R21(B.Tech ECE)

Curriculum & Syllabus for B.Tech Under Autonomy

Electronics and Communication Engineering

(Effective From 2021-22 admission Batch)

Curriculum for B.Tech
Under Autonomy
Electronics & Communication Engineering
(Effective From 2021-22 admission Batch)
L – Lecture; T- Tutorial; P- Practical [1L=1Cr, 1T=1Cr, 1P =0.5 Cr]

First Year First Semester

Sl. N	Category	Course Code	Course Title	Hours per week				Credits
	A. THEORY			L	T	P	Total	
1	Basic Science course	CH101	Chemistry-I	3	0	0	3	3
2	Basic Science course	M101	Mathematics –I	4	0	0	4	4
3	Engineering Science Courses	EE101	Basic Electrical Engineering	3	0	0	3	3
4	Humanities and Social Sciences including Management courses	HSMC 101	Professional Communication	2	0	0	2	2
	B. PRACTICAL							
5	Basic Science course	CH191	Chemistry-I Lab	0	0	3	3	1.5
6	Engineering Science Courses	EE 191	Basic Electrical Engineering Lab	0	0	3	3	1.5
7	Engineering Science Courses	ME 192	Engineering Graphics & Design Lab	0	0	3	3	1.5
8	PROJECT	PR191	Theme based Project I	0	0	1	1	0.5
9	PROJECT	PR192	Skill Development I: Soft Skill	0	0	1	1	0.5
	C. MANDATORY ACTIVITIES / COURSES							
10	Mandatory Course	MC181	Induction Program	0	0	0	0	2Units
	TOTAL CREDIT							17.5

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First Year 2nd Semester

Sl. No.	Category	Course Code	Course Title	Hours per week				Credits
	A. THEORY			L	T	P	Total	
1	Basic Science courses	PH 201	Physics-I	3	0	0	3	3
2	Basic Science courses	M 201	Mathematics –II	4	0	0	4	4
3	Engineering Science Courses	CS 201	Programming for Problem Solving	3	0	0	3	3
	B. PRACTICAL							
4	Basic Science course	PH 291	Physics-I Lab	0	0	3	3	1.5
5	Humanities and Social Sciences including Management courses	HSMC 291	Professional Communication LAB	0	0	3	3	1
6	Engineering Science Courses	ME 291	Workshop & Manufacturing Practices Lab	0	0	3	3	1.5
7	Engineering Science Courses	CS 291	Programming for Problem Solving Lab	0	0	3	3	1.5
8	PROJECT	PR291	Theme based Project II	0	0	1	1	0.5
9	PROJECT	PR292	Skill Development II: Life Skill	1	0	0	1	0.5
	C. MANDATORY ACTIVITIES / COURSES							
10	Mandatory Course	MC281	NSS/ Physical Activities / Meditation & Yoga / Photography/ Nature Club	0	0	3	3	3 Units
	TOTAL CREDIT							16.5

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2nd Year 1st Semester: 3rd Semester

Sl. No.	Category	Course Code	Course Title	Hours per week				Credits/ Unit
				L	T	P	Total	
A. THEORY								
1	BS	M 301	Mathematics III	3	0	0	3	3
2	ES	EC 301	Data Structure	3	0	0	3	3
3	ES	EC302	Circuit Theory & Network	3	0	0	3	3
4	PC	EC303	Electronic Devices	3	0	0	3	3
5	PC	EC304	Signal & Systems	3	0	0	3	3
6	HSMC	HSMC 303	Universal Human Values 2: Understanding Harmony	3	0	0	3	3
B. PRACTICAL								
7	ES	M (CS)391	Numerical Methods Lab	1	0	3	3	2.5
8	ES	EC391	Data Structure Lab	0	0	3	3	1.5
9	ES	EC392	Circuit Theory & Network Lab	0	0	3	3	1.5
10	PC	EC393	Electronic Devices Lab	0	0	3	3	1.5
11	PROJECT	PR391	Theme based Project III	0	0	1	1	0.5
12	PROJECT	PR392	Skill Development III: Technical Seminar Presentation	0	0	1	1	0.5
C. MANDATORY ACTIVITIES / COURSES								
13	MC	MC 301	Environmental Science	3	0	0	3	0
	TOTAL CREDIT WITHOUT MOOCS COURSES							26.0
D.MOOCS COURSES**								
14	MOOCS COURSES	HM301	MOOCS COURSE-II	1	3	1	4	4
TOTAL CREDIT WITH MOOCS COURSES								30

** MOOCS COURSES for HONOURS/MINOR Degree are Program specific and to be taken from MOOCS BASKET

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2nd Year 2nd Semester: 4th Semester

Sl. No.	Category	Course Code	Course Title	Hours per week				Credits /Unit
				L	T	P	Total	
A. THEORY								
1	PC	EC401	EM Theory & Antenna	3	0	0	3	3
2	PC	EC402	Analog Circuits	3	0	0	3	3
3	PC	EC403	Digital Electronics	3	0	0	3	3
4	PC	EC404	Analog & Digital Communication	3	0	0	3	3
5	PC	EC405	Digital Signal Processing	3	0	0	3	3
6	HSMC	HSMC 402	Gender Culture and Development	2	0	0	2	2
B. PRACTICAL								
6	PC	EC491	EM Theory & Antenna Lab	0	0	3	3	1.5
7	PC	EC492	Analog Circuits Lab	0	0	3	3	1.5
8	PC	EC493	Digital Electronics Lab	0	0	3	3	1.5
9	PC	EC494	Analog & Digital Communication Lab	0	0	3	3	1.5
10	PC	EC495	Digital Signal Processing Lab	0	0	3	3	1.5
11	PROJECT	PR 491	Theme based Project IV	0	0	1	1	0.5
12	PROJECT	PR492	Skill Development IV:Soft Skill & Aptitude	0	0	1	1	0.5
C. MANDATORY ACTIVITIES / COURSES								
13	MC	MC 481	Learning an Art Form [vocal or instrumental, dance, painting, clay modeling, etc.] OR Environmental Protection Initiatives	0	0	2	2	0
	TOTAL CREDIT WITHOUT MOOCS COURSES							25.5
D.MOOCS COURSES								
14	MOOCS COURSES	HM401	MOOCS COURSE-III	3	1	0	4	4
TOTAL CREDIT WITH MOOCS COURSES (FOR CSE, ECE, EE, EIE)								29.5

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2nd Year 2nd Semester: 4th Semester

Sl. No.	Category	Course Code	Course Title	Hours per week				Credits /Unit
				L	T	P	Total	
A. THEORY								
1	PC	EC401	EM Theory & Antenna	3	0	0	3	3
2	PC	EC402	Analog Circuits	3	0	0	3	3
3	PC	EC403	Digital Electronics	3	0	0	3	3
4	PC	EC404	Analog & Digital Communication	3	0	0	3	3
5	PC	EC405	Digital Signal Processing	3	0	0	3	3
6	HSMC	HSMC 402	Gender Culture and Development	2	0	0	2	2
B. PRACTICAL								
6	PC	EC491	EM Theory & Antenna Lab	0	0	3	3	1.5
7	PC	EC492	Analog Circuits Lab	0	0	3	3	1.5
8	PC	EC493	Digital Electronics Lab	0	0	3	3	1.5
9	PC	EC494	Analog & Digital Communication Lab	0	0	3	3	1.5
10	PC	EC495	Digital Signal Processing Lab	0	0	3	3	1.5
11	PROJECT	PR 491	Theme based Project IV	0	0	1	1	0.5
12	PROJECT	PR492	Skill Development IV:Soft Skill & Aptitude	0	0	1	1	0.5
C. MANDATORY ACTIVITIES / COURSES								
13	MC	MC 481	Learning an Art Form [vocal or instrumental, dance, painting, clay modeling, etc.] OR Environmental Protection Initiatives	0	0	3	3	0
	TOTAL CREDIT WITHOUT MOOCS COURSES							25.5
D.MOOCS COURSES								
14	MOOCS COURSES	HM401	MOOCS COURSE-III	3	1	0	4	4
TOTAL CREDIT WITH MOOCS COURSES (FOR CSE, ECE, EE, EIE)								29.5

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3rd Year 1st Semester: 5th Semester

Sl. No.	Category	Course Code	Course Title	Hours per week				Credits/ Unit
				L	T	P	Total	
A. THEORY								
1	HSMC	HSMC 505	Principles of Management	2	0	0	2	2
2	PC	EC501	Microprocessor & Micro Controller	3	0	0	3	3
3	PC	EC502	RF & Microwave Engineering	3	0	0	3	3
4	PC	EC503	Computer Network	3	0	0	3	3
5	PE	PEC 501	Professional Elective-I A: Mobile Communication & Network B: Fiber Optic Communication C: Electronics Measurement & Instrumentation D: Satellite Communication	3	0	0	3	3
6	PE	PEC 502	Professional Elective-II A: Computer Architecture B: Digital Image & Video Processing C: Embedded System D: Advanced Python Programming	3	0	0	3	3
B. PRACTICAL								
7	PC	EC591	Microprocessor & Micro Controller Lab	0	0	3	3	1.5
8	PC	EC592	RF & Microwave Engineering Lab	0	0	3	3	1.5
9	PE	PEC 591	Professional Elective-I Lab A: Mobile Communication & Network Lab B: Fiber Optic Communication Lab C: Electronics Measurement & Instrumentation Lab D: Satellite Communication Lab	0	0	3	3	1.5
10	PE	PEC 592	Professional Elective-II Lab A: Computer Architecture Lab B: Digital Image & Video Processing Lab C: Embedded System Lab D: Advanced Python Programming Lab	0	0	3	3	1.5
11	PROJECT	PR 591	Minor Project I	0	0	3	2	1
12	PROJECT	PR 592	Skill Development V: Soft Skill & Aptitude-II	0	0	1	1	0.5
C. MANDATORY ACTIVITIES / COURSES								
13	MC	MC 501	Constitution of India	2	0	0	2	0
	TOTAL CREDIT WITHOUT MOOCS COURSES							24.5
D. MOOCS COURSES** [For Honors/Minor]								
14	MOOCS COURSES	HM501	MOOCS COURSE-IV	3	1	0	4	4
TOTAL CREDIT WITH MOOCS COURSES								28.5

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3rd Year 2nd Semester: 6th Semester

Sl. No.	Category	Course Code	Course Title	Hours per week				Credits /Unit
				L	T	P	Total	
A. THEORY								
1	HSMC	HSMC 604	Economics for Engineers	2	0	0	2	2
2	PC	EC601	VLSI & Microelectronics	3	0	0	3	3
3	PC	EC602	Control System	3	0	0	3	3
4	PE	PEC602	Professional Elective-III A: Information Theory & Coding B: Renewable Energy Sources & Applications C: Nano Technology D: Remote Sensing & GIS	3	0	0	3	3
5	OE	OEC 601	Open Elective-I A: Object Oriented Programming using JAVA. B: Fundamentals of Sensors & Transducers C: Introduction to Quantum Computing D: Fundamentals of Operating System	3	0	0	3	3
6	OE	OEC 602	Open Elective-II A: Database Management System B: 3D Printing and Design C: Web Intelligence & Big Data D: Scientific Computing	3	0	0	3	3
B. PRACTICAL								
7	PC	EC691	VLSI & Microelectronics Lab	0	0	3	3	1.5
8	PC	EC692	Control System Lab	0	0	3	3	1.5
9	OE	OEC 691	Open Elective-I Lab A: Object Oriented Programming using JAVA Lab B: Fundamentals of Sensors & Transducers Lab C: Quantum Computing Lab D: Fundamentals of Operating System Lab	0	0	3	3	1.5
10	OE	OEC 692	Open Elective-II Lab A: Database Management System Lab B: 3D Printing and Design Lab C: Web Intelligence & Big Data Lab D: Scientific Computing Lab	0	0	3	3	1.5
11	PROJECT	PR 691	Minor Project II	0	0	3	2	1
12	PROJECT	PR 692	Skill Development VI: Soft Skill & Aptitude-III	0	0	1	1	0.5
C. MANDATORY ACTIVITIES / COURSES								
13	MC	MC 601	Intellectual Property Right	2	0	0	2	0
	TOTAL CREDIT WITHOUT MOOCS COURSES							24.5
D.MOOCS COURSES**								
14	MOOCS COURSES	HM601	MOOCS COURSE-V	3	1	0	4	4
TOTAL CREDIT WITH MOOCS COURSES								28.5

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4th Year 1st Semester: 7th Semester

Sl. No	Course Code	Paper Code	Theory	Contact Hours /Week				Credits/Unit
				L	T	P	Total	
A. THEORY								
1	PE	PEC701	Professional Elective-IV A: Internet of Things B: Artificial Intelligence C: Digital Control System D: Cloud Computing (AWS)	3	0	0	3	3
2	PE	PEC702	Professional Elective-V A: Biomedical Electronics & Imaging B: Introduction to EDA tool C: Radar & Missile Communication D: Introduction to MEMS	3	0	0	3	3
4	OE	OEC 702	Open Elective-III A: Data Science B: Machine Learning C: Cyber Security & Cryptography D: Advanced Bio Signal Processing E: Mixed signal Design	3	0	0	3	3
B. PRACTICAL								
5	PE	PEC 791	Professional Elective-IV lab A: Internet of Things Lab B: Artificial Intelligence Lab C: Digital Control System Lab D: Cloud Computing (AWS) Lab	0	0	0	3	1.5
6	OE	OEC 792	Open Elective-III Lab A: Data Science Lab B: Machine Learning Lab C: Cyber Security & Cryptography Lab D: Advanced Bio Signal Processing Lab E: Mixed signal Design Lab	0	0	3	3	1.5
7	PROJECT	PR 791	Major Project-I	0	0	0	4	2
8	PROJECT	PR 792	Skill Development VII: Seminar & Group Discussion	0	0	1	1	0.5
9	PROJECT	PR 793	Industrial Training / Internship	0	0	0	0	1
C. MANDATORY ACTIVITIES / COURSES								
10	MC	MC 701	Entrepreneurship & Innovation Skill	2	0	0	2	0
TOTAL CREDIT WITHOUT MOOCS COURSES								15.5
D.MOOCS COURSES**								
11	MOOCS COURSES	HM701	MOOCS COURSE-VI	3	1	0	4	4
TOTAL CREDIT WITH MOOCS COURSES								19.5

*Collective Data from 3rd to 6th Semester (Summer/Winter Training during SemesterBreak & Internship should be done after 5th Semester or 6th Semester). All related certificates to be collected by the training/internship coordinator(s).

