राष्ट्रीय प्रौद्योगिकी संस्थानमेघालय

NATIONAL INSTITUTE OF TECHNOLOGY MEGHALAYA

UG Curriculum

with effect from

AY 2024-25

in view

of

NEP2020

इलेक्ट्रॉनिक्स और संचार इंजीनियरिंग विभाग

Department of Electronics and Communication Engineering

National Institute of Technology Meghalaya

UG Curriculum with effect from AY 2024-25

In view of NEP2020

Abbreviations

SC	:	Science Core
ESA	:	Engineering Science & Arts
DSC	:	Dept. Specific Core
DSE	:	Dept. Specific Elective
OE	:	Open Elective
AECC	:	Ability Enhancement Compulsory Course
SECC	:	Skill Enhancement Compulsory Course
VAC	:	Value Added Course
L	:	Laboratory Course
A	:	Audit Course

1st Year Common Structure

Semester Wise Model Plan – First Semester							
Course Code	**Course Title**	**Course Type**	**Contact Hours**			**Credit**	**Pre-requisites**
			L	**T**	**P**	**C**	
Science Core							
MA101	Engineering Maths-I (calculus, linear algebra, & statistics)	SC	3	1	0	4	None
CB101/ PH101	Engineering Chemistry/ Engineering Physics	SC	3	0	0	3	None
CB151/ PH151	Engineering Chemistry/Engineering Physics Lab	SC (L)	0	0	2	1	None
CB103	Biology for Engineers	SC	2	0	0	2	None
Engineering Science and Arts							
ME101	Engineering Mechanics	ESA	3	1	0	4	None
CS101	Computer & Coding	ESA	2	0	0	2	None
CS151	Computer & Coding Lab	ESA (L)	0	0	2	1	None
CE101	Engineering Graphics	ESA (L)	0	1	3	2	None
Skill Enhancement Compulsory Course							
HS151	Communication Skills	SECC(L)	0	1	2	2	None
Value Added Course							
Total Contact Hours – Component wise			**13**	**4**	09		-
Total Contact Hours			**26**			**21**	-

Semester Wise Model Plan – Second Semester							
Course Code	Course Title	Course Type	Contact Hours			Credit	Pre-requisites
			L	T	P	C	
Science Core							
MA102	Engineering Maths-II (Integral Transforms (I):, Complex Analysis (V), Numerical Methods (VI)	SC	3	1	0	4	None
PH101/ CB101	Engineering Physics/Engineering Chemistry	SC	3	0	0	3	None
PH151/ CB151	Engineering Physics/Engineering Chemistry Lab	SC (L)	0	0	2	1	None
Engineering Science and Arts							
CB102	Environmental Science	ESA	2	0	0	2	None
EE102	Basic Electrical & Electronics Engineering	ESA	3	0	0	3	None
EE152	Basic Electrical & Electronics Engineering Lab	ESA (L)	0	0	2	1	None
ME152	Workshop Practice	ESA (L)	0	0	3	1	None
Skill Enhancement Compulsory Course							
HS102	Introduction to Innovation and Entrepreneurship	SECC	2	0	0	2	None
Ability Enhancement Compulsory Course							
CS152	Python Programming	AECC (L)	0	1	2	2	None
Value Added Course							
HS104	Human Values and Ethical Mindfulness	VAC	2	0	0	2	None
VA102	Skill Development & Prototyping	VAC (L)	0	0	2	1	None
Total Contact Hours – Component wise			**15**	**1**	**11**		-
Total Contact Hours			**27**			**22**	-

Semester Wise Model Plan – Third Semester							
Course Code	Course Title	Course Type	Contact Hours			Credit	Pre-requisites
			L	T	P	C	
Department Specific Core							
EC 201	Semiconductor Devices	DSC	3	0	0	3	
EC 203	Digital Logic Design	DSC	3	0	0	3	
EC 205	Network Analysis and Synthesis	DSC	3	0	0	3	
EC 207	Signals and Systems	DSC	3	0	0	3	
Department Specific Elective (Any One)							
EC 211	Probability and Random Processes	DSE	3	0	0	3	
EC 213	Data Structures & Algorithms	DSE	3	0	0	3	
Open Elective							
EC 271	Computer Architecture	OE	2	0	0	2	
Value Added course/ Dissertation							
EC 291	PCB Fabrication	VAC	2	0	0	2	
Laboratory							
EC 253	Digital Logic Design Laboratory	L	0	0	2	1	
EC 255	Network Analysis Laboratory	L	0	0	2	1	
EC 257	Signals and System Laboratory	L	0	0	2	1	
Total Contact Hours – Component wise			**19**	**0**	**6**		-
Total Contact Hours			**25**			**22**	-

* DP stands for 2-digit respective Department code

Basket of Elective Courses to be decided by the Departments, MOOC/NPTEL courses are to be encouraged.

Semester Wise Model Plan – Fourth Semester							
Course Code	Course Title	Course Type	Contact Hours			Credit	Pre-requisites
			L	T	P	C	
Department Specific Core							
EC 200	Electronic Circuits	DSC	3	0	0	3	
EC 202	Electromagnetic Theory	DSC	3	0	0	3	
EC 204	Principles of Communication	DSC	3	0	0	3	
EC 206	Microprocessor and Microcontroller	DSC	3	0	0	3	
Department Specific Elective (Any One)							
EC 210	Linear Integrated Circuits	DSE	3	0	0	3	
EC 212	Statistical Detection Theory	DSE	3	0	0	3	
Open Elective							
EC 270	IC packaging	OE	2	0	0	2	
Skill Enhancement Compulsory Course							
DP23X	Entrepreneur Essential and Early Stage Start UP	SECC	2	0	0	2	
Laboratory							
EC 250	Electronics Circuit Laboratory	L	0	0	2	1	
EC 254	Principles of Communication Laboratory	L	0	0	2	1	
EC 256	Microprocessor and Microcontroller Laboratory	L	0	0	2	1	
Total Contact Hours – Component wise			**19**	**0**	**6**		-
Total Contact Hours			**25**			**22**	-

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Basket of Elective Courses to be decided by the Departments, MOOC/NPTEL courses are to be encouraged.

Semester Wise Model Plan – Fifth Semester							
Course Code	Course Title	Course Type	Contact Hours			Credit	Pre-requisites
			L	T	P	C	
Department Specific Core							
EC 301	Digital Communication	DSC	3	0	0	3	
EC 303	Digital Signal Processing	DSC	3	0	0	3	
EC 305	Microwave Engineering	DSC	3	0	0	3	
Department Specific Elective (Any One)							
EC 311	Linear Control Systems	DSE	3	0	0	3	
EC 313	Power Electronics	DSE	3	0	0	3	
Open Elective (Any One)							
EC 371	Sensors and Applications	OE	2	0	0	2	
EC 373	Electronics Instrumentation	OE	2	0	0	2	
Ability Enhancement Compulsory Course							
EC 381	Internship-1	AECC	0	0	0	1	
Skill Enhancement Compulsory Course							
EC 391	Seminar and Technical Report Writing	SECC	0	0	2	1	
Value Added course/ Dissertation							
EC 383	Minor Project-1	VAC	0	0	4	2	
Laboratory							
EC 351	Digital Communication Laboratory	L	0	0	2	1	
EC 353	Digital Signal Processing Laboratory	L	0	0	2	1	
EC 355	Microwave Engineering Laboratory	L	0	0	2	1	
Total Contact Hours – Component wise			**14**	**0**	**12**		-
Total Contact Hours			**26**			**21**	-

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Basket of Elective Courses to be decided by the Departments, MOOC/NPTEL courses are to be encouraged.

Semester Wise Model Plan – Sixth Semester							
Course Code	Course Title	Course Type	Contact Hours			Credit	Pre-requisites
			L	T	P	C	
Department Specific Core							
EC 300	Digital and Analog Int. Circuits	DSC	3	0	0	3	
EC 302	Wireless Communication: 5G and Beyond	DSC	3	0	0	3	
Department Specific Elective (Any One from EC 310/EC 312 and EC 314/EC 316)							
EC 310	Antenna wave propagation	DSE	3	0	0	3	
EC 312	Digital Image Processing	DSE	3	0	0	3	
EC 314	Embedded System	DSE	3	0	0	3	
EC 316	MEMS	DSE	3	0	0	3	
Open Elective (Any One)							
EC 370	Satellite communication	OE	2	0	0	2	
EC 372	Cyber Physical System based on 5G communication	OE	2	0	0	2	
Value Added course/ Dissertation							
VA30X	Indian Knowledge System	VAC	2	0	0	2	
EC 380	Minor Project-2	VAC	0	0	4	2	
Laboratory							
EC 350	Digital and Analog Int. Circuits Laboratory	L	0	0	2	1	
EC 352	Wireless Communication: 5G and Beyond Laboratory	L	0	0	2	1	
EC 364 /EC 366	Microcontroller and Embedded System / MEMS Laboratory	L	0	0	2	1	
Total Contact Hours – Component wise			**16**	**0**	**10**		-
Total Contact Hours			**26**			**21**	-

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Basket of Elective Courses to be decided by the Departments, MOOC/NPTEL courses are to be encouraged.

Semester Wise Model Plan – Seventh Semester							
Course Code	Course Title	Course Type	Contact Hours			Credit	Pre-requisites
			L	T	P	C	
Department Specific Elective (Any 4 Subjects)							
EC 411	Electronic Device Fabrication	DSE	3	0	0	3	
EC 413	An Introduction to Artificial Intelligence	DSE	3	0	0	3	
EC 415	Internet of Thing	DSE	3	0	0	3	
EC 417	VLSI Design	DSE	3	0	0	3	
EC 419	Information Theory and Coding	DSE	3	0	0	3	
EC 421	Biomedical Signal Processing	DSE	3	0	0	3	
EC 423	Optical Communication	DSE	3	0	0	3	
EC 425	Analog VLSI	DSE	3	0	0	3	
Open Elective							
EC 471	Introduction to Quantum Computing and Algorithms	OE	2	0	0	2	
EC 473	CAD for VLSI Design	OE	2	0	0	2	
Ability Enhancement Compulsory Course							
EC 481	Internship-2	AECC	0	0	0	1	
Value Added course/ Dissertation							
EC 483	Major Project-1	VAC	0	0	8	4	
Total Contact Hours – Component wise			**14**	**0**	**8**		-
Total Contact Hours			**22**			**19**	-

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Basket of Elective Courses to be decided by the Departments, MOOC/NPTEL courses are to be encouraged.

Semester Wise Model Plan – Eighth Semester							
Course Code	Course Title	Course Type	Contact Hours			Credit	Pre-requisites
			L	T	P	C	
Department Specific Elective (Any 2 Subjects)							
EC 410	Pattern Recognition and Applications	DSE	3	0	0	3	
EC 412	VLSI Signal Processing	DSE	3	0	0	3	
EC 414	VLSI Design Flow: RTL to GDS	DSE	3	0	0	3	
EC 416	Principles and Techniques of Modern Radar Systems	DSE	3	0	0	3	
EC 418	Nanophotonics, Plasmonics and Metamaterials	DSE	3	0	0	3	
EC 420	Deep Learning	DSE	3	0	0	3	
Value Added course/ Dissertation							
EC482	Major Project-1	VAC	0	0	22	11	
Total Contact Hours – Component wise			**6**	**0**	**22**		-
Total Contact Hours			**28**			**17**	-

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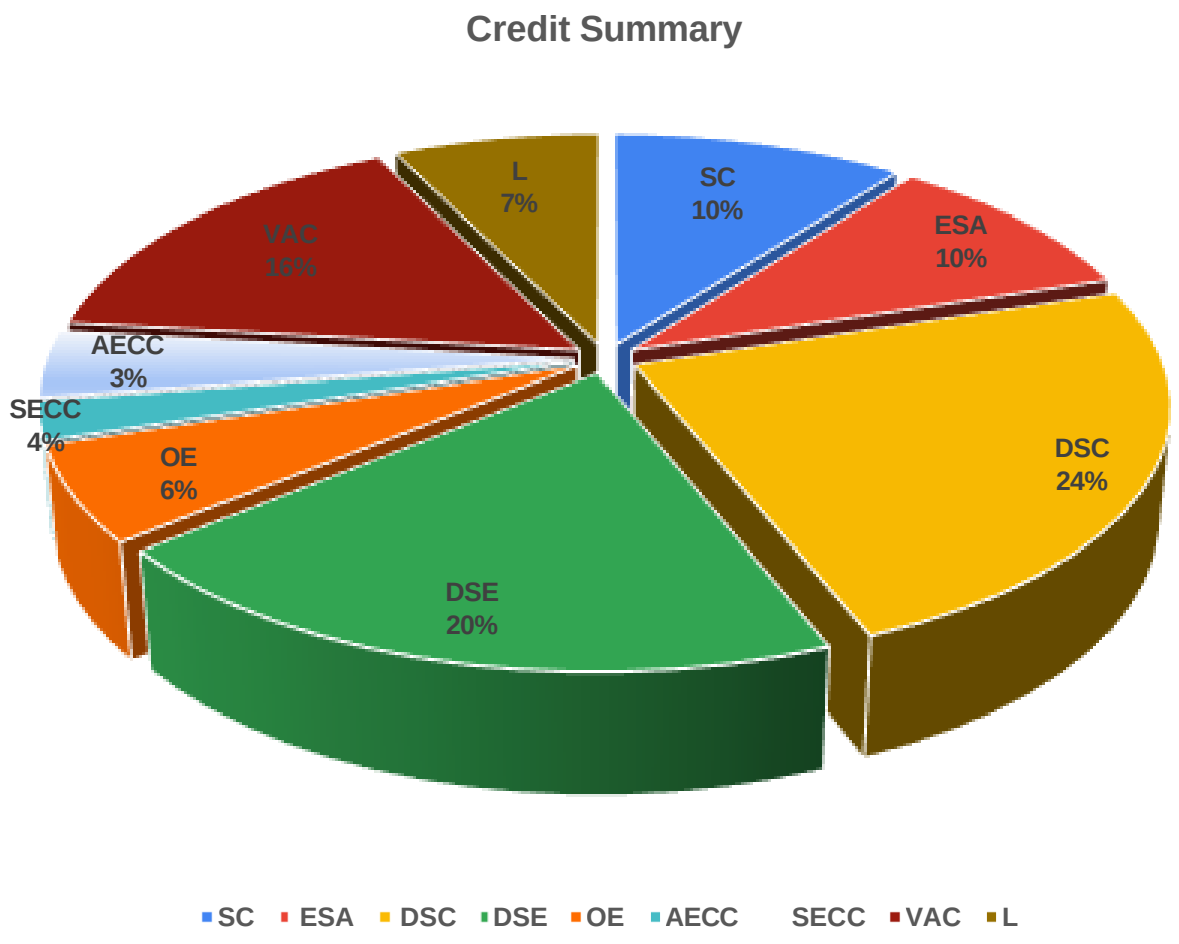
Basket of Elective Courses to be decided by the Departments, MOOC/NPTEL courses are to be encouraged.

Semester Wise Model Plan – Eighth Semester										
Sem	SC	ESA	DSC	DSE	OE	AECC	SECC	VAC	Lab	Total Credit
I	SC1 [4] SC2 [3] SC3 [2] SC-L [1]	ESA1 [4] ESA2 [2] ESA-L [1] ESA-L [2]					SECC-L [2]	VAC-A [0]		**21**
II	SC4 [4] SC5 [3] SC-L [1]	ESA3 [2] ESA4 [3] ESA-L [1] ESA-L [1]				AECC-L [2]	SECC1 [2]	VAC1 [2] VAC-L [1] VAC-A [0]		**22**
III			DSC1 [3] DSC2 [3] DSC3 [3] DSC4 [3]	DSE1 [3]	OE1 [2]			VAC2 [2]	L1 [1] L2 [1] L3 [1]	**22**
IV			DSC5 [3] DSC6 [3] DSC7 [3] DSC8 [3]	DSE2 [3]	OE2 [2]		SECC2 [2]		L4 [1] L5 [1] L6 [1]	**22**
V			DSC9 [3] DSC10 [3] DSC11 [3]	DSE3 [3]	OE3 [2]	AECC1 [1]	SECC3 [1]	VAC3 [2]	L7 [1] L8 [1] L9 [1]	**21**
VI			DSC12 [3] DSC13 [3]	DSE4 [3] DSE5 [3]	OE4 [2]			VAC4 [2] VAC5 [2]	L10 [1] L11 [1] L12 [1]	**21**
VII				DSE6 [3] DSE7 [3] DSE8 [3] DSE9 [3]	OE5 [2]	AECC2 [1]		VAC6 [4]		**19**
VIII				DSE10 [3] DSE11 [3]				VAC7 [11]		**17**
Total Credit	**18**	**16**	**39**	**33**	**10**	**4**	**7**	**26**	**12**	**165**

Components Credit Summary - BTech Curriculum										
Course Type with Abbreviation		**I**	**II**	**III**	**IV**	**V**	**VI**	**VII**	**VIII**	**Total**
SC	Science Core	10	8							**18**
ESA	Engineering Science & Arts	9	7							**16**
DSC	Dept. Specific Core			12	12	9	6			**39**
DSE	Dept. Specific Elective			3	3	3	6	12	6	**33**
OE	Open Elective			2	2	2	2	2		**10**
AECC	Ability Enhancement Compulsory Course		2			1		1		**4**
SECC	Skill Enhancement Compulsory Course	2	2		2	1				**7**
VAC	Value Added Course		3	2		2	4	4	11	**26**
L	Laboratory Course			3	3	3	3			**12**
Total Credits										**165**



Course structure and credit requirements

<table>
<tr><th>Description</th><th>Total Credits</th><th>Comments</th><th colspan="4">Exit Degree</th></tr>
<tr><td>SC</td><td>18</td><td rowspan="5">Mandatory Credits (A=43) for 1-year Course</td><td rowspan="5">Eligible for Certificate on Foundations of Engineering</td><td rowspan="12">Eligible for Diploma in ECE</td><td rowspan="17">Eligible for Advanced Diploma in ECE</td><td rowspan="22">Eligible for B.Tech. Degree in ECE</td></tr>
<tr><td>ESA</td><td>16</td></tr>
<tr><td>Ability/Skill Enhancement (AECC & SECC)</td><td>6</td></tr>
<tr><td>Value Added (VAC)</td><td>3</td></tr>
<tr><td>Total (A)</td><td>43</td></tr>
<tr><td>Major & Electives (DSC & DSE)</td><td>30</td><td colspan="2" rowspan="6">Mandatory Credits (B=87) for 2-year Course</td></tr>
<tr><td>Open Elective (OE)</td><td>4</td></tr>
<tr><td>Ability/Skill Enhancement (AECC & SECC)</td><td>2</td></tr>
<tr><td>Value Added (VAC)</td><td>2</td></tr>
<tr><td>Laboratory (L)</td><td>6</td></tr>
<tr><td>Total (B1)</td><td>44</td></tr>
<tr><td>Total (B=A+B1)</td><td>87</td><td colspan="2" rowspan="7">Mandatory credits (C=129) for 3-year Course</td></tr>
<tr><td>Additional Major & Elective (DSC & DSE)</td><td>24</td></tr>
<tr><td>Additional Open Elective (OE)</td><td>4</td></tr>
<tr><td>Additional Ability/Skill Enhancement (AECC & SECC)</td><td>2</td></tr>
<tr><td>Value Added (VAC)-Minor Project</td><td>6</td></tr>
<tr><td>Laboratory (L)</td><td>6</td></tr>
<tr><td>Total (C1)</td><td>42</td></tr>
<tr><td>Total (C=B+C1)</td><td>129</td><td colspan="3" rowspan="5">Mandatory credits (D=165) for 4-year Course</td></tr>
<tr><td>Advance Elective (DSE & OE)</td><td>20</td></tr>
<tr><td>Advance Ability/Skill Enhancement (AECC & SECC)</td><td>1</td></tr>
<tr><td>Value Added (VAC)-Major Project</td><td>15</td></tr>
<tr><td>Total (D1)</td><td>36</td></tr>
<tr><td>Total (D=C+D1)</td><td>165</td></tr>
</table>

First Semester Courses

National Institute of Technology Meghalaya

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CURRICULUM

Programme	**Bachelor of Technology**	Year of Regulation	**2024-25**
Department	**Mathematics**	Semester	**I**

Course Code	Course Name	Pre-Requisite	Credit Structure				Marks Distribution			
			L	T	P	C	INT	MID	END	Total
MA101	**Engineering Mathematics-I**	**---**	**3**	**1**	**0**	**4**	**50**	**50**	**100**	**200**

		CO's	**Statement**	**Bloom's Taxonomy**
Course Objectives	To enable the students to have a good understanding of fundamental concepts of single and multivariable calculus.	Course Outcomes MA101.1	Able to acquire **knowledge** of limit, continuity and differentiation for functions of single and multi-variables and the consequences of different mean value theorems.	**Understand Analyze**
	To provide the basic and important concepts of linear algebra.	MA101.2	Able to **apply** Taylor's series to approximate differentiable functions of single and multi-variables and **estimate** the error.	**Apply Evaluate**
	To prepare the students to apply the mathematical principles of calculus and linear algebra to solve engineering problems.	MA101.3	Able to **apply** definite integrals to **evaluate** length of plane curves, volume and surface area of solids of rotation.	**Apply Evaluate**
		MA101.4	Able to **understand** the basic concepts of vector spaces and to solve systems of linear equations.	**Understand Evaluate**
	To enable the students to have a good understanding of essential methods of statistical inference.	MA101.5	Able to **demonstrate** and **apply** estimation of parameters, confidence interval, and testing hypotheses for normal distribution.	**Understand Apply**
		MA101.6	Able to **formulate** relationships among random variables using regression and correlation.	**Create**

COs	Mapping with Program Outcomes (POs)												Mapping with PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
MA101.1	**2**														
MA101.2	**3**														
MA101.3	**3**														
MA101.4	**3**														
MA101.5	**2**														
MA101.6	**3**														
MA101	**2.67**														

SYLLABUS

No.	Content	Hours	COs
I	**Differential Calculus:** Real valued functions of single variable: Limit; continuity; differentiation, Taylor & Maclaurin series, indeterminate forms, L'Hospital's rule. Real valued functions of two/three variables: Limit, continuity, partial differentiation; Taylor and Maclaurin series for function of two variables; Extreme values of functions of two variables.	**14**	**MA101.1 MA101.2**
II	**Integral Calculus:** Definite integral: length of a plane curve, surface area of revolution, volume of solids of revolution; Differentiation under sign of integral: Leibnitz rule; Improper integrals, convergence tests, beta and gamma functions; Multiple Integrals: double and triple integrals, volume and surface integrals.	**16**	**MA101.3**
III	**Linear Algebra:** Vector space over R, subspaces, bases and dimension; Echelon form, rank of a matrix, system of linear equations-direct & iterative methods; eigenvalues and eigenvectors; Symmetric, skew-symmetric, Hermitian, skew-Hermitian, orthogonal, and unitary matrices.	**14**	**MA101.4**
IV	**Statistics:** Random variables, Probability distributions, Point estimation of parameters, Confidence Intervals, Testing Hypotheses, goodness of fit: Chi-square test, Regression: fitting straight lines, correlation.	**12**	**MA101.5 MA101.6**
	Total Hours (4 Modules)	**56**	

Essential Readings

1. J. Stewart, D. K. Clegg and S. Watson, "Calculus", Cengage Learning India Pvt. Limited, 9th edition, 2023.
2. E. Kreyszig, "Advanced Engineering Mathematics", John Wiley & Sons, 10th edition 2023.

Supplementary Readings

1. R. K. Jain and S. R. K. Iyengar, "Advanced Engineering Mathematics", Narosa Publishing House, 5th edition, 2019.
2. N. Piskunov, "Differential Calculus and Integral Calculus – I", CBS, 1996.
3. N. Piskunov, "Differential Calculus and Integral Calculus – II", CBS, 1996.
4. D. C. Montgomery and G. C. Runger, "Applied Statistics and Probability for Engineers", John Wiley & Sons, 7th edition, 2018.

	National Institute of Technology Meghalaya An Institute of National Importance	**CURRICULUM**

Programme	**Bachelor of Technology (All Branches)**	Year of Regulation	**2024-25**
Department	**Chemical and Biological Sciences**	Semester	**I/II**

Course Code	Course Name	Pre requisite	Credit Structure				Marks Distribution			
			L	T	P	C	INT	MID	END	Total
CB 101	**Engineering Chemistry**	**NIL**	**3**	**0**	**0**	**3**	**50**	**50**	**100**	**200**

Course Objectives		Course Outcomes	**CO's**	**Statement**	**Bloom's Taxonomy**
	To introduce the students to the concept, classifications, and industrial applications of polymers		CB101.1	The students will be apply the knowledge about polymers, polymerization processes, and their industrial applications.	**Apply**
	To gain knowledge of different types of fuels and their analysis		CB101.2	Able to describe different types of fuels and their analysis, petroleum technology	**Understand**
	To learn about metallurgy, metal extraction process, composition, and properties of alloys		CB101.3	Able to explain the process of metal extraction from ores and discuss the properties of alloys and composition	**Analyze**
	To introduce students to different types of materials, properties, and their applications.		CB101.4	Able to analyze the properties of different materials and apply the knowledge of nanotechnology for various practical applications.	**Analyse**

COs	Mapping with Program Outcomes (POs)												Mapping with PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CB101.1	2	2	3	-	-	-	-	-	-	-	-	-	-	-	-
CB101.2	2	2	3	-	-	-	-	-	-	-	-	-	-	-	-
CB101.3	2	2	3	-	-	-	-	-	-	-	-	-	-	-	-
CB101.4	2	2	3	-	-	-	-	-	-	-	-	-	-	-	-
CB101	2	2	3												

SYLLABUS

No.	Content	Hours	COs
I	**Polymer Chemistry:** Concepts, classification, structures, and molecular weights of polymers, mechanism and kinetics of various polymerization processes, natural rubber and its properties, vulcanization of rubber, synthesis and applications of various industrial polymers, adhesives, paints, conducting polymers and their applications in electronic devices, biodegradable polymers.	**10**	CB101.1
II	**Petroleum Chemistry:** Composition, characteristics of crude oil, cracking. Solid, liquid and gaseous fuels, coal analysis; classification of coal; anti-knocking agents, octane number and cetane number, aviation fuel and biofuels, lubricants.	**08**	CB101.2
III	**Metallurgy:** Minerals, ores, and general methods of extraction and purification of metals (Fe, Al, Cu, Zn). Alloys: Definition of alloy, types of alloys (ferro, non-ferro & amalgam), composition, properties, and uses of brass, bronze, and steel.	**08**	CB101.3
IV	**Material Chemistry:** Introduction and properties of glass, ceramics and their composites, magnetic materials, and smart materials. Piezoceramic materials, electro-active materials, shape-memory materials, energy harvesting materials, self-healing materials, semiconducting materials, and liquid crystals. **Nanomaterials** Introduction, classification, properties of nanomaterials, carbon-based nanomaterials, synthesis of nanomaterials, top-down and bottom-up approaches, characterization of nanomaterials, applications of nanomaterials - materials for light emitting diodes, batteries, and fuel cells, memory devices and sensors, nanotechnology for pharmaceutical applications, nanomaterials for tissue engineering, carbon nanotubes and nanocomposites in textiles.	**16**	CB101.4
	Total Hours	**42**	

Essential Readings

1. P. C. Jain and M. Jain, "Engineering Chemistry", 17th Edition", Dhanpat Rai Publication Co., 2019.
2. S. Chawla, "A Text Book of Engineering Chemistry", 1st Edition, Dhanpat Rai & Co. (P) Limited, 2017

Supplementary Readings

1. M. G. Fontana, "Corrosion Engineering", Third Edition, McGraw-Hill Book Company, 2017
2. R. Gopalan, D. Venkappayya, S. Nagarajan, " A textbook of Engineering Chemistry" 4th Edition, Vikas Publishing House Pvt. Ltd.
3. S. Agarwal, "Engineering Chemistry: Fundamentals and Applications", 2nd edition, Cambridge University Press, 2019

National Institute of Technology Meghalaya

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CURRICULUM

Programme	**Bachelor of Technology**	Year of Implementation	**2024-2025**
Department	**Physics**	Semester	**I/II**

Course Code	Course Name	Pre-Requisite	Credit Structure				Marks Distribution			
			L	T	P	C	INT	MID	END	Total
PH101	**Engineering Physics**	**-----**	**3**	**0**	**0**	**3**	**50**	**50**	**100**	**200**

		CO's	**Statement**	**Bloom's Taxonomy**
Course Objectives	To understand the concepts of fundamentals of em wave, vectors, vector calculus and its relevance to science and engineering	PH101.1	Able to gain the **knowledge** of electromagnetism **applied** to Engineering concepts	Understanding Applying
	To introduce various concepts of special theory of relativity	PH101.2	Able to gain the **knowledge** of special theory of relativity	Understanding
	To introduce various concepts of different optical phenomena observed in nature.	PH101.3	Able to gain the **knowledge** about Geometrical and Physical Optics and its **applications**.	Understanding Applying
	To introduce the developments of Quantum Physics in the beginning of 20th century and the development thereafter.	PH101.4	Able to understand the **concepts** and theories of 20-th century Physics and its **applications**.	Understanding Applying

COs	Mapping with Program Outcomes (POs)												Mapping with PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
PH101.1	**3**	**2**													
PH101.2	**3**	**2**													
PH101.3	**3**	**2**													
PH101.4	**3**	**2**													
PH101	**3**	**2**													

SYLLABUS

No.	Content	Hours	COs
I	**Electromagnetism**: Vector calculus**,** Gauss's law and its applications, divergence and curl of electrostatic fields, electrostatic potential. Lorentz force, Biot-Savart and Ampere's laws and their applications, divergence and curl of magnetostatic fields, force and torque on a magnetic dipole, motional EMF, Faraday's law, Lenz's law, Maxwell's equations, Postulates of Special theory of relativity, Lorentz transformation, time dilation, length contraction.	**14**	**PH101.1, PH101.2**
II	**Optics:** Interference - coherence, principle of superposition, Young's double slit experiment, Newton's rings, diffraction - Fresnel and Fraunhofer diffracting, grating and its usages, polarization, Malus' law, polarization by reflection and Brewster's law.	**14**	**PH101.3**
III	**Modern Physics:** Old quantum theory, black body radiation, Planck's law, photoelectric effect, Compton effect, de-Broglie's hypothesis, Heisenberg uncertainty principle, wave packet, group and phase velocities, postulates of Quantum mechanics. Schrödinger's equation, application in 1-dimension: particle in a box.	**14**	**PH101.4**
	Total Hours	**42**	

Essential Readings

1. R. A. Serway and J. W. Jewett, "Physics for Scientists and Engineers with Modern Physics", CENGAGE Learning Custom Publishing, 10th edition, 2017.
2. Paul G. Hewitt, "Conceptual Physics", Pearson, 13th edition, 2022.

Supplementary Readings

1. J. C. Morrison, Modern Physics for Scientists and Engineers, Elsevier; 2nd edition, 2015.
2. M. Mansfield and C. O'Sullivan, "Understanding Physics", Wiley-Blackwell; 3rd Edition, 2020.

	National Institute of Technology Meghalaya An Institute of National Importance		CURRICULUM
Programme	**Bachelor of Technology (All branches)**	Year of Regulation	**2024-2025**
Department	**Chemical and Biological Sciences**	Semester	**I/II**

Course Code	Course Name	Credit Structure				Marks Distribution		
		L	T	P	C	Continuous Evaluation		Total
CB 151	**Chemistry Laboratory**	**0**	**0**	**2**	**1**	**01 Expt.**	**10**	**100**

Course Objectives	To provide the students with knowledge of various titration-based techniques for chemical analysis. To teach the fundamentals of basic chemistry-related aspects for practical applications and sample analysis. To develop the student's ability to use different instrumental methods for chemical analysis and testing of various samples.	Course Outcomes	**COs**	**Statement** / **Bloom's Taxonomy**
			CB151.1	Able to explain the concepts of acid-base, redox, potentiometric and pH metric titration for quantitative analysis — Understand
			CB151.2	Able to prepare standard solutions for various quantitative analysis — Apply
			CB151.3	Able to analyze water sample, alloy samples by complexometric iodometric and spectrophotometric analysis — Analyse
			CB151.4	Able to apply the concepts of partition coefficient, viscosity in analysis — Apply

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	CB151.1	**2**	**2**	-	-	-	-	-	-	-	-	-	-	-	-	-
2	CB151.2	**2**	**2**	-	-	-	-	-	-	-	-	-	-	-	-	-
3	CB151.3	**2**	**2**	-	-	-	-	-	-	-	-	-	-	-	-	-
4	CB151.4	**2**	**2**													
	CB151	**2**	**2**													

SYLLABUS

No.	Content	Hours	COs
1	To determine the alkalinity of a given water sample	**2**	CB151.1 CH151.2
2	Estimation of Fe(II) in Mohr's salt solution using standard $KMnO_4$ solution via Redox titration	**2**	CB151.1 CB151.2
3	Conductometric titration of an unknown acid solution using a standard base solution	**2**	CB151.1 CB151.2
4	pH-metric titration of an unknown acid solution using a standard base solution	**2**	CB151.1 CB151.2
5	Complexometric determination of hardness of water	**2**	CB151.3
6	Iodometric determination of copper in brass alloy	**2**	CB151.3
7	Spectrophotometry on copper sulphate solution	**2**	CB151.3
8	Determination of partition coefficient of acetic acid between *n*-butanol and water	**2**	CB151.4
9	Determination of percentage composition of sugar solution from viscosity	**2**	CB151.4
10	Estimation of Fe(II) in a solution using standard $K_2Cr_2O_7$ solution via potentiometric titration	**2**	CB151.1
	Total Hours	**20**	

Essential Readings

1. J. Mendham, R. Denny, J. Barnes, M. Thomas, "Vogel's Quantitative Chemical Analysis", 6th Edition, Pearson.

Supplementary Readings

1. V. D. Athawale, P. Mathur, "Experimental Physical Chemistry", 1st Edition, New Age International (P) Limited Publishers, 2001.
2. Departmental laboratory manual

	National Institute of Technology Meghalaya An Institute of National Importance	**CURRICULUM**

Programme	**Bachelor of Technology**		Year of Implementation						**2024-2025**
Department	**Physics**		Semester						**I/II**
Course Code	Course Name	Pre-Requisite	Credit Structure				Marks Distribution		
			L	T	P	C	Continuous Assessment		Total
PH 151	**Engineering Physics Laboratory**	----------	**0**	**0**	**2**	**1**	**01 Experiment**	**10**	**100**

		CO's	**Statement**	**Bloom's Taxonomy**
Course Objectives	To understand the fundamentals of electromagnetism	Course Outcomes	PH151.1	Able to gain the **knowledge** of electromagnetism **applied** to Engineering	Understanding Applying
	To understand various concepts of Optical phenomena in Physics and Engineering		PH151.2	Able to gain the **knowledge** about Geometrical and Physical Optics	Understanding
	To understand the fundamentals of General Physics		PH151.3	Able to **understand** the concepts of General Physics and its **applications**	Understanding Applying
	To understand the fundamentals of Semiconductor Physics		PH 151.4	Able to gain the **knowledge** of Semiconductor Physics and its **applications**	Understanding Applying

COs	Mapping with Program Outcomes (POs)											Mapping with PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
PH 151.1	**3**	**2**													
PH 151.2	**3**	**2**													
PH 151.3	**3**	**2**													
PH 151.4	**3**	**2**													
PH 151	**3**	**2**													

SYLLABUS

S. No.	Title of the Experiment	Hours	COs
I	To verify inverse square law (using a point source of light)	**02**	**PH 151.1**
II	To verify Coulomb's Law of force between two electric poles	**02**	
III	To determine the variation of magnetic field along the axis of the current carrying coil	**02**	
IV	To find resonance frequency in series and parallel LCR circuit	**02**	
V	To find the refractive index of prism by measuring angle of prism and angle of minimum deviation	**03**	**PH 151.2**
VI	Determination of wavelength of monochromatic light (LASER) using Fresnel Biprism	**02**	
VII	To determine the wavelength of sodium light by measuring the diameters of Newton's rings	**03**	
VIII	To determine the wavelength of LASER using Diffraction grating	**02**	
IX	To find the refractive index of a glass plate & water by using a travelling microscope	**02**	
X	To determine frequency of A.C. Mains using sonometer	**03**	**PH 151.3**
XI	To determine the Young's modulus of elasticity of the material of a sample beam by bending	**02**	
XII	I-V characteristic curve of a P-N junction in forward bias and reverse bias	**02**	**PH 151.4**
XIII	Half-wave rectifier circuit without and with filter (HWR)	**02**	
XIV	Evaluation and Viva of all experiments	**03**	**PH 151.1, PH 151.2, PH 151.3, PH 151.4**
XV	Laboratory written test	**01**	**PH 151.1, PH 151.2, PH 151.3, PH 151.4**
	Total Hours (for any 10 experiments from Sl. No. I to XIII)	**27**	

Essential Readings

1. R. A. Serway and J. W. Jewett, "Physics for Scientists and Engineers with Modern Physics", CENGAGE Learning Custom Publishing, 10th edition, 2017.

2. Paul G. Hewitt, "Conceptual Physics", Pearson, 13th edition, 2022.

2.D. J. Griffiths, "Introduction to Electrodynamics", Prentice-Hall of India, 5th Edition, 2023

3.A. Ghatak, "Optics", Tata McGraw-Hill, 7th Edition, 2020

Supplementary Readings

1. D. Kleppner, and R. J. Kolenkow, "An Introduction to Mechanics", Cambridge University Press, 2nd Edition, 2021.

2. R. Eisberg, and R. Resnick, "Quantum Physics of Atoms, Molecules, Solids, Nuclei and Particles", Wiley, 2nd Edition, 2006

	National Institute of Technology Meghalaya An Institute of National Importance		CURRICULUM
Programme	**Bachelor of Technology (All branches)**	Year of Regulation	**2024-2025**
Department	**Chemical and Biological Sciences**	Semester	**I/II**

Course Code	Course Name	Credit Structure				Marks Distribution			
		L	T	P	C	INT	MID	END	Total
CB 103	**Biology for Engineers**	**2**	**0**	**0**	**2**	**50**	**50**	**100**	**200**

Course Objectives		Course Outcomes			
	To provide the basic knowledge of various biomolecules, which are essential for life, their structures, and functions.		COs	Statement	**Bloom's Taxonomy**
	To discuss the structure and function of cells, different cellular processes, and biological signal transduction.		CY103.1	Able to understand the significance of biomolecules for sustaining life, including the knowledge of the structure of the cell and the biological signal transduction process.	**Understand**
	To provide the knowledge of heredity, how genes work, the concept of the central dogma of life, genetic engineering, and genomics.		CY103.2	Able to interpret the heredity, variation, and central dogma of life followed by gene expression and their applications.	**Understand**
	To provide basic knowledge on engineering tools in disease biology, stem cell engineering, 3D printing of artificial organs and various biomaterials.		CY103.3	Able to apply the concepts of engineering tools to solve the issues related to disease aspects, diagnosis, etc.	**Apply**
			CY103.4	Able to apply the concepts of biomaterial processing and their applications.	**Apply**

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	CB103.1	**2**	**3**	**3**	-	-	-	-	-	-	-	-	-	-	-	-
2	CB103.2	**2**	**3**	**3**	-	-	-	-	-	-	-	-	-	-	-	-
3	CB103.3	**2**	**3**	**3**	-	-	-	-	-	-	-	-	-	-	-	-
4	CB103.4	**2**	**3**	**3**	-	-	-	-	-	-	-	-	-	-	-	-
	CB103	2	3	3												

SYLLABUS

No.	Content	Hours	COs
I	**Molecules of life**: Chemical basis of life, protein structure and function, nucleic acids and the RNA, carbohydrates, lipids, membranes, and cells, cellular interactions, cell cycle, biological signal transduction.	**06**	CB103.1
II	**Gene structure and expression**: Mitosis, meiosis, Mendelian Genetics. DNA and the gene- Synthesis and repair, how genes work, the central dogma of life, transcription, RNA processing, translation, control of gene expression, analyzing and engineering genes, genomics.	**06**	CB103.2
III	**Trends in bioengineering**: Genetic engineering, disease biology and biopharmaceuticals, stem cell engineering, metabolic engineering, biosafety, and bioethics. Bioprinting techniques and materials, 3D printing of ear, bone, and skin. Bioimaging and Artificial Intelligence for disease diagnosis.	**08**	CB103.3
IV	**Biomaterials Processing**: Classification, concept of biocompatibility, quantification of structure-property correlation - bioglass/ glass-ceramics, biodegradable polymers, biocomposites, bioplastics, macroporous scaffolds. Self-healing bioconcrete (based on bacillus spores, calcium lactate nutrients and biomineralization processes) and bioremediation via microbial surface adsorption (removal of heavy metals like lead, cadmium, mercury, arsenic).	**08**	CB103.4
	Total Hours	**28**	

Essential Readings

1. E. Engner, R. Ross, D. Bailey, "*Concepts in Biology"*, 14th Edition, McGraw Hill Education, New York, 2011.
2. R. Renneberg, V. Berkling and V. Loroch, "Biotechnology for Beginners", 2nd Edition, Academic Press, 2016.

