Course Curriculum for B. Tech.

In

Electronics & Communication Engineering

(For students admitted in 2025-26 onwards)

National Institute of Technology Arunachal Pradesh

P.O.: Jote, Dist.: Papumpare, Arunachal Pradesh, Pin–791113

www.nitap.ac.in

Semesters	1	2	3	4	5	6	7	8	
Minimum Credits	**20**	**42**	**64**	**85**	**105**	**126**	**148**	**160-172**	
Multiple Entry	ENTRY		ENTRY		ENTRY		ENTRY		
Student Support Programs	Intensive Orientation	Finishing School	Bridge Course	Finishing School	Bridge Course	Finishing School	Bridge Course	Finishing School	Finishing School
Degree/ Certification		Certificate		Diploma		B.Sc. Degree		B. Tech	B. Tech Honors
Multiple Exit Points		EXIT		EXIT		EXIT		EXIT	EXIT

Table 2. Course Structure and Credit Requirements

Description	**Details**	**Total Credits**	**Comments**	**Exit Degree**
Mathematics + Science + Humanities + Arts	SMASH1	26	Science+ Mathematics + Arts + Social Science + Humanities (SMASH) Basket	
Major	MA1	50	Major for 2-year Diploma	
Project and Internship	AP1	6	If opting for 2-year course	
Electives	E1	3	If opting for 2-year course	
Total (D)	SMASH + MA1 + AP1 + E1	**85**	Mandatory Credits for 2 Year Course	Eligible for Diploma in ECE
Humanities	SMASH2	SMASH1 + 3 = 29	Science+ Mathematics + Arts + Social Science + Humanities (SMASH) Basket	
Major	MA2	MA1+15 = 65	Major Basket - 1	
Project and Internship	AP2	AP1+5=11		
Electives	E2	E1+18 = 21	Electives + Open Electives	
Total (B1)	SMASH + MA2 + AP2 + E2	**126**	Mandatory Credits for 3 Year Course	Eligible for B. Sc. in Engineering Degree with Major in ECE
Major	MA3	MA2 + 3 = 68	Major Basket – 2	
Electives	E3	E2 + 24 = 45	Electives	
Project & Internship	AP3	AP2 + 7 =18		
Total (B2)	SMASH2 + MA3 + AP3+E3	**160**	Mandatory Credits for 4 Year Course	Eligible for B. Tech. Degree (4-Year) with Major in ECE
Honours*	Theory	12	Additional Subjects	
Total (B3)	Total	**172**		Eligible for B. Tech. With Honours Degree (4 Years) with Major in ECE

Year	SMASH	Project/AP	Major	Electives	Open Elective	Total	Cumulative Credit	Exit Degree
1st	21	2	19			42	42	Certificate
2nd	5	4	31	3		43	85	Diploma
3rd	3	5	15	12	6	41	126/132*	B.Sc (Eng)
4th	0	7	3	24		34	160/172*	B.Tech
Total	29	18	68	39	6	160		
***Credit for B.Tech Hons**								

Semester wise Break Up for Credit Requirement								
Course Category	1st Semester Credits	2nd Semester Credits	3rd Semester Credits	4th Semester Credits	5th Semester Credits	6th Semester Credits	7th Semester Credits	8th Semester Credits
SMASH	13	8	5	0	3	0	0	0
MAJOR	7	12	16	15	12	3	3	0
AP01	0	2	1	3	0		0	0
AP02	0	0	0	0	2	3	4	3
ELECTIVE	0	0	0	3	0	12	15	9
OPEN ELECTIVE	0	0	0	0	3	3	0	0
Hons*					3*	3*	3*	3
Total	20	22	22	21	20 + 3*	21 + 3*	22 + 3*	12 + 3*
*Credit for B.Tech Hons								

Semester wise Credit point distribution

Sl. No.	Year	Credit Point		
		ODD	EVEN	Hons
1	First	20	22	
2	Second	22	21	
3	Third	20	21	6
4	Fourth	22	12	6
Total Credit Point		**84**	**76**	**12**
		160		**172***

1.0 Course Structure

Ist Semester							
Sl No	Course Code	Subject Category	Course Title	L	T	P	C
1	BS-1101	SC1/SM1	Engineering Mathematics-I	2	0	0	2
2	BS-1102	SC2/SM2	Engineering Chemistry	2	0	0	2
3	BS-1103	SC3/SM3	Engineering Physics	2	0	0	2
4	CS-1101	ESA1/MAJ1	Coding Laboratory	0	1	2	2
5	EC-1101	DSC1/MAJ2	Digital Logic Design	3	0	0	3
6	MH-1101	SECC1/SM4	Communication Skill	2	0	0	2
7	EE-1101	ESA2/SM5	Basic of Electrical and Electronics Engineering	2	0	0	2

8	EE-1102	ESA3/SM6	Basic of Electrical and Electronics Engineering Laboratory	0	0	2	1
9	BS-1104	SC4/SM7	Engineering Physics Laboratory	0	0	2	1
10	ME-1102	ESA4/MAJ3	Engineering Drawing	0	0	2	1
11	EC-1102	DSC2/MAJ4	Digital Logic Design Laboratory	0	0	2	1
12	MH-1102	SECC2/SM8	Language Laboratory	0	0	2	1
13	MH-1103	VAC1	NSS/NCC/Yoga (Audit Pass)	0	0	0	0
Contact Hours				13	1	12	
Total Credits							20
IInd Semester							
Sl No	**Course Code**	**Subject Category**	**Course Title**	**L**	**T**	**P**	**C**
1	BS-1201	SC5/SM9	Engineering Mathematics-II	2	0	0	2
2	BT-1201	ESA5/SM10	Biology for Engineers	2	0	0	2
3	CS-1201	ESA6/MAJ5	Programming and Data Structure	3	0	0	3
4	CS-1202	ESA7/MAJ6	AI in Engineering	2	0	0	2
5	ME-1201	ESA8/MAJ7	Engineering Mechanics	3	0	0	3
6	EE-1201	DSC3/MAJ8	Electromagnetics Field Theory	3	0	0	3
7	MH-1201	ESA9/SM11	Law and Financial Aspects in Engineering	2	0	0	2
8	EC-1201	VAC2/AP1-01	Do It Yourself (DIY)/Industry Exposure	0	0	4	2
9	BS-1202	SC6/SM12	Engineering Chemistry Laboratory	0	0	2	1
10	CS-1205	ESA10/MAJ9	Programming and Data Structure Laboratory	0	0	2	1
11	MH-1202	VAC3/SM13	Indian Knowledge System	0	0	2	1
Contact Hours				17	0	10	
Total Credits							22
IIIrd Semester							
Sl No	**Course Code**	**Subject Category**	**Course Title**	**L**	**T**	**P**	**C**
1	BS-2101	SC7/SM14	Engineering Mathematics-III	3	0	0	3
2	MH-2101	ESA11/SM15	Introduction to Innovation and Creativity	2	0	0	2
3	EE-2101	DSC4/MAJ10	Linear Control Systems	3	0	0	3
4	EC-2101	DSC5/MAJ11	Signals and Systems	3	0	0	3
5	EC-2102	DSC6/MAJ12	Semiconductor Device Physics	3	0	0	3
6	EE-2102	DSC7/MAJ13	Electrical Circuit Analysis	3	0	0	3
7	EC-2103	DSC8/MAJ14	Microprocessor and Interfacing	3	0	0	3
8	EE-2106	LAB1/MAJ15	Linear Control Systems Laboratory	0	0	2	1
9	EC-2104	SECC3/AP1-02	Skill Development-I (Microprocessor Lab)	0	0	2	1
Contact Hours				20	0	4	
Total Credits							22
IVth Semester							

Sl No	Course Code	Subject Category	Course Title	L	T	P	C
1	EC-2201	DSC9/MAJ16	Electronic Circuits	3	0	0	3
2	EC-2202	DSC10/MAJ17	Analog Communication	3	0	0	3
3	EC-2203	DSC11/MAJ18	Introduction to Digital Integrated Circuits	3	0	0	3
4	EC-2204	DSC12/MAJ19	Digital Signal Processing	3	0	0	3
5	EC-2205	DSC13/MAJ20	Microcontrollers and Embedded Systems	3	0	0	3
6	EC-2206	LAB2/MAJ21	Electronic Circuits Laboratory	0	0	2	1
7	EC-2207	LAB3/MAJ22	Analog Communication Laboratory	0	0	2	1
8	EC-2208	LAB4/MAJ23	Digital Signal Processing Laboratory	0	0	2	1
9	EC-2209	SECC4/AP1-03	Skill Development-II (Microcontroller Lab)	0	0	2	1
10	EC-2210	VAC4/AP1-04	Minor Project-I	0	0	4	2
Contact Hours				15	0	12	
Total Credits							21
Vth Semester							
Sl No	**Course Code**	**Subject Category**	**Course Title**	**L**	**T**	**P**	**C**
1	EC-3101	DSC14/MAJ24	Digital Communication	3	0	0	3
2	EC-3102	DSC15/MAJ25	Antennas & Microwaves	3	0	0	3
3	EC-3103	DSC16/MAJ26	Introduction to Analog Integrated Circuits	3	0	0	3
4	MH-3101	ESA12/SM16	Entrepreneur Essential and Early Stage Start Up	3	0	0	3
5	EC-3104	LAB5/MAJ27	VLSI Circuit Laboratory	0	0	2	1
6	EC-3105	LAB6/MAJ28	Digital Communication Laboratory	0	0	2	1
7	EC-3106	LAB7/MAJ29	Antennas & Microwaves Laboratory	0	0	2	1
8	EC-3107	SECC5/AP2-02	Skill Development-III (Verilog HDL)	0	0	2	1
9	EC-3108	AECC1/AP2-01	Internship-I	0	0	2	1
10	EC-310X	OE1	Basics of Information Theory & Coding	3	0	0	3
11	EC-310H	HONS1	Power Electronics	3	0	0	3*
Contact Hours				15	0	10	
Total Credits							20
* Credit for B. Tech (Hons)							23
VIth Semester							
Sl No	**Course Code**	**Subject Category**	**Course Title**	**L**	**T**	**P**	**C**
1	EC-321A	DSE1	Introduction to VLSI Fabrication	3	0	0	3
2	EC-322A	DSE2	Information Theory and Coding	3	0	0	3
3	EC-323A	DSE3	Wireless Communication	3	0	0	3
4	EC-324A	DSE4	Electronic Instrument and Measurement	2	0	0	2
5	EC-325A	DSE5	Machine Learning	3	0	0	3
6	EC-3201	LAB8/MAJ30	Electronic Instrument and Measurement Laboratory	0	0	2	1

7	EC-3202	SECC6/AP2-04	Skill Development-IV (Machine Learning)	0	0	2	1
8	EC-3203	VAC5/AP2-03	Minor Project-II	0	0	4	2
9	EC-320X	OE2	Basics of Wireless Communication	3	0	0	3
10	EC-320H	HONS2	Computer Network	3	0	0	3*
Contact Hours				17	0	8	
Total Credits							21
* Credit for B. Tech (Hons)							24

VIIth Semester

Sl No	Course Code	Subject Category	Course Title	L	T	P	C
1	EC-411A	DSE6	ELECTIVE – 24 – DSE23 – Robotics Engineering	3	0	0	3
2	EC-412A	DSE7	ELECTIVE – 24 – DSE23 – 5G & Advanced Communication	3	0	0	3
3	EC-413A EC-413B	DSE8	ELECTIVE – 24 – DSE23 – Biomedical Instrumentation ELECTIVE – 24 – DSE23 – Memory Design	3	0	0	3
4	EC-414A EC-414B	DSE9	ELECTIVE – 24 – DSE23 – Optical Communication ELECTIVE – 24 – DSE23 – VLSI System Design	3	0	0	3
5	EC-415A EC-415B	DSE10	ELECTIVE – 24 – DSE23 – Low Power VLSI ELECTIVE – 24 – DSE23 – Digital Image Processing	3	0	0	3
6	EC-4101	LAB9/MAJ31	Robotics Engineering Laboratory	0	0	2	1
7	EC-4102	LAB10/MAJ32	5G & Advanced Communication Laboratory	0	0	2	1
8	EC-416A EC-416B	LAB11/MAJ33	Optical Communication Laboratory VLSI System Design Laboratory	0	0	2	1
9	EC-4105	AECC2/AP2-06	AP2 – 05 – AECC2 – Internship-II	0	0	2	1
10	EC-4106	VAC6/AP2-05	Major Project-I	0	0	6	3
11	EC-410H	HONS	Satellite Communication	3	0	0	3*
Contact Hours				15	0	14	
Total Credits							22
* Credit for B. Tech (Hons)							25

VIIIth Semester

Sl No	Course Code	Subject Category	Course Title	L	T	P	C
1	EC-421A	DSE11	SWAYAM	3	0	0	3
2	EC-422A	DSE12	SWAYAM	3	0	0	3
3	EC-423A	DSE13	SWAYAM	3	0	0	3
4	EC-4201	VAC7/AP2-07	Major Project-II	0	0	6	3
5	EC-420H	HONS4	Sensors and Transducers	3	0	0	3*
Contact Hours				9	0	6	
Total Credits							12

* Credit for B. Tech (Hons)		15

2.0 Open elective (offered by other departments)

- Students are free to choose any subjects of their interest offered as open electives by other department of the Institute.
- The total course has to be of 6 credits.
- During the beginning of the 5th semester onwards, HoD, Electronics & Communication will notify the specific subject offered as an open elective for other departments.

Sl No	Course Code	Subject Category	Course Title	L	T	P	C
1	EC-310X	OE1	Basics of Information Theory & Coding	3	0	0	3
2	EC-320X	OE2	Basics of Wireless Communication	3	0	0	3

3.0 Internship

- Internship - I: Student will go for internship during summer vacation (after 4th semester) for a period of 4 weeks. The assessment will be done on 5th semester
- Internship - II: Student will go for internship during summer vacation (after 6th semester) for a period of 4 weeks. The assessment will be done on 7th semester
- At least one internship has to be done in Industry preferably during Internship - II.

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INSTITUTE VISION

"Our vision is to impart quality technical education with strong underpinning of sound knowledge in the domain. Our approach is interactive, innovative and quintessentially holistic. Our goal is to produce imaginative entrepreneurs, technology leaders of the new millennium and researchers with a profound sense of humanistic and ethical values."

INSTITUTE MISSION

"Our mission is that of producing such Technical Engineers who will not run after jobs, but for whom jobs will run after them, and such that they will create employment and develop new technologies for a faster, sustainable and inclusive growth."

DEPARTMENT VISION

"To pursue excellence in education and research in Electronics and Communication Engineering"

DEPARTMENT MISSION

The mission of the Department of Electronics and Communication Engineering are:

- To impart strong theoretical and experimental foundation in Electronics and Communication Engineering
- To educate students with state of art technologies to meet the growing challenges of industry as well as society
- To produce and disseminate theory, principles, practice and know – how of various fields of Electronics such as Communication, signal processing, VLSI, Nanotechnology and many more in tune with the needs and demands of changing times.

Programme Outcomes (POs)

The students who have undergone the B.Tech. programme in Electronics and Communication Engineering (ECE) will be able to:

PO1	Apply basic science and mathematics to analyze complex engineering problems
PO2	Gather requirement specifications, design and test electronic systems.
PO3	Apply EDA tools to design linear and digital IC systems.
PO4	Analyze and design noise-free analog and digital communication systems
PO5	Evaluate strengths and weaknesses of evolving state of art communication systems.
PO6	Understand and practice professional ethics.
PO7	Work in a team using technical skills, common tools and environments to achieve project objective.
PO8	Communicate effectively with peers and others.

राष्ट्रीय प्रौद्योगिकी संस्थान अरुणाचल प्रदेश

NATIONAL INSTITUTE OF TECHNOLOGY ARUNACHAL PRADESH

(शिक्षा मंत्रालय, भारत सरकार के तहत राष्ट्रीय महत्व का संस्थान)

(Institute of National Importance under Ministry of Education, Govt. of India)

CURRICULUM

Programme	B. Tech in Electronics & Communication Engineering	**Academic Year of Regulation**	**2025-26**
Department	Electronics & Communication Engineering	**Semester**	**I**

Course Code	**Course Name**	**Credit Structure**					**Marks Distribution**			**Bloom's Taxonomy**
		L	**T**	**P**	**C**	**INT**	**MID**	**END**	**Total**	
EC-1101	Digital Logic Design	**3**	**0**	**0**	**3**	**20**	**30**	**50**	**100**	

Course Objectives	**Course Outcomes**			**Bloom's Taxonomy**
1. To understand the principles of Boolean logic and optimize the circuits. **2.** To develop the skills for modular Boolean, Arithmetic and Sequential circuits. **3.** To develop the student ability to design circuits using EDA tools		**CO1**	Explain the basic concepts of Boolean algebra, optimization of circuits and introduction of digital logic families.	Knowledge
		CO2	To understand the design aspects of combinational and sequential circuits along with Verilog HDL	Understand
		CO3	To apply the knowledge of simplification of Boolean expressions to predict and analyse the behaviour of synchronous and asynchronous circuits.	Apply
		CO4	To analyze the digital circuits and behaviour using CAD tools.	Analyze

No.	**COs**	**Mapping with Program Outcomes (POs)**												**Mapping with PSOs**		
		PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
1	CO1	3	2	2	1	-	-	-	-	-	-	-	-	2	1	2
2	CO2	2	2	1	1	-	-	-	-	-	-	-	-	2	1	2
3	CO3	3	3	3	1	2	-	-	-	-	-	-	-	3	3	3
4	CO4	2	2	2	1	2	-	-	-	-	-	-	-	2	3	3
(Average)		2.5	2.25	2	1	1	-	-	-	-	-	-	-	2.25	2	2.5

SYLLABUS

No.	**Content**	**Hours**	**COs**
I	***Number systems***: Decimal, Binary, Octal and Hexadecimal systems, Conversion of a number from one base to another, Introduction to logic gates. ***Boolean algebra***: Theorems and operations, Boolean expressions and truth tables, Duality and inversion, Multiplying out and factoring expressions, Exclusive-OR and equivalence operations, Positive and negative logic.	**5**	**CO1**
II	***Minimization techniques***: Minterms and maxterms expressions. Algebraic method, Karnaugh maps (including 5 and 6 variables), Quine-McCluskey method, multi-output circuits, multi-level circuits, Design of circuits with universal gates. ***Codes***: BCD, Excess- 3, Gray, ASCII, EBCDIC.	**5**	**CO1**
III	***Combinational circuits***: Arithmetic circuits: adders and subtractor-ripple carry adders, carry look ahead adders, Adder cum subtractor, BCD Adder and Subtractor, Comparator, Decoder, Encoder, Priority encoder, MUX/DEMUX and their structures, logic using ROM array, Applications of MSI designs.	**5**	**CO2**
IV	***Sequential circuits***: Latches and Flip-Flops: SR latch, SR Flip-Flop, JK Flip-Flop, D Flip-Flop, T Flip-Flop, Flip-Flops with preset and clear inputs, Triggering methods and their circuits, Conversion of one type of flip flop to another, Excitation table, Applications of Flip Flops. Difference between synchronous and asynchronous circuits.	**7**	**CO2, CO3**
V	***Shift registers***: Right shift, Left shift, Bidirectional, SISO, SIPO, PISO, PIPO, Universal shift registers. Counters: Operation; up counter, Down counter, up/down counter, mod n counters, other types of Counters: Ring counter, Johnson counter, BCD counter.	**6**	**CO3**
VI	***Finite State Machines***: Mealy & Moore types, Basic design steps, Design of counters using sequential circuit approach. ***Asynchronous sequential circuits***: Analysis and synthesis, State reduction and state assignment, Hazards.	**7**	**CO3**
VII	***Introduction to digital logic families***: Characteristics, Basic working of TTL NAND gate, ECL gate and CMOS logic gate, Memory Devices: types of memories, RAM BJT cell and MOS RAM cells, Organization of a RAM	**5**	**CO1**
VIII	Introduction to Verilog HDL, Structural, Dataflow and behavioural modelling of combinational and sequential logic circuits.	**5**	**CO4**
	Total Hours	**45**	

Textbooks:

1. M. Morris Mano, Digital Logic & Computer Design, Prentice Hall, 1/e, 2018.
2. A. P. Malvino, D. P. Leach, G. Saha, Digital Principles and Applications, McGraw Hill Education, 8/e, 2014
3. J. Bhasker, A Verilog HDL Primer, Star Galaxy Publishing, 3/e, 2018.

Reference Books:

1. A. A. Kumar, Fundamentals of Digital Circuits, Prentice Hall, 4/e, 2022.
2. C. H. Roth (Jr.), L. L. Kinney, Raghunandan G. H, Fundamentals of Logic Design, Cengage India Private Limited, 1/e, 2019.

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Programme	B. Tech in Electronics & Communication Engineering	**Academic Year of Regulation**	**2025-26**
Department	Electronics & Communication Engineering	**Semester**	**I**

Course Code	**Course Name**	**Credit Structure**					**Marks Distribution**			
		L	**T**	**P**	**C**	**Attend.**	**Exam**	**Viva**	**Total**	**Bloom's Taxonomy**
EC-1102	Digital Logic Design Laboratory	**0**	**0**	**2**	**1**	**20**	**50**	**30**	**100**	

Course Objectives		**Course Outcomes**			
	1. To understand the principles of Boolean logic and optimize the circuits. **2.** To develop the skills for modular Boolean, Arithmetic and Sequential. **3.** To develop the student ability to design circuits using EDA tools		**CO1**	Explain the basic concepts of Boolean algebra, optimization of circuits and introduction of digital logic families.	Knowledge
			CO2	To understand the design aspects of combinational and sequential circuits along with Verilog HDL	Understand
			CO3	To apply the knowledge of simplification of Boolean expressions to predict and analyse the behaviour of synchronous and asynchronous circuits.	Apply
			CO4	To analyze the digital circuits and behaviour using CAD tools.	Analyze

No.	**COs**	**Mapping with Program Outcomes (POs)**												**Mapping with PSOs**		
		PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
1	CO1	3	2	2	1	-	-	-	-	-	-	-	-	2	1	2
2	CO2	2	2	1	1	-	-	-	-	-	-	-	-	2	1	2
3	CO3	3	3	3	1	2	-	-	-	-	-	-	-	3	3	3
4	CO4	2	2	2	1	2	-	-	-	-	-	-	-	2	3	3
(Average)		2.5	2.25	2	1	1	-	-	-	-	-	-	-	2.25	2	2.5

SYLLABUS

No.	**Content**	**Hours**	**COs**
I	Design and verification of adder subtractor circuits using universal gates.	**24**	**CO1, CO2, CO3, CO4**
II	Minimize with SOP/POS by tabular technique & implement the circuit.		
III	Design Gray to Binary and Binary to Gray code Converter & test the circuit.		
IV	Design of the Multiplexer / Demultiplexer and associated applications.		
V	Design and test of flip-flops using NOR/NAND gates.		
VI	Verification of 3-bit synchronous / asynchronous up / down counter.		
VII	Basic GATEs implementation in Verilog		
VIII	Design and implementation of 3-bit synchronous up/down counter in Verilog on FPGA Board		
IX	Design and implementation of 4-bit ripple counter and Mod-10 / Mod-12 Ripple counters using JK flip-flop in Verilog on FPGA Board		
	Total Hours	**24**	

Textbooks:

1. A. P. Malvino, D. P. Leach, G. Saha, Digital Principles and Applications, McGraw Hill Education, 8/e, 2014
2. M. Morris Mano, Digital Logic & Computer Design, Prentice Hall, 1/e, 2018.
3. J. Bhasker, A Verilog HDL Primer, Star Galaxy Publishing, 3/e, 2018.
4. FPGA Board Manuals

Reference Books:

1. A. A. Kumar, Fundamentals of Digital Circuits, Prentice Hall, 4/e, 2022.
2. C. H. Roth (Jr.), L. L. Kinney, Raghunandan G. H, Fundamentals of Logic Design, Cengage India Private Limited, 1/e, 2019.