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4th Year 2nd Semester: 8th Semester

Sl. No	Course Code	Paper Code	Theory	Contact Hours /Week				Credits /Unit
				L	T	P	Total	
A. THEORY								
1	PE	PEC801	Professional Elective-VI A: Industrial Automation & Robotics B: Electronic System Design C: Automotive Electronics D: Adaptive Signal Processing	3	0	0	3	3
2	OE	OEC801	Open Elective-IV A: Block Chain B: Deep Learning C: Biology for Engineers D: Foreign Language E: Product Design & Manufacturing Processes F: Business Research Method	3	0	0	3	3
B. PRACTICAL								
4	PROJECT	PR 891	Major Project-II	0	0	0	12	6
5	PROJECT	PR 892	Grand Viva	0	0	0	0	1
C. MANDATORY ACTIVITIES / COURSES								
6	MC	MC 801	Essence of Indian Knowledge Tradition	3	0	0	3	0
TOTAL CREDIT								13

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Total FOR ECE		
Semester	Without MOOCS	With MOOCS
I	13	13
II	21	21
III	26	30
IV	25.5	29.5
V	24.5	28.5
VI	24.5	28.5
VII	15.5	19.5
VIII	13.0	13
Total:	163	183 (for Honors/minor)

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Credit Distribution

Subject Category	Subjects	Credit Distribution as per AICTE (%)	Suggested Breakup of Credits (Total 160) as per AICTE	As per R21 Curriculum
Humanities and Social Sciences including Management courses (HSMC)	**Humanities & Social Science:** (i)English (ii)Language / English Lab **Management courses** (i)Principle of Management, (ii)Economics for Engineers (iii)Principles of Management (iv)Values & Ethics in Profession	5 to 10%	**8-16**	**9** **5.63%**
Basic Sciences (BS)	**Physics** (i)Introduction to Electromagnetic Theory (ii)Introduction to Mechanics (iii)Quantum Mechanics for Engineers (iv) Oscillation, Waves and Optics (v) Semiconductor Optoelectronics (vi)Semiconductor Physics	15 to 20%	**24-32**	**20** **12.5 %**
	Chemistry & Biology (i)Chemistry – I (Concepts in chemistry for engineering) (ii)Chemistry Laboratory **Elective Courses** (i)Chemistry-II (Chemical Applications) (ii)Polymer Chemistry (iii)Experiments in Polymer Chemistry **Biology**			
	Mathematics (i)Mathematics (Option 1) Mathematics 1 Mathematics 2 Mathematics 3			

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	(ii)Mathematics (Option 2) (for CSE students)			
Engineering Sciences and Skills (ES)	(i) Workshop / Manufacturing Practice (ii) Drawing / Engineering Graphics & Design, (iii)Basics of Electrical (iv)Computer / Programming for Problem Solving (v)Numerical Methods (vi)Circuit theory	15 to 20%	**24-32**	**23.5** **14.69%**
Professional core courses (PC)	Courses relevant to chosen branch	30 to 40%	**48-64**	**51** **31.88%**
Professional Elective	Elective courses relevant to chosen specialization/branch	10 to 15%	**16-24**	**22.5** **14.06%**
Open Elective	Elective Courses from other technical programs and /or **emerging subjects**: 1. Artificial Intelligence (AI) 2. Internet of Things (IoT) 3. Block Chain 4. Robotics 5. Quantum Computing 6. Data Sciences 7. Cyber Security 8. 3D Printing and Design 9. Virtual Reality (VR)	5 to 10%	**8-16**	**16.5** **10.31%**
Project work, seminar and internship in industry or elsewhere	(i) PROJECT (PR….91): Project work (ii)PROJECT (PR….92): (iii) PROJECT (PR …93): (iv) Industrial Training/ Internship (iv)Grand Viva - 1	10 to 15%	**16-24**	**17.5** **10.94 %**
Mandatory Courses [Environmental Sciences, Induction training,	**MC Courses:** (i)Environmental Science, (ii)Foreign language, (iii)Constitution of India (iv)Behavioral & Interpersonal skills	**No Credit Course**	Minimum 2 units per semester min. Max: 28	

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Indian Constitution, Essence of	(v)Essence of Indian Knowledge Tradition **& others as mentioned in AICTE guidelines**		Units/Program	
Indian Knowledge Tradition]	**MC Activities:** (i)Induction Programming (ii)NSS/NCC/Yoga (iii)Technical Lecture Presentation **& others as mentioned in AICTE guidelines**			

Summary:

Sub	Credit	%	AICTE %
HSMC	9	5.63	5to10
BSHU	20	12.5	15to20
ES	23.5	14.69	15to20
PC	51	31.88	30to40
PE	22.5	14.06	10to15
OE	16.5	10.31	5to10
Project	17.5	10.94	10to15
	160	100.00	

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Professional Electives (It is expected Options in a vertical column would lead to expertise in a specific/allied domain)				
	Option 1	**Option 2**	**Option 3**	**Option 4**
Professional Elective I (With Lab)	A: Mobile Communication & Network	B: Fibre Optic Communication	C: Electronics Measurement & Instrumentation	D: Satellite Communication
Professional Elective II (With Lab)	A: Advanced Microprocessor & Microcontroller	B: Digital Image & Video Processing	C: Embedded System	D: Python Programming
Professional Elective III (Without Lab)	A: Information Theory & Coding	B: Renewable Energy Sources & Applications	C: Nano Technology	D: Remote Sensing & GIS
Professional Elective IV (With Lab)	A: Internet of Things	B: Artificial Intelligence	C: Digital Control System	D: Cloud Computing (AWS)
Professional Elective V (Without Lab)	A: Biomedical Electronics & Imaging	B: Physical Design, Verification & Testing	C: Radar & Missile Communication	D: Introduction to MEMS
Professional Elective VI (Without Lab)	A: Industrial Automation & Robotics	B: Electronic System Design	C: Automotive Electronics	D: Adaptive Signal Processing

Open Electives (It is expected Options in a vertical column would lead to expertise in a specific/allied domain)				
	Option 1	**Option 2**	**Option 3**	**Option 4**
Open Elective I (With Lab)	A: Object Oriented Programming using JAVA.	B: Fundamentals of Sensors & Transducers	C: Quantum Computing	D: Fundamentals of Operating System
Open Elective II (With Lab)	A: Database Management System	B: 3D Printing and Design	C: Intelligent wave & Big Data	D: Scientific Computing
Open Elective III (With Lab)	A: Data Science	B: Machine Learning	C: Cyber Security & Cryptography	D: Advanced Bio Signal Processing E: Computer

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				Architecture
Open Elective IV (Without Lab)	A: Block Chain	B: Probability & Stochastic Process	C: Biology for Engineers	D: Foreign Language E: Product Design & Manufacturing Processes F: Business Research Method

MOOCs (It is expected Options in a vertical column would lead to expertise in a specific/allied domain)						
	Sem	Credit	Option 1	Option 2	Option 3	Option 4
MOOCS COURSE-I	II	2	Course related to MAR			
MOOCS COURSE-II	III	4	Related to Minor/Honors	Related to Minor/Honors	Related to Minor/Honors	Related to Minor/Honors
MOOCS COURSE-III	IV	4	Related to Minor/Honors	Related to Minor/Honors	Related to Minor/Honors	Related to Minor/Honors
MOOCS COURSE-IV	V	4	Related to Minor/Honors	Related to Minor/Honors	Related to Minor/Honors	Related to Minor/Honors
MOOCS COURSE-V	VI	4	Related to Minor/Honors	Related to Minor/Honors	Related to Minor/Honors	Related to Minor/Honors
MOOCS COURSE-VI	VII	4	Related to Minor/Honors	Related to Minor/Honors	Related to Minor/Honors	Related to Minor/Honors

**Please define your Honors/Minor programme credit point of 20 to be earned by the student. Related BoS would endorse the selection of these courses followed by the necessary intimation at the Academic Council of the Institute.

***In 2nd semester MOOCs course credit would be contributed to MAR SCORE

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First Year First Semester

Sl. N	Category	Course Code	Course Title	Hours per week				Credits
	A. THEORY			L	T	P	Total	
1	Basic Science course	CH101	Chemistry-I	3	0	0	3	3
2	Basic Science course	M101	Mathematics –I	4	0	0	4	4
3	Engineering Science Courses	EE101	Basic Electrical Engineering	3	0	0	3	3
4	Humanities and Social Sciences including Management courses	HSMC 101	Professional Communication	2	0	0	2	2
	B. PRACTICAL							
5	Basic Science course	CH191	Chemistry-I Lab	0	0	3	3	1.5
6	Engineering Science Courses	EE 191	Basic Electrical Engineering Lab	0	0	3	3	1.5
7	Engineering Science Courses	ME 192	Engineering Graphics & Design Lab	0	0	3	3	1.5
8	PROJECT	PR191	Theme based Project I	0	0	1	1	0.5
9	PROJECT	PR192	Skill Development I: Soft Skill	0	0	1	1	0.5
	C. MANDATORY ACTIVITIES / COURSES							
10	Mandatory Course	MC181	Induction Program	0	0	0	0	2Units
	TOTAL CREDIT							17.5

COURSE NAME: CHEMISTRY
COURSE CODE: CH 101 CONTACT:
3:0:0
TOTAL CONTACT HOURS: 36
CREDITS: 3

Prerequisites: A basic knowledge in 10+2 science with chemistry

Course Outcomes (COs):

After completion of this course students will be able to

CO1: Describe the fundamental properties of atoms & molecules, atomic structure and the periodicity of elements in the periodic table

CO2: Apply fundamental concepts of thermodynamics in different engineering applications.

CO3: Apply the knowledge of water quality parameters, corrosion control & polymers to different industries.

CO4: Determine the structure of organic molecules using different spectroscopic techniques.

CO5: Evaluate theoretical and practical aspects relating to the transfer of the production of chemical products from laboratories to the industrial scale, in accordance with environmental considerations.

Course Content

Module- I: Inorganic Chemistry **9L**

(i) Atomic structure **5L**

Bohr's theory to hydrogen-like atoms and ions; spectrum of hydrogen atom. Quantum numbers, Introduction to the concept of atomic orbitals, diagrams of s, p and d orbitals, Pauli's exclusion principle, Hund's rule, exchange energy, Aufbau principle and its limitation, introduction to Schrodinger equation.

(ii) Periodic properties **4L**

Modern Periodic table, group trends and periodic trends in physical properties: electron affinity, electronegativity, polarizability, oxidation states, effective nuclear charges, penetration of orbitals, variations of s, p and d orbital energies of atoms.

Module II: Physical Chemistry **8L**

(i) Use of free energy in chemical equilibria **6L**

Thermodynamic functions: internal energy, enthalpy, entropy and free energy. 2nd Law of Thermodynamics, Estimations of entropy and free energies, Free energy and emf, Cell potentials, the Nernst equation and applications.

(ii) Real Gases **2L**

Reason for deviation of real gases from ideal behavior, Equations of state of real gases,Vander Waals' equation, pressure & volume correction, validity, critical state of gas.

Module III: Organic Chemistry **8L**

(i) Stereochemistry **4L**

Representations of 3 dimensional structures, Chirality, optical activity, isomerism, structural isomerism, stereoisomers, enantiomers, diastereomers, configurations (D,L & cis trans), racemisation.

(ii) Organic reactions **4L**

Concepts of inductive effect, resonance, hyperconjugation, introduction to reactions involving substitution, addition, elimination, oxidation (Baeyer villiger oxidation), reduction (Clemmensen reduction, Wolff-Kishner reduction).

Module IV: Industrial Chemistry **8L**

(i) Water **2L**

Hardness, alkalinity, numerical

(ii) Corrosion. **2L**

Types of corrosion: wet & dry, preventive measures

(iii) Polymers **3L**

Classification of polymers, conducting polymers, biodegradable polymers

(iv) Synthesis of a commonly used drug molecule. **1L**

Paracetamol, Aspirin

Module V: Spectroscopic techniques in Chemistry **3L**

Electromagnetic radiation, Principles of spectroscopy, spectrophotometer, infrared spectroscopy, fingerprint region, functional group region, UV-VIS spectroscopy, ^{1}H Nuclear magnetic resonance spectroscopy, chemical shift.

Textbooks

1. A Text Book of Organic Chemistry, Arun Bahl & Arun Bahl
2. General & Inorganic Chemistry, P.K. Dutt
3. General & Inorganic Chemistry, Vol I, R.P. Sarkar
4. Physical Chemistry, P.C. Rakshit

Reference Books

1. Chemistry: Principles and Applications, by M. J. Sienko and R. A. Plane
2. Fundamentals of Molecular Spectroscopy, by C. N.Banwell
3. Engineering Chemistry (NPTEL Web-book), by B. L. Tembe, Kamaluddin and M. S.Krishnan
4. Physical Chemistry, by P. W.Atkins
5. Organic Chemistry: Structure and Function by K. P. C. Volhardt and N. E. Schore, 5th Editionhttp://bcs.whfreeman.com/vollhardtschore5e/default.asp

Project Domain

1. Application of Thermodynamics
2. Application of polymers in daily life
3. Nanomaterials and its applications
4. Determination of water quality parameters
5. Electronic storage devices
6. Managing E –wastes
7. Application of chemistry in core engineering
8. Application of spectroscopy in medical field
9. Applications of green chemistry
10. Merits of commercial organic products
11. Bioplastics
12. Any other related topics

CO-PO Mapping

Weightage Values: 3 = Strongly matched, 2 = Moderately matched, 1 = Weakly matched, (-) = Not matched

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2	2	2	-	-	-	-	2	2	2	2
CO2	3	3	3	3	-	-	-	-	2	2	2	3
CO3	3	3	2	2	-	2	2	-	2	-	3	3
CO4	3	2	3	2	-	-	2	-	2	2	3	3
CO5	3	3	3	3	2	2	2	-	2	-	2	3

CO-PSO Mapping

COs	PSO1	PSO2	PSO3
CH101.1	-	-	2
CH101.2	-	-	2
CH101.3	-	-	2
CH101.4	-	-	2
CH101.5	-	-	2

COURSE NAME: MATHEMATICS-I
COURSE CODE: M 101
CONTACT: 4:0:0
TOTAL CONTACT HOURS: 48
CREDITS: 4

Prerequisite: The students to whom this course will be offered must have the concept of (10+2) standard matrix algebra, calculus, and vector algebra.

Course Outcomes (COs):

On successful completion of the learning sessions of the course, the learner will be able to

CO1: Recall the properties and formula related to matrix algebra, differential calculus, multivariable calculus, vector calculus and infinite series.

CO2: Determine the solutions of the problems related to matrix algebra, differential calculus, multivariable calculus, vector calculus and infinite series.

CO3: Apply the appropriate mathematical tools of matrix algebra, differential calculus, multivariable calculus, vector calculus and infinite series for the solutions of the problems.

CO4: Analyze different engineering problems linked with matrix algebra, differential calculus, multivariable calculus, vector calculus.

CO5: Apply different engineering problems linked with matrix algebra, differential calculus, IntegraCalculus, multivariable calculus, vector calculus.

Course Content:

Module I: Matrix Algebra 11L

Echelon form and Normal (Canonical) form of a matrix; Inverse and rank of a matrix; Consistency and inconsistency of system of linear equations, Solution of system of linear equations; Eigenvalues and eigenvectors; Diagonalization of matrices; Cayley-Hamilton theorem.