Supplementary Readings

1. G.K. Suraishkumar, "Biology for Engineers", 1st Edition, Oxford University Press, New Delhi, 2019.
2. G. Karp, "Cell and Molecular Biology: Concepts and Experiments", 7th edition, Wiley, New York, 2013.
3. D. Floreano and C. Mattiussi, "Bio-Inspired Artificial Intelligence: Theories, Methods and Technologies", 1st Edition, MIT Press, 2008.

	National Institute of Technology Meghalaya An Institute of National Importance	**CURRICULUM**

Programme	**Bachelor of Technology in Mechanical Engineering**	Year of Regulation	**2024-25**
Department	**Mechanical Engineering**	Semester	**I**

Course Code	Course Name	Pre-Requisite	Credit Structure				Marks Distribution			
			L	T	P	C	INT	MID	END	Total
ME101	**Engineering Mechanics**	-----	**3**	1	**0**	**4**	**50**	**50**	**100**	**200**

			COs	Statement	Bloom's Taxonomy
Course Objectives	This course describes the different laws of forces associated with different engineering elements.	Course Outcomes	ME101.1	Able to understand vector mechanics and classify the different laws of forces associated with engineering systems	Knowledge Identification
	This course introduces the use of force, moments and MOIs in various conditions.		ME101.2	Able to i) Illustrate the use of force and moments in various working conditions (Understanding). ii) understand the centre of gravity, centroid, centre of mass and details of MOIs.	Knowledge Identification and Application
	This course illustrates the use of subject knowledge in the fields of engineering.		ME101.3	Able to identify the equilibrium conditions of engineering structures (truss, beams, frames) under various loads.	Knowledge Identification and Analyse
	This course introduces the states of engineering elements and structures under various loading conditions.		ME101.4	Able to solve the basics of friction and its associated laws along with the related problems.	Knowledge Identification and Analyse
	This course explains how to solve the practical problems of mechanics to determine the static forces with their magnitudes and directions.		ME101.5	Able to understand the kinematics of particles and Rigid Bodies and principle of work along with the related problems.	Knowledge Identification and Analyse

COs	Mapping with Program Outcomes (POs)												Mapping with PSOs	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
ME 101.1	3	2	2	2								2	3	2
ME 101.2	3	2	2	2								2	3	2
ME 101.3	3	2	2	2								2	2	2
ME 101.4	3	2	1	1								2	2	2
ME 101.5	3	2	1	2								2	2	2
ME 101	**3**	**2**	**1.6**	**1.8**								**2**	**2.4**	**2**

SYLLABUS

No.	Content	Hours	COs
I	Vector Mechanics with applications: Definition and representation of vectors, projection and decomposition, force vector and types, dot product, resolving force vector along and perpendicular to a given direction, cross product and scalar triple product	**06**	**ME101.1**
II	Compositions of two force system, Resolution of forces, General method of composition of forces, Equilibrium of bodies, Free body diagram. Lami's theorem, Equilibrium of connected bodies	**06**	**ME101.1**
III	Moment of force, Varignon's theorem, Couple, Resolution of a force into a force and couple, Resultant of non-concurrent force system, Equilibrium of non-concurrent system of forces.	**06**	**ME101.2**
IV	Center of gravity, Centroid, Use of axis of symmetry, Centroid of a composite section, Center of gravity of a flat plate, Difference between center of gravity and centroid, Determination of centroid from first principle.	**06**	**ME101.1 ME101.2 ME101.3**
V	Moment of inertia, Radius of gyration, Polar moment of inertia, Moment of inertia from first principles, Theorems of moment of inertia, Moment of inertia of composite sections, Moment of inertia of standard sections	**06**	**ME101.3**
VI	Frames, Truss, Assumptions in analysis of frame and Truss, Nature of forces, Methods of analysis, Method of joints, Method of sections	**06**	**ME101.3**
VII	Laws of friction, Angle of friction, angle of repose, cone of friction, Wedges, Problems involving non-concurrent force system, Rope/belt friction, pulleys, screw-jack, rolling resistance	**05**	**ME101.1 ME101.2 ME101.4**
VIII	Types of supports, Types of beam, Types of loading, finding reactions at support, shear force and bending moment, axial force and twisting moment, Concept of Stress and Strain – Stress strain, diagram, factor of safety, uniaxial loading, single and double shear, applications. Generalized Hooke's law - Poisson's ratio, Generalized Hooke's law, Relations between E, G and K	**06**	**ME101.2 ME101.4**
IX	Kinematics of Particles and Rigid Bodies: rectilinear motion, curvilinear motion, velocity and acceleration in cylindrical and path coordinate system, relative and constrained motion, rate of change of a vector in a rotating frame, three-dimensional motion of a particle relative to a rotating frame, rigid body kinematics.	**05**	**ME101.1**
X	Work, Work done by varying force, Energy, Power, Work energy equation for translation, Motion of connected bodies, work done by spring	**04**	**ME101.1**
	Total Hours	**56**	

Essential Readings

1. F.P. Bear, E. R. Johnston, Vector Mechanics for Engineers, Tata McGraw Hill, 12th Edition 2019,
2. S. Timoshenko, D.H., Young, JV Rao, S. Pati, Engineering Mechanics, McGraw Hill Education, 5th Edition, 2017

Supplementary Readings

1. H. J. Shah, S. B. Junarkar, Applied Mechanics, Charotar Publication, 19th Edition 2015
2. S. S. Bhavikatti, K. G. Rajashekarappa, Engineering Mechanics, Wiley Eastern Ltd., 2018
3. R. C. Hibbeler, Engineering Mechanics –Statics & Dynamics, Macmillan Publication Co., 11th Edition, 2006

National Institute of Technology Meghalaya

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CURRICULUM

Programme	**Bachelor of Technology in Computer Science and Engineering**	Year of Regulation	**2024-25**
Department	**Computer Science and Engineering**	Semester	**I**

Course Code	Course Name	Pre-Requisite	Credit Structure				Marks Distribution			
			L	T	P	C	INT	MID	END	Total
CS101	**Computer and Coding**		**3**	**0**	**0**	**3**	**50**	**50**	**100**	**200**

Course Objectives		Course Outcomes	CO's	Statement	Bloom's Taxonomy
	To introduce the basic architecture of a computer, the concept of algorithm, the basic concepts and terminology of programming in general and concept of functional hierarchical code organization.		CS101.1	**Able to explain the basic architecture of a computer, the concept of algorithm, and the basic concepts and terminology of programming in general.**	Understand
	To inculcate the ability to do algorithmic thinking to analyse real-world problems and develop algorithms to solve those.		CS101.2	**Able to develop the ability to do algorithmic thinking to analyse a problem and develop an algorithm to solve it.**	Create
	To introduce programming using C language and writing programs in C on a computer, and edit, compile, debug, correct, recompile and run those.		CS101.3	**Able to apply the C programming language to implement various algorithms.**	Apply
	To train the students in choosing right data representation formats based on a problem specification.		CS101.4	**Able to choose the right data representation formats based on the requirements of the problem.**	Apply
			CS101.5	**Able to develop programs on a computer, edit, compile, debug, correct, recompile and run those.**	Create
			CS101.6	**Able to understand the concept of functional hierarchical code organization.**	Understand

COs	Mapping with Program Outcomes (POs)												Mapping with PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CS101.1	3		1		1					1	1	1			
CS101.2	2	3	3	2	1	1			1				1	1	1
CS101.3	3	3	3	2	1				1					1	1
CS101.4	3	1	1	2										2	3
CS101.5	3		3	1	3				1					1	1
CS101.6	3	2	2	2					2						1
CS101	2.83	2.25	2.17	1.80	1.50	1.00			1.25	1.00	1.00	1.00	1.00	1.25	1.40

SYLLABUS

No.	Content	Hours	COs
I	**Introduction** **Organization of a Computer: Von Neumann architecture; CPU; Memory; RAM; ROM; Hardware; Software; Application Programs; System Programs; Operating Systems; Number Systems.** **Concept of Programming and Programming Languages: Machine Language; Assembly Language; High-Level Programming language; Compiler; Assembler; Interpreter; Linker; Loader; Compiling a C program in command line and in an IDE** **Concept of Algorithm, Flowchart, Pseudo code, Illustrative Problem Solving Examples.**	**5**	**CS101.1** **CS101.2**
II	**Introduction to C programming language** **Features of a Programming Language: Character Set; Constants; Escape Sequences; Identifiers; Keywords; Data Types; Data Type Qualifiers; Variables; Declarations; enum; typedef; Operators & Expressions - Binary operators :- Arithmetic Operators, Logical Operators, Relational Operators, Bitwise Operators; Assignment Operator; Shorthand Assignment Operators; Unary Operators; Ternary Operators; Special Operators; sizeof(); Operator Precedence and Associativity in expressions; Data type conversion: coercion (implicit type conversion), type casting (explicit type conversion); Statements: Assignment statements, Input/ Output statements for standard input/ output devices.** **Flow Control - Conditionals and Branching:- Simple if Statement, if-else Statement, Nested if-else Statement, Ladder structure of if-else, switch-case statement, goto statement;** **Iteration - while Statement, do-while Statement, for Statement, break and continue.** **Functions; Function Types - standard library functions, user defined functions; syntax of functions; Arguments and Parameters; Call by Value; Call by Reference; parameterized main function; Storage Classes - auto, register, static, extern; Scope Rule: Variable scope - local, global; Recursion.** **Arrays - Single Dimensional Arrays, Multi-Dimensional Arrays, Introduction to strings :- Definition of a string, character arrays and strings, pointers and strings, standard library string functions, arrays of strings; Pointers - different types of pointers, pointer arithmetic, pointers and arrays.** **Structures - creating structures using struct, Arrays in Structures, Array of Structures, Difference between arrays and structures; Unions - creating structures using union, difference between structures and unions.** **Preprocessor directives and Files - Preprocessor directives :- File inclusion by macro, macros, macros and functions; Basic Input/ Output operations on Files :- Text files and binary files, file opening modes, opening, closing, reading, writing and appending to a file.** **(A programming language like C/ C++ shall be used as a basis language. The same language is to be used for the laboratory).**	**23**	**CS101.3** **CS101.4** **CS101.5** **CS101.6**
	Total Hours	**28**	

Essential Readings

1. E. Balagurusamy, "Programming in ANSI C", McGraw-Hill Education, 8th edition, 2019.
2. V. Rajaraman, "Fundamentals of Computers", PHI Learning, 6th revised edition, 2014.

3. Yashavant Kanetkar, “Let Us C”, BPB Publications, 19th edition, 2022.

Supplementary Readings

1. Byron S. Gottfried, “Programming with C”, McGraw-Hill Education, 4th edition, 2018.

2. Brian W. Kernighan, Dennis M. Ritchie, “The C Programming Language: ANSI C Version”, Pearson Education India, 2nd edition, 2015.

3. Darrel L. Graham, “C Programming Language”, Createspace Independent Publishing, 1st edition, 2016.

National Institute of Technology Meghalaya

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CURRICULUM

Programme	**Bachelor of Technology in Computer Science and Engineering**	Year of Regulation	**2024-25**
Department	**Computer Science and Engineering**	Semester	**I**

Course Code	Course Name	Pre-Requisite	Credit Structure				Marks Distribution		
			L	T	P	C	Continuous Evaluation	Quiz/ Viva	Total
CS151	**Computer & Coding Lab**		**0**	**0**	**2**	**1**	**70**	**30**	**100**

Course Objectives

- **To introduce programming using C language and to write programs in C on a computer, and to edit, compile, debug, correct, recompile and run those.**
- **To inculcate the ability to do algorithmic thinking to analyse real-world problems and develop algorithms to solve those.**
- **To train the students in choosing right data representation formats based on a problem specification.**

Course Outcomes

CO's	Statement	Bloom's Taxonomy
CS151.1	**Able to explain the basic concepts and terminology of programming in general.**	Understand)
CS151.2	**Able to do algorithmic thinking to analyse a problem and develop an algorithm to solve it.**	Create
CS151.3	**Able to use the C programming language to implement various algorithms.**	Apply
CS151.4	**Able to choose the right data representation formats based on the requirements of the problem.**	Apply
CS151.5	**Able to develop programs on a computer, edit, compile, debug, correct, recompile and run those.**	Create
CS151.6	**Able to understand the concept of functional hierarchical code organization.**	Understand

COs	Mapping with Program Outcomes (POs)												Mapping with PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CS151.1	3		1		1					1	1	1			
CS151.2	2	3	3	2	1	1			1					1	
CS151.3	3	3	3	2	1				1					3	
CS151.4	3	2	1	2										1	
CS151.5	3		3	2	3	1			1					2	
CS151.6	3	2	2	2					2					1	
CS151	**2.83**	**2.50**	**2.17**	**2.00**	**1.50**	**1.00**			**1.25**	**1**	**1**	**1**		**1.60**	

SYLLABUS

No.	Content	Hours	COs
I	1. C program to print the paragraph as shown below: " Hello World " % Hello World % \\ Hello World \\ 2. C program to print the result of the following arithmetic expression where a=4, b= 5. $\frac{5a + ab^2}{\sqrt{a^2+9}}$	**02**	**CS101.1** **CS101.2** **CS101.3** **CS101.4** **CS101.5** **CS101.6**
II	3. C program to check a given number is odd or even and positive or negative. 4. C program to read three numbers and find the greatest one.	**02**	
III	5. C program to read five numbers and find the second smallest number. 6. C program to find GCD and LCM of two numbers.	**02**	
IV	7. C program to store ten numbers in an array and find the largest and smallest. 8. C program to store N numbers in an array and count the total positive, negative, odd and even numbers [0 < N < 11].	**02**	
V	9. C program to check whether a given number is prime or not. 10. C program to print first N numbers of Fibonacci series.	**02**	
VI	11. C program to find a key from n numbers using sequential search (Linear search), and if found, show the position. 12. Implementation of an algorithm to insert an element at any arbitrary position in an array of integer numbers and also the implementation of an algorithm to display the condition of the array before and after insertion.	**04**	
VII	13. Implementation of an algorithm to delete an element in an array of integer numbers and also the implementation of an algorithm to display the condition of the array before and after deletion. 14. Implementation of an algorithm to reverse the elements of an array of integer numbers and also the implementation of an algorithm to display the condition of the array before and after reversal.	**04**	
VIII	15. C program to solve Tower of Hanoi problem for n disks. 16. C program to generate n Fibonacci numbers using both recursive and non-recursive methods.	**04**	
IX	17. C program to implement a swap function to swap the values of two variables. 18. C program to store the name, roll number, marks and grades of 5 students using array of structure.	**04**	
X	19. C program to create a file named "StudentDatabase" and storing the name, roll number, phone number and average marks of N students, where N is a natural number between 2 to 10.	**02**	
	Total Hours	**28**	

Essential Readings

1. E. Balagurusamy, "Programming in ANSI C", McGraw-Hill Education, 8th edition, 2019.

2. V. Rajaraman, “Fundamentals of Computers”, PHI Learning, 6th revised edition, 2014.
3. Yashavant Kanetkar, “Let Us C”, BPB Publications, 19th edition, 2022.

Supplementary Readings

1. Byron S. Gottfried, “Programming with C”, McGraw-Hill Education, 4th edition, 2018.
2. Brian W. Kernighan, Dennis M. Ritchie, “The C Programming Language: ANSI C Version”, Pearson Education India, 2nd edition, 2015.
3. Darrel L. Graham, “C Programming Language”, Createspace Independent Publishing, 1st edition, 2016.

	National Institute of Technology Meghalaya An Institute of National Importance	CURRICULUM

Programme	**Bachelor of Technology in Civil Engineering**	Year of Regulation	**2024-25**
Department	**Civil Engineering**	Semester	**I**

Course Code	Course Name	Pre-Requisite	Credit Structure				Marks Distribution			
			L	T	P	C	INT	MID	END	Total
CE 101	**Engineering Graphics**	**-----**	**0**	**1**	**3**	**2**	**50**	**50**	**100**	**200**

Course Objectives

- To develop the student's ability to understand the role and importance of technical drawings in engineering drawing process, and application of BIS and ISO conventions.
- To develop the student's ability to understand the proper representation and practice of Lines, Lettering, and dimensioning.
- To develop student's ability to understand the importance of types of scales.
- To develop the student's ability to construct plane geometry.
- To develop the student's ability to understand the concepts of projection and their application in technical drawing.
- To develop the student's ability to apply projection technique to draw Multi-view, pictorial view (Isometric View) drawings.
- To develop the student's ability to understand development process of surfaces of various objects.

Course Outcomes

CO's	Statement	Bloom's Taxonomy
CE101.1	Able to acquire knowledge about BIS conventions and it's application to draw letters, lines and dimensions.	Knowledge Application
CE101.2	Able to acquire knowledge about developing various types of scales associated with engineering drawing and it's application.	Knowledge Application
CE101.3	Able to acquire knowledge about constructing points, lines, curves, polygons, planes, solids etc. and it's application.	Knowledge Application
CE101.4	Able to acquire knowledge about the system of projection with respect to the observer, object, the reference planes and it's application.	Knowledge Application
CE101.5	Able to acquire knowledge about creating orthographic, isometric, multi-view drawing, and sectional views of objects and it's application.	Knowledge Application
CE101.6	Able to acquire knowledge about the development process of surfaces of various objects and it's application.	Knowledge Application

COs	Mapping with Program Outcomes (POs)												Mapping with PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CE101.1	2	2	2		2				1	3		1	3		
CE101.2	2	2	2		2				1	3		1	3		
CE101.3	2	2	2		2				1	3		1	3		
CE101.4	2	2	2		2				1	3		1	3		
CE101.5	2	2	2		2				1	3		1	3		
CE101.6	2	2	2		2				1	3		1	3		
CE101	**2**	**2**	**2**		**2**				**1**	**3**		**1**	**3**		

SYLLABUS

No.	Content	Hours	COs
I	**Introduction:** Importance of Engineering Drawing, drawing Instruments and materials, B.I.S. and ISO conventions, Lines, Lettering, and Dimensioning	**02**	**CE101.1**
II	**Scales:** Construction of scales – plane scale, diagonal scale, Vernier scale, functional scale; concept of conversion scale and nomogram	**02**	**CE101.2**
III	**Plane Geometry:** Geometrical Construction: line, arc, and angle, divisions of straight line and circumference, construction of polygon	**02**	**CE101.3**
IV	**Conic Sections and other Curves:** Construction of Ellipse, Parabola, Hyperbola, Rectangular Hyperbola, Cycloidal Curves: Cycloid, Involute	**02**	**CE101.3**
V	**Projection:** Principle of Projection and Orthographic Projection, Projection of points and lines, Projection of Planes.	**03**	**CE101.4**
VI	**Solid Geometry:** Types of Solids: polyhedral, prisms, pyramids, cylinder, cone, sphere, auxiliary projection method, Orthographic projection of solids: one view, two view and three view drawings, Missing view, rules for selection of views.	**03**	**CE101.4**
VII	Sectional view, section plane perpendicular to the HP & VP and other Various positions, true shape of sections.	**03**	**CE101.4**

VIII	Classification, line of intersection, line/generator method and section plane method: intersection of two prisms, two cylinders, intersection of cone and cylinder	**03**	**CE101.4**
IX	Terminology, isometric scale, isometric view and isometric projection, isometric axes, and lines, missing view	**02**	**CE101.5**
X	Method of development, parallel line development, radial line development, developments of cylinder, cone, prism, pyramid, true length of edges – oblique surface.	**02**	**CE101.6**
XI	Introduction to CAD software	**04**	**All COs**
Total Hours		**28**	

Essential Readings

1. N.D. Bhatt, Engineering Drawing, Chrotar Publishing House, 2011.
2. Dhananjay A Jolhe, Engineering drawing, TMH, 2008
3. M.B. Shah and B.C. Rana, Engineering Drawing, Pearson, 2009.

Supplementary Readings

1. T E French, C J Vierck and R J Foster, Graphic Science and Design, 4th edition, McGraw Hill, 1984
2. W J Luzadder and J M Duff, Fundamentals of Engineering Drawing, 11th edition, Prentice-Hall of India, 1995.
3. K Venugpoal, Engineering Drawing and Graphics, 3nd edition, New Age International, 1998.
4. Gary R. Bertoline, Eric N. Wiebe, Nathan W. Hartman, William A. Ross, Technical graphics Communication, 4th Edition, McGraw Hill Higher Education, 2009
5. Frederick E. Giesecke, Shawna Lockhart, Marla Goodman, Cindy M. Johnson Technical Drawing With Engineering Graphics, 15th Edition, Prentice Hall, 2016
6. SP 46: 2003, Engineering Drawing Practice for schools and colleges.

B.Tech. Semester - I

	National Institute of Technology Meghalaya An Institute of National Importance	**CURRICULUM**

Programme	**Bachelor of Technology**	Year of Implementation	**2024-25**
Department	**Humanities and Social Sciences**	Semester	**I**

Course Code	Course Name	Pre-Requisite	Credit Structure				Marks Distribution	
			L	T	P	C	Continuous Assessment	Total
HS151	**Communication Skills**	**Nil**	**0**	**1**	**2**	**2**	**01 Experiment X 10**	**100**

Course Objectives		Course Outcomes			
				COs	**Statement**	**Bloom's Taxonomy**
	To introduce the basic concepts of communication		HS151.1	Describe and apply the skill of listening in Communicative English	Apply
	To improve English communication skills of students which are essential to succeed in today's business environment.		HS151.2	Demonstrate good reading skills in English	Apply
	To improve oratory skills and body language		HS151.3	Demonstrate good writing skills in English	Apply
	To develop the ability to critically analyze topics and contexts independently or in groups		HS151.4	Demonstrate good oratory skills in English	Apply

COs	Mapping with Program Outcomes (POs)												Mapping with PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
HS151.1	-	-	-	-	-	-	-	-	1	3	-	3			
HS151.2	-	-	-	-	-	-	-	-	1	3	-	3			
HS151.3	-	-	-	-	-	-	-	-	1	3	-	3			
HS151.4	-	-	-	-	-	-	-	-	1	3	-	3			
HS151	-	-	-	-	-	-	-	-	1.0	3.0	-	3.0			

SYLLABUS

No.	Activities/Experiments	Hours	COs
I	Short speeches or other audio files: Listening; Conversing with the teacher or other students; Writing a summary; Speaking and recording of important points	6	HS151.1
II	Short movies or other video files: Watching; Conversing with the teacher or other students; Writing a summary; Speaking and recording of important points	6	HS151.1
III	Unseen comprehension: Reading passages or essays; Conversing with the teacher or other students; Writing a summary or answering questions	6	HS151.2
IV	Written composition: Writing paragraphs and argumentative and narrative essays; Letter writing–official, personal, job application; Notice writing; Reports	12	HS151.3
V	Oratory: Greetings & introductions; Extempore; Debate; Group discussion; Individual/group seminar presentations; Vocabulary building; Taking and giving interviews; pronunciation skills exercises	12	HS151.4
	Total Hours	**42**	

Essential Readings

1. C. Muralikrishna and Sunita Mishra, *Communication Skills for Engineers*, Pearson, 2nd Edition, 2011.
2. Nitin Bhatnagar and Mamta Bhatnagar, *Communicative English for Engineers and Professionals*, Pearson, 2010.

Supplementary Readings

1. J. K. Gangal, *A Practical Course for Developing Writing Skills in English*, PHI, 2011.
2. John Seely, *Oxford Guide to Effective Writing and Speaking*, Oxford University Press, 3rd Edition, 2013.
3. Sanjay Kumar and Pushp Lata, *Communication Skills*, Oxford University Press, 2nd Edition, 2015.

Second Semester Courses

	National Institute of Technology Meghalaya An Institute of National Importance	**CURRICULUM**

Programme	**Bachelor of Technology**	Year of Regulation	**2024-25**
Department	**Mathematics**	Semester	**II**

Course Code	Course Name	Pre-requisite	Credit Structure				Marks Distribution			
			L	T	P	C	INT	MID	END	Total
MA 102	**Engineering Mathematics-II**	**NIL**	**3**	**1**	**0**	**4**	**50**	**50**	**100**	**200**

		CO's	**Statement**	**Bloom's Taxonomy**
Course Objectives	1. To introduce the fundamental concepts of various engineering mathematics tools involving integral transforms, differential equations and complex variables. 2. To develop problem-solving and critical thinking skills in engineering mathematics.	Course Outcomes	MA102.1	Able to **describe** the basic concepts of Fourier series, Fourier transform, Laplace transform and their applications.	**Understand**
			MA102.2	Able to s**olve** ordinary differential equations analytically and **implement** the ODEs to model real world problems.	**Apply**
			MA102.3	Able to **compare** second order PDEs and **solve** Laplace, heat and wave equations using Fourier series.	**Analyze Apply**
			MA102.4	Able to **recognize** analytic functions, **solve** contour integrals and **determine** the Taylor and Laurent series expansions.	**Understand Apply**
			MA102.5	Able to **use** the basic knowledge of engineering Mathematics in solving real-world problems .	**Apply**

COs	Mapping with Program Outcomes (POs)												Mapping with PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
MA102.1	**3**														
MA102.2	**3**														
MA102.3	**3**														
MA102.4	**3**														
MA102.5	**3**														
MA102	**3**														

SYLLABUS

No.	Content	Hours	COs
I	**Integral Transforms:** Fourier series of a function with arbitrary period, Fourier series of even and odd functions, half-range Fourier series, Fourier Transform: Fourier integral theorem, Fourier sine and cosine integrals, complex form of Fourier integral, Fourier transform of derivative of a function, applications of Fourier transform in boundary value problems; Laplace Transform: Laplace transform of a function, existence theorem, Laplace transform of derivatives and integrals, inverse Laplace transform, convolution theorem.	**14**	**MA102.1 MA102.5**
II	**Ordinary Differential Equations:** First order ordinary differential equations: exact, integrating factors, linear and Bernoulli's equations, Higher order differential equations with constant coefficients, Cauchy-Euler equations, method of variation of parameters, system of differential equations. Use of Laplace and Fourier transform in solving ordinary differential equations**.**	**14**	**MA102.2 MA102.5**
III	**Partial Differential Equations:** First order partial differential equation: linear, semi-linear, quasi-linear, and non-linear types. Classification of integrals. Lagrange's method of solution and its geometrical interpretation, compatibility condition, Charpit's method, special types of first order equations. Method of separation of variables to solve Wave equation, Laplace equation, Heat equation. Use of Laplace and Fourier transform in solving partial differential equations**.**	**14**	**MA102.2 MA102.5**
IV	**Complex Analysis:** Basic concept of complex numbers, limits, continuity and differentiability of a complex valued function of a complex variable, analytic functions, Cauchy-Riemann Equations, harmonic functions, complex exponential, trigonometric, hyperbolic and logarithmic functions, line integral in complex plane, Cauchy's Integral Theorem, Cauchy's Integral Formula, Taylor and Laurent series, singularities.	**14**	**MA102.4 MA102.5**
	Total Hours (4 Modules)	**56**	

Essential Readings

1. E. Kreyszig, "Advanced Engineering Mathematics", John Wiley & Sons, 10th edition 2023.
2. R. K. Jain and S. R. K. Iyengar, "Advanced Engineering Mathematics", Narosa Publishing House, 5th edition, 2019.

Supplementary Readings

1. P. Dyke, "An Introduction to Laplace Transforms and Fourier Series", Springer Nature; 2nd edition, 2014.
2. Shepley L. Ross, "Differential Equations", John Wiley & Sons, Inc, 3rd edition 2007.
3. S. J. Farlow, "Partial Differential Equations for Scientist and Engineers", Dover Publications, 2003.
4. J. W. Brown and R. V. Churchill, "Complex Variables and Applications", McGraw Hill; 9th edition, 2021.

	National Institute of Technology Meghalaya An Institute of National Importance	CURRICULUM

Programme	**Bachelor of Technology (All branches)**	Year of Regulation	**2024-2025**
Department	**Chemical and Biological Sciences**	Semester	**II**

Course Code	Course Name	Credit Structure				Marks Distribution			
		L	T	P	C	INT	MID	END	Total
CB 102	**Environmental Science**	**2**	**0**	**0**	**2**	**50**	**50**	**100**	**200**

			COs		**Bloom's taxonomy**
Course Objectives	To introduce students to natural resources and the impact of various human activities on natural resources and the environment.	Course Outcomes	CB102.1	The students will be able to discuss various types of natural resources, their proper utilization, and conservation for maintaining ecological balance.	**Understand**
	To provide basic knowledge about the environment and its related socio-economic problems, environment protection, and environment improvement programs.		CB102.2	Able to analyze the impacts of various types of pollutants on the environment and provide a proper scientific and technical solutions to control them.	**Analyze**
	To study the causes and effects of air, and water pollution and the techniques for monitoring air and water quality in the environment.		CB102.3	Able to apply different techniques to manage solid wastes and recovery of useful materials from wastes.	**Apply**
	To provide basic knowledge and overview of solid waste management and its impact on human health and surrounding environments.		CB102.4	Able to understand the features of renewable energy resources and their importance for sustainable development.	**Understand**

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	CB102.1	-	-	-	-	-	-	2	-	-	-	-	-	-	-	-
2	CB102.2	-	-	-	-	-	-	2	-	-	-	-	-	-	-	-
3	CB102.3	-	-	-	-	-	-	2	-	-	-	-	-	-	-	-
4	CB102.4	-	-	-	-	-	-	2	-	-	-	-	-	-	-	-
	CB102							2								

SYLLABUS

No.	Content	Hours	COs
I	**Natural resources:** Scope and importance, concept of sustainability and sustainable development. Land resources- Land degradation, soil erosion and desertification. Deforestation; impacts due to mining, dam building on environment, forests, biodiversity and tribal populations. Water- Surface and ground water, floods, droughts, population growth, and associated problems.	**05**	CB102.1 CB102.2
II	**Human communities and the Environment:** Demography, population, population explosion and population control, family welfare programs, resettlement and rehabilitation of affected persons, case studies. Disaster management- flood, earthquake, cyclones and landslides. Environmental movements – Chipko, Silent valley and Bishnois of Rajasthan. Environmental ethics, environmental conservations, public awareness. Environmental Protection Acts.	**04**	CB102.1
III	**Air pollution:** Source and effect of pollutants, primary and secondary pollutants, control measures. Acid rain and its impacts. Green-house effects and their impact on global climate change. Depletion of the ozone layer and its effects. Air pollution monitoring techniques. **Water pollution:** Natural water, pollutants- their origin and effects, oxygen demanding wastes, pathogens, nutrients, salts, heavy metals, pesticides, volatile organic compounds. River/ lake/ ground water pollution. Water pollution monitoring techniques	**08**	CB102.2
IV	**Solid Waste Management:** Municipal, industrial, commercial, agricultural, hazardous solid wastes, recovery and conversion method of waste and waste management, land filling/disposal, incineration, composting. Environment management and sustainability tools (material management and recovery planning) for sustainable management including ISO, RIOS & R2 certifications, environment audit. E-waste- composition and generation, global context in e- waste, effects of pollutant (E- waste) on human health and surrounding environment, e-waste control measures, steps in recycling and recovery of materials from e-waste.	**07**	CB102.3
V	**Energy Resources:** Renewable and non-renewable energy sources, use of alternate energy sources [solar energy, hydro (tidal) energy, wind energy, geothermal, biomass, nuclear energy).	**04**	CB102.4
	Total Hours	**28**	

Essential Readings

1. A. Basak, "Environmental Studies", 2nd Edition, Pearson, 2015.
2. D. Dave and S.S. Katewa, "Text Book of Environmental Studies", Cenage Learning, 2nd Edition, 2012.

Supplementary Readings

1. R. Daniels and J. Khrishnaswamy, "Environmental Studies", 1st Edition, Wiley, 2009.
2. A. Khan, Inamuddin, A. M. Asiri "E-waste Recycling and Management", Springer Nature Switzerland AG, 2020

National Institute of Technology Meghalaya

An Institute of National Importance

CURRICULUM

Programme	**Bachelor of Technology in Electrical and Electronics Engineering**	Year of Regulation	**2024-25**
Department	**Electrical Engineering & Electronics and Communication Engineering**	Semester	**II**

Course Code	Course Name	Pre-Requisite	Credit Structure				Marks Distribution			
			L	T	P	C	INT	MID	END	Total
EE102	**Basic Electrical & Electronics Engineering**	**-----**	**3**	**0**	**0**	**3**	**50**	**50**	**100**	**200**

Course Objectives	To understand basic circuit theorems and laws	Course Outcomes	**CO's**	**Statement** / **Bloom's Taxonomy**
	To develop the skills to analyze the basic DC/AC system		EE102.1	Acquire knowledge of circuit theorems, understand and apply circuit theorems to DC circuits — Knowledge Application
	To introduce the principle of semiconductor physics		EE102.2	Understand the laws of electricity and magnetism and apply them in simple circuits — Knowledge Synthesis
	To understand the concept of diode and its applications		EE102.3	Analyze single phase AC circuits for voltage and circuit and calculate complex power — Comprehension Application
	To understand the fundamentals of Bipolar Junction Transistors		EE102.4	Able to acquire knowledge about the fundamentals of semiconductor physics. — Knowledge Synthesis
			EE102.5	Able to gather knowledge about diode and its applications. — Knowledge Application
			EE102.6	Able to understand the Bipolar Junction Transistors — Knowledge Application

COs	Mapping with Program Outcomes (POs)												Mapping with PSOs			
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
EE102.1	**3**	**3**	**1**	**1**	**1**	**2**	**1**	-	-	-	-	-	-	**2**	**3**	-
EE102.2	**3**	**2**	**2**	**1**	**1**	**2**	**2**	-	-	-	-	-	-	**2**	**3**	-
EE102.3	**3**	**3**	**1**	**2**	**2**	**2**	**1**			-	-	-	-	**2**	**3**	-
EE102.4	**3**	**2**	**2**	**1**	**1**	**1**	**1**			-	-	-	**3**	**2**	**2**	-
EE102.5	**3**	**2**	**2**	**1**	**1**	**1**	**1**			-	-	-	**3**	**2**	**2**	-
EE102.6	**3**	**2**	**2**	**1**	**1**	**1**	**1**			-	-	-	**3**	**2**	**2**	-
EE102	**3**	**2.33**	**1.67**	**1.17**	**1.17**	**1.50**	**1.17**						**3**	**2.00**	**2.50**	

SYLLABUS

No.	Content	Hours	COs
I	**Analysis of DC circuits** Mesh, node, branch, Ohm's law, series and parallel circuit, basic devices: resistors, capacitors, inductors, dependent and independent sources, Kirchhoff's Laws, Mesh and Node Analysis, Star-Delta conversion, Superposition theorem, Source conversion, Thevenin theorem, Norton theorem, Maximum power transfer theorem.	**06**	EE102.1
II	**Electromagnetic Induction & Magnetic Circuit** Magnetic field, Right hand rule, Left hand rule, Electromechanical laws, relation between electricity and magnetism, production of emfs (ac & dc), Faraday's law of electromagnetic induction, direction of induced emf, Lenz law, dynamically and statically induced emfs, self-inductances, and mutual inductances, coefficient of coupling, Inductance in series and parallel, energy stored in a magnetic field.	**06**	EE102.2
III	**A.C Fundamentals and R.L.C circuits** Phasors, Complex quantities, Application of complex algebra to A.C circuit, series and parallel RL, RC, RLC circuit, concept of impedance triangle, complex power: active, reactive and apparent power, power triangle, admittance triangle, series parallel circuit. Balanced two phase and three phase systems, Balanced Star-Delta connections, phase and line currents and voltages and their relations, Measurement of three phase power.	**06**	EE102.3
IV	**Introduction:** Fundamentals of semiconductor, Energy Bandgap, intrinsic and extrinsic semiconductors, Mobility, Conductivity & Resistivity.	**07**	**EE102.4**
V	**Diodes & applications**: Physical structure and working mechanism of the p-n junction, p-n junction under forward & reverse bias, I/V characteristics, Half wave & full-wave, bridge rectifiers.	**07**	**EE102.5**
VI	**Bipolar Junction Transistors:** Physical structure and working mechanism of BJT transistors, Input Output characteristics, Regions of operation, Transistor configurations: CB, CE, CC.	**07**	**EE102.6**
	Total Hours	**39**	

Essential Readings

1. A. Hussain, Fundamental of Electrical Engineering, Dhanpat Rai & Co. Ltd., 3rd edition, 2007.

2. W.H. Hayt, J.E. Kemmerley, Engineering circuit analysis, Int. St. Ed. McGraw Hill, 8th edition 2013

3. D. Chattopadhyay, P.C. Rakshit, Electronics Fundamentals and Applications, New Age International Publisher, 7th Edition 2008

Supplementary Readings

1. A. Chakroborty, S. Nath and C.K. Chanda, “Basic Electrical Engineering”, McGraw Hill Education Pvt. Ltd., 1st Edition, 2009.

2. V.N Mittle, Basic Electrical Engineering, Tata McGraw Hill, 2nd edition 2017.

3. A. Malvino, Electronics Principles, Tata McGraw-Hill, 7th Edition, 2017.

4. T.L. Floyd, Electronics Devices, Publisher: Pearson Education, 9th Edition,2018.

5. https://onlinecourses.nptel.ac.in/noc21_ee55/preview.