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Programme	B. Tech in Electronics & Communication Engineering	**Academic Year of Regulation**	**2025-26**
Department	Electronics & Communication Engineering	**Semester**	**II**

Course Code	**Course Name**	**Credit Structure**				**Marks Distribution**				
		L	**T**	**P**	**C**	**INT**	**MID**	**END**	**Total**	**Bloom's taxonomy**
EE-1201	Electromagnetic Field Theory	**3**	**0**	**0**	**3**	**20**	**30**	**50**	**100**	

Course Objectives		**Course Outcomes**		
	1. To understand the various operations of vector calculus & the basic laws of electromagnetism. 2. To obtain the electric and magnetic fields for simple configurations under static conditions. 3. To analyze time varying electric and magnetic fields. 4. To understand Maxwell's equation in different forms and different media.	**CO1**	Differentiate different types of coordinate systems and use them for solving the problems of EM field theory	Knowledge
		CO2	Describe static electric and magnetic fields, their behavior in different media, associated laws, boundary conditions and electromagnetic potentials	Understand
		CO3	Use integral and point form of Maxwell`s equations for solving the problems of electromagnetic field theory.	Apply
		CO4	Describe time varying fields, propagation of EM waves in different media, pyonting theorem, their sources & effects and to apply the theory of in practical problems. Also, to analyze concepts of Wave reflection and refraction, Smith Chart in practical Field.	Analyze

No.	**COs**	**Mapping with Program Outcomes (POs)**												**Mapping with PSOs**		
		PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
1	CO1	3	3	3	2	-	-	-	-	-	-	-	-	1	1	1
2	CO2	2	2	2	2	-	-	-	-	-	-	-	-	1	1	1
3	CO3	3	3	3	3	-	-	-	-	-	-	1	-	2	1	2
4	CO4	3	3	3	3	-	-	-	-	-	-	1	-	3	2	3
(Average)		2.75	2.75	2.75	2.5	-	-	-	-	-	-	0.5	-	1.75	1.25	1.75

SYLLABUS

No.	**Content**	**Hours**	**COs**
I	***Review of vector algebra***: Rectangular, cylindrical and spherical, Curvilinear coordinates, Line, surface and volume integrals, Gradient, Divergence, Curl, Divergence theorem, Stoke's theorem.	**7**	**CO1**
II	***Coulomb's Law***: Electric flux and flux density, Gauss's law and applications. Poisson's and Laplace equations and their solutions. Electric Current: Charge conservation and continuity equation–conductivity and Ohm's law.	**5**	**CO2**
III	***Lorentz force, magnetic field intensity (H)***: Biot–Savart's Law - Ampere's Circuit Law – H due to straight conductors, circular loop, infinite sheet of current, Magnetic flux density (B) – B in free space, conductor, magnetic materials – Magnetization, Magnetic field in multiple media –Boundary conditions, scalar and vector potential, Poisson's Equation, Magnetic force, Torque, Inductance, Energy density, Applications. Faraday's law – Displacement current.	**11**	**CO2**
IV	***Maxwell's equations (differential and integral form)***: Relation between field theory and circuit theory, wave equation, Wave parameters; velocity, intrinsic impedance, propagation constant – Waves in free space, lossy, lossless dielectrics and conductors- skin depth, Flow of energy and Poynting vector, Plane wave reflection and refraction: linear, elliptic and circular polarization, reflection coefficient and standing wave ratio, Brewster's angle. Transmission Lines; Concept of Lumped parameters and Distributed parameters. Line Parameters, Transmission line equations and solutions, Physical significance of the solutions, Propagation constant, Characteristic Impedance; Wavelength; Velocity of Propagation; Distortion-less, lossy, lossless Line, Reflection and Transmission coefficients; Standing Waves, VSWR, Input Impedance, Smith Chart - Applications; Load Matching Techniques / Quarter wave Matching.	**15**	**CO3, CO4**
V	Waves between parallel planes, TE and TM waves, Characteristics of TE and TM waves, TEM waves, Velocities of propagation, Attenuation in parallel plane guides, Wave impedance, Electric field and current flow within the conductor.	**7**	**CO4**
	Total Hours	**45**	

Textbooks:

1. Mathew N. O. Sadiku, Principles of Electromagnetics, 6th Edition, Oxford University Press Inc. Asian edition, 2015.
2. William H. Hayt and John A. Buck, Engineering Electromagnetics, McGraw Hill Special Indian edition, 2014.

Reference Books:

1. Kraus and Fleish, Electromagnetics with Applications, McGraw Hill International Editions, Fifth Edition, 2010.
2. V. V. Sarwate, Electromagnetic fields and waves, First Edition, Newage Publishers, 1993.
3. J. P. Tewari, Engineering Electromagnetics - Theory, Problems and Applications, Second Edition, Khanna Publishers.
4. S. P. Ghosh, Lipika Datta, 'Electromagnetic Field Theory, First Edition, McGraw Hill, Education (India) Private Limited, 2012.

राष्ट्रीय प्रौद्योगिकी संस्थान अरुणाचल प्रदेश **NATIONAL INSTITUTE OF TECHNOLOGY ARUNACHAL PRADESH** (शिक्षा मंत्रालय, भारत सरकार के तहत राष्ट्रीय महत्व का संस्थान) (Institute of National Importance under Ministry of Education, Govt. of India)	**CURRICULUM**

Programme	B. Tech in Electronics & Communication Engineering	**Academic Year of Regulation**	**2025-26**
Department	Electronics & Communication Engineering	**Semester**	**III**

Course Code	**Course Name**	**Credit Structure**				**Marks Distribution**				
		L	**T**	**P**	**C**	**INT**	**MID**	**END**	**Total**	**Bloom's Taxonomy**
EC-2101	Signals & Systems	**3**	**0**	**0**	**3**	**20**	**30**	**50**	**100**	

Course Objectives	**Course Outcomes**			
1. To understand the fundamental characteristics of signals and systems. 2. To understand signals and systems in terms of both the time and transform domains, taking advantage of the complementary insights and tools that these different perspectives provide. 3. To analyze the spectral characteristics of signals using Fourier analysis. 4. To develop the mathematical skills to solve problems involving convolution, filtering, modulation and sampling.		**CO1**	To identify and illustrate signals in both time and frequency domain	Knowledge
		CO2	To classify systems based on their properties and determine the response of LTI system	Understand
		CO3	To apply Laplace transform and Z- transform to analyze continuous-time and discrete-time signals	Apply
		CO4	To analyze the spectral characteristics of continuous-time signal using Fourier analysis and to analyze systems using LT & ZT	Analyze

No.	**COs**	**Mapping with Program Outcomes (POs)**												**Mapping with PSOs**		
		PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
1	CO1	3	3	-	-	-	-	-	-	-	-	-	1	3	-	1
2	CO2	3	3	-	-	-	-	-	-	-	-	-	1	3	-	1
3	CO3	3	3	1	1	-	-	-	-	-	-	-	1	3	-	1
4	CO4	3	3	1	1	-	-	-	-	-	-	-	1	3	-	1
(Average)		3	3	0.5	0.5	-	-	-	-	-	-	-	1	3	-	1

SYLLABUS

No.	**Content**	**Hours**	**COs**
I	***Signal and Systems*:** Introduction, Operations on signals, Classification of signals, Classification of systems, System model- input output description. ***Continuous Time Signal Analysis - The Fourier Series*:** Periodic signal representation by trigonometric Fourier series, Existence and convergence of the Fourier series, Exponential Fourier series, properties, LTIC system response to periodic inputs ***Continuous Time Signal Analysis - The Fourier Transform*:** Aperiodic signal representation by Fourier integral, Properties of FT, Transforms of some useful function, Frequency response of LTIC system.	**12**	**CO1**
II	***Time Domain Analysis of Continuous Time Systems*:** Introduction, Convolution, System response to internal conditions - Zero input response, Unit impulse response, System response to external input-Zero state response, Classical solution of differential equations, System stability	**11**	**CO2**
III	***Continuous Time System Analysis Using the Laplace Transform*:** Laplace transform, Relation to FT, Properties of Laplace transform, Solution of differential equations, Unilateral Laplace transform: Properties of the unilateral Laplace transform.	**09**	**CO3, CO4**
IV	***Sampling*:** Sampling theorem, Signal reconstruction. ***Discrete Time System Analysis Using the Z-Transform*:** Discrete-time signals and systems, Z-transform (BZT & UZT) and its properties, Analysis of LTI systems using Z – transform.	**09**	**CO3, CO4**
	Total Hours	**45**	

Textbooks:

1. A. V. Oppenheim, A. Willsky, S. Hamid Nawab, Signals and Systems, 2/e, Pearson, 2015
2. S. Haykin, B. Van Veen, Signals and Systems, Wiley, 2/e, 2021.
3. B. P. Lathi, R. A. Green, Linear Systems and Signals, Oxford University Press, 2017.

Reference Books:

1. S. S. Soliman, M. D. Srinath, Continuous and Discrete Signals and Systems, Prentice Hall, 2/e, 2015.
2. M. Mandal, A. Asif, Continuous and Discrete Time Signals and Systems, Cambridge University Press, 2007.

राष्ट्रीय प्रौद्योगिकी संस्थान अरुणाचल प्रदेश NATIONAL INSTITUTE OF TECHNOLOGY ARUNACHAL PRADESH (शिक्षा मंत्रालय, भारत सरकार के तहत राष्ट्रीय महत्व का संस्थान) (Institute of National Importance under Ministry of Education, Govt. of India)	CURRICULUM

Programme	B. Tech in Electronics & Communication Engineering	**Academic Year of Regulation**	**2024-25**
Department	Electronics & Communication Engineering	**Semester**	**IV**

Course Code	**Course Name**	**Credit Structure**				**Marks Distribution**				
		L	**T**	**P**	**C**	**INT**	**MID**	**END**	**Total**	**Bloom's Taxonomy**
EC-2102	Semiconductor Device Physics	**3**	**0**	**0**	**3**	**20**	**30**	**50**	**100**	

Course Objectives		**Course Outcomes**		**Bloom's Taxonomy**
1. To understand the physical structure and electrical properties of semiconductor materials 2. To master the fundamental concepts and equations of semiconductor devices. 3. To understand the terminal characteristics of junction diodes, bipolar transistors, and field-effect transistors.		**CO1**	Explain the principle of semiconductor physics	Knowledge
		CO2	To interpret the current voltage characteristics and mathematical model of PN Junction and BJT	Understand
		CO3	To apply the concept of current voltage characteristics in analyzing small signal model of transistors	Apply
		CO4	To analyze the working and characteristics of MOSFET and JFET	Analyze

No.	**COs**	**Mapping with Program Outcomes (POs)**												**Mapping with PSOs**		
		PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
1	CO1	3	3	2	-	1	-	-	-	-	-	-	1	3	2	2
2	CO2	3	3	2	-	1	-	-	-	-	-	-	1	2	2	3
3	CO3	3	3	2	-	1	-	-	-	-	-	-	1	2	2	3
4	CO4	2	2	2	-	1	-	-	-	-	-	-	1	2	2	2
(Average)		2.75	2.75	2	-	1	-	-	-	-	-	-	1	2.25	2	2.5

SYLLABUS

No.	**Content**	**Hours**	**COs**
I	***Understanding Semiconductors:*** Intrinsic and extrinsic semiconductors, Fermi-Dirac distribution, Carrier concentration, Density of states, Effective mass, Drift and diffusion, Recombination and generation, Mobility, Einstein relation, Hall effect	**12**	**CO1**
II	***P-N junction*****:** Device structure, Barrier Potential, Space Charge width, forward & reverse characteristics, junction breakdown, linearly graded & hyper-abrupt junctions, PN diode forward current and reverse saturation current, minority carrier distribution, Small-signal equivalent, switching characteristics. ***Other semiconductor junction*****:** Schottky Barrier Diode: Qualitative characteristics and difference with PN diode, metal-semiconductor Ohmic Contacts, tunnelling barrier, Hetero-junction: materials, band diagrams & I-V characteristics.	**10**	**CO2, CO3**
III	***Bipolar junction transistor*****:** History, Device structures and fabrication, Transistor action and amplification, Minority carrier distribution, Nonideal Effects: Base Width Modulation, High Injection, Emitter Bandgap Narrowing, Current Crowding, Nonuniform Base Doping, Breakdown Voltage, CB, CE, CC configuration, Transistor currents and current gains, Small-signal equivalent: Ebers-Moll model and Hybrid-pi model.	**8**	**CO2**
IV	***Metal oxide semiconductor field effect transistor*****:** Two-Terminal MOS, Energy-Band Diagrams, Depletion Layer, Surface Charge Density, Work Function Differences, Flat-Band Voltage, Threshold Voltage, CV characteristics & frequency effects, MOSFET structure: operation & I-V equation derivation, Substrate Bias effect and Channel length modulation, Small-Signal Equivalent: Frequency Limitation Factors and Cutoff Frequency, MOSFET Scaling	**8**	**CO3, CO4**
V	***Junction field effect transistor:*** JFET Concepts, Basic pn JFET Operation, Pinch-off Voltage, Drain-to-Source Saturation I-V Relationship, Depletion Mode JFET, Transconductance, Basic MESFET, Smal l-Signal Equivalent: Frequency Limitation Factors and Cutoff Frequency	**7**	**CO3, CO4**
	Total Hours	**45**	

Textbooks:

1. D. A. Neamen, D. Biswas, Semiconductor Physics and Devices: Basic Principles, McGraw Hill Education, 4/e, 2017.
2. B. G. Streetman, S. K. Banerjee, Solid State Electronic Devices, Pearson Education, 7/e, 2015.
3. A. S. Sedra, K. C. Smith, T. C. Carusone, V. Gaudet, Microelectronic Circuits, Oxford University Press, 2020.

Reference Books:

1. S. M. Sze, K. K. Ng, Physics of Semiconductor Devices, Wiley Eastern, 3/e, 2008.
2. J. P. Colinge, C. A. Colinge, Physics of Semiconductor Devices, Springer-Verlag New York Inc., 2/e, 2005.
3. K. F. Brennan, The Physics of Semiconductors, Cambridge Univ. Press, 1999.

राष्ट्रीय प्रौद्योगिकी संस्थान अरुणाचल प्रदेश

NATIONAL INSTITUTE OF TECHNOLOGY ARUNACHAL PRADESH

(शिक्षा मंत्रालय, भारत सरकार के तहत राष्ट्रीय महत्व का संस्थान)

(Institute of National Importance under Ministry of Education, Govt. of India)

CURRICULUM

Programme	B. Tech in Electronics & Communication Engineering	**Academic Year of Regulation**	**2025-26**
Department	Electronics & Communication Engineering	**Semester**	**III**

Course Code	**Course Name**	**Credit Structure**				**Marks Distribution**				
		L	**T**	**P**	**C**	**INT**	**MID**	**END**	**Total**	**Bloom's Taxonomy**
EC-2103	Microprocessor & Interfacing	**3**	**0**	**0**	**3**	**20**	**30**	**50**	**100**	

Course Objectives	**Course Outcomes**			
1. To introduce students with the architecture and operation of typical microprocessors. 2. To familiarize the students with the programming and interfacing of microprocessors. 3. To provide strong foundation for designing real world applications using microprocessors.		**CO1**	Assess basic binary operations using the microprocessor and explain the microprocessor's internal architecture & its operation along with performance.	Knowledge
		CO2	Demonstrate programming proficiency using the various addressing modes and data transfer instructions of the target microprocessor.	Understand
		CO3	Apply an appropriate algorithm, program, and peripheral for the application.	Apply
		CO4	Design a microprocessor-based system to solve real time problems. (Prepare a case study model to get a first prototype)	Analyze

No.	**COs**	**Mapping with Program Outcomes (POs)**												**Mapping with PSOs**		
		PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
1	CO1	2	2	2	2	-	-	-	-	-	-	-	-	2	1	1
2	CO2	2	2	2	2	-	-	-	-	-	-	-	-	2	1	1
3	CO3	2	3	3	3	-	-	-	-	-	-	-	1	2	2	2
4	CO4	2	3	3	3	-	-	-	-	-	-	-	1	2	2	2
(Average)		2	2.5	2.5	2.5	-	-	-	-	-	-	-	0.5	2	1.5	1.5

SYLLABUS

No.	**Content**	**Hours**	**COs**
I	***Introduction***: Evolution and classification of microprocessors, Comparison of 8-bit, 16-bit, and 32-bit microprocessors, Microprocessor applications and trends.	**2**	**CO1**
II	**8085 & 8086 Microprocessor:** Architecture and internal organization, Minimum and Maximum mode configurations, Memory segmentation and addressing, Addressing modes and instruction set, Assembly language programming with MASM/TASM, Interrupt structure and interrupt vector table, Direct Memory Access (DMA).	**12**	**CO1, CO2**
III	***8087 Math Co-Processor:*** Need for a Math Co-Processor, Architecture and pin configuration of 8087, Data types supported by 8087, Instruction set and programming with 8087, Integration of 8087 with 8086: Coprocessor interface and communication, Example programs using 8086-8087.	**8**	**CO2**
IV	***ARM Processor:*** Introduction to ARM architecture, ARM design philosophy and features, ARM instruction set and addressing modes, Pipeline architecture in ARM processors, ARM programming: Assembly and C language integration, Exception and interrupt handling in ARM, Overview of ARM Cortex-M series and its applications.	**9**	**CO1, CO2**
V	***Peripheral interfacing applications***: Basic interfacing concepts, Memory / IO interfacing, nonprogrammable peripheral interface, 8255 programmable peripheral interface, Interfacing display, Keyboards, 8279 programmable keyboard / display interface, 8253/54 programmable timer, DMA controller, Interrupt controller, ADC and DAC interfacing, 8086 interrupts and types, 8259A priority interrupt controller, Software interrupt applications.	**6**	**CO2, CO3, CO4**
VI	***Advanced Topics and Applications:*** Introduction to advanced processors and co-processors, Comparison of x86 and ARM architectures, Recent trends in microprocessor technology.	**3**	**CO2, CO3, CO4**
	Total Hours	**40**	

Textbooks:

1. S. Mathur, Microprocessor 8085 and its Interfacing, PHI, 2/e, 2011.
2. S. Mathur, Microprocessor 8086: Architecture, Programming and Interfacing, PHI, 2010.
3. R. S. Gaonkar, Microprocessor Architecture, Programming and Applications with 8085, Penram International Publishers, 6/e, 2013.
4. J. Uffenbeck, The 8086/8088 Family: Design, Programming, and Interfacing, Pearson Education, 1986.
5. A. Sloss, D. Symes, C. Wright, ARM System Developer's Guide: Designing and Optimizing System Software, Morgan Kaufmann, 2004

Reference Books:

1. B. Ram, Fundamental of Microprocessor & Microcomputers, Dhanpat Rai Publications, 8/e, 2012.
2. D. V. Hall, S. S. S. P. Rao, Microprocessor and Interfacing, Tata McGraw-Hill, 3/e, 2017.
3. L. A. Leventhal, Introduction to Microprocessor - Software, Hardware and Programming, Prentice Hall, 1979.

Programme	B. Tech in Electronics & Communication Engineering	**Academic Year of Regulation**	**2025-26**
Department	Electronics & Communication Engineering	**Semester**	**III**

Course Code	**Course Name**	**Credit Structure**					**Marks Distribution**			**Bloom's Taxonomy**
		L	**T**	**P**	**C**	**Attend.**	**Exam**	**Viva**	**Total**	
EC-2104	Skill Development-I	**0**	**0**	**2**	**1**	**20**	**50**	**30**	**100**	

Course Objectives	**Course Outcomes**		Bloom's Taxonomy
1. To introduce students to basic concepts of microprocessor 2. To give knowledge of Assembly Level Language 3. To introduce interfacing of peripheral with microprocessor	**CO1**	To describe the evolution of microprocessor	Knowledge
	CO2	To infer and learn the interfacing	Understand
	CO3	To relate idea of doing embedded design projects	Apply
	CO4	To devise hands-on skills in programming and troubleshooting microprocessors	Analyze

No.	**COs**	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
		Mapping with Program Outcomes (POs)												**Mapping with PSOs**		
1	CO1	2	3	-	1	-	-	-	-	-	-	-	-	2	-	2
2	CO2	2	3	-	1	-	-	-	-	-	-	-	-	2	-	2
3	CO3	2	3	3	1	2	-	-	-	-	-	-	1	2	1	3
4	CO4	2	3	3	1	2	1	3	-	-	-	-	1	3	1	2
(Average)		2	3	1.5	1	1	0.25	0.75	-	-	-	-	0.5	2.25	1	2.25

SYLLABUS

No.	**Content**	**Hours**	**COs**
I	**8085 Microprocessor Experiments** 1. *LED Blinking and Pattern Generation:* ○ Objective: Interface LEDs with 8085 and create various blinking patterns. ○ Application: Basic digital output control. 2. *Seven Segment Display Interfacing:* ○ Objective: Display numbers (0-9) using 8085 and seven-segment display. ○ Application: Digital counters and timers. 3. *Keyboard Interfacing and Debouncing:* ○ Objective: Interface a keypad to take input and display it on LEDs or seven-segment display. ○ Application: User input systems like calculators.	**24**	**CO1, CO2, CO3, CO4**
II	**8086 Microprocessor Experiments** 4. *Arithmetic Operations using 8086:* ○ Objective: Perform addition, subtraction, multiplication, and division. ○ Application: Understanding ALU operations in microprocessors. 5. *String Manipulation and Sorting:* ○ Objective: Implement programs for string operations (e.g., reversing, sorting). ○ Application: Data handling in text-based applications. 6. *Stepper Motor Interfacing:* ○ Objective: Control the rotation of a stepper motor (clockwise and anti-clockwise). ○ Application: Robotics and automation systems. 7. *ADC and DAC Interfacing with 8086:* ○ Objective: Read analog input using ADC and convert digital output to analog using DAC. ○ Application: Sensor data acquisition and control systems. 8. *Serial Communication with 8251 USART:* ○ Objective: Establish serial communication between 8086 and PC. ○ Application: Data communication in embedded systems.		
III	**8087 Math Co-Processor Experiments** 9. *Floating Point Arithmetic Operations:* ○ Objective: Perform floating-point addition, subtraction, multiplication, and division using 8087. ○ Application: Scientific calculations requiring high precision. 10. *Trigonometric and Exponential Calculations:* ○ Objective: Implement trigonometric (sin, cos) and exponential functions using 8087. ○ Application: Engineering simulations and graphics computations.		
IV	**ARM Processor Experiments** 11. *ARM Assembly Programming for Arithmetic Operations:* ○ Objective: Perform basic arithmetic operations using ARM assembly language. ○ Application: Understanding low-level programming in modern processors. 12. *GPIO Interfacing and LED Control using ARM:* ○ Objective: Interface GPIO pins to control LEDs and push buttons using ARM. ○ Application: Building interactive embedded systems.		
	Total Hours	**24**	

Textbooks:

1. S. Mathur, Microprocessor 8085 and its Interfacing, PHI, 2/e, 2011.
2. S. Mathur, Microprocessor 8086: Architecture, Programming and Interfacing, PHI, 2010.
3. R. S. Gaonkar, Microprocessor Architecture, Programming and Applications with 8085, Penram International Publishers, 6/e, 2013.
4. J. Uffenbeck, The 8086/8088 Family: Design, Programming, and Interfacing, Pearson Education, 1986.
5. A. Sloss, D. Symes, C. Wright, ARM System Developer's Guide: Designing and Optimizing System Software, Morgan Kaufmann, 2004

Reference Books:

1. B. Ram, Fundamental of Microprocessor & Microcomputers, Dhanpat Rai Publications, 8/e, 2012.
2. D. V. Hall, S. S. S. P. Rao, Microprocessor and Interfacing, Tata McGraw-Hill, 3/e, 2017.
3. L. A. Leventhal, Introduction to Microprocessor - Software, Hardware and Programming, Prentice Hall, 1979.