Module II: Differential Calculus and Infinite Series 10L

Rolle's Theorem, Mean value theorems, Taylor's and Maclaurin theorems with remainders; Concept of sequence and series, Tests for convergence of infinite series: Comparison test, D'Alembert's ratio test, Raabe's test, Cauchy's root test, Leibnitz's Test, Power series; Taylor's series, Series for exponential, trigonometric and logarithm functions.

Module III: Multivariable Calculus (Differentiation) 13L

Function of several variables, Concept of limit, continuity and differentiability; Partial derivatives, Total derivative and its application; Chain rules, Derivatives of implicit functions Euler's theorem on homogeneous function, Jacobian. Maxima and minima of functions of two variables, Method of Lagrange multipliers.

Module IV: Multivariable Calculus (Integration) 6L

Line Integral, Double Integral, Triple Integral,Change of order in multiple integrals, Change of variables in multiple integrals.

Module V: Vector Calculus 8L

Gradient, Directional derivatives, Divergence, Curl, vector line integrals, vector surface integrals, vector volume integrals, Green's theorem, Gauss divergence theorem and Stokes' theorem.

Project Domain:

1. Study on eigenvalues and eigenvectors.
2. Study on convergence of infinite series.
3. Application of partial derivatives.
4. Application of vector calculus
5. Application of integral calculus.

Text Books:

1. Kreyszig, E., Advanced Engineering Mathematics, 9th Edition, John Wiley & Sons, 2006.
2. Ramana, B.V., Higher Engineering Mathematics, Tata McGraw Hill New Delhi, 11th Reprint, 2010.
3. Veerarajan, T., Engineering Mathematics for first year, Tata McGraw-Hill, New Delhi, 2008.
4. Grewal, B.S., Higher Engineering Mathematics, Khanna Publishers, 36th Edition, 2010.
5. Bali, N.P. and Goyal, M., A text book of Engineering Mathematics, Laxmi Publications, Reprint, 2008.
6. Samanta Guruprasad, A text book of Engineering Mathematics-I, New age International Publishers

Reference Books:

1. Thomas, G.B. and Finney, R.L., Calculus and Analytic geometry, 9th Edition, Pearson, Reprint, 2002.
2. Apostol, M., Calculus, Volumes 1 and 2 (2nd Edition), Wiley Eastern, 1980.
3. Kumaresan, S., Linear Algebra - A Geometric approach, Prentice Hall of India, 2000.
4. Poole, D., Linear Algebra: A Modern Introduction, 2nd Edition, Brooks/Cole, 2005.
5. Bronson, R., Schaum's Outline of Matrix Operations. 1988.
6. Piskunov, N., Differential and Integral Calculus, Vol. I & Vol. II, Mir Publishers, 1969

CO-PO Mapping:

PO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2	-	-	-	-	-	-	-	-	-	2
CO2	3	2	-	-	-	-	-	-	-	-	-	2
CO3	3	2	2	-	-	-	-	-	-	-	-	2
CO4	2	3	2	2	-	-	-	-	-	-	-	2

CO-PSO Mapping

COs	PSO1	PSO2	PSO3
M101.1	2	2	2
M101.2	2	2	2
M101.3	2	2	2
M101.4	2	2	2
M101.5	2	2	2

COURSE NAME: BASIC ELECTRICAL ENGINEERING
COURSE CODE: EE101
CONTACT: 3:0:0
TOTAL CONTACT HOURS: 36
CREDITS: 3

Pre-requisite: Basic 12th standard Physics and Mathematics, Concept of components of electric circuit.

Course Outcomes (COs):

After attending the course students' would be able to

CO1: understand and analyze basic electric circuits
CO2: study the working principles of electrical machines.
CO3: Understand and analysis transient and steady-state response of any electrical circuit/network by applying different circuit analysis methods. To understand and analyze basic electric and magnetic circuits.
CO4: Understand the single-phase transformer using EMF equation, No Load no load and on load operation, phasor diagram and equivalent circuit, losses of a transformer.
CO5: Understand 3-phase induction motor using Slip and Frequency ,rotor emf and current, Equivalent circuit and phasor diagram, Torque Slip characteristics torque-speed characteristics Starting of induction motor by star delta starter.

Course Content

Module- I: DC Circuits **8L**

Definition of electric circuit, linear circuit, non-linear circuit, bilateral circuit, unilateral circuit, Dependent source, node, branch, active and passive elements, Kirchhoff's laws, Source equivalence and conversion, Network Theorems - Superposition Theorem, Thevenin's Theorem, Norton Theorem, Maximum Power Transfer Theorem, Star-Delta Conversions.

Module- II: AC Fundamentals **8L**

Representation of sinusoidal waveforms, peak and rms values, phasor representation, real power, reactive power, apparent power, power factor. Analysis of single-phase ac circuits consisting of R, L, C, RL, RC, RLC combinations (series and parallel), resonance. Three phase balanced circuits, voltage and current relations in star and delta connections.

Module- III: Electrical Machines **10L**

Transformer: Magnetic materials, BH characteristics, ideal and practical transformer, equivalent circuit, losses in transformers, regulation and efficiency. Auto-transformer and three-phase transformer connections.

Rotating Machines - DC Machines: Brief idea on constructional features, classifications, working principle of both motor and generator. Simple problems on Voltage equation. Three-Phase Induction Motor: Basic concept of three phase circuit and production of rotating magnetic field. Working principle of three-phase induction motor and torque-speed characteristics (concept only).

Module- IV: Electrical Installations **3L**

Earthing of Electrical Equipment, ideas of basic components- MCB, MCCB, ELCB, SFU, Megger. Types of Wires and Cables, Earthing.

Module- V: Fundamentals of Power Systems **5L**

Generation of power: Block schematic representation of Thermal and nuclear power plants. Renewable energy sources: solar, wind, tidal and geothermal (Block diagram and working only- No Problems). Power transmission: Typical electrical power transmission scheme-need for high voltage transmission-(Derivation is not needed, No Problems). Power Distribution: substation equipments, primary and secondary transmission and distribution systems- feeder, service mains.

Module- VI: Introduction to Control Systems **2L**

Concept control systems, Objectives of control system, Types of control systems, Real examples of control systems.

Text books:

A. P. Kothari & I. J. Nagrath, Basic Electrical Engineering, TMH.

1. V. Mittle& Arvind Mittal, Basic Electrical Engineering, TMH.
2. Ashfaq Hussain, Basic Electrical Engineering, S. Chand Publication.
3. Chakrabarti, Nath& Chanda, Basic Electrical Engineering, TMH.
4. C.L. Wadhwa, Basic Electrical Engineering, Pearson Education.

Reference books:

1. E. Hughes, ―Electrical and Electronics Technology‖, Pearson, 2010.
2. V. D. Toro, ―Electrical Engineering Fundamentals‖, Prentice Hall India, 1989.

CO-PO Mapping:

Weightage Values: 3 = Strongly matched, 2 = Moderately matched, 1 = Weakly matched, (-) = Not matched

COs	PO 1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
EE 101.1	3	3	3	-	-	3	-	-	3	-	2	3
EE 101.2	3	3	2	-	-	2	-	-	3	-	1	3
EE 101.3	3	3	3	-	-	1	-	-	3	-	1	3
EE 101.4	3	3	3	-	-	2	-	-	3	-	2	3
EE 101.5	3	3	3	-	-	2	-	-	3	-	2	3

CO-PSO mapping

COs	PSO1	PSO2	PSO3
CO1	**3**	**3**	-
EE 101.2	**3**	**3**	-
EE 101.3	**3**	**3**	-
EE 101.4	**3**	**3**	-
EE 101.5	**3**	**3**	-

COURSE NAME: PROFESSIONAL COMMUNICATION
COURSE CODE: HSMC 101
CONTACT: 2:0:0
TOTAL CONTACT HOURS: 24
CREDITS: 2

Pre-requisites: Basic (10+2) level of knowledge of English grammar, vocabulary reading and writing skills.

Course Outcomes (COs):

After attending the course students' should be able to

CO1: apply the modalities and nuances of communication in a workplace context.

CO2: analyze communication across cultures and societies.

CO3: apply the basic formats, templates of business and official communication.

CO4: employ formal communication modes in meetings and reports.

CO5: justify importance of culturally neutral language in interpersonal and business communication.

Course Content:

Module- 1: Verbal and Non-verbal communication **4L**

1.1 : Definition, Relevance and Effective Usage
1.2 : Components of Verbal Communication: Written and Oral Communication
1.3 : Components of Non-verbal Communication: Kinesics, Proxemics, Chronemics, Haptics Paralanguage
1.4 : Barriers to Effective Communication

Module- 2: Social Communication Essentials and Cross-Cultural Communication **6L**

2.1 : Communication in Society and the Workplace
2.2 : Greetings, Courtesies and Socially Useful Language
2.3 : Cultural Contexts: High Context and Low Context Cultures
2.4: Understanding Cultural Nuances and Stereotyping
2.5: Achieving Culturally Neutral Communication in Speech and Writing

Module- 3: Meetings **4L**

3.1 : Meetings: Nature and Types
3.2 : Conducting Meetings: Organization and Procedures
3.3 : Meeting Coordination: Roles of Chairpersons and Members
3.4: Notice and Agenda for a Meeting
3.5: Preparing the Minutes of a Meeting (MOM)

Module- 4: Report Writing **4L**

4.1: Nature and Function of Reports
4.2: Types of Reports
4.3: Researching for a Business Report
4.4: Format, Language and Style
4.5: Report Documentation

Module 5: Employment Communication **6L**

5.1: Writing Business Letters- (Enquiry, Order, Sales, Complaint, Adjustment, Job Application, Offer)

5.2: Preparing a CV or Rẽsumẽ

5.3: Creating a Digital/Online Profile – LinkedIn (Résumé/Video Profile)

5.4: Writing E-mails: types, convention, and etiquette

5.5 : Memo, Notices and Circulars

5.6 : Writing Technicalities—Paragraphing, Sentence Structure and Punctuation

Text Books &Reference Books:

1. Meenakshi Raman and Sangeetha Sharma. *Technical Communication*. 3rd edition. New Delhi: Oxford University Press, 2015.
2. Mark Ibbotson. *Cambridge English for Engineering*. Cambridge: Cambridge University Press, 2008.
3. Mark Ibbotson. *Professional English in Use: Engineering*. Cambridge: Cambridge UP, 2009.
4. Lesikar et al. *Business Communication: Connecting in a Digital World*. New Delhi: Tata McGraw-Hill, 2014.
5. John Seeley. *Writing Reports*. Oxford: Oxford University Press, 2002.
6. Judith Leigh. *CVs and JobApplications*. Oxford: Oxford University Press, 2002.
7. Judith Leigh. *Organizing and Participating in Meetings*. Oxford: Oxford University Press, 2002.
8. Michael Swan. *Practical English Usage*. Oxford: OUP, 1980.
9. Pickett, Laster and Staples. *Technical English: Writing, Reading & Speaking*. 8th ed. London: Longman, 2001.
10. Diana Booher. *E-writing: 21st Century Tools for Effective Communication*.

Links:

1. Purdue University's Online Writing Lab (OWL)-https://owl.purdue.edu/
2. Business English Pod-https://www.businessenglishpod.com/

CO-PO Mapping

Weightage Values: 3 = Strongly matched, 2 = Moderately matched, 1 = Weakly matched, (-) = Not matched

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	-	-	-	-	-	2	-	-	3	-	2
CO2	2	3	2	-	-	2	2	2	-	3	-	3
CO3	2	3	-	-	-	3	3	3	-	3	-	3
CO4	-	-	-	-	-	3	3	3	-	3	-	3
CO5	-	-	-	-	-	-	3	3	-	3	-	3

CO-PSO Mapping

COs	PSO1	PSO2	PSO3
CO1	-	-	2
CO2	-	-	2
CO3	-	-	2
CO4	-	-	2
CO5	-	-	2

COURSE NAME: CHEMISTRY LAB
COURSE CODE: CH 191
CONTACT: 0:0:3
CREDITs: 1.5

Pre-requisite: A basic knowledge in 10+2 science with chemistry.

Course Outcomes (COs):

After attending this course, students would be
CO1: able to operate different types of instruments for estimation of small quantities chemicals used in industries and scientific and technical fields.
CO2: able to analyze and determine the composition of liquid and solid samples working as an individual and also as a team member.
CO3: able to analyze different parameters of water considering environmental issues.
CO4: able to synthesize drug and polymer materials.
CO5: Capable to design innovative experiments applying the fundamentals of chemistry.

Course Content:

Choice of 10-12 experiments from the following:

1. Determination of surface tension and viscosity
2. Thin layer chromatography
3. Determination of hardness of water
4. Determination of chloride content of water
5. Determination of the rate constant of a reaction
6. Determination of cell constant and conductometric tritration
7. pH metric titrations
8. Synthesis of a polymer/drug
9. Saponification/acid value of an oil
10. Chemical analysis of a salt
    Chemical oscillations- Iodine clock reaction
11. Determination of the partition coefficient of a substance between two immiscible liquids
12. Adsorption of acetic acid by charcoal
13. Estimation of iron in Mohr's salt solution by permanganometry (Redox Titration)
14. Innovative experiments (any one)
    - Synthesis of silver nano-particles
    - Green synthesis

CO-PO Mapping

Weightage Values: 3 = Strongly matched, 2 = Moderately matched, 1 = Weakly matched, (-) = Not matched

Cos	PO1	PO 2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO1 0	PO1 1	PO12
CH191.1	2	2	3	2	-	2	-	-	-	-	-	2
CH191.2	2	2	3	2	-	2	-	-	-	-	-	2
CH191.3	2	2	3	2	-	2	-	-	-	-	-	2
CH191.4	2	2	3	2	-	2	-	-	-	-	-	2
CH191.5	3	3	3	3	-	2	-	-	-	-	-	2

CO-PSO Mapping

COs	PSO1	PSO2	PSO3
CH191.1	-	-	2
CH191.2	-	-	2
CH191.3	-	-	2
CH191.4	-	-	2
CH191.5	-	-	2

COURSE NAME: BASIC ELECTRICAL ENGINEERING LABORATORY
COURSE CODE: EE191
CONTACT: 0:0:3
CREDITS: 1.5

Prerequisite: Basic Physics and applied physics, Basic Mathematics, Basic concept of Electric Circuit.

Course Outcomes (COs):

After completion of this course students will be able to

CO1: Identify common electrical components and their ratings.
CO2: Make Circuit connection by wires of appropriate ratings.
CO3: Understand the basic characteristics of transformers and electrical machines.
CO4: Design Open circuit and short circuit test of a single phase Transformer.
CO5: Design DC shunt motor and analyse single phase Energy Meter.