National Institute of Technology Meghalaya

An Institute of National Importance

CURRICULUM

Programme	**Bachelor of Technology in Electrical and Electronics Engineering**	Year of Regulation	**2024-25**
Department	**Electrical Engineering & Electronics and Communication Engineering**	Semester	**II**

Course Code	Course Name	Pre-Requisite	Credit Structure				Marks Distribution		
			L	T	P	C	Continuous	Exam	Total
EE152	**Basic Electrical and Electronics Engineering Lab**	**EE**	**0**	**0**	**2**	**1**	**70**	**30**	**100**

			CO's	Statement	Bloom's Taxonomy
Course Objectives	To understand basic circuit theorems and laws	Course Outcomes	EE152.1	Acquire knowledge of circuit theorems, understand and apply circuit theorems to DC circuits	Knowledge Application
	To develop the skills to analyze the basic DC/AC system		EE152.2	Understand the laws of electricity and magnetism and apply them in simple circuits	Knowledge Synthesis
	To develop the student's ability to apply the basic principles of electronics in circuit designing		EE152.3	Analyze single phase AC circuits for voltage and circuit and calculate complex power	Comprehension Application
	To develop the student's ability to design circuits based on diode		EE152.4	Verify the V-I characteristics of the basic diodes	Knowledge Application
	To develop the student's ability to study characteristics of BJT		EE152.5	Study the operational mechanism of diode circuits as a rectifier	Knowledge Application
			EE152.6	Study the characterises of BJT	Knowledge Application

COs	Mapping with Program Outcomes (POs)												Mapping with PSOs			
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
EE102.1	**3**	**3**	**1**	**1**	**1**	**2**	**1**	-	-	-	-	**2**	-	**2**	**3**	-
EE102.2	**3**	**2**	**2**	**1**	**1**	**2**	**2**	-	-	-	-	**2**	-	**2**	**3**	-
EE102.3	**3**	**3**	**1**	**2**	**2**	**2**	**1**	-	-	-	-	**2**	-	**2**	**3**	-
EE102.4	**3**	**2**	**1**	**1**	**1**	**1**	-	-	-	-	-	**2**	**3**	**2**	**2**	-
EE102.5	**3**	**2**	**1**	**1**	**1**	**1**	-	-	-	-	-	**2**	**3**	**2**	**2**	-
EE102.6	**3**	**2**	**1**	**1**	**1**	**1**	-	-	-	-	-	**2**	**3**	**2**	**2**	-
EE102	**3.00**	**2.33**	**1.17**	**1.17**	**1.17**	**1.50**	**1.33**					**2.00**	**3.00**	**2.00**	**2.50**	

SYLLABUS

No.	Content	Hours	COs
1	Study and verification of Kirchhoff's Current Law & Kirchhoff's voltage law applied to D.C. circuit.	**02**	**EE152.1**
2	To Study & Verify the Maximum Power Transfer theorem.	**02**	**EE152.1**
3	To find the inductance of the choke coil.	**02**	**EE152.2**
4	To study the R-L-C series circuit.	**02**	**EE152.3**
5	To study three-phase power measurement using The two-wattmeter method.	**02**	**EE152.3**
6	I-V characteristics of forward biased P-N junction Diode.	**02**	**EE152.4**
7	Reverse characteristics of Zener Diode.	**02**	**EE152.4**
8	Half-wave rectifier using diode.	**02**	**EE152.5**
9	Full-wave rectifier using diode.	**02**	**EE152.5**
10	Bridge rectifier using diode.	**02**	**EE152.5**
11	Input & output characteristics of BJT in CE mode.	**02**	**EE152.6**
12	Input & output characteristics of BJT in CB mode	**02**	**EE152.6**
	Total Hours	**24**	

Essential Readings

1. A. Hussain, Fundamental of Electrical Engineering, Dhanpat Rai & Co. Ltd., 3rd edition, 2007.

2. W.H. Hayt, J.E. Kemmerley, Engineering circuit analysis, Int. St. Ed. McGraw Hill, 8th edition 2013
3. D. Chattopadhyay, P.C. Rakshit, Electronics Fundamentals and Applications, New Age International Publisher, 7th Edition 2008
Supplementary Readings
4. A. Chakroborty, S. Nath and C.K. Chanda, “Basic Electrical Engineering”, McGraw Hill Education Pvt. Ltd., 1st Edition, 2009.
5. V.N Mittle, Basic Electrical Engineering, Tata McGraw Hill, 2nd edition 2017.
6. A. Malvino, Electronics Principles, Tata McGraw-Hill, 7th Edition, 2017.
7. T.L. Floyd, Electronics Devices, Publisher: Pearson Education, 9th Edition,2018.

	National Institute of Technology Meghalaya An Institute of National Importance	CURRICULUM

Programme	**Bachelor of Technology in Mechanical Engineering**	Year of Regulation	**2024-25**
Department	**Mechanical Engineering**	Semester	**II**

Course Code	Course Name	Pre-Requisites	Credit Structure				Marks Distribution	
			L	T	P	C	Continuous Evaluation	Total
ME 152	**Workshop practice**	**--**	**0**	**0**	**2**	**1**	**100**	**100**

Course Objectives		Course Outcomes			
			CO's	**Statement**	**Bloom's Taxonomy**
	Explain the tools, equipment and safety procedures of carpentry, fitting, welding and foundry shops. (Understanding).		ME152.1	Utilize the tools and equipment to perform specified jobs in fitting shop and compare with prescribed dimensions.	Applying
			ME152.2	Utilize the tools and equipment to perform specified jobs in carpentry shop and compare with prescribed dimensions.	Applying
			ME152.3	Utilize the tools and equipment to perform specified jobs in welding shop and compare with prescribed dimensions.	Applying
			ME152.4	Utilize the casting process to develop the prescribed job	Application

COs	Mapping with Program Outcomes (POs)												Mapping with PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO 7	PO8	PO9	PO10	PO11	PO 12	PSO1	PSO2	PSO 3
ME152.1	2	1				2			2				2	1	
ME152.2	2	1				2			2				2	1	
ME152.3	2	1				2			2				2	1	
ME152.4	2	1				2			2				2	1	
ME152	**2**	**1**				**2**			**2**				**2**	**1**	

SYLLABUS

No.	Content	Hours	COs
I	To perform T-join with drilling in the centre in the fitting with the use of specific tools	**07**	**ME152.1**
II	To develop cross join/dovetail join/ briddle join in carpentry shop with the use of specific tools	**07**	**ME152.2**
III	To develop T-join Oxy-acetylene gas welding	**07**	**ME152.3**
IV	To make specific job using casting process	**07**	**ME152.4**
	Total Hours	**28**	

Essential Readings

1. S.K. Hajra Chaudhary, Elements of Workshop Technology Vol-I and II, Asia Publishing House, 2008

Supplementary Readings

1. K.N. Gupta, J. P. Kaushish, Workshop Technology, New Delhi Heights Publications, 1992
2. H.S. Bava, Workshop Technology, Tata McGraw Hill Publishing Co. Ltd., 2nd Edition, 2009
3. W.A.J. Chapman, Workshop Technology, ELBS Low Price Text, Edward Donald Pub. Ltd., 5th Edition, 1972

B.Tech. Semester - II

National Institute of Technology Meghalaya

An Institute of National Importance

CURRICULUM

Programme	**Bachelor of Technology**	Year of Implementation	**2024-25**
Department	**Humanities and Social Sciences**	Semester	**II**

Course Code	Course Name	Prerequisite	Credit Structure				Marks Distribution			
			L	T	P	C	INT	MID	END	Total
			2	**0**	**0**	**2**	**50**	**50**	**100**	**200**
HS102	**Creativity, Innovation and Entrepreneurship**	**Nil**		**COs**	**Statement**				**Bloom's Taxonomy**	
Course Objectives	To introduce the basic aspects of creativity, innovation and entrepreneurship		Course Outcomes	HS102.1	Describe the basic concepts of creativity, innovation and entrepreneurship				Understand	
	To familiarize the importance of creativity, innovation, and entrepreneurship			HS102.2	Describe and illustrate the importance of creativity				Apply	
	To discuss the role and importance of creativity, innovation, and entrepreneurship for social development			HS102.3	Describe and illustrate the importance of innovation				Apply	
	To discuss the stages of the entrepreneurial process for the successful development of entrepreneurial projects			HS102.4	Describe and illustrate the importance of entrepreneurship				Apply	

COs	Mapping with Program Outcomes (POs)												Mapping with PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO 1	PSO2	PSO3
HS102.1	-	-	1	-	1	2	2	-	3	2	3	2			
HS102.2	-	-	1	-	1	2	2	-	3	2	3	2			
HS102.3	-	-	3	-	1	2	2	-	3	2	3	2			
HS102.4	-	-	3	-	1	2	2	-	3	2	3	2			
HS102	-	-	2.0	-	1.0	2.0	2.0	-	3.0	2.0	3.0	2.0			

SYLLABUS

No.	Content	Hours	COs
I	Meaning and definition of creativity, innovation, and entrepreneurship; Relation between creativity, innovation, and entrepreneurship; Differences between creativity and innovation; Differences between creativity and entrepreneurship; Differences between innovation and entrepreneurship; Event funding	06	HS102.1
II	Individual creativity, behaviour and psychological aspects of creativity; Idea generation; Creativity tools and techniques; Creativity in groups	06	HS102.2
III	Innovation and competitive advantage; Framework of innovative strategies; Organizational issues of innovation; Innovation in a competitive environment; Sources of innovation; Innovation selection; Effective implementation of innovative ideas	08	HS102.3
IV	Historical development of entrepreneurship; Types of entrepreneurship; Entrepreneurial opportunities; Entrepreneurial processes; Entrepreneurial strategies; Entrepreneurial practice; Sources of entrepreneurial ideas; Entrepreneurial project; Start-up; Contributions of entrepreneurs in society	08	HS102.4
	Total Hours	**28**	

Essential Readings

1. Pradip N. Khandwalla, *Lifelong Creativity: An Unending Quest*, Tata McGraw Hill, 2004.
2. Vinnie Jauhari and Sudanshu Bhushan, Innovation Management, Oxford Higher Education, 2014.
3. Robert D. Hisrich et. al. *Entrepreneurship*, McGraw Hill Higher Education, 6th Edition, 2004.

Supplementary Readings

1. D. H. Holt, *Entrepreneurship: New Venture Creation*, Prentice Hall, 1992.
2. Lewrick, M., Link, P., and Leifer, L., *The Design Thinking Toolbox: A Guide to Mastering the Most Popular and Valuable Innovation Methods,* John Wiley & Sons, 2020.
3. Hisrich, R. D., Peters, M. P., and Shepherd, D. A., *Entrepreneurship,* New York: McGraw-Hill, 2020.

National Institute of Technology Meghalaya

An Institute of National Importance

CURRICULUM

Programme	**Bachelor of Technology in Computer Science and Engineering**	Year of Regulation	**2024-25**
Department	**Computer Science and Engineering**	Semester	**II**

Course Code	Course Name	Pre-Requisite	Credit Structure				Marks Distribution		
			L	T	P	C	Continuous Evaluation	Quiz/ Viva	Total
CS152	**Python Programming**		**0**	**1**	**2**	**2**	**70**	**30**	**100**

Course Objectives

- **To introduce programming using Python and to write programs in python on a computer, and to edit, compile, debug, correct, recompile and run those.**
- **To inculcate the ability to do algorithmic thinking to analyze real-world problems and develop algorithms to solve those.**
- **To train the students in choosing right data representation formats based on a problem specification.**

Course Outcomes

CO's	Statement	Bloom's Taxonomy
CS152.1	**Able to understand the basic concepts of scripting and the contributions of scripting language.**	Understand
CS152.2	**Able to develop Python programs with conditionals and loops, functions and calling them.**	Create
CS152.3	**Able to analyse and explore python data structures like Lists, Tuples, Sets and dictionaries.**	Analyze
CS152.4	**Able to develop Python program to read and write data from/to files**	Create

COs	Mapping with Program Outcomes (POs)												Mapping with PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CS152.1	3		1		1					1	1	1			
CS152.2	2	3	3	2	1				1					1	
CS152.3	3	3	3	2	1				1					3	
CS152.4	3	2	1	2										1	
CS152	2.75	2.67	2.00	2.00	1.00				1.00	1.00	1.00	1.00		1.67	

SYLLABUS

No.	Content	Hours	COs
I	1. Python program to print the paragraph as shown below: " Hello World " % Hello World % \\ Hello World \\ 2. Python program to print the result of the following arithmetic expression where a=4, b= 5. $\frac{5a+ab^2}{\sqrt{a^2+9}}$	**02**	**CS152.1 CS152.2 CS152.3 CS152.4**
II	3. Python program to check a given number is odd or even and positive or negative. 4. Python program to read three numbers and find the greatest one.	**02**	
III	5. Python program to read five numbers and find the second smallest number. 6. Python program to find GCD and LCM of two numbers.	**02**	
IV	7. Python program to store ten numbers in a list and find the largest and smallest. 8. Python program to store N numbers in a list and count the total positive, negative, odd and even numbers [0 < N < 11].	**02**	
V	9. Python program to check whether a given number is prime or not. 10. Python program to print first N numbers of Fibonacci series.	**02**	
VI	11. Python program to create a menu with the following options 1. TO PERFORM ADDITITON 2. TO PERFORM SUBTRACTION 3. TO PERFORM MULTIPICATION 4. TO PERFORM DIVISION Accepts users input and perform the operation accordingly. Use functions with arguments. 12. Python program to check whether the given string is palindrome or not.	**02**	
VII	13. Python program to find factorial of a given number using functions. 14. Python function that takes two lists and returns True if they are equal otherwise false	**04**	
VIII	15. Python program to open and write "hello world" into a file. 16. Python program to read a csv file using pandas module and print the first and last five lines of a file.	**04**	
IX	17. Python program to open a file and check what are the access permissions acquired by that file using os module. 18. Python program to copy the contents of a file to another file.	**04**	
X	19. Python program to count frequency of characters in a given file. 20. Python program to print each line of a file in reverse order.	**04**	
	Total Hours	**28**	

Essential Readings

1. Mark Lutz, " Programming Python", Prentice Hall India, 7th Edition, 2017
2. Mark Lutz, "Learning Python", McGraw-Hill publication, 6th Edition, 2021
3. Luciano Ramalho, "Fluent Python", O'Reilly Media, 2nd Edition, 2021

Supplementary Readings

1. Allen Downey, "Think Python", O'Reilly Media, 2nd Edition, 2015
2. Marl Pilgrim, "Dive into Python", APress Media LLC, 1st Edition, 2005
3. Brett Slatkin , "Effective Python: 59 Specific Ways to Write Better Python", Pearson Education, Inc, 2nd Edition 2019

National Institute of Technology Meghalaya

An Institute of National Importance

CURRICULUM

Programme	**Bachelor of Technology**	Year of Implementation	**2024-25**
Department	**Humanities and Social Sciences**	Semester	**II**

Course Code	Course Name	Prerequisite	Credit Structure				Marks Distribution			
			L	T	P	C	INT	MID	END	Total
			2	**0**	**0**	**2**	**50**	**50**	**100**	**200**
HS104	**Ethics and Morals**	**Nil**								

			COs	**Statement**	**Bloom's Taxonomy**
Course Objectives	To introduce the basic aspects of human values and ethics	Course Outcomes	HS104.1	Explain the basic aspects of ethics, values, and morals	Understand
	To familiarize a few ethical theories that guide human values and principles		HS104.2	Explain a few theories that guide ethics, values, and morals	Understand
	To discuss a multi-dimensional perspective of human values and ethics		HS104.3	Demonstrate a multi-dimensional perspective of human values and ethics	Apply
	To help in applying the concepts of ethics to personal ethical lifestyle choices and for community well-being		HS104.4	Apply the concepts of ethics to personal ethical lifestyle choices and decision making	Apply

COs	Mapping with Program Outcomes (POs)												Mapping with PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
HS104.1	-	-	2	-	-	3	2	3	1	1	1	-			
HS104.2	-	-	2	-	-	3	2	3	1	1	1	-			
HS104.3	-	-	2	-	-	3	2	3	1	1	1	-			
HS104.4	-	-	2	-	-	3	2	3	1	1	1	-			
HS104	-	-	2.0	-	-	3.0	2.0	3.0	1.0	1.0	1.0	-			

SYLLABUS

No.	Content	Hours	COs
I	Meaning and definition of ethics, morals, and values; Differences between ethics, morals, and values; Types of ethics; Dimensions of ethics; Ethics in human actions; Role of family, society, and educational institutions in inculcating values	06	HS104.1
II	Theories on ethics; Egoism; Ethical ideologies; Moral development; Moral thinking; Values; Transparent standards; Fair competition; Equal opportunity; Conflict of interest; Code of conduct	08	HS104.2
III	Emotional intelligence and ethics; Corporate social responsibility and consumer protection; Environment ethics; Industry and environment management; Discrimination; Privacy; Surveillance; Coping with failures; Performance appraisals	07	HS104.3
IV	Relationship between attitude, thought and behaviour; Ethics and attitude; Social influence and persuasion; Ethical decision making; Personal values and ethical decision making; Trustworthiness; Respect; Responsibility; Fairness; Integrity	07	HS104.4
	Total Hours	**28**	

Essential Readings

1. R. R. Gaur, R. Sangal and G. P. Bagaria, *A Foundation Course in Human Values and Professional Ethics*, Excel Books, 2010.
2. R. Subramanian, *Professional Ethics*, Oxford University Press, 2nd Edition, 2017.

Supplementary Readings

1. A. Carr, *Positive Psychology: The Science of Happiness and Human Strength*, Brunner-Routledge, 2004.
2. Charles E. Harris et.al. *Engineering Ethics: Concepts and Cases*, Wadsworth Publishing Co. Inc., 5th Edition, 2013.

	National Institute of Technology Meghalaya An Institute of National Importance	CURRICULUM

Programme	**Bachelor of Technology in Mechanical Engineering**	Year of Regulation	**2024-25**
Department	**Mechanical Engineering**	Semester	**II**

Course Code	Course Name	Pre-Requisite	Credit Structure				Marks Distribution	
			L	T	P	C	Continuous Evaluation	Total
VA 102	**Skill Development and Prototyping**	**-----**	**0**	**0**	**2**	**1**	**100**	**100**

Course Objectives	Course Outcomes			
		CO's	**Statement**	**Bloom's Taxonomy**
To develop basic skills in the field of Electrical and Mechanical Engineering.		VA102.1	Students will be able to design domestic electric circuits and other basic circuits and function of different measuring instruments.	design
To make students familiar with different electrical, automobile, and plumbing instruments, setups, assembly, and tools.		VA102.2	Students will be able to understand the concept of battery charging/discharging systems and construction of machines, its starting, and fabrication of armature coil.	understand
To develop basic skills and understanding in 3-D printing technology		VA102.3	Students will be able to understand the functioning of different automobile parts and assemblies.	understand
		VA102.4	Students will be able to understand the functioning of different plumbing parts, tools, and assemblies.	understand
		VA102.5	Students will be able to understand the concepts of 3-D printing and its superiority over conventional manufacturing.	understand

COs	Mapping with Program Outcomes (POs)												Mapping with PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
VA102.1	3	3	3	2	1	3	3		1		1	1	3	3	2
VA102.2	3	3	3	2	1	1			1		1	1	3	3	3
VA102.3	3	3	2	3	3	3	3		1		1	1	3	3	3
VA102.4	3	3	3	3	3	2	1		1		1	1	3	3	3
VA102.1	3	3	3	2	1	3	3		1		1	1	3	3	2
VA102	**3**	**3**	**2.75**	**2.5**	**2**	**2.25**	**2.33**		**1**		**1**	**1**	**3**	**3**	**2.75**

SYLLABUS

No.	Content	Hours	COs
I	**Electrical Shop:** Study and design different types of electrical wiring with loads, Study the cut- section of different types of AC/DC machines, Design and fabricate an armature coil using a handy coil winding machine, Assembling different parts of the electrical machine and testing its operation, Charging and discharging circuit of Batteries, Familiarization with analog /digital universal IC tester and advanced digital measuring instruments, To study the measurement of earth resistance using an earth tester, Energy measurement using a smart energy meter, Measurement of insulation resistance of cable/machine using insulation tester/megger, Starting of machine using various starters.	**6**	**VA102.1 VA102.2**
II	**Automobile Shop:** Demonstration on the cut section of the single and multicylinder engine (diesel and petrol), anti-lock braking system, constructional view and internal details of common automobile parts, fuel supply system of petrol and diesel engine, and coil ignition and electrical ignition system of an automobile.	**5**	**VA102.3**
III	**Plumbing Shop:** Demonstration on full-scale sewerage system, assembly station pipes, valves and fittings, tools for plumbing (plumbing wrenches, drain tools, and tools and supports for PVC pipes), cut away models of straightway valve, corner valve, angle seat valve, nonreturn valve, pressure reducing valve, strainer, gate valve, straightway plug valve, three ways plug valve, safety valve, screwed pipe connections, changeover valve, nonreturn butterfly valve, and strainer.	**4**	**VA102.4**
IV	**Additive Manufacturing Lab:** Introduction to 3-d printing, additive v/s conventional manufacturing, Engineering graphics, coordinate systems and their transformation, CAD, product design and prototyping, solid modeling and slicing software, STL files, additive manufacturing techniques, FDM printing, printing materials, support materials.	**5**	**VA102.5**
V	**Prototyping:** Circuit designing based on Electrical Shop, prototyping of automobile parts, plumbing tools, and parts, 3-D printing, etc.	**8**	**All COs**
	Total Hours	**28**	

Essential Readings

1. R.P. Singh, 'Electrical Workshop, Dreamtech Press, 3rd Edition, 2019
2. S.L. Uppal, "Electrical Wiring Estimating and Costing", Khanna Publishers, 6th Edition, 2015
3. K. Singh, "Automobile Engineering", Standard Publishers, 2020.
4. U. Rathore, N. K. Sharma, "A Textbook of Electrical Workshop Practices", S.K. Kataria & Sons, 1st Edition 2019
5. C.K. Chua, K. F. Leong, "3D Printing and Rapid Prototyping- Principles and Applications", World Scientific, 2017.

Supplementary Readings

1. R.C. Mullin, P. Simmons, "Electrical Wiring Residential", Cengage Learning, 17th Edition, 2011.

Third Semester Courses

	National Institute of Technology Meghalaya An Institute of National Importance	**CURRICULUM**

Programme	**Bachelor of Technology in Electronics and Communication Engineering**	Year of Regulation	**2024-25**
Department	**Electronics and Communication Engineering**	Semester	**III**

Course Code	Course Name	Pre-Requisite	Credit Structure				Marks Distribution			
			L	T	P	C	INT	MID	END	Total
EC 201	**Semiconductor Devices**	-----	**3**	**0**	**0**	**3**	**50**	**50**	**100**	**200**

Course Objectives		Course Outcomes			
			CO's	**Statement**	**Bloom's Taxonomy**
	1. To understand the physical structure and electrical properties of semiconductor materials.		EC201.1	Understand the principles of semiconductor physics	Knowledge Comprehension
	2. To master the fundamental concepts and equations of semiconductor devices.		EC201.2	Understand the current-voltage characteristics and mathematical models of semiconductor junction diodes.	Knowledge Application
	3. To understand the terminal characteristics of junction diodes, bipolar transistors, and field-effect transistors.		EC201.2	Understand the current-voltage characteristics and mathematical models of bipolar junction transistors and field-effect transistors.	Knowledge Application

COs	Mapping with Program Outcomes (POs)												Mapping with PSOs			
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
EC201.1	**2**	**3**	**2**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**3**	**1**	**-**	**-**
EC201.2	**3**	**3**	**2**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**3**	**1**	**-**	**-**
EC201.2	**3**	**2**	**3**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**3**	**1**	**-**	**-**
EC201	**2.67**	**2.67**	**2.33**										**3**	**1**		

SYLLABUS

No.	Content	Hours	COs
I	***Semiconductor Physics:*** Introduction to Semiconductor Physics, Energy bands in intrinsic and extrinsic silicon; Carrier transport: diffusion current, drift current, mobility and resistivity, Generation and recombination of carriers; Poisson and continuity equation	**10**	**EC201.1**
II	**Semiconductor Junction Diodes:** P-N junction characteristics, I-V characteristics, and small signal switching models; Avalanche and Zener breakdown, Zener diode, Schottky diode, LED, photodiode and solar cell.	**10**	**EC201.2**
III	**Bipolar Junction Transistor (BJT):** Bipolar Junction Transistor and its type, I-V characteristics, configuration types, biasing type, BJT model like Ebers-Moll Model, and small signal model.	**11**	**EC201.3**
IV	**Field effect transistor (JFET) & Metal Oxide Semiconductor (MOS):** Junction Field effect Transistor and its type, MOSFET and its type, I-V characteristics of MOSFET, MOS capacitor, C-V characteristics, MOSFET, I-V characteristics, and small signal models of MOS transistor,	**11**	**EC201.3**
	Total Hours	**42**	

Essential Readings

1. G. Streetman and S. K. Banerjee, "Solid State Electronic Devices", Pearson, Seventh Edition, 2016.
2. D.A. Neamen, "Semiconductor Physics and Devices", Tata McGraw Hill Education, Fourth Edition, 2017
3. C.C. Hu, "Modern Semiconductor Devices for Integrated Circuits", Pearson, 2010.

Supplementary Readings

1. S. M. Sze and K. N. Kwok, "Physics of Semiconductor Devices", John Wiley & Sons, Third Edition, 2006.
2. C.T. Sah, "Fundamentals of solid state electronics," World Scientific Publishing Co. Inc, 1991.
3. Y. Tsividis and M. Colin, "Operation and Modeling of the MOS Transistor," Oxford Univ.Press, 2011..

	National Institute of Technology Meghalaya An Institute of National Importance	**CURRICULUM**

Programme	**Bachelor of Technology in Electronics and Communication Engineering**	Year of Regulation	**2024-25**
Department	**Electronics and Communication Engineering**	Semester	**III**

Course Code	Course Name	Pre-Requisite	Credit Structure				Marks Distribution			
			L	T	P	C	INT	MID	END	Total
EC 203	**Digital Logic Design**	-----	**3**	**0**	**0**	**3**	**50**	**50**	**100**	**200**

Course Objectives		Course Outcomes			
			CO's	**Statement**	**Bloom's Taxonomy**
	To understand the principles of Boolean logic and optimize the circuits.		EC203.1	Able to understand the basic concepts of Boolean algebra and optimization of circuits.	Knowledge Comprehension
	To understand the principles of combinational and Sequential Circuits.		EC203.2	To design combinational and sequential circuits.	Knowledge Application
	To develop the skills for modular Boolean, Arithmetic and Sequential circuits.		EC203.3	Able to predict and analyze the behavior of synchronous and asynchronous circuits.	Knowledge Application
	To develop the student ability to design circuits using EDA tools		EC203.4	To apply the CAD tools to realize digital circuits and behavior & to apply logic for sub-system design.	Knowledge Application

Cos	Mapping with Program Outcomes (Pos)												Mapping with PSOs			
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
EC203.1	**3**	**2**	**3**	**1**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**3**	**-**	**3**	**3**
EC203.2	**2**	**2**	**-**	**1**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**3**	**-**	**3**	**3**
EC203.3	**3**	**3**	**2**	**1**	**2**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**2**	**3**	**2**	**2**
EC203.4	**2**	**2**	**2**	**-**	**2**	**2**	**-**	**-**	**-**	**-**	**-**	**-**	**2**	**3**	**3**	**2**
EC203	**2.50**	**2.25**	**2.33**	**1**	**2**	**2**							**2.50**	**3**	**2.67**	**2.50**

SYLLABUS

No.	Content	Hours	Cos
I	**Number Systems and Codes:** Addition, Subtraction, Multiplication and Division using Different Number Systems; Representation of Binary Number in Sign-Magnitude, Sign 1's Complement and Sign 2's Complement Notation; Rules for Addition and Subtraction with Complement Representation; BCD, EBCDIC, ASCII, Extended ASCII, Gray and other Codes. **Boolean Algebra and Switching Functions:** Basic Logic Operation and Logic Gates, Truth Table, Basic Postulates and Fundamental Theorems of Boolean Algebra, Standard Representations of Logic Functions- SOP and POS Forms, Simplification of Switching Functions-K-Map and Quine-Mc- Cluskey Tabular Methods, Synthesis of Combinational Logic Circuits.	**06**	**EC203.1**
II	**Combinational Logic Circuits Using MSI Integrated Circuits** Binary Parallel Adder, BCD Adder, Encoder Priority Encoder, Decoder, Multiplexer and Demultiplexer Circuits, Implementation of Boolean Functions using Decoder and Multiplexer, Arithmetic and Logic Units, BCD-To-Segment Decoder, Common Anode and Common Cathode, 7-Segment Displays, Random Access Memory, Read Only Memory and Erasable Programmable ROMs, Programmable Logic Arrays(PLA) and Programmable Array Logic (PAL)	**07**	**EC203.1, EC203.2**
III	**Introduction to Flip-Flops:** Basic Concepts of Sequential Circuits, Cross Coupled SR Flip-Flop Using NAND or NOR Gates, JK Flip-Flop Rise Conditions, Clocked Flip-flops, D-Types and Toggle Flip-flops, Truth Tables and Excitation Tables for Flip-flop. Master Slave Configuration Edge Triggered and Level Triggered Flip-flop, Elimination of Switch Bounce using Flip-flop, Flip-flop with Pre-set and Clear.	**08**	**EC203.2, EC203.3**
IV	**Sequential Logic Circuit Design:** Introduction to State Machine, Mealy and Moore Model, State Machine Notation, State Diagram, State Table, Transition Table, Table Excitation, Table and Equation, Basic Concepts of Counters and Register, Binary Counters, BCD Counters, Up Down Counter, Johnson Counter, Module-N Counter, Design of Counter using State Diagrams and Tables, Sequence Generators, Shift Left and Right Register, Registers with Parallel Load, Serial -in-Parallel-Out(SIPO) and Parallel-In-Serial-Out(PISO), Register Using Different Types of Flip-flops Designing synchronous circuits like Pulse train generator, Pseudo Random Binary Sequence generator, Clock generation.	**09**	**EC203.3**
V	**VLSI Design flow:** Design entry: Schematic, FSM & HDL, different modelling styles in VHDL/Verilog, Data types and objects, Dataflow, Behavioural and Structural Modelling, Synthesis and Simulation VHDL/Verilog constructs and codes for combinational and sequential circuit.	**07**	**EC203.3, EC203.4**
VI	**Digital System Design:** Small digital system like: Frequency multiplier, divider; keyboard/keypad design; Random number generator	05	**EC203.4**
	Total Hours	**42**	

Essential Readings

1. Mano Morris, Digital Logic and Computer Design, Pearson Education, 14th ed. 2012.
2. Digital Circuits: Vol-I & II: Combinational Circuits and Sequential Circuits, Platinum Publishers; 2nd edition (1 January 2013)
3. A. Anand Kumar Fundamentals of Digital Circuits Prentice Hall India Learning, 4th ed. 2016.

Supplementary Readings

1. Brown S. and Zvonko Vranesic, Fundamental of Logic with Verilog Design, Tata McGraw Hill, 3rd Edition, 2013.
2. Kime Charies R and Morris Mano, Logic and Computer Design Fundamentals, Pearson Education, 4th Edition, 2013.
3. D.V. Hall, "Digital Circuits and Systems", Tata McGraw Hill, 1st ed., 1989.

4. Charles Roth, “Digital System Design using VHDL”, Tata McGraw Hill, 2nd edition, 2012.

	National Institute of Technology Meghalaya An Institute of National Importance	**CURRICULUM**

Programme	**Bachelor of Technology in Electronics and Communication Engineering**	Year of Regulation	**2024-25**
Department	**Electronics and Communication Engineering**	Semester	**III**

Course Code	Course Name	Pre-Requisite	Credit Structure				Marks Distribution			
			L	T	P	C	INT	MID	END	Total
EC 205	**Network Analysis and Synthesis**	-----	**3**	**0**	**0**	**3**	**50**	**50**	**100**	**200**

			CO's	**Statement**	**Bloom's Taxonomy**
Course Objectives	To understand the fundamentals of electrical circuits	Course Outcomes	EC205.1	Able to acquire the knowledge about the fundamentals of electrical circuits	Knowledge Comprehension
	To understand the concepts of network theorems and resonant circuits		EC205.2	Able to analyse and solve problems on network theorems and resonant circuits	Analysis Application
	To analyse the two port network and network topology		EC205.3	Able to analyse and solve problems on two port network and network topology	Analysis Application
	To understand the concepts of network synthesis and Laplace transformation		EC205.4	Able to analyse and solve problems on network synthesis and Laplace transformation	Analysis Application

COs	Mapping with Program Outcomes (POs)												Mapping with PSOs			
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
EC205.1	**3**	**2**	**2**	**2**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**3**	**2**	**1**	**-**
EC205.2	**3**	**2**	**2**	**2**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**3**	**2**	**1**	**-**
EC205.3	**3**	**2**	**2**	**2**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**3**	**2**	**1**	**-**
EC205.4	**3**	**2**	**2**	**2**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**3**	**2**	**1**	**-**
EC205	**3**	**2**	**2**	**2**									**3**	**2**	**1**	

SYLLABUS

No.	Content	Hours	COs
I	***Introduction to electrical circuits:*** Electrical Circuit and Network: Concept and Terminology, Classification of electrical networks, R-L-C Parameters, Voltage and current sources, Independent and dependent sources, Source transformation, Voltage-current relationship for passive elements, Kirchhoff's laws, Network reduction techniques-Series, Parallel, Series-parallel, Star to Delta transformation, Nodal and Mesh analysis. Concept of Self and Mutual inductance, Co-efficient of coupling, Dot convention and loop analysis.	**5**	**EC205.1, EC205.2**
II	**Network theorems:** Statement and proof: Superposition theorem, Thevenin's theorem, Norton's theorem, Maximum power transfer theorem, Millman's theorem, Reciprocity theorem, Tellegen's theorem under the dependent and independent sources for DC and AC excitation. **Resonance in AC circuits:** Characteristics and properties of resonance circuits, Series and parallel resonance circuits, Selectivity, Bandwidth and Quality factor.	**12**	**EC205.1, EC205.2**
III	**Two port networks:** Limitations Z, Y, ABCD, h-parameters, Conversion of one parameter to another parameter, Condition for reciprocity and symmetry, Two port network connections in series, parallel and cascaded. **Network topology:** Concept of Tree, Branch, Tree link, Incidence matrix, Tie-set matrix and Loop currents, Cut-set matrix and node pair potentials, Duality and Dual networks.	**8**	**EC205.3**
IV	**Network Synthesis:** Synthesis vs. analysis, Elements of circuit synthesis, LL FPB networks, Purpose and scope of network synthesis. **Positive Real Functions:** Definition, Necessary and sufficient conditions for a function to be positive real, Testing of driving point functions for positive realness. **FOSTER and CAUER Forms:** Foster and cauer forms of LC Networks, Synthesis of RC and RL networks.	**9**	**EC205.4**
V	**Laplace transform and Transient analysis:** Advantages of Laplace transform method, Definition and basic theorems of Laplace transform, Laplace transform of some basic functions and periodic functions, Inverse Laplace transform Transient response of R-L, R-C, R-L-C networks using Laplace transform method with DC and AC excitation. Response to step, Impulse and ramp inputs.	**8**	**EC205.4**
	Total Hours	**40**	

Essential Readings

1. Valkenberg, "Network Analysis", Prentice-Hall of India Pvt. Ltd, Revised 3rd Edition, 2019.
2. F. F. Kuo, "Network Analysis and Synthesis", John Wiley & Sons, 2nd Edition, 2006.
3. C. L. Wadhwa, "Network Analysis and Synthesis", New Age International Publishers, 2nd Edition, 2007.

Supplementary Readings

1. D. R. Choudhary, "Networks and Systems", New Age International, 2nd Edition, , 2013.
2. A. Chakrabarti, "Circuit Theory: Analysis and Synthesis", Dhanpat Rai & Co., 6th Edition, 2014.
3. D. E. Scott, "An Introduction to Circuit analysis: A System Approach", 1st Edition McGraw Hill, 1987.

	National Institute of Technology Meghalaya An Institute of National Importance	CURRICULUM
Programme	Bachelor of Technology in Electronics and Communication Engineering	Year of Regulation: 2024-25
Department	Electronics and Communication Engineering	Semester: III

Course Code	Course Name	Pre-Requisite	Credit Structure				Marks Distribution			
			L	T	P	C	INT	MID	END	Total
EC 207	Signals and Systems	-----	3	0	0	3	50	50	100	200

Course Objectives

- To familiarize elementary ideas of signals and systems classification and their properties for both continuous-time and discrete- time cases
- To analyze the continuous and discrete linear time invariant system using impulse response
- To represent the continuous and discrete signals in terms of Fourier series and transform
- To analyze the linear time invariant system using Fourier series and transform for both continuous-time and discrete- time
- To analyze and investigate stability and instability of a system using Laplace and Z-transforms.

Course Outcomes

CO's	Statement	Bloom's Taxonomy
EC207.1	Able to understand the classification of continuous time and discrete time signals and systems.	Knowledge Comprehension
EC207.2	Able to represent any general signals as a linear combination of impulses and characterization of any linear time invariant system using convolution sum and integral.	Knowledge Application
EC207.3	Able to analyze the spectral characteristics of signals using Fourier series and transform.	Analysis Application
EC207.4	Able to analyze continuous time/ discrete time signals and systems using Laplace transform and z transform.	Analysis Application

COs	Mapping with Program Outcomes (POs)												Mapping with PSOs			
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
EC207.1	2	2	2	1	1	-	-	-	-	-	-	-	2	-	1	-
EC207.2	2	2	2	1	-	-	-	-	-	-	-	-	2	-	2	-
EC207.3	2	2	2	2	2	-	-	-	-	-	-	2	2	2	2	-
EC207.4	2	2	2	2	2	-	-	-	-	-	-	2	2	2	2	-
EC207	**2**	**2**	**2**	**1.50**	**1.33**							**2**	**2**	**2**	**1.75**	

SYLLABUS

No.	Content	Hours	COs
I	**Signals and Systems:** Classification of Signals, Operation on Continuous Signals and Discrete Signals, Properties of Signals, Classification of Systems and Properties of Systems.	6	EC207.1
II	**Linear Time Invariant Systems:** Discrete-Time LTI system, Continuous- time LTI Systems, Convolution sum, Convolution of Finite Sequences, Properties of LTI systems, Correlation of signals.	6	EC207.2
III	**Fourier Series Representation of Periodic Signals:** Response of LTI systems to Complex Exponentials, Fourier series Representation of continuous time periodic Signals, properties of continuous time Fourier Series, Fourier Series representation of discrete time periodic signals, properties of Discrete Fourier Series, Fourier series and LTI Systems, Filtering.	8	EC207.3
IV	**Continuous Time Fourier Transform and Discrete Time Fourier Transform :** Representation of aperiodic Signals by continuous Fourier Transform, Fourier Transform of periodic signals, Properties of Fourier Transform, Fourier transform representation of aperiodic discrete time signals, Fourier Transform of periodic signals, Properties of Discrete Time Fourier Transform, Magnitude and phase representation of Fourier Transform, Magnitude and phase response of LTI systems.	8	EC207.3
V	**Laplace transform and Z-transforms:** Introduction of Laplace- transform, Properties of the Laplace transforms, Inversion of the Laplace transform, Analysis and characterization of Linear-Time-Invariant Systems using Laplace transforms. Introduction of Z-transforms, Region of convergence and its properties, Inverse Z-transform, properties of Z-transform, Analysis and characterization of LTI systems using Z-transform.	10	EC207.4
VI	**Applications:** Applications to analog communications, digital communications, digital signal processing and wireless communications.	4	EC207.1, EC207.2, EC207.3, EC207.4
	Total Hours	42	

Essential Readings

1. Oppenheim Alan V., Wilsky Alan S. and Nawab Hamid S., "Signals and Systems, Pearson Educations, 2nd edition, 1997

2. Prokis John G., "Digital Signal Processing: Principle, Algorithms, and Applications", Pearson Educations, 4th edition, 2007

Supplementary Readings
1. Lathi B. P., “Linear Systems and Signals”, Oxford University Press, 2nd edition, 2009

	National Institute of Technology Meghalaya An Institute of National Importance	CURRICULUM

Programme	**Bachelor of Technology in Electronics and Communication Engineering**	Year of Regulation	**2024-25**
Department	**Electronics and Communication Engineering**	Semester	**III**

Course Code	Course Name	Pre-Requisite	Credit Structure				Marks Distribution			
			L	T	P	C	INT	MID	END	Total
EC211	**Probability Theory and Stochastic Processes**	-----	**3**	**0**	**0**	**3**	**50**	**50**	**100**	**200**

Course Objectives		Course Outcomes			
			CO's	**Statement**	**Bloom's Taxonomy**
	To provide the fundamental concepts of probability theory to support graduate coursework		EC211.1	Able to understand the basic concepts of probability theory	Knowledge Comprehension
	To be familiar with some of the commonly encountered random variables, in particular, the Gaussian random variable		EC211.2	Able to characterize probability models and function of random variables based on single and multiple random variables.	Knowledge Application
	To explore the functions of random variables and operations on single/multiple random variables		EC211.3	Able to develop mathematical models for practical design with functions of random variables, joint distribution problems, evaluate and apply moments & characteristic functions and central limit theorem	Knowledge Application
	To understand the classifications of random processes concepts such as strict stationarity and wide-sense stationarity, ergodicity, power spectral density, and the propagation of random signals in LTI systems		EC211.4	Able to understand the concept of random processes and determine covariance and spectral density of stationary random processes.	Knowledge Application

COs	Mapping with Program Outcomes (POs)												Mapping with PSOs			
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
EC211.1	**3**	**2**	**2**	**1**	**-**	**-**	**-**	**-**	**2**	**-**	**-**	**-**	**3**	**2**	**3**	**-**
EC211.2	**2**	**3**	**2**	**2**	**-**	**-**	**-**	**-**	**2**	**-**	**-**	**-**	**3**	**-**	**2**	**-**
EC211.3	**1**	**2**	**2**	**2**	**2**	**-**	**-**	**-**	**-**	**-**	**-**	**1**	**2**	**3**	**3**	**-**
EC211.4	**-**	**3**	**1**	**-**	**-**	**-**	**-**	**-**	**1**	**-**	**-**	**-**	**2**	**3**	**2**	**-**
EC211	**2**	**2.50**	**1.75**	**1.67**	**2**				**1.67**			**1**	**2.50**	**2.67**	**2.50**	

SYLLABUS

No.	Content	Hours	COs
I	**Basics of Probability:** probability through sets, axioms of probability, probability space, joint and conditional probability, total probability, Bayes theorem **Application:** Bayes theorem application to digital communication.	**06**	EC211.1
II	**The concept of a Random Variable:** discrete random variables, probability mass function, cumulative distribution function, example random variables and distributions (Bernoulli, Binomial, Poisson distributions, Negative binomial distributions, etc.,); continuous random variables, probability density function, cumulative distribution function, example distributions (uniform, exponential, chi-square, Rayleigh, Nakagami-m, Normal distributions, etc.,) **Application:** Random variable application to wireless communication.	**10**	EC211.2
III	**Functions of a random variable(s):** one function of one random variable: expectation, variance, moments, characteristic functions, transformations of a random variable, problems; One function of two random variables: joint distributions, Marginal distribution, joint moments, joint characteristic functions, conditional distributions, conditional expected values, transformations of multiple random variables, Markov, Chebyshev, and Chernoff bounds, central limit theorem (CLT) **Application:** change of variable/CLT application to wireless communication	**12**	EC211.3
IV	**Stochastic Processes:** Random process, stationary processes, auto-correlation function, and its properties, mean and covariance functions, power spectral density, and its properties, cross-correlation function and its properties, ergodicity, linear systems with random inputs, transmission of random process through linear-time invariant systems, power spectral density of the response. **Application:** noise random process application to communication systems	**12**	EC211.4
	Total Hours	**40**	

Essential Readings

1. H. Stark and J. Woods, ``Probability and Random Processes with Applications to Signal Processing," Third Edition, Pearson Education, 2001.