Programme	Minor in Electronics & Communication Engineering	**Academic Year of Regulation**	**2024-25**
Department	Electronics & Communication Engineering	**Semester**	**IV**

Course Code	Course Name	Credit Structure				Marks Distribution				Bloom's Taxonomy
		L	T	P	C	INT	MID	END	Total	
EC-2201	Electronic Circuits	**3**	**0**	**0**	**3**	**20**	**30**	**50**	**100**	

Course Objectives		Course Outcomes		Bloom's Taxonomy
Course Objectives	1. To understand basics of wave shaping circuits 2. To understand input-output characteristics of diode and transistors 3. To understand small signal model of diode and transistors 4. To understand the concept of feedback	**Course Outcomes**	**CO1** To explain working, current voltage characteristics and small signal model of diodes and transistors	Knowledge
			CO2 To interpret circuits made of diodes and transistors	Understand
			CO3 To teach frequency response of amplifiers and to note small signal parameters	Apply
			CO4 To connect the concept of feedback and oscillator	Analyze

No.	COs	Mapping with Program Outcomes (POs)												Mapping with PSOs		
		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	CO1	3	2	3	1	-	-	-	-	-	-	-	-	2	2	2
2	CO2	2	2	3	1	-	-	-	-	-	-	-	-	2	2	2
3	CO3	3	2	3	1	-	-	-	-	-	-	-	-	2	2	2
4	CO4	3	2	3	1	-	-	-	-	-	-	-	-	2	2	2
(Average)		2.75	2	3	1	-	-	-	-	-	-	-	-	2	2	2

SYLLABUS

No.	Content	Hours	COs
I	***Wave-shaping circuits***: Linear wave shaping circuits, RC high pass and low pass circuits with phase and frequency analysis, RC integrator and differentiator circuits, Piece-wise linear model of diode, Nonlinear wave shaping circuits, Rectifier, Series-shunt and two-level diode clipper circuits, Clamping circuits	**4**	**CO1**
II	***Transistor biasing and thermal stabilization***: Need for biasing, Operating point, Load line analysis, BJT Biasing methods, Stabilization against VBE, Ic, and β, Stability factors, (S, S', S"), Bias compensation, Thermal runaway, Thermal stability, FET biasing methods and analysis	**9**	**CO1, CO2**
III	***Transistor amplifiers & frequency response***: Basic amplifier circuit, small signal analysis, Hybrid parameters, Phase splitter, low frequency and high frequency response amplifiers, Miller's theorem, Cascade/Cascode amplifiers	**11**	**CO2, CO3**
IV	***Power amplifiers***: Amplifier terms, two load lines, Class-A & Class-B operation, Class-B push pull emitter follower, Biasing class B/AB Amplifiers, Class B/AB driver, Class-C operation, Class-D operation.	**5**	**CO2, CO3**
V	***Feedback amplifier***: Introduction, Basic concepts of feedback, Effect of negative feedback, Different topologies, Method of identifying feedback topology and feedback factor, Stability of feedback amplifier, Frequency response of the feedback amplifiers.	**7**	**CO4**
VI	***Oscillators***: Conditions for oscillations, RC and LC type oscillators, Crystal oscillators, Frequency and amplitude stability of oscillators, Generalized analysis of LC oscillators, Quartz, Hartley, Colpitts, RC-phase shift and Wien-bridge oscillators.	**9**	**CO2, CO4**
	Total Hours	**40**	

Textbooks:

1. J. Millman, C. Halkias, C. D. Parikh, Millman's Integrated Electronics - Analog and Digital Circuit and Systems, McGraw Hill Education, 2/e, 2017.
2. A. S. Sedra, K. C. Smith, T. C. Carusone, V. Gaudet, Microelectronic Circuits, Oxford University Press, 2020.
3. R. L. Boylestad, L. Nashelsky, Electronic Devices and Circuit Theory, Pearson Education India, 11/e, 2015

Reference Books:

1. D. L. Schilling, C. Belove, Electronic Circuits: Discrete and Integrated, 3/e, McGraw Hill, 2002.
2. D. A. Bell, Electronic Devices and Circuits, Prentice Hall of India, 5/e, 2008.

Programme	B. Tech in Electronics & Communication Engineering	**Academic Year of Regulation**	**2025-26**
Department	Electronics & Communication Engineering	**Semester**	**IV**

Course Code	Course Name	Credit Structure					Marks Distribution			Bloom's Taxonomy
		L	T	P	C	INT	MID	END	Total	
EC-2202	Analog Communication	3	0	0	3	20	30	50	100	

Course Objectives

1. To understand the analog communication system and representation of signals.
2. To comprehend various analog modulation & demodulation schemes, their design, operation & applications.
3. To understand the sampling, pulse modulation schemes.
4. To analyze the performance of analog communication system in presence of noise and.

Course Outcomes

CO	Outcome	Bloom's Taxonomy
CO1	Explain the basic concepts of a communication system, need of modulation, and representation of signals in time and frequency domain.	Knowledge
CO2	To acquire knowledge to design linear and non-linear analog modulation techniques and differentiate between AM and FM transmitter and super heterodyne receivers.	Understand
CO3	To apply the theory of sampling theory and analyze different pulse modulation and demodulation techniques.	Apply
CO4	To analyze the impact of noise in analog communication systems.	Analyze

No.	COs	Mapping with Program Outcomes (POs)												Mapping with PSOs		
		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	CO1	2	2	1	-	-	-	-	-	-	-	-	-	1	1	1
2	CO2	3	3	2	2	1	-	-	-	-	-	-	1	3	3	2
3	CO3	3	3	2	-	-	-	-	-	-	-	-	-	2	2	2
4	CO4	3	3	2	2	1	-	-	-	-	-	-	1	3	3	3
(Average)		2.75	2.75	1.75	1	0.5	-	-	-	-	-	-	0.5	2.25	2.25	2

SYLLABUS

No.	Content	Hours	COs
I	***Elements of communication system***: Transmitters, Transmission channels & receivers, Concept of modulation.	2	CO1
II	***Amplitude Modulation***: AM, DSB-SC, SSB-SC and VSB-SC, Methods of generation and detection, FDM, Super heterodyne receivers.	9	CO2
III	***Angle Modulation***: Basic definitions, FM, PM, narrow band FM, wide band FM, transmission bandwidth of FM waves, Generation of FM waves: indirect FM and direct FM, Demodulation/detection of FM waves, FM stereo multiplexing, Phase-locked loop, Nonlinear effects in FM systems.	9	CO2
IV	***Random Process***: Random variables, Several random variables, Statistical averages, Function of random variables, Moments, Mean, Correlation and covariance function, Principles of autocorrelation function, Cross – correlation functions, Central limit theorem, Properties of Gaussian process.	5	CO4
V	***Noise***: Internal and external noise, Noise calculation, Noise figure, Noise in linear and nonlinear AM receivers, Threshold effect. Noise in FM receivers, Threshold effect, Capture effect, FM threshold reduction, Preemphasis and deemphasis.	5	CO4
VI	***Sampling Theorem***: Nyquist sampling theorem, Low pass and band pass sampling theorems	7	CO3
VII	***Pulse Modulation***: Pulse Amplitude Modulation (PAM), Pulse Width Modulation (PWM), Pulse Position Modulation (PPM) their generation and detection.	8	CO3
	Total Hours	**45**	

Textbooks:

1. S. Haykin, M. Moher Communications Systems, John Wiley & Sons, 5/e, 2009
2. H. Taub, D. L. Schilling, G. Saha, Principles of Communication System, McGraw Hill, New Delhi, 4/e, 2017.

Reference Books:

1. B.P. Lathi, D. Zhu, H. M. Gupta, Modern Digital and Analog Communication Systems, Oxford University Press, 4/e, 2017.
2. J. G. Proakis and M. Salehi, Digital Communications, McGraw-Hill, 5/e, 2007
3. B. Sklar, P. K. Ray, Digital Communications - Fundamentals and Applications, Pearson Education, 2e, 2009.

राष्ट्रीय प्रौद्योगिकी संस्थान अरुणाचल प्रदेश

NATIONAL INSTITUTE OF TECHNOLOGY ARUNACHAL PRADESH

(शिक्षा मंत्रालय, भारत सरकार के तहत राष्ट्रीय महत्व का संस्थान)

(Institute of National Importance under Ministry of Education, Govt. of India)

CURRICULUM

Programme	B. Tech in Electronics & Communication Engineering	**Academic Year of Regulation**	**2025-26**
Department	Electronics & Communication Engineering	**Semester**	**IV**

Course Code	Course Name	Credit Structure					Marks Distribution			Bloom's Taxonomy
		L	T	P	C	INT	MID	END	Total	
EC-2203	Introduction to Digital Integrated Circuits	**3**	**0**	**0**	**3**	**20**	**30**	**50**	**100**	

Course Objectives	Course Outcomes			Bloom's Taxonomy
1. To understand MOS structure and working 2. To understand working of different MOS inverters and to analyze VTC 3. To understand MOS use in combinational and sequential circuits		**CO1**	To describe the MOS working and identify the difference with BJT	Knowledge
		CO2	To interpret and infer MOS input output characteristics	Understand
		CO3	To use MOS in combination and sequential circuit	Apply
		CO4	To devise idea and conclude the importance of design metrics	Analyze

No.	COs	Mapping with Program Outcomes (POs)												Mapping with PSOs		
		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	CO1	3	-	-	2	-	-	-	-	-	-	-	-	3	2	3
2	CO2	3	2	2	2	2	-	-	-	-	-	-	-	2	3	2
3	CO3	3	2	2	2	2	-	-	-	-	-	-	-	3	3	2
4	CO4	3	2	2	2	2	-	-	-	-	-	-	-	2	2	2
(Average)		3	1.5	1.5	2	1.5								2.5	2.5	2.25

SYLLABUS

No.	Content	Hours	COs
I	***MOS Devices & Operation***: Semiconductor surfaces, the ideal and non-ideal MOS capacitors and diagrams and CVs, Device structures and fabrication, Energy band diagram, MOS I/V characteristics, Effects of oxide charges, Defects and interface states; Threshold voltage, Body effect, Channel Length Modulation, Scaling Effects, Common source DC characteristics, Small-signal equivalent circuit SPICE level model, MOS as a switch	8	CO1
II	***Inverter Switching Characteristics:*** Inverter types, Inverter characteristics, Switching characteristics, VTC, Noise Margin, Delay models, Power dissipation, Super buffer design.	8	CO1, CO2
III	***Combinational logic circuits***: CMOS logic circuits, Complex logic circuits, CMOS transmission gates, Pseudo-nMOS.	8	CO3
IV	***Sequential logic circuits***: Behaviour of bi-stable elements, Latch, Clocked latch and flip-flop circuits.	7	CO3
V	***Dynamic logic circuits***: Principle of pass transistor, Dynamic circuit techniques: Domino, NORA Logic Zipper CMOS, High performance dynamic CMOS.	8	CO3
VI	***Memories:*** Basics of SRAM and DRAM, ROM	6	CO2, CO3, CO4
	Total Hours	**45**	

Textbooks:

1. S. M. Kang, Y. Leblebici, C. Kim, CMOS Digital Integrated Circuits, Analysis and Design, McGraw Hill India, 2018.
2. J. M. Rabaey, A. Chandrakasan, B. Nikolic, Digital Integrated Circuits, PHI, 2e, 2016.

Reference Books:

1. D. M. Harris, N. H. E. Weste, CMOS VLSI Design: A Circuits and Systems Perspective, Pearson Education India, 4/e, 2015.
2. A. Sedra, K. C. Smith, T. C. Carusone, V. Gaudet, Microelectronic Circuits, Oxford University Press, 2020.
3. K. Martin, T. C. Carusone, D. Johns, Analog Integrated Circuit Design, Wiley, 2/e, 2013.

Programme	B. Tech in Electronics & Communication Engineering	**Academic Year of Regulation**	**2025-26**
Department	Electronics & Communication Engineering	**Semester**	**IV**

Course Code	**Course Name**	**Credit Structure**				**Marks Distribution**				**Bloom's Taxonomy**
		L	**T**	**P**	**C**	**INT**	**MID**	**END**	**Total**	
EC-2204	Digital Signal Processing	**3**	**0**	**0**	**3**	**20**	**30**	**50**	**100**	

Course Objectives

1. To understand & describe discrete-time signals & systems mathematically and perform mathematical operation thereon.
2. To understand signals in both time and frequency domain by using DTFT & DFT.
3. To derive DFT using FFT algorithms.
4. To acquire knowledge of the basic design and structure of FIR and IIR filters with desired frequency responses and design digital filters.

Course Outcomes

		Bloom's Taxonomy
CO1	To be able to describe discrete-time signals & systems in both time & transform domain	Knowledge
CO2	To interpret discrete-time signals & systems characteristics	Understand
CO3	To analyze digital signals & systems using various digital transforms DFT, FFT etc.	Apply
CO4	To design and develop the basic digital system	Analyze

No.	**COs**	**Mapping with Program Outcomes (POs)**												**Mapping with PSOs**		
		PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
1	CO1	3	3	2	1	-	-	-	-	-	-	-	-	1	-	2
2	CO2	3	3	2	1	-	-	-	-	-	-	-	-	1	-	2
3	CO3	3	3	2	1	-	-	-	-	-	-	-	2	1	-	2
4	CO4	3	3	3	2	-	-	-	-	-	-	-	2	1	-	2
(Average)		3	3	2.25	1.25								1	1		2

SYLLABUS

No.	**Content**	**Hours**	**COs**
I	***Introduction***: Review of signals and systems, Concept of frequency in continuous-time and discrete-time signals, Analog to digital conversion. ***Discrete time signals and systems:*** Discrete time signals, Discrete time systems, Analysis of discrete-time linear time invariant systems, Convolution, Discrete time systems described by differential equations, Implementation of discrete time systems, Correlation of discrete time signals.	**13**	**CO1**
II	***Discrete Time Fourier Transform (DTFT):*** DTFT and its Properties. ***Discrete Fourier Transform:*** Frequency domain sampling, Properties of DFT, Linear filtering methods based on DFT.	**10**	**CO1**
III	***Efficient computation of the DFT:*** FFT algorithms, Linear filtering, Approach to computation of the DFT.	**7**	**CO3**
IV	***Implementation of Discrete-Time System:*** FIR system, IIR system ***Design of Digital Filters:*** Design of FIR filters Design of IIR filters from analog filters, Frequency transformations.	**15**	**CO4**
	Total Hours	**45**	

Textbooks:

1. J. G. Proakis, D. G. Manolakis, Digital Signal Processing: Principles Algorithms and Applications, Pearson Education, 4e, 2007.
2. S. K. Mitra, Digital Signal Processing: A computer-based approach, McGraw Hill Education, 4e, 2013.
3. B. P. Lathi, R. A. Green, Linear Systems and Signals, Oxford University Press, 2017.

Reference Books:

1. P. Ramesh Babu, Digital Signal Processing, Scitech Publications (India) Pvt. Ltd, 2011.
2. A. V. Oppenheim, R. W. Schafer, Digital Signal Processing, Pearson Education, 2015.

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Programme	B. Tech in Electronics & Communication Engineering	**Academic Year of Regulation**	**2025-26**
Department	Electronics & Communication Engineering	**Semester**	**IV**

Course Code	**Course Name**	**Credit Structure**				**Marks Distribution**				**Bloom's Taxonomy**
		L	**T**	**P**	**C**	**INT**	**MID**	**END**	**Total**	
EC-2205	Microcontroller & Embedded Systems	**3**	**0**	**0**	**3**	**20**	**30**	**50**	**100**	

Course Objectives	**Course Outcomes**			
1. To understand microcontrollers and the concept of embedded system 2. To understand the operation of 8051 and PIC 3. To get familiar with the ARM processor family, Raspberry Pi and Arduino processor	**CO1**	To understand microcontrollers and embedded systems	Knowledge
	CO2	To infer Arudino processor	Understand
	CO3	To use interfacing and interrupt driven input and output	Apply
	CO4	To analyze industrial applications	Analyze

No.	**COs**	**Mapping with Program Outcomes (POs)**												**Mapping with PSOs**		
		PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
1	CO1	3	2	2	1	-	-	-	-	-	-	-	-	3	1	3
2	CO2	2	3	2	2	1	-	-	-	-	-	-	-	2	2	3
3	CO3	1	3	3	2	2	1	1	-	-	-	-	1	2	2	3
4	CO4	1	1	2	1	-	1	-	-	-	-	-	1	2	2	2
(Average)		1.75	2.25	2.25	1.5	0.75	0.5	0.25	-	-	-	-	0.5	2.25	1.75	2.75

SYLLABUS

No.	**Content**	**Hours**	**COs**
I	***Introduction to microcontroller and embedded processors*:** Introduction to microcontrollers, types of microcontrollers, Concept of embedded systems, embedded system classifications, Use of embedded systems software and its applications, scheduling algorithms, RTOS- Inter process communication, ***8051 microcontroller programming*:** Bit wise handling of registers, Timers and counter, Normal mode, Match mode, PWM mode.	**15**	**CO1**
II	***Embedded controller Arduino family*:** Introduction and its variety, Intel Galileo, Reading data from analog and digital sensors on serial monitor/LCD monitor, Work with LED controlled by switch/potentiometer, 7 segment LED display/control, Interfacing relays and servomotors to Arduino and Galileo.	**10**	**CO2, CO3**
III	***Interrupts*:** Theory, Vectored and nested vectored interrupts, Internal and external interrupts, Non- maskable interrupt, Software interrupt for different microcontrollers.	**8**	**CO1, CO3**
IV	Application of Embedded System in Mechatronics, Robotics and Industrial Automation	**12**	**CO1, CO4**
	Total Hours	**45**	

Textbooks:

1. M. A. Mazidi, J. G. Mazidi, R. D. McKinlay, The 8051 Microcontroller and Embedded Systems Using Assemble and C, Pearson, 2/e, 2007.
2. L. B. Das, Embedded Systems- An Integrated Approach, Pearson, 1/e, 2012.
3. Rajkamal, Microcontrollers, Architecture, Programming, interfacing and System design, Pearson, 2/e, 2011.
4. S. Monk, Programming Arduino: Getting Started with Sketches, Tab Books, 2022
5. J. Blum, Exploring Arduino: Tools and Techniques for Engineering Wizardry, Wiley, 2/e, 2019

Reference Books:

1. K. Ayala, The 8051 Microcontroller, Cengage learning, India, 3/e, 2007.
2. K. M. Bhurchandi, A. K. Ray, Advanced microprocessors and Peripherals, McGraw Hill Education India, 3/e, 2017.
3. K. V. Shibu, Introduction to Embedded Systems, Tata McGraw Hill Education, India, 2017.

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Programme	Minor in Electronics & Communication Engineering	**Academic Year of Regulation**	**2024-25**
Department	Electronics & Communication Engineering	**Semester**	**IV**

Course Code	**Course Name**	**Credit Structure**				**Marks Distribution**				
		L	**T**	**P**	**C**	**Attend.**	**Exam**	**Viva**	**Total**	**Bloom's Taxonomy**
EC-2206	Electronic Circuits Laboratory	**3**	**0**	**0**	**3**	**20**	**50**	**30**	**100**	

Course Objectives	**Course Outcomes**			
1. To understand basics of wave shaping circuits **2.** To understand input-output characteristics of diode and transistors **3.** To understand small signal model of diode and transistors **4.** To understand the concept of feedback	**CO1**	To explain working, current voltage characteristics and small signal model of diodes and transistors	Knowledge
	CO2	To interpret circuits made of diodes and transistors	Understand
	CO3	To teach frequency response of amplifiers and to note small signal parameters	Apply
	CO4	To connect the concept of feedback and oscillator	Analyze

No.	**COs**	**Mapping with Program Outcomes (POs)**												**Mapping with PSOs**		
		PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
1	CO1	3	2	3	1	-	-	-	-	-	-	-	-	2	2	2
2	CO2	2	2	3	1	-	-	-	-	-	-	-	-	2	2	2
3	CO3	3	2	3	1	-	-	-	-	-	-	-	-	2	2	2
4	CO4	3	2	3	1	-	-	-	-	-	-	-	-	2	2	2
(Average)		2.75	2	3	1									2	2	2

SYLLABUS

No.	**Content**	**Hours**	**COs**
I	RC Low Pass and High Pass Filter Circuits.	**24**	**CO1, CO2, CO3, CO4**
II	RC Integrator / Differentiator Circuits.		
III	CE/CS amplifier with given spec. X gain and biasing		
IV	RC-Phase shift and Wien-bridge oscillator.		
V	Class A/B/AB/C amplifier		
VI	Push pull amplifier		
	Total Hours	**24**	

Textbooks:

1. J. Millman, C. Halkias, C. D. Parikh, Millman's Integrated Electronics - Analog and Digital Circuit and Systems, McGraw Hill Education, 2/e, 2017.
2. R. L. Boylestad, L. Nashelsky, Electronic Devices and Circuit Theory, Pearson Education India, 11/e, 2015

Reference Books:

1. D. L. Schilling, C. Belove, Electronic Circuits: Discrete and Integrated, 3/e, McGraw Hill, 2002.
2. D. A. Bell, Electronic Devices and Circuits, Prentice Hall of India, 5/e, 2008.

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Programme	B. Tech in Electronics & Communication Engineering	**Academic Year of Regulation**	**2025-26**
Department	Electronics & Communication Engineering	**Semester**	**IV**

Course Code	**Course Name**	**Credit Structure**					**Marks Distribution**			**Bloom's Taxonomy**
		L	**T**	**P**	**C**	**Attend.**	**Exam**	**Viva**	**Total**	
EC-2207	Analog Communication Laboratory	**0**	**0**	**2**	**1**	**20**	**50**	**30**	**100**	

Course Objectives		**Course Outcomes**			
	1. To understand the analog communication system and representation of signals. 2. To comprehend various analog modulation & demodulation schemes, their design, operation & applications. 3. To understand the sampling, pulse modulation schemes. 4. To analyze the performance of analog communication system in presence of noise and.		**CO1**	Explain the basic concepts of a communication system, need of modulation, and representation of signals in time and frequency domain.	Knowledge
			CO2	To acquire knowledge to design linear and non-linear analog modulation techniques and differentiate between AM and FM transmitter and super heterodyne receivers.	Understand
			CO3	To apply the theory of sampling theory and analyze different pulse modulation and demodulation techniques.	Apply
			CO4	To analyze the impact of noise in analog communication systems.	Analyze

No.	**COs**	**Mapping with Program Outcomes (POs)**												**Mapping with PSOs**		
		PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
1	CO1	2	2	1	-	-	-	-	-	-	-	-	-	1	1	1
2	CO2	3	3	2	2	1	-	-	-	-	-	-	1	3	3	2
3	CO3	3	3	2	-	-	-	-	-	-	-	-	-	2	2	2
4	CO4	3	3	2	2	1	-	-	-	-	-	-	1	3	3	3
(Average)		2.75	2.75	1.75	1	0.5	-	-	-	-	-	-	0.5	2.25	2.25	2

SYLLABUS

No.	**Content**	**Hours**	**COs**
I	Amplitude Modulation & Demodulation.		**CO1, CO2, CO3 CO4**
II	Measurement of output power with varying modulation index an AM signal.		
III	Voltage-controlled oscillator (VCO) using IC 4046.		
IV	Performance of a phase locked loop.		
V	Frequency Modulation and Demodulation System.		
VI	Pre-emphasis & de-emphasis		
VII	Double Side Band Suppressed Carrier (DSB-SC) Modulation & Demodulation Technique.		
VIII	Single Side Band Suppressed Carrier (SSB-SC) Modulation & Demodulation Technique		
IX	Functioning of Superheterodyne AM Receiver.		
X	Measurement of Noise Figure using a noise generator.		
XI	Pulse Amplitude Modulation & Demodulation.		
XII	Pulse Width Modulation & Demodulation.		
XIII	Pulse Position Modulation & Demodulation.		
	Total Hours	**24**	

Textbooks:

1. S. Haykin, M. Moher Communications Systems, John Wiley & Sons, 5/e, 2009
2. H. Taub, D. L. Schilling, G. Saha, Principles of Communication System, McGraw Hill, New Delhi, 4/e, 2017.