List of Experiments

1. Basic safety precautions – earthing, introduction to measuring instruments – Voltmeter, Ammeter, Multimeter, Wattmeter, Real life Resistor, Capacitor, Inductor.
2. Verification of Thevenin's and Norton's Theorem.
3. Verification of Superposition and Maximum Power Transfer Theorem.
4. Characteristics of Fluorescent, Tungsten and Carbon filament lamps.
5. Study of R-L-C series circuit.
6. Three-phase Power measurement with two wattmeter methods.
7. Demonstration of cut-out sections of machines: DC Machine (commutator-brush arrangement), Induction Machine (squirrel cage rotor).
8. Measurement of primary and secondary voltage and current of single-phase transformer – Open Circuit and Short Circuit Test.
9. Starting, Reversing and speed control of DC shunt motor.
10. Torque-Speed characteristics of DC Machine.
11. Torque-Speed characteristics of Three-phase Induction Motor.
12. Test on single-phase Energy Meter.
13. Innovative experiments

CO-PO Mapping

Weightage Values: 3 = Strongly matched, 2 = Moderately matched, 1 = Weakly matched, (-) = Not matched

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
EE 191.1	2	2	3	3	-	-	-	-	3	3	-	2
EE 191.2	3	3	2	3	-	-	-	-	3	3	-	3
EE 191.3	2	3	3	2	-	-	-	-	2	3	-	2
EE 191.4	2	3	3	3	-	-	-	-	3	3	-	2
EE 191.5	2	3	3	3	-	-	-	-	3	3	-	2

CO-PSO Mapping

COs	PSO1	PSO2	PSO3
EE 191.1	3	3	-
EE 191.2	3	3	-
EE 191.3	3	3	-
EE 191.4	3	3	-
EE 191.5	3	3	-

COURSE NAME: ENGINEERING GRAPHICS & DESIGN
COURSE CODE: ME192
CONTACT: 0:0:3
CREDITS: 1.5

Prerequisites: Basic knowledge of geometry

Course Outcomes (COs):

After attending the course students would

CO1: get introduced with Engineering Graphics and visual aspects of design.

CO2: know and use common drafting tools with the knowledge of drafting standards.

CO3: able to apply computer aided drafting techniques to represent line, surface or solid models in different Engineering viewpoints.

CO4: able to produce part models; carry out assembly operation and show working procedure of a designed project work using animation.

List of Drawing:

Traditional Engineering Graphics:

Principles of Engineering Graphics; Orthographic Projection; Descriptive Geometry; Drawing Principles; Isometric Projection; Surface Development; Perspective; Reading a Drawing; Sectional Views; Dimensioning & Tolerances; True Length, Angle; intersection, Shortest Distance.

Module 1: Introduction to Engineering Drawing

Principles of Engineering Graphics and their significance, Usage of Drawing instruments, lettering, Conic sections including Rectangular Hyperbola (General method only); Cycloid, Epicycloid and Involute; Scales – Plain, Diagonal and Vernier Scales.

Module 2: Orthographic & Isometric Projections

Principles of Orthographic Projections-Conventions - Projections of Points and lines inclined to both planes; Projections of planes on inclined Planes - Auxiliary Planes; Projection of Solids inclined to both the Planes- Auxiliary Views; Isometric Scale, Isometric Views of lines, Planes, Simple and compound Solids; Conversion of Isometric Views to Orthographic Views and Vice-versa.

Module 3: Sections and Sectional Views of Right Angular Solids

Drawing sectional views of solids for Prism, Cylinder, Pyramid, Cone and project the true shape of the sectioned surface, Auxiliary Views; Development of surfaces of Right Regular Solids - Prism, Pyramid, Cylinder and Cone; Draw sectional orthographic views of objects from industry and dwellings (foundation to slab only).

Computer Graphics:

Engineering Graphics Software; -Spatial Transformations; Orthographic Projections; Model Viewing; Co-ordinate Systems; Multi-view Projection; Exploded Assembly; Model Viewing; Animation; Spatial Manipulation; Surface Modeling; Solid Modeling.

Module 4: Overview of Computer Graphics

Demonstration of CAD software [The Menu System, Toolbars (Standard, Properties, Draw, Modify and Dimension), Drawing Area (Background, Crosshairs, Coordinate System), Dialog boxes and windows, Shortcut menus (Button Bars), Zooming methods, Select and erase objects].

Module 5: CAD Drawing, Customization, Annotations, layering

Set up of drawing page including scale settings, ISO and ANSI standards for dimensioning and tolerancing; Using various methods to draw straight lines, circles, applying dimensions and annotations to drawings; Setting up and use of Layers, changing line lengths (extend/lengthen); Drawing sectional views of solids; Drawing annotation,
CAD modeling of parts and assemblies with animation, Parametric and nonparametric solid, surface and wireframe modeling, Part editing and printing documents.

Module 6: Demonstration of a simple team design project

Illustrating Geometry and topology of engineered components: creation of engineering models and their presentation in standard 2D blueprint form and as 3D wire-frame and shaded solids; Meshed topologies for engineering analysis and tool-path generation for component manufacture, use of solid-modeling software for creating associative models at the component and assembly levels.

Text Books:

1. Bhatt N.D., Panchal V.M. & Ingle P.R, (2014), Engineering Drawing, Charotar Publishing House
2. K. Venugopal, Engineering Drawing + AutoCAD, New Age International publishers

Reference Books:

1. Pradeep Jain, Ankita Maheswari, A.P. Gautam, Engineering Graphics & Design, Khanna Publishing House
2. Agrawal B. & Agrawal C. M. (2012), Engineering Graphics, TMH Publication.
3. Shah, M.B. & Rana B.C. (2008), Engineering Drawing and Computer Graphics, Pearson Education
4. Narayana, K.L. & P Kannaiah (2008), Text book on Engineering Drawing, Scitech Publishers.

CO-PO Mapping:

Weightage Values: 3 = Strongly matched, 2 = Moderately matched, 1 = Weakly matched, (-) = Not matched

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	2	3	2	2	2	2	-	2	2	2	2
CO2	2	2	3	2	2	2	2	2	2	2	2	2
CO3	2	2	3	2	3	2	2	-	2	2	2	3
CO4	2	2	3	3	3	3	2	2	3	3	2	2

CO-PSO Mapping

COs	PSO1	PSO2	PSO3
CO1	-	-	-
CO2	-	-	-
CO3	-	-	-
CO4	-	-	-

R21 B.Tech (ECE)

Curriculum for B.Tech
Under Autonomy
Electronics & Communication Engineering
(Effective from 2021-22 admission Batch)
L –Lecture; T- Tutorial; P- Practical [1L=1Cr, 1T=1Cr, 1P =0.5 Cr]

First Year 2nd Semester

Sl. No.	Category	Course Code	Course Title	Hours per week				Credits
	A. THEORY			L	T	P	Total	
1	Basic Science courses	PH 201	Physics-I	3	0	0	3	3
2	Basic Science courses	M 201	Mathematics –II	4	0	0	4	4
3	Engineering Science Courses	CS 201	Programming for Problem Solving	3	0	0	3	3
	B. PRACTICAL							
4	Basic Science course	PH 291	Physics-I Lab	0	0	3	3	1.5
5	Humanities and Social Sciences including Management courses	HSMC 291	Professional Communication LAB	0	0	3	3	1
6	Engineering Science Courses	ME 291	Workshop & Manufacturing Practices Lab	0	0	3	3	1.5
7	Engineering Science Courses	CS 291	Programming for Problem Solving Lab	0	0	3	3	1.5
8	PROJECT	PR291	Theme based Project II	0	0	1	1	0.5
9	PROJECT	PR292	Skill Development II: Life Skill	1	0	0	1	0.5
	C. MANDATORY ACTIVITIES / COURSES							
10	Mandatory Course	MC281	NSS/ Physical Activities / Meditation & Yoga / Photography/ Nature Club	0	0	3	3	3 Units
	TOTAL CREDIT							16.5

PAPER NAME: PHYSICS –I
PAPER CODE: PH 201
CONTACT: 3:0:0
TOTAL CONTACT HOURS: 36
CREDIT: 3

Prerequisites: Knowledge of Physics up to 12th standard.

Course Outcomes (COs):

After attending the course students should be able to

CO1: describe various types of mechanical resonance and its electrical equivalence
CO2: explain basic principles of Laser, Optical fibers and Polarization of light
CO3: apply superposition principle to explain the phenomena of interference and diffraction.
CO4: analyze different crystallographic structures according to their co-ordination number and packing factors
CO5: justify the need of a quantum mechanics as remedy to overcome limitations imposed by classical physics

Course Content:
Module 1 (5L):-
Waves & Oscillations:-
Simple Harmonic Motion (Recap), superposition of waves, damped harmonic motion-over damped, critically damped and under damped motion, energy decay, logarithmic decrement, force vibration and resonance (amplitude, velocity resonance), sharpness of resonance, quality factor, related numerical problems. 5L

Module 2 (12L):-
Classical Optics:
2.01- Interference of light: Huygens's principle, conditions of sustained interference, classification of interference, Newton's ring (qualitative descriptions of working principles and procedures-no deduction required). Engineering applications, related numerical problems. 4L

2.02- Diffraction of light: Fresnel and Fraunhofer class, Fraunhoffer diffraction of a single slit, double slit, multiple slits, intensity distributions, missing order, Rayleigh criterion (no deduction) and resolving power of grating and microscope (no deduction), related numerical problems.
4L

2.03- Polarization: Definition, Plane of polarization, Plane of vibration, Malus Law, Fundamental concepts of plane, circular & elliptical polarizations (only qualitative idea) with examples, Brewster's law, Double refraction: Ordinary & Extra ordinary rays, positive and negative crystal, Nicol's prism, Numerical problems 4L

Module 3 (8L):-
Quantum Mechanics-I
3.01 Quantum Theory: Inadequacy of classical physics-concept of quantization of energy, particle concept of electromagnetic wave (example: photoelectric and Compton Effect; no derivation required, origin of

modified and unmodified lines), wave particle duality; phase velocity and group velocity; de Broglie hypothesis; Davisson and Germer experiment. 4L

3.02 Quantum Mechanics 1: Concept of wave function, physical significance of wave function, probability interpretation; normalization of wave functions; uncertainty principle, relevant numerical problems. Introduction of Schrödinger wave equation (only statement). 4L

Module 4 (3L):-
Solid State Physics-I:
4.01 Crystal Structure: Structure of solids, amorphous and crystalline solids (definition and examples), lattice, basis, unit cell, Fundamental types of lattices –Bravais lattice, simple cubic, fcc and bcc lattices, Miller indices and miller planes, co-ordination number and atomic packing factor, Bragg's equation, applications, numerical problems. 3L

Module 5 (8L):
Modern Optics-I:
5.01- Laser: Concepts of various emission and absorption processes, Einstein A and B coefficients and equations, working principle of laser, metastable state, population inversion, condition necessary for active laser action, optical resonator, illustrations of Ruby laser, He-Ne laser, Semiconductor laser, applications of laser, related numerical problems. 5L

5.02-Fibre optics-Principle and propagation of light in optical fibers (Step index, Graded index, single and multiple modes) - Numerical aperture and Acceptance angle, Basic concept of losses in optical fiber, related numerical problems. 3L

Recommended Text Books for Physics I (PH 101):

Waves & Oscillations:
1. Sound-N. K. Bajaj (TMH)
2. Advanced Acoustics-D. P. Roy Chowdhury (Chayan Publisher)
3. Principles of Acoustics-B.Ghosh (Sridhar Publisher)
4. A text book of sound-M. Ghosh (S. Chand publishers)
5. A text book of Light- K.G. Mazumder & B.Ghoshs, (Book & Allied Publisher)
6. Physics of Oscillations and Waves- R.P. Singh
7. College Physics Vol. II - A.B. Gupta
8. Vibration, Waves and Acoustics- Chattopadhyay and Rakshit

Classical & Modern Optics:
1. A text book of Light- K.G. Mazumder & B.Ghoshs (Book & Allied Publisher)
2. A text book of Light-Brijlal & Subhramanium, (S. Chand publishers)
3. Modern Optics-A. B. Gupta (Book & Allied Publisher)
4. Optics-Ajay Ghatak (TMH)
5. Optics-Hecht
6. Optics-R. Kar, Books Applied Publishers
7. Physical Optics Möler
8. Optics -F.A. Jenkins and H.E White

Quantum Mechanics-I
1. Introduction to Quantum Mechanics-S. N. Ghoshal (Calcutta Book House)
2. Quantum Mechanics-Bagde and Singh (S. Chand Publishers)
3. Perspective of Quantum Mechanics-S. P. Kuilla (New Central Book Agency)

4. Quantum Mechanics-Binayak Datta Roy (S. Chand Publishers)
5. Quantum Mechanics-Bransden (Pearson Education Ltd.)
6. Perspective of Modern Physics-A. Beiser (TMH)
7. Quantum mechanics -A.K. Ghatak and S Lokenathan
8. Modern Physics -E.E. Anderson
9. Physics Volume 2 -Haliday, Resnick & Krane, Published by Wiley India

Solid State Physics-I:

1. Solid state physics-Puri & Babbar (S. Chand publishers)
2. Materials Science & Engineering-Kakani Kakani
3. Solid state physics- S. O. Pillai
4. Introduction to solid state physics-Kittel (TMH)
5. Solid State Physics and Electronics-A. B. Gupta and Nurul Islam (Book & Allied Publisher)
6. Problem in Solid state physics -S.O. Pillai (a. b.)

Text Books:

1. Refresher courses in physics (Vol. 1, Vol. 2 & Vol. 3)-C. L. Arora (S. Chand Publishers)
2. Basic Engineering Physics-Amal Chakraborty (Chaya Prakashani Pvt. Ltd.)
3. Perspective & Concept of Modern Physics -Arthur Baiser
4. Principles of engineering physics – Md. N Khan and S Panigrahi.
5. Basic Engineering Physics-Sujoy Bhattacharya, Saumen Pal (MG)
6. Engineering Physics (Vol. 1, Vol. 2)-S.P. Kuila (S. Chand Publishers)
7. Engineering Physics-A. S. Vasudeva

**Total marks of the questions set from each module should be in proportion to the number of lectures allotted.

Project Domains

1. Study of Superposition of waves: Lissajous figures.

2. Electrical analogue of mechanical vibrations: application to electrical circuit (LC and LCR circuits), Electrical and mechanical impedance, quality factor, complex representation and phasor diagram.

3. Study of N-slit diffractions

4. Optical Fiber & its applications: Study of losses, estimation of numerical aperture in practical problems.

5. Photonic nature of electromagnetic waves

6. Optical Rotation

CO-PO Mapping:

Weightage Values: 3 = Strongly matched, 2 = Moderately matched, 1 = Weakly matched, (-) = Not matched

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	2	2	-	-	-	-	-	-	-	-
CO2	3	3	2	2	-	-	-	-	-	-	-	-
CO3	3	3	2	2	-	-	-	-	-	-	-	-
CO4	3	3	2	2	-	-	-	-	-	-	-	-
CO5	3	3	2	2	-	-	-	-	-	-	-	-

CO-PSO Mapping

COs	PSO1	PSO2	PSO3
PH201.1	3	2	2
PH201.2	3	2	2
PH201.3	3	2	2
PH201.4	3	2	2
PH201.5	3	2	2

COURSE NAME: MATHEMATICS-II

COURSE CODE: M 201

CONTACT: 4:0:0

TOTAL CONTACT HOURS: 48

CREDIT: 4

Prerequisite: The students to whom this course will be offered must have the concept of (10+2) calculus.