2. A. Papoulis and S. Unnikrishnan Pillai, ``Probability, Random Variables and Stochastic Processes,'' Fourth Edition, McGraw Hill, 2017.
3. P.Z. Peebles, “PROBABILITY, RANDOM VARIABLES AND RANDOM SIGNAL PRINCIPLES”, Tata McGraw Hill Education, 4th edition, 2017.

Supplementary Readings

1. P. G. Hoel, S. C. Port and C. J. Stone, Introduction to ProbabilityThoery, Houghtion Mifflin; 1st Edition, 1972
2. P. G. Hoel, S. C. Port and C. J. Stone, Introduction to Stochastic Processes, Waveland PrInc Publishers, 1986
3. S. M. Ross, Introduction to Probability Models, Harcourt Asia, Academic Press, 10th Edition, 2010.

	National Institute of Technology Meghalaya An Institute of National Importance	**CURRICULUM**

Programme	**Bachelor of Technology in Electronics and Communication Engineering**	Year of Regulation	**2024-25**
Department	**Electronics and Communication Engineering**	Semester	**III**

Course Code	Course Name	Pre-Requisite	Credit Structure				Marks Distribution			
			L	T	P	C	INT	MID	END	Total
EC213	**Data Structure and Algorithms**	**-----**	**3**	**0**	**0**	**3**	**50**	**50**	**100**	**200**

		CO's	**Statement**	**Bloom's Taxonomy**
Course Objectives	To understand the fundamental concept of data structures and algorithms.	Course Outcomes: EC213.1	Students shall be able to understand of basic concepts of dynamic memory management, data types, algorithms, asymptotic notation and basic data structures.	Knowledge Comprehension
	To develop skill for choosing data structures for different applications.	EC213.2	Students shall be able to find the bugs in programs with data structures, formulate new solutions and improve in existing code using learned algorithms and data structures	Knowledge Application
	To develop skill for designing, analyzing, correctness and implementing algorithms using various data structures.	EC213.3	Students shall be able design of algorithm for representing and implementing nonlinear data structure such as Tree, Graph in real world applications	Knowledge Application
	To implement hashing, linear and nonlinear data structures for real word application as per requirements.	EC213.4	Students shall be able to apply important algorithmic design paradigms and methods of analysis.	Knowledge Application

COs	Mapping with Program Outcomes (POs)												Mapping with PSOs			
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
EC213.1	2	3	-	3	-	-	-	-	-	-	-	-	2	-	2	-
EC213.2	3	2	-	3	-	-	-	-	-	-	-	-	2	2	2	-
EC213.3	3	3	2	-	-	-	-	-	-	-	-	-	2	3	2	-
EC213.4	2	1	-	-	-	-	-	-	-	-	-	-	3	2	2	-
EC213	2.50	2.25	2	3									2.25	2.33	2	

SYLLABUS

No.	Content	Hours	COs
I	**Introduction & Overview:** Concept of data type, definition and brief description of various data structures, operations on data structures, algorithm complexity, Big Oh notation, recursion, some illustrative examples of recursive functions. **Review of Pointers and Dynamic Memory Management:** Understanding pointers, usage of pointers, memory management functions. **Arrays:** Linear and multi-dimensional arrays and their representation, operations on arrays, sparse matrices and their storage	**10**	**EC213.1**
II	**Linked Lists:** Linear linked list, operations on linear linked list, doubly linked list, operations on doubly linked list, application of linked lists. **Stacks:** Sequential and linked representations, operations on stacks, multi stacks, application of stacks such as parenthesis checker, evaluation of postfix expressions, conversion from infix to postfix representation, implementing recursive functions. **Queues:** Sequential representation of queue, linear queue, circular queue, operations on linear and circular queue, linked representation of a queue and operations on it, priority queues, applications of queues.	**11**	**EC213.2**
III	**Sorting & Searching:** Sorting arrays using bubble sort, selection sort, insertion sort, quick sort, merge sort, heap sort, shell sort, tree sort, radix sort, etc., **Heaps:** Representing a heap in memory, operations on heaps. **Trees:** Basic terminology, array and linked representations of trees, traversing a binary tree using recursive and no recursive procedures, inserting a new node, deleting a node, counting nodes, finding height, finding a mirror image of a binary tree. **Graphs:** Basic terminology, representation of graphs (adjacency matrix, adjacency list), traversal of a graph (breadth first search and depth-first search), adding nodes, deleting nodes, applications of graphs in problems such as finding shortest paths, obtaining minimum cost spanning tree, etc. **Hashing:** Comparing direct address tables with hash tables, hash functions, concept of collision and its resolution using open addressing and separate chaining, double hashing, rehashing	**11**	**EC213.3**
IV	Algorithm Specification, Algorithm Analysis, Analysis of Recursive Algorithms, Greedy Algorithms, String searching and Pattern matching, Knuth-Morris-Pratt algorithm and its analysis, Computational Complexity Classes	**10**	**EC213.4**
	Total Hours	**42**	

Essential Readings

1. Mark Allen Weiss, "Data Structures and Algorithm Analysis In C", 2nd Edition, Pearson Education, 2002.
2. Seymour Lipschutz, "Data Structures", Revised 1st Edition, Tata McGraw hill Publication, 2013

3. D.S. Kushwaha, Dr. Arun Kumar Mishra, “A Programming approach with C “, 2nd Edition, PHI India, 2014.
4. A. Aho, J. Hopcroft and J. Ullman, “The Design and Analysis of Computer Algorithms”, 4th Impression, Addison-Wesley, 2009.

Supplementary Readings

1. H Bashin, “Algorithms Design and Analysis”, 1st Edition, Oxford University Press, 2015.
2. Steven S Skiena, “The Algorithm Design Manual”, 2nd Edition, Springer, 2011.
3. A.K. Sharma,” Data Structures using C”, Pearson, 2011.
4. NPTEL Video lectures on Data Structure and Algorithms: https://nptel.ac.in/courses/106102064

	National Institute of Technology Meghalaya An Institute of National Importance	**CURRICULUM**

Programme	**Bachelor of Technology in Electronics and Communication Engineering**	Year of Regulation	**2024-25**
Department	**Electronics and Communication Engineering**	Semester	**III**

Course Code	Course Name	Pre-Requisite	Credit Structure				Marks Distribution			
			L	T	P	C	INT	MID	END	Total
EC 271	**Computer Architecture**	**-----**	**2**	**0**	**0**	**2**	**50**	**50**	**100**	**200**

Course Objectives		Course Outcomes	CO's	Statement	Bloom's Taxonomy
	To describe computer architecture concepts and mechanisms related to the design of modern processors, memories.		EC271.1	Ability to understand the basic structure of computer.	Knowledge Comprehension
	To apply this understanding to new computer architecture design problems within the context of balancing application requirements against technology constraints.		EC271.2	Ability to understand control unit operations.	Knowledge Comprehension
	To evaluate various design alternatives and make a compelling quantitative and/or qualitative argument for why one design is superior to the other approaches.		EC271.3	Ability to perform computer arithmetic operations.	Knowledge Application
			EC271.4	Ability to understand the concept of cache mapping techniques.	Knowledge Comprehension

COs	Mapping with Program Outcomes (POs)												Mapping with PSOs			
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
EC271.1	**2**	**3**	**3**	**3**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**2**	**-**	**3**	**-**
EC271.2	**2**	**3**	**2**	**2**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**3**	**-**	**3**	**-**
EC271.3	**2**	**3**	**3**	**2**	**2**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**1**	**3**	**1**	**-**
EC271.4	**2**	**3**	**2**	**2**	**2**	**2**	**-**	**-**	**-**	**-**	**-**	**-**	**2**	**2**	**-**	**-**
EC271	**2**	**3**	**2.5**	**2.25**	**2**	**2**							**2.25**	**2.5**	**2.33**	

SYLLABUS

No.	Content	Hours	COs
I	**Fundamental Processors:** Instruction set architecture; single-cycle, FSM, and pipelined processor microarchitecture; resolving structural, data, control, and name hazards; and analyzing processor performance.	**04**	**EC271.1**
II	**Processor Organization:** Instruction set architecture- types, formats, addressing modes; Register set; Assembly language programming. Data path organization, Control unit design - Hardwired control, Microprogramming. CISC and RISC architecture, Instruction pipelining.	**06**	**EC271.2**
III	**Arithmetic and Logic unit:** Computer arithmetic- Review of addition and subtraction; Multiplication- Booth's, Array; Division- Restoring and non-restoring; Floating-point arithmetic.	**06**	**EC271.2,EC271.3**
IV	**Fundamental Memories:** Memory technology; direct-mapped vs. associative caches; write- through vs write-back caches; memory protection, translation, and virtualization; FSM and pipelined cache microarchitecture; analyzing memory performance; and integrating processors and memories.	**06**	**EC271.4**
V	**Advanced Memories:** Advanced cache microarchitecture; memory synchronization, consistency, and coherence.	**06**	**EC271.3, EC271.4**
	Total Hours	**28**	

Essential Readings

1. Hamacher, Vranesic, and Zaky, "Computer Organization", McGraw Hill, 5th ed, 2002.
2. Mano M.M., "Computer System Architecture", PHI (EEE), 3rd ed, 2016.

Supplementary Readings

1. William Stallings, "Computer Organization and Architecture", PHI 8th ed, 2010.

	National Institute of Technology Meghalaya An Institute of National Importance	**CURRICULUM**

Programme	**Bachelor of Technology in Electronics and Communication Engineering**	Year of Regulation	**2024-25**
Department	**Electronics and Communication Engineering**	Semester	**III**

Course Code	Course Name	Pre-Requisite	Credit Structure				Marks Distribution		
			L	T	P	C	CONTINUOS EVALUATION	VIVA	Total
EC 291	**PCB Fabrication**	-----	**0**	**1**	**2**	**2**	**70**	**30**	**100**

			CO's	Statement	Bloom's Taxonomy
Course Objectives	To introduce the fundamental concepts of Printed Circuit Board (PCB) design and fabrication.	Course Outcomes	EC291.1	**Understand** the basic concepts and principles of PCB design and fabrication (Knowledge, Remembering).	Knowledge Comprehension
	To provide hands-on experience in designing, developing, and testing PCBs.		EC291.2	**Apply** the techniques and tools used in PCB layout and manufacturing (Application, Applying).	Knowledge Application
	To understand the materials, tools, and techniques used in PCB fabrication.		EC291.3	**Analyze** PCB fabrication's design requirements and constraints (Analysis, Analyzing).	Knowledge Analysis
	To equip students with the skills required to produce reliable and functional PCBs for electronic applications.		EC291.4	**Design** and develop PCBs using appropriate software and hardware tools (Synthesis, Creating).	Synthesis
	To familiarize students with industry standards and safety practices in PCB fabrication.		EC291.5	**Evaluate and Demonstrate** the performance of fabricated PCBs by using PCB fabrication equipment(Evaluation, Evaluating, Skills, Applying).	Evaluation

COs	Mapping with Program Outcomes (POs)												Mapping with PSOs			
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
EC291.1	**3**	**2**	**3**	**1**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**3**	**-**	**-**	**-**
EC291.2	**2**	**2**	**-**	**1**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**3**	**-**	**-**	**-**
EC291.3	**3**	**3**	**2**	**1**	**2**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**2**	**3**	**-**	**-**
EC291.4	**2**	**2**	**2**	**-**	**2**	**2**	**-**	**-**	**-**	**-**	**-**	**-**	**2**	**3**	**-**	**-**
EC291.5	**2**	**2**	**2**	**1**	**1**	**1**	**-**	**-**	**-**	**-**	**-**	**-**	**3**	**2**	**-**	**-**
EC291	**2.4**	**2.2**	**2.25**	**1**	**1.67**	**1.5**							**2.2**	**2.67**		

SYLLABUS

No.	Content	Hours	COs
1	Introduction to PCB Design and Fabrication: History and evolution of PCBs, Types of PCBs (single-sided, double-sided, multi-layer), Applications of PCBs.	1	EC291.1
2	PCB Materials and Components: Substrate materials (FR-4, CEM-3, etc.), Conductive materials (copper foils), Components and their placement.	2	EC291.1, EC291.2
3	PCB Design Process: Schematic capture, PCB layout design, Design rules and guidelines, Introduction to PCB design software (e.g., Eagle, Altium Designer).	7	EC291.2, EC291.4
4	PCB Fabrication Techniques: Photoengraving, Silk screen printing, Mechanical etching, Additive and subtractive processes..	**2**	EC291.2, EC291.3
5	Hands-on PCB Design and Fabrication: Designing a simple PCB project, Hands-on experience with PCB design software, Fabrication process including etching, drilling, and soldering.	**10**	EC291.4, EC291.5
6	PCB Testing and Quality Control: Electrical testing methods, Visual inspection, Common defects and troubleshooting, Reliability and durability testing.	**2**	EC291.3, EC291.5
7	Advanced PCB Technologies: High-density interconnect (HDI) PCBs, Flexible PCBs, Rigid-flex PCBs, Future trends in PCB technology.	**2**	EC291.1, EC291.5
8	Industry Standards and Safety Practices: IPC standards, Environmental and safety regulations, Best practices in PCB fabrication.	**2**	EC291.1, EC291.5
	Total Hours	**28**	

Essential Readings

1. Khandpur, Raghbir Singh. "Printed Circuit Boards Design, Fabrication, and Assembly." (2006).
2. Archambeault, Bruce R., and James Drewniak. *PCB design for real-world EMI control*. Vol. 696. Springer Science & Business Media, 2013.
3. Brooks, Douglas. *Signal integrity issues and printed circuit board design*. Prentice Hall Professional, 2003.

Supplementary Readings

1. Johnson, Howard, and Martin Graham. "A handbook of Black Magic." (1993).

2. Russell, G. A., and B. von Turkovich. "Design for manufacturability of printed circuit board assemblies." *CIRP annals* 34.1 (1985): 37-40.
3. Standards - IPC Standards (e.g., IPC-2221, IPC-6012)
4. Software manuals : Eagle PCB Design Software Tutorial and Altium Designer User Manual

	National Institute of Technology Meghalaya An Institute of National Importance	CURRICULUM

Programme	**Bachelor of Technology in Electronics and Communication Engineering**	Year of Regulation	**2024-25**
Department	**Electronics and Communication Engineering**	Semester	**III**

Course Code	Course Name	Pre-Requisite	Credit Structure				Marks Distribution		
			L	T	P	C	CONTINUOS EVALUATION	VIVA	Total
EC 253	**Digital Logic Design Laboratory**	**-----**	**0**	**1**	**2**	**2**	**70**	**30**	**100**

Course Objectives		Course Outcomes	**CO's**	**Statement**	**Bloom's Taxonomy**
	To understand the principles of Boolean logic and optimize the circuits.		CO1	Able to understand the basic concepts of Boolean algebra and optimization of circuits.	Knowledge Comprehension
	To develop the skills for modular Boolean, Arithmetic and Sequential circuits.		CO2	To design combinational and sequential circuits.	Knowledge Application
	To develop the student ability to design circuits using EDA tools		CO3	Able to predict and analyse the behaviour of synchronous and asynchronous circuits.	Knowledge Analysis

COs	Mapping with Program Outcomes (POs)												Mapping with PSOs			
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
EC253.1	**3**	**2**	**3**	**1**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**3**	**-**	**-**	**-**
EC253.2	**2**	**2**	**-**	**1**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**3**	**-**	**-**	**-**
EC253.3	**3**	**3**	**2**	**1**	**2**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**2**	**3**	**-**	**-**
EC253	**2.67**	**2.33**	**1.5**	**1**	**2**	**2**							**2.67**	**3**		

SYLLABUS

No.	Content	Hours	COs
1	Implement half-adder/ half-subtractor circuits using a serial input.	**28**	EC253.1**,** EC253.2**,** EC253.3
2	Implement full-adder/ full-subtractor Circuits using a serial input.		
3	Perform 4-Bit Gray to Binary/ Binary to Gray code conversion using select input.		
4	Perform and implement logic expression/sub-modules with the help of **MUX ICs**.		
5	Perform and implement logic expression/sub-modules with the help of Decoder ICs		
6	Implement the flip-flops using NAND/ NOR gate.		
7	Implement Excess-3 BCD adder/subtractor with select input.		
8	Implement modulo ripple counters.		
9	Implement 4-bit shift left/right register.		
10	Implement the sequence generator, frequency multiplier and divider.		
11	Verify the behavior of logic circuits and sequential circuits using EDA tools.		
12	Design of a small digital Sub-system		
	Total Hours	**28**	

Essential Readings

1. Mano Morris, Digital Logic and Computer Design, Pearson Education, 14th ed. 2012.
2. Digital Circuits: Vol-I & II: Combinational Circuits and Sequential Circuits, Platinum Publishers; 2nd edition (1 January 2013)
3. A. Anand Kumar Fundamentals of Digital Circuits Prentice Hall India Learning, 4th ed. 2016.

Supplementary Readings

1. Brown S. and Zvonko Vranesic, Fundamental of Logic with Verilog Design, Tata McGraw Hill, 3rd Edition, 2013.
2. Kime Charies R and Morris Mano, Logic and Computer Design Fundamentals, Pearson Education, 4th Edition, 2013.
3. D.V. Hall, "Digital Circuits and Systems", Tata McGraw Hill, 1st ed., 1989.
4. Charles Roth, "Digital System Design using VHDL", Tata McGraw Hill, 2nd edition, 2012.

	National Institute of Technology Meghalaya An Institute of National Importance	CURRICULUM

Programme	**Bachelor of Technology in Electronics and Communication Engineering**	Year of Regulation	**2024-25**
Department	**Electronics and Communication Engineering**	Semester	**III**

Course Code	Course Name	Pre-Requisite	Credit Structure				Marks Distribution		
			L	T	P	C	CONTINUOS EVALUATION	VIVA	Total
EC 255	**Network Analysis and Synthesis Laboratory**	**-----**	**0**	**0**	**2**	**1**	**70**	**30**	**100**

Course Objectives	To understand the fundamentals of electrical circuits	Course Outcomes	**CO's**	**Statement** / **Bloom's Taxonomy**
	To understand the concepts of transient response of RLC circuits		EC255.1	Will develop understanding on electrical circuits — Knowledge Comprehension
	To understand the two port network and network topology		EC255.2	Will develop understanding on of transient response of RLC circuits — Knowledge Application
	To understand network synthesis		EC255.3	Will develop understanding on two port network — Knowledge Application
			EC255.4	Will develop understanding on network synthesis — Knowledge Application

COs	Mapping with Program Outcomes (POs)												Mapping with PSOs			
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
EC255.1	**3**	**3**	**2**	**1**	**3**	-	-	-	-	-	-	-	**3**	**2**	**1**	-
EC255.2	**3**	**3**	**2**	**1**	**3**	-	-	-	-	-	-	-	**3**	**2**	**1**	-
EC255.3	**3**	**3**	**2**	**1**	**3**	-	-	-	-	-	-	-	**3**	**2**	**1**	-
EC255.4	**3**	**3**	**2**	**1**	**3**	-	-	-	-	-	-	-	**3**	**2**	**1**	-
EC255	**3**	**3**	**2**	**1**	**3**								**3**	**2**	**1**	

SYLLABUS

No.	Content	Hours	COs
I	Verify principle of Superposition theorem with dc and ac sources.	**28**	**EC255.1**
II	Verify Thevenin and Norton theorems in ac circuits.		
III	Verify Maximum Power Transfer theorem in ac circuits.		
IV	Verify Reciprocity and Tellegen's theorems.		
V	Verify resonance phenomenon in RLC series circuit.		**EC255.2**
VI	Verify resonance phenomenon in RLC parallel circuit.		
VII	Determination of self-inductance, mutual inductance and coupling co-efficient of a single-phase two winding transformer representing a coupled circuit.		**EC255.3**
VIII	Observe the transient response of current in RL and RC circuits with step voltage input.		
IX	Observe the transient response of current in RLC circuits with step voltage input for under-damp, critically damp and over-damp cases.		**EC255.4**
X	Determination of z and h parameters (dc only) for a network and computation of Y and ABCD parameters.		
XI	Study LC network synthesis.		
	Total Hours	**28**	

Essential Readings

1. V. Valkenberg, "Network Analysis", Prentice-Hall of India Pvt. Ltd, Revised 3rd Edition, 2019.
2. F. F. Kuo, "Network Analysis and Synthesis", John Wiley & Sons, 2nd Edition, 2006.
3. C. L. Wadhwa, "Network Analysis and Synthesis", New Age International Publishers, 2nd Edition, 2007.

Supplementary Readings

1. D. R. Choudhary, "Networks and Systems", New Age International, 2nd Edition,, 2013.
2. A. Chakrabarti, "Circuit Theory: Analysis and Synthesis", Dhanpat Rai & Co., 6th Edition, 2014.
3. D. E. Scott, "An Introduction to Circuit analysis: A System Approach", 1st Edition McGraw Hill, 1987.

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Programme	Bachelor of Technology in Electronics and Communication Engineering	Year of Regulation	**2024-25**
Department	Electronics and Communication Engineering	Semester	**III**

Course Code	Course Name	Pre-Requisite	Credit Structure				Marks Distribution		
			L	T	P	C	CONTINUOUS EVALUATION	VIVA	Total
EC 257	**Signals and Systems Laboratory**	**-----**	**0**	**0**	**2**	**1**	**70**	**30**	**100**

			CO's	**Statement**	**Bloom's Taxonomy**
Course Objectives	To develop the student's ability to analyze signals and systems	Course Outcomes	EC257.1	Able to analyze the signals using simulation tools	Knowledge Analysis
			EC257.2	Able to apply the signal analysis techniques to real time applications	Knowledge Analysis

COs	Mapping with Program Outcomes (POs)												Mapping with PSOs			
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
EC257.1	**3**	**3**	**1**	**-**	**-**	**1**	**-**	**-**	**-**	**-**	**-**	**2**	**3**	**-**	**2**	**-**
EC257.2	**2**	**2**	**2**	**2**	**1**	**-**	**-**	**-**	**-**	**-**	**-**	**1**	**-**	**2**	**2**	**-**
EC257	**2.5**	**2.5**	**1.5**	**2**	**1**	**1**						**1.5**	**3**	**2**	**2**	

SYLLABUS

Sl No.	List of Experiments	Hours	COs
1	Generate continuous/discrete time signals and perform various signal operations.	26	EC257.1, EC257.2
2	Implement convolution and correlation on discrete time signals		
3	Implement convolution and correlation on continuous time signals		
4	Analyze the continuous signals in the frequency domain using Fourier transform.		
5	Analyze the discrete signals in frequency domain Fourier transform.		
6	Analyze the continuous time signals and systems using Laplace transform.		
7	Analyze the discrete time signals and systems using z transform.		

Reference Books

1. Oppenheim Alan V., Wilsky Alan S. and Nawab Hamid S., "Signals and Systems, Pearson Educations, 2nd edition, 1997.
2. Prokis John G., "Digital Signal Processing: Principle, Algorithms, and Applications", Pearson Educations, 4th edition, 2007
3. Lathi B. P., "Linear Systems And Signals", Oxford University Press, 2nd edition, 2009.

Fourth Semester Courses

	National Institute of Technology Meghalaya An Institute of National Importance	**CURRICULUM**

Programme	**Bachelor of Technology in Electronics and Communication Engineering**	Year of Regulation	**2024-25**
Department	**Electronics and Communication Engineering**	Semester	**IV**

Course Code	Course Name	Pre-Requisite	Credit Structure				Marks Distribution			
			L	T	P	C	INT	MID	END	Total
EC 200	**Electronic Circuits**	-----	**3**	**0**	**0**	**3**	**50**	**50**	**100**	**200**

Course Objectives	To understand the fundamental concepts of semiconductor devices	Course Outcomes	**CO's**	**Statement** / **Bloom's Taxonomy**
	To understand the terminal characteristics of diodes, bipolar junction transistors, and field-effect transistors.		EC200.1	Understand the basic operation, current voltage characteristics and small signal models of semiconductor devices — Knowledge Comprehension
	To understand the small signal models of diodes and transistors.		EC200.2	Design and analyze electronic circuits consisting of diodes and transistors — Application Analysis
	Design and analyze electronic circuits consisting of diodes and transistors.		EC200.3	Draw the input and output waveforms and frequency response characteristics of various diode and transistors based electronic circuits — Knowledge Application
	To analyze the input and output waveforms, and the frequency response of various electronic circuits.			

COs	Mapping with Program Outcomes (POs)												Mapping with PSOs			
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
EC200.1	**2**	**2**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**2**	**2**	**1**	**-**	**-**
EC200.2	**2**	**2**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**2**	**2**	**1**	**-**	**-**
EC200.3	**2**	**2**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**2**	**2**	**1**	**-**	**-**
EC200	**2**	**2**										**2**	**2**	**1**		

SYLLABUS

No.	Content	Hours	COs
I	Review of basics of Semiconductors, Energy Levels, Extrinsic and Intrinsic semiconductors, Semiconductor Diode, Resistance Levels, Diode Equivalent Circuits, Transition and Diffusion Capacitance, Reverse Recovery Time, Load-Line Analysis	**10**	**EC200.1**
II	Bipolar Junction Transistors, Construction and Operation, Common-Base, Common-Emitter, Common-Collector Configuration, Transistor Amplifying Action, Limits Of Operation, DC Biasing of BJT, Operating Point, Fixed-Bias Circuit, Emitter-Stabilized Bias Circuit, Voltage-Divider Bias, DC Bias with Voltage Feedback, Thermal Stability	**10**	**EC200.1, EC200.2, EC200.3**
III	BJT Transistor Modeling, Small Signal Parameters Zi, Zo, Av, Ai, The re Transistor Model, Hybrid Equivalent Model, Graphical Determination of h-Parameters, BJT Small-Signal Analysis, Common-Emitter with Fixed-Bias, Voltage-Divider Bias and Emitter-Bias Configuration, Emitter-Follower Configuration, Common-Base Configuration, Effect of a Load and Source Impedance, Low and High Frequency Response of BJT Amplifier, Multistage Amplifier using BJT and other configurations	**11**	**EC200.1, EC200.2, EC200.3**
IV	Field-Effect Transistors, Construction And Characteristics Of JFETS, Transfer Characteristics, Depletion and Enhancement-Type MOSFET, JFET Biasing, Fixed-Bias Configuration, Self-Bias Configuration, Voltage-Divider Biasing, JFET Small-Signal Analysis, Small-Signal Model, JFET Common Source Configuration, Source-Follower (Common-Drain) Configuration, Common-Gate Configuration, Effect of a Load and Source Impedance, Low and High Frequency Response of JFET Amplifier, Multistage Amplifier using JFET and other configurations	**11**	**EC200.1, EC200.2, EC200.3**
Total Hours		**42**	

Essential Readings

1. R.L. Boylestad and L. Nashelsky, "Electronic Devices And Circuit Theory", Prentice Hall, Eleventh Edition, 2015.
2. D.A. Bell ,"Electronic Devices and Circuits", Prentice Hall of India, 5th Edition, 2004

Supplementary Readings

1. A.S. Sedra and K.C. Smith, "Microelectronic Circuits", Oxford, Seventh Edition, 2017.
2. D.A.Neaman, "Microelectronics: Circuit Analysis and Design", McGraw Hill, Fourth Edition, 2010.

	National Institute of Technology Meghalaya An Institute of National Importance	**CURRICULUM**

Programme	**Bachelor of Technology in Electronics and Communication Engineering**	Year of Regulation	**2024-25**
Department	**Electronics and Communication Engineering**	Semester	**IV**

Course Code	Course Name	Pre-Requisite	Credit Structure				Marks Distribution			
			L	T	P	C	INT	MID	END	Total
EC202	**Electromagnetic Theory**	-----	**3**	**0**	**0**	**3**	**50**	**50**	**100**	**200**

		CO's	**Statement**	**Bloom's Taxonomy**
Course Objectives	To introduce the principle of Electrostatic and Magnetostatic field as well as the significance of Maxwell's equations	Course Outcomes: EC202.1	Able to acquire knowledge about the static fields and the significance of Maxwell's equations.	Knowledge Synthesis
	To understand the concept of electromagnetic wave propagation and develop their conceptual idea	EC202.2	Able to gather knowledge about electromagnetic wave propagation	Knowledge Comprehension
	To understand and analyze the fundamental concept of radiation	EC202.3	Able to understand the mechanism of field radiation and its application	Knowledge Comprehension
	To introduce the fundamental concepts of transmission lines and its application as an antenna	EC202.4	Able to acquire the fundamental concepts of the transmission line and antenna with their applications	Knowledge Application

COs	Mapping with Program Outcomes (POs)												Mapping with PSOs			
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
EC202.1	3	3	2	2	1	-	-	-	-	-	-	1	3	2	2	-
EC202.2	3	3	2	2	1	-	-	-	-	-	-	1	3	2	2	-
EC202.3	3	3	2	2	1	-	-	-	-	-	-	1	3	2	2	-
EC202.4	3	3	2	2	1	-	-	-	-	-	-	1	2	3	3	-
EC202	**3**	**3**	**2**	**2**	**1**							**1**	**2.75**	**2.25**	**2.25**	

SYLLABUS

No.	Content	Hours	COs
I	**Static Field:** Divergence Theorem, Poisson's and Laplace's equation in various co-ordinate systems, solution of single dimensional Laplace equation, Conditions at a boundary between dielectrics, Cylindrical and spherical geometries, Ampere's law, Magnetic vector Potential, Magnetic scalar Potential.	**10**	**EC202.1**
II	**Maxwell's Equations & Electromagnetic Waves:** The Equation of Continuity For Time-Varying Fields, Inconsistency Of Ampere's Law, Maxwell's Equation, Condition at a Boundary Surface, Solution For Free-Space Conditions, Uniform Plane Waves & Propagation, The Wave Equations For A Conducting Medium.	**10**	**EC202.2**
III	**Radiation:** Potential Functions And Electromagnetic Field, Power Radiated By Current Element, Application To Short Antennas, Radiation From Dipole.	**10**	**EC202.3**
IV	**Transmission Line:** Need For Transmission Line, Examples Of Transmission Lines, Equivalent Circuit Representation, General Transmission Line Equation, Transmission Line Input Impedance. **Antenna:** Directional Properties Of Dipole Antennas, Two Element Array, Antenna Parameters.	**14**	**EC202.4**
	Total Hours	**42**	

Essential Readings

1. Matthew N.O. Sadiku, "Elements of Electromagnetics", Oxford, 6th Edition, 2020.
2. J. Buck and W.H. Hayt, "Engineering Electromagnetic", Tata McGraw-Hill,9th Edition, 2020.

Supplementary Readings

1. F. J. Milford, J.R. Reitz and R.W. Christy, "Foundations of Electromagnetic Theory", Addison-Wesley Pub., 4th Edition, 2014.
2. E. C. Jordan and Balmain K. G., "Electromagnetic Waves and Radiating Systems", Prentice Hall, 2nd Edition, 2015.
3. J. D. Kraus, R.J. Marhefka and A. S. Khan, "Antennas and Wave Propagation", Tata McGraw-Hill, 5th Edition,2017
4. NPTEL Video lectures on Electromagnetic Theory: https://onlinecourses.nptel.ac.in/noc24_ee137/preview

	National Institute of Technology Meghalaya An Institute of National Importance	**CURRICULUM**

Programme	**Bachelor of Technology in Electronics and Communication Engineering**	Year of Regulation	**2024-25**
Department	**Electronics and Communication Engineering**	Semester	**IV**

Course Code	Course Name	Pre-Requisite	Credit Structure				Marks Distribution			
			L	T	P	C	INT	MID	END	Total
EC204	**Principles of Communication**	-----	**3**	**0**	**0**	**3**	**50**	**50**	**100**	**200**

			CO's	Statement	Bloom's Taxonomy
Course Objectives	To understand the fundamentals of modulation and demodulation of analog communication system.	Course Outcomes	EC204.1	Able to acquire the knowledge about the modulation and demodulation of AM signal.	Knowledge Comprehension
	To understand the concepts FM and PM modulated signals.		EC204.2	Able to understand and design a communication system using FM and PM signals.	Knowledge Application
	To understand and analyse the signal for baseband data transmission.		EC204.3	Able to design the communication systems for baseband data transmission.	Knowledge Application
	To understand the concepts of baseband data reception and its performance.		EC204.4	Able to design the system for baseband data reception and analyse its performance.	Knowledge Application

COs	Mapping with Program Outcomes (POs)												Mapping with PSOs			
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
EC204.1	2	3	-	3	-	-	-	-	-	-	-	-	2	-	2	-
EC204.2	3	2	-	3	-	-	-	-	-	-	-	-	2	2	2	-
EC204.3	3	3	2	-	-	-	-	-	-	-	-	-	2	3	2	-
EC204.4	2	1	-	-	-	-	-	-	-	-	-	-	3	2	2	-
EC204	**2.5**	**2.25**	**2**	**3**									**2.25**	**2.33**	**2**	

SYLLABUS

No.	Content	Hours	COs
I	**Amplitude Modulation (AM):** Introduction communication systems, Review of Fourier Transforms, need for modulation and its advantages, Circuits for generation and detection of Amplitude modulation-*Double Sideband (DSB), DSB suppressed carrier (DSB-SC), Single Sideband (SSB), Vestigial Sideband (VSB)*, Bandwidth and spectrum of AM, Superheterodyne AM receiver.	**10**	**EC204.1**
II	**Angle Modulation:** Concept of instantaneous frequency, Circuits for generation and detection of Angle modulation (*Narrowband (NB), Wideband (WB)*)-Frequency Modulation (FM), Phase Modulation (PM), spectra and bandwidth of Angle Modulation, Phase locked loop (PLL), FM Receivers, White Noise, Signal-to-noise ratio (SNR) analysis for analog communications.	**11**	**EC204.2**
III	**Baseband Transmission:** Introduction to digital communications, analog communication vs digital communication, sampling-*natural and flat-top*, Quantization of Signals, Quantization Error, Companding, waveform coding-pulse *code modulation (PCM), Differential PCM (DPCM), Delta Modulation (DM)*,	**11**	**EC204.3**
IV	**Baseband Reception:** Review of Gaussian random process, detection of binary signals in Gaussian noise-*maximum likelihood (ML), matched filter (MF) and correlation receivers*, *error probability performance of binary signaling*	**10**	**EC204.4**
	Total Hours	**42**	

Essential Readings

1. B.P. Lathi and Ding-Zhu, "Modern Digital and Analog Communication Systems", Oxford University Press, 4th Edition, 2010.
2. Simon. Haykin, Michael Moher, "An Introduction to Analog and Digital Communications," John Wiley & Sons, 2nd Edition, 2007.