Reference Books:

1. B.P. Lathi, D. Zhu, H. M. Gupta, Modern Digital and Analog Communication Systems, Oxford University Press, 4/e, 2017.
2. J. G. Proakis and M. Salehi, Digital Communications, McGraw-Hill, 5/e, 2007
3. B. Sklar, P. K. Ray, Digital Communications - Fundamentals and Applications, Pearson Education, 2e, 2009.

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Programme	B. Tech in Electronics & Communication Engineering	**Academic Year of Regulation**	**2025-26**
Department	Electronics & Communication Engineering	**Semester**	**IV**

Course Code	**Course Name**	**Credit Structure**				**Marks Distribution**				
		L	**T**	**P**	**C**	**Attend.**	**Exam**	**Viva**	**Total**	**Bloom's Taxonomy**
EC-2208	Digital Signal Processing Laboratory	**0**	**0**	**2**	**1**	**20**	**50**	**30**	**100**	

Course Objectives		**Course Outcomes**		
	1. To study properties of discrete time signals 2. To introduce efficient transforms in the frequency domain and analyze their properties 3. To develop knowledge in designing and developing systems suitable for various applications 4. To apply knowledge in designing filters for various domain	**CO1**	To Simulate various waveform generations	Knowledge
		CO2	To simulate and realize DFT and IDFT using different techniques	Understand
		CO3	To simulate and realize IIR Filters	Apply
		CO4	To simulate and realize FIR Filters	Analyze

No.	**COs**	**Mapping with Program Outcomes (POs)**												**Mapping with PSOs**		
		PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
1	CO1	3	3	2	1	-	-	-	-	-	-	-	-	1	-	2
2	CO2	3	3	2	1	-	-	-	-	-	-	-	-	1	-	2
3	CO3	3	3	2	1	-	-	-	-	-	-	-	2	1	-	2
4	CO4	3	3	3	2	-	-	-	-	-	-	-	2	1	-	2
(Average)		3	3	2.25	1.25								1	1		2

SYLLABUS

No.	**Content**	**Hours**	**COs**
I	Generation of waveforms & verification of Sampling Theorem.	**24**	**CO1, CO2, CO3, CO4**
II	Time and Frequency Response of LTI systems (First and second order).		
III	To analyze unilateral and bilateral z transforms of various signals. Also to analyze how unilateral z transform can be used to obtain system responses with initial conditions or changing inputs.		
IV	To find DFT and IDFT of discrete-time signals, Linear Convolution using DFT (Overlap-add and Overlap-Save methods), Generation of Linear convolution using DFT (Overlap-add and Overlap-Save methods).		
V	Linear Convolution, Circular Convolution and Linear Convolution using Circular Convolution. To analyze Fast Fourier algorithms and see how it can efficiently be used to calculate discrete Fourier transforms.		
VI	Linear Convolution, Circular Convolution and Linear Convolution using Circular Convolution. To find FFT and IFFT for the given input sequence.		
VII	To design and simulate Chebychev and Butterworth filters and analyze their responses on MATLAB. To design and simulate Infinite Impulse Response (IIR) filters and Finite Impulse Response (FIR) filters and analyzes their responses on MATLAB.		
	Total Hours	**24**	

Textbooks:

1. J. G. Proakis, D. G. Manolakis, Digital Signal Processing: Principles Algorithms and Applications, Pearson Education, 4e, 2007.
2. S. K. Mitra, Digital Signal Processing: A computer-based approach, McGraw Hill Education, 4e, 2013.
3. B. P. Lathi, R. A. Green, Linear Systems and Signals, OUP, 2017.

Reference Books:

1. P. Ramesh Babu, Digital Signal Processing, Scitech Publications (India) Pvt. Ltd, 2011.
2. A. V. Oppenheim, R. W. Schafer, Digital Signal Processing, Pearson Education, 2015.

	राष्ट्रीय प्रौद्योगिकी संस्थान अरुणाचल प्रदेश **NATIONAL INSTITUTE OF TECHNOLOGY ARUNACHAL PRADESH** (शिक्षा मंत्रालय, भारत सरकार के तहत राष्ट्रीय महत्व का संस्थान) (Institute of National Importance under Ministry of Education, Govt. of India)		**CURRICULUM**
Programme	B. Tech in Electronics & Communication Engineering	**Academic Year of Regulation**	**2025-26**
Department	Electronics & Communication Engineering	**Semester**	**IV**

Course Code	Course Name	Credit Structure					Marks Distribution			Bloom's Taxonomy
		L	**T**	**P**	**C**	**Attend.**	**Exam**	**Viva**	**Total**	
EC-2209	Skill Development-II	**0**	**0**	**2**	**1**	**20**	**50**	**30**	**100**	

Course Objectives		Course Outcomes			Bloom's Taxonomy
Course Objectives	1. To implement and test numerical programs on Keil 8051 and the hardware platform 2. To interface simple peripherals with 8051 loading considerations 3. To complete embedded system product with different actuators and system	**Course Outcomes**	**CO1**	To explain the need of embedded systems and integrated product design procedure	Knowledge
			CO2	To infer the appropriate selection of actuators and different control methodology	Understand
			CO3	To relate the various types of microcontrollers, sensors and transducers	Apply
			CO4	To relate and develop innovative solution for real life applications	Analyze

No.	COs	Mapping with Program Outcomes (POs)												Mapping with PSOs		
		PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
1	CO1	1	1	1	1	1	1	1	1	2	2	1	2	2	1	1
2	CO2	2	2	1	1	1	1	1	1	1	1	2	1	1	2	1
3	CO3	1	1	1	1	1	2	1	2	1	1	2	1	1	1	1
4	CO4	1	1	1	2	2	1	3	1	2	1	1	1	1	1	2
(Average)		1.25	1.25	1	1.25	1.25	1.25	1.5	1.25	1.5	1.25	1.5	1.25	1.25	1.25	1.25

SYLLABUS

No.	Content	Hours	COs
I	Toggle any port output using Keil software.	**24**	**CO1, CO2, CO3, CO4**
II	Find Least Common Multiple (LCM) and Greatest Common Divisor (GCD) of two given numbers using Keil software.		
III	Sort an array in ascending and descending order using Keil software		
IV	Interface LED with 8051 microcontrollers using Keil software.		
V	Interface stepper motor with 8051 microcontrollers		
VI	Interface servo motor with 8051 microcontroller and control based on different sensors inputs.		
VII	Interface DC motor with 8051 microcontrollers		
VIII	Toggle LEDs using ARDUINO.		
IX	Interface servo motor with ARDUINO		
	Total Hours	**24**	

Textbooks:

1. M. A. Mazidi, J. G. Mazidi, R. D. McKinlay, The 8051 Microcontroller and Embedded Systems Using Assemble and C, Pearson, 2e, 2007.
2. Lyla B. Das; Embedded Systems- An Integrated Approach, Pearson, 1e, 2012.
3. Rajkamal, Microcontrollers, Architecture, Programming, interfacing and System design, Pearson, 2e, 2011.
4. S. Monk, Programming Arduino: Getting Started with Sketches, Tab Books, 2022
5. J. Blum, Exploring Arduino: Tools and Techniques for Engineering Wizardry, Wiley, 2/e, 2019

Reference Books:

1. K. Ayala, The 8051 Microcontroller, Cengage learning, India, 3/e, 2007.
2. K. M. Bhurchandi, A. K. Ray, Advanced microprocessors and Peripherals, McGraw Hill Education India, 3/e, 2017.
3. K. V. Shibu, Introduction to Embedded Systems, Tata McGraw Hill Education, India, 2017.

Programme	B. Tech in Electronics & Communication Engineering	Academic Year of Regulation	2025-26
Department	Electronics & Communication Engineering	Semester	V

Course Code	Course Name	Credit Structure				Marks Distribution				Bloom's Taxonomy
		L	T	P	C	INT	MID	END	Total	
EC-3101	Digital Communication	3	0	0	3	20	30	50	100	

Course Objectives		Course Outcomes			
	1. To develop understanding of fundamental operations namely quantization, and reconstruction required to design a digital communication system. 2. To develop understanding of digital baseband transmission (i.e., PCM, DPCM, DM) and digital passband transmission techniques (i.e., BPSK, QPSK, BFSK, QAM, noncoherent BFSK, DPSK, etc.). 3. To understand concept of spread spectrum communication system.		CO1	To gain knowledge of fundamental operations quantization, and reconstruction required for signal transmission and reception in a digital communication system.	Knowledge
			CO2	To understand digital baseband signalling using PCM, DPCM, and DM techniques for a digital communication system.	Understand
			CO3	To design digital passband signalling using coherent BPSK, QPSK, BFSK, QAM, noncoherent BFSK, DPSK, etc. for a digital communication system.	Apply
			CO4	To analyze error performance of a digital communication system in presence of noise and other interferences.	Analyze

No.	COs	Mapping with Program Outcomes (POs)												Mapping with PSOs		
		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	CO1	2	2	1	1	-	-	-	-	-	-	-	-	2	1	1
2	CO2	2	2	1	1	-	-	-	-	-	-	-	-	2	1	1
3	CO3	2	2	2	2	-	-	-	-	-	-	-	1	2	2	1
4	CO4	3	3	3	2	-	-	-	-	-	-	-	1	2	2	2
(Average)		2.25	2.25	1.75	1.5	-	-	-	-	-	-	-	0.5	2	1.5	1.25

SYLLABUS

No.	Content	Hours	COs
I	***Source coder***: Pulse code modulation, Quantization noise, Linear and non-linear quantization, Companding (μ -law and A-law), Differential pulse code modulation, Delta modulation, Adaptive delta modulation, Delta sigma modulation, Linear predictive coders, Vocoder.	10	CO1, CO2
II	***Waveform coder***: Unipolar, Polar, Bipolar – RZ/NRZ, Manchester, Miller, Differential encoding and their spectral characteristic, B3ZS, HDB3, Calculation of PSD.	5	CO2
III	***Base band signal receiver***: Integrate and dump type filter, Probability of error calculations, Optimum filters, Coherent reception, Matched filter and its transfer function, Probability of error of matched filter, Regenerative repeater. Inter symbol interference (ISI), Purpose of equalization, Eye pattern, Nyquist criterion for zero ISI, Fixed equalizer, Design of equalizer, Partial response signalling.	9	CO2, CO4
IV	***Digital Modulation***: ASK, FSK, PSK, DPSK, M-ary PSK, QPSK, M-ary FSK, MSK, Error calculation.	13	CO3, CO4
V	***Advanced Digital Modulation:*** Overview of Spread Spectrum, OFDM principles, system block diagram, FFT based implementation, DMT	8	CO3, CO4
	Total Hours	45	

Textbooks:

1. S. Haykin, M. Moher Communications Systems, John Wiley & Sons, 5/e, 2009
2. B.P. Lathi, D. Zhu, H. M. Gupta, Modern Digital and Analog Communication Systems, Oxford University Press, 4e, 2017.

Reference Books:

1. J. G. Proakis and M. Salehi, Digital Communications, McGraw-Hill, 5e, 2007.
2. B. Sklar, P. K. Ray, Digital Communications - Fundamentals and Applications, Pearson Education, 2e, 2009.
3. H. Taub, D. L. Schilling, G. Saha, Principles of Communication System, McGraw Hill, New Delhi, 4/e, 2017.

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CURRICULUM

Programme	Minor in Electronics & Communication Engineering	**Academic Year of Regulation**	**2025-26**
Department	Electronics & Communication Engineering	**Semester**	**V**

Course Code	**Course Name**	**Credit Structure**				**Marks Distribution**				**Bloom's Taxonomy**
		L	**T**	**P**	**C**	**INT**	**MID**	**END**	**Total**	
EC-3102	Antenna & Microwaves	**3**	**0**	**0**	**3**	**20**	**30**	**50**	**100**	

Course Objectives

1. To study the operation, functions of microwave sources, diodes and devices and to know about the application of these devices for microwave circuits & systems, radar and satellite communication.
2. Measurement of microwave & RF circuits.
3. To study antennas & their characteristics and propagation patterns
4. To be aware of EM wave propagation under different modes

Course Outcomes

CO1	To interpret the operation, functions of microwave sources, diodes and devices and also know about the application of these devices for microwave circuits & systems	Knowledge
CO2	To interpret various radio propagation models and the fading effects on the system performance	Understand
CO3	To apply the effectiveness of diversity techniques to mitigate the multichannel fading effects on received different signals	Apply
CO4	To know about EM wave propagation effects & pattern in different media	Analyze

No.	**COs**	**Mapping with Program Outcomes (POs)**												**Mapping with PSOs**		
		PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
1	CO1	3	2	2	-	1	-	-	-	-	-	-	-	3	1	3
2	CO2	2	3	2	1	2	-	-	-	-	-	-	-	2	2	3
3	CO3	1	3	3	2	2	1	1	-	-	-	-	1	2	2	3
4	CO4	1	1	2	-	1	1	-	-	-	-	-	1	2	2	2
(Average)		1.75	2.25	2.25	0.75	1.5	0.5	0.25	-	-	-	-	0.5	2.25	1.75	2.75

SYLLABUS

No.	**Content**	**Hours**	**COs**
I	Rectangular waveguide and circular waveguide – mode structure, Cut-off frequency, Wall current, Attenuation, Microwave cavities – rectangular cavity resonator, Q factor, scattering matrix and transmission matrix, Return loss, Gain considerations, Noise figure, Attenuator, Phase shifter, Directional coupler, Bethe hole coupler, Magic tee, Hybrid ring, Circulator, Isolator. Microwave Tubes: Limitations of conventional tubes, Multicavity klystron, Reflex klystron, Magnetron, Travelling wave tube, Backward wave oscillator VSWR measurement, Power measurement, Impedance measurement, Frequency measurement.	**10**	**CO1**
II	Antenna concept, Different types of antennas, Directivity, Beam Width, Gain, Radiation resistance, Application of network theorems, Basic terminology, Field radiated by dipole & loop antennas, Monopole antenna, Parabolic antenna, Effect of ground, Travelling wave antennas, Antenna impendence & bandwidth, Array analysis & synthesis special arrays like Binomial Yagi	**12**	**CO2, CO3**
III	Introduction to adaptive & retro directive arrays, Circularly polarized antennas, Helical antennas, Broadband antennas and arrays (Log periodic & other), Secondary source & aperture antenna, Microwave antennas, Horn, Slot, Paraboloidal Reflector, Lens & Microstrip antenna, Smart antennas. Remote sensing application of antennas, Radar range equations. Propagation effect to Link on EM	**12**	**CO3**
IV	Wave propagation in different frequency ranges, Interference effects of ground, Antennas located over flat & spherical earth's magnetic fields, Troposphere scatter, Ducts & nonstandard refraction, EIF propagation using earth-ionosphere waveguide model, Scattering & absorption at microwave frequencies, Introduction to propagation modeling and predictive studies on propagation, Fading, Friis transmission formula, Brightness & temperature of antenna and their role in link calculation.	**11**	**CO4**
	Total Hours	**45**	

Textbooks:

1. J. D. Kraus, R. J. Marhefka, A. S. Khan, Antennas and Wave Propagation, Tata McGraw Hill, 5/e, 2017.
2. C. A. Balanis, Antenna Theory: Analysis and Design, John Wiley & Sons Inc, 4/e, 2016.
3. J. D. Kraus, A. Fleisch, Electromagnetics with Applications, McGraw Hill Education, 5/e, 2017.
4. S. Y. Liao, Microwave Devices and Circuits, Prentice Hall of India, 3/e, 2003.

Reference Books:

1. D. M. Pozar, Microwave Engineering, Willy, 4/e, 2013.
2. P. A. Rizzi, Microwave Engineering – Passive Circuits, Prentice Hall of India, 1998.
3. W. H. Hayt, J. A. Buck, J. M. Akhtar, Engineering Electromagnetics, Tata McGraw Hill, 9e, 2020.

Programme	B. Tech in Electronics & Communication Engineering	Academic Year of Regulation	2025-26
Department	Electronics & Communication Engineering	Semester	V

Course Code	Course Name	Credit Structure				Marks Distribution				Bloom's Taxonomy
		L	T	P	C	INT	MID	END	Total	
EC-3103	Introduction to Analog Integrated Circuits	3	0	0	3	20	30	50	100	

Course Objectives	Course Outcomes			Bloom's Taxonomy
1. To understand single stage and differential operation		CO1	To identify MOS single stage and differential circuits behaviour	Knowledge
2. To understand design and analysis of current mirror		CO2	To interpret working of current mirror & operational amplifier	Understand
3. To understand design and analysis of operational amplifier		CO3	To relate operational amplifier working in applications	Apply
4. To understand operational amplifier applications		CO4	To connect and conclude operational amplifier applications	Analyze

No.	COs	Mapping with Program Outcomes (POs)												Mapping with PSOs		
		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	CO1	3	2	2	2	-	-	-	-	-	-	-	-	2	3	2
2	CO2	3	2	3	3	-	-	-	-	-	-	-	-	3	2	2
3	CO3	3	2	3	3	-	-	-	-	-	-	-	-	2	2	2
4	CO4	3	2	2	2	-	-	-	-	-	-	-	-	2	2	2
(Average)		3	2	2.5	2.5									2.25	2.25	2

SYLLABUS

No.	Content	Hours	COs
I	**MOSFET**: As a switch, Current Source Voltage Source, Gm/I_D	4	CO1
II	***Single stage & differential amplifiers***: Common source, Source follower, common gate, differential operations, basic differential pair.	10	CO2, CO3
III	***Current mirror***: Basic current mirror, Cascode current mirror- large signal and small signal analysis	7	
IV	***Basics of operational amplifiers***: Ideal op-amp, general op-amp stages, One / two stage op-amp design, DC & AC performance characteristics, Slew rate, Open and closed loop configurations, DC offset, Common mode rejection, Common mode gain and CMRR	2	CO1, CO2
V	***Applications of operational amplifiers***: Sign changer, Scale changer, Phase shift circuits, Voltage follower, V-to-I and I-to-V converters, Adder, Subtractor, Instrumentation amplifier, Integrator, Differentiator, Logarithmic amplifier, Antilogarithmic amplifier, Comparators, Schmitt trigger, Precision rectifier, Peak detector.	10	CO2, CO3
VI	***Analog multiplier***: Gilbert multiplier cell, Variable trans-conductance technique, Analog multiplier ICs and their applications.	5	CO3, CO4
VII	***Active filters***: Introduction, RC active filters, Chebyshev & Butterworth filters, State variable filter, Switched capacitor filter.	7	CO3, CO4
	Total Hours	45	

Textbooks:

1. B. Razavi, Design of Analog CMOS Integrated Circuits, McGraw Hill Education, 2/e, 2017.
2. K. Martin, T. C. Carusone, D. Johns, Analog Integrated Circuit Design, Wiley, 2/e, 2013
3. S. Franco, Design with Operational Amplifiers and Analog Integrated Circuits, Tata Mc Graw-Hill, 3/e, 2007.

Reference Books:

1. P. R. Gray, R. G. Meyer, P. J. Hurst and S. H. Lewis, Analysis and Design of Analog Integrated Circuits, Wiley International, 5e, 2009.
2. R. A, Gayakward, Op-Amps and Linear Integrated Circuits, Pearson, 4/e, 2015.

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CURRICULUM

Programme	B. Tech in Electronics & Communication Engineering	**Academic Year of Regulation**	**2025-26**
Department	Electronics & Communication Engineering	**Semester**	**V**

Course Code	**Course Name**	**Credit Structure**				**Marks Distribution**				**Bloom's Taxonomy**
		L	**T**	**P**	**C**	**Attend.**	**Exam**	**Viva**	**Total**	
EC-3104	VLSI Circuit Laboratory	**0**	**0**	**2**	**1**	**20**	**50**	**30**	**100**	

Course Objectives		**Course Outcomes**			
	1. To understand MOS I/V characteristics. **2.** To interpret CMOS inverter working and how to design basic gates, adders, latches. **3.** To teach each experiment from schematic, layout and GDS II **4.** To understand single stage and differential operation, current mirror, operational amplifier		**CO1**	To describe MOS I/V characteristics	Knowledge
			CO2	To identify MOS single stage and differential circuits behaviour	Understand
			CO3	To interpret working of current mirror & operational amplifier and to relate operational amplifier working in applications	Apply
			CO4	To discover working of basic gates, adders, latches using CMOS logic and TG and to get an exposure of entire design flow in industry standard PDK till GDS II	Analyze

No.	**COs**	**Mapping with Program Outcomes (POs)**												**Mapping with PSOs**		
		PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
1	CO1	3	2	2	2	-	-	-	-	-	-	-	-	2	3	2
2	CO2	3	2	3	3	-	-	-	-	-	-	-	-	3	2	2
3	CO3	3	2	3	3	-	-	-	-	-	-	-	-	2	2	2
4	CO4	3	2	2	2	-	-	-	-	-	-	-	-	2	2	2
(Average)		3	2	2.5	2.5									2.25	2.25	2

SYLLABUS

No.	**Content**	**Hours**	**COs**
I	Estimation of resistance and transconductance of NMOS/ PMOS and verify its mathematical equation.	**24**	**CO1, CO2, CO3, CO4**
II	Design and study of common source, source follower and common gate amplifiers to understand input output characteristics.		
III	Design of CMOS differential amplifier with different gate size and input with different slew rate for the generation I/V plot.		
IV	Design of study differential amplifier with input output plots and to understand the difference from single stage amplifiers		
V	Design of single stage op-amp & study the characteristics of operational amplifiers (IC741)		
VI	Study and Implement circuits using IC741 for many applications: Voltage Follower, adder, subtractor, Instrumentation amplifier, Integrator, Differentiator, Logarithmic amplifier, Antilogarithmic amplifier, Comparators, Schmitt trigger, Precision rectifier, peak detector		
VII	Study and note I/V plot of NMOS and PMOS.		
VIII	Design CMOS inverter and to note the effect of W and L on voltage transfer characteristic to understand critical points.		
IX	Understand delay estimation of CMOS inverter and to note the design parameters affecting delay.		
X	Design basic gates, adders and understanding of timing diagram.		
XI	Design latch, clocked latch and understanding of timing diagram.		
XII	Design basic gates using TG, dynamic logic and domino logic and note parameter dependencies on metrics.		
XIII	Design of CMOS a Circuit (CMOS to GDS II)		
	Total Hours	**24**	

Textbooks:

1. Sergio Franco, Design with Operational Amplifiers and Analog Integrated Circuits, 3e, Tata Mc Graw-Hill, 2007.
2. B. Razavi, Design of Analog CMOS Integrated Circuits, McGraw Hill Education, 2e, 2017.
3. S. M. Kang, Y. Leblebici, C. Kim, CMOS Digital Integrated Circuits, Analysis and Design, McGraw Hill India, 2018.
4. J. M. Rabaey, A. Chandrakasan, B. Nikolic, Digital Integrated Circuits, PHI, 2e, 2016.

Reference Books:

1. A. Hastings, The Art of Analog Layout: International Edition, Pearson, 2/e, 2004
2. Cadence Manual/Cadence Help
3. P. R. Gray, R. G. Meyer, P. J. Hurst and S. H. Lewis, Analysis and Design of Analog Integrated Circuits, Wiley International, 4e, 2005.
4. R. A, Gayakward, Op-Amps and Linear Integrated Circuits, Pearson, 4/e, 2015.
5. D. M. Harris, N. H. E. Weste, CMOS VLSI Design: A Circuits and Systems Perspective, Pearson Education India, 4/e, 2015.
6. K. Martin, T. C. Carusone, D. Johns, Analog Integrated Circuit Design, Wiley, 2/e, 2013.