Course Outcomes (COs):

On successful completion of the learning sessions of the course, the learner will be able to

CO1: Determine and recall the properties and formula related to Ordinary differential equations, Basic Graph Theory and Laplace transform.

CO2: Determine the solutions of the problems related to Ordinary differential equations, Basic Graph Theory and Laplace transform.

CO3: Apply appropriate mathematical tools of Ordinary differential equations, Basic Graph Theory and Laplace transform.

CO4: Analyze engineering problems on Ordinary differential equations, Basic Graph Theory.

CO5 : Apply engineering solutions by using Laplace transform.

Course Content:

Module I: First Order Ordinary Differential Equations (ODE): 10L

Solution of first order and first degree ODE: Exact ODE, Rules for finding Integrating factors, Linear ODE, Bernoulli's equation, Solution of first order and higher degree ODE: solvable for p, solvable for y solvable for x and Clairaut's equation.

Module II: Second Order Ordinary Differential Equations (ODE): 10L

Solution of second order ODE with constant coefficients: C.F. & P.I., Method of variation of parameters, Cauchy-Euler equations, Solution of simultaneous linear ODEs.

Module III: Laplace Transform (LT): 14L

Improper integrals; Beta and Gamma functions and their properties.
Definition and existence of LT, LT of elementary functions, First and second shifting properties, Change of scale property, LT of $t f(t)$, LT of $\frac{f(t)}{t}$, LT of derivatives of f (t), LT of integral of f(t), Evaluation of improper integrals using LT, LT of periodic and step functions, Inverse LT: Definition and its properties, Convolution theorem (statement only) and its application to the evaluation of inverse LT, Solution of linear ODE with constant coefficients (initial value problem) using LT.

Module IV: Numerical Methods 14L

Introduction to error analysis, Calculus of finite difference. Interpolation: Newton forward and backward interpolation, Lagrange's interpolation, Newton's divided difference interpolation formula. Numerical integration: Trapezoidal rule, Simpson's 1/3 rule, Weddle's rule. Numerical solution of ordinary differential equation: Euler method, Modified Euler method, Fourth order Runge-Kutta method.

Project Domains:

1. Mathematical modeling using ODE.
2. Application of ODE.
3. Application of Laplace Transform in different engineering branches.
4. Application of Numerical Methods in different engineering branches.

Text Books:

1. Kreyszig, E., Advanced Engineering Mathematics, 9th Edition, John Wiley & Sons, 2006.
2. Ramana, B.V., Higher Engineering Mathematics, Tata McGraw Hill New Delhi, 11th Reprint, 2010.
3. Veerarajan, T., Engineering Mathematics for first year, Tata McGraw-Hill, New Delhi, 2008.
4. Grewal, B.S., Higher Engineering Mathematics, Khanna Publishers, 36th Edition, 2010.
5. Bali, N.P. and Goyal, M., A text book of Engineering Mathematics, Laxmi Publications, Reprint, 2008.
6. Samanta Guruprasad, A text book of Engineering Mathematics-II, New age International Publishers
7. Mollah, S. A, Numerical Analysis and Computational Procedures, Books and Allied (P) Ltd.

Reference Books:

1. Thomas, G.B. and Finney, R.L., Calculus and Analytic geometry, 9th Edition, Pearson, Reprint, 2002.
2. Boyce, W. E. and DiPrima, R. C., Elementary Differential Equations and Boundary Value Problems, 9th Edn., Wiley India, 2009.
3. Ross, S. L., Differential Equations, 3rd Ed., Wiley India, 1984.
4. Piskunov, N., Differential and Integral Calculus, Vol. I & Vol. II, Mir Publishers, 1969.
5. Coddington, E. A., An Introduction to Ordinary Differential Equations, Prentice Hall, India, 1995.
6. Dey, Sukhendu, Gupta Sisir, Numerical Methods, MsGraw Hill Education(India) Private Limited.
7. Jain, M. K., Iyengar, S. R. K., Jain, R. K., Numerical Methods, New age International Publishers

CO-PO Mapping:

Weightage Values: 3 = Strongly matched, 2 = Moderately matched, 1 = Weakly matched, (-) = Not matched

PO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	P10	P11	P12
CO1	3	3	2	-	-	-	-	-	-	-	-	2
CO2	3	3	3	3	-	-	-	-	-	-	-	2
CO3	3	3	3	3	-	-	-	-	-	-	-	2
CO4	3	3	3	3	-	-	-	-	-	-	-	2
CO5	3	3	3	3	-	-	-	-	-	-	-	2

CO-PSO Mapping

COs	PSO1	PSO2	PSO3
M201.1	2	2	2
M201.2	2	2	2
M201.3	2	2	2
M201.4	2	2	2
M201.5	2	2	2

COURSE NAME: PROGRAMMING FOR PROBLEM SOLVING
COURSE CODE: CS 201
CONTACT: 3:0:0
TOTAL CONTACT HOURS: 36
CREDITS: 3

Prerequisites: Number system, Boolean Algebra

Course Outcomes (COs): After completion of the course students will be able to

CO1: Understand the fundamental concept of Computer and mathematical knowledge and apply them in designing solution to engineering problem.

CO2: Understand the basic concept of C programming and use of data types/operators/input/output function for developing and implementing complete program leading to solution of mathematical and engineering problem.

CO3: Use conditional branching, iteration, recursion and formulate algorithms and programs in solving mathematical/ scientific/ engineering problem leading to lifelong learning.

CO4: Understand the concept of arrays, pointers, file and dynamic memory allocation and apply it for problem solving and also create new data types using structure, union and enum.

CO5: Understand how to decompose a problem into functions and assemble into a complete program by means of modular programming possibly as a team.

Course Content:

Module-1: Fundamentals of Computer **9L**

History of Computer, Generation of Computer, Classification of Computers, Basic structure of Computer System, Primary & Secondary Memory, Processing Unit, Input & Output devices.
Number System: basic of Binary, Octal, Decimal and Hexadecimal number systems; Representation and interchanging of number in different number systems. Introduction to complements system, Representation of signed and unsigned numbers in singed magnitude singed 1's complement system and signed 2's complement system.

Arithmetic– Addition and Subtraction (using1'scomplementand2'scomplement).
Representation of Characters-ASCII Code
Basics of Compiler, Interpreter and Assembler
Problem solving – Basic concept of Algorithm. Representation of algorithm using flow chart and pseudo code. Some basic examples.

Module-2: Introduction to C Programming **5L**

Overview of Procedural vs Structural language; History of C Programming Language.
Variable and Data Types: The C characterse identifiers
And keywords, data type & sizes, variable names, declaration, statements.
Operators & Expressions: Arithmetic operators,relational operators, logical operators, increment

anddecrementoperators,bitwiseoperators,assignmentoperators,conditionaloperators,specialoperators-typeconversion, C expressions, precedence and associativity.
Input and Output: Standard input and output, formatted output–print f,formatted input scan f.

Module-3: Branch and Loop **5L**

Branching: Concept of Statement and Blocks in C, Simple if, if -else, nested if-else and if-else ladder.
Switch Case: break andcontinue; switch-case, concept of goto and labels
Loops - while, for, do while

Module-4: Program Structures **4L**

Function: Basics of Functions, function types, function prototypes, formal and actual parameter, function calling, functions returning values, functions not returning values. Recursion and Recursive Function.
Storage Class in C: Storage Class-auto, external, static and register storage class, scope rules and life time of variables
C pre-processor: Pre-processing directive and macro, parameterized macro.

Module-5: Array and Pointer **7L**

Arrays: One dimensional arrays, Two-dimensional arrays, Passing an array to a function
Pointers: Pointers, Pointer andArray, Pointer and functions.
Strings: Character array and string, array of strings, Passing a string to a function, String related functions, Pointer and String.
Dynamic memory allocation: Malloc, calloc, realloc and free with example.

Module-6: Structures, Unions and Enum **3L**

Basic of structures, arrays of structures, structures and pointers, bit fields. Basics of union and enum, difference between structure and union.

Module-7: File in C **3L**

Files handling- opening and closing a file in different mode, formatted and unformatted files, Command line arguments, f open, f close, f get c, f put c, f print f, f scan f function.

Textbook:

1. Byron Gottfried, Schaum's Outline of Programming with C, McGraw-Hill
2. KanetkarY.-LetusC,BPBPublication,15th Edition

ReferenceBooks:

1. Brian W. Kernighan and Dennis M. Ritchie, The C Programming Language, Prentice Hall of India
2. K R Venugopal & S R Prasad – MASTERING C, TMH, 2nd Edition

CO–PO Mapping:

Weightage Values: 3 = Strongly matched, 2 = Moderately matched, 1 = Weakly matched, (-) = Not matched

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	3	3	2	-	-	-	-	-	-	-
CO2	2	2	3	2	-	-	-	-	-	-	-	-
CO3	2	3	2	2	-	-	-	-	-	-	-	3
CO4	3	2	2	2	3	-	-	-	-	-	-	-
CO5	2	2	2	2	-	-	-	-	3	2	-	-

CO-PSO Mapping

COs	PSO1	PSO2	PSO3
CO1	3	3	3
CO2	3	3	3
CO3	3	3	3
CO4	3	3	3
CO5	3	3	3

PAPER NAME: PHYSICS I LAB
PAPER CODE: PH 291
CONTACT HOURS: 0:0:3
CREDIT: 1.5

Prerequisites: Knowledge of Physics up to 12th standard.

Course Outcomes (COs):

After attending the course students' will be able to

CO1 : demonstrate experiments allied to their theoretical concepts

CO2 : conduct experiments using LASER, Optical fiber, Torsional pendulum, Spectrometer

CO3 : Analyze and participate as an individual, and as a member or leader in groups in laboratory sessions actively

CO4 : analyze experimental data from graphical representations , and to communicate effectively them in Laboratory reports including innovative experiments.

CO5 : Develop critical thinking skills to solve for real life challenges.

General idea about Measurements and Errors (One Mandatory):

i) Error estimation using Slide calipers/ Screw-gauge/travelling microscope for one experiment.
ii) Proportional error calculation using Carrey Foster Bridge.

Any 6 to be performed from the following experiments

Experiments on Waves & Oscillations:
1. Study of Torsional oscillation of Torsional pendulum & determination of time using various load of the oscillator.
2. Determination of elastic moduli of different materials (Young's modulus /Rigidity modulus)
3. Determination of Q factor using LCR Circuit.
4. Calibration of an oscillator using Lissajous Figure.

Experiments on Classical Optics:
5. Determination of wavelength of light by Newton's ring method.
6. Determination of wavelength of light by Laser diffraction method.
7. To determine the angle of optical rotation of a polar solution using polarimeter

Experiments on Quantum Physics-I:
8. Determination of Planck's constant using photoelectric cell.
9. Verification of Bohr's atomic orbital theory through Frank-Hertz experiment.
10. Determination of Stefan's Constant

In addition it is **recommended that each student should carry out at least one experiment beyond the syllabus/one experiment as Innovative experiment

Probable experiments beyond the syllabus:

1. Determination of wavelength of light by Fresnel's bi-prism method (beyond the syllabus).

3. Study of dispersive power of material of a prism.
4. Study of viscosity using Poiseuille's capillary flow method/using Stoke's law.
5. Measurement of nodal and antipodal points along transmission wire and measurement of wavelength.
6. Any other experiment related to the theory**.**

Recommended Text Books for Physics I Lab (PH 291):

Waves & Oscillations:
1. Vibration, Waves and Acoustics- Chattopadhyay and Rakshit

Classical & Modern Optics:
1. A text book of Light- K.G. Mazumder & B.Ghoshs (Book & Allied Publisher)

Quantum Mechanics-I
1. Introduction to Quantum Mechanics-S. N. Ghoshal (Calcutta Book House)

Solid State Physics-I:
1. Solid State Physics and Electronics-A. B. Gupta and Nurul Islam (Book & Allied Publisher)

Text Books:
1. Practical Physics by Chatterjee & Rakshit (Book & Allied Publisher)
2. Practical Physics by K.G. Mazumder (New Central Publishing)
3. Practical Physics by R. K. Kar (Book & Allied Publisher)

CO-PO Mapping:
Weightage Values: 3 = Strongly matched, 2 = Moderately matched, 1 = Weakly matched, (-) = Not matched

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	3	2	3	3	-	-	-	-	-	-	-
CO2	2	3	2	3	3	-	-	-	-	-	-	-
CO3	2	3	2	3	3	-	-	-	-	-	-	-
CO4	2	3	2	3	3	-	-	-	-	-	-	-
CO5	2	3	2	3	2	-	-	-	-	-	-	-

C0-PSO MAPPING

COs/POs	PSO1	PSO2	PSO3
CO1	3	3	2
CO2	3	3	2
CO3	3	3	2
CO4	3	3	2
CO5	3	3	2

COURSE NAME: PROFESSIONAL COMMUNICATION LAB
COURSE CODE: HSMC291
Contact: 0:0:2
CREDIT: 1

Pre requisites: Basic knowledge of LSRW skills.

Course Outcomes (COs):

After attending the course students' would be able to

CO1: explain advanced skills of Technical Communication in English through Language Laboratory.

CO2: apply listening, speaking, reading and writing skills in societal and professional life.

CO3: demonstrate the skills necessary to be a competent Interpersonal communicator.

CO4: analyze communication behaviours.

CO5: adapt to multifarious socio-economical and professional arenas with the help of effective communication and interpersonal skills.

Course Content:

Module- 1: Introduction to the Language Lab

a. The Need for a Language Laboratory
b. Tasks in the Lab
c. Writing a Laboratory Note Book

Module- 2: Active Listening

a. What is Active Listening?
b. Listening Sub-Skills—Predicting, Clarifying, Inferencing, Evaluating, Note-taking
c. Academic Listening vs Business Listening
d. Listening in Business Telephony
e. Study of Contextualized Examples based on Lab Recordings

Module- 3: Speaking

a. Speaking—Accuracy and Fluency Parameters
b. Pronunciation Guide—Basics of Sound Scripting, Stress and Intonation
c. Fluency-focussed activities—JAM, Conversational Role Plays, Speaking using Picture/Audio Visual inputs
d. Accuracy-focussed activities—Identifying Minimal Pairs, Sound Mazes, Open and Closed Pair Drilling, Student Recordings (using software)
e. Group Discussion: Principles and Practice
f. Business Meetings and Sales Talks

Module- 4: Lab Project Work

a. Making a brief Advertisement video (1-2 minutes)
b. Making a brief Business Documentary film (5-7 minutes)
c. Client interaction video (5-7 minutes)
d. Making a short video CV (1-2 minutes)

References:

1. IIT Mumbai, Preparatory Course in English syllabus
2. IIT Mumbai, Introduction to Linguistics syllabus
3. Sasikumar et al. A Course in Listening and Speaking. New Delhi: Foundation Books, 2005.
4. Tony Lynch, Study Listening. Cambridge: Cambridge UP, 2004.