Supplementary Readings

1. Leon W. Couch, II, "Digital and Analog Communication Systems," Pearson Education, 6th Edition, 2004.
2. R. P. Singh and S. D. Sapre, "Communication Systems: Analog and Digital", Tata McGraw Hills, 3rd Edition, 2012.
3. K. Sam Shanmugam, "Digital and Analog Communication Systems", Wiley India Pvt Ltd, 2006.
4. NPTEL Video lectures on Principles of Communication: https://onlinecourses.nptel.ac.in/noc22_ee05/preview

	National Institute of Technology Meghalaya An Institute of National Importance	**CURRICULUM**

Programme	**Bachelor of Technology in Electronics and Communication Engineering**	Year of Regulation	**2018-19**
Department	**Electronics and Communication Engineering**	Semester	**IV**

Course Code	Course Name	Pre-Requisite	Credit Structure				Marks Distribution			
			L	T	P	C	INT	MID	END	Total
EC 206	**Microprocessors and Microcontrollers**	-----	**3**	**0**	**0**	**3**	**50**	**50**	**100**	**200**

			CO's	**Statement**	**Bloom's Taxonomy**
Course Objectives	To introduce students to the basic concepts and architecture of processors and microcontrollers, enabling them to understand instruction execution and system design.	Course Outcomes	EC206.1	Able to understand the basic concepts of processors, controllers, and instruction execution. *(Bloom's Level: Remembering, Understanding)*	Knowledge Comprehension
	To develop students' skills in programming processors and microcontrollers using both assembly and high-level languages, fostering their ability to write efficient and effective code.		EC206.2	Able to apply assembly and high-level languages to program processors and controllers. *(Bloom's Level: Applying)*	Knowledge Application
	To equip students with the knowledge and techniques required to interface processors and controllers with various peripherals, including I/O devices, A/D converters, D/A converters, and timers.		EC206.3	Able to apply techniques for interfacing processors/controllers with peripherals like I/O, A/D, D/A, timers, etc. *(Bloom's Level: Applying)*	Knowledge Application
	To provide students with the expertise to design and implement real-time applications using different microcontrollers, applying theoretical knowledge to practical scenarios.		EC206.4	Able to design real-time applications using different microcontrollers. *(Bloom's Level: Creating)*	Knowledge Application

COs	Mapping with Program Outcomes (POs)													
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
EC206.1	2	3	-	3	-	-	-	-	-	-	-	-	2	-
EC206.2	3	2	-	3	-	-	-	-	-	-	-	-	2	2
EC206.3	3	3	2	-	-	-	-	-	-	-	-	-	2	3
EC206.4	2	1	-	-	-	-	-	-	-	-	-	-	3	2
EC206	**2.5**	**2.25**	**2**	**3**									**2.25**	**2.33**

SYLLABUS

No.	Content	Hours	COs
I	**Introduction to Microprocessors** 8085 Internal Architecture, Addressing Modes, Bus Timings, ASM Programming, Memory organization, overview of I/O interfacing and advanced microprocessors.	**8**	**EC206.1**
II	**Microcontroller: 8051 Architecture** Introduction to embedded systems, Overview of the 8051 family, Architectural Enhancements of PIC, AVR and ARM- based micro-controllers, 8051 architecture, memory organization, I/O ports, addressing modes, Assembly instructions, timing and instruction execution,	**9**	**EC206.1**
III	**8051 Programming** Programming examples on bit processing, Arithmetic instructions, program flow control, look up table and array processing, programming through C.	**7**	**EC206.1, EC206.2**
IV	**Concepts of Hardware Interfacing** System Design and Troubleshooting, Concepts and Programming of I/O ports, timer/counter, Serial communication (RS- 232/422), Interrupt.	**9**	**EC206.2, EC206.3**
V	**Interfacing with External devices** Sensors and calibration methods, ADC/DAC, Relays, Opto-couplers, Stepper motor, DC motors, External memory, RTC, I2C, SPI, USB, VGA etc.,	**7**	**EC206.3, EC206.4**
	Total Hours	**40**	

Essential Readings

1. Gaonkar R. S., "Microprocessor Architecture, Programming and Applications with 8085", Penram International, Fifth edition 1999

2. M. A. Mazidi , J. G. Mazidi and R. D. Mckinlay others, "The 8051 Microcontroller and Embedded Systems", Prentice Hall of India. Second Edition, 2007

Supplementary Readings

1. M.K. Patel "The 8051 Microcontrollers based Embedded Systems", MCGraw Hill, 2014

2. Hall D., "Microprocessors and Interfacing : Programming and Hardware", Tata McGraw-Hill,1992

3. Wilmshurst, T. "Designing Embedded Systems With PIC Microcontrollers : Principles and Applications", Elsevier (Newnes) Second Edition, 201

	National Institute of Technology Meghalaya An Institute of National Importance	CURRICULUM

Programme	**Bachelor of Technology in Electronics and Communication Engineering**	Year of Regulation	**2024-25**
Department	**Electronics and Communication Engineering**	Semester	**IV**

Course Code	Course Name	Pre-Requisite	Credit Structure				Marks Distribution			
			L	T	P	C	INT	MID	END	Total
EC210	**Linear Integrated Circuits**	-----	**3**	**0**	**0**	**3**	**50**	**50**	**100**	**200**

Course Objectives		Course Outcomes			
			CO's	**Statement**	**Bloom's Taxonomy**
	To understand the fundamentals of the Operational Amplifier		EC210.1	Able to acquire knowledge about the fundamentals of the operational amplifier and its application	Knowledge Comprehension
	To understand the concepts of Oscillators		EC210.2	Able to understand the basic concepts of Filters	Knowledge Application
	To understand the concept of 555 Timer and PLL		EC210.3	Able to understand and analyze different 555 timer based circuits	Knowledge Application
	To understand the concept of ADC and DAC		EC210.4	Able to understand the concept of ADC and DAC	Knowledge Application

COs	Mapping with Program Outcomes (POs)												Mapping with PSOs			
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
EC210.1	3	3	2	2	1	-	-	-	-	-	-	-	3	2	2	-
EC210.2	3	3	2	2	1	-	-	-	-	-	-	-	3	2	2	-
EC210.3	3	3	2	2	1	-	-	-	-	-	-	-	3	2	2	-
EC210.4	3	3	2	2	1	-	-	-	-	-	-	-	3	2	2	-
EC210	3	3	2	2	1								3	2	2	

SYLLABUS

No.	Content	Hours	COs
I	**Fundamentals of Operational Amplifier and Its Application:** Integrated circuits basics, Operational Amplifiers: Introduction to ideal and practical Op. amps, Characteristics, Modes of operation, Adder, Subtractor, Integrator, Differentiator, Instrumentation amplifier	**10**	**EC210.1**
II	**Filters and Oscillators:** Lowpass, Highpass, Bandpass and Band reject filters, Sinewave Oscillators: RC phase shift, Wien bridge Oscillators, Non-linear applications of Op. amp: Comparators, Zero crossing detectors and Schmitt trigger, waveform generator	**10**	**EC210.2**
III	**555 Timer:** Operation, Monostable and Astable modes PLL: Operation and applications Voltage regulators: Features, three terminal voltage regulators	**10**	**EC210.3**
IV	**ADC and DAC:** Digital to Analog Converters: Weighted resistor DAC and R-2R ladder DAC **Analog to Digital Converters:** Flash type, counter type, successive approximation type and dual slope integrating type	**10**	**EC210.4**
	Total Hours	**40**	

Essential Readings

1. D.Roy Choudhry, Shail Jain, -Linear Integrated Circuits, New Age International Pvt. Ltd., 2018, Fifth Edition.
2. Sergio Franco, -Design with Operational Amplifiers and Analog Integrated Circuits, 4th Edition, Tata Mc Graw-Hill, 2016

Supplementary Readings

1. Ramakant A. Gayakwad, -Operational Amplifiers and Linear IC, 4th Edition, Prentice Hall / Pearson Education, 2015.
2. Robert F.Coughlin, Frederick F.Driscoll, -Operational Amplifiers and Linear Integrated Circuits, Sixth Edition, PHI, 2001.
3. B.S.Sonde, -System design using Integrated Circuits , 2nd Edition, New Age Pub, 2001.
4. S.Salivahanan & V.S. Kanchana Bhaskaran, -Linear Integrated Circuits, TMH,2nd Edition, 4 th Reprint, 2016

	National Institute of Technology Meghalaya An Institute of National Importance	**CURRICULUM**

Programme	**Bachelor of Technology in Electronics and Communication Engineering**	Year of Regulation	**2024-25**
Department	**Electronics and Communication Engineering**	Semester	**IV**

Course Code	Course Name	Pre-Requisite	Credit Structure				Marks Distribution			
			L	T	P	C	INT	MID	END	Total
EC212	**Statistical Detection Theory**	-----	**3**	**0**	**0**	**3**	**50**	**50**	**100**	**200**

			CO's	Statement	Bloom's Taxonomy
Course Objectives	To provide students with an understanding of the basic concepts related to statistical detection theory for communication.	Course Outcomes	EC212.1	Able to use the statistical information in basic detection theory to solve problems related to communication engineering.	Knowledge Application
	To explore the detection of deterministic and random signals knowledge in various applications.		EC212.2	Able to gain insights into the detection of deterministic and random signals	Knowledge Application
	To familiarize students on hypothesis testing and application to signals with unknown parameters		EC212.3	Able to analyse the hypothesis testing and application to signals with unknown parameters	Knowledge Analysis
	To summarize the detection of random signals with unknown parameters		EC212.4	Enabling the students to think in terms of innovative ideas to improve the existing technology in the field of communication through the detection of random signals with unknown parameters	Application Analysis

COs	Mapping with Program Outcomes (POs)												Mapping with PSOs			
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
EC212.1	**3**	**2**	**2**	**1**	**-**	**-**	**-**	**-**	**2**	**-**	**-**	**-**	**3**	**2**	**3**	**-**
EC212.2	**2**	**2**	**2**	**2**	**-**	**-**	**-**	**-**	**2**	**-**	**-**	**-**	**2**	**1**	**2**	**-**
EC212.3	**3**	**3**	**2**	**2**	**1**	**-**	**-**	**-**	**1**	**2**	**1**	**1**	**2**	**2**	**2**	**-**
EC212.4	**3**	**3**	**2**	**2**	**-**	**-**	**-**	**-**	**1**	**2**	**1**	**-**	**2**	**3**	**2**	**-**
EC212	**2.75**	**2.50**	**2**	**1.75**	**1**				**1.50**	**2**	**1**	**1**	**2.75**	**2**	**2.25**	

SYLLABUS

No.	Content	Hours	COs
I	**Statistical Decision Theory I:** Introduction, Summary of important probability density functions (PDF) (Gaussian, Chi-Squared, Rayleigh, Rician), Neyman-Pearson theorem, receiver operating characteristics (ROC), minimum error probability criterion, Bayes risk, multiple hypothesis testing. **Application:** Detection of digital signal in additive white Gaussian noise channel.	**10**	**EC212.1**
II	**Detection of deterministic & random signals:** matched filter, generalized matched filter, multiple signal models, estimator-correlator, linear models. **Application:** applications to binary and M-ary communication systems, incoherent FSK detection	**10**	**EC212.2**
III	**Statistical Decision Theory II:** Composite hypothesis testing, generalized likelihood ratio test (GLRT), multiple hypothesis testing, deterministic signals with unknown parameters **Application:** detection of signals with unknown amplitude, phase, frequency, arrival of time	**10**	**EC212.3**
IV	**Random signals with unknown parameters:** incompletely known signal covariance, weak signal detection **Application:** detection of periodic random signals	**10**	**EC212.3, EC212.4**
	Total Hours	**40**	

Essential Readings

1. S. M. Kay, "Fundamentals of Statistical Signal Processing: Detection Theory", First edition, Printice hall, Volume II, 1998.
2. Mourad Barkat, "Signal Detection and Estimation", Second Edition, Artech House, 2005.

Supplementary Readings

1. H.V.Poor, "An Introduction to Signal Detection and Estimation", Second Edition, Spring Verlag.1994.
2. H. L. Van Trees, "Detection, Estimation and Modulation Theory, Part I", John Wiley, 1968.

	National Institute of Technology Meghalaya An Institute of National Importance	CURRICULUM
Programme	**Bachelor of Technology in Electronics and Communication Engineering**	Year of Regulation: **2024-25**
Department	**Electronics and Communication Engineering**	Semester: **IV**

Course Code	Course Name	Pre-Requisite	Credit Structure				Marks Distribution			
			L	T	P	C	INT	MID	END	Total
EC 270	**IC Packaging**	-----	**2**	**0**	**0**	**2**	**50**	**50**	**100**	**200**

Course Objectives	To introduce the fundamental concepts and importance of IC (Integrated Circuit) packaging.	Course Outcomes	**CO's**	**Statement** / **Bloom's Taxonomy**
	To understand the various types of IC packages and the materials used.		EC270.1	**Understand** the basic concepts and functions of IC packaging (Comprehension, Understanding). — Comprehension
	To provide knowledge on the processes and techniques involved in IC packaging.		EC270.2	**Identify** different types of IC packages and the materials used (Comprehension, Understanding). — Comprehension
	To explore the challenges and solutions in IC packaging, including thermal management and reliability.		EC270.3	**Apply** the techniques and processes involved in IC packaging (Application, Applying). — Application
	To familiarize students with industry standards and emerging trends in IC packaging technology.		EC270.4	**Analyze** the challenges and solutions related to thermal management and reliability in IC packaging (Analysis, Analyzing). — Analysis
			EC270.5	Evaluate the performance and reliability of different IC packaging methods (Evaluation, Evaluating) and Design an IC package considering the constraints and requirements of specific applications (Synthesis, Creating) — Synthesis

COs	Mapping with Program Outcomes (Pos)												Mapping with PSOs			
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
EC270.1	**3**	**2**	**3**	**1**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**3**	**-**	**3**	**3**
EC270.2	**2**	**2**	**-**	**1**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**3**	**-**	**3**	**3**
EC270.3	**3**	**3**	**2**	**1**	**2**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**2**	**3**	**2**	**2**
EC270.4	**2**	**2**	**2**	**-**	**2**	**2**	**-**	**-**	**-**	**-**	**-**	**-**	**2**	**3**	**3**	**2**
EC270.5	**2**	**3**	**3**	**2**	**2**	**3**	**-**	**-**	**-**	**-**	**-**	**-**	**2**	**2**	**3**	**2**
EC270	**2.40**	**2.40**	**2.50**	**1.25**	**2**	**1.50**							**2.40**	**2.67**	**2.80**	**2.40**

SYLLABUS

No.	Content	Hours	Cos
I	Introduction to IC Packaging: Importance of IC packaging, Functions of IC packaging, Historical evolution.	**02**	**EC270. 1**
II	Types of IC Packages: Dual In-line Package (DIP), Surface Mount Device (SMD), Ball Grid Array (BGA), Chip-on-Board (COB), and other advanced packaging types.	**02**	**EC270.2, EC270.3**
III	Materials for IC Packaging: Substrate materials, Encapsulation materials, Interconnect materials, Properties and selection criteria.	**03**	**EC270.2, EC270.3**
IV	IC Packaging Processes and Techniques: Wafer dicing, Die attachment, Wire bonding, Flip-chip bonding, Encapsulation, Testing, and inspection	**03**	**EC270.3, EC270.5**
V	Thermal Management in IC Packaging: Heat generation in ICs, Thermal resistance, Heat sinks, Thermal interface materials, Cooling techniques.	**04**	**EC270.4, EC270.5**
VI	Reliability and Testing of IC Packages: Failure mechanisms, Accelerated life testing, Environmental testing, Reliability standards.	**04**	**EC270.4, EC270.5**
VII	Advanced and Emerging Trends in IC Packaging: 3D IC packaging, System-in-Package (SiP), Wafer-level packaging, MEMS packaging, Future trends.	**04**	**EC270.1, EC270.5**
VIII	Industry Standards and Best Practices: IPC standards, JEDEC standards, Industry best practices, Safety considerations.	**04**	**EC270.1, EC270.5**
	Total Hours	**26**	

Essential Readings

1. Tummala, Rao R. "Fundamentals of microsystems packaging." (2001): 190-193.
2. Yeh, Lian-Tua, R. C. Chu, and W. S. Janna. "Thermal management of microelectronic equipment: heat transfer theory, analysis methods, and design practices. ASME press book series on electronic packaging." *Appl. Mech. Rev.* 56.3 (2003): B46-B48.
3. Ulrich, Richard K., and William D. Brown, eds. *Advanced electronic packaging*. Vol. 9. John Wiley & Sons, 2006.

Supplementary Readings
1. IPC Standards (e.g., IPC-6012); JEDEC Standards
2. Tu, King-Ning, Chih Chen, and Hung-Ming Chen. *Electronic packaging science and technology*. John Wiley & Sons, 2021.
3. Khan, M. Shafkat M., et al. "Exploring advanced packaging technologies for reverse engineering a system-in-package (sip)." *IEEE Transactions on Components, Packaging and Manufacturing Technology* (2023).

	National Institute of Technology Meghalaya An Institute of National Importance	CURRICULUM

Programme	**Bachelor of Technology in Electronics and Communication Engineering**	Year of Regulation	**2024-25**
Department	**Electronics and Communication Engineering**	Semester	**IV**

Course Code	Course Name	Pre-Requisite	Credit Structure				Marks Distribution		
			L	T	P	C	CONTINOUS EVALUATION	VIVA	Total
EC 250	**Electronic Circuits Lab**	-----	**0**	**0**	**2**	**1**	**70**	**30**	**100**

Course Objectives	To develop the student's ability verify the theoretical concepts and IV-characteristics of various electronic devices, studied in Electronic Devices (EC 200) through laboratory experiments.	Course Outcomes	**CO's**	**Statement**	**Bloom's Taxonomy**
			EC250.1	Able to experimentally test the IV characteristics of various semiconductor devices studied in EC200, and interpret the results	Application Analysis
			EC250.2	Operate electronic test equipments (CRO, Function Generator, Multimeter, power supply etc.) to characterize the behavior of semiconductor devices and circuits.	Knowledge Application
			EC250.3	Prepare professional quality textual and graphical presentations of laboratory data	Knowledge Application

COs	Mapping with Program Outcomes (POs)												Mapping with PSOs			
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
EC250.1	**2**	**2**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**2**	**2**	**1**	**-**	**-**
EC250.2	**2**	**2**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**2**	**2**	**1**	**-**	**-**
EC250.3	**2**	**2**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**2**	**2**	**1**	**-**	**-**
EC250	**2**	**2**										**2**	**2**	**1**		

SYLLABUS

No.	Content	Hours	COs
I	Experiments related to measure the electrical current- voltage characteristics of various semiconductor devices including semiconductor diodes, bipolar junction transistor and field effect transistors. To study and plot the output waveforms of diode based clipper and clamper circuits. To study and plot the output waveforms and frequency response of RC low and high pass filter circuits. To study the input & output waveforms and frequency response of BJT in common emitter (CE) amplifier circuit. To study the input & output waveforms and frequency response of BJT in common base (CB) amplifier circuit. To study the input & output waveforms and frequency response of BJT in common collector (CC) amplifier circuit. To study the input & output waveforms and frequency response of FET in common source (CS) amplifier circuit. To study the input & output waveforms and frequency response of FET in common gate (CG) amplifier circuit. To study the input & output waveforms and frequency response of FET in common drain (CD) amplifier circuit. To study the input & output waveforms and frequency response of differential amplifier circuit. To study the input & output waveforms and frequency response of multistage amplifier circuit.	**28**	**EC250.1** **EC250.2** **EC250.3**
	Total Hours	**28**	

Essential Readings

1. R.L. Boylestad and L. Nashelsky, "Electronic Devices And Circuit Theory", Prentice Hall, Tenth Edition, 2011.
2. D.A. Bell ,"Electronic Devices and Circuits", Prentice Hall of India, 5th Edition, 2004

Supplementary Readings

1. A.S. Sedra and K.C. Smith, "Microelectronic Circuits", Oxford, Seventh Edition, 2017.
2. D.A.Neaman, "Microelectronics: Circuit Analysis and Design", McGraw Hill, Fourth Edition, 2010.

	National Institute of Technology Meghalaya An Institute of National Importance	CURRICULUM
Programme	**Bachelor of Technology in Electronics and Communication Engineering**	Year of Regulation: **2024-25**
Department	**Electronics and Communication Engineering**	Semester: **IV**

Course Code	Course Name	Pre-Requisite	Credit Structure				Marks Distribution			
			L	T	P	C	INT	MID	END	Total
EC254	**Principles of Communication Laboratory**	-----	**0**	**0**	**2**	**1**	**50**	**0**	**0**	**50**

Course Objectives		Course Outcomes	CO's	Statement	Bloom's Taxonomy
	To develop the student's ability to analyse and design AM modulated systems.		EC254.1	Able to develop AM-modulated system using simulation tools/hardware kit.	Knowledge Application
	To develop the student's ability to analyse and design angle modulated systems		EC254.2	Able to develop angle-modulated systems using simulation tools/hardware kit.	Knowledge Application
	To understand and analyze the conversion of analog signals to digital signal.		EC254.3	Able to work in teams to plan and execute the conversion of analog signals to digital signal.	Knowledge Application

COs	Mapping with Program Outcomes (POs)												Mapping with PSOs			
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
EC254.1	2	2	3	3	-	1	-	-	-	-	-	2	-	-	3	-
EC254.2	2	3	3	3	-	1	-	-	-	-	-	2	-	-	2	-
EC254.3	3	2	1	1	-	3	-	-	-	-	-	1	2	2	2	1
EC254	**2.33**	**2.33**	**2.33**	**2.33**		**1.67**						**1.67**	**2**	**2**	**2.33**	**1**

SYLLABUS

No.	Content	Hours	COs
1.	List of experiments related to Principles of Communication: 1. Generation and demodulation of conventional AM signal. 2. Generation and demodulation of DSB-SC AM signal. 3. Generation and demodulation of SSB signal. 4. Generation and demodulation of FM signal. 5. To calculate the SNR for the AM, DSB-SC, SSB-SC signal with AWGN channel. 6. To observe the pre-emphasis and de-emphasis of a signal. 7. Perform the signal generation and reconstruction using sampling theorem and Nyquist criteria. 8. To perform pulse code modulation. 9. To perform the delta modulation and demodulation of the signal. 10. To perform the equalization using MATLAB software by considering AWGN channel.	**28**	EC254.1, EC254.2, EC254.3
	Total Hours	**28**	

Essential Readings

1. B.P. Lathi and Ding Zhu, "Modern Digital and Analog Communication Systems", Oxford University Press, 4th Edition, 2010.

2. Simon. Haykin, Michael Moher, “An Introduction to Analog and Digital Communications”, John Wiley & Sons, 2nd Edition, 2007.
3. John G. Proakis and Masoud Salehi, "Contemporary Communication Systems using MATLAB”, Cengage learning, 3rd edition, 2011.

Supplementary Readings

1. Leon W. Couch, II, "Digital and Analog Communication Systems," Pearson Education, 6th Edition, 2004.
2. K. Sam Shanmugam, "Digital and Analog Communication Systems", Wiley India Pvt Ltd, 2006.

	National Institute of Technology Meghalaya An Institute of National Importance	**CURRICULUM**

Programme	**Bachelor of Technology in Electronics and Communication Engineering**	Year of Regulation	**2024-25**
Department	**Electronics and Communication Engineering**	Semester	**IV**

Course Code	Course Name	Pre-Requisite	Credit Structure				Marks Distribution			
			L	T	P	C	INT	MID	END	Total
EC 256	**Microprocessors and Microcontrollers**	------	**0**	**0**	**2**	**1**	**50**	**50**	**100**	**200**

		CO's	**Statement**	**Bloom's Taxonomy**
Course Objectives	Ability to design real time applications using different microcontrollers	Course Outcomes	EC256.1 Ability to understand the basic concepts of processors, controllers and instruction execution.	Knowledge Comprehension
	To develop the skills for programme the processors with low and high level programming languages		EC256.2 Ability to apply assembly and high level languages to program processors and controllers	Application
			EC256.3 Ability to apply interfacing processor/controller with peripherals like, I/O, A/D, D/A, timer etc	Application
			EC256.4 Ability to design real time applications using different microcontrollers	Evaluation

COs	Mapping with Program Outcomes (POs)												Mapping with PSOs			
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
EC256.1	2	3	-	3	-	-	-	-	-	-	-	-	2	-	2	-
EC256.2	3	2	-	3	-	-	-	-	-	-	-	-	2	2	2	-
EC256.3	3	3	2	-	-	-	-	-	-	-	-	-	2	3	2	-
EC256.4	2	1	-	-	-	-	-	-	-	-	-	-	3	2	2	-
EC256	**2.5**	**2.25**	**2**	**3**									**2.25**	**2.33**	**2**	

SYLLABUS

No.	Content	Hours	COs
I	**8085/86 Based programming (Assembly):** Program set for Logical and Decimal. Program set for Subroutines and Delay. Interfacing	**06**	EC256.1
II	**8051 Based system programming (Assembly and C):** Arithmetical and logical, I/O port interfacing, Timer based system, Interrupt generation, Display and Keyboard interfacing, Serial Communication, Sensor interfacing	**10**	EC256.1
III	**PIC Based system programming (Assembly and C):** I/O port interfacing. Timer based system. Display/Keyboard interfacing	**10**	EC256.1, EC256.2
	Total Hours	**26**	

Essential Readings

1. Gaonkar R. S., "Microprocessor Architecture, Programming and Applications with 8085", Penram International, Fifth edition 1999

2. M. A. Mazidi , J. G. Mazidi and R. D. Mckinlay others, "The 8051 Microcontroller and Embedded Systems", Prentice Hall of India. Second Edition, 2007

Supplementary Readings

1. M.K. Patel "The 8051 Microcontrollers based Embedded Systems", MCGraw Hill, 2014

2. Hall D., "Microprocessors and Interfacing : Programming and Hardware", Tata McGraw-Hill,1992

3. Wilmshurst, T. "Designing Embedded Systems With PIC Microcontrollers : Principles and Applications", Elsevier (Newnes) Second Edition, 201

Fifth Semester Courses

	National Institute of Technology Meghalaya An Institute of National Importance	**CURRICULUM**

Programme	**Bachelor of Technology in Electronics and Communication Engineering**	Year of Regulation	**2024-25**
Department	**Electronics and Communication Engineering**	Semester	**V**

Course Code	Course Name	Pre-Requisite	Credit Structure				Marks Distribution			
			L	T	P	C	INT	MID	END	Total
EC301	**Digital Communication**	-----	**3**	**0**	**0**	**3**	**50**	**50**	**100**	**200**

		CO's	**Statement**	**Bloom's Taxonomy**
Course Objectives	To understand the concepts of baseband data transmission	Course Outcomes EC301.1	Able to design the communication systems for baseband data transmission and analyze its performance in Gaussian noise	Application Analysis
	To understand the concepts of bandpass signal transmission of digital data using ASK, PSK, FSK modulation schemes	EC301.2	Able to design the system for pass-band signal transmission of digital data using ASK, PSK, FSK modulation schemes	Knowledge Application
	To understand and analyze the detection performance of digital data transmission in noise environment	EC301.3	Able to analyze the detection performance of pass-band signals in a noise environment.	Knowledge Analysis
	To understand the concepts of spread spectrum communication and information theory	EC301.4	Able to use the concepts of spread spectrum communication and information theory in designing advanced digital communication systems	Knowledge Application

COs	Mapping with Program Outcomes (POs)												Mapping with PSOs			
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
EC301.1	2	3	-	3	-	-	-	-	-	-	-	-	2	-	2	-
EC301.2	2	3	-	3	-	-	-	-	-	-	-	-	2	2	2	-
EC301.3	3	2	2	-	-	-	-	-	-	-	-	-	2	2	2	-
EC301.4	2	1	-	-	-	-	-	-	-	-	-	-	2	2	2	-
EC301	**2.25**	**2.25**	**2**	**3**									**2**	**2**	**2**	

SYLLABUS

No.	Content	Hours	COs
I	**Introduction:** Elements of digital communication systems, advantages of digital communication system, overview of sampling theorem, quantization process, and encoding, review of Gaussian random process	**02**	EC301.1
II	**Baseband pulse data transmission:** Baseband transmission of digital data, intersymbol interference (ISI), the Nyquist criterion for distortionless transmission, pulse shaping to reduce ISI, baseband transmission of M-ary data, the eye pattern, tapped delay line equalization (zero forcing), bit error rate (BER), detection of signal pulse in noise (matched filter, correlator receiver), optimum detection of binary PAM in noise **Application**: Transmission over two pairs of twisted copper wire.	**08**	EC301.1
III	**Digital pass band transmission:** Passband transmission model, transmission of binary amplitude shift keying (BASK), binary phase shift keying (BPSK), frequency shift keying (BFSK), M-ary digital modulation schemes, mapping of digitally modulated signals to constellation of signal points, Differential PSK (DPSK), minimum shift keying (FSK), Gaussian MSK (GMSK), **Application**: Global system for mobile (GSM) communication and digital television.	**10**	EC301.2
IV	**Optimum Receivers:** Coherent detection, optimal detection of BPSK, BASK, BFSK, QPSK, error performance of M-ary signalling schemes in AWGN channels, performance comparison of digital modulation schemes (SER, BER), Non-coherent detection **Application: O**rthogonal frequency division multiplexing (OFDM).	**10**	EC301.3
V	**Spread spectrum communications:** Frequency-hopping spread spectrum (FHSS) systems, direct sequence spread spectrum systems, code division multiple access (CDMA) **Application: C**ellular phone networks **Introduction to information theory:** Measure of information, entropy, source coding theorem, lossless data compression **Application**: File compression	**10**	EC301.4
	Total Hours	**40**	

Essential Readings

1. Simon Haykin, "Communication systems", John Wiley & Sons, 5th Edition, 2009.
2. John G. Proakis and Masoud Salehi, "Digital Communications", McGraw-Hill, 5th Edition 2008.
3. Lathi B.P. and Ding Zhu, "Modern Digital and Analog Communication Systems", Oxford University Press, 4th Edition, 2010.
4. Sklar Bernard, "Digital Communications - Fundamentals and Applications," Pearson Education, 2nd Edition, 2001.

Supplementary Readings
1. Leon W. Couch, II, "Digital and Analog Communication Systems," Pearson Education, 6th Edition, 2004.
2. K.Sam Shanmugam, "Digital and Analog Communication Systems", Wiley India Pvt Ltd, 2006.

	National Institute of Technology Meghalaya An Institute of National Importance	**CURRICULUM**

Programme	Bachelor of Technology in Electronics and Communication Engineering	Year of Regulation	**2024-25**
Department	Electronics and Communication Engineering	Semester	**V**

Course Code	Course Name	Pre-Requisite	Credit Structure				Marks Distribution			
			L	T	P	C	INT	MID	END	Total
EC 303	**Digital Signal Processing**	EC207	**3**	**0**	**0**	**3**	**50**	**50**	**100**	**200**

Course Objectives		Course Outcomes	CO's	Statement	Bloom's Taxonomy
	To develop the student's ability to analyze discrete time signals and systems in the time domain and frequency domain.		EC303.1	Able to identify, formulate, and solve engineering problems in the area of signal processing.	Knowledge Comprehension
	To develop the student's ability to perform Discrete Fourier Transform (DFT) by using different types of Fast Fourier Transform algorithms.		EC303.2	Able to implement FFT algorithms for computing the DFT.	Knowledge Application
	To develop student's ability to design FIR and IIR filter for various applications		EC303.3	Able to design and implement FIR and IIR filters.	Knowledge Application
	To develop the student's ability to implement digital infinite Impulse Response (IIR) and Finite Impulse Response (FIR) filters.		EC303.4	Able to apply down and up sampling techniques in designing of advanced digital signal processing systems.	Knowledge Application
	To understand the concepts of Multirate Signal Processing				

COs	Mapping with Program Outcomes (POs)												Mapping with PSOs			
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
EC303.1	**3**	**3**	**1**	**1**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**3**	**-**	**3**	**-**
EC303.2	**3**	**3**	**2**	**2**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**2**	**2**	**2**	**-**
EC303.3	**3**	**3**	**3**	**3**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**2**	**2**	**-**	**2**	**-**
EC303.4	**3**	**3**	**3**	**3**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**2**	**2**	**2**	**2**	**-**
EC303	**3**	**3**	**2.25**	**2.25**								**2**	**2.25**	**2**	**2.25**	

SYLLABUS

No.	Content	Hours	Cos
I	**Review of Discrete-Time Signals and Systems**: Discrete - Time signals, systems and their classification, Analysis of Discrete - Time LTI systems: Impulse response, Difference equation, Frequency Response, Transfer Function, DTFT, DTFS and Z-transform.	**06**	**EC303.1**
II	**Fast Fourier Transform:** Introduction, Direct Evolution Of DFT, The Fast Fourier Transform, Decimation-In-Time Algorithm, Summary Of Steps Of Radix-2 DIT-FFT Algorithm, Decimation-In-Frequency Algorithm, Summary Of Steps Of Radix-2 DIF-FFT Algorithm.	**10**	**EC303.2**
III	**Finite Impulse Response Filters:** Linear Phase FIR Filters, Frequency Response of Linear Phase FIR Filters, Location of the Zeros of Linear Phase FIR Filters Fourier Series method of Designing FIR Filters, Design of FIR filters using Windows, Frequency Sampling Method of Designing FIR Filters, Application of IIR filters. **Infinite Impulse Response Filters:** Design of IIR Filters from Analog Filters: using Approximation of Derivatives, Impulse Invariance Technique, Bilinear Transformation and Frequency Transformation in Digital Domain, Application of IIR filters.	**12**	**EC303.3**
IV	**Realization of Digital Filters:** Realization of FIR filters; Realization of IIR Filters.	**06**	**EC303.3**
V	**Multirate Signal Processing and applications:** Introduction, Down Sampling, Spectrum of The Down Sampled Signal, Up Sampling Spectrum Of The Up-Sampled Signal, Anti-Imaging Filter, Cascading Sample Rate Converters, Efficient Transversal Structure For Decimator, Efficient Transversal Structure For Interpolator.Applications:Phase Shifters,Digital Filter Banks,Sub band Coding of Speech Signals, Quadrature Mirror Filters, Trans multiplexers, Over Sampling, A/D and D/AConversion.	**08**	**EC303.4**
	Total Hours	**42**	

Essential Readings

1. Proakis J. G. and Manolakis D. G., "Digital Signal Processing: Principles, Algorithms and Applications", Pearson Education, 4th Edition, 2007.
2. Oppenhein A. V. and Shafer R. W., "Discrete-Time Signal Processing", Pearson Education India; 3rd edition, 2014.

Supplementary Readings

1. Mitra Sanjit K., "Digital Signal Processing: A Computer Based Approach", McGraw Hill Education; 4th edition, 2013.
2. Babu Ramesh P., "Digital Signal Processing", SciTech Publication, 2011.
3. Shaliwahan S., Vallavaraj A. and Gnanapriya C., "Digital Signal Processing", Tata McGraw-Hill, 1st Edition, 2008.
4. Padmanabhan K., "A Practical Approach to Digital Signal Processing", New Age International, 2nd Edition, 2013.

	National Institute of Technology Meghalaya An Institute of National Importance	CURRICULUM

Programme	**Bachelor of Technology in Electronics and Communication Engineering**	Year of Regulation	**2024-25**
Department	**Electronics and Communication Engineering**	Semester	**V**

Course Code	Course Name	Credit Structure				Marks Distribution			
		L	T	P	C	INT	MID	END	Total
EC305	**RF & Microwave Engineering**	**3**	**0**	**0**	**3**	**50**	**50**	**100**	**200**

Course Objectives		Course Outcomes	CO's	Statement	Bloom's Taxonomy
	To develop the ability to understand the RF behaviours of passive components and single- and multiport networks.		EC305.1	Able to acquire knowledge about RF behaviours of passive components and single- and multiport networks.	Knowledge Comprehension
	To develop an understanding of the RF passive circuits.		EC305.2	Able to understand the working mechanism of microwave waveguides and RF filters.	Knowledge Application
	To develop an understanding of microwave antennas.		EC305.3	Able to gather fundamental knowledge about microwave antenna and antenna parameters.	Knowledge Application
	To develop an understanding of RADAR and microwave communications.		EC305.4	Able to gather fundamental knowledge about RADAR systems and microwave communication.	Knowledge Application

COs	Mapping with Program Outcomes (POs)												Mapping with PSOs			
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
EC305.1	3	2	3	2	1	-	-	-	-	-	-	-	3	2	2	-
EC305.2	3	2	3	2	1	-	-	-	-	-	-	-	3	2	2	-
EC305.3	3	2	3	2	1	-	-	-	-	-	-	-	3	2	2	-
EC305.4	3	2	3	2	1	-	-	-	-	-	-	-	2	3	3	-
EC305	**3**	**2**	**3**	**2**	**1**								**2.67**	**2.25**	**2.25**	

SYLLABUS

No.	Content	Hours	COs
I	**Single- and multiport networks:** Introduction, Basic Definitions, Network Properties, and Application, Scattering Parameters- Definition and Properties Of S- Parameters, Application of S-Parameters.	**12**	**EC305.1**
II	**RF Passive Circuits:** Rectangular Waveguides, Rectangular Cavity Resonators, Microwave Hybrid Circuits, and Filter Configurations.	**12**	**EC305.2**
III	**Microwave Antennas:** Antenna Characteristics & Antenna Parameters, Radiation Fields and Characteristics of Dipole, Monopoly Antenna, Current Distribution and Radiation Patterns, Horizontal and Vertical antennas over a plane ground, Antenna Arrays.	**9**	**EC305.3**
IV	**RADAR and Microwave Communications:** Basic Radar, Simple Form of Radar Equation, Radar Block Diagram, Detection of Signal Noise, Receiver Noise & SNR, Transmitted Power, Polarization.	**9**	**EC305.4**
	Total Hours	**42**	

Essential Readings

1. S. Y. Liao, "Microwave Devices and Circuits", PHI, 3rd Edition, 2014.
2. F. Gustrao, "RF & Microwave Engineering", Wiley, 2nd edition, 2012.

Supplementary Readings

1. M. I. Skolnik , "Introduction to Radar Systems", Tata McGraw-Hill, 3rd edition, 2014.
2. D. M. Pozar, "Microwave Engineering", Wiley, 4th Edition, 2013
3. R.S. Rao, "Microwave Engineering", PHI, 2nd Edition, 2012
4. NPTEL Video lectures on Microwave Engineering: https://onlinecourses.nptel.ac.in/noc24_ee115/preview

	National Institute of Technology Meghalaya An Institute of National Importance	**CURRICULUM**

Programme	**Bachelor of Technology in Electronics and Communication Engineering**	Year of Regulation	**2024-25**
Department	**Electronics and Communication Engineering**	Semester	**V**

Course Code	Course Name	Pre-Requisite	Credit Structure				Marks Distribution			
			L	T	P	C	INT	MID	END	Total
EC 311	**Linear Control Systems**	-----	**3**	**0**	**0**	**3**	**50**	**50**	**100**	**200**

Course Objectives	To introduce the basic concepts, elements and terminologies of control systems	Course Outcomes	**CO's**	**Statement** / **Bloom's Taxonomy**
	To model and discuss different physical systems (plants) in Laplace and state-space frameworks.		EC311.1	Acquire knowledge about the control systems, its applications. — Knowledge Comprehension
	To study the performance and stability of LTI systems in time and frequency domains.		EC311.2	Obtain the mathematical models of dynamic systems in transfer function and state-space forms. — Knowledge Comprehension
	To discuss and design compensators/controllers using analytical and graphical techniques.		EC311.3	Analyse and define the LTI system performance and stability in both time-domain and frequency domain. — Knowledge Analysis
			EC311.4	Compute the Root Locus and Design the Appropriate compensator using Root Locus technique. — Comprehension Application
			EC311.5	Compute Bode, Nyquist Plots and Design the Appropriate compensator using Bode Plot Technique. — Comprehension Application

COs	Mapping with Program Outcomes (POs)												Mapping with PSOs			
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
EC311.1	**3**	**2**	**1**	**-**	**1**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**2**	**1**	**1**	**-**
EC311.2	**1**	**3**	**3**	**2**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**3**	**2**	**2**	**-**
EC311.3	**2**	**3**	**3**	**3**	**1**	**-**	**-**	**-**	**-**	**-**	**-**	**2**	**3**	**2**	**1**	**-**
EC311.4	**2**	**2**	**3**	**2**	**1**	**-**	**-**	**-**	**-**	**-**	**-**	**2**	**2**	**3**	**1**	**-**
EC311.5	**2**	**2**	**3**	**2**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**3**	**3**	**1**	**-**
EC311	**2**	**2.40**	**2.60**	**2.25**	**2**							**2**	**2.40**	**2.20**	**1.2**	

SYLLABUS

No.	Content	Hours	COs
I	**Basic Concepts** Basic definition, basic elements of control system, open loop control system, closed loop control system, control system terminology, manually controlled closed loop systems, automatic controlled closed loop systems, basic elements of a servo mechanism, electrical analogue of multidisciplinary systems, Notion of Feedback.	**07**	**EC311.1**
II	**Modelling and Representations of Control Systems** Ordinary Differential Equations, derivation of transfer functions of physical systems, block diagram representation of physical systems, signal flow graphs, conversion of block diagram to signal flow graph, block diagram reduction technique, signal flow graph Manipulation using Mason's gain formula. State-Space Representation of physical systems.	**07**	**EC311.2**
III	**Linear System Performance in Time and Frequency Domain** Standard test signals, significance of system impulse response, Transient step response analysis of zero, first and second order systems and determination of different time domain performance specification, steady state error analysis for Type-0, Type-1 and Type-2 systems, static and dynamic errors coefficients, and errors criteria, significance of system sinusoidal response, Frequency response analysis of first and second order system, link between time and frequency domain response, Effect of addition of poles and zeros on system time response.	**08**	**EC311.1, EC311.3**
IV	**Stability of LTI Systems** Fundamental Concepts of LTI system stability, Definitions of stability: BIBO stability, Absolute Stability, relative stability, limited stability, asymptotic stability etc., Determination of closed loop control system stability from characteristic equation: Routh Stability criterion, Hurwitz stability criterion.	**07**	**EC311.1, EC311.3**
V	**Graphical Techniques for Measurement of System Relative Stability** The Root-Locus Concepts, Construction Root Loci, Root contour,Frequency Domain Techniques: Bode-plot, Polar-plot, Nyquist plot, Nyquist Stability Criterion for open loop stable and unstable systems, concept of Gain Margin, Phase Margin, Closed loop frequency response.	**06**	**EC311.4, EC311.5**
VI	**Compensator Design** Introduction, different types of compensators, design of lag, lead, lag-lead compensator using root locus and Bode diagrams **Applications:** Design of P, PI, PD and PID controllers by analytical method, frequency response method and root locus technique.	**07**	**EC311.4, EC3115**
	TotalHours	**42**	

EssentialReadings

1.K.Ogata,"Modern Control Engineering", PHI, 5th edition, 2015.