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CURRICULUM

Programme	B. Tech in Electronics & Communication Engineering	**Academic Year of Regulation**	**2025-26**
Department	Electronics & Communication Engineering	**Semester**	**V**

Course Code	**Course Name**	**Credit Structure**				**Marks Distribution**				**Bloom's Taxonomy**
		L	**T**	**P**	**C**	**Attend.**	**Exam**	**Viva**	**Total**	
EC-3105	Digital Communication Laboratory	**0**	**0**	**2**	**1**	**20**	**50**	**30**	**100**	

Course Objectives	**Course Outcomes**			**Bloom's Taxonomy**
1. To develop understanding of fundamental operations namely sampling, quantization, and reconstruction required to design a digital communication system. 2. To develop understanding of digital baseband transmission (i.e., PCM, DM) and digital passband transmission techniques (i.e., BPSK, QPSK, BFSK, etc.).		**CO1**	To gain knowledge of fundamental operations sampling, quantization, and reconstruction required for signal transmission and reception in a digital communication system.	Knowledge
		CO2	To understand digital baseband signalling using PCM, and DM techniques for a digital communication system.	Understand
		CO3	To design digital passband signalling for a digital communication system.	Apply
				Analyze

No.	**COs**	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
1	CO1	2	2	1	1	-	-	-	-	-	-	-	-	2	1	1
2	CO2	2	2	1	1	-	-	-	-	-	-	-	-	2	1	1
3	CO3	2	2	2	2	-	-	-	-	-	-	-	-	2	2	1
(Average)		2	2	1.33	1.33	-	-	-	-	-	-	-	-	2	1.33	1

(PO1–PO12: Mapping with Program Outcomes (POs); PSO1–PSO3: Mapping with PSOs)

SYLLABUS

No.	**Content**	**Hours**	**COs**
I	Pulse code modulation and demodulation	**24**	**CO1, CO2, CO3**
II	Delta modulation and demodulation		
III	Pulse data coding techniques for NRZ formats		
IV	Amplitude shift keying modulator and demodulator		
V	Frequency shift keying modulator and demodulator		
VI	Phase shift keying modulator and demodulator		
VII	Quadrature phase shift keying modulator and demodulator		
VIII	Time division multiplexing		
	Total Hours	**24**	

Textbooks:

1. S. Haykin, M. Moher Communications Systems, John Wiley & Sons, 5/e, 2009
2. B.P. Lathi, D. Zhu, H. M. Gupta, Modern Digital and Analog Communication Systems, Oxford University Press, 4e, 2017.

Reference Books:

1. J. G. Proakis and M. Salehi, Digital Communications, McGraw-Hill, 5e, 2007.
2. B. Sklar, P. K. Ray, Digital Communications - Fundamentals and Applications, Pearson Education, 2e, 2009.
3. H. Taub, D. L. Schilling, G. Saha, Principles of Communication System, McGraw Hill, New Delhi, 4/e, 2017.

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CURRICULUM

Programme	Minor in Electronics & Communication Engineering	**Academic Year of Regulation**	**2025-26**
Department	Electronics & Communication Engineering	**Semester**	**V**

Course Code	Course Name	Credit Structure				Marks Distribution				
		L	**T**	**P**	**C**	**Attend.**	**Exam**	**Viva**	**Total**	**Bloom's Taxonomy**
EC-3106	Antenna & Microwaves Laboratory	**0**	**0**	**2**	**1**	**20**	**50**	**30**	**100**	

Course Objectives	1. To study microwave spectrum, tubes, components, diodes and device. 2. To study the operation, functions of microwave sources, diodes and devices and to know about the application of these devices for microwave circuits & systems. 3. To understand the basic of Horn, Yagi antenna and its utilization 4. To become familiar with Printed antenna and its utilization	**Course Outcomes**	**CO1**	To interpret the operation, functions of microwave sources, diodes and devices and also know about the application of these devices for microwave circuits & systems, radar and satellite communication	Knowledge
			CO2	To analyze in depth of the theory and the technology of microwave components, devices, diodes, tubes and sources	Understand
			CO3	To understand and utilize antenna radiation pattern	Apply
			CO4	To analyze EM wave propagation effects & pattern in different media	Analyze

No.	COs	Mapping with Program Outcomes (POs)												Mapping with PSOs		
		PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
1	CO1	3	2	2	-	1	-	-	-	-	-	-	-	3	1	3
2	CO2	2	3	2	1	2	-	-	-	-	-	-	-	2	2	3
3	CO3	1	3	3	2	2	1	1	-	-	-	-	1	2	2	3
4	CO4	1	1	2	-	1	1	-	-	-	-	-	1	2	2	2
(Average)		1.75	2.25	2.25	0.75	1.5	0.5	0.25	-	-	-	-	0.5	2.25	1.75	2.75

SYLLABUS

No.	Content	Hours	COs
I	Determination of guide wavelength, frequency measurement.	**24**	**CO1, CO2, CO3, CO4**
II	Mode Characteristics of Klystron Oscillator		
III	Measurement of Attenuator characteristics		
IV	Measurement of Tee junction characteristics		
V	Measurement of Directional Coupler characteristics		
VI	Measurement of Radiation Pattern of Horn Antenna		
VII	Measurement of Radiation Pattern of Parabolic Antenna		
VIII	Measurement of Radiation Pattern of Dipole Antenna		
IX	Design and Analysis of Microstrip Line		
X	Design and Analysis of patch antenna		
	Total Hours	**24**	

Textbooks:

1. J. D. Kraus, R. J. Marhefka, A. S. Khan, Antennas and Wave Propagation, Tata McGraw Hill, 5/e, 2017.
2. C. A. Balanis, Antenna Theory: Analysis and Design, John Wiley & Sons Inc, 4/e, 2016.
3. J. D. Kraus, A. Fleisch, Electromagnetics with Applications, McGraw Hill Education, 5/e, 2017.
4. S. Y. Liao, Microwave Devices and Circuits, Prentice Hall of India, 3/e, 2003.

Reference Books:

1. D. M. Pozar, Microwave Engineering, Willy, 4/e, 2013.
2. P. A. Rizzi, Microwave Engineering – Passive Circuits, Prentice Hall of India, 1998.
3. W. H. Hayt, J. A. Buck, J. M. Akhtar, Engineering Electromagnetics, Tata McGraw Hill, 9e, 2020.

Programme	Minor in Electronics & Communication Engineering	**Academic Year of Regulation**	**2025-26**
Department	Electronics & Communication Engineering	**Semester**	**V**

Course Code	**Course Name**	**Credit Structure**					**Marks Distribution**			**Bloom's Taxonomy**
		L	**T**	**P**	**C**	**Attend.**	**Exam**	**Viva**	**Total**	
EC-3107	Skill Development-III	**0**	**0**	**2**	**1**	**20**	**50**	**30**	**100**	

Course Objectives		**Course Outcomes**		**Bloom's Taxonomy**
	1. To introduce the fundamentals of digital hardware modeling and design using HDL. 2. To design, simulate, and verify digital circuits. 3. To develop skills in writing efficient, synthesizable Verilog code.	**CO1**	To demonstrate understanding of Verilog syntax, data types, and constructs for hardware description.	Knowledge
		CO2	To explain modeling of digital circuits at abstraction levels, including behavioral, dataflow, and structural.	Understand
		CO3	To design and simulate digital systems using Verilog, including combinational and sequential circuits.	Apply
		CO4	To evaluate designs for function, timing, & optimization, ensuring compliance with desired specifications.	Analyze

No.	**COs**	**Mapping with Program Outcomes (POs)**												**Mapping with PSOs**		
		PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
1	CO1	3	3	3	3	-	-	-	-	-	-	-	3	3	3	3
2	CO2	3	3	3	3	-	-	-	-	-	-	-	3	3	3	3
3	CO3	3	3	3	3	-	-	-	-	-	-	-	3	3	3	3
4	CO4	3	3	3	3	-	-	-	-	-	-	-	3	3	3	3
(Average)		3	3	3	3	-	-	-	-	-	-	-	3	3	3	3

SYLLABUS

No.	**Content**	**Hours**	**COs**
I	***Basic Combinational Circuits:*** 1. Basic Gates Implementation: o AND, OR, NOT, NAND, NOR, XOR, and XNOR gates. o Objective: Understand gate-level modeling. 2. Multiplexer and Demultiplexer: o Design 2:1, 4:1, and 8:1 MUX and DEMUX. o Objective: Practice conditional statements and data routing. 3. Decoder and Encoder: o Design 2-to-4, 3-to-8 decoders and priority encoders. o Objective: Implement behavioral and structural modeling. 4. Half Adder and Full Adder: o Design and simulate half adder and full adder circuits. o Objective: Get familiar with data flow modeling. 5. Comparator: o Design a 4-bit magnitude comparator. o Objective: Practice relational operators and conditional logic.	**24**	**CO1, CO2, CO3, CO4**
II	***Sequential Circuits:*** 6. Flip-Flops: o Implement SR, D, JK, and T flip-flops. o Objective: Understand sequential logic and timing. 7. Shift Registers: o Design 4-bit SISO, SIPO, PISO, and PIPO shift registers. o Objective: Learn data storage and transfer mechanisms. 8. Counters: o Asynchronous and Synchronous counters (e.g., Mod-8, Mod-10). o Objective: Practice sequential state transitions. 9. Sequence Detector: o Detect a specific binary sequence (e.g., 1011). o Objective: Practice state machine design using FSM (Finite State Machine). 10. Memory Design: o Implement a 4x4 RAM module. o Objective: Understand memory modeling and read-write operations.		
III	***Advanced Digital Systems:*** 11. ALU (Arithmetic Logic Unit): o Design a 4-bit ALU supporting operations like ADD, SUB, AND, OR, NOT, etc. o Objective: Combine combinational and sequential logic. 12. Simple CPU Design: o Implement a basic 4-bit CPU with an instruction set (Fetch-Decode-Execute). o Objective: Learn micro-architecture design. 13. Serial Communication Interface: o Design UART (Universal Asynchronous Receiver Transmitter). o Objective: Practice asynchronous communication protocols. 14. Digital Clock: o Design a digital clock with hour, minute, and second counters. o Objective: Work on timing, clock dividers, and display logic. 15. Vending Machine Controller: o Design an FSM-based vending machine controller. o Objective: Master state transitions, sequential logic, and complex decision making.		
	Total Hours	**24**	

Textbooks:

1. S. Palnitkar, Verilog HDL, Pearson Education, 2/e, 2009.
2. S. Brown, Z. Vranesic, Fundamentals of Digital Logic with Verilog Design, McGraw Hill Higher Education, 3/e, 2013.

Reference Books:

1. Z. Navabi, Verliog Digital System Design, McGraw-Hill Education, 2/e, 2005.

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Programme	B. Tech in Electronics & Communication Engineering	**Academic Year of Regulation**	**2025-26**
Department	Electronics & Communication Engineering	**Semester**	**V**

Course Code	**Course Name**	**Credit Structure**				**Marks Distribution**			
		L	**T**	**P**	**C**	**INT**	**MID**	**END**	**Total**
EC-3109	Basics of Information Theory and Coding	**3**	**0**	**0**	**3**	**20**	**30**	**50**	**100**

Course Objectives

1. To equip students with the basic understanding of the fundamental concept of entropy and information as they are used in communications.
2. To make students equip with various data compression technique.
3. To apply various linear block codes and convolution codes for error detection and correction.

Course Outcomes

		Bloom's Taxonomy
CO1	Explain the basic notions of information and entropy	Knowledge
CO2	To interpret the fundamental limits on performance of communication systems channels.	Understand
CO3	To apply a suitable lossy data compression technique for a given situation in communication systems	Apply
CO4	To analyze the performance of error control codes, convolutional and block codes	Analyze

Mapping with Program Outcomes (POs) / **Mapping with PSOs**

No.	**COs**	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
1	CO1	2	3	-	1	-	-	-	-	-	-	-	-	3	-	3
2	CO2	2	3	-	1	-	-	-	-	-	-	-	-	2	-	2
3	CO3	2	3	3	1	2	-	-	-	-	-	-	1	2	2	2
4	CO4	2	3	3	1	2	1	3	-	-	-	-	1	2	2	2
(Average)		2	3	1.5	1	1	0.25	0.75	-	-	-	-	0.5	2.25	1	2.25

SYLLABUS

No.	**Content**	**Hours**	**COs**
I	***Information Theory***: Information, channel capacity, The concept of amount of information, entropy, Information rate, Conditional and joint entropies	**8**	**CO1**
II	***Source Coding***: Noise less coding, Shannon's first fundamental theorem, Discrete memoryless channels, Mutual information, sources with finite memory, Markov sources, Shannon's second fundamental theorem on coding, Huffman coding, Lempel-Ziv algorithm, Shannon-Fanon algorithm	**13**	**CO2, CO3**
III	***Channel Coding***: Error detecting codes, Hamming distance, Error correcting codes, Repetition codes, Linear block codes, Binary cyclic codes, BCH codes, Reed-Solomon codes, Golay codes	**15**	**CO4**
IV	***Convolutional Codes***: Code tree, State diagram, Trellis diagram, Maximum likelihood decoding-Viterbi's algorithm, Sequential decoding	**9**	**CO4**
	Total Hours	**45**	

Textbooks:

1. T. M. Cover and J. A. Thomas, Elements of Information Theory, John Wiley, 2e, 2006.
2. R. Togneri and C. J. S. DeSilva, Fundamentals of information theory and coding design, CRC Press, 1e, 2003.

Reference Books:

1. S. Haykin, Communication Systems, Wiley, 4e, 2006.
2. S. Lin, D. Costello, Error Control Coding: Fundamentals and Applications, Pearson, 2/e, 2004
3. B P Lathi, Z. Ding, H. M. Gupta, Modern Digital and Analog Communication Systems, Oxford University Press, 4/e, 2017.
4. J. Proakis, M. Salehi, Digital Communications, Tata Mc Graw Hill, 5e, 2007.

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Programme	B. Tech in Electronics & Communication Engineering	**Academic Year of Regulation**	**2025-26**
Department	Electronics & Communication Engineering	**Semester**	**V**

Course Code	**Course Name**	**Credit Structure**				**Marks Distribution**				
		L	**T**	**P**	**C**	**INT**	**MID**	**END**	**Total**	**Bloom's Taxonomy**
EC-310H	Power Electronics	**3**	**0**	**0**	**3**	**20**	**30**	**50**	**100**	

Course Objectives		**Course Outcomes**			
	1. Understand the operating principles of power semiconductor devices and switching circuits. 2. Learn the analysis and design of AC-DC, DC-DC, and DC-AC converters. 3. Study control, modulation, and protection techniques for power electronic systems. 4. Apply power electronics in drives, renewable energy, and power systems.		**CO1**	Explain characteristics and operation of power semiconductor devices.	Knowledge
			CO2	Analyze and design various power converter topologies.	Understand
			CO3	Evaluate control, modulation, and protection techniques in converters.	Apply
			CO4	Apply power electronics concepts to real-world systems such as drives and renewable energy.	Analyze

No.	**COs**	**Mapping with Program Outcomes (POs)**												**Mapping with PSOs**		
		PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
1	CO1	3	2	1	1	0	0	1	0	0	0	0	1	3	2	1
2	CO2	3	3	3	2	2	0	1	0	1	0	1	2	3	3	2
3	CO3	2	3	3	3	2	0	1	1	1	0	1	2	2	3	3
4	CO4	2	2	3	2	2	1	3	1	1	1	2	3	2	3	2
(Average)		2.5	2.5	2.5	2	1.5	0.25	1.5	0.5	0.875	0.25	1	2	2.5	2.75	2

SYLLABUS

No.	**Content**	**Hours**	**COs**
I	Power semiconductor devices: diodes, MOSFETs, IGBTs, switching characteristics	**6**	**CO1**
II	AC–DC rectifiers: single-phase and three-phase controlled/uncontrolled rectifiers	**6**	**CO2**
III	DC–DC converters: buck, boost, buck-boost, Cúk, isolated converters	**6**	**CO2**
IV	DC–AC inverters: single-phase, three-phase, PWM modulation strategies	**6**	**CO2, CO3**
V	Converter control: feedback control, current/voltage mode control, dynamic response	**6**	**CO3**
VI	Protection and thermal management of power devices	**3**	**CO3**
VII	Power factor correction, harmonic reduction, EMI/EMC basics	**3**	**CO3**
VIII	Applications: motor drives, EV powertrains, UPS, renewable energy converters Case studies and simulation using MATLAB/Simulink / PLECS	**6**	**CO4**
	Total Hours	**42**	

Textbooks:

1. Ned Mohan, Tore M. Undeland, William P. Robbins, Power Electronics: Converters, Applications, and Design, Wiley, 3rd Ed.
2. Muhammad H. Rashid, Power Electronics: Devices, Circuits and Applications, Pearson, 4th Ed.

Reference Books:

1. B. W. Williams, Power Electronics: Devices, Drivers, Applications and Passive Components, McGraw Hill.
2. Daniel W. Hart, Power Electronics, McGraw Hill.
3. L. Umanand, Power Electronics: Essentials & Applications, Wiley.

Programme	Minor in Electronics & Communication Engineering	**Academic Year of Regulation**	**2025-26**
Department	Electronics & Communication Engineering	**Semester**	**VI**

Course Code	**Course Name**	**Credit Structure**				**Marks Distribution**				
		L	**T**	**P**	**C**	**INT**	**MID**	**END**	**Total**	**Bloom's Taxonomy**
EC-321A	Introduction to VLSI Fabrication	**3**	**0**	**0**	**3**	**20**	**30**	**50**	**100**	

Course Objectives

1. Understand the Fabrication Process of IC Technology
2. Understand the concept of conversion of a single crystal of silicon into an IC requires.
3. Exposer to different fabrication steps such as epitaxy, oxidation, chemical vapor deposition, metallization.
4. Understand the concepts of ion implantation, etching and lithography.

Course Outcomes

CO1	Understand the basic steps of MOS transistor fabrication.	Knowledge
CO2	Learn the basics theory of Crystal Growth and Wafer Preparation.	Understand
CO3	Students understand the concepts of Epitaxy, Diffusion, Oxidation, Lithography and Etching.	Apply
CO4	Understands the process of film deposition and metallization in Chip manufacturing	Analyze

No.	**COs**	**Mapping with Program Outcomes (POs)**												**Mapping with PSOs**		
		PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
1	CO1	3	2	3	1	-	-	-	-	-	-	-	-	2	2	2
2	CO2	2	2	3	1	-	-	-	-	-	-	-	-	2	2	2
3	CO3	3	2	3	1	-	-	-	-	-	-	-	-	2	2	2
4	CO4	3	2	3	1	-	-	-	-	-	-	-	-	2	2	2
(Average)		2.75	2	3	1	-	-	-	-	-	-	-	-	2	2	2

SYLLABUS

No.	**Content**	**Hours**	**COs**
I	VLSI Process Integration: Introduction, Fundamental Considerations for IC Processing, NMOS IC Technology, CMOS IC Technology, MOS Memory IC Technology, IC Fabrication.	**8**	**CO1**
II	Crystal Growth and Wafer Preparation: Introduction, Electronic grade Silicon, Czochralski Crystal Growing, Silicon Shaping, Processing Considerations	**8**	**CO2**
III	Epitacy: Introduction, Vapor Phase Epitaxy, Molecular Beam Epitaxy, Silicon on Insulators, Epitaxial Evaluation. Oxidation: Introduction, Growth Mechanism and Kinematics, Thin Oxides, Oxidation Techniques and Systems, Oxidation of Polysilicon	**8**	**CO3**
IV	Lithography: Introduction, Optical Lithography, Electron Lithography, Ion Lithography, Plasma properties, Feature size control and Anisotropic Etch Mechanism, Reactive Plasma Etching Techniques and Equipment, Specific Etch Process.	**8**	**CO3**
V	Dielectric and Polysilicon Film Deposition: Introduction, Deposition Process, Polysilicon, Silicon Dioxide, Automatic Diffusion Mechanism, Measurement Techniques, Range Theory, Metalization, Metalization Applications, Metalization Choices, Patterning, Metalization Problems.	**8**	**CO4**
VI	Case Study: Fabrication flow of classical and non-classical devices.	**5**	**CO4**
	Total Hours	**45**	

Textbooks:

1. S.M. Sze, VLSI Technology, McGraw Hill Companies Inc. 2nd Edition, 2017
2. C.Y. Chang and S.M. Sze (Ed), ULSI Technology, McGraw Hill Companies Inc, 1996

Reference Books:

1. S. A. Campbell, The Science and Engineering of Microelectronic Fabrication, 2nd Edition, Oxford University Press, 2001
2. J. D. Plummer, M. Deal, P. Griffin, Silicon VLSI Technology, Pearson Education, 1st Edition, 2000

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Programme	B. Tech in Electronics & Communication Engineering	**Academic Year of Regulation**	**2025-26**
Department	Electronics & Communication Engineering	**Semester**	**V**

Course Code	**Course Name**	**Credit Structure**					**Marks Distribution**			
		L	**T**	**P**	**C**	**INT**	**MID**	**END**	**Total**	**Bloom's Taxonomy**
EC-322A	Information Theory and Coding	**3**	**0**	**0**	**3**	**20**	**30**	**50**	**100**	

Course Objectives		**Course Outcomes**		
	1. To equip students with the basic understanding of the fundamental concept of entropy and information as they are used in communications. 2. To make students equip with various data compression technique. 3. To apply various linear block codes and convolution codes for error detection and correction.		**CO1**	Explain the basic notions of information and entropy	Knowledge
			CO2	To interpret the fundamental limits on performance of communication systems channels.	Understand
			CO3	To apply a suitable lossy data compression technique for a given situation in communication systems	Apply
			CO4	To analyze the performance of error control codes, convolutional and block codes	Analyze

No.	**COs**	**Mapping with Program Outcomes (POs)**												**Mapping with PSOs**		
		PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
1	CO1	2	3	-	1	-	-	-	-	-	-	-	-	3	-	3
2	CO2	2	3	-	1	-	-	-	-	-	-	-	-	2	-	2
3	CO3	2	3	3	1	2	-	-	-	-	-	-	1	2	2	2
4	CO4	2	3	3	1	2	1	3	-	-	-	-	1	2	2	2
(Average)		2	3	1.5	1	1	0.25	0.75	-	-	-	-	0.5	2.25	1	2.25

SYLLABUS

No.	**Content**	**Hours**	**COs**
I	***Information Theory***: Information, channel capacity, The concept of amount of information, entropy, Information rate, Conditional and joint entropies	**8**	**CO1**
II	***Source Coding***: Noise less coding, Shannon's first fundamental theorem, Discrete memoryless channels, Mutual information, sources with finite memory, Markov sources, Shannon's second fundamental theorem on coding, Huffman coding, Lempel-Ziv algorithm, Shannon-Fanon algorithm	**13**	**CO2, CO3**
III	***Channel Coding***: Error detecting codes, Hamming distance, Error correcting codes, Repetition codes, Linear block codes, Binary cyclic codes, BCH codes, Reed-Solomon codes, Golay codes	**15**	**CO4**
IV	***Convolutional Codes***: Code tree, State diagram, Trellis diagram, Maximum likelihood decoding-Viterbi's algorithm, Sequential decoding	**9**	**CO4**
	Total Hours	**45**	

Textbooks:

1. T. M. Cover and J. A. Thomas, Elements of Information Theory, John Wiley, 2e, 2006.
2. R. Togneri and C. J. S. DeSilva, Fundamentals of information theory and coding design, CRC Press, 1e, 2003.

Reference Books:

1. S. Haykin, Communication Systems, Wiley, 4e, 2006.
2. S. Lin, D. Costello, Error Control Coding: Fundamentals and Applications, Pearson, 2/e, 2004
3. B P Lathi, Z. Ding, H. M. Gupta, Modern Digital and Analog Communication Systems, Oxford University Press, 4/e, 2017.
4. J. Proakis, M. Salehi, Digital Communications, Tata Mc Graw Hill, 5e, 2007.