CO-PO Mapping
Weightage Values: 3 = Strongly matched, 2 = Moderately matched, 1 = Weakly matched, (-) = Not matched

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	-	-	-	-	-	2	-	-	3	-	2
CO2	2	3	2	-	-	2	2	2	-	3	-	3
CO3	2	3	-	-	-	3	3	3	-	3	-	3
CO4	-	-	-	-	-	3	3	3	-	3	-	3
CO5	-	-	-	-	-	-	3	3	-	3	-	3

CO-PSO mapping

COs/POs	PSO1	PSO2	PSO3
CO1	-	-	-
CO2	-	-	-
CO3	-	-	-
CO4	-	-	-

COURSE NAME: WORKSHOP/MANUFACTURING PRACTICES
COURSE CODE: ME291
CONTACT: 0:0:3
CREDITS: 1.5

Prerequisite: Higher Secondary with Mathematics, Physics and Chemistry.

Course Outcomes (COs):

After completion of this course students will be able to

CO1: Identify and operate various hand tools related to variety of manufacturing operations

CO2: Safely fabricate simple components with their own hands.

CO3: Get practical knowledge of the dimensional accuracies and tolerances applicable for different manufacturing processes.

CO4: Produce small devices of their interest in project or research purpose.

Course Content:

(i) Theoretical discussion & videos: 3P

1. Manufacturing Methods- casting, forming, machining, joining, advanced manufacturing methods
2. Fitting operations & power tools
3. Carpentry
4. Welding (arc welding & gas welding), brazing
5. Electrical & Electronics
6. Metal casting
7. CNC machining, Additive manufacturing
8. Plastic moulding& Glass Cutting

(ii) Workshop Practice:

Module 1 - Machine shop 6P

Typical jobs that may be made in this practice module:

i. To make a pin from a mild steel rod in a lathe.

ii. To make rectangular and vee slot in a block of cast iron or mild steel in a shaping and / or milling machine.

Module 2 - Fitting shop 6P

Typical jobs that may be made in this practice module:

i. To make a Gauge from MS plate.

Module 3 - Carpentry 6P

Typical jobs that may be made in this practice module:

i. To make wooden joints and/or a pattern or like.

Module 4 - Welding shop (Arc welding 3P + gas welding 3P) 3P

Typical jobs that may be made in this practice module:

i. ARC WELDING (3P): To join two thick (approx 5mm) MS plates by manual metalarcwelding.

ii. GAS WELDING (3P): To join two thin mild steel plates or sheets by gas welding.

Module 5 - Electrical & Electronics 3P

House wiring, soft Soldering

Module 6 – Smithy 3P

Typical jobs that may be made in this practice module:
i. A simple job of making a square rod from a round bar or similar.
For further study (Optional)

Module 7 - Casting **3P**

Typical jobs that may be made in this practice module:
i. One/ two green sand moulds to prepare, and a casting be demonstrated.

Module 8 - Plastic moulding & Glass Cutting **3P**

Typical jobs that may be made in this practice module:
i. For plastic moulding, making at least one simple plastic component should be made.
ii. At least one sample shape on glass should be made using laser cutting machine.
Examinations could involve the actual fabrication of simple components, utilizing one or more of the techniques covered above.

Text Books:

1. Hajra Choudhury S.K., Hajra Choudhury A.K. and Nirjhar Roy S.K., "Elements of Workshop Technology", Vol. I 2008 and Vol. II 2010, Media promoters and publishers private limited, Mumbai.
2. Rao P.N., "Manufacturing Technology", Vol. I and Vol. II, Tata McGrawHill House, 2017.

Reference Books:

1. Gowri P., Hariharan and A. Suresh Babu, Manufacturing Technology – I, Pearson Education, 2008.
2. Roy A. Lindberg, "Processes and Materials of Manufacture", 4th edition, Prentice Hall India, 1998.
3. Kalpakjian S. and Steven S. Schmid, Manufacturing Engineering and Technology, 4th edition, Pearson Education India Edition, 2002.
4. Manufacturing Science by A. Ghosh and A.K. Mallick, Wiley Eastern.
5. Principles of Metal Cutting/Principles of Machine Tools by G.C. Sen and A. Bhattacharya, New Central Book Agency, Kolkata.

CO-PO Mapping:

Weightage Values: 3 = Strongly matched, 2 = Moderately matched, 1 = Weakly matched, (-) = Not matched

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	2	2	-	2	3	2	-	2	2	2	3
CO2	2	2	3	2	2	2	2	-	3	2	2	3
CO3	3	2	2	2	2	2	2	2	2	2	2	3
CO4	2	2	3	2	3	3	2	-	3	3	3	3

CO-PSO mapping

COs/POs	PSO1	PSO2	PSO3
CO1	-	-	-
CO2	-	-	-
CO3	-	-	-
CO4	-	-	-

COURSENAME: PROGRAMMING FOR PROBLEM SOLVING LAB
COURSE CODE: CS 291
CONTACT: 0:0:3
CREDITS: 1.5

Prerequisites: Number system, Boolean Algebra

Course Outcomes (COs):

After completion of the course students will be able to

CO1: Understand and propose appropriate command or function in running system or developing program for engineering and mathematical problems depending on the platform used even in changed environment leading to their lifelong learning.

CO2: Identify and propose appropriate data type, arithmetic operators, input/output functions and also conditional statements in designing effective programs to solve complex engineering problem using modern tools.

CO3: Design and develop effective programs for engineering and mathematical problems using iterative statements as well as recursive functions using modular programming approach possibly as a team maintaining proper ethics of collaboration.

CO4: Explain and organize data in arrays, strings and structures and manipulate them through programs and also define pointers of different types and use them in defining self-referential structures and also to construct and use files for reading and writing to and from leading to solution of engineering and mathematical problem.

CO5: Prepare laboratory reports on interpretation of experimental results and analyze it for validating the same maintaining proper ethics of collaboration.

Course Content:

Module-1: Familiarization with some basic commands of DOS and Linux. File handling and Directory structures, file permissions, creating and editing simple C program in different editor and IDE, compilation and execution of C program. Introduction to Code block.

Module-2: Problem based on

a) Basic data types
b) Different arithmetic operators.
c) Print f( ) and scan f( ) functions.

Module-3: Problem based on conditional statements using

a) if-else statements
b) different relational operators
c) different logical operators

Module-4: Problem based on

a) **for** loop

CO-PO Mapping

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	2	2	-	-	-	-	3	-	-	3
CO2	3	3	3	2	-	-	-	-	3	-	-	3
CO3	3	3	3	2	-	-	-	-	3	-	-	3
CO4	3	3	3	2	-	-	-	-	3	-	-	3
CO5	2	3	3	3	-	-	-	-	3	-	-	3

CO-PSO mapping

COs/POs	PSO1	PSO2	PSO3
CO1	3	3	3
CO2	3	3	3
CO3	3	3	3
CO4	3	3	3
CO5	3	3	3

Curriculum for B.Tech
Under Autonomy
Electronics & Communication Engineering
(Effective From 2021-22 admission Batch)
L – Lecture; T- Tutorial; P- Practical [1L=1Cr, 1T=1Cr, 1P =0.5 Cr]

2nd Year 1st Semester: 3rd Semester

Sl. No.	Category	Course Code	Course Title	Hours per week				Credits/ Unit
				L	T	P	Total	
A. THEORY								
1	BS	M 301	Mathematics III	3	0	0	3	3
2	ES	EC 301	Data Structure	3	0	0	3	3
3	ES	EC302	Circuit Theory & Network	3	0	0	3	3
4	PC	EC303	Electronic Devices	3	0	0	3	3
5	PC	EC304	Signal & Systems	3	0	0	3	3
6	HSMC	HSMC 303	Universal Human Values 2: Understanding Harmony	3	0	0	3	3
B. PRACTICAL								
7	ES	M (CS)391	Numerical Methods Lab	1	0	3	3	2.5
8	ES	EC391	Data Structure Lab	0	0	3	3	1.5
9	ES	EC392	Circuit Theory & Network Lab	0	0	3	3	1.5
10	PC	EC393	Electronic Devices Lab	0	0	3	3	1.5
11	PROJECT	PR391	Theme based Project III	0	0	1	1	0.5
12	PROJECT	PR392	Skill Development III: Technical Seminar Presentation	0	0	1	1	0.5
C. MANDATORY ACTIVITIES / COURSES								
15	MC	MC 301	Environmental Science	3	0	0	3	0
	TOTAL CREDIT WITHOUT MOOCS COURSES							26.0
D.MOOCS COURSES**								
16	MOOCS COURSES	HM301	MOOCS COURSE-II	1	3	1	4	4
TOTAL CREDIT WITH MOOCS COURSES								30

** MOOCS COURSES for HONOURS/MINOR Degree are Program specific and to be taken from MOOCS BASKET

Course Name: Mathematics-III
Course Code: M 301
Contact: 3:0:0
Total Contact Hours: 36
Credits: 3

Prerequisite:

The students to whom this course will be offered must have the concept of (10+2) standard calculus, basic probability and differential equations.

Course Outcomes:
On successful completion of the learning sessions of the course, the learner will be able to:

CO1: Recall the underlying principle and properties of Fourier series, Fourier transform, probability distribution of a random variable, calculus of complex variable, and partial differential equation.

CO2: Exemplify the variables, functions, probability distribution and differential equations and find their distinctive measures using the underlying concept of Fourier series, Fourier transform, probability distribution of a random variable, calculus of complex variable, and partial differential equation.

CO3: Apply Cauchy's integral theorem and the residue theorem to find the value of complex integration, and compute the probability of real world uncertain phenomena by indentifying probability distribution that fits the phenomena.

CO4: Solve partial differential equation using method of separation of variables

CO5: Find the Fourier series and Fourier transform of functions by organizing understandings of underlying principles and also evaluate the integral using Parseval's identity.

Course Content:

MODULE I: Fourier series and Fourier Transform: (9 L)

Fourier series: Dirichlet's Conditions; Euler's Formula for Fourier Series; Fourier Series for functions of period 2π; Sum of Fourier series (examples); Theorem for the convergence of Fourier series (statement only); Fourier series of a function with its periodic extension; Half range Fourier series: Construction of half range Sine series and half range Cosine Series; Parseval's identity (statement only) and related problems.
Fourier Transform: Fourier Transform, Fourier Cosine Transforms, Fourier Sine Transforms (problems only); Properties of Fourier Transform: Linearity, Shifting, Change of Scale, Modulation (problems only); Fourier Transform of Derivatives (problems only); Convolution Theorem (statement only), Inverse of Fourier Transform (problems only).

MODULE II: Probability Distributions: (9 L)

Random Variable: Discrete and Continuous (definition & examples); Probability Distribution (definition & examples); Probability Mass Function, Probability Density Functionand Distribution Function for a single random variable only (definition, properties & related problems); Expectation, Varianceand Standard Deviation for a single random variable only (definition, properties & related problems); Binomial Distribution, Poisson Distribution, Binomial Approximation to Poisson Distribution and Normal Distribution (problems only), Mean, Variance and Standard Deviation of Binomial, Poisson and Normal Distribution (problems only).

MODULE III: Calculus of Complex Variable: (13 L)

Functions of a Complex Variable (definition and examples); Concept of Limit, Continuity and Differentiability (problems only); Analytic Functions (definition and examples); Cauchy-Riemann Equations (statement only& related problems); Sufficient condition for a function to be analytic (statement only & related problems).
Concept of Simple Curve, Closed Curve, Smooth Curve & Contour; Some elementary properties of complex integrals (problems only); Cauchy's Theorem (statement only & related problems); Cauchy's Integral Formula(statement only & related problems); Cauchy's Integral Formula for the derivative of an analytic function(statement only & related problems); Cauchy's Integral Formula for the successive derivatives of an analytic function (statement only & related problems); Taylor's series and Laurent's series (problems only). Zero of an Analytic Function and its order (definition & related problems); Singularities of an Analytic Function: Isolated Singularity and Non-isolated Singularity (definition & related problems); Essential Singularities, Poles (Simple Pole and Pole of Order m) and Removable Singularities (definition & related problems); Determination of singularities and their nature (problems only); Residue (definition & examples); Determination of the residue of a given function; Cauchy's Residue theorem (statement only & related problems). Application of Residue.

MODULE IV: Partial Differential Equation (PDE): (5 L)

Solution of PDE: Method of Separation of Variables.
Solution of Initial Value & Boundary Value Problem: One Dimensional Wave Equation, One Dimensional Heat Equation, Two Dimensional Laplace Equation.

Project Domains:

6. Study of physical processes through PDE and ODE.
7. Application of calculus of complex variable in real world engineering problems.
8. Study of uncertainty in real world phenomena using probability distribution.
9. Application of Fourier series and Fourier transform in engineering problems.

Text Books:

1. Herman, R. L. An Introduction to Fourier Analysis, Chapman and Hall/CRC, 2016.
2. Grafakos, L. Classical Fourier Analysis, Springer, India, Private Ltd.
3. Das, N.G. Probability and Statistics; The McGraw Hill Companies.
4. Gupta, S. C. and Kapoor, V. K. Fundamentals of Mathematical Statistics, Sultan Chand & Sons.
5. Mathews, J. H. and Howell, R. W. Complex Analysis for Mathematics & Engineering, Jones & Bartlett Pub, 2006.
6. Chowdhury, B. Elements of Complex Analysis, New Age International, 1993.
7. Raisinghania, M .D. Advanced Ordinary & Partial Differential. Equation; S. Chand Publication.
8. Grewal, B. S. Higher Engineering Mathematics, Khanna Pub.
9. Kreyszig, E. Advanced Engineering Mathematics, John Wiley & Sons, 2006.

Reference Books:

7. Gray, R. M. and Goodman, J. Fourier Transforms: An Introduction for Engineers, Springer, US, 1995.
8. Lipschutz & Lipson, Schaum's Outline in Probability (2ndEd), McGraw Hill Education.

9. Spiegel, M. R. Theory and Problems of Probability and Statistics (Schaum's Outline Series), McGraw Hill Book Co.
10. Goon, A.M., Gupta M .K. and Dasgupta, B. Fundamental of Statistics, The World Press Pvt. Ltd.
11. Soong, T. T. Fundamentals of Probability and Statistics for Engineers, John Wiley & Sons Inc, 2004.
12. Delampady, M. Probability & Statistics, Universities Press.
13. Spiegel, M. R. Theory and Problems of Complex Variables (Schaum's Outline Series), McGraw Hill Book Co.
14. Sneddon, I. N. Elements of Partial Differential Equations, McGraw Hill Book Co.