2.I.J.Nagrath,M.Gopal,"Control System Engineering",New Age International, 6thedition, 2018

SupplementaryReadings

1. N. S.Nise,“Control System Engineering”,WileyIndia,2018
2.R.C.Dorf, R.H.Bishop ,“Modern Control Systems”, Pearson,12th edition, 2010
3.B.C.Kuo,“AutomaticControl Systems”,WileyIndia, 9th edition, 2014

	National Institute of Technology Meghalaya An Institute of National Importance	CURRICULUM

Programme	**Bachelor of Technology in Electronics and Communication Engineering**	Year of Regulation	**2024-25**
Department	Electronics and Communication Engineering	Semester	**V**

Course Code	Course Name	Pre-Requisite	Credit Structure				Marks Distribution			
			L	T	P	C	INT	MID	END	Total
EC 313	**POWER ELECTRONICS**	-----	**3**	**0**	**0**	**3**	**50**	**50**	**100**	**200**

			CO's	Statement	Bloom's Taxonomy
Course Objectives	To describe power electronics concepts and mechanisms related to the design of modern convertors.	Course Outcomes	EC313.1	Ability to identify the properties of power semiconductors device	Knowledge Comprehension
	To apply this understanding to new power electronics circuits design problems.		EC313.2	Ability to understand the basic concepts of power electronics such as DC/AC-DC/AC converter (rectifier, choppers, inverter & cyclo-converter)	Knowledge Comprehension
	To evaluate various design alternatives and make a compelling quantitative and/or qualitative argument for which applications these convertors are utilized.		EC313.3	Ability to define and calculate efficiency of the various convertors	Knowledge Application

COs	Mapping with Program Outcomes (POs)												Mapping with PSOs			
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
EC313.1	**2**	**3**	**2**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**3**	**1**	**-**	**-**
EC313.2	**3**	**3**	**2**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**3**	**1**	**-**	**-**
EC313.3	**3**	**2**	**3**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**3**	**1**	**-**	**-**
EC313	**2.67**	**2.67**	**2.33**										**3**	**1**		

SYLLABUS

No.	Content	Hours	COs
I	Introduction to Power Device: Power Electronics Scope and Applications, Interdisciplinary Nature of Power Electronics, Types of power electronics circuits, Introduction to power electronic devices like Thyristor (SCR), Power BJT, Power MOSFET, GTO, IGBT, Thyristor. Characteristics, GaN HEMT, LDMOS, Super-Junction (Cool MOS), Methods of triggering and commutation.	**10**	**EC313.1**
II	**Phase Controlled Rectifiers / AC-DC Converter:** Principle of phase control, half wave and full wave rectifiers with R, R-L, R-L-E load, triggering scheme, Effect of source impedance on the performance or the converters.	**08**	**EC313.2, EC313.3**
III	**Choppers / DC-DC Converter:** Basic principle of chopper operation, Different methods of classification, Control strategies Duty Ratio Control and Frequency Control, Types of idealized chopper circuit, Thyristor Chopper Circuits.	**08**	**EC313.2, EC313.3**
IV	**Inverters / DC-AC Converter:** Voltage Source Inverter (VSI)- Single phase voltage source inverters, Half bridge inverters, full bridge inverters, Voltage control in single phase inverters, Pulse Width Modulated (PWM) inverters- single pulse, multiple pulse, and sinusoidal pulse modulation. Current Source Inverter (CSI), Series and parallel inverter.	**08**	**EC313.2, EC313.3**
V	**Cyclo-converter / AC-AC Converter:** Principle of AC Voltage Controllers Integral Cycle Control and Phase Control, Types of AC voltage controllers, Principle of operation of cyclo-converters, circulating and non-circulating mode of operation.	**08**	**EC313.2, EC313.3**
	Total Hours	**42**	

Essential Readings

1. M. H Rashid, "Power Electronics Circuits, Devices, and Applications", Prentice-Hall of India Pvt. Ltd., 2004.
2. L. Umanand, "Power Electronics Essential and Applications", Wiley India, 2009.
3. P. S. Bimbhra, "Power Electronics", Khanna Publishers, 2003.

Supplementary Readings

1. M. D. Singh and K. B. Khanchandani, "Power Electronics", Tata McGraw-Hill Publishing Co. Ltd., 2008.
2. M. Ned and T. M. Undeland, "Power Electronics Converters Applications and Design", John Willey Inc., 2007.
3. V. R. Moorthi, "Power Electronics Devices, Circuits and Applications", Oxford University Press, 2005.

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CURRICULUM

Programme	**Bachelor of Technology in Electronics and Communication Engineering**	Year of Regulation	**2024-25**
Department	**Electronics and Communication Engineering**	Semester	**V**

Course Code	Course Name	Pre-Requisite	Credit Structure				Marks Distribution			
			L	T	P	C	INT	MID	END	Total
EC 371	**SENSORS AND APPLICATIONS**	-----	**2**	**0**	**0**	**2**	**50**	**50**	**100**	**200**

			COs	**Statement**	**Bloom's Taxonomy**
Course Objectives	To understand the fundamental concepts of sensors and measurement systems	Course Outcomes	EC371.1	Fundamental concepts of various sensors, transducers and related electronic circuits.	Knowledge
	To make students understand the working principle of resistive, capacitive, piezoelectric and thermal transducers and their applications.		EC371.2	Apply the fundamental principles of resistive, capacitive, piezoelectric and thermal transduction mechanisms for the design of various sensors and transducers.	Application
	To understand various types of electronic circuits for resistive, capacitive, piezoelectric and thermal sensors and transducers.		EC371.3	Design and analysis of electronic circuits for various sensors and transducers.	Design Evaluation

COs	Mapping with Program Outcomes (POs)												Mapping with PSOs			
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
EC371.1	2	1	-	-	-	-	-	-	-	-	-	-	2	1	-	-
EC371.2	2	1	-	-	-	-	-	-	-	-	-	-	2	1	-	-
EC371.3	2	1	-	-	-	-	-	-	-	-	-	-	2	1	-	-
EC371	**2**	**1**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**2**	**1**	**-**	**-**

SYLLABUS

No.	Content	Hours	COs
I	**Basics of Sensor and Measurement Systems** General Concepts And Terminology, Sensor Classification, General Input-Output Configuration, Static Characteristics Of Measurement Systems, Dynamic Characteristics, Review of Stress and Strain, Internal Force Analysis, Stress—Strain Relations, Bending Analysis of flexural beams and plates under simple Loading Conditions, Spring Constants, Resonant Frequency, and Quality Factor	**10**	**EC371.1**
II	**Sensors. Actuators and Applications** Piezoresistive Sensor, Piezoresistive Sensor Materials, Applications of Piezoresistive Sensors, Electrostatic Sensors and Actuators, Parallel-Plate Capacitor, Electrostatic Actuator under Bias, Applications of Electrostatic Sensors and Actuators, Piezoelectric Effects, Piezoelectric Sensing/Actuator Model, Properties of Piezoelectric Materials, Applications of Piezoelectric Sensors and Actuators, Thermal Sensors, Thermal Actuators, Thermal Couples, Thermal Resistors, Applications of Thermal Sensors and Actuators	**10**	**EC371.1,** **EC371.2**
III	**Electronic Circuits for Sensors and Transducers** DC and AC Bridges: Kelvin bridge and Wheatstone bridge for resistance measurement, Schering bridge and Wien bridge for capacitance measurement, Maxwell bridge and Hay's bridge for inductance measurement, Operational Amplifiers and Signal Conditioning for Sensors and Transducers	**8**	**EC371.3**
	Total Hours	**28**	

Essential Readings

1. Ghosh A. K., "Introduction to Transducers", Prentice-Hall India, 1st Ed., 2015.
2. Chang Liu, "Foundations of MEMS", Pearson, 2nd Edition, 2012.
3. H S Kalsi, "Electronic Instrumentation and Measurement", Mc Graw Hill, 4th Ed, 2019.

Supplementary Readings

1. Patranabis D., "Sensors And Transducers", Prentice-Hall India, 2nd Ed., 2004.
2. Webster J.G., "Instrumentation and Sensors Handbook", CRC Press, 1st Ed., 1999.

National Institute of Technology Meghalaya An Institute of National Importance			CURRICULUM
Programme	Bachelor of Technology in Electronics and Communication Engineering	Year of Regulation	2024-25
Department	Electronics and Communication Engineering	Semester	III

Course Code	Course Name	Pre-Requisite	Credit Structure				Marks Distribution			
			L	T	P	C	INT	MID	END	Total
EC 373	**Electronics Instrumentation**	-----	3	0	0	3	50	50	100	200

			COs	**Statement**	**Bloom's Taxonomy**
Course Objectives	To provide students with a comprehensive understanding of the principles and operations of electronic instrumentation systems.	Course Outcomes	EC373.1	Able to explain the basic concepts and principles of electronic instrumentation systems.	Knowledge Comprehension
	To enable students to analyze, design, and implement various types of electronic instrumentation systems.		EC373.2	Able to analyze and troubleshoot different types of electronic instrumentation systems.	Analyze
	To familiarize students with the different types of sensors and transducers and their applications in instrumentation.		EC373.3	Able to design and implement electronic instrumentation systems using appropriate sensors and transducers.	Design
	To develop students' practical skills in using electronic instrumentation tools and techniques for real-world applications.		EC373.4	Able to develop practical skills in using electronic instrumentation tools and software for measurement and data analysis.	Application

COs	Mapping with Program Outcomes (POs)												Mapping with PSOs			
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
EC373.1	2	2	2	1	1	-	-	-	-	-	-	-	2	-	1	-
EC373.2	2	2	2	1	-	-	-	-	-	-	-	-	2	-	2	-
EC373.3	2	2	2	2	2	-	-	-	-	-	-	2	2	2	2	-
EC373.4	2	2	2	2	2	-	-	-	-	-	-	2	2	2	2	-
EC373	**2**	**2**	**2**	**1.5**	**1.25**	**-**	**-**	**-**	**-**	**-**	**-**	**2**	**2**	**2**	**1.75**	**-**

SYLLABUS

No.	Content	Hours	COs
I	Introduction to Electronic Instrumentation: Overview of Electronic Instrumentation Systems, Classification and Characteristics of Instruments, Static and Dynamic Characteristics, Errors in Measurement and their Analysis	4	EC373.1
II	Sensors and Transducers: Introduction to Sensors and Transducers, Types of Sensors: Resistive, Capacitive, Inductive, and Piezoelectric, Temperature, Pressure, and Flow Sensors, Sensor Specifications and Selection Criteria	4	EC373.2
III	Signal Conditioning and Processing: Signal Conditioning Techniques, Amplifiers, Filters, and Converters, Data Acquisition Systems, Analog-to-Digital and Digital-to-Analog Conversion	4	EC373.3
IV	Measurement and Calibration: Measurement Techniques for Electrical and Non-Electrical Quantities, Calibration Methods and Standards, Instrumentation Amplifiers, Interfacing Sensors with Microcontrollers and Microprocessors	4	EC373.3
V	Instrumentation Systems and Applications: Instrumentation for Process Control, Biomedical Instrumentation, Industrial Automation and Control Systems, Environmental Monitoring Systems	4	EC373.4
VI	Practical and Laboratory Work: Hands-on Experiments with Various Sensors and Transducers, Design and Implementation of Signal Conditioning Circuits, Calibration and Testing of Instrumentation Systems, Use of Software Tools for Data Analysis and Visualization	6	EC373.1, EC373.2, EC373.3, EC373.4
Total Hours		26	

Essential Readings

1. "Modern Electronic Instrumentation and Measurement Techniques" by Albert D. Helfrick and William D. Cooper

2. "Introduction to Instrumentation and Measurements" by Robert B. Northrop
3. "Principles of Measurement Systems" by John P. Bentley
Supplementary Readings
1. "Measurement and Instrumentation: Theory and Application" by Alan S. Morris and Reza Langari

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Programme	**Bachelor of Technology in Electronics and Communication Engineering**	Year of Regulation	**2024-25**
Department	**Electronics and Communication Engineering**	Semester	**V**

Course Code	Course Name	Pre-Requisite	Credit Structure				Marks Distribution			
			L	T	P	C	INT	MID	END	Total
EC 351	**Digital Communication Laboratory**	-----	**0**	**0**	**2**	**1**	**50**	**0**	**0**	**50**

			COs	**Statement**	**Bloom's Taxonomy**
Course Objectives	To develop the student's ability to analyze and design Digital Communication systems	Course Outcomes	EC351.1	Able to develop a Digital Communication system using simulation tools	Knowledge Application
			EC351.2	Able to work in teams to plan and execute the creation of Advanced Digital Communication systems	Knowledge Comprehension

COs	Mapping with Program Outcomes (POs)												Mapping with PSOs			
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
EC351.1	3	3	3	3	-	1	-	-	-	-	-	2	-	-	3	-
EC351.2	2	2	1	1	-	3	-	-	-	-	-	1	2	2	2	1
EC351	**2.5**	**2.5**	**2**	**2**	**-**	**2**	**-**	**-**	**-**	**-**	**-**	**1.5**	**2**	**2**	**2.5**	**1**

SYLLABUS

No.	Content	Hours	COs
1.	List of experiments related to digital communication using MATLAB software: 1) MATLAB basics for communication system design: signal generation, operations and Interpretation (sinusoidal, discrete, unit step, impulse, random sequences, signal addition, signal multiplication, Scaling, Shifting, Folding, Energy, Convolution) 2) Simulation of baseband digital communication system in MATLAB 3) Study and Implement the Effect of Raised Cosine Filter 4) To generate and demodulate amplitude shift keyed (ASK) signal, binary phase shift keyed (BPSK) signal, and binary frequency shift keyed (FSK) 5) To generate and demodulate Quadrature Phase shift keying technique (QPSK) signal, differential phase-shift keying (DPSK), and Quadrature amplitude modulation signal 6) Transmission of signals using digital modulation techniques: M-ary QAM 7) Study of Eye Diagram, Constellation Diagram 8) Assume BPSK modulation is used for SNR range of 0-15 dB with a step of 2 dB. Length=1000 bits. Simulate: i) BER of system ii) Plot BER vs SNR performance for simulated results 9) Error performance of M-ary signalling schemes in AWGN channels 10) To design and simulate CDMA transmitter and receiver with BPSK/QPSK/QAM modulation scheme and measuring the BER in AWGN channel 11) Study of source coding techniques	**26**	EC351.1 EC351.2
	Total Hours	**26**	

Essential Readings

1. Simon Haykin, "Communication systems", John Wiley & Sons, 5th Edition, 2009.
2. John G. Proakis and Masoud Salehi, "Digital Communications", McGraw-Hill, 5th Edition 2008.
3. Lathi B.P. and Ding Zhu, "Modern Digital and Analog Communication Systems", Oxford University Press, 4th Edition, 2010.
4. Sklar Bernard, "Digital Communications - Fundamentals and Applications," Pearson Education, 2nd Edition, 2001.

Supplementary Readings

1. Leon W. Couch, II, "Digital and Analog Communication Systems," Pearson Education, 6th Edition, 2004.
2. K.Sam Shanmugam, "Digital and Analog Communication Systems", Wiley India Pvt Ltd, 2006.

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Programme	Bachelor of Technology in Electronics and Communication Engineering	Year of Regulation	**2024-25**
Department	Electronics and Communication Engineering	Semester	**V**

Course Code	Course Name	Pre-Requisite	Credit Structure				Marks Distribution		
			L	T	P	C	CONTINUOUS EVALUATION	VIVA/QUIZ	Total
EC 353	**Digital Signal Processing Laboratory**	**EC 207**	**0**	**0**	**2**	**1**	**70**	**30**	**100**

Course Objectives		Course Outcomes			
			COs	**Statement**	**Bloom's Taxonomy**
	To develop the student's ability to analyze discrete time signals and systems.		EC352.1	Able to analyze the discrete time signals and systems.	Analyse
	To develop the student's ability to design FIR and IIR filters.		EC352.2	Able to design FIR and IIR filters.	Design
	To develop the student's ability to understand the working of multirate signal processing systems and DSP processor TMS320C6748		EC352.3	Able to understand the working of multirate signal processing systems and DSP processor TMS320C6748	Knowledge Understand

COs	Mapping with Program Outcomes (POs)												Mapping with PSOs			
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
EC352.1	3	3	3	3	-	1	-	-	-	-	-	2	-	-	3	-
EC352.2	3	3	3	2	-	-	-	-	-	-	-	3	2	2	2	-
EC352.3	2	1	1	1	-	1	-	-	-	-	-	1	2	2	2	2
EC352	**2.6**	**2.3**	**2.3**	**2**	**-**	**1**	**-**	**-**	**-**	**-**	**-**	**2**	**2**	**2**	**2.3**	**2**

SYLLABUS

No.	Content	Hours	COs
1	Generation of discrete-time signals in the time domain and performing basic operations.	**14**	EC353.1, EC353.2, EC353.3
2	Analyze the discrete-time signals using DFT.		
3	Investigate their time domain and frequency domain properties of some simple discrete-time systems.		
4	Design of FIR and IIR filters.		
5	Study of Multirate signal processing.		
6	Implementation of linear and circular convolution on DSP processor TMS320C6748.		
7	Implementation of FIR filters on DSP processor TMS320C6748.		
	Total Hours	**14**	

Essential Readings

1. Proakis J. G. and Manolakis D. G., "Digital Signal Processing: Principles, Algorithms and Applications", Pearson Education, 4th Edition,2007.
2. Oppenhein A. V. and Shafer R. W., "Discrete-Time Signal Processing", Pearson Education India; 3rd edition, 2014.

Supplementary Readings

1. Padmanabhan K., "A Practical Approach to Digital Signal Processing", New Age International, 2nd Edition, 2013.
2. Mitra Sanjit K., "Digital Signal Processing: A Computer Based Approach", McGraw Hill Education; 4th edition, 2013.

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Department	**Electronics and Communication Engineering**	Semester	**V**

Course Code	Course Name	Pre-Requisite	Credit Structure				Marks Distribution		
			L	T	P	C	CONTINUOUS EVALUATION	VIVA	Total
EC355	**Microwave Engineering Lab**	-----	0	0	2	1	70	30	100

			CO's	**Statement**	**Bloom's Taxonomy**
Course Objectives	To develop the student's ability to understand the Microwave bench and filters.	Course Outcomes	EC355.1	To understand Microwave bench and analyze microwave filters using simulation tools.	Knowledge Application
	Develop an understanding of the characteristics of microwave passive devices and antenna.		EC355.2	To develop an understanding of microwave passive devices and antenna through EM simulations.	Knowledge Application
	To develop an understanding of waveguides and the application of boundary conditions.		EC355.3	To implement a waveguide using simulation tools and develop an understanding of boundary conditions.	Knowledge Application

COs	Mapping with Program Outcomes (POs)												Mapping with PSOs			
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
EC355.1	3	2	3	2	1	-	-	-	-	-	-	-	3	2	2	-
EC355.2	3	2	3	2	1	-	-	-	-	-	-	-	3	2	2	-
EC355.3	3	2	3	2	1	-	-	-	-	-	-	-	3	2	2	-
EC355	**3**	**2**	**3**	**2**	**1**	-	-	-	-	-	-	-	**3**	**2**	**2**	-

SYLLABUS

No.	Content	Hours	COs
I	Introduction on Microwave Bench.	**26**	**EC355.1, EC355.2 & EC355.3**
II	To Study Microstrip Band Pass and Band Stop Filters.		
III	To design and simulate a miniaturized slot antenna.		
IV	To design and simulate a microstrip patch antenna.		
V	To Study the Fundamental Mode of Rectangular waveguide.		
VI	To Study the Effect of Metallic post-loading on Rectangular waveguide		
VII	To Study the Effect of Drilling Hole Along Broad Wall & Narrow Wall Direction of Waveguide Using Electromagnetic Boundary Condition		
	Total Hours		

Essential Readings

1. Matthew N.O. Sadiku, "Elements of Electromagnetics", Oxford, 6th Edition, 2020.
2. D. M. Pozar, "Microwave Engineering", Wiley, 4th Edition, 2013

Supplementary Readings

1. J. D. Kraus, R.J. Marhefka and A. S. Khan, "Antennas and Wave Propagation", Tata McGraw-Hill, 5th Edition, 2017.
1. E. C. Jordan and Balmain K. G., "Electromagnetic Waves and Radiating Systems", Prentice Hall, 2nd Edition, 2015.

Sixth Semester Courses

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Programme	**Bachelor of Technology in Electronics and Communication Engineering**	Year of Regulation	**2024-25**
Department	**Electronics and Communication Engineering**	Semester	**VI**

Course Code	Course Name	Pre-Requisite	Credit Structure				Marks Distribution			
			L	T	P	C	INT	MID	END	Total
EC 300	**Digital and Analog Integrated Circuits**	-----	**3**	**0**	**0**	**3**	**50**	**50**	**100**	**200**

Course Objectives		Course Outcomes			
			CO's	**Statement**	**Bloom's Taxonomy**
	To understand the MOSFET structure and Operation		EC300.1	Able to acquire knowledge of Model the behaviour of a MOS Transistor	Knowledge Comprehension
	To understand the CMOS differential Amplifier		EC300.2	Able to understand the basic Design of MOS differential amplifier	Knowledge Application
	To develop an ability of CMOS operational amplifier		EC300.3	Able to compute the MOS operational amplifier	Knowledge Application
	To develop the CMOS digital circuits		EC300.4	Able to Able to analyse CMOS Inverter	Knowledge Application
			EC300.5	Able to analyse and design of CMOS digital circuits	Knowledge Application

COs	Mapping with Program Outcomes (POs)												Mapping with PSOs			
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
EC300.1	1	3	2	2	1	2	-	-	-	-	-	-	3	2	2	-
EC300.2	1	3	2	2	1	2	-	-	-	-	-	-	3	2	2	-
EC300.3	1	3	2	2	1	3	-	-	-	-	-	-	3	2	2	-
EC300.4	1	3	2	2	1	3	-	-	-	-	-	-	3	2	2	-
EC300	**1**	**3**	**2**	**2**	**1**	**2.5**	-	-	-	-	-	-	**3**	**2**	**2**	-

No.	Content	Hours	COs
I	**MOS Transistor:** MOS Structure and Operation, MOSFET Structure And Operations, MOSFET Current- Voltage Characteristics, Channel Length Modulation, Substrate Bias Effect, MOSFET Capacitances, MOSFET Model.	**9**	**EC300.1**
II	**CMOS Differential Amplifiers:** BJT/MOSFET Differential Amplifier, DC Transfer Characteristics of An Emitter-Coupled Pair / Source - Coupled Pair, Current Mirrors (Bipolar / MOS), Bipolar Widlar Current Source/ MOS Widlar Current Source, Cascaded Differential Amplifier Stages and Level Translator, AC and DC Analysis of Cascade Amplifier.	**7**	**EC300.2**
III	**CMOS Operational Amplifier Fundamentals:** Operational Amplifier, Basic Op-Amp Configuration, An Op-Amp with Negative Feedback, Voltage Series and Voltage Shunt Configurations, Difference Amplifiers, Specification of An Op-Amp, Offset Voltages and Currents, CMRR, Slew Rate, PSRR, Frequency Response, GBW Product, Input Bias and Offset Currents.	**7**	**EC300.3**
IV	**NMOS Logic Design:** Resistive-Load Inverter, Saturated-Loaded Inverter, Linear Loaded Inverter, Depletion Loaded Inverter, Graphical Determination of VTC, Calculation of VTC Critical Points, Power Dissipation and Rise Time - Fall Time, NMOS Logic Gates.	**7**	**EC300.4**
V	**CMOS Logic Design:** CMOS Inverter Technology, Static Characteristics, Dynamic Behavior, Static and Dynamic Power Dissipation, Power-Delay Product. CMOS Gates, TTL-CMOS Interfacing.	**10**	
	Total Hours	**40**	

Essential Readings

1. S-M. Kang and Y. Leblebici, "CMOS Digital Integrated Circuits: Analysis and Design", Tata McGraw-Hill, 3rd Edition, 2002.
2. B. Razavi, "Design of Analog CMOS Integrated Circuit" Tata McGraw-Hill, 2rd Edition, 2017

Supplementary Readings

1. H. Taub and D. Schilling, "Digital Integrated Electronics", McGraw-Hill, International, 2017.
2. R. Jan, A. Chandrakasan, and B. Nikolic, "Digital Integrated Circuits: A Design Perspective", Pearson Education, 2nd Edition 1999
3. John P. Uyemura, Introduction to VLSI Circuits and Systems, Wiley, 2006
4. S.Salivahanan & V.S. Kanchana Bhaskaran, -Linear Integrated Circuits, TMH,2nd Edition, 4 th Reprint, 2016

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Department	**Electronics and Communication Engineering**	Semester	**VI**

Course Code	Course Name	Pre-Requisite	Credit Structure				Marks Distribution			
			L	T	P	C	INT	MID	END	Total
EC302	**Wireless Communication: 5G and Beyond**	-----	**3**	**0**	**0**	**3**	**50**	**50**	**100**	**200**

			COs	**Statement**	**Bloom's Taxonomy**
Course Objectives	To provide students an understanding of cellular systems	Course Outcomes	EC302.1	Able to model the wireless channel in terms of large-scale/small-scale fading, delay spread, coherence time parameters, and understand the basic concepts of Cellular Systems and the design requirements	Knowledge Application
	To explore the concepts related to wireless channel propagation models and fading		EC302.2	Able to gain insights into various mobile radio propagation models and the fading effects on the system performance	Knowledge Application
	To familiarize students on how diversity can be exploited to improve performance and channel capacity analysis		EC302.3	Able to analyse the effectiveness of diversity techniques to mitigate the multichannel fading effects on received signals with insights on MIMO technology and understanding channel capacity	Knowledge Analyze
	To familiarize students with multiple access techniques in 3G, 4G, 5G and beyond		EC302.4	Enabling the students to think in terms of innovative ideas to improve the existing technology in the field of wireless communication in multiuser scenarios and beyond 5G	Application

COs	Mapping with Program Outcomes (POs)												Mapping with PSOs			
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO 9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
EC302.1	3	2	2	1	-	-	-	-	2	-	-	-	3	2	3	-
EC302.2	2	3	2	2	-	-	-	-	2	-	-	-	3	1	2	-
EC302.3	1	2	3	2	2	-	-	-	-	-	-	1	2	2	3	-
EC302.4	1	3	3	-	-	-	-	-	1	-	-	-	2	3	2	-
EC302	**1.75**	**2.5**	**2.5**	**1.25**	**2**	**-**	**-**	**-**	**1.25**	**-**	**-**	**1**	**2.5**	**2**	**2.5**	**-**

SYLLABUS

No.	Content	Hours	COs
I	**Overview of wireless systems:** Motivation and introduction for wireless communication, The cellular concept fundamentals: cell capacity and reuse.	**05**	**EC302.1**
II	**Wireless propagation models and fading:** Large scale path loss - Free-space propagation model, propagation path loss, outdoor propagation models (Okumura model & Hata model), combined pathloss and shadowing. Small scale and multipath fading - AWGN Channel, multipath fading, flat and frequency selective fading, BER performance for various modulations (BPSK, QPSK, QAM, PAM), slow and fast fading, delay spread and coherence bandwidth, Rayleigh, Rician and Nakagami channel models.	**10**	**EC302.1** **EC302.2**
III	**Diversity & Combining Techniques:** Introduction to SIMO, MISO, MIMO, Realization of independent fading paths, Receiver diversity: selection combining (SC), maximum ratio combining (MRC), equal gain combining (EGC), Transmitter diversity: the Alamouti scheme, BER performance of all above schemes, Singular Value Decomposition of Channel, Optimal Power Allocation, MIMO Zero-Forcing, and MMSE Receivers. **Capacity of wireless channels:** AWGN channel capacity, capacity of fading channels– slow fading, fast fading channel	**12**	**EC302.3**
IV	**Multiuser communication, and multiple access techniques:** Introduction to 2G, 3G, and 4G technologies, Time Division Multiple Access (TDMA), Frequency Division Multiple Access (FDMA), Orthogonal Frequency-Division Multiplexing (OFDM), and Orthogonal Frequency Division for Multiple Access (OFDMA), Single Carrier FDMA schemes, Introduction to MIMO-OFDM, Long Term Evolution (LTE)	**08**	**EC302.4**
V	**Application to 5G and Beyond:** Generalized Frequency-Division Multiplexing (GFDM), Filter Bank Multicarrier (FBMC), Non-orthogonal multiple access (NOMA), Intelligent Reflecting Surfaces (IRS)	**05**	**EC302.4**
	Total Hours	**40**	

Essential Readings

1. T.S. Rappaport, "Wireless Communications – Principles and Practice", 2nd edition, Pearson, 2010.
2. D. Tse and P. Vishwanath, "Fundamentals of Wireless Communications", Cambridge Univ Press, 2005.
3. A. Molisch, "Wireless Communications", Wiley, 2005.

Supplementary Readings
1. A. Goldsmith, “Wireless Communications”, Cambridge Univ Press, 2005
2. William C.Y. Lee, “Wireless and Cellular Telecommunications,” Third edition, Mc. Graw Hill, 2006
3. Aditya K. Jagannatham, “Principles of Modern Wireless Communications Systems” McGraw Hill Education, 1st edition, 2015.
4. NPTEL Video Lectures on Advanced 3G and 4G Communication

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Course Code	Course Name	Pre-Requisite	Credit Structure				Marks Distribution			
			L	T	P	C	INT	MID	END	Total
EC310	**Antenna & Wave propagation**	-----	**3**	**0**	**0**	**3**	**50**	**50**	**100**	**200**

Course Objectives	
	To understand the fundamentals of the antenna and its parameters
	To understand the concepts of antenna array
	To understand and analyse different types of antenna
	To understand various propagation characteristics

Course Outcomes	CO's	Statement	Bloom's Taxonomy
	EC310.1	Able to acquire knowledge about the fundamentals of the antenna and its parameters.	Knowledge Comprehension
	EC310.2	Able to understand the basic concepts of antenna array.	Knowledge Application
	EC310.3	Able to understand and analyze different types of antenna.	Knowledge Application
	EC310.4	Able to understand various propagation characteristics.	Knowledge Application

COs	Mapping with Program Outcomes (POs)												Mapping with PSOs			
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
EC310.1	3	3	2	2	1	-	-	-	-	-	-	-	3	2	2	-
EC310.2	3	3	2	2	1	-	-	-	-	-	-	-	3	2	2	-
EC310.3	3	3	2	2	1	-	-	-	-	-	-	-	3	2	2	-
EC310.4	3	3	2	2	1	-	-	-	-	-	-	-	3	2	2	-
EC310	**3**	**3**	**2**	**2**	**1**	-	-	-	-	-	-	-	**3**	**2**	**2**	-

SYLLABUS

No.	Content	Hours	COs
I	**Fundamentals of antenna and antenna parameters:** Antenna Characteristics: Radiation Pattern, Beam Width, Radiation Resistance and efficiency, Directivity and Gain, Impedance, VSWR, Polarization, Effective height and Receive Aperture, Noise Temperature of Antenna. Radiation fields and Characteristics of λ/2 dipole, discussion on λ/4 monopole antenna, Horizontal and Vertical antennas over a plane ground.	**10**	**EC310.1**
II	**Array antenna:** Electric Field due to 2-element arrays, 3-element Arrays; Pattern Multiplication; Uniform Linear Array: End fire and Broadside; Phased array.	**10**	**EC310.2**
III	**Analysis of different types of antenna:** Compute the input and mutual impedance of the antennas, Characteristics and properties of : Travelling Wave Antenna, Helical Antenna, Folded Dipole, Yagi-Uda Array, Loop Antenna, Electrically Short Antennas, Broad Band Antenna (Log periodic Antenna), Microstrip Patch Antenna. Radiation from an aperture: Sectoral and Pyramidal Horn Antennas, Design of Optimum Horn Antenna; Parabolic and Corner Reflectors and feed systems.	**10**	**EC310.3**
IV	**Propagation characteristics:** Methods of Propagation: Ground Wave Propagation, Components of ground wave, Field strength dependence on physical factors. Skywave Propagation, Ionospheric Layers, Virtual Height, Critical Frequency, MUF, Skip distance, Sporadic Reflections. Space wave propagation: Tropospheric Scatter, Ducting Super refraction, Sub refraction. Friss Transmission Formula, SNR of a Radio Link. Physical (Medium) effects on Radio wave Propagation: Absorption, Refraction and Radio Horizon, Diffraction, Multipath Propagation and fading, Noise, Doppler effect.	**12**	**EC310.4**
	Total Hours	**42**	

Essential Readings

1. J. D. Kraus, R.J. Marhefka and A. S. Khan, "Antennas and Wave Propagation", Tata McGraw-Hill, 5th Edition,2017.
2. C. A. Balanis, "Antenna Theory: Analysis & Design", John Wiley & Sons, 4th Edition, 2016.

Supplementary Readings

1. E. C. Jordan and Balmain K. G., "Electromagnetic Waves and Radiating Systems", Prentice Hall, 2nd Edition, 2015.
2. C. A. Balanis, "Modern Antenna Handbook", John Wiley & Sons, 3rd Edition, 2007.
3. A. R. Harish, M. Sachidananda, "Antennas and Wave Propagation", Oxford University Press,4th Edition, 2007.
4. NPTEL Video lectures on Antenna & Wave propagation: https://onlinecourses.nptel.ac.in/noc24_ee150/preview

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Department	**Electronics and Communication Engineering**	Semester	**VI**

Course Code	Course Name	Pre-Requisites	Credit Structure				Marks Distribution			
			L	T	P	C	INT	MID	END	Total
EC 312	**Digital Image Processing**	----	**3**	**0**	**0**	**3**	**50**	**50**	**100**	**200**

Course Objectives		Course Outcomes			
			COs	**Statement**	**Bloom's Taxonomy**
	To study fundamentals of digital image processing.		EC312.1	Ability to understand the fundamentals of digital image processing.	Knowledge Understand
	To study the various image enhancement techniques in spatial and frequency domain		EC312.2	Ability to analyse the various image enhancement techniques in spatial and frequency domain.	Analyze
	To study different causes for image degradation and image restoration techniques.		EC312.3	Ability to understand the different causes for image degradation and image restoration techniques.	Knowledge Understand
	To study the data compression used in image processing.		EC312.4	Ability to analyze the various image compression techniques.	Analyze
	To study the morphological operations, segmentation techniques, feature extraction for image analysis.		EC312.5	Ability to understand the different techniques used in image analysis.	Knowledge Understand

COs	Mapping with Program Outcomes (POs)												Mapping with PSOs			
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
EC312.1	3	1	1	-	1	-	-	-	1	-	-	-	3	1	1	-
EC312.2	3	3	3	2	3	-	-	-	2	-	-	-	3	2	2	-
EC312.3	3	2	2	-	2	-	-	-	2	-	-	-	3	1	2	-
EC312.4	3	3	3	2	3	-	-	-	2	-	-	-	3	2	2	-
EC312.5	3	3	3	2	3	-	-	-	2	-	-	-	3	2	2	-
	3	**2.4**	**2.4**	**2**	**2.4**	**-**	**-**	**-**	**1.8**	**-**	**-**	**-**	**3**	**1.6**	**1.8**	**-**

SYLLABUS

No.	Content	Hours	COs
I	**Digital image fundamental:** Elements of digital image processing systems, Vidicon and Digital Camera working principles, - Elements of visual perception, brightness, contrast, hue, saturation, mach band effect, Color image fundamentals - RGB, HSI models, Image sampling, Quantization. Image Transformation: 2D DFT, DCT, SVD, Walsh-Hadamard transform, KLT, Haar transform and discrete wavelet transform	**8**	**EC312.1**
II	**Image Enhancement:** Point processing, Histograms, Histogram equalization and specification techniques, Image Smoothing, Spatial Filtering: Median, Geometric mean, Harmonic mean, Contraharmonic mean filters, Homomorphic filtering, Color image enhancement, Frequency domain filtering.	**8**	**EC312.2**
III	**Image Restoration:** Image Restoration - degradation model, Unconstrained and Constrained restoration, Inverse filtering, Wiener filtering, Geometric transformations-spatial transformations.	**8**	**EC312.3**
IV	**Image Compression and its applications:** Need for data compression, Huffman, Run Length Encoding, Shift codes, Arithmetic coding, Vector Quantization, Transform coding, JPEG standard, MPEG.	**8**	**EC312.4**
V	**Image Analysis and its applications:** Detection of Discontinuities Point, Line And Edges; Boundary Detection, Morphological Operations, Segmentation techniques, Spatial and transform features, Classifications.	**10**	**EC312.5**
	Total Hours	**42**	

Essential Readings

1. Gonzalez R. C. and Woods R. E, "Digital Image Processing", Pearson Prentice Hall, 4th edition, 2018.
2. Anil K. Jain, "Fundamentals of Digital Image Processing", Pearson Education, Inc., 2015.

Supplementary Readings

1. Sonka M. Hlavac V., Boyle R., "Image Processing, Analysis and Machine Vision", Cengage Learning, 3rd edition, 2007.
2. Gonzalez R. C, Woods R. E and Eddins S. L "Digital Image Processing using MATLAB", McGraw Hill Education, 2nd edition, 2017.

