To learn about the power electronics and motor drive systems used in EVs, including inverters, converters, and motor control algorithms.
4. To understand the different types of EV charging stations, charging protocols, and the development of EV charging infrastructure.
5. To explore energy management strategies for EVs, including regenerative braking, powertrain optimization, and energy-efficient driving techniques.

Teaching-Learning Process (General Instructions)

These are sample new pedagogical methods, where teacher can use to accelerate the attainment of the various course outcomes.

1. Lecture method means it includes not only traditional lecture method, but also different type of teaching methods may be adopted to develop the course outcomes.
2. Interactive Teaching: Adopt the Active learning that includes brainstorming, discussing, group work, focused listening, formulating questions, notetaking, annotating, and roleplaying.
3. Show Video/animation films to explain functioning of various concepts.
4. Encourage Collaborative (Group Learning) Learning in the class.
5. To make Critical thinking, ask at least three Higher order Thinking questions in the class.
6. Adopt Problem Based Learning analytical thinkingskillssuchastheabilitytoevaluate, generalize, andanalyzeinformationrather than simply recallit.
7. Show the different ways to solve the same problem and encourage the students to come up with their own creative ways to solve them.
8. Discuss how every concept can be applied to the real world - and when that's possible,it helps improve the students' understanding.

Dayananda Sagar University

School of Engineering

Devarakaggalahalli , Harohalli , Kanakapura Road , Ramanagar District- 562112

DEPARTMENT OF ELECTRONICS AND COMMUNICATION ENGINEERING

COURSE CONTENT:	
UNIT - I	**08 Hrs**
Electric Vehicles-An Overview: Electric vehicles (EVs) and their history, Types of EVs: Battery Electric Vehicles (BEVs), Plug-in Hybrid Electric Vehicles (PHEVs), Hybrid Electric Vehicles (HEVs) Comparison of EVs with internal combustion engine vehicles, Environmental impact and benefits of EVs	
UNIT - II	**08Hrs**
Electric Vehicle Components and Architecture: Electric vehicle architecture: powertrain, battery, motor, controller, charging system Types of batteries used in EVs: Lithium-ion, Nickel-Metal Hydride (NiMH) Electric motors: DC motors, AC induction motors, permanent magnet synchronous motors Power electronics: inverters, converters, and their role in EVs	
UNIT - III	**8 Hrs**
Electric Vehicle Charging Infrastructure: Overview of EV charging: Level 1, Level 2, Level 3 (DC fast charging), Charging station components and standards: CHAdeMO, CCS, Type 2 (Mennekes), Tesla Supercharger, Charging network development and challenges, Smart charging and vehicle-to-grid (V2G) technology	
UNIT - IV	**08Hrs**
Electric Vehicle Drivetrain and Control Systems: Electric vehicle drivetrain configurations: front-wheel drive, rear-wheel drive, all-wheel drive, Regenerative braking: principle and implementation in EVs, Vehicle control systems: traction control, stability control, torque vectoring, Energy management systems and optimization techniques	
UNIT - V	**07Hrs**
Electric Vehicle Testing, Safety, and Standards: Testing and certification of EV components and systems, Safety considerations for EVs: high-voltage systems, crash safety, fire safety, Global standards for EVs: ISO, IEC, SAE standards, Future trends in electric vehicle technology	

Dayananda Sagar University
School of Engineering
Devarakaggalahalli , Harohalli , Kanakapura Road , Ramanagar District- 562112

DEPARTMENT OF ELECTRONICS AND COMMUNICATION ENGINEERING

Course Outcome	Description	Bloom's Taxonomy
At the end of the course the student will be able to:		
CO1	To demonstrate a comprehensive understanding of electric vehicle technologies, including their principles, components, and	L1
CO2	To understand different battery technologies used in electric vehicles and evaluate their advantages and limitations.	L1, L2
CO3	To apply power electronics systems for electric vehicles, including inverters, converters, and motor drives.	L3
CO4	To analyze energy management strategies for electric vehicles, such as regenerative braking and powertrain optimization.	L4
CO5	To analyze the environmental and economic impacts of electric vehicles compared to conventional vehicles.	L4

Table: Mapping Levels of COs to POs / PSOs

COs	Program Outcomes (POs)												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	3	2	-	-	-	1	-	-	-	-	-	3	3	2
CO2	3	2	-	-	-	1	-	-	-	-	-	3	3	2
CO3	3	2	-	-	3	1	-	-	-	-	-	3	3	2
CO4	3	2	-	-	-	1	-	-	-	-	-	3	3	2
CO5	3	2	-	-	3	1	-	-	-	-	-	3	3	2

TEXT BOOKS:

1. Larminie, J. and Lowry, J., 2012. Electric vehicle technology explained. John Wiley & Sons.
2. Sandeep Dharmeja, Electric Vehicle Battery Systems, 1st Edition, Newnes, 2001
3. Mehrdad Ehsani, Yimin Gao, sebastien E. Gay and Ali Emadi, "Modern Electric, Hybrid Electric and Fuel Cell Vehicles: Fundamentals, Theory and Design", CRC Press, 2009

REFERENCES:

1. Husain, I., 2021. Electric and hybrid vehicles: design fundamentals. CRC press.
2. Young, K., Wang, C., Wang, L.Y. and Strunz, K., 2012. Electric vehicle battery
3. C.C Chan, K.T Chau: Modern Electric Vehicle Technology, Oxford University Press Inc., New York 2001.

Dayananda Sagar University

School of Engineering

Devarakaggalahalli , Harohalli , Kanakapura Road , Ramanagar District- 562112

DEPARTMENT OF ELECTRONICS AND COMMUNICATION ENGINEERING

ALTERNATIVE NPTEL/SWAYAM COURSE:

Sl.No.	NPTEL Course Name	Instructor	Host Institute
1	Electric Vehicle and Renewable Energy Part 1: Introduction to Electric Vehicles and Vehicle subsystem requirements	Prof. Ashok Jhunjhunwala	IIT Madras