CO-PO Mapping:

PO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	P10	P11	P12
CO 1	3	1	1	-	-	-	-	-	-	-	-	1
CO 2	3	2	1	-	-	-	-	-	-	-	-	1
CO 3	3	2	2	-	-	-	-	-	-	-	-	1
CO 4	3	2	2	-	-	-	-	-	-	-	-	1
CO 5	3	3	2	3	-	-	-	-	-	-	-	1

CO-PSO mapping

COs/POs	PSO1	PSO2	PSO3
M 301.1	3	3	3
M 301.2	3	3	3
M 301.3	3	3	3
M 301.4	3	3	3
M 301.5	3	3	3

Course Name: Data Structure
Course Code: EC 301
Contact: 3:0:0
Total Contact Hours: 36
Credits: 3

Prerequisite: Fundamentals of Computer & C Programming

Course Outcome:

CO1: Able to understand the concept of linear and nonlinear data structures.
CO2: Able to evaluate the efficiency of algorithms.
CO3: Able to understand searching and sorting techniques
CO4: Able to illustrate the hashing technique.
CO5: Able to evaluate data using BFS, DFS, Prim's and Kruskal's algorithms.

Course Content:

Module I: Introduction [2L]
Data and data structure (Linear & Non-linear), abstract Data Type. Algorithms and programs, basic idea of pseudo-code, Algorithm efficiency and analysis, time and space analysis of algorithms, Big-O notations.

Module-II: Arrays & Linked List [6L]
Different representations - row major, column major, Sparse matrix - its implementation and usage, Array representation of polynomials, singly linked list - operations, doubly linked list – operations, Circular linked list - operations, Linked list representation of polynomial and applications.

Module III: Stack and Queue [4L]
Stack and its implementations (using array and linked list), Applications (infix to Postfix, Postfix Evaluation), Queue, circular queue de-queue, Implementation of queue- linear and circular (using array and linked list).

Module IV: Recursion [2L]
Principles of recursion - use of stack, tail recursion, Applications - The Tower of Hanoi, Eight Queens Puzzle.

Module V: Trees [8L]
Basic terminologies, forest, tree representation (using array and linked list), Binary trees - binary tree traversal (pre-, in-, post- order), Threaded binary tree, Binary search tree- operations (creation, insertion, deletion, searching), Concept of Max-Heap and Min-Heap (creation, deletion), Height balanced binary tree - AVL tree (insertion with examples only), Height balanced binary tree - AVL tree (deletion with examples only), m -Way Search Tree, B+ Tree - operations (insertion, deletion).

Module VI: Graphs [4L]
Graph theory review, Graph traversal and connectivity - Depth-first search (DFS), Breadth-first search (BFS) - concepts of edges used in DFS and BFS (tree-edge, back-edge, cross-edge, and forward-edge), Minimal spanning tree - Prim's algorithm, Kruskal's algorithm (basic idea of greedy methods).

Module VII: Searching & Sorting [8L]
Bubble sort, Insertion sort, Selection sort- with notion of complexity, Quick sort, Merge sort - with complexity, Radix sort - with complexity, Sequential search - with complexity, Binary search, Interpolation Search- with complexity.

Module VIII: Hashing [2L]
Introduction to Hashing and Hashing functions, Collision resolution techniques.

Textbooks:

1. "Fundamentals of Data Structures of C" by Ellis Horowitz, SartajSahni, Susan Anderson-freed.

Reference books:

1. "The Art of Computer Programming" by Donald Knuth.
2. "Data Structures, Algorithms, and Software Principles in C" by Thomas A. Standish.
3. "Data Structures" by S. Lipschutz.
4. "Data Structures and Program Design In C, 2nd Edition" by Robert L. Kruse, Bruce P. Leung.
5. "Data Structures in C" by Aaron M. Tenenbaum.

CO-PO Mapping:

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	3	2	-	-	-	-	2	-	-	2
CO2	3	3	3	3	-	-	-	-	2	-	-	3
CO3	3	3	3	2	-	-	-	-	2	-	-	3
CO4	3	3	3	3	-	-	-	-	2	-	-	3
CO5	3	3	3	3	-	-	-	-	2	-	-	2

Weightage Values: (3) Strongly matched, (2) Moderately matched, (1) Weakly matched, (-) Not matched.

CO-PSO mapping

COs/POs	PSO1	PSO2	PSO3
CO1	-	2	3
CO2	-	2	3
CO3	-	2	3
CO4	-	2	3
CO5	-	2	3

Course Name: Circuit Theory & Network
Course Code: EC 302
Contact: 3:0:0
Total Contact Hours: 36
Credits: 3

Prerequisites: Properties of series and parallel connections, concept of KCL, KVL, complex number, current- voltage phasor diagram, DC and AC, Charging and discharging of capacitor, Energizing and decaying of inductor.

Course Outcomes: Graduates of the ECE program will be able to:

CO1: Determine current, voltage and power at different branch/node for DC and AC circuit having independent & dependent sources with the help of various networks theorems and methods like nodal &mesh analysis and star-delta transformation.

CO2: Explain Laplace transform of step function, gate function, impulse function, triangular & rectangular function, stain of pulses, initial & final value theorem and able to apply the concept of Laplace transform to determine the circuit parameters in S-domain.

CO3: Determine and analyze circuit parameters of RC, RL and RLC network at transient conditions intime domain & S-domain with DC excitations and able to demonstrate transient behavior of RC, RL andRLC circuit with AC excitations

CO4: Construct and analyze performance of RLC series & parallel resonance circuit based on the parameters- resonance frequency, bandwidth, upper & lower cut-off frequency, quality factor and impedance at prototype level for audio frequency range.

CO5: Determine Z, Y, h & T parameters, analyze & develop two port equivalent circuit for an unknown DC and AC network with the concept of open& short circuit test.

Course Content:

Module I: Methods of Analysis and Network Theorems. [10L]
Node and Mesh analysis in DC and AC circuits with independent and dependent sources, super node & super mesh; Star-Delta transformation technique in DC &AC circuits; Solving problems using network theorems- Superposition theorem, Thevenin's theorem, Norton's theorem, Maximum Power Transfer theorem, Reciprocity theorem in DC & AC Circuits with independent and dependent sources; Sinusoidal steady state analysis, complex power.

Module II: Application of Laplace Transform in Circuit Analysis [4L]
Laplace transform: Step function, GATE function, Impulse function, Delta function, Periodic functions - Rectangular & Triangular wave, strain of pulses; initial & final value theorem; Circuit analysis & solution of numerical problems in S-domain.

Module III: Transient Analysis in RC, RL and RLC Circuit [5L]
Transient analysis in RC, RL, RLC circuit with DC excitations – determination of circuit parameters at time (t=0, t=0+, t=0-, t > 0) with numerical examples; RC, RL, RLC circuit with sinusoidal excitation (concept only).

Module IV: Resonance in RLC Circuit [4L]
RLC series and parallel resonance circuit - condition of resonance, resonance frequency, impedance & admittance characteristics, quality factor, half power points, bandwidth, phasor diagrams, properties of series and parallel resonance; Solution of problems.

MODULE V: Two Port Network [5L]
Two port network analysis – Z, Y, h and ABCD parameters; conditions of reciprocity and symmetry in terms of two port parameters; equivalent circuit in terms of Z, Y and h parameters; Interrelation between different two port parameters (concept only); Solutions of circuit problems using two port parameters.

Module VI: Magnetically Coupled Circuit [4L]
Self & Mutual inductance; Polarity of induced voltage in magnetically coupled circuit; Determination of equivalent inductance in series and parallel magnetically coupled network; Numerical examples for the determination current, voltage and power of a magnetically coupled network.

Module VII: Graph of a Network [4L]
Development of graph of a network -planner and non-planner graph, branch, tree, twigs; Incidence Matrix, Cut Set Matrix, Tie Set Matrix for a graph of circuit; Application of graph to solve problems in circuit.

Textbooks:

1. A.Chakrabarti - Circuit Theory: Analysis and Synthesis , Dhanpat Rai & Co.
2. Valkenburg M. E. Van, "Network Analysis", Prentice Hall. /Pearson Education
3. Hayt "Engg Circuit Analysis" 6/e Tata McGraw-Hill
4. D. Roy Chowdhury -Networks and Systems, New Age International

Reference Books:

1.B.L. Thereja and A.K. Thereja - A Textbook of Electrical Technology: Basic Electrical Engineering in S. Units (Volume - 1), S-Chand
2. Sudhakar: Circuits & Networks: Analysis & Synthesis" 2/e TMH
3. D.A.Bell- Electrical Circuits-Oxford
4 P.Ramesh Babu- Electrical Circuit Analysis-Scitech
5. M.S.Sukhija & T.K.NagSarkar- Circuits and Networks-Oxford
6. Skilling H.H.: "Electrical Engineering Circuits", John Wiley & Sons.
7. Edminister J.A.: "Theory & Problems of Electric Circuits", McGraw-Hill Co.
8. Kuo F. F., "Network Analysis & Synthesis", John Wiley & Sons.

9. Sivandam- Electric Circuits and Analysis, Vikas

CO-PO Mapping:

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2	2	2	-	-	-	-	2	-	-	2
CO2	3	3	3	3	-	-	-	-	-	-	-	3
CO3	3	3	3	2	-	-	-	-	-	-	-	3
CO4	3	3	3	3	-	-	-	-	-	-	-	3
CO5	3	3	3	3	-	-	-	-	2	-	-	2

Weightage Values: 3 = Strongly matched, 2 = Moderately matched, 1 = Weakly matched, (-) = Not matched.

CO-PSO mapping

COs/POs	PSO1	PSO2	PSO3
CO1	3	3	3
CO2	3	3	2
CO3	3	3	3
CO4	3	3	3
CO5	3	3	3

Course Name: Electronic Devices
Course Code: EC303
Contact: 3:0:0
Total Contact Hours: 36
Credits: 3

Prerequisites: Electronic structure of atoms, crystalline and non-crystalline solids, unit cells, Millerindex, conductors, semiconductors and insulators, electrical properties, basic concept of electronic devices.

Course Outcomes: Graduates of the ECE program will be able to:

CO1: Able to explain charge carrier transport phenomenon and generation-recombination process of intrinsic and extrinsic semiconductor materials with the help of energy band diagram & Fermi-Dirac distribution function.
CO2: Able to illustrate electrical characteristics of rectifier diodes, Zener diode, varactor diode, PIN diode, Gunn diode, IMPATT diode, Tunnel diode, & LED based on properties of PN junction and understand the usages of solar cell as a renewable energy source for societal & environmental benefit.
CO3: Able to explain formation of Ohmic & non-Ohmic contact in metal semiconductor junction and 2D Electron Gas in Heterojunction based on energy band diagram.
CO4: Able to illustrate current flow mechanism, electrical characteristics, and electrical equivalent model of BJT with the help of energy band diagram at forward & reverse biased PN junction.
CO5: Able to determine drain current in linear & saturation region for JFET & MOSFET, MOS capacitances in accumulation, depletion & inversion stages, Pinch off voltage of JFET and threshold voltage of MOSFET with the help of mathematical expressions.

Course Contents:

Module I: Charge Carriers in Semiconductors: [6L]

Introduction to semiconductor physics: review of quantum mechanics, electrons in periodic lattices, E-k diagrams. Energy bands in intrinsic and extrinsic silicon; intrinsic & extrinsic semiconductor. Effect of temperature and energy gap on intrinsic concentration, effect of temperature on extrinsic semiconductor, derivation of equilibrium electron and hole concentration in terms of effective density of states and intrinsic level, derivation of electron and hole concentration in a compensated semiconductor, basic concept on optical absorption, photoluminescence, carrier lifetime, carrier generation and recombination, continuity equation (expression and significance only). Degeneracy and non- degeneracy of semiconductors.
Non-equilibrium condition: Effect of temperature and doping concentration on mobility, Effective mobility due to scattering effect, drift & diffusion of carriers, high field effect on drift velocity, Hall effect and piezoelectric effect, generation and recombination, quasi- Fermi energy level (concept only).

Module II: P-N Junction Diode: [8L]

P-N junction formation and depletion region, energy band diagram of p-n junction at equilibrium and barrier energy, built in potential at p-n junction, energy band diagram and current through p-n junction at forward and reverse bias, V-I characteristics and current expression of diode, temperature dependencies of V-I characteristics of diode, p-n junction breakdown – conditions, avalanche and Zener breakdown, Concept of Junction capacitance, Zener diode and characteristics.

Diode half wave and full wave rectifiers circuits and operation (IDC, Irms, VDC, Vrms, ripple factor without filter, efficiency, PIV, TUF; Reduction of ac ripples using filter circuit (Qualitative analysis); Design of diode clipper and clamper circuit - explanation with example, application of Zener diode in regulator circuit. Numerical problems

Module III: Device Physics of Bipolar Junction Transistor: [6L]

Physical mechanism, carrier distribution in forward active mode, terminal current equations, common base current gain (α) , common emitter current gain (β), controlling parameters for β, punch-through and avalanche effect, expression for punch through voltage and avalanche breakdown voltage (no derivation), Solution of continuity equation and Poisson's equation for BJT, Eber's Moll model for Static behavior & Charge controlled model (without derivation) for dynamic behavior, equivalent circuits, origin of parameters in hybrid-pi model, time delay factors in BJT, alpha and beta cut-off frequency, idea of photo transistor.
Numerical Problems.

Module IV: Field Effect Transistors: [6L]

Junction Field Effect Transistor (JFET):

Construction, field control action and I-V characteristics, JFET parameters, Schokley equation, Numerical Problems.

Metal Oxide Field Effect Transistor (MOSFET):

Types of MOSFET , structure of E-MOSFET, MOS structure under external bias -accumulation, depletion and inversion phenomenon with energy band diagram ,threshold voltage and flat band voltage; working of E- MOSFET with characteristics ;drain current equation for linear and saturation region with condition (expression only); channel length modulation ;derivation of threshold voltage of ideal and non- ideal MOSFET Capacitance- Different types of MOSFET Capacitances, MOS capacitance variation with gate to source voltage under low frequency & High Frequency; large and small signal model of MOSFET (explanation with diagram). Basics of MESFET, Numerical Problems.

Module V: Feedback and Operational Amplifier [6L]

Concept of feedback with block diagram, positive and negative feedback, gain with feedback. Feedback topologies, effect of feedback on input and output impedance, distortion, concept of oscillation and Barkhausen criterion.
Operational amplifier – electrical equivalent circuit, ideal characteristics, non-ideal characteristics of op- amp – offset voltages; bias current; offset current; Slew rate; CMRR and bandwidth, Configuration of inverting and non-inverting amplifier using Op-amp, closed loop voltage gain of inverting and non- inverting amplifier, Concept of virtual ground, Applications op-amp – summing amplifier; differential amplifier; voltage follower; basic differentiator and integrator.
Problems on Characteristics of Op-amp, CMRR, slew rate, amplifier, and application of Op-amp to be discussed. Any other relevant problems related to topic may be discussed or assigned.

Module VI: [4L]

Photo Devices:
Solar cell – photo-voltaic effect, constructional features of solar cell, conversion efficiency and fill factor; LED; Basic idea about Photo Diode. Numerical Problems.
Hetero Junction
Energy band diagram, Classification of Heterojunction; 2D Electron Gas (Isotype Heterojunction), n-isotype Heterojunction, I-V Characteristics.