	National Institute of Technology Meghalaya An Institute of National Importance	**CURRICULUM**

Programme	**Bachelor of Technology in Electronics and Communication Engineering**	Year of Regulation	**2024-25**
Department	Electronics and Communication Engineering	Semester	**VI**

Course Code	Course Name	Pre-Requisite	Credit Structure				Marks Distribution			
			L	T	P	C	INT	MID	END	Total
EC 314	**Embedded Systems**	**-----**	**3**	**0**	**0**	**3**	**50**	**50**	**100**	**200**

Course Objectives		Course Outcomes			
			COs	**Statement**	**Bloom's Taxonomy**
	To make the students to understand and program embedded systems using modern embedded ARM processors		EC314.1	Design embedded systems with appropriate hardware and software components	Knowledge Design
	To build embedded platforms, interfaces, peripherals, processors and operating systems associated with embedded systems		EC314.2	Analyze, program and use a typical ARM processor and its peripherals	Knowledge Analyze
	Design high-level drivers usage for the integration of sensors		EC314.3	Interface various real-time sensors using different communication protocols	Application
	Develop a comprehensive view of the software framework being developed around embedded SOCs.		EC314.4	Categorize and classify operating system tasks with particular emphasis on real-time system	Knowledge Understand
	Develop real time operating systems on embedded system based applications		EC314.5	Apply the study of embedded technology to product design	Application

COs	Mapping with Program Outcomes (POs)												Mapping with PSOs			
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
EC314.1	2	2	3	3	-	-	-	-	-	-	-	-	2	1	-	-
EC314.2	3	2	-	3	-	-	-	-	-	-	-	-	2	1	-	-
EC314.3	3	3	2	-	-	-	-	-	-	-	-	-	2	1	-	-
EC314.4	3	2	1	2	-	-	-	-	-	-	-	-	2	1	-	-
EC314.5	-	-	3	-	2	-	-	-	-	-	-	-	-	-	-	-
EC314	**2.75**	**2.25**	**2.25**	**2.6**	**2**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**2**	**1**	**-**	**-**

SYLLABUS

No.	Content	Hours	COs
I	**Introduction to Embedded Computing:** Characteristics of Embedding Computing Applications, Concept of Real-time Systems, Challenges in Embedded System Design, Design Process. Embedded System Architecture: Instruction Set Architecture of ARM	**8**	**EC314.1**
II	**Embedded Computing Platform:** Bus Protocols, Bus Organization, Memory Devices and their Characteristics, Memory-mapped I/O, I/O Devices, I/O mapped I/O, Timers and Counters, Watchdog Timers, Interrupt Controllers, Interrupt programming, GPIO control, Sensors, Actuators, A/D and D/A Converters, Need of low power for embedded systems, Mixed Signals Processing	**8**	**EC314.2, EC314.3**
III	**Programming Embedded Systems:** Basic Features of an Operating System, Kernel Features, Real-time Kernels, Processes and Threads, Context Switching, Scheduling, Shared Memory Communication, Message-Based Communication, Real-time Memory Management, Dynamic Allocation, Device Drivers, Real-time Transactions and Files, Real time OS (VxWorks, RT-Linux, Psos).	**12**	**EC314.3, EC314.4**
IV	**Network Based Embedded Applications:** Embedded Networking Fundamentals, Layers and Protocols, Distributed Embedded Architectures, Internet-Enabled Systems, IoT overview and architecture, Interfacing Protocols (like UART, SPI, I2C, GPIB, FIREWIRE, USB,). Various wireless protocols and its applications: NFC, Zig Bee, Bluetooth, Bluetooth Low Energy, Wi-Fi. CAN. Overview of wireless sensor networks and design examples. **Case Studies:** Programming in Embedded C, Embedded system design using Arduino, ATOM processors, Galileo, STM, Tiva based embedded system applications.	**14**	**EC314.2, EC314.3, EC314.5**
	Total Hours	**42**	

Essential Readings

1. Alexander G. Dean "Embedded Systems Fundamentals with Arm Cortex M Based Microcontrollers: A Practical Approach" ARM Education media Publishers , Ist edition, 2017
2. Rob Toulson and Tim wilmshrrst "Fast and Effective Embedded Systems Design: Applying the ARM mbed "Newnes Publishers , IInd edition, 2017
3. Wayne Wolf, "Computers as Components- Principles of Embedded Computing System Design", Morgan Kaufmann Publishers, IInd edition, 2008
4. Dogan Ibrahim"ARM-based Microcontroller Projects Using mbed", Newnes Publishers Ist edition, 2019

Supplementary Readings

1. Lyla B. Das, "Embedded Systems –An Integrated Approach", Pearson Publishers, Ist edition, 2013
2. Marwedel Peter, "Embedded System Design, Springer Publishers, Ist edition , 2006.
3. Barry Crowley, "Modern Embedded Computing", Morgan Kaufmann Publishers, Ist edition, 2012

	National Institute of Technology Meghalaya An Institute of National Importance	**CURRICULUM**

Programme	**Bachelor of Technology in Electronics and Communication Engineering**	Year of Regulation	**2024-25**
Department	**Electronics and Communication Engineering**	Semester	**VI**

Course Code	Course Name	Pre-Requisite	Credit Structure				Marks Distribution			
			L	T	P	C	INT	MID	END	Total
EC 316	**MICRO-ELECTROMECHANICAL SYSTEMS (MEMS)**	-----	**3**	**0**	**0**	**3**	**50**	**50**	**100**	**200**

			COs	**Statement**	**Bloom's Taxonomy**
Course Objectives	Familiarization to the fundamentals and applications of MEMS	Course Outcomes	EC316.1	Ability to understand the basic operation of MEMS devices and their applications	Knowledge Comprehension
	Understand the basic principles and operation of MEMS devices		EC316.2	Able to design MEMS devices based on various transduction techniques	Knowledge Application
	Understand various materials fabrication technologies used in MEMS		EC316.3	Able to identify materials and fabrication processes to develop MEMS devices	Knowledge Application

COs	Mapping with Program Outcomes (POs)												Mapping with PSOs			
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
EC316.1	**2**	**2**	-	-	-	-	-	-	-	-	-	-	**2**	**1**	-	-
EC316.2	**2**	**2**	-	-	-	-	-	-	-	-	-	-	**2**	**1**	-	-
EC316.3	**2**	**2**	-	-	-	-	-	-	-	-	-	**2**	**2**	**1**	-	-
EC 316	**2**	**2**	-	-	-	-	-	-	-	-	-	**2**	**2**	**1**	-	-

SYLLABUS

No.	Content	Hours	COs
I	Overview of MEMS: Introduction to MEMS, Typical MEMS devices and products, Evolution of Microfabrication, Microelectronics and MEMS, Applications of MEMS.	**10**	**EC316.1**
II	Working Principles of MEMS devices: Introduction to MEMS based sensors ans actuators, Basic Mechanical Structures used in MEMS (Diaphagms, Cantilever, Bridge structures), Various Transduction Mechanisms for MEMS devices (Piezoresistive, Piezoelectric, Capacitive, Electrostatic transduction mechanisms), Basic electronic circuitry for interfacing of MEMS devices.	**10**	**EC316.2**
III	Materials and Fabrication Processes for MEMS: Materials - Silicon as a Substrate Material, Silicon Compounds, Gallium Arsenide, Quartz, Piezoelectric Crystals, Polymers, Packaging Materials, Fabrication processes: Photolithography, Diffusion, Ion Implantation, Oxidation, Chemical Vapor Deposition, Physical Vapor Deposition – Sputtering, Deposition by Epitaxy, Dry and Wet Etching Techniques, Micromachining processes: Bulk and Surface Micromachining, The LIGA Process.	**10**	**EC316.3**
IV	Study of various and recently developed MEMS based devices for various applications.	**12**	**EC316.1** **EC316.2** **EC316.3**
	Total Hours	**42**	

Essential Readings

1. T.R. Hsu, "MEMS and Microsystems: Design and Manufacture", McGraw Hill, 1st Edition, 2002.
2. M.H. Bao, "Analysis and Design Principles of MEMS Devices", Elsevier, 1st Edition, 2008.
3. M.J. Madou, "Fundamentals of Microfabrication: The Science of Miniaturization", CRC Press, 2nd Edition, 2002.

Supplementary Readings

1. G.K. Ananthasuresh, K.J. Vinoy, S. Gopalakrishnan, K.N. Bhat and V.K. Aatre, "Micro and Smart Systems", Wiley India, 1st Edition, 2010.
2. S.D. Senturia, "Microsystem Design", Springer, 1st Edition, 2001.

	National Institute of Technology Meghalaya An Institute of National Importance	**CURRICULUM**

Programme	**Bachelor of Technology in Electronics and Communication Engineering**	Year of Regulation	**2024-25**
Department	**Electronics and Communication Engineering**	Semester	**VI**

Course Code	Course Name	Pre-Requisite	Credit Structure				Marks Distribution			
			L	T	P	C	INT	MID	END	Total
EC370	**Satellite Communication**	-----	3	0	0	3	50	50	100	200

		CO's	**Statement**	**Bloom's Taxonomy**
Course Objectives	To understand the fundamentals of satellite communication and its parameters.	Course Outcomes	EC370.1 Able to acquire knowledge about the fundamentals of satellite Communication and its parameters.	Knowledge Synthesis
	To understand the concepts of satellite orbits and trajectories.		EC370.2 Able to understand the basic concepts of satellite orbits and Trajectories.	Knowledge Comprehension
	To understand the basics of satellite launch vehicles, subsystems and earth Station.		EC370.3 Able to understand the basics of the satellite launch vehicle, subsystem, and earth station.	Knowledge Comprehension
	To understand various multiple access techniques.		EC370.4 Able to understand various multiple access techniques.	Knowledge Application

COs	Mapping with Program Outcomes (POs)												Mapping with PSOs			
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
EC370.1	3	3	2	2	-	-	-	-	-	-	-	-	3	2	2	-
EC370.2	3	3	2	2	-	-	-	-	-	-	-	-	2	2	2	-
EC370.3	3	3	2	2	-	-	-	-	-	-	-	-	2	3	2	-
EC370.4	3	3	2	2	-	-	-	-	-	-	-	-	3	2	2	-
EC370	**3**	**3**	**2**	**2**	-	-	-	-	-	-	-	-	**2.5**	**2.25**	**2**	-

SYLLABUS

No.	Content	Hours	COs
I	**Introduction & fundamental parameters:** Historical background, Basic concepts, Frequency allocation for satellite services, orbital & spacecraft problems, comparison of networks and services, modulation techniques used for satellite communication	**10**	**EC370.1**
II	**Satellite orbits and trajectories:** Two-body problem, orbital mechanics, Orbital parameters, the geostationary orbit, change in longitude, orbital manoeuvres, orbital transfer, orbital perturbations, Injection velocity and satellite trajectory, Types of Satellite orbits, Orbital perturbations, Satellite stabilization, Orbital effects on satellite's performance, Eclipses, Look angles: Azimuth angle, Elevation angle.	**10**	**EC370.2**
III	**Satellite launch vehicle:** Launch Vehicles- principles of Rocket propulsion, powered flight, Launch vehicles for communication satellite subsystem. **Power supply subsystem:** Attitude and Orbit control, Tracking, Telemetry and command subsystem, Payload. **Earth station:** Types of earth station, Architecture, Design considerations, Testing, Earth station Hardware, Satellite tracking.	**12**	**EC370.3**
IV	**Multiple accesses:** Introduction, FDMA (No derivation), SCPC Systems, MCPC Systems, TDMA, CDMA, SDMA**.**	**10**	**EC370.4**
	Total Hours	**42**	

Essential Readings

1. D. Roddy, "Satellite Communications", Tata- MacGraw Hill, 4th Edition, 2017.
2. T. Pratt, C. Bostian, J. Allnutt, "Satellite Communications", John Wiley & Sons, 3rd Edition, 2019.

Supplementary Readings

1. W.L. Pritchard, H. G. Suyderhoud, R. A. Nelson, "Satellite Communications Systems Engineering", Prentice-Hall,4th Edition, 2008.
2. A. K. Maini, V. Agrawal, "Satellite Technology: Principles and Applications", John Wiley & Sons, 3rd Edition, 2014.
3. J. Louis, Jr. Ippolito , "Satellite Communications Systems Engineering: Atmospheric Effects, Satellite Link Design and System Performance", Wiley,1st Edition, 2017.

	National Institute of Technology Meghalaya An Institute of National Importance	**CURRICULUM**

Programme	**Bachelor of Technology in Electronics and Communication Engineering**	Year of Regulation	**2024-25**
Department	**Electronics and Communication Engineering**	Semester	**VI**

Course Code	Course Name	Pre-Requisite	Credit Structure				Marks Distribution			
			L	T	P	C	INT	MID	END	Total
EC 372	**Cyber Physical System**	**-----**	3	0	0	3	50	50	100	200

		CO's	**Statement**	**Bloom's Taxonomy**
Course Objectives	To provide students with a comprehensive understanding of the fundamental principles and concepts of Cyber Physical Systems (CPS).	EC 372.1	Able to describe the basic components and architecture of Cyber Physical Systems (CPS) and explain their applications in various domains.	*Remembering, Understanding*
	To equip students with the skills to design and model CPS using various tools and techniques	EC 372.2	Ability to apply design principles and modeling techniques to develop and analyze CPS.	*Applying, Analyzing*
	To develop the ability to integrate computational algorithms with physical processes through sensors and actuators.	EC 372.3	Able to integrate software and hardware components effectively to create functional CPS prototypes, and evaluate their performance and reliability..	*Evaluating, Creating*
	To impart knowledge on the security, privacy, and reliability challenges in CPS and approaches to address them.	EC 372.4	Able to identify and analyze security and privacy issues in CPS, and propose and justify appropriate solutions.	*Analyzing, Creating*

COs	Mapping with Program Outcomes (POs)												Mapping with PSOs			
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
EC 372.1	3	3	2	2	-	-	-	-	-	-	-	-	3	2	2	-
EC 372.2	3	3	2	2	-	-	-	-	-	-	-	-	2	2	2	-
EC 372.3	3	3	2	2	-	-	-	-	-	-	-	-	2	3	2	-
EC 372.4	3	3	2	2	-	-	-	-	-	-	-	-	3	2	2	-
EC 372	**3**	**3**	**2**	**2**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**2.5**	**2.25**	**2**	**-**

SYLLABUS

No.	Content	Hours	COs
I	**Introduction to Cyber Physical Systems: Definition and Characteristics, Examples and Applications in Various Domains, Basic Architecture and Components, Challenges and Opportunities, Types of Sensors and Actuators, Sensor Networks, Data Acquisition and Signal Processing, Interface and Communication Protocols, Microcontrollers and Microprocessors, Real-Time Operating Systems (RTOS), Embedded Software Design, Hardware-Software Co-Design.**	**10**	**EC 372.1**
II	**Modeling and Design of CPS: System Modeling Techniques, Design Methodologies, Simulation Tools (e.g., MATLAB, Simulink), Case Studies, Communication Protocols for CPS, Network Topologies and Architectures, Wireless Sensor Networks, Internet of Things (IoT) in CPS.**	**8**	**EC 372.2**
III	**Security and Privacy in CPS: Security Threats and Vulnerabilities, Cryptographic Techniques, Privacy-preserving Mechanisms, Case Studies on Security Breaches and Solutions, Fault Models and Error Detection, Fault Tolerance Techniques, Redundancy and Recovery Mechanisms, Dependability Metrics and Evaluation**	**12**	**EC 372.3**
IV	**Applications of CPS: Smart Grids, Autonomous Vehicles, Healthcare Systems, Industrial Automation, Case Studies and Emerging Trends**	**10**	**EC 372.4**
	Total Hours	**40**	

Essential Readings

1. Edward A. Lee, Sanjit A. Seshia, "Introduction to Embedded Systems: A Cyber-Physical Systems Approach", MIT Press, 2016
2. Wolfgang E. Isch, "Understanding Cyber-Physical Systems", Springer, 2020.

Supplementary Readings

1. Danda B. Rawat, Joel J.P.C. Rodrigues, Ivan Stojmenovic, "Cyber-Physical Systems: From Theory to Practice", CRC Press, 2015.
2. Fei Hu, "Cyber-Physical Systems: Integrated Computing and Engineering Design", CRC Press, 2013.
3. Rajeev Alur, "Principles of Cyber-Physical Systems", MIT Press, 2015.

	National Institute of Technology Meghalaya An Institute of National Importance	**CURRICULUM**

Programme	**Bachelor of Technology in Electronics and Communication Engineering**	Year of Regulation	**2024-25**
Department	**Electronics and Communication Engineering**	Semester	**VI**

Course Code	Course Name	Pre-Requisite	Credit Structure				Marks Distribution		
			L	T	P	C	CONTINUOUS EVALUATION	VIVA	Total
EC350	**Digital and Analog Integrated Circuits Lab**	-----	0	0	2	1	70	30	100

Course Objectives	To understand Spice Simulation of Circuits	Course Outcomes	**CO's**	**Statement** / **Bloom's Taxonomy**
	To understand the amplifier characteristics		EC350.1	To understand Design of circuits using Spice simulator — Knowledge Application
	To develop an ability of CMOS Circuits design		EC350.2	To develop Design of amplifier using Spice simulator — Knowledge Application
			EC350.3	To understand the design of CMOS analog digital circuits — Knowledge Application

COs	Mapping with Program Outcomes (POs)												Mapping with PSOs			
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
EC350.1	-	2	3	2	1	3	-	-	-	-	-	-	3	2	2	-
EC350.1	-	2	3	2	1	3	-	-	-	-	-	-	3	2	2	-
EC350.1	-	2	-	2	1	3	-	-	-	-	-	-	3	2	2	-
EC350	**-**	**2**	**3**	**2**	**1**	**3**	**-**	**-**	**-**	**-**	**-**	**-**	**3**	**2**	**2**	**-**

SYLLABUS

No.	Content	Hours	COs
I	**Introduction to SPICE Circuit Simulator.**	**28**	**EC350.1, EC350.2 & EC350.3**
II	Inverting and Non-Inverting Amplifiers. Summing, Scaling and Averaging. Integrator and Differentiator		
III	Implementation of CMOS Inverter. Obtain & Plot Its Transfer Characteristics, Determine Noise Margins and Measure Propagation Delay. Realization of MOSFET Characteristics Using Circuit Simulator Characteristics and BSIM Models. Realization of CMOS logic Gates.		
IV	Realization of CMOS Half Adder & Full Adder Circuit.		
V	Layout of CMOS Inverter and Parasitic Extraction and Obtain VTC of Extracted Netlist		
	Total Hours		

Essential Readings

1. S-M. Kang and Y. Leblebici, "CMOS Digital Integrated Circuits: Analysis and Design", Tata McGraw-Hill, 3rd Edition, 2002
2. B. Razavi, "Design of Analog CMOS Integrated Circuit" Tata McGraw-Hill, 2rd Edition, 2017

Supplementary Readings

1. H. Taub and D. Schilling, "Digital Integrated Electronics", McGraw-Hill, International, 2017.
2. R. Jan, A. Chandrakasan, and B. Nikolic, "Digital Integrated Circuits: A Design Perspective", Pearson Education, 2nd Edition 1999.

	National Institute of Technology Meghalaya An Institute of National Importance	**CURRICULUM**

Programme	**Bachelor of Technology in Electronics and Communication Engineering**				Year of Regulation			**2024-25**	
Department	**Electronics and Communication Engineering**				Semester			**VI**	

Course Code	Course Name	Pre-Requisite	Credit Structure				Marks Distribution			
			L	T	P	C	INT	MID	END	Total
EC352	**Wireless Communication: 5G and Beyond Laboratory**	-----	**0**	**0**	**2**	**1**	**50**	**0**	**0**	**50**

			COs	**Statement**	**Bloom's Taxonomy**
Course Objectives	To develop the student's ability to analyze and design wireless communication systems	Course Outcomes	EC352.1	Able to develop a wireless communication system using simulation tools	Knowledge Application
			EC352.2	Able to work in teams to plan and execute the creation of Advanced wireless communication systems	Knowledge Application

COs	Mapping with Program Outcomes (POs)												Mapping with PSOs			
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
EC352.1	3	3	3	3	-	1	-	-	-	-	-	2	-	-	3	-
EC352.2	2	2	1	1	-	3	-	-	-	-	-	1	2	2	2	-
EC352	**2.5**	**2.5**	**2**	**2**	**-**	**2**	**-**	**-**	**-**	**-**	**-**	**1.5**	**2**	**2**	**2.5**	**-**

SYLLABUS

No.	Content	Hours	COs
1.	List of experiments related to digital communication using MATLAB software: 1. Path Loss model to determine the free space loss and the received power 2. Plot bit error rate (BER) vs signal-to-noise ratio (SNR) graph for different types of fading channel i) No Fading ii) frequency selective fading 3. To plot the bit error rate (BER) probability for modulation schemes (BPSK/QPSK/QAM) in Rayleigh channel using selection combining (SC) 4. To plot the bit error rate (BER) probability for modulation schemes (BPSK/QPSK/QAM) in AWGN/Rayleigh channel using maximum ratio combining (MRC) 5. To plot the bit error rate (BER) probability for modulation schemes (BPSK/QPSK/QAM) in AWGN/Rayleigh channel using equal gain combining (EGC) 6. To plot the bit error rate (BER) probability for modulation schemes (BPSK/QPSK/QAM) in AWGN/Rayleigh channel using maximal ratio transmission (assuming channel known at the transmitter) 7. To plot the bit error rate (BER) probability for modulation schemes (BPSK/QPSK/QAM) in AWGN/Rayleigh channel using the Alamouti scheme 8. To design and simulate CDMA transmitter and receiver with BPSK/QPSK/QAM modulation scheme and measuring the BER in i) AWGN channel ii) Rayleigh channel. 9. To analyze the effect of a specific modulation scheme on the bit rate of OFDM system in i) AWGN channel ii) Rayleigh channel 10. To analyze the effect of a specific modulation scheme on the bit rate of GFDM/FBMC system in i) AWGN channel ii) Rayleigh channel	**28**	EC352.1 EC352.2
	Total Hours	**28**	

Essential Readings

1. T.S. Rappaport, "Wireless Communications – Principles and Practice", 2nd edition, Pearson, 2010.
2. D. Tse and P. Vishwanath, "Fundamentals of Wireless Communications", Cambridge Univ Press, 2005.
3. A. Molisch, "Wireless Communications", Wiley, 2005.

Supplementary Readings

1. A. Goldsmith, “Wireless Communications”, Cambridge Univ Press, 2005
2. William C.Y. Lee, “Wireless and Cellular Telecommunications,” Third edition, Mc. Graw Hill, 2006

	National Institute of Technology Meghalaya An Institute of National Importance		CURRICULUM
Programme	**Bachelor of Technology in Electronics and Communication Engineering**	Year of Regulation	**2024-25**
Department	**Electronics and Communication Engineering**	Semester	**VI**

Course Code	Course Name	Pre-Requisite	Credit Structure				Marks Distribution			
			L	T	P	C	INT	MID	END	Total
EC364	**Embedded Systems Laboratory**	-----	**0**	**0**	**2**	**1**	**50**	**0**	**0**	**50**

Course Objectives		Course Outcomes			
			COs	**Statement**	**Bloom's Taxonomy**
	Develop real time operating systems on embedded system based applications		EC364.1	Interface various real-time sensors using different communication protocols	Knowledge Application
			EC364.2	Apply the study of embedded technology to product design	Knowledge Application

COs	Mapping with Program Outcomes (POs)												Mapping with PSOs			
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
EC364.1	3	3	3	3	-	1	-	-	-	-	-	2	-	-	3	-
EC364.2	2	2	1	1	-	3	-	-	-	-	-	1	2	2	2	1
EC364	**2.5**	**2.5**	**2**	**2**	-	**2**	-	-	-	-	-	**1.5**	**2**	**2**	**2.5**	**1**

SYLLABUS

No.	Content	Hours	COs
	1. Interfacing Arduino with various sensors like temperature, humidity, ultrasonic sensor, LDR, LED etc 2. Sending data to the cloud (thinkspeak) through ESP module. 3. Simulation and synthesis of Verilog code 4. Dumping verilog code on FPGA 5. Interfacing the sensors with the FPGA	**28**	**EC364.1, EC364.2**
	Total Hours	**28**	

Essential Readings

1. Alexander G. Dean "Embedded Systems Fundamentals with Arm Cortex M Based Microcontrollers: A Practical Approach" ARM Education media Publishers , Ist edition, 2017
2. Rob Toulson and Tim wilmshrrst "Fast and Effective Embedded Systems Design: Applying the ARM mbed "Newnes Publishers , IInd edition, 2017
3. Wayne Wolf, "Computers as Components- Principles of Embedded Computing System Design", Morgan Kaufmann Publishers, IInd edition, 2008
4. Dogan Ibrahim"ARM-based Microcontroller Projects Using mbed", Newnes Publishers Ist edition, 2019

Supplementary Readings

1. Lyla B. Das, "Embedded Systems –An Integrated Approach", Pearson Publishers, Ist edition, 2013
2. Marwedel Peter, "Embedded System Design, Springer Publishers, Ist edition , 2006.
3. Barry Crowley, "Modern Embedded Computing", Morgan Kaufmann Publishers, Ist edition, 2012

	National Institute of Technology Meghalaya An Institute of National Importance	**CURRICULUM**

Programme	**Bachelor of Technology in Electronics and Communication Engineering**	Year of Regulation	**2024-25**
Department	**Electronics and Communication Engineering**	Semester	**VI**

Course Code	Course Name	Pre-Requisite	Credit Structure				Marks Distribution		
			L	T	P	C	CONTINOUS EVALUATION	VIVA	Total
EC 366	**MEMS Lab**	-----	**0**	**0**	**2**	**1**	**70**	**30**	**100**

		COs	**Statement**	**Bloom's Taxonomy**
Course Objectives	To develop the student's ability to understand the working principle of various MEMS structures and sensors.	Course Outcomes EC366.1	Able to learn about working principle of various MEMS structures and sensors, studied in MEMS course (EC 316) through laboratory experiments/simulations.	Knowledge Application
	To develop the student's ability to studied in MEMS course (EC 316) through laboratory experiments/simulations.	EC366.2	To learn the use of MEMS simulation software for simulation of various MEMS structures and sensors.	Knowledge Application
		EC366.3	Prepare professional quality textual and graphical presentations of laboratory data	Design

COs	Mapping with Program Outcomes (POs)												Mapping with PSOs			
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
EC366.1	2	2	-	-	-	-	-	-	-	-	-	2	2	1	-	-
EC366.2	2	2	-	-	-	-	-	-	-	-	-	2	2	1	-	-
EC366.3	2	2	-	-	-	-	-	-	-	-	-	2	2	1	-	-
EC366	**2**	**2**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**2**	**2**	**1**	**-**	**-**

SYLLABUS

No.	Content	Hours	COs
I	Experiments related to MEMS Lab. 1 Simulation of diaphragm structures 2 Simulation of cantilever structure. 3 Simulation of bridge structure. 4 Simulation of MEMS piezoresistive pressure sensor 5 Development of MASK layout for MEMS piezoresistive pressure sensor 6 Virtual fabrication of MEMS piezoresistive pressure sensor 7 Simulation of Wheatstone bridge circuits using EDA tools.	**28**	**EC366.1** **EC366.12** **EC366.3**
	Total Hours	**28**	

Essential Readings

1. T.R. Hsu, "MEMS and Microsystems: Design and Manufacture", McGraw Hill, 1st Edition, 2002.
2. M.H. Bao, "Analysis and Design Principles of MEMS Devices", Elsevier, 1st Edition, 2008.

Supplementary Readings

1. G.K. Ananthasuresh, K.J. Vinoy, S. Gopalakrishnan, K.N. Bhat and V.K. Aatre, "Micro and Smart Systems", Wiley India, 1st Edition, 2010.
2. S.D. Senturia, "Microsystem Design", Springer, 1st Edition, 2001.

Seventh Semester Courses

	National Institute of Technology Meghalaya An Institute of National Importance	**CURRICULUM**

Programme	**Bachelor of Technology in Electronics and Communication Engineering**	Year of Regulation	**2024-25**
Department	**Electronics and Communication Engineering**	Semester	**VII**

Course Code	Course Name	Pre-Requisite	Credit Structure				Marks Distribution			
			L	T	P	C	INT	MID	END	Total
EC 411	**Electronic Device Fabrication**	-----	**3**	**0**	**0**	**3**	**50**	**50**	**100**	**200**

Course Objectives		Course Outcomes	**COs**	**Statement**	**Bloom's Taxonomy**
	To learn about clean room, wafer cleaning and wet etching process		EC411.1	Able to understand the fundamentals of electronics device fabrication and clean room environment	Knowledge Application
	To learn about the impurity incorporation technology		EC411.2	Able to learn the various processes involved in the manufacturing of semiconductor devices	Knowledge Application
	To learn about the oxidation and deposition technology		EC411.3	Able to learn the step by stem fabrication processes of semiconductor devices such as diode, BJT, MOSFET and CMOS	Knowledge Application
	To learn about the lithography technology				

COs	Mapping with Program Outcomes (POs)												Mapping with PSOs			
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	
EC411.1	**2**	**3**	**2**	**1**	**-**	**3**	**-**	**-**	**2**	**-**	**-**	**-**	**3**	**-**	**3**	
EC411.2	**3**	**2**	**0**	**1**	**-**	**-**	**-**	**-**	**2**	**-**	**-**	**-**	**2**	**-**	**2**	
EC411.3	**2**	**3**	**3**	**1**	**2**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**2**	**3**	**-**	
EC411	**2.3**	**2.6**	**1.6**	**1**	**2**	**3**	**-**	**-**	**2**	**-**	**-**	**-**	**2.3**	**3**	**1.6**	

SYLLABUS

No.	Content	Hours	COs
I	Introduction and overview of semiconductor device fabrication and clean room environment	**10**	**EC411.1**
II	Oxidation, Diffusion and Lithography: Oxidation technologies in VLSI and ULSI, Dry and Wet oxidation processes; Solid State diffusion modelling and technology; Ion Implantation technology and damage annealing, Photolithography, E-beam lithography and newer lithography techniques for VLSI/ULSI; Mask generation. .	**10**	**EC411.2**
III	Thin film deposition and Etching techniques: CVD techniques for deposition of polysilicon, silicon dioxide, silicon nitride and metal films; PVD techniques: Evaporation and sputtering techniques, Etching techniques: Wet and Dry etching techniques,	**10**	**EC411.2**
IV	Fabrication of semiconductor devices including diode, BJT, MOSFET, CMOS and other advanced semiconductor devices.	**12**	**EC411.3**
	Total Hours	**42**	

Essential Readings

1. Gary S. May, S. M. Sze, "Fundamentals of Semiconductor Fabrication", John Wiley Inc. , 2014.
2. S.M. Sze, "VLSI Technology", McGraw Hill, 2nd ed, 1988.

Supplementary Readings

1. S.K. Ghandhi, "VLSI Fabrication Principles", John Wiley Inc., New York, 2nd ed, 1994
2. S. Cambell,, "The Science and Engineering of Microelectronic Fabrication", Oxford University Press., revised ed, 2003.

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Programme	**Bachelor of Technology in Electronics and Communication Engineering**	Year of Regulation	**2024-25**
Department	**Electronics and Communication Engineering**	Semester	**VII**

Course Code	Course Name	Pre-Requisite	Credit Structure				Marks Distribution			
			L	T	P	C	INT	MID	END	Total
EC 413	**An Introduction to Artificial Intelligence**	-----	**3**	**0**	**0**		**50**	**50**	**100**	**200**

			COs	**Statement**	**Bloom's Taxonomy**
Course Objectives	To understand the concept of Artificial intelligence and apply it to real world problems.	Course Outcomes	EC413.1	Ability to design a plan for the real world problems	Knowledge Design
			EC413.2	Ability to find the search strategies of AI problems.	Create
	To understand the developing technologies through Artificial intelligence.		EC413.3	Ability to design an agents for the real world problem	Knowledge
			EC413.4	Ability to design AI systems and propose algorithms.	Design
			EC413.5	Ability to solve complex problems by the AI methods.	Knowledge Application

COs	Mapping with Program Outcomes (POs)												Mapping with PSOs			
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
EC413.1	**2**	**1**	**-**	**-**	**1**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**2**	**-**	**1**	**-**
EC413.2	**1**	**2**	**2**	**2**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**1**	**2**	**-**	**2**	**-**
EC413.3	**-**	**2**	**2**	**1**	**2**	**-**	**-**	**-**	**-**	**-**	**-**	**2**	**2**	**2**	**2**	**-**
EC413.4	**-**	**2**	**-**	**1**	**2**	**-**	**-**	**-**	**-**	**-**	**-**	**2**	**2**	**2**	**2**	**-**
EC413	**1.5**	**1.75**	**2**	**1.3**	**1.6**	**-**	**-**	**-**	**-**	**-**	**-**	**1.6**	**2**	**2**	**1.75**	**-**

SYLLABUS

No.	Content	Hours	Cos
I	**Introduction** to Artificial Intelligence - Characteristics of Intelligent Agents - Typical Intelligent Agents - Problem Solving Approach to Typical AI problems	**8**	**EC413.1**
II	**Problem Solving Methods** : Search Strategies - Uninformed - Informed - Heuristics - Local Search Algorithms and Optimization Problems - Searching with Partial Observations - Backtracking Search - Performance of search algorithms.	**8**	**EC413.2**
III	**Knowledge Representation** First Order Predicate Logic - Unification - Forward Chaining - Backward Chaining - Resolution - Knowledge Representation using First order Predicate logic - Reasoning Systems.	**8**	**EC413.3**
IV	**Planning** Planning with state-space search - partial-order planning - planning graphs - planning and acting in the real world - Plan generation systems.	**8**	**EC413.4**
V	**Uncertain Knowledge and Reasoning** Uncertainty - review of probability - probabilistic Reasoning - Bayesian networks - inferences in Bayesian networks - Temporal models - Hidden Markov models **Applications:** Path planning, Health care system	**8**	**EC413.5**
	Total Hours	**40**	

Essential Readings

1. S. Russel, P. Norvig, "Artificial Intelligence – A Modern Approach", Third Edition, Pearson Education, 2015.

Supplementary Readings

1. Kevin Night, Elaine Rich, Nair B., "Artificial Intelligence (SIE)", Third Edition, McGraw Hill, 2017.
2. Dan W. Patterson, "Introduction to AI and ES", Pearson Education, 2007.

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Programme	**Bachelor of Technology in Electronics and Communication Engineering**	Year of Regulation	**2024-25**
Department	**Electronics and Communication Engineering**	Semester	**VII**

Course Code	Course Name	Pre-Requisite	Credit Structure				Marks Distribution			
			L	T	P	C	INT	MID	END	Total
EC 415	**Internet of Things**	**-----**	**3**	**0**	**0**	**3**	**50**	**50**	**100**	**200**

			CO's	**Statement**	**Bloom's Taxonomy**
Course Objectives	To understand the fundamentals of IoT System	Course Outcomes	EC415.1	Able to acquire knowledge about the fundamentals of IoT System	Knowledge Comprehension
	To understand the concepts of Communication in IoT System		EC415.2	Able to understand the basic concepts Communication in IoT system	Knowledge Application
	To understand the concepts of Programming of IoT System		EC415.3	Able to understand and analyze Programming of IoT system	Knowledge Application
	To understand the concept of Smart technology		EC415.4	Able to understand the concept of Smart Technologies	Knowledge Application

COs	Mapping with Program Outcomes (POs)												Mapping with PSOs			
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
EC415.1	1	3	2	2	2	-	-	-	-	-	-	-	3	2	2	-
EC415.2	2	3	2	2	3	-	-	-	-	-	-	-	3	2	2	-
EC415.3	1	3	2	2	3	-	-	-	-	-	-	-	3	2	2	-
EC415.4	1	3	2	2	3	-	-	-	-	-	-	-	3	2	2	-
EC415	**1.25**	**3**	**2**	**2**	**3**	-	-	-	-	-	-	-	**3**	**2**	**2**	-

SYLLABUS

No.	Content	Hours	COs
I	**IoT System-Introduction to IoT: Part I, Part II, Sensing, Actuation, Basics of Networking: Part-I, Part-II, Part III, Part IV.**	**10**	**EC415.1**
II	**Communication in IoT System -Communication Protocols: Part I, Part II, Part III, Part IV, Part V, Sensor Networks: Part I, Part II,Part III, Part IV, Part V, Part VI, Machine-to-Machine Communications**	**10**	**EC415.2**
III	**Programming of IoT System - Interoperability in IoT, Introduction to Arduino Programming: Part I, Part II, Integration of Sensors and Actuators with Arduino: Part I, Part II, Introduction to Python programming, Introduction to Raspberry Pi, Implementation of IoT with Raspberry Pi**	**10**	**EC415.3**
IV	**Smart Technology -Implementation of IoT with Raspberry Pi (contd), Introduction to SDN, SDN for IoT, Data Handling and Analytics, Cloud Computing, Sensor-Cloud, Fog Computing, Smart Cities and Smart Homes, Connected Vehicles, Smart Grid, Industrial IoT, Case Study: Agriculture, Healthcare, Activity Monitoring**	**10**	**EC415.4**
	Total Hours	**40**	

Essential Readings

1. S. Misra, A. Mukherjee, and A. Roy, 2020. *Introduction to IoT*. Cambridge University Press.Availability:
2. S. Misra, C. Roy, and A. Mukherjee, 2020. *Introduction to Industrial Internet of Things and Industry 4.0.* CRC Press.

Supplementary Readings

1. Bahga, Arshdeep, and Vijay Madisetti. *Internet of Things: A hands-on approach*. Vpt, 2014.
2. Ismail, Yasser, ed. *Internet of things (IoT) for automated and smart applications*. BoD–Books on Demand, 2019.
3. Tripathy, B. K., and J. Anuradha, eds. Internet of things (IoT): technologies, applications, challenges and solutions. CRC press, 2017.

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Programme	**Bachelor of Technology in Electronics and Communication Engineering**	Year of Regulation	**2024-25**
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Course Code	Course Name	Pre-Requisite	Credit Structure				Marks Distribution			
			L	T	P	C	INT	MID	END	Total
EC 417	**VLSI Design**	**-----**	**3**	**0**	**0**	**3**	**50**	**50**	**100**	**200**

Course Objectives		Course Outcomes			
			CO's	**Statement**	**Bloom's Taxonomy**
	To understand the fundamentals of MOS Simulation		EC417.1	Able to acquire knowledge about the fundamentals of MOS based Circuit Simulation	Knowledge Comprehension
	To understand the concepts of Combinational Logic Circuits and Spice Simulation		EC417.2	Able to understand the basic concepts Combinational Logic Circuits and Spice Simulation	Knowledge Application
	To understand the concepts of Sequential Logic Circuits and Spice Simulation		EC417.3	Able to understand and analyze Sequential Logic Circuits and Spice Simulation	Knowledge Application
	To understand the Memory Design and Spice Simulation		EC417.4	Able to understand the concept of Memory Design and Spice Simulation	Knowledge Application

COs	Mapping with Program Outcomes (POs)												Mapping with PSOs			
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
EC417.1	1	3	2	2	2	-	-	-	-	-	-	-	3	2	2	-
EC417.2	2	3	2	2	3	-	-	-	-	-	-	-	3	2	2	-
EC417.3	1	3	2	2	3	-	-	-	-	-	-	-	3	2	2	-
EC417.4	1	3	2	2	3	-	-	-	-	-	-	-	3	2	2	-
EC417	**1.25**	**3**	**2**	**2**	**2.75**	-	-	-	-	-	-	-	**3**	**2**	**2**	-

SYLLABUS

No.	Content	Hours	COs
I	**MOS Transistor:** MOS Transistor, MOS Parasitic & SPICE Model, CMOS Inverter	**10**	**EC417.1**
II	**Combinational Logic Circuits: Combinational Logic Circuits, Combinational Logic Circuits and Spice Simulation**	**10**	**EC417.2**
III	**Sequential Logic Design: Sequential Logic Circuits, Sequential Logic Circuits and Spice Simulation**	**10**	**EC417.3**
IV	**Clocking Strategies: Sequential Circuits, Logical Effort, Concept of Memory & its Designing, Complexity and Analysis**	**10**	**EC417.4**
	Total Hours	**40**	

Essential Readings

1. P. Ashenden, "Digital Design using VHDL", Elsevier, 1st Edition, 2007
2. P.J Anderson, "The designer's guide to VHDL", Morgan Kaufman, 1st Edition, 2008

Supplementary Readings

1. N.H.E. Weste, K. Haase, D. Harris, A. Banerjee, "CMOS VLSI Design: A circuits and Systems Perspective", Pearson Education, 4th Edition, 2011
2. W.Wolf , "FPGA System design", Pearson, 1st Edition, 2004
3. S. H. Gerez, "Algorithms for VLSI design automation", Wiley, 1st Edition, 1998

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Course Code	Course Name	Pre-Requisite	Credit Structure				Marks Distribution			
			L	T	P	C	INT	MID	END	Total
EC419	**Information Theory and Coding**	-----	**3**	**0**	**0**	**3**	**50**	**50**	**100**	**200**

Course Objectives		Course Outcomes			
			COs	**Statement**	**Bloom's Taxonomy**
	To enhance knowledge of probabilities, entropy, and measures of information.		EC419.1	Able to understand the basic notions of information and entropy	Knowledge
	To develop the mathematical formulation of channel capacity under different channels		EC419.2	Able to analyse the fundamental limits on performance of communication systems channels.	Knowledge Analyze
	To understand the source coding and data compression techniques		EC419.3	Able to evaluate a suitable lossy data compression technique for a given situation in communication systems	Evaluate
	To introduce the fundamentals of error control coding techniques and their applications		EC419.4	Able to analyse the performance of error control codes,convolutional and block codes	Analyze

COs	Mapping with Program Outcomes (POs)												Mapping with PSOs			
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
EC419.1	2	3	-	1	-	-	-	-	2	-	-	-	3	-	3	2
EC419.2	3	2	-	1	-	-	-	-	2	-	-	-	2	-	2	3
EC419.3	2	3	3	1	2	-	-	-	-	-	-	-	2	3	2	1
EC419.4	2	3	3	-	2	2	3	-	2	-	-	1	2	3	2	2
EC419	**2.25**	**2.75**	**3**	**1**	**2**	**2**	**3**	-	**3**	-	-	**1**	**2.25**	**3**	**2.25**	**2**

SYLLABUS

No.	Content	Hours	COs
I	**Introduction to Information and Entropy:** Information preview, Entropy of a source, Properties of entropy, Joint and conditional entropies, Mutual information, Relationship between entropy and mutual Information, Chain rules for entropy, Jensen's inequality and its consequences, Log sum inequality and its applications, Data processing inequality, Sufficient statistics, Fano's inequality.	**10**	**EC419.1**
II	**Information Channels** Information Channels, BSC and BEC Channels, Noiseless and Deterministic Channels, Cascaded Channels, Additivity of Mutual Information, Channel Capacity: Maximum Mutual Information (BSC and BEC), Channel Capacity of Weakly Symmetric Channels, Continuous Channels and Gaussian Channels, Information Capacity Theorem.	**10**	**EC419.1** **EC419.2**
III	**Source Coding and Data Compression:** Instantaneous Codes, Examples of codes, Kraft inequality, Shannon's Noiseless Coding Theorem, Optimal codes, Bounds on the optimal code length, Huffman codes, Optimality of Huffman codes, Some comments on Huffman codes, Optimality of Huffman codes, Shannon–Fano–Elias coding, Competitive optimality of the Shannon code. Basic Concepts of Data Compression, Block-sorting Compression, Dictionary Coding, Statistical Compression, Prediction by Partial Matching, Image Coding.	**10**	**EC419.3**
IV	**Error-Correcting Codes:** Hamming Distance, Rings and Fields, Linear Spaces, Linear Spaces over the Binary Fields, Linear Codes, Encoding and Decoding, Codes Derived from Hadamard Matrices, Cyclic Codes: The Golay Code, Hamming Codes, Cyclic Redundancy Check Codes, Reed-Muller Codes, Burst-Correcting Codes: Bursts of Errors, Bose-Chaudhuri-Hocquenghem Codes, Reed-Solomon Codes. Convolutional Codes: Binary Convolutional Code, The Viterbi Algorithm, Trellis Modulation, Turbo Codes, Case study.	**10**	**EC419.4**
	Total Hours	**40**	

Essential Readings

1. Thomas M. Cover, Joy A Tomas. Elements of information theory. John Wiley & Sons, 2nd Edition, 2006.
2. Togneri, Roberto, and J. S. Christopher. Fundamentals of information theory and coding design. CRC Press, 2003.