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Programme	B. Tech in Electronics & Communication Engineering	**Academic Year of Regulation**	**2025-26**
Department	Electronics & Communication Engineering	**Semester**	**VI**

Course Code	**Course Name**	**Credit Structure**					**Marks Distribution**			**Bloom's Taxonomy**
		L	**T**	**P**	**C**	**INT**	**MID**	**END**	**Total**	
EC-323A	Wireless Communication	**3**	**0**	**0**	**3**	**20**	**30**	**50**	**100**	

Course Objectives		**Course Outcomes**		**Bloom's Taxonomy**
	1. To provide students an understanding of the concepts related to wireless channel modelling. 2. To explore communication concepts and techniques for exploiting wireless channel characteristics and application of these concepts in a system context. 3. To familiarize students on how the diversity can be exploited to improve performance. 4. To familiarize students with capacity analysis and multiple access techniques in 3G, 4G and 5G.	**CO1**	Explain the basic notions of cellular system design and technical challenges	Knowledge
		CO2	To interpret various mobile radio propagation models and the fading effects on the system performance	Understand
		CO3	To apply the effectiveness of diversity techniques to mitigate the multichannel fading effects on received signals and spectral efficiency improvements through spatial multiplexing	Apply
		CO4	To analyze multiuser systems, CDMA, WCDMA network planning and OFDM Concepts	Analyze

No.	**COs**	**Mapping with Program Outcomes (POs)**												**Mapping with PSOs**		
		PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
1	CO1	3	2	2	1	-	-	-	-	-	-	-	-	3	1	3
2	CO2	2	3	2	2	1	-	-	-	-	-	-	-	2	2	3
3	CO3	1	3	3	2	2	1	1	-	-	-	-	1	2	2	3
4	CO4	1	1	2	1	-	1	-	-	-	-	-	1	2	2	2
(Average)		1.75	2.25	2.25	1.5	0.75	0.5	0.25	-	-	-	-	0.5	2.25	1.75	2.75

SYLLABUS

No.	**Content**	**Hours**	**COs**
I	***Introduction to wireless communication****:* Evolution of mobile radio communication, Examples of wireless communication system.	**2**	**CO1**
II	***The cellular engineering fundamentals***: Frequency reuse, Channel assignment strategies, Handoff strategies, Interference and system capacity, Improving coverage and capacity.	**9**	**CO1**
III	***Mobile Radio Propagation models***: Free space propagation models, Two Ray model, Knife edge diffraction model, Log-distance path loss model, Outdoor propagation model, Indoor propagation model, Small scale multipath propagation, Small scale fading	**9**	**CO2**
IV	***Modulation techniques for mobile radio***: Analog modulation techniques, Line Coding, Pulse shaping, Linear modulation techniques, Constant envelope modulation techniques, Combined modulation techniques.	**9**	**CO3**
V	***Multiple access techniques:*** TDMA, FDMA, SDMA, CSMA, OFDMA	**7**	**CO4**
VI	GSM, 3G, 4G (LTE), NFC systems, WLAN technology, WLL, Ad hoc networks.	**9**	**CO1, CO4**
	Total Hours	**45**	

Textbooks:

1. T. S. Rappaport, Wireless Communications – Principles and Practice, Pearson, 2/e, 2010.
2. A. Goldsmith, Wireless Communications, Cambridge University Press, 2005.

Reference Books:

1. K. Feher, Wireless Digital Communications: Modulation and Spread Spectrum Applications, 1/e, 2015.
2. A. K. Jagannatham, Principles of Modern Wireless Communications Systems, McGraw Hill Education, 1/e, 2017.
3. W. C. Y. Lee, Wireless and Cellular Telecommunications, Mc. Graw Hill, 3/e, 2005.

Programme	B. Tech in Electronics & Communication Engineering	**Academic Year of Regulation**	**2025-26**
Department	Electronics & Communication Engineering	**Semester**	**VI**

Course Code	**Course Name**	**Credit Structure**					**Marks Distribution**			
		L	**T**	**P**	**C**	**INT**	**MID**	**END**	**Total**	**Bloom's taxonomy**
EC-324A	Electronic Instrument and Measurement	**3**	**0**	**0**	**3**	**20**	**30**	**50**	**100**	

Course Objectives	**Course Outcomes**			
1. To understand Different types of Errors in Electrical and Electronic Instruments and their analysis. 2. Understand and do the statistical analysis of data. 3. Analyze basic transducers and sensors used in measurement of different parameters.		**CO1**	To clear Knowledge on utilization of major test instruments	Knowledge
		CO2	To understand the measurement techniques of various parameters	Understand
		CO3	To apply transducers and actuators and to measure their performances to apply in particular systems.	Apply
		CO4	To analyze and develop different instruments	Analyze

No.	**COs**	**Mapping with Program Outcomes (POs)**												**Mapping with PSOs**		
		PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
1	CO1	2	2	1	1	-	-	-	-	-	-	-	1	1	1	1
2	CO2	3	2	1	1	-	-	-	-	-	-	-	1	1	1	1
3	CO3	2	2	1	1	-	-	-	-	-	-	-	1	1	1	1
4	CO4	2	3	1	1	-	-	-	-	-	-	-	1	1	1	1
(Average)		2.75	2.75	1	1	-	-	-	-	-	-	-	1	1	1	1

SYLLABUS

No.	**Content**	**Hours**	**COs**
I	***Errors in measurements***: Limiting Errors, Relative Limiting Errors; Static and Dynamic Errors; Types of Errors: Gross Errors. Systematic Errors, Instrumental Errors. Environmental Errors, Observational Errors, Random Errors. ***Statistical treatment of data***: Histogram, Arithmetic Mean, Measure of Dispersion from the Mean, Range, Deviation, Average Deviation, Standard Deviation, Variance.	**12**	**CO1**
II	***AC/DC bridges***: Wheatstone Bridge, Kelvin Bridge, Wein Bridge, Anderson Bridge and Scherring bridge for Measurement of inductance, capacitance, resistance and frequency ***Oscilloscope*:** Construction and principle of operation, Sweep and sweep synchronization, Measurement of various parameters by CRO, High frequency and low frequency limitations, sampling and digital storage oscilloscopes	**11**	**CO2**
III	***Basic measurement techniques***: Analog Ammeters, Voltmeters and Ohmmeters: Moving coil, Moving Iron, Dynamometer, Wattmeter, Electrostatic Instruments, DMM (Digital Multimeter)	**9**	**CO3**
IV	***Displacement measurement***: Resistive, inductive and capacitive type LVDT and RVDT ***Pressure measurement***: Bourden Tube, Liquid field, Manometer for use of pressure measurement, Low pressure measurements. ***Flow measurement***: Pitot tube, Orifice plate, Venturi tube; Rotameter, Turbine type flow meter, Electromagnetic flow meter, Doppler flow meter. ***Temperature measurement***: Temperature scale, change in dimensions-bimetals, liquid-in-glass thermometers, Filled system thermometers, RTD, Thermistor, Thermocouple.	**13**	**CO4**
	Total Hours	**45**	

Textbooks:

1. E. O. Doebelin, Measurement Systems - Application and Design, Tata McGraw-Hill, 2004.
2. M. M. S. Anand, Electronic Instruments and Instrumentation Technology, Prentice-Hall of India, 1/e, 2020.
3. D. A. Bell, Electronic Instrumentation and Measurements. Oxford University Press India, 3e, 2013.

Reference Books:

1. R. P. Areny, J. G. Webster, Sensors and Signal Conditioning, Wiley-Interscience, 2/e, 2000.
2. R. A. Witte, Electronic Test Instruments: Analog & Digital Measurements, Pearson Education, 2/e, 2002.
3. C. F. Coombs, Electronic Instrument Handbook, McGraw-Hill, 3/e, 1999.
4. B. G. Liptak, Instrument Engineers' Handbook: Process Measurement and Analysis, CRC Press, 4e, 2003.

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Programme	B. Tech in Electronics & Communication Engineering	Academic Year of Regulation	2025-26
Department	Electronics & Communication Engineering	Semester	VI

Course Code	Course Name	Credit Structure					Marks Distribution			Bloom's Taxonomy
		L	T	P	C	INT	MID	END	Total	
EC-325A	Machine Learning	3	0	0	3	20	30	50	100	

Course Objectives		Course Outcomes			Bloom's Taxonomy
Course Objectives	1. To understand the basic theory underlying machine learning 2. To understand a range of machine learning algorithms along with their strengths and weaknesses 3. To be able to formulate machine learning problems corresponding to different applications.	Course Outcomes	CO1	Identify and apply the appropriate machine learning technique to classification, pattern recognition, and optimization and decision problems.	Knowledge
			CO2	Understand working of supervised learning	Understand
			CO3	Understand working of unsupervised learning	Apply
			CO4	Understand working of Reinforcement learning	Analyze

No.	COs	Mapping with Program Outcomes (POs)												Mapping with PSOs		
		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	CO1	3	3	-	-	-	-	-	-	-	-	-	3	3	-	1
2	CO2	3	3	-	-	-	-	-	-	-	-	-	3	3	-	1
3	CO3	3	3	1	1	-	-	-	-	-	-	-	3	3	-	1
4	CO4	3	3	1	1	-	-	-	-	-	-	-	3	3	-	1
(Average)		3	3	0.5	0.5	-	-	-	-	-	-	-	3	3	-	1

SYLLABUS

No.	Content	Hours	COs
I	***Introduction***: Introduction to Machine Learning, Examples of Machine Learning applications, Types of machine learning. Generalization and regularization, Performance Measure. **Supervised Learning**: Linear Regression, Classification and Regression. **Neural Networks**: The Perceptron, Activation Functions, Training Feed Forward Network by Back Propagation, MLP. **Dimensionality Reduction**: Linear Discriminant Analysis (LDA), Principal Components Analysis (PCA)	12	CO1, CO2
II	**Probabilistic Learning**: HMM, Gaussian Mixture Models, Nearest Neighbour Methods **Support Vector Machines**: Optimal Separation, Kernels, The Support Vector Machine Algorithm	10	CO2
III	**Learning with Trees**: Entropy, Information Gain, using and constructing decision trees, CART, Applications of Trees **Reinforcement Learning**: Markov Decision Processes, Uses of Reinforcement Learning	10	CO2, CO4
IV	**Unsupervised Learning:** The *K*-Means Algorithm, Vector Quantisation, Hierarchical Clustering Methods, Density based clustering	8	CO3
V	**Generative AI, applications of AI ML**	5	CO4
	Total Hours	45	

Textbooks:

1. T. Mitchell, Machine Learning, McGraw Hill, 2017.
2. R. O. Duda, P. E. Hart, D. G. Stork, Pattern classification, Wiley, New York, 2/e, 2007.
3. S. Marsland, Machine Learning an algorithmic perspective, CRC Press, Taylor & Francis Group, 2/e, 2015.

Reference Books:

1. C. M. Bishop, Pattern Recognition and Machine Learning, Springer, 2011.
2. I. Goodfellow, Y. Bengio, A. Courville, Deep Learning, MIT Press, 2016.

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Programme	B. Tech in Electronics & Communication Engineering	**Academic Year of Regulation**	**2025-26**
Department	Electronics & Communication Engineering	**Semester**	**VI**

Course Code	**Course Name**	**Credit Structure**				**Marks Distribution**				
		L	**T**	**P**	**C**	**Attend.**	**Exam**	**Viva**	**Total**	**Bloom's taxonomy**
EC-3201	Electronic Instrument and Measurement Laboratory	**0**	**0**	**2**	**1**	**20**	**50**	**30**	**100**	

Course Objectives		**Course Outcomes**		
	1. To understand Different types of Errors in Electrical and Electronic Instruments and their analysis. **2.** Understand and do the statistical analysis of data. **3.** Analyze basic transducers and sensors used in measurement of different parameters.	**CO1**	To have a clear understanding of different test instruments and get familiarize with those instruments	Knowledge
		CO2	To understand the measurement techniques of various parameters	Understand
		CO3	To apply the measurement techniques of different parameters using electronic instruments	Apply
		CO4	To analyze and develop different instruments	Analyze

No.	**COs**	**Mapping with Program Outcomes (POs)**												**Mapping with PSOs**		
		PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
1	CO1	2	2	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
4	CO4	3	3	1	1	-	-	-	-	-	-	-	1	1	1	1
(Average)		2.25	2.25	1	1		-	-	-	-	-	-	1	1	1	1

SYLLABUS

No.	**Content**	**Hours**	**COs**
I	To observe the construction of PMMC, Dynamometer, Electro thermal and Rectifier type instrument, Oscilloscope and digital multimeter. To calibrate moving iron and electrodynamometer type ammeter/voltmeter by potentiometer. To calibrate dynamometer type wattmeter by potentiometer. To study voltage shunt and series ammeter behavior.	**24**	**CO1, CO2, CO3, CO4**
II	To measure the resistivity of material using Kelvin double bridge. To understand measurement technique of power using instrument transformer To understand measurement technique of in polyphase circuits To understand measurement technique of frequency by Wien bridge using oscilloscope To understand measurement technique of by Anderson bridge To understand measurement technique of capacitance by De Sauty bridge		
III	To find out static characteristic, accuracy, precision, hysteresis, repeatability, linearity of a measuring instrument. To find out dynamic characteristic, fidelity, speed of response To acquaint with basic structure of DMM and measurement of different electrical parameters. To understand statistical analysis of errors in measurement using computer simulation To study of advanced A/D and D/A converter along with its associate circuitry		
IV	To realize data acquisition system To study wave and spectrum analysis using digital storage oscilloscope & spectrum analyzer		
Total Hours		**24**	

Textbooks:

1. E. O. Doebelin, Measurement Systems - Application and Design, Tata McGraw-Hill, 2004.
2. J. P. Bentley, Measurement Systems- Application and Design, Pearson Education, 3e, 2005.

Reference Books:

1. A. K. Ghosh, Introduction to Measurements and Instrumentation, PHI Learning, New Delhi, 4/e, 2012.
2. A. K. Sawhney, A Course in Electronic Measurements and Instrumentation, Dhanpat Rai Co., 2021

राष्ट्रीय प्रौद्योगिकी संस्थान अरुणाचल प्रदेश

NATIONAL INSTITUTE OF TECHNOLOGY ARUNACHAL PRADESH

(शिक्षा मंत्रालय, भारत सरकार के तहत राष्ट्रीय महत्व का संस्थान)

(Institute of National Importance under Ministry of Education, Govt. of India)

CURRICULUM

Programme	B. Tech in Electronics & Communication Engineering	**Academic Year of Regulation**	**2025-26**
Department	Electronics & Communication Engineering	**Semester**	**VI**

Course Code	**Course Name**	**Credit Structure**				**Marks Distribution**				
		L	**T**	**P**	**C**	**Attend.**	**Exam**	**Viva**	**Total**	**Bloom's taxonomy**
EC-3202	Skill Development-IV	**0**	**0**	**2**	**1**	**20**	**50**	**30**	**100**	

Course Objectives		**Course Outcomes**		
	1. To become familiar with data and visualize univariate, bivariate, and multivariate data using statistical techniques and dimensionality reduction. 2. Implement the machine learning concepts and algorithms in any suitable language of choice.	**CO1**	Implement and demonstrate ML algorithms	Apply
		CO2	Evaluate different algorithms.	Evaluate
		CO3		
		CO4		

No.	**COs**	**Mapping with Program Outcomes (POs)**												**Mapping with PSOs**		
		PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
1	CO1	3	3	-	-	-	-	-	-	-	-	-	3	3	-	1
2	CO2	3	3	-	-	-	-	-	-	-	-	-	3	3	-	1
3	CO3	3	3	1	1	-	-	-	-	-	-	-	3	3	-	1
4	CO4	3	3	1	1	-	-	-	-	-	-	-	3	3	-	1
(Average)		3	3	0.5	0.5	-	-	-	-	-	-	-	3	3	-	1

SYLLABUS

No.	**Content**	**Hours**	**COs**
I	Develop a program to create histograms for all numerical features and analyze the distribution of each feature. Generate box plots for all numerical features and identify any outliers	**2**	**CO1**
II	Write a Python program to implement Simple Linear Regression and plot the graph.	**2**	**CO1**
III	Develop a program to demonstrate the working of Logistic Regression and show the confusion matric and show the results.	**2**	**CO1 CO2**
IV	Develop a program to implement k-Nearest Neighbour algorithm to classify the randomly generated datapoints or you may select appropriate data set for your experiment and draw graphs. Vary the value of K and compare the results.	**2**	**CO1 CO2**
V	Develop a program to implement LDA for reducing the dimensionality.	**2**	**CO1 CO2**
VI	Develop a program to implement Principal Component Analysis (PCA) for reducing the dimensionality of the Iris dataset.	**2**	**CO1 CO2**
VII	Implement Support Vector Machine for a dataset and compare the accuracy by applying the following kernel functions: i. Linear ii. Polynomial iii. RBF	**2**	**CO1 CO2**
VIII	Write a program to demonstrate the working of the decision tree based ID3 algorithm. Use an appropriate data set for building the decision tree and apply this knowledge to classify a new sample.	**2**	**CO1 CO2**
IX	Develop a program to implement k-means clustering using a dataset of your choice. Vary the number of k values as follows and compare the results	**2**	**CO1 CO2**
X	Develop an artificial neural network that would work as logic gates.	**2**	**CO1 CO2**
	Total Hours	**20**	

Textbooks:

1. Tom Mitchell, *Machine Learning*, McGraw Hill , 1997, ISBN 0-07-042807-7
2. Richard O. Duda, Peter E. Hart, David G. Stork, *Pattern classification*, Wiley, (2nd edition). Wiley, New York, 2001
3. Stephen Marsland, Machine Learning an algorithmic perspective, 2nd ed., CRC Press, Taylor & Francis Group, 2015

Reference Books:

1. Christopher M. Bishop, *Pattern Recognition and Machine Learning*, Springer, 2011 edition
2. Ian Goodfellow, Yoshua Bengio, Aaron Courville, *Deep Learning*, MIT Press , 2016

Programme	B. Tech in Electronics & Communication Engineering	**Academic Year of Regulation**	**2025-26**
Department	Electronics & Communication Engineering	**Semester**	**VI**

Course Code	**Course Name**	**Credit Structure**					**Marks Distribution**			**Bloom's Taxonomy**
		L	**T**	**P**	**C**	**INT**	**MID**	**END**	**Total**	
EC-3204	Basics of Wireless Communication	**3**	**0**	**0**	**3**	**20**	**30**	**50**	**100**	

Course Objectives

1. To provide students an understanding of the concepts related to wireless channel modelling.
2. To explore communication concepts and techniques for exploiting wireless channel characteristics and application of these concepts in a system context.
3. To familiarize students on how the diversity can be exploited to improve performance.
4. To familiarize students with capacity analysis and multiple access techniques in 3G, 4G and 5G.

Course Outcomes

	Outcome	Bloom's Taxonomy
CO1	Explain the basic notions of cellular system design and technical challenges	Knowledge
CO2	To interpret various mobile radio propagation models and the fading effects on the system performance	Understand
CO3	To apply the effectiveness of diversity techniques to mitigate the multichannel fading effects on received signals and spectral efficiency improvements through spatial multiplexing	Apply
CO4	To analyze multiuser systems, CDMA, WCDMA network planning and OFDM Concepts	Analyze

No.	**COs**	**Mapping with Program Outcomes (POs)**												**Mapping with PSOs**		
		PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
1	CO1	3	2	2	1	-	-	-	-	-	-	-	-	3	1	3
2	CO2	2	3	2	2	1	-	-	-	-	-	-	-	2	2	3
3	CO3	1	3	3	2	2	1	1	-	-	-	-	1	2	2	3
4	CO4	1	1	2	1	-	1	-	-	-	-	-	1	2	2	2
(Average)		1.75	2.25	2.25	1.5	0.75	0.5	0.25	-	-	-	-	0.5	2.25	1.75	2.75

SYLLABUS

No.	**Content**	**Hours**	**COs**
I	***Introduction to wireless communication**:* Evolution of mobile radio communication, Examples of wireless communication system.	**2**	**CO1**
II	***The cellular engineering fundamentals***: Frequency reuse, Channel assignment strategies, Handoff strategies, Interference and system capacity, Improving coverage and capacity.	**9**	**CO1**
III	***Mobile Radio Propagation models***: Free space propagation models, Two Ray model, Knife edge diffraction model, Log-distance path loss model, Outdoor propagation model, Indoor propagation model, Small scale multipath propagation, Small scale fading	**9**	**CO2**
IV	***Modulation techniques for mobile radio***: Analog modulation techniques, Line Coding, Pulse shaping, Linear modulation techniques, Constant envelope modulation techniques, Combined modulation techniques.	**9**	**CO3**
V	***Multiple access techniques:*** TDMA, FDMA, SDMA, CSMA, OFDMA	**7**	**CO4**
VI	GSM, 3G, 4G (LTE), NFC systems, WLAN technology, WLL, Ad hoc networks.	**9**	**CO1, CO4**
	Total Hours	**45**	

Textbooks:

1. T. S. Rappaport, Wireless Communications – Principles and Practice, Pearson, 2/e, 2010.
2. A. Goldsmith, Wireless Communications, Cambridge University Press, 2005.

Reference Books:

1. K. Feher, Wireless Digital Communications: Modulation and Spread Spectrum Applications, 1/e, 2015.
2. A. K. Jagannatham, Principles of Modern Wireless Communications Systems, McGraw Hill Education, 1/e, 2017.
3. W. C. Y. Lee, Wireless and Cellular Telecommunications, Mc. Graw Hill, 3/e, 2005.

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Programme	B. Tech in Electronics & Communication Engineering	**Academic Year of Regulation**	**2025-26**
Department	Electronics & Communication Engineering	**Semester**	**VI**

Course Code	**Course Name**	**Credit Structure**				**Marks Distribution**				**Bloom's Taxonomy**
		L	**T**	**P**	**C**	**INT**	**MID**	**END**	**Total**	
EC-320H	Computer Network	**3**	**0**	**0**	**3**	**20**	**30**	**50**	**100**	

Course Objectives	**Course Outcomes**			**Bloom's Taxonomy**
1. Understand computer network architectures, protocols, and layered models.		**CO1**	Explain network models, protocols, and communication architectures.	Knowledge
2. Learn the design and operation of physical, data link, network, and transport layers.		**CO2**	Analyze algorithms and protocols at physical, data link, and network layers.	Understand
3. Analyze routing, congestion control, and reliable data transfer mechanisms.		**CO3**	Evaluate transport services, congestion control, and network performance metrics.	Apply
4. Apply networking concepts to design, simulate, and troubleshoot communication systems.		**CO4**	Design and simulate network protocols and applications using modern tools.	Analyze

No.	**COs**	**Mapping with Program Outcomes (POs)**												**Mapping with PSOs**		
		PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
1	CO1	3	2	1	1	1	1	0	0	0	1	0	2	2	2	1
2	CO2	3	3	2	2	2	1	1	0	1	1	1	2	3	3	2
3	CO3	2	3	2	3	2	1	1	1	1	1	1	3	2	3	2
4	CO4	2	2	3	3	3	1	1	1	2	2	2	3	3	3	3
(Average)		2.5	2.5	2	2.25	2	1	0.75	0.5	1	1.25	1	2.5	2.5	2.75	2

SYLLABUS

No.	**Content**	**Hours**	**COs**
I	Introduction to networks, Internet architecture, OSI/TCP-IP layers	**6**	**CO1**
II	Physical layer: transmission media, bandwidth, modulation basics Data Link: framing, error detection/correction, MAC protocols, Ethernet	**12**	**CO2**
III	Network layer: IP addressing, subnetting, ARP, ICMP, routing algorithms Transport layer: UDP, TCP, congestion control, flow control Application layer: DNS, HTTP, FTP, email protocols	**15**	**CO1, CO2, CO3**
IV	Wireless and mobile networks, 802.11, cellular networks Network management, SDN, QoS, cloud networking Simulation using NS2/NS3/Wireshark — mini-projects	**9**	**CO4**
	Total Hours	**42**	

Textbooks:

1. Andrew S. Tanenbaum & David J. Wetherall, Computer Networks, 5th Ed., Pearson.
2. James F. Kurose & Keith W. Ross, Computer Networking: A Top-Down Approach, 8th Ed., Pearson.