Textbooks:

1. Streetman & Banerjee - Solid State Electronic Devices, PHI.
2. S.M. Sze, Physics of semiconductor devices, Wiley.

Reference Books:

1. Milman, Halkias–Integrated Electronics –TMH.
2. Sedra & Smith-Microelectronic Circuits-Oxford.
3. Neamen-Semiconductor Physics and Devices TMH.
4. S.M. Kang and Y. Leblebici. -CMOS Digital Integrated Circuits, Tata McGraw-Hill.

CO- PO Mapping:

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2	2	2	-	-	-	-	2	-	-	2
CO2	3	3	3	3	-	-	2	-	2	-	-	3
CO3	3	3	2	3	-	-	-	-	2	-	-	3
CO4	3	2	3	2	-	-	-	-	2	-	-	2
CO5	3	3	3	3	-	-	-	-	2	-	-	3

Weightage Values: 3 = Strongly matched, 2 = Moderately matched, 1 = Weakly matched, (-) = Not matched.

CO-PSO Mapping

COs/Pos	PSO1	PSO2	PSO3
CO1	2	2	2
CO2	2	2	2
CO3	2	2	2
CO4	3	2	2
CO5	2	2	2

Course Name: Signals & Systems
Course Code: EC 304
Contacts: 3:0:0
Total Contact Hours: 36
Credits: 3
Course Objectives:

To explain the basic properties of signal & systems and the various methods of classification. To define Fourier series, Fourier transform, and Z transform and their properties
To illustrate LTI systems and random process.

Course Outcome:
Graduates of the ECE program will be able to:

CO 1: Identify different signals and systems and state their properties both in Continuous and discrete time domain.
CO2: Apply the concept of impulse response and perform convolution in both Continuous and discrete domain to analyze the LTI systems.
CO 3: Compute spectral analysis of signals using Fourier series, Fourier transform, and Z-transform techniques.
CO 4: Demonstrate the application of sampling theorem and concepts of random processes.
CO5: The graduates should learn mathematics, basic knowledge of differential equations and difference equations.

Module-1: [15L]

Introduction to signals and systems: [6L]
Continuous and discrete time signals: Definition and Classification of signals, Types of sampling, Sampling theorem, Reconstruction of a Signal from its samples, Definitions and Numerical on Unit step, Unit Impulse, Unit Ramp, Definitions of Exponential and Sinusoid both for continuous and discrete, Rectangular Pulse function, Triangular pulse function, Signum function, Sync function, Gaussian function. Representation of signals using graphical, tabular, and sequential form, Operations on signals.

LTI systems:
Definition, Relationship between LTI system properties and Impulse Response. [1L]
Classification and convolution of Signals: Definitions and numerical of Periodic & Aperiodic signals, Even & Odd signals, Energy & Power signals, Deterministic & Random signals, Causal, Anti causal and non causal signals, convolution of two signals using graphical and matrix method. [3L]
Systems and its classifications: Definition of systems and its representation, Definition and numerical of Linear & Non-linear system, Causal & non causal system, Time variant & invariant system, Stability of the system, Systems with memory and without memory, Invertible and noninvertible Systems. Examples of discrete-time system model. [3L]

Correlation of Two Sequences:
Cross-correlation, Auto-correlation, Computation of correlation, Correlation of power and periodic signals. [2L]

Module-II:
Fourier series of Continuous-time and Discrete–time Signals [6L]

Fourier series analysis & Derivation of Fourier Coefficients Equation (Exponential form only), Fourier Series Properties, Symmetry Properties of the Fourier Series, Diminishing of Fourier Coefficients, Dirichlet Conditions, Fourier Spectrum, Gibbs's Phenomena, Parseval's relation (statement only), Problems on Fourier series & Basic concept of Discrete time Fourier series. [6L]

Module-III:
Signal Transformation [6L]
Introduction to Continuous time Fourier Transform (CTFT): Definition, Importance, Relation with Fourier series, Examples, Computation of Fourier transform of different signals.[2L]

Properties of Fourier Transform
Linearity, Time shifting, Conjugation, Differentiation, Integration, Time scaling, Parseval's theorem, Duality, Convolution. [1L]

Discrete time Fourier Transform (DTFT):
Introduction, Definition, Computation of DTFT of different sequences. [1L]

Linear Phase systems, Ideal filters, Signal Bandwidth, Relationship between bandwidth and Rise Time.[2L]

Module IV Z-Transforms [6L]

Introduction to Z-Transforms: Definition, Relationship between Fourier transform and Z- transform, Region of convergence (ROC), Properties of ROC, Properties of Z-transform, transfer function, conceptof Poles and zeroes, Z-transform of different sequences. [4L]

Inverse Z-transform:
Inverse Z -transform using residue theorem, power series expansion and partial fraction method. [2L] Module V
Introduction to Random Variables [3L]

Definition of Random Signal, Random Variables and Probability Distributions, Examples. [1L]

Statistical Properties of Random Signal: Independent and conditional random variables, StandardDeviation, mean, variance, Examples. [1L]

Independent and Dependent Random Variables, Arithmetic Mean. [1L]

Textbooks:

Linear Signals and Systems by B.P.Lathi-OXFORD University Press

Signals &Systems by A.V.Oppenheim, A.S.Willsky and S.H.Nawab - PearsonSignals and Systems by

P.Ramesh Babu & R.Anandanatarajan - Scitech References:
Signals &Systems by A.Anand Kumar-PHI

Signals and Systems by S.Haykin & B.V.Veen-John Wiley Signals and Systems by A.Nagoor Kani- McGraw Hill

Signals and Systems by S Ghosh- Pearson

Digital Signal Processing by M.H.Hays- TMHSignals and Systems by Salivahanan

Signals and Systems with MATLAB by Wŏn-yŏng Yang-Springer

Signals and Systems by A. Nagoor Kani- McGraw Hill

Digital Signal Processing by P.Ramesh Babu & R.Anandanatarajan - Scitech

Mapping of CO with PO:

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	3	3	2	3	1	2	1	-	-	-	3
CO2	3	3	3	1	3	1	1	1	-	-	-	2
CO3	3	2	3	3	3	2	2	1	-	-	-	3
CO4	2	3	3	3	3	2	2	1	-	-	-	3
CO5	3	3	3	1	3	1	1	1	-	-	-	2

Weightage Values: 3 = Strongly matched, 2 = Moderately matched, 1 = Weakly matched, (-) = Notmatched.

CO-PSO mapping

COs/POs	PSO1	PSO2	PSO3
CO1	3	3	3
CO2	3	3	3
CO3	3	3	3
CO4	3	3	3
CO5	3	3	3

Course Name: Universal Human Values 2: Understanding Harmony
Course Code: HSMC 303
Contacts: 3:0:0
Total Contact Hours: 36
Credit: 3

Prerequisite: None

Course Outcomes: On successful completion of the learning sessions of the course, the graduates of the ECE program will be able to:

CO1: Develop holistic perspective based on self-exploration about themselves (human being), family,society and nature/existence.
CO2: Cultivate the harmony in the human being, family, society and nature/existence.
CO3: Strengthen self-reflection.
CO4: Build commitment and courage to act.

Course Content:

Module-1: Course Introduction - Need, Basic Guidelines, Content and Process for Value Education [8L]

Self-Exploration–what is it? - Its content and process; 'Natural Acceptance' and Experiential Validation- as the process for self-exploration. Continuous Happiness and Prosperity- A look at basic Human Aspirations. Right understanding, Relationship and Physical Facility- the basic requirements for fulfilment of aspirations of every human being with their correct priority. Understanding Happiness and Prosperity correctly- A critical appraisal of the current scenario. Method to fulfil the above human aspirations: understanding and living in harmony at various levels. Practice sessions to discuss natural acceptance in human being as the innate acceptance for living with responsibility (living in relationship, harmony, and co-existence) rather than as arbitrariness in choice based on liking-disliking.

Module-2: Understanding Harmony in the Human Being - Harmony in Myself: [6L]

Understanding human being as a co-existence of the sentient 'I' and the material 'Body'. Understanding the needs of Self ('I') and 'Body' - happiness and physical facility. Understanding the Body as an instrument of 'I' (I am being the doer, seer, and enjoyer). Understanding the characteristics and activities of 'I' and harmony in 'I'. Understanding the harmony of I with the Body: Sanyam and Health; correct appraisal of Physical needs, meaning of Prosperity in detail.
Programs to ensure Sanyam and Health. Practice sessions to discuss the role others have played in making material goods available to me. Identifying from one's own life. Differentiate between prosperity and accumulation. Ensuring health vs dealing with disease discussion.

Module- 3:

Understanding Harmony in the Family and Society- Harmony in Human Relationship: [7L]

Understanding values in human-human relationship; meaning of Justice (nine universal values in relationships) and program for its fulfilment to ensure mutual happiness; Trust and Respect as the foundational values of relationship. Understanding the meaning of Trust; Difference between intention and competence. Understanding the meaning of Respect, Difference between respect and differentiation; the other salient values in relationship. Understanding the harmony in the society (society being an extension of family): Resolution, Prosperity, fearlessness (trust) and co-existenceas comprehensive Human Goals. Visualizing a universal harmonious order in society- Undivided Society, Universal Order- from family to world family. Practice sessions to reflect on relationships in family, hostel and institute as extended family, real life examples, teacher-student relationship, goal of education etc. Gratitude as a universal value in relationships. Elicitexamples from students' lives.

Module-4:

Understanding Harmony in the Nature and Existence –

Whole existence as Coexistence: [8L]

Understanding the harmony in the Nature. Interconnectedness and mutual fulfilment among the four orders of nature- recyclability and self- regulation in nature. Understanding Existence as Co-existenceof mutually interacting units in all-pervasive space. Holistic perception of harmony at all levels of existence. Practice sessions to discuss human being as cause of imbalance in nature (film "Home" can be used), pollution, depletion of resources and role of technology etc.

Module-5:

Implications of the above Holistic Understanding of Harmony on Professional Ethics: [7L]
Natural acceptance of human values. Definitiveness of Ethical Human Conduct. Basis for Humanistic Education, Humanistic Constitution and Humanistic Universal Order.

Competence in professional ethics:

a) Ability to utilize the professional competence for augmenting universal human order
b) Ability to identify the scope and characteristics of people- friendly and eco-friendly production systems,
c) Ability to identify and develop appropriate technologies and management patterns for above production systems.
d) Case studies of typical holistic technologies, management models and production systems. Strategy for transition from the present state to Universal Human Order:
e) At the level of individual: as socially and ecologically responsible engineers, technologists, and managers
f) At the level of society: as mutually enriching institutions and organizations.
g) Practice Exercises and Case Studies in Practice (tutorial) Sessions to discuss the conduct as an engineer or scientist etc.

Textbooks:

1. Human Values and Professional Ethics by R R Gaur, R Sangal, G P Bagaria, ExcelBooks,New Delhi, 2010

Reference Books:

1. Jeevan Vidya: Ek Parichaya, A Nagaraj, Jeevan Vidya Prakashan, Amarkantak, 1999.
2. Human Values, A.N. Tripathi, New Age Intl. Publishers, New Delhi, 2004.
3. The Story of Stuff (Book).
4. The Story of My Experiments with Truth - by Mohandas Karamchand Gandhi
5. Small is Beautiful - E. F Schumacher.
6. Slow is Beautiful - Cecile Andrews
7. Economy of Permanence - J C Kumarappa
8. Bharat Mein Angreji Raj - PanditSunderlal
9. Rediscovering India - by Dharampal
10. Hind Swaraj or Indian Home Rule - by Mohandas K. Gandhi
11. India Wins Freedom - Maulana Abdul Kalam Azad
12. Vivekananda - Romain Rolland (English)
13. Gandhi - Romain Rolland (English)

CO-PO Mapping:

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	1	-	2	1	-	-	-	2	3	3	1	-	2

CO2	3	2	-	1	3	2	-	1	2	-	3	3	2	-	1
CO3	3	2	2	-	2	3	1	-	2	1	3	3	3	1	-
CO4	3	1	-	2	-	-	-	2	-	3	3	3	2	-	2

Weightage Values: 3 = Strongly matched, 2 = Moderately matched, 1 = Weakly matched, (-) = Not matched.

CO-PSO mapping

COs/POs	PSO1	PSO2	PSO3
CO1	-	-	-
CO2	-	-	-
CO3	-	-	-
CO4	-	-	-

Course Name: Numerical Methods Lab

Course Code: M (CS) 391
Contact: 1:0:3
Credits: 2.5

Prerequisites: Any introductory course on programming language (example.C / Matlab).

Course Outcome (s):
On successful completion of the learning sessions of the course, the Graduates of the ECE program willbe able to:
CO1: Understand the theoretical workings of numerical techniques with the help of C/ Matlab
CO2: Execute basic command and scripts in a mathematical programming language
CO3: Apply the programming skills to solve the problems using multiple numerical approaches.
CO4: Analyze if the results are reasonable, and then interpret and clearly communicate the results.

List of Experiment:

1. Assignments on Newton forward /backward, Lagrange's interpolation.
2. Assignments on numerical integration using Trapezoidal rule, Simpson's 1/3 rule.
3. Assignments on numerical solution of a system of linear equations using Gauss elimination, Tridiagonal matrix algorithm, Gauss-Seidel iterations. LU Factorization method.
4. Assignments on numerical solution of Algebraic Equation by Bisection method, Regula-Falsi method, Secant Method, Newton-Raphson method.
5. Assignments on ordinary differential equation: Euler's method, Euler's modified method, Runge-Kutta methods, Taylor series method and Predictor-Corrector method.

Implementation of numerical methods on computer through C/C++ and commercial Software Packages: Matlab / Scilab / Labview / Mathematica/NAG (Numerical Algorithms Group)/Python.

CO-PO Mapping:

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	P10	P11	P12
CO1	3	2	1	-	-	-	-	-	-	-	-	1
CO2	3	2	2	-	-	-	-	-	-	-	-	1
CO3	3	2	2	-	-	-	-	-	-	-	-	1
CO4	3	3	2	3	-	-	-	-	-	-	-	1

Weightage Values: (3) Strongly matched, (2) Moderately matched, (1) Weakly matched, (-) Not matched.

CO-PSO mapping

COs/POs	PSO1	PSO2	PSO3
CO1	2	2	2
CO2	2	2	2
CO3	2	2	2
CO4	2	2	2
CO5	2	2	2

Course Name: Data Structures Lab

Course Code: EC391
Contacts: 0:0:3
Credits: 1.5

Prerequisites: Fundamentals of Computer & C Programming

Course Outcome:

CO1: Understand the theoretical workings of numerical techniques with the help of C/ Matlab.
CO2: Execute basic command and scripts in a mathematical programming language.
CO3: Able to apply searching, sorting algorithms.
CO4: Able to apply graph theory and hash function.

Course Content:

1. Write a C program that uses functions to perform the following:
   a. Create a singly linked