Supplementary Readings

1. Borda, Monica. *Fundamentals in information theory and coding*. Springer Science & Business Media, 2011.
2. Kelbert, Mark, and Yuri Suhov. *Information theory and coding by example*. Cambridge University Press, 2013.

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Course Code	Course Name	Pre-Requisite	Credit Structure				MarksDistribution			
			L	T	P	C	INT	MID	END	Total
EC 421	**Biomedical Signal Processing**	-----	**3**	**0**	**0**	**3**	**50**	**50**	**100**	**200**

		COs	**Statement**	**Bloom's Taxonomy**
Course Objectives	To make the students understand the different types of biomedical signals.	Course Outcomes	EC421.1 Ability to understand the various types of biomedical signals	Knowledge
	To understand the Sources, Types & Characteristics of Different Noises and Artifacts Present in Biomedical Signals.		EC421.2 Ability to analyze the characteristics of different noises and artifacts in biomedical signals.	Knowledge Analyze
	To understand and design Time Domain and Frequency Domain Filters for Noise and Artifact Removal from Biomedical signals.		EC421.3 Ability to design the time domain as well as frequency domain filters for noise removal from biomedical signals.	Design
	To understand the various methods used for analyzing biomedical signal characteristics.		EC421.4 Ability to design computer aided diagnosis systems for analyzing biomedical signal.	Design Analyze

COs	Mapping with Program Outcomes (POs)												Mapping with PSOs			
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
EC421.1	3	1	-	1	-	-	-	-	1	-	-	-	3	1	3	-
EC421.2	3	3	2	3	-	-	-	-	2	-	-	-	3	2	3	-
EC421.3	3	2	-	2	-	-	-	-	2	-	-	-	3	2	3	-
EC421.4	3	3	2	3	-	-	-	-	2	-	-	-	3	2	3	-
EC 421	**3**	**2.25**	**2**	**2.25**	**-**	**-**	**-**	**-**	**1.75**	**-**	**-**	**-**	**3**	**1.75**	**3**	**-**

SYLLABUS

No.	Content	Hours	COs
I	**Introduction to Biomedical Signals** Origin and Waveform Characteristics of Basic Biomedical Signals, Objectives of Biomedical Signal Analysis, Difficulties in Biomedical Signal Analysis, Computer-Aided Diagnosis.	**06**	**EC421.1**
II	**Removal of Noise and Artifacts from Biomedical Signal** Statistical Preliminaries, Time domain filtering (Synchronized Averaging, Moving Average), Time domain filtering (Moving Average Filter to Integration, Derivative-based operator), Frequency Domain Filtering (Notch Filter), Optimal Filtering: The Weiner Filter, Adaptive Filtering.	**10**	**EC421.2**
III	**EEG Signal Processing and Event Detection in Biomedical Signals** EEG Signal and Its Characteristics, EEG Analysis, Linear Prediction Theory, Autoregressive Method, Sleep EEG, Application of Adaptive Filter for Noise Cancellation in ECG and EEG Signals; Detection of P, Q, R, S and T Waves in ECG, EEG Rhythms, Waves and Transients, Detection of Waves and Transients, Correlation Analysis and Coherence Analysis of EEG Channels.	**12**	**EC421.3**
IV	**Modelling of Biomedical Systems** Motor unit firing pattern, Cardiac rhythm, Formants and pitch of speech, Point process, Parametric system modelling, Autoregressive model, Autocorrelation method, Application to random signals, Computation of model parameters, Levinson-Durbin algorithm, Computation of gain factor, Covariance method, Spectral matching and parameterization, Model order selection, Relation between AR and Cepstral coefficients. Design of various filters used in biomedical signal analysis.	**12**	**EC421.4**
	Total Hours	**40**	

EssentialReadings

1. Rangayyan, R.M., 2015. Biomedical signal analysis (Vol. 33). John Wiley & Sons.
2. Reddy, D.C., 2005. Biomedical signal processing: principles and techniques. McGraw-Hill

SupplementaryReadings

1. Tompkins, W.J., 1993. Biomedical digital signal processing. Editorial Prentice Hall.
2. Sörnmo, L. and Laguna, P., 2005. Bioelectrical signal processing in cardiac and neurological applications (Vol. 8). Academic Press.

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Course Code	Course Name	Pre-Requisite	Credit Structure				Marks Distribution			
			L	T	P	C	INT	MID	END	Total
EC 423	**Optical Communication**	-----	**3**	**0**	**0**	**3**	**50**	**50**	**100**	**200**

			CO's	**Statement**	**Bloom's Taxonomy**
Course Objectives	To develop the student's ability to analyze the different kinds of losses, signal distortion in fiber optical communication and other signal degradation factors.	Course Outcomes	EC423.1	Ability to understand the terminology, concepts used in optical communication.	Knowledge Identification
	To familiarize students with the fiber optical source materials, LED structures and Laser diodes.		EC423.2	Able to identify, formulate, and solve engineering problems in the area of optical communication.	Identification Application
	To familiarize students with the fiber optical receivers and optical amplifiers.		EC423.3	Able to analyze the optical receiver and amplifiers used in optical communication.	Knowledge Analyze
	To familiarize students with operational principles of WDM and measurement analysis.				

COs	Mapping with Program Outcomes (POs)												Mapping with PSOs			
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
EC423.1	**3**	**2**	**2**	**1**	**-**	**-**	**-**	**-**	**2**	**-**	**-**	**-**	**3**	**2**	**2**	**-**
EC423.2	**2**	**3**	**2**	**2**	**-**	**-**	**-**	**-**	**2**	**-**	**-**	**-**	**3**	**-**	**2**	**-**
EC423.3	**1**	**2**	**2**	**2**	**2**	**-**	**-**	**-**	**-**	**-**	**-**	**1**	**2**	**3**	**2**	**-**
EC423	**2**	**2.3**	**2**	**1.6**	**2**	**-**	**-**	**-**	**2**	**-**	**-**	**1**	**2.6**	**1.6**	**2**	**-**

SYLLABUS

No.	Content	Hours	COs
I	**Introduction** Overview of optical fiber communications, Optical transmitter components--lasers and optical modulators, Signal Degradation in optical fibers.	**10**	**EC423.1**
II	General digital communication system, Line coding and Pulse shaping, Signal space representation, Digital modulation formats: ASK, PSK, and QAM, Higher-order modulation (star and square QAM) and Multicarrier modulation (OFDM), Optimum receiver principles	**10**	**EC423.2, EC423.3**
III	**Photo Detectors, Receiver System:** Photodetectors and its performance characteristics, noise in photodetection, common types of photodetectors, Direct detection, self-homodyne (differential) detection, and coherent detection, Sensitivity, Impact of noise, Lasers, rate equations, RIN and phase noise.	**10**	**EC423.2, EC423.3**
IV	**WDM Concepts and Components:** Principles of WDM, WDM System Configuration, Types of WDM System, WDM Components, Applications of WDM Systems. **Optical amplifiers:** Principle of Optical Amplification, Erbium Doped Fiber Amplifiers, Raman Amplifiers, Semiconductor Optical Amplifiers, Refractive Index Measurements, Attenuation Measurement, Dispersion Measurement, OTDR Field Applications	**10**	**EC423.3**
	Total Hours	**40**	

Essential Readings

1. Gerd Kaiser, "Optical Fiber Communication", McGraw Hill, 5th edition, 2017.
2. Senior J. M., "Optical Fiber Communication - Principle And Practice", PHI, 3rd Ed., 15th Indian Reprint, 2009.

Supplementary Readings

1. Agrawal G.P., "Fiber Optic Communication Systems", John Wiley & Sons, 4th Ed., 2010.
2. Mynbave and Scheiner, "Fiber Optics Communications Technology", Pearson Education, 1ST Indian Ed., 2001.

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Programme	**Bachelor of Technology in Electronics and Communication Engineering**	Year of Regulation	**2024-25**
Department	**Electronics and Communication Engineering**	Semester	**VII**

Course Code	Course Name	Pre-Requisite	Credit Structure				Marks Distribution			
			L	T	P	C	INT	MID	END	Total
EC 425	**Analog VLSI**	**-----**	**3**	**0**	**0**	**3**	**50**	**50**	**100**	**200**

Course Objectives	
	To understand the fundamentals of IoT System
	To understand the concepts of Communication in IoT System
	To understand the concepts of Programming of IoT System
	To understand the concept of Smart technology

Course Outcomes	CO's	Statement	Bloom's Taxonomy
	EC 425.1	Able to acquire knowledge about the fundamentals of IoT System	Knowledge Comprehension
	EC 425.2	Able to understand the basic concepts Communication in IoT system	Knowledge Application
	EC 425.3	Able to understand and analyze Programming of IoT system	Knowledge Application
	EC 425.4	Able to understand the concept of Smart Technologies	Knowledge Application

COs	Mapping with Program Outcomes (POs)												Mapping with PSOs			
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
EC 425.1	1	3	2	2	2	-	-	-	-	-	-	-	3	2	2	-
EC 425.2	2	3	2	2	3	-	-	-	-	-	-	-	3	2	2	-
EC 425.3	1	3	2	2	3	-	-	-	-	-	-	-	3	2	2	-
EC 425.4	1	3	2	2	3	-	-	-	-	-	-	-	3	2	2	-
EC425	**1.25**	**3**	**2**	**2**	**2.75**	-	-	-	-	-	-	-	**3**	**2**	**2**	-

SYLLABUS

No.	Content	Hours	COs
I	**IoT System-Introduction to IoT: Part I, Part II, Sensing, Actuation, Basics of Networking: Part-I, Part-II, Part III, Part IV.**	**10**	**EC 425.1**
II	**Communication in IoT System -Communication Protocols: Part I, Part II, Part III, Part IV, Part V, Sensor Networks: Part I, Part II,Part III, Part IV, Part V, Part VI, Machine-to-Machine Communications**	**10**	**EC 425.2**
III	**Programming of IoT System - Interoperability in IoT, Introduction to Arduino Programming: Part I, Part II, Integration of Sensors and Actuators with Arduino: Part I, Part II, Introduction to Python programming, Introduction to Raspberry Pi, Implementation of IoT with Raspberry Pi**	**10**	**EC 425.3**
IV	**Smart Technology -Implementation of IoT with Raspberry Pi (contd), Introduction to SDN, SDN for IoT, Data Handling and Analytics, Cloud Computing, Sensor-Cloud, Fog Computing, Smart Cities and Smart Homes, Connected Vehicles, Smart Grid, Industrial IoT, Case Study: Agriculture, Healthcare, Activity Monitoring**	**10**	**EC 425.4**
	Total Hours	**40**	

Essential Readings

1. S. Misra, A. Mukherjee, and A. Roy, 2020. Introduction to IoT. Cambridge University Press.Availability:
2. S. Misra, C. Roy, and A. Mukherjee, 2020. Introduction to Industrial Internet of Things and Industry 4.0. CRC Press.

Supplementary Readings

1. Bahga, Arshdeep, and Vijay Madisetti. Internet of Things: A hands-on approach. Vpt, 2014.
2. Ismail, Yasser, ed. Internet of things (IoT) for automated and smart applications. BoD–Books on Demand, 2019.
3. Tripathy, B. K., and J. Anuradha, eds. Internet of things (IoT): technologies, applications, challenges and solutions. CRC press, 2017.

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Department	**Electronics and Communication Engineering**	Semester	**VII**

Course Code	Course Name	Pre-Requisite	Credit Structure				Marks Distribution			
			L	T	P	C	INT	MID	END	Total
EC 471	**Introduction to Quantum Computing and Algorithms**	-----	**3**	**0**	**0**	**3**	**50**	**50**	**100**	**200**

Course Objectives		Course Outcomes	CO's	Statement	Bloom's Taxonomy
	To describe the mathematical framework of quantum computing to solve computational problems.		EC471.1	Ability to use the mathematical framework of quantum computing to solve computational problems	Knowledge Application
	To apply this understanding to relate quantum complexity classes to the classical classes.		EC471.2	Ability to relate quantum complexity classes to the classical ones	Knowledge Analyze
	To evaluate various quantum algorithms and explain and analyze any quantum algorithms described in quantum circuit or measurement-based quantum computing models.		EC471.3	Ability to explain and analyze any quantum algorithms described in quantum circuit or measurement-based quantum computing models	Knowledge Application

COs	Mapping with Program Outcomes (POs)												Mapping with PSOs			
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
EC471.1	**2**	**3**	**3**	**3**	-	-	-	-	-	-	-	-	**2**	-	**3**	-
EC471.2	**2**	**3**	**2**	**2**	-	-	-	-	-	-	-	-	**3**	-	**3**	-
EC471.3	**2**	**3**	**3**	**2**	**2**	-	-	-	-	-	-	-	**1**	**3**	**1**	-
EC471	**2**	**3**	**2.6**	**2.3**	**2**	-	-	-	-	-	-	-	**2**	**3**	**2.3**	-

SYLLABUS

No.	Content	Hours	COs
I	**Basic structures of quantum computation:** Qubits, Single qubit transformations, Composite quantum systems, Operations on subsystems and partial measurements **Basics of quantum information:** Bell's theorem and the EPR paradox, The No-Cloning Theorem and quantum teleportation, Quantum coins and one-time pads	**15**	**EC471.1**
II	**Quantum information theory:** Quantum probability, Quantum information	**11**	**EC471.2**
III	**Quantum algorithms:** Bernstein-Vazirani, Simon's algorithm, the quantum Fourier transform, Shor's algorithm I: Period finding, Shor's algorithm II: Factoring, Grover's algorithm	**16**	**EC471.2, EC471.3**
	Total Hours	**42**	

Essential Readings

1. Phillip Kaye, Raymond Laflamme et. al., An introduction to Quantum Computing, Oxford University Press, 2007.
2. Nielsen, Michael A., and Isaac L. Chuang. Quantum computation and quantum information. Cambridge University Press (10th Anniversary Edition), 2010.

Supplementary Readings

1. Introduction to Quantum Computing: https://homes.cs.washington.edu/~jrl/teaching/cse599Q/
2. Introduction to Quantum Computing: https://www.cs.umd.edu/class/spring2022/cmsc457/
3. Introduction to Quantum Computing: Quantum Algorithms and Qiskit: https://archive.nptel.ac.in/courses/106/106/106106232/#

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Course Code	Course Name	Pre-Requisite	Credit Structure				Marks Distribution			
			L	T	P	C	INT	MID	END	Total
EC473	**CAD for VLSI Design**	-----	**3**	**0**	**0**	**3**	**50**	**50**	**100**	**200**

Course Objectives		Course Outcomes			
			CO's	**Statement**	**Bloom's Taxonomy**
	To understand the fundamentals of CAD Tools		EC473.1	Able to acquire knowledge about the fundamentals of CAD Tools	Knowledge Comprehension
	To understand the concepts of Digital Circuits Modelling		EC473.2	Able to understand the basic concepts Digital Circuits Modelling using Verilog	Knowledge Application
	To understand the concepts of Synthesis of VLSI Design		EC473.3	Able to understand and analyze Synthesis of VLSI Design using Verilog	Knowledge Application
	To understand the FPGA and Circuit Implementation using FPGAs		EC473.4	Able to understand the concept of Digital Circuits Implementation using FPGA	Knowledge Application

COs	Mapping with Program Outcomes (POs)												Mapping with PSOs			
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
EC473.1	1	3	2	2	2	-	-	-	-	-	-	-	3	2	2	-
EC473.2	2	3	2	2	3	-	-	-	-	-	-	-	3	2	2	-
EC473.3	1	3	2	2	3	-	-	-	-	-	-	-	3	2	2	-
EC473.4	1	3	2	2	3	-	-	-	-	-	-	-	3	2	2	-
EC473	**1.25**	**3**	**3**	**3**	**2.75**	-	-	-	-	-	-	-	**3**	**2**	**2**	**-**

SYLLABUS

No.	Content	Hours	COs
I	Introduction to CAD Tools : Introduction to Verilog, Gate Level Modelling, Higher Level Modelling	**6**	**EC473.1**
II	Modelling of Logic Circuits: Delay Modelling, Behavioural Modelling, Blocking and Non Blocking Assignments, Memory Modelling	**6**	**EC473.2**
III	Synthesis: Operators, Assignments, Optimizations	**7**	**EC473.3**
IV	FPGA: Introductions to reconfigurable Computing, FPGAs, Altera Quartus Fow	**7**	**EC473.4**
	Total Hours	**26**	

Essential Readings

1. Samir Palnitkar, "Verilog HDL", Pearson, 2nd Edition, 2003
2. D. Ciletti Micahel , "Advanced Digital Design with the Verilog HDL, Pearson, 2nd Edition, 2017

Supplementary Readings

1. N.H.E. Weste, K. Haase, D. Harris, A. Banerjee, "CMOS VLSI Design: A circuits and Systems Perspective", Pearson Education, 4th Edition, 2011
2. W.Wolf , "FPGA System design", Pearson, 1st Edition, 2004
3. S. H. Gerez, "Algorithms for VLSI design automation", Wiley, 1st Edition, 1998

Eighth Semester Courses

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CURRICULUM

Programme	**Bachelor of Technology in Electronics and Communication Engineering**	Year of Regulation	**2024-25**
Department	**Electronics and Communication Engineering**	Semester	**VIII**

Course Code	Course Name	Pre-Requisite	Credit Structure				Marks Distribution			
			L	T	P	C	INT	MID	END	Total
EC 410	**Pattern Recognition and Applications**	**-----**	**3**	**0**	**0**	**3**	**50**	**50**	**100**	**200**

Course Objectives		Course Outcomes	CO's	Statement	Bloom's Taxonomy
	To study the fundamentals of pattern recognition.		EC410.1	Ability to acquire the knowledge of pattern recognition and its applications.	Knowledge Application
	To study the various parameters based estimation methods.		EC410.2	Ability to analyse the various parameter based estimation methods.	Analyse
	To study some dimensionality reduction methods.		EC410.3	Ability to analyse some dimensionality reduction methods.	Analyse
	To study the fundamentals of artificial neural networks.		EC410.4	Ability to acquire the knowledge of artificial neural networks and its applications.	Knowledge Application

COs	Mapping with Program Outcomes (POs)												Mapping with PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
EC410.1	**3**	**1**	**1**	**-**	**1**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**3**	**1**	**1**
EC410.2	**3**	**3**	**3**	**2**	**3**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**3**	**2**	**-**
EC410.3	**3**	**2**	**2**	**-**	**2**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**3**	**2**	**-**
EC410.4	**3**	**3**	**3**	**2**	**3**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**3**	**1**	**1**
EC410	**3**	**2.25**	**2.25**	**2**	**2.25**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**3**	**1.5**	**1**

SYLLABUS

No.	Content	Hours	COs
I	Introduction: Introduction to statistical pattern recognition, Bayes Decision Theory: Minimum-error-rate classification. Classifiers, Discriminant functions, Decision surfaces. Discrete features.	**10**	**EC410.1**
II	Parameter Estimation Methods: Maximum-Likelihood estimation, Bayesian estimation, Unsupervised learning and clustering - Criterion functions for clustering. Algorithms for clustering: K-Means, Hierarchical and other methods. Cluster validation. Gaussian mixture models, Expectation-Maximization method for parameter estimation. Hidden Markov Models (HMMs). Discrete HMMs. Continuous HMMs.	**10**	**EC410.2**
III	Dimensionality reduction: Principal component analysis - its relationship to eigen analysis. Fisher discriminant analysis - Generalised eigen analysis, Self-Organizing Maps: Basic feature mapping models, Self-organizing map, Learning vector quantization, Hierarchical vector quantization.	**10**	**EC410.3**
IV	Artificial neural networks: Multilayer perceptron - feedforward neural network. A brief introduction to deep neural networks, convolutional neural networks, recurrent neural networks.	**10**	**EC410.4**
	Total Hours	**40**	

Essential Readings

1. R. O. Duda, P. E. Hart and D. G. Stork, "Pattern classification", John Wiley & Sons, 2nd edition, 2007.
2. C. M. Bishop, Neural Networks for Pattern Recognition, Oxford University Press, 1st edition, 1995.

Supplementary Readings

1. C.M. Bishop, "Pattern Recognition and Machine Learning", 2nd Edition, Springer, 2011

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Course Code	Course Name	Pre-Requisite	Credit Structure				Marks Distribution			
			L	T	P	C	INT	MID	END	Total
EC 412	**VLSI Signal Processing**	**-----**	**3**	**0**	**0**	**3**	**50**	**50**	**100**	**200**

Course Objectives		Course Outcomes			
			CO's	**Statement**	**Bloom's Taxonomy**
	To study high level architectures of hardware specific systems		EC412.1	Able to acquire knowledge about the fundamentals of MOS based Circuit Simulation	Knowledge Comprehension
	To understand concept of digital signal processor architecture		EC412.2	Able to understand the basic concepts Combinational Logic Circuits and Spice Simulation	Knowledge Application
	To develop the subsystem for Digital signal processors		EC412.3	Able to understand and analyze Sequential Logic Circuits and Spice Simulation	Knowledge Application
	To understand the concept filter design techniques in VLSI		EC412.4	Able to understand the concept of Memory Design and Spice Simulation	Knowledge Application

COs	Mapping with Program Outcomes (POs)												Mapping with PSOs			
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
EC412.1	1	3	2	2	2	-	-	-	-	-	-	-	3	2	2	-
EC412.2	2	3	2	2	3	-	-	-	-	-	-	-	3	2	2	-
EC412.3	1	3	2	2	3	-	-	-	-	-	-	-	3	2	2	-
EC412.4	1	3	2	2	3	-	-	-	-	-	-	-	3	2	2	-
EC412	**1.25**	**3**	**2**	**2**	**2.75**	-	-	-	-	-	-	-	**3**	**2**	**2**	-

SYLLABUS

No.	Content	Hours	COs
I	**DSP algorithms: Signal flow graph (SFG), data flow graph (DFG) and dependence graph (DG), high level transformation, critical path.**	**10**	**EC412.1**
II	**Realization: Parallel realization of DSP algorithms, idea of unfolding, unfolding theorem, loop unfolding, FIR Filter and Parallel Filter Architectures**	**10**	**EC412.2**
III	**Hardware minimization by folding, folding formula, examples from biquad digital filters,**	**10**	**EC412.3**
IV	**Pipelining digital filters, look ahead techniques, clustered and scattered look ahead, combining parallel processing with pipelining in digital filters**	**10**	**EC412.4**
	Total Hours	**40**	

Essential Readings

1. Keshab K. Parhi, "VLSI Digital Signal Processing Syustems", Wiley Eastern
2. Keshab K. Parhi and Takao Nishitani, Marcel Dekker, "Digital Signal Processing for Multimedia Systems", Kluwer

Supplementary Readings

1. J. G. Chung and Keshab K. Parhi, "Pipelined Lattice and Wave Digital Recursive Filters", Kluwer
2. W.Wolf , "FPGA System design", Pearson, 1st Edition, 2004
3. S. H. Gerez, "Algorithms for VLSI design automation", Wiley, 1st Edition, 1998

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Course Code	Course Name	Pre-Requisite	Credit Structure				Marks Distribution			
			L	T	P	C	INT	MID	END	Total
EC 414	**VLSI Design Flow: RTL to GDS**	**-----**	**3**	**0**	**0**	**3**	**50**	**50**	**100**	**200**

Course Objectives	To understand the concept of V**LSI Design Flow: Design Flows and Abstraction**	Course Outcomes	**CO's**	**Statement** / **Bloom's Taxonomy**
	To understand concept of **Logic Optimization and Formal Verification**		EC414.1	Able to acquire knowledge about the fundamentals of MOS based Circuit Simulation — Knowledge Comprehension
	To understand the concept of P**ower-driven Optimizations and Design for Test**		EC414.2	Able to understand the basic concepts Combinational Logic Circuits and Spice Simulation — Knowledge Application
	To understand the concept of **Physical Design**		EC414.3	Able to understand and analyze Sequential Logic Circuits and Spice Simulation — Knowledge Application
			EC414.4	Able to understand the concept of Memory Design and Spice Simulation — Knowledge Application

COs	Mapping with Program Outcomes (POs)												Mapping with PSOs			
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
EC414.1	1	3	2	2	2	-	-	-	-	-	-	-	3	2	2	-
EC414.2	2	3	2	2	3	-	-	-	-	-	-	-	3	2	2	-
EC414.3	1	3	2	2	3	-	-	-	-	-	-	-	3	2	2	-
EC414.4	1	3	2	2	3	-	-	-	-	-	-	-	3	2	2	-
EC414	**1.25**	**3**	**2**	**2**	**2.75**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**3**	**2**	**2**	**-**

SYLLABUS

No.	Content	Hours	COs
I	**Basic Concepts of Integrated Circuit: Structure, Fabrication, Types, Design Styles, Designing vs. Fabrication, Economics, Figures of Merit, Overview of VLSI Design Flow: Design Flows and Abstraction; Pre-RTL Methodologies: Hardware-software Partitioning, SoC Design, Intellectual Property (IP) Assembly, Behavioral Synthesis**	**8**	EC414.1
II	**Hardware Modeling, Simulation, Synthesis,**	**8**	EC414.2
III	**Logic Optimization: Multi-level logic optimization, FSM Optimization Formal Verification: Introduction, Formal Engines: BDD, SAT Solver**	**8**	EC414.3
IV	**Formal Verification: Model Checking, Combinational Equivalence Checking Technology Library: Delay models of Combinational and Sequential Cells, Static Timing Analysis: Synchronous Behavior, Timing Requirements, Timing Graph, Mechanism, Delay Calculation, Graph Based Analysis, Path-based Analysis, Accounting for Variations**	**8**	EC414.4
V	**Power Analysis, Power-driven Optimizations Design for Test: Basics and Fault Models, Scan Design Methodology , Design for Test: ATPG, BIST Basic Concepts for Physical Design: IC Fabrication, FEOL, BEOL, Interconnects and Parasitics, Signal Integrity, Antenna Effect, LEF files, Chip Planning: Partitioning, Floorplanning, Power Planning Placement: Global Placement, Wirelength Estimates, Legalization, Detailed Placement, Timing-driven Placement, Scan Cell Reordering, Spare Cell Placement**	**8**	EC414.4
Total Hours		**40**	

Essential Readings

1. S. Saurabhi, "Introduction to VLSI Design Flow", Chembridge University Publication, 2023
1. A. B. Kahng, J. Lienig, I. L. Markov, Jin Hu, "VLSI Physical Design: From Graph Partitioning to Timing Closure", Springer, 2014

Supplementary Readings

2. W. Wolf , "FPGA System design", Pearson, 1st Edition, 2004
3. S. H. Gerez, "Algorithms for VLSI design automation", Wiley, 1st Edition, 1998

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Course Code	Course Name	Pre-Requisite	Credit Structure				Marks Distribution			
			L	T	P	C	INT	MID	END	Total
EC416	**Principles and Techniques of Modern Radar Systems**	-----	**3**	**0**	**0**	**3**	**50**	**50**	**100**	**200**

			CO's	**Statement**	**Bloom's Taxonomy**
Course Objectives	To understand the fundamentals of radar and its parameters	Course Outcomes	EC416.1	Able to acquire knowledge about fundamentals radar and its parameters.	Knowledge Comprehension
	To familiarize with the concepts of different radar types		EC416.2	Able to familiarize with the basic concepts of different radar types	Knowledge Comprehension
	To introduce the idea of radar signals & clutter		EC416.3	Able to understand the basics of radar signals & clutter	Knowledge Comprehension
	To understand radar systems & applications		EC416.4	Able to understand various radar systems and applications	Knowledge Application

COs	Mapping with Program Outcomes (POs)												Mapping with PSOs			
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
EC416.1	3	3	2	2	1	-	-	-	-	-	-	1	3	2	2	-
EC416.2	3	3	2	2	1	-	-	-	-	-	-	1	3	2	2	-
EC416.3	3	3	2	2	1	-	-	-	-	-	-	1	3	2	2	-
EC416.4	3	3	2	2	1	-	-	-	-	-	-	1	2	3	3	-
EC416	**3**	**3**	**2**	**2**	**1**	-	-	-	-	-	-	**1**	**2.75**	**2.25**	**2.25**	**-**

SYLLABUS

No.	Content	Hours	COs
I	**Introduction:** Historical background, Radar terminology, Radar band designations, Radar block diagram, and Radar equation: detection of signals in noise and signal-to-noise ratio, introduction to Radar clutter.	**10**	**EC416.1**
II	**Radar types**: CW Radar, FMCW Radar, Pulsed Radar Principles, Doppler radar and MTI: Doppler effect, delay-line cancellers, blind speeds, staggered PRFs, Digital filter bank, Moving Target Detector, limitations of MTI, Imaging Radar: Resolution Concept, Pulse Compression.	**10**	**EC416.2**
III	**Radar signals & clutter**: Clutter Analysis, Tracking Radar, Angular resolution, Monopulse Technique, Detection Theory: Match Filtering, Radar Ambiguity Function, Probability of false alarm and Detection, Modified Radar Range Equation with Swerling Models.	**10**	**EC416.3**
IV	**Radar System & Applications:** Synthetic Aperture Processing, ISAR Imaging, Ground Penetrating Radar for close sensing, Radar Tomography and Radar based Microwave Imaging, Emerging and Modern Applications of Radar Principles.	**12**	**EC416.4**
	Total Hours	**42**	

Essential Readings

1. M. I. Skolnik, "Introduction to Radar Systems ", Tata- MacGraw Hill, 3rd Edition, 2002.
2. M. H. Carpentier, "Principles of Modern Radar", Artech House, 3rd Edition, 2010.

Supplementary Readings

1. B. R. Mahafza, "Radar Systems Analysis and Design using MATLAB", CRC Press, 3rd Edition, 2022.
2. S. M .Sherman and D.K.Barton , "Monopulse Principles and Techniques" , 2nd Edition,Artech house, 2011.
3. M. A. Richards, "Fundamentals of Radar Signal Processing", TMH,3rd Edition, 2005.
4. H.M. Jolt, "Ground Penetrating Radar: Theory and Applications", Elsevier,1st Edition, 2008.
5. M. Pastorino, "Microwave Imaging", John Wiley, 2010.

	National Institute of Technology Meghalaya An Institute of National Importance	**CURRICULUM**

Programme	**Bachelor of Technology in Electronics and Communication Engineering**	Year of Regulation	**2024-25**
Department	**Electronics and Communication Engineering**	Semester	**VIII**

Course Code	Course Name	Pre-Requisite	Credit Structure				Marks Distribution			
			L	T	P	C	INT	MID	END	Total
EC418	**Nanophotonics, Plasmonics, and Metamaterials**	**-----**	**3**	**0**	**0**	**3**	**50**	**50**	**100**	**200**

		CO's	**Statement**	**Bloom's Taxonomy**
Course Objectives	To understand the fundamentals of nanophotonics, plasmonics, and metamaterials.	Course Outcomes	EC418.1 Able to acquire knowledge about the fundamentals of nanophotonics, plasmonics, and metamaterials.	Knowledge Comprehension
	To familiarize with the concepts of nanophotonics and periodic structures		EC418.2 Able to familiarize with the basic concepts of nanophotonics and periodic structures.	Knowledge Comprehension
	To introduce the idea of metal optics		EC418.3 Able to understand the basics of metal optics.	Knowledge Comprehension
	To understand the application of nanophotonics, plasmonics, and metamaterials		EC418.4 Able to understand the application of nanophotonics, plasmonics, and metamaterials.	Knowledge Application

COs	Mapping with Program Outcomes (POs)												Mapping with PSOs			
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
EC418.1	3	3	2	2	1	-	-	-	-	-	-	3	3	2	2	-
EC418.2	3	3	2	2	1	-	-	-	-	-	-	3	3	2	2	-
EC418.3	3	3	2	2	1	-	-	-	-	-	-	3	3	2	2	-
EC418.4	3	3	2	2	1	-	-	-	-	-	-	3	2	3	3	-
EC418	**3**	**3**	**2**	**2**	**1**	**-**	-	-	-	-	-	**3**	**2.75**	**2.25**	**2.25**	-

SYLLABUS

No.	Content	Hours	COs
I	**Introduction:** Motivation, brief introduction to nanophotonics, plasmonics and metamaterials; Overview of current status of research in academia and industry in the fields of nanophotonics, plasmonics, and metamaterials. Electromagnetic theory of light; Electromagnetic properties of material; Constitutive relationships and material parameters; Electromagnetic waves in dielectric media.	**10**	**EC418.1**
II	**Nanophotonics & Periodic Structures**: Electromagnetic theory of light; Electromagnetic properties of material; Constitutive relationships and material parameters; Electromagnetic waves in dielectric media, Polarization of light; Reflection and refraction; Fresnel equations; Absorption, dispersion, and scattering of electromagnetic waves, Real and reciprocal lattices; 2D and 3D Photonic crystals; Bandgap engineering; Devices based on photonic crystals; Emerging Applications of Photonic Crystals.	**10**	**EC418.2**
III	**Metal Optics:** : Optical properties of metals; Surface Plasmon Polaritons (SPP) on planar interfaces; SPP modes for shape resonances, gratings, and light scattering from rough surfaces; Applications of SPPs: Surface Enhanced Raman Spectroscopy (SERS), Sensing, Subwavelength properties in light-guiding, spasers, and plasmonic circuitry, plasmonic subwavelength enhanced transmission of light, Plasmonic nanoparticles; Localized plasmon resonances; Chain of plasmonic nanoparticles; Applications of localized plasmon resonances: SERS, Sensing, optical nanoantennas and plasmonic waveguides, biomedical applications, tunable plasmonic devices.	**10**	**EC418.3**
IV	**Applications:** Metamaterials, Metasurfaces, Transformation Optics, Realization of Nanophotonic Devices	**12**	**EC418.4**
	Total Hours	**42**	

Essential Readings

1. S. Maier, "Plasmonics: Fundamentals and Applications", Springer, 2007.
2. B. E. A. Saleh, M. C. Teich, "Fundamentals of Photonics", Wiley,3rd Edition, (2019).

Supplementary Readings

1. J. W. Haus, "Fundamentals and Applications of Nanophotonics", 1st Edition, Woodhead Publishing, 2016.
2. W. Cai and V. Shalaev, "Optical Metamaterials: Fundamentals and Applications", Springer ,2010.
3. https://onlinecourses.nptel.ac.in/noc24_ee142/preview

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CURRICULUM

Programme	**Bachelor of Technology in Electronics and Communication Engineering**	Year of Regulation	**2024-25**
Department	**Electronics and Communication Engineering**	Semester	**VIII**

Course Code	Course Name	Pre-Requisite	Credit Structure				Marks Distribution			
			L	T	P	C	INT	MID	END	Total
EC 420	**Deep learning**	**-----**	**3**	**0**	**0**	**3**	**50**	**50**	**100**	**200**

Course Objectives		Course Outcomes	CO's	Statement	Bloom's Taxonomy
	Introducing of fundamentals of neural networks		EC420.1	Able to explain the mathematical methods in development of neural networks.	Mathematical methods
	Introducing of better training neural networks		EC420.2	Able to use better training methods in development of deep neural networks.	Methods
	Introducing of advanced topics such recurrent neural networks, long short term memory cells and convolutional neural networks		EC420.3	Able to develop advanced neural networks for various applications.	Applications
			EC420.4	Able to develop multi-task deep learning networks and analyse its application.	Analyse Applications

COs	Mapping with Program Outcomes (POs)												Mapping with PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
EC420.1	**2**	**1**	**-**	**-**	**1**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**2**	**-**	**1**
EC420.1	**1**	**2**	**2**	**2**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**1**	**2**	**-**	**2**
EC420.1	**-**	**2**	**2**	**1**	**2**	**-**	**-**	**-**	**-**	**-**	**-**	**2**	**2**	**2**	**2**
EC420.1	**-**	**2**	**-**	**1**	**2**	**-**	**-**	**-**	**-**	**-**	**-**	**2**	**2**	**2**	**2**
EC420	**1.5**	**1.75**	**2**	**1.33**	**1.66**	**-**	**-**	**-**	**-**	**-**	**-**	**1.66**	**2**	**2**	**1.75**

SYLLABUS

No.	Content	Hours	COs
I	Biological Neuron, Idea of computational units, McCulloch–Pitts unit and Thresholding logic, Linear Perceptron, Perceptron Learning Algorithm, Linear separability. Convergence theorem for Perceptron Learning Algorithm. Multilayer Perceptron, Gradient Descent, Backpropagation, Empirical Risk Minimization, regularization, autoencoders.	**10**	**EC420.1**
II	Difficulty of training deep neural networks, Greedy layerwise training. Newer optimization methods for neural networks (Adagrad, adadelta, rmsprop, adam, NAG), second order methods for training, Saddle point problem in neural networks, Regularization methods (dropout, drop connect, batch normalization).	**10**	**EC420.2**
III	Recurrent Neural Networks: Backpropagation through time, Long Short Term Memory, Gated Recurrent Units, Bidirectional LSTMs, Bidirectional RNNs. Convolutional Neural Networks: LeNet, AlexNet. Generative models: Restrictive Boltzmann Machines (RBMs), Introduction to MCMC and Gibbs Sampling, gradient computations in RBMs, Deep Boltzmann Machines	**10**	**EC420.3**
IV	Recent trends: Variational Autoencoders, Generative Adversarial Networks, Multi-task Deep Learning, Multi-view Deep Learning. Applications: Object Detection, biomedical signal processing.	**12**	**EC420.4**
	Total Hours	**42**	

Essential Readings

1. Deep Learning- Ian Goodfelllow, Yoshua Benjio, Aaron Courville, The MIT Press, 2016.
2. R. O. Duda, P. E. Hart and D. G. Stork, "Pattern classification", John Wiley & Sons, 2nd edition, 2007.

Supplementary Readings

1. Raúl Rojas, "Neural Networks: A Systematic Introduction", Springer, 1996.
2. C.M. Bishop, "Pattern Recognition and Machine Learning", 2nd Edition, Springer, 2011