Reference Books:

1. William Stallings, Data and Computer Communications, Pearson.
2. Behrouz Forouzan, Data Communications and Networking, McGraw Hill.
3. Larry Peterson & Bruce Davie, Computer Networks: A Systems Approach, Morgan Kaufmann.

Programme	B. Tech in Electronics & Communication Engineering	**Academic Year of Regulation**	**2025-26**
Department	Electronics & Communication Engineering	**Semester**	**VII**

Course Code	**Course Name**	**Credit Structure**					**Marks Distribution**			**Bloom's Taxonomy**
		L	**T**	**P**	**C**	**INT**	**MID**	**END**	**Total**	
EC-411A	Robotics Engineering	**3**	**0**	**0**	**3**	**20**	**30**	**50**	**100**	

Course Objectives		**Course Outcomes**			**Bloom's Taxonomy**
	1. To impart knowledge about basic mathematics related to industrial robots for their control, design and application in robotics & automation Industries. 2. Illustrate the Kinematics and Dynamics of robotics. 3. Elucidate the need and implementation of related Instrumentation & control in robotics. 4. Illustrate the movement of robotic joints with computers/microcontrollers. 5. Explain sensors and instrumentation in robotics.		**CO1**	To describe kinematic and dynamic analyses with simulation.	Knowledge
			CO2	To interpret design control laws for a simple robot.	Understand
			CO3	To integrate mechanical and electrical hardware for a real prototype of robotic device.	Apply
			CO4	To illustrate a robotic system for given industrial application.	Analyze

No.	**COs**	**Mapping with Program Outcomes (POs)**												**Mapping with PSOs**		
		PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
1	CO1	3	3	2	1	-	-	-	-	-	-	-	-	3	1	3
2	CO2	2	2	3	2	1	-	-	-	-	-	-	-	2	2	3
3	CO3	1	3	2	2	2	1	1	-	-	-	-	1	2	2	3
4	CO4	1	1	2	1	-	1	-	-	-	-	-	1	2	2	2
(Average)		1.75	2.25	2.25	1.5	0.75	0.5	0.25	-	-	-	-	0.5	2.25	1.75	2.75

SYLLABUS

No.	**Content**	**Hours**	**COs**
I	***Introduction to robotics*:** Types and components of a robot, Classification of robots, Kinematics systems, Definition of mechanisms and manipulators, Degrees of Freedom Robot Kinematics and Dynamics	**3**	**CO1**
II	***Dynamic modelling*:** Forward and inverse dynamics, Equations of motion using Euler-Lagrange formulation, Newton Euler formulation	**15**	**CO2**
III	***Sensor*:** Contact and Proximity, Position, Velocity, Force, Tactile, etc. Introduction to Cameras, Camera calibration, Geometry of Image formation, Euclidean/Similarity/Affine/Projective transformations Vision applications in robotics. **Actuators:** Electric, Hydraulic and Pneumatic; Transmission: Gears, Timing Belts and Bearings, Parameters for selection of actuators.	**8**	**CO3**
IV	***Basics of control*:** open loop- closed loop, Transfer functions, Control laws: P, PD, PID Linear and Non-linear controls, Control Hardware and Interfacing.	**6**	**CO4**
V	***Embedded systems*:** Microcontroller Architecture and Integration with Sensors, Actuators, Components, Programming Applications for Industrial Robot – Programming.	**6**	**CO1, CO4**
VI	***AI in robotics*:** Applications in Unmanned Systems, Defence, Medical, Industries, etc, Robotics and Automation for Industry 4.0 Robot Safety and Social Robotics.	**7**	**CO1, CO3**
	Total Hours	**45**	

Textbooks:

1. M. Corrales, M. Fenwick, N. Forgó, Robotics, AI and the Future of Law, Springer, 2018.
2. Y. Wang, Space robotics. Springer, 2021.

Reference Books:

1. J. Craig, Introduction to Robotics: Mechanics and Control, Pearson, 3/e, 2004.
2. M. W. Spong, M, Vidyasagar, Robot Dynamics and Control, Wiley India Pvt. Limited, 2008.
3. K. S. Saha, Introduction to Robotics, Mc Graw Hill, 2024.
4. N. Odrey, M. Weiss, M. Groover, R. Nagel, A. Dutta, Industrial Robotics - Technology, Programming and Applications, McGraw Hill, 2017.

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Programme	B. Tech in Electronics & Communication Engineering	**Academic Year of Regulation**	**2025-26**
Department	Electronics & Communication Engineering	**Semester**	**VII**

Course Code	Course Name	Credit Structure				Marks Distribution			
		L	T	P	C	INT	MID	END	Total
EC-412A	5G & Advanced Communication	**3**	**0**	**0**	**3**	**20**	**30**	**50**	**100**

Course Objectives		Course Outcomes		Bloom's Taxonomy
1. To learn basics of 5G and beyond wireless communication. 2. To provide basic understanding of key technology and enablers of 5G and beyond communication systems. 3. To study 5G wireless channel model. 4. To learn 5G techniques.		**CO1**	To describe how 5G is revolutionizing the way we do business in the 2020s.	Knowledge
		CO2	To infer about the technologies that make 5G possible, including mm Wave, Massive MIMO, RAN, and more.	Understand
		CO3	To teach how companies can take advantage of 5G private Networks and Industrial IoT to transform the way they operate on a daily basis.	Apply
		CO4	To connect base-level knowledge of 5G needed to continue wireless education and advancement in the rapidly growing field of wireless technology.	Analyze

No.	COs	Mapping with Program Outcomes (POs)												Mapping with PSOs		
		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	CO1	2	3	-	1	-	-	-	-	-	-	-	-	2	-	2
2	CO2	2	3	-	1	-	-	-	-	-	-	-	-	2	-	2
3	CO3	2	3	3	1	2	-	-	-	-	-	-	1	2	1	3
4	CO4	2	3	3	1	2	1	3	-	-	-	-	1	3	1	2
(Average)		2	3	1.5	1	1	0.25	0.75	-	-	-	-	0.5	2.25	1	2.25

SYLLABUS

No.	Content	Hours	COs
I	***Overview of 5G broadband wireless communications***: Evaluation of mobile technologies 1G to 4G (LTE, LTEA, LTEA Pro), An Overview of 5G requirements, Regulations for 5G, Spectrum Analysis and Sharing for 5G.	**9**	**CO1**
II	***The 5G wireless propagation channels***: Channel modelling requirements, propagation scenarios and challenges in the 5G modelling, Channel Models for mm wave MIMO Systems.	**9**	**CO2**
III	***Transmission and Design Techniques for 5G***: Basic requirements of transmission over 5G, Modulation Techniques – Orthogonal frequency division multiplexing (OFDM), generalized frequency division multiplexing (GFDM), filter bank multi-carriers (FBMC) and universal filtered multi-carrier (UFMC), Multiple Accesses Techniques – orthogonal frequency division multiple accesses (OFDMA), generalized frequency division multiple accesses (GFDMA), non-orthogonal multiple accesses (NOMA).	**11**	**CO3**
IV	***Device-to-device (D2D) and machine-to-machine (M2M) type communications***: Extension of 4G D2D standardization to 5G, radio resource management for mobile broadband D2D, multi-hop and multi-operator D2D communications, URLLC	**7**	**CO4**
V	***Millimeter-wave communications***: spectrum regulations, deployment scenarios, beamforming, physical layer techniques, interference and mobility management, Massive MIMO propagation channel models, Channel Estimation in Massive MIMO, Massive MIMO with Imperfect CSI, Multi-Cell Massive MIMO, Pilot Contamination, Spatial Modulation (SM).	**9**	**CO3, CO4**
	Total Hours	**45**	

Textbooks:

1. M. Sauter, From GSM to LTE– Advanced Pro and 5G: An Introduction to Mobile Networks and Mobile Broadband, Wiley-Blackwell, 2017.
2. A. Osseiran, J. F. Monserrat, P. Marsch, M. Dohler, 5G Mobile and Wireless Communication Technology, Cambridge University Press, 2016.

Reference Books:

1. J. Rodriguez, Fundamentals of 5G Mobile Networks, John Wiley & Sons, 2015.
2. A. Ghosh, R. Ratasuk, Essentials of LTE and LTE-A, Cambridge University Press, 2011.
3. A. G. Kanatos, Konstantina S. Nikita, Panagiotis Mathiopoulos, New Directions in Wireless Communication Systems from Mobile to 5G, CRC Press, 2020.
4. T. S. Rappaport, R. W. Heath, R. C. Danials, J. N. Murdock, Millimeter Wave Wireless Communications, Prentice Hall Communications, 2014.

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Programme	B. Tech in Electronics & Communication Engineering	**Academic Year of Regulation**	**2025-26**
Department	Electronics & Communication Engineering	**Semester**	**VII**

Course Code	Course Name	Credit Structure				Marks Distribution			
		L	**T**	**P**	**C**	**INT**	**MID**	**END**	**Total**
EC-413A	Biomedical Instrumentation	**3**	**0**	**0**	**3**	**20**	**30**	**50**	**100**

Course Objectives	Course Outcomes		Bloom's Taxonomy
1. Understand the basic principles and components of biomedical instruments. 2. Study measurement techniques for physiological parameters and biomedical signals. 3. Learn design and safety aspects of medical electronic systems. 4. Apply instrumentation concepts to develop and evaluate biomedical devices.	**CO1**	Explain the working principles of biomedical sensors and transducers.	Knowledge
	CO2	Analyze instrumentation systems for measuring physiological variables (ECG, EEG, EMG, BP, etc.).	Understand
	CO3	Evaluate system design aspects including signal conditioning, isolation, and patient safety.	Apply
	CO4	Design or simulate basic biomedical instruments and signal acquisition systems.	Analyze

No.	COs	Mapping with Program Outcomes (POs)												Mapping with PSOs		
		PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
1	CO1	3	2	2	1	-	-	-	-	-	-	-	-	3	-	3
2	CO2	2	3	2	1	-	-	-	-	-	-	-	-	2	-	2
3	CO3	1	2	2	2	2	1	2	-	-	-	-	1	2	2	2
4	CO4	1	3	1	2	2	1	2	-	-	-	-	1	2	2	2
(Average)		1.75	2.5	1.75	1.5	1	0.5	1	-	-	-	-	0.5	2.25	1	2.25

SYLLABUS

No.	Content	Hours	COs
I	Introduction to biomedical instrumentation; physiological systems overview; biomedical signals Transducers and sensors for biomedical applications.	**12**	**CO1**
II	Bioelectric signals and electrodes: ECG, EEG, EMG electrodes and recording systems Cardiovascular measurements: blood pressure, heart sounds, pulse oximetry Respiratory and neural measurements: spirometers, EEG analysis, evoked potentials	**15**	**CO2**
III	Patient safety, grounding, electrical hazards, standards (IEC60601)	**9**	**CO3**
IV	Imaging instrumentation basics: X-ray, CT, MRI, ultrasound Case studies and mini-projects in biomedical device design	**6**	**CO4**
	Total Hours	**45**	

Textbooks:

1. R. S. Khandpur, Handbook of Biomedical Instrumentation, 3rd Ed., McGraw Hill, 2020.
2. Leslie Cromwell, Fred J. Weibell, and Erich A. Pfeiffer, Biomedical Instrumentation and Measurements, 2nd Ed., Pearson, 2011.

Reference Books:

1. J. G. Webster, Medical Instrumentation: Application and Design, 4th Ed., Wiley, 2009.
2. John Enderle, Joseph Bronzino, Introduction to Biomedical Engineering, 4th Ed., Elsevier, 2015.
3. C. R. Chatwin and P. A. Young, Biomedical Imaging: Applications and Advances, Woodhead Publishing, 2012.

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Programme	B. Tech in Electronics & Communication Engineering	Academic Year of Regulation	2025-26
Department	Electronics & Communication Engineering	Semester	VII

Course Code	Course Name	Credit Structure				Marks Distribution				Bloom's Taxonomy
		L	T	P	C	INT	MID	END	Total	
EC-413B	Memory Design	3	0	0	3	20	30	50	100	

Course Objectives	Course Outcomes		
1. Understand the fundamental concepts, types, and organization of semiconductor memories. 2. Analyze design parameters, cell structures, and peripheral circuits in memory systems. 3. Learn design strategies for SRAM, DRAM, ROM, and non-volatile memories. 4. Evaluate and optimize memory design for power, area, and performance trade-offs.	CO1	Explain memory hierarchy, classification, and operation principles.	Knowledge
	CO2	Design memory cell circuits and peripheral subsystems.	Understand
	CO3	Compare and analyze various volatile and non-volatile memory technologies.	Apply
	CO4	Evaluate memory performance and implement low-power, high-density designs.	Analyze

No.	COs	Mapping with Program Outcomes (POs)												Mapping with PSOs		
		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	CO1	3	2	2	1	-	-	-	-	-	-	-	-	3	-	3
2	CO2	2	3	2	1	-	-	-	-	-	-	-	-	2	-	2
3	CO3	1	2	2	2	2	1	2	-	-	-	-	1	2	2	2
4	CO4	1	3	1	2	2	1	2	-	-	-	-	1	2	2	2
(Average)		1.75	2.5	1.75	1.5	1	0.5	1	-	-	-	-	0.5	2.25	1	2.25

SYLLABUS

No.	Content	Hours	COs
I	Introduction to memory systems: hierarchy, classification, and performance metrics	6	CO1
II	SRAM design: cell sizing, stability analysis, static/dynamic noise margins Peripheral circuits: address decoders, word-line/bit-line drivers, precharge circuits, sense amplifier basics DRAM design: storage capacitor design, refresh mechanisms, and control logic	18	CO2
III	Non-volatile memories: ROM, Flash, ReRAM, MRAM, PCRAM, FeRAM fundamentals.		
IV	Concept of memory bank and Memory Compiler Memory testing, reliability, and yield considerations	9	CO3
V	Low-power and high-speed memory design techniques Emerging memory technologies: 3D memories, HBM, NVM integration in SoC	9	CO4
	Total Hours	**42**	

Textbooks:

1. Kiyoo Itoh, VLSI Memory Chip Design and Technologies, Springer, 2nd Ed., 2018.
2. Baker, R. Jacob, CMOS: Circuit Design, Layout, and Simulation, 4th Ed., Wiley, 2019.
3. Shimeng Yu, Semiconductor Memory Devices and Circuits, CRC Press, 2022

Reference Books:

1. Ashok K. Sharma, Advanced Semiconductor Memories: Architectures, Designs, and Applications, Wiley, 2003.
2. Sung-Mo Kang and Yusuf Leblebici, CMOS Digital Integrated Circuits: Analysis and Design, McGraw Hill, 4th Ed., 2014.
3. Bruce Jacob, Spencer Ng, and David Wang, Memory Systems: Cache, DRAM, Disk, Morgan Kaufmann, 2010.
4. Kiat-Seng Yeo and Kaushik Roy, Low Voltage, Low Power VLSI Subsystems, McGraw-Hill, 2005

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CURRICULUM

Programme	B. Tech in Electronics & Communication Engineering	**Academic Year of Regulation**	**2025-26**
Department	Electronics & Communication Engineering	**Semester**	**VII**

Course Code	**Course Name**	**Credit Structure**				**Marks Distribution**				**Bloom's Taxonomy**
		L	**T**	**P**	**C**	**INT**	**MID**	**END**	**Total**	
EC-414A	Optical Communication	**3**	**0**	**0**	**3**	**20**	**30**	**50**	**100**	

Course Objectives		**Course Outcomes**		
	1. To develop the student's ability to analyze the different kind of losses, signal distortion in fiber optical communication and other signal degradation factors. 2. To familiarize students with the fiber optical source materials, LED structures and Laser diodes. 3. To familiarize students with the fiber optical receivers such as PIN photodiode and APD diodes, noise performance in photo detector receiver operation and configuration. 4. To familiarize students with operational principles of WDM and measurement analysis.			
		CO1	Explain the basic structures and types of Optical fiber and discuss the channel impairments like losses and dispersion	Knowledge
		CO2	To understand basic terminology, concepts and take the lead in fiber optic discussions and what are its requirements.	Understand
		CO3	To analyze the operation of LEDs, laser diodes and PIN photodetectors (spectral properties, bandwidth and circuits) and apply in optical systems	Apply
		CO4	To analyze the amount of light lost going through an optical system and different optical amplifiers	Analyze

No.	**COs**	**Mapping with Program Outcomes (POs)**												**Mapping with PSOs**		
		PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
1	CO1	3	2	2	1	-	-	-	-	-	-	-	-	3	-	3
2	CO2	2	3	2	1	-	-	-	-	-	-	-	-	2	-	2
3	CO3	1	2	2	2	2	1	2	-	-	-	-	1	2	2	2
4	CO4	1	3	1	2	2	1	2	-	-	-	-	1	2	2	2
(Average)		1.75	2.5	1.75	1.5	1	0.5	1	-	-	-	-	0.5	2.25	1	2.25

SYLLABUS

No.	**Content**	**Hours**	**COs**
I	Fiber Structures and Types, Rays and modes, Single-mode and multimode fibers, Refractive index profiles, Graded index fiber, Numerical aperture, Acceptance angle, V-parameter, Loss mechanisms in fibers, Loss vs. wavelength plot and its significance, Dispersion mechanisms in Fibers: Intermodal and intramodal (chromatic) dispersions, Components of intramodal dispersions, Dispersion vs. wavelength plots and their significance.	**13**	**CO1 CO2**
II	***Optical Sources***: LED and LASER structures, Operating principle and modulation characteristics.	**8**	**CO2, CO3**
III	***Photo Detectors***: PIN diode and avalanche photodiode (APD) as photo detector: Structure, operating principle, Shot noise, Avalanche multiplication (excess) noise.	**8**	**CO2, CO3**
IV	Optical isolators, polarizer, Circulators, Attenuators, Oscillators, Filters, Add/drop multiplexers, Optical modulators. Optical amplifiers: Basic applications and types, Semiconductor optical amplifiers, EDFA.	**8**	**CO4**
V	Wave division multiplexing and demultiplexing, Intensity modulation/direct detection system, Link budget using direct detection, Coherent system, Wavelength converters, Coherent and WDM systems.	**8**	**CO4**
	Total Hours	**45**	

Textbooks:

1. R. P. Khare, Fiber Optics and Optoelectronics, Oxford University Press, 2004.
2. J. M. Senior, Optical Fiber Communication - Principle and Practice, PHI, 3/e, 2010.

Reference Books:

1. G. P. Agrawal, Fiber Optic Communication Systems, John Wiley & Sons, 4/e, 2010.
2. G. Kaiser, Optical Fiber Communication, McGraw Hill, 5/e, 2017.

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CURRICULUM

Programme	B. Tech Electronics & Communication Engineering	**Academic Year of Regulation**	**2025-26**
Department	Electronics & Communication Engineering	**Semester**	**VII**

Course Code	**Course Name**	**Credit Structure**					**Marks Distribution**			**Bloom's taxonomy**
		L	**T**	**P**	**C**	**INT**	**MID**	**END**	**Total**	
EC-414B	VLSI System Design	**3**	**0**	**0**	**3**	**20**	**30**	**50**	**100**	

Course Objectives		**Course Outcomes**			
	1. To understand basics of system hardware, programmable logic devices **2.** To understand design and analysis of synchronous, asynchronous circuits and memories **3.** To understand clock distribution in design and analysis FIFO and Network-on-Chip **4.** To understand datapath and control in processor design		**CO1**	To identify basics of system hardware design and programmable logic devices	Knowledge
			CO2	To interpret design using basic building blocks, synchronous and asynchronous circuits	Understand
			CO3	To relate clock distribution in Network-on-Chip and FIFO design	Apply
			CO4	To connect and conclude datapath & control in processor design	Analyze

No.	**COs**	**Mapping with Program Outcomes (POs)**												**Mapping with PSOs**		
		PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
1	CO1	3	2	2	2	-	-	-	-	-	-	-	-	2	3	2
2	CO2	3	2	3	3	-	-	-	-	-	-	-	-	3	2	2
3	CO3	3	2	3	3	-	-	-	-	-	-	-	-	2	2	2
4	CO4	3	2	2	2	-	-	-	-	-	-	-	-	2	2	2
(Average)		3	2	2.5	2.5									2.25	2.25	2

SYLLABUS

No.	**Content**	**Hours**	**COs**
I	***Basics of system hardware design***: Hierarchical design using top down and bottom-up methodology, System partitioning techniques, Interfacing between system components. ***Programmable logic devices***: FPGA, CPLD, PLA, PAL. ***Design phases***: Design, Testing, Fabrication, packaging, Abstraction and types. ***Computer aided design***: Modeling & simulation, VLSI design flow, ASIC design flow.	**11**	**CO1**
II	***Designing basic building blocks***: Digital system design using conventional components such as gates, flipflops, PALs, FPGAs ***Synchronous and asynchronous circuits***: Concept of finite state machine, Moore and Mealy machines, Synchronous FSM design, State diagram, state assignment, Derivation of next state and output expressions, Arithmetic logic design, Designing multi data path ALU, Algorithmic state machine. ***Memories***: Introduction to different types of memories, Single and multiport memories. ***Introduction to globally asynchronous locally synchronous***	**11**	**CO1, CO2**
III	***Introduction to Network-on-Chip***. ***Introduction to FIFO and designing fast FIFOs***. ***Clocks***: Static timing analysis, Handling multiple clock domains, Global and local clock distribution.	**10**	**CO2, CO3**
IV	***Processor design***: Von Neumann architecture, Harvard architecture ***Datapath & control***: Enhancing performance with pipelining, Exploiting memory hierarchy. Concept of near memory computing and in-memory computing. ***x86 microprocessor architecture***: Hardware of 186, 286,386, 486 and Pentium processors with architectural evolutions, IO and Memory Interfacing	**8**	**CO3, CO4**
	Total Hours	**40**	

Textbooks:

1. M. Morris Mano, Digital Logic & Computer Design, Pearson Education India, 1e, 2016.
2. S. Brown and Z. Vranesic, Digital Logic Design with Verilog, McGraw Hill Higher Education, 2002.
3. D. A. Patterson and J. L. Hennessy, Computer Organization and Design: The Hardware / Software Interface, Morgan Kaufmann, 2007.

Reference Books:

1. J. Rabey, A. Chandrakasan and B. Nikolic, Digital Integrated Circuits- A Design Perspective, Pearson, 2e, 2011.

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Programme	B. Tech in Electronics & Communication Engineering	**Academic Year of Regulation**	**2025-26**
Department	Electronics & Communication Engineering	**Semester**	**VII**

Course Code	**Course Name**	**Credit Structure**					**Marks Distribution**			
		L	**T**	**P**	**C**	**INT**	**MID**	**END**	**Total**	**Bloom's Taxonomy**
EC-415A	Low Power VLSI	**3**	**0**	**0**	**3**	**20**	**30**	**50**	**100**	

Course Objectives		**Course Outcomes**			
	1. Understand sources of power dissipation in CMOS and low-power design principles. 2. Learn circuit- and logic-level techniques for minimizing static and dynamic power. 3. Explore architecture-level and system-level low-power methodologies. 4. Apply CAD tools and power estimation methods to analyze and optimize VLSI designs.		**CO1**	Explain power dissipation mechanisms in CMOS circuits.	Knowledge
			CO2	Analyze and apply circuit and logic-level low-power design techniques.	Understand
			CO3	Evaluate power-performance trade-offs at architecture and system levels.	Apply
			CO4	Simulate, measure, and optimize power in VLSI circuits using CAD tools.	Analyze

No.	**COs**	**Mapping with Program Outcomes (POs)**												**Mapping with PSOs**		
		PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
1	CO1	3	2	2	1	-	-	-	-	-	-	-	-	3	-	3
2	CO2	2	3	2	1	-	-	-	-	-	-	-	-	2	-	2
3	CO3	1	2	2	2	2	1	2	-	-	-	-	1	2	2	2
4	CO4	1	3	1	2	2	1	2	-	-	-	-	1	2	2	2
(Average)		1.75	2.5	1.75	1.5	1	0.5	1	-	-	-	-	0.5	2.25	1	2.25

SYLLABUS

No.	**Content**	**Hours**	**COs**
I	Introduction: CMOS power dissipation sources, metrics, and low-power design need Power estimation techniques: analytical, simulation-based, and probabilistic models	**12**	**CO1**
II	Circuit-level low-power techniques: transistor sizing, voltage scaling, threshold adjustment Logic-level techniques: logic styles, glitch reduction, clock gating	**12**	**CO2**
III	Power management: dynamic voltage/frequency scaling (DVFS), power gating, multi-VDD design Near V_{TH} and Subthreshold design: logic circuits and memory	**12**	**CO3**
IV	CAD tools for power analysis and optimization Case studies and mini-projects	**6**	**CO4**
	Total Hours	**42**	

Textbooks:

1. Kaushik Roy and Sharat C. Prasad, Low Power CMOS VLSI Circuit Design, Wiley, 2nd Ed., 2009.
2. Jan M. Rabaey, Anantha Chandrakasan, and Borivoje Nikolic, Digital Integrated Circuits: A Design Perspective, 2nd Ed., Pearson, 2016.

Reference Books:

1. A. P. Chandrakasan and R. W. Brodersen, Low Power Digital CMOS Design, Kluwer Academic Publishers, 1995.
2. B. Razavi, Design of Analog CMOS Integrated Circuits, McGraw Hill, 2016.
3. N. Weste and D. Harris, CMOS VLSI Design: A Circuits and Systems Perspective, 4th Ed., Pearson, 2010.

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CURRICULUM

Programme	B. Tech in Electronics & Communication Engineering	**Academic Year of Regulation**	**2025-26**
Department	Electronics & Communication Engineering	**Semester**	**VII**

Course Code	**Course Name**	**Credit Structure**					**Marks Distribution**			
		L	**T**	**P**	**C**	**INT**	**MID**	**END**	**Total**	
EC-415B	Digital Image Processing	**3**	**0**	**0**	**3**	**20**	**30**	**50**	**100**	

Course Objectives	**Course Outcomes**		**Bloom's Taxonomy**
1. Understand the fundamental concepts and mathematical foundations of digital image processing. 2. Learn various image enhancement, restoration, and compression techniques. 3. Analyze image segmentation, feature extraction, and pattern recognition methods. 4. Apply image processing algorithms to real-world applications using software tools.	**CO1**	Explain digital image formation, sampling, and quantization principles.	Knowledge
	CO2	Apply image enhancement and restoration techniques in spatial and frequency domains.	Understand
	CO3	Perform segmentation, feature extraction, and classification for object recognition.	Apply
	CO4	Design and implement image processing algorithms for real-life applications.	Analyze

No.	**COs**	**Mapping with Program Outcomes (POs)**												**Mapping with PSOs**		
		PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
1	CO1	3	2	2	1	-	-	-	-	-	-	-	-	3	-	3
2	CO2	2	3	2	1	-	-	-	-	-	-	-	-	2	-	2
3	CO3	1	2	2	2	2	1	2	-	-	-	-	1	2	2	2
4	CO4	1	3	1	2	2	1	2	-	-	-	-	1	2	2	2
(Average)		1.75	2.5	1.75	1.5	1	0.5	1	-	-	-	-	0.5	2.25	1	2.25

SYLLABUS

No.	**Content**	**Hours**	**COs**
I	Introduction to digital image processing, human visual system, image sampling, quantization	**6**	**CO1**
II	Image enhancement in spatial domain: contrast stretching, histogram processing, smoothing/sharpening filters Frequency domain processing: Fourier transform, filtering, homomorphic enhancement	**12**	**CO2**
III	Image restoration: noise models, inverse and Wiener filtering, morphological operations Image segmentation: thresholding, edge detection, region growing, clustering	**12**	**CO2, CO3**
IV	Feature extraction and representation: texture, color, and shape descriptors Image compression: coding redundancy, JPEG/MPEG standards, wavelet compression	**6**	**CO3, CO4**
V	Object recognition and classification: template matching, machine learning basics Case studies and mini-projects using MATLAB / Python (OpenCV, scikit-image)	**6**	**CO4**
	Total Hours		

Textbooks:

1. Rafael C. Gonzalez and Richard E. Woods, Digital Image Processing, 4th Ed., Pearson, 2018.
2. Anil K. Jain, Fundamentals of Digital Image Processing, Pearson, 2002.

Reference Books:

1. Kenneth R. Castleman, Digital Image Processing, Pearson, 2015.
2. B. Chanda and D. Dutta Majumder, Digital Image Processing and Analysis, 2nd Ed., PHI, 2011.
3. Milan Sonka, Vaclav Hlavac, Roger Boyle, Image Processing, Analysis, and Machine Vision, Cengage Learning, 2015.

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CURRICULUM

Programme	B. Tech in Electronics & Communication Engineering	**Academic Year of Regulation**	**2025-26**
Department	Electronics & Communication Engineering	**Semester**	**VII**

Course Code	**Course Name**	**Credit Structure**					**Marks Distribution**			**Bloom's taxonomy**
		L	**T**	**P**	**C**	**Attend.**	**Exam**	**Viva**	**Total**	
EC-4101	Robotics Engineering Laboratory	**0**	**0**	**2**	**1**	**20**	**50**	**30**	**100**	

Course Objectives

1. Implement and test numerical programs on assembly and Embedded C and IDE platform.
2. Interface simple peripherals like Keys, LED's, etc. with loading considerations.
3. Design using Solidworks different link and manipulators.
4. Complete Embedded System product with different actuators and sensors

Course Outcomes

CO1	Able to understand the need of embedded systems and integrated product design procedure and role of embedded systems in various engineering fields.	Knowledge
CO2	Able to understand the appropriate selection of actuators and different control methodology for different types of real life applications.	Understand
CO3	Able to understand the various types of microcontrollers, sensors and transducers and acquire the knowledge on different types of instrumentation systems.	Apply
CO4	Able to design and develop innovative solution for real life applications in various engineering fields.	Analyze

No.	**COs**	**Mapping with Program Outcomes (POs)**												**Mapping with PSOs**		
		PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
1.	CO1	1	1	1	1	1	1	1	1	2	2	1	2	2	1	1
2.	CO2	2	2	1	1	1	1	1	1	1	1	2	1	1	2	1
3.	CO3	1	1	1	1	1	2	1	2	1	1	2	1	1	1	1
4.	CO4	1	1	1	2	2	1	3	1	2	1	1	1	1	1	2
(Average)		1.25	1.25	1	1.25	1.25	1.25	1.5	1.25	1.5	1.25	1.5	1.25	1.25	1.25	1.25

SYLLABUS

No.	**Content**	**Hours**	**COs**
I	1. Write an assembly language program to toggle the any port output using Keil software. 2. Write an assembly language program to interface LED with 8051 microcontroller using Keil software.	**4**	**CO1**
II	1. Write an assembly language program and Embedded C program to interface stepper motor 2. Write an assembly language program and Embedded C program to interface servo 3. Write an assembly language program to interface DC motor 4. Application of microcontroller as switches and timers	**4**	**CO1 & CO2**
II	Solidworks Design of Different links of robot manipulators	**8**	**CO1 & CO3**
IV	Complete case study/mini project of robot	**8**	**CO3 & CO4**
	Total Hours	**24**	

Textbooks:

1. James K. Peckol, Anikt A. Bhurane, Dushyant K. Sing, Lachit Dutta, Sahadev Roy, Trailokya Nath Sasamal "Embedded Systems A Contemporary Design Tool", Wiley , 378-93-5746-396-6, (2024)
2. M A Mazidi, J G Mazidi, R D McKinlay, The 8051 Microcontroller and Embedded Systems Using Assemble and C, Pearson/Prentice Hall, 2nd Ed
3. Lyla B Das; Embedded Systems and Integrated Approach, Pearson, India, 2013, first edition,
4. Rajkamal, Microcontrollers, Archi, Progr, interfacing and Sys design, Pearson, India, 2nd ed, 2012

Reference Books:

1. Kenneth Ayala, The 8051 Microcontroller, Cengage learning, India, 2004 3rd Ed
2. K M Bhurchandi, A K Ray, Advanced microprocessors and Peripherals, McGraw Hill Education India, 2012, 3rd ed Top
3. K V Shibu, Introduction to Embedded Systems, Tata McGraw Hill Education, India, 2009

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Programme	B. Tech in Electronics & Communication Engineering	**Academic Year of Regulation**	**2025-26**
Department	Electronics & Communication Engineering	**Semester**	**VII**

Course Code	**Course Name**	**Credit Structure**				**Marks Distribution**				**Bloom's taxonomy**
		L	**T**	**P**	**C**	**Attend.**	**Exam**	**Viva**	**Total**	
EC-4102	5G and Advance Communication Laboratory	**0**	**0**	**2**	**1**	**20**	**50**	**30**	**100**	

Course Objectives

1. Provide hands-on experience in simulation, measurement, and performance analysis of 5G systems.
2. Enable students to explore and evaluate advanced communication protocols and network layers used in next-generation mobile systems using SDR.
3. Familiarize students with the fundamentals of 5G architecture, technologies, and communication standards.
4. Develop practical understanding of advanced wireless communication concepts such as MIMO, OFDM, and beamforming.

Course Outcomes

	Outcome	Bloom's taxonomy
CO1	FM Transmitter & Receiver configuration and generation using SDR	Knowledge
CO2	Amplitude Shift Keying (ASK) configuration and generation using SDR	Understand
CO3	Demonstrate understanding of 5G architecture, frequency bands, and enabling technologies.	Apply
CO4	Identify and recall various 5G protocols, standards, and performance parameters. Analyze and interpret performance metrics of 5G and advanced communication systems through laboratory experiments.	Analyze

No.	**COs**	**Mapping with Program Outcomes (POs)**												**Mapping with PSOs**		
		PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
1.	CO1	1	1	1	1	1	1	1	1	2	2	1	2	2	1	1
2.	CO2	2	2	1	1	1	1	1	1	1	1	2	1	1	2	1
3.	CO3	1	1	1	1	1	2	1	2	1	1	2	1	1	1	1
4.	CO4	1	1	1	2	2	1	3	1	2	1	1	1	1	1	2
(Average)		1.25	1.25	1	1.25	1.25	1.25	1.5	1.25	1.5	1.25	1.5	1.25	1.25	1.25	1.25

SYLLABUS

No.	**Content**	**Hours**	**COs**
I	Application Program to configure the SDR as different Analog Modulation Transmitter & Receiver	**6**	**CO1**
II	Different Digital Modulation & Demodulation schemes using SDR.	**6**	**CO1 & CO2**
II	To study and simulate the 5G NR OFDM-based physical layer and observe its time-frequency structure.	**6**	**CO1 & CO3**
IV	Complete case study/mini project.	**6**	**CO3 & CO4**
	Total Hours	**24**	

Textbooks:

1. M. Sauter, From GSM to LTE– Advanced Pro and 5G: An Introduction to Mobile Networks and Mobile Broadband, Wiley-Blackwell, 2017.
2. A. Osseiran, J. F. Monserrat, P. Marsch, M. Dohler, 5G Mobile and Wireless Communication Technology, Cambridge University Press, 2016.

Reference Books:

1. J. Rodriguez, Fundamentals of 5G Mobile Networks, John Wiley & Sons, 2015.
2. A. Ghosh, R. Ratasuk, Essentials of LTE and LTE-A, Cambridge University Press, 2011.
3. A. G. Kanatos, Konstantina S. Nikita, Panagiotis Mathiopoulos, New Directions in Wireless Communication Systems from Mobile to 5G, CRC Press, 2020.
4. T. S. Rappaport, R. W. Heath, R. C. Danials, J. N. Murdock, Millimeter Wave Wireless Communications, Prentice Hall Communications, 2014.

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CURRICULUM

Programme	B. Tech in Electronics & Communication Engineering	**Academic Year of Regulation**	**2025-26**
Department	Electronics & Communication Engineering	**Semester**	**VII**

Course Code	Course Name	Credit Structure				Marks Distribution				Bloom's Taxonomy
		L	T	P	C	Attend.	Exam	Viva	Total	
EC-416A	Optical Communication Laboratory	**0**	**0**	**2**	**1**	**20**	**50**	**30**	**100**	

Course Objectives

1. To develop the student's ability to analyze the different kind of losses, signal distortion in fiber optical communication and other signal degradation factors.
2. To familiarize students with the fiber optical source materials, LED structures and Laser diodes.
3. To familiarize students with the fiber optical receivers such as PIN photodiode and APD diodes, noise performance in photo detector receiver operation and configuration.
4. To familiarize students with operational principles of WDM and measurement analysis.

Course Outcomes

	Course Outcome	Bloom's Taxonomy
CO1	Explain the basic structures and types of Optical fiber and discuss the channel impairments like losses and dispersion	Knowledge
CO2	To understand basic terminology, concepts and take the lead in fiber optic discussions and what are its requirements.	Understand
CO3	To analyze the operation of LEDs, laser diodes and PIN photodetectors (spectral properties, bandwidth and circuits) and apply in optical systems	Apply
CO4	To analyze the amount of light lost going through an optical system and different optical amplifiers	Analyze

No.	COs	Mapping with Program Outcomes (POs)												Mapping with PSOs		
		PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
1	CO1	3	2	2	1	-	-	-	-	-	-	-	-	3	-	3
2	CO2	2	3	2	1	-	-	-	-	-	-	-	-	2	-	2
3	CO3	1	2	2	2	2	1	2	-	-	-	-	1	2	2	2
4	CO4	1	3	1	2	2	1	2	-	-	-	-	1	2	2	2
(Average)		1.75	2.5	1.75	1.5	1	0.5	1	-	-	-	-	0.5	2.25	1	2.25

SYLLABUS

No.	Content	Hours	COs
I	Characterization of LED	**24**	**CO1, CO2, CO3**
II	Characterization of Laser diode		
III	Intensity modulation of laser output through an optical fiber		
IV	Measurement of data rate for digital optical link		
V	Measurement of numerical aperture		
VI	Measurement of losses in plastic fiber		
VII	Characteristics of APD		
VIII	Optical Power Measurements		
	Total Hours	**24**	

Textbooks:

1. R. P. Khare, Fiber Optics and Optoelectronics, Oxford University Press, 2004.
2. J. M. Senior, Optical Fiber Communication - Principle and Practice, PHI, 3/e, 2010.

Reference Books:

1. G. P. Agrawal, Fiber Optic Communication Systems, John Wiley & Sons, 4/e, 2010.
2. G. Kaiser, Optical Fiber Communication, McGraw Hill, 5/e, 2017.

Programme	B. Tech Electronics & Communication Engineering	**Academic Year of Regulation**	**2025-26**
Department	Electronics & Communication Engineering	**Semester**	**VII**

Course Code	**Course Name**	**Credit Structure**				**Marks Distribution**				
		L	**T**	**P**	**C**	**Attend.**	**Exam**	**Viva**	**Total**	**Bloom's taxonomy**
EC-416B	VLSI System Design Laboratory	**0**	**0**	**2**	**1**	**20**	**50**	**30**	**100**	

Course Objectives

1. To design and verify combinational, sequential, and FSM-based circuits using Verilog HDL.
2. To understand behavioral, dataflow, and structural modeling styles.
3. To synthesize RTL designs for FPGA targets and perform on-board testing.
4. To gain exposure to simple processor (RISC-V) submodules and control path implementation.

Course Outcomes

		Bloom's taxonomy
CO1	To identify basics of system hardware design and programmable logic devices	Knowledge
CO2	To interpret design using basic building blocks, synchronous and asynchronous circuits	Understand
CO3	To relate clock distribution in Network-on-Chip and FIFO design	Apply
CO4	To connect and conclude datapath & control in processor design	Analyze

No.	**COs**	**Mapping with Program Outcomes (POs)**												**Mapping with PSOs**		
		PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
1	CO1	3	2	2	2	-	-	-	-	-	-	-	-	2	3	2
2	CO2	3	2	3	3	-	-	-	-	-	-	-	-	3	2	2
3	CO3	3	2	3	3	-	-	-	-	-	-	-	-	2	2	2
4	CO4	3	2	2	2	-	-	-	-	-	-	-	-	2	2	2
(Average)		3	2	2.5	2.5									2.25	2.25	2

SYLLABUS

No.	**Content**	**Hours**	**COs**
I	Implement 4-bit comparator, 4×1 multiplexer, 3×8 decoder, priority encoder, and parity generator	**24**	**CO1, CO2, CO3, CO4**
II	Design an 8-bit Arithmetic Logic Unit (ALU) capable of performing addition, subtraction, AND, OR, XOR, complement, and shift operations.		
III	Design JK, D, T flip-flops using behavioral and structural modeling.		
IV	Implement 4-bit synchronous up/down counter and bidirectional shift register.		
V	Implement and test a Moore and Mealy Sequence Detector		
VI	Implement Serial Adder using shift registers and a controller FSM		
VII	Implement a 32×32 register file (2 read ports, 1 write port) and Instruction Decoder for a subset of RISC-V (ADD, SUB, AND, OR, XOR, BEQ)		
VIII	Mini Project: a) Mini RISC-V Core with Basic Instruction Execution (ADD, SUB, AND, OR, BEQ) b) FSM-Controlled Vending Machine / Traffic Light Controller with Timer and Display Interface		
	Total Hours	**24**	

Textbooks:

1. M. Morris Mano, Digital Logic & Computer Design, Pearson Education India, 1e, 2016.
2. S. Brown and Z. Vranesic, Digital Logic Design with Verilog, McGraw Hill Higher Education, 2002.
3. D. A. Patterson and J. L. Hennessy, Computer Organization and Design: The Hardware / Software Interface, Morgan Kaufmann, 2007.

Reference Books:

1. J. Rabey, A. Chandrakasan and B. Nikolic, Digital Integrated Circuits- A Design Perspective, Pearson, 2e, 2011.

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Programme	B. Tech in Electronics & Communication Engineering	**Academic Year of Regulation**	**2025-26**
Department	Electronics & Communication Engineering	**Semester**	**VII**

Course Code	**Course Name**	**Credit Structure**				**Marks Distribution**				
		L	**T**	**P**	**C**	**INT**	**MID**	**END**	**Total**	**Bloom's Taxonomy**
EC-410H	Satellite Communication	**3**	**0**	**0**	**3**	**20**	**30**	**50**	**100**	

Course Objectives		**Course Outcomes**		
	1. Understand satellite orbits, link principles, and space system components.		**CO1**	Explain satellite orbits, system architecture, and space segment principles.	Knowledge
	2. Learn multiple access, modulation, and coding for satellite links.		**CO2**	Analyze modulation, coding, and multiple access techniques for satellite links.	Understand
	3. Analyze satellite communication channels, link budgets, and propagation effects.		**CO3**	Evaluate link budgets and propagation impairments in satellite channels.	Apply
	4. Apply satellite technologies to navigation, broadband, DTH, and remote sensing systems.		**CO4**	Design and assess satellite-based communication applications using modern tools.	Analyze

No.	**COs**	**Mapping with Program Outcomes (POs)**												**Mapping with PSOs**		
		PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
1	CO1	3	2	1	1	1	0	1	0	0	1	0	2	2	3	1
2	CO2	3	3	2	2	2	0	1	1	0	1	1	3	3	3	2
3	CO3	2	3	2	2	2	1	1	1	1	1	1	3	2	3	2
4	CO4	2	2	3	3	3	1	1	2	2	2	2	3	3	3	3
(Average)		2.5	2.5	2	2	2	0.5	1	1	0.75	1.25	1	2.75	2.5	3	2

SYLLABUS

No.	**Content**	**Hours**	**COs**
I	Introduction, history, applications of satellite communication Satellite orbits, orbital mechanics, inclination, launch methods Space segment: transponders, antennas, TT&C Earth segment: earth stations, HPA, LNA, VSAT	**12**	**CO1**
II	Satellite link: basic link equation, C/N, G/T Link budget analysis and design Propagation effects: rain attenuation, atmospheric losses	**9**	**CO3**
III	Modulation techniques: BPSK, QPSK, QAM for satellite Coding: convolutional, turbo, LDPC coding Multiple access: FDMA, TDMA, CDMA, DAMA	**9**	**CO4**
IV	Satellite navigation: GPS, GLONASS, GNSS Mobile and broadband satellite systems DTH, satellite TV, remote sensing Modern trends: LEO satellites, CubeSats, Starlink, ISRO missions	**12**	**CO4**
	Total Hours	**42**	

Textbooks:

1. Pratt, Bostian & Allnutt, Satellite Communications, Wiley.
2. Timothy Pratt, Satellite Communications, Wiley.
3. Dennis Roddy, Satellite Communications, McGraw Hill.

Reference Books:

1. Tri T. Ha, Digital Satellite Communications, McGraw Hill.
2. Maral & Bousquet, Satellite Communications Systems, Wiley.
3. Rappaport, Wireless Communications: Principles and Practice, Pearson.

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Department	Electronics & Communication Engineering	**Semester**	**VIII**

Course Code	**Course Name**	**Credit Structure**				**Marks Distribution**				
		L	**T**	**P**	**C**	**INT**	**MID**	**END**	**Total**	**Bloom's Taxonomy**
EC-420H	Sensors and Transducers	**3**	**0**	**0**	**3**	**20**	**30**	**50**	**100**	

Course Objectives

1. Understand the principles, characteristics, and classifications of sensors and transducers.
2. Learn measurement concepts, signal conditioning, and calibration techniques.
3. Analyze various physical, chemical, and biological sensing mechanisms.
4. Apply appropriate sensors for real-world engineering and industrial applications.

Course Outcomes

		Bloom's Taxonomy
CO1	Explain the working principles and characteristics of sensors and transducers.	Knowledge
CO2	Analyze signal conditioning, interfacing, and calibration requirements.	Understand
CO3	Evaluate different sensing mechanisms for physical, chemical, and biomedical quantities.	Apply
CO4	Select and integrate suitable sensors for engineering and industrial applications.	Analyze

No.	**COs**	**Mapping with Program Outcomes (POs)**												**Mapping with PSOs**		
		PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
1	CO1	3	2	1	1	1	0	1	0	0	1	0	2	3	2	1
2	CO2	3	3	2	2	2	0	1	1	0	1	1	3	3	3	2
3	CO3	2	3	2	2	2	1	1	1	1	1	1	3	2	3	2
4	CO4	2	2	3	3	3	1	1	2	2	2	2	3	3	3	3
(Average)		2.5	2.5	2	2	2	0.5	1	1	0.75	1.25	1	2.75	2.75	2.75	2

SYLLABUS

No.	**Content**	**Hours**	**COs**
I	Introduction to sensors & transducers, classification Static & dynamic characteristics: accuracy, precision, sensitivity	**6**	**CO1**
II	Errors, reliability, standards, calibration Signal conditioning: filtering, amplification, ADC/DAC	**6**	**CO2**
III	Resistive sensors: RTDs, thermistors, strain gauges Inductive & magnetic sensors: LVDT, RVDT, Hall sensors Capacitive sensors, piezoelectric sensors Temperature sensors: thermocouples, IR sensors	**12**	**CO3**
IV	Pressure & flow sensors Optical sensors: photodiodes, fiber-optic sensors Chemical & gas sensors	**9**	**CO3**
V	Biosensors & MEMS/NEMS sensors Industrial sensor applications Smart sensors, IoT sensor networks, trends	**9**	**CO4**
	Total Hours	**42**	

Textbooks:

1. D. Patranabis, Sensors and Transducers, PHI.
2. R. S. Saini & S. K. Singh, Instrumentation and Sensors, McGraw Hill.

Reference Books:

1. A. K. Sawhney, Electrical and Electronic Measurements and Instrumentation, Dhanpat Rai.
2. Fraden Jacob, Handbook of Modern Sensors, Springer.
3. John G. Webster, Measurement, Instrumentation and Sensors Handbook, CRC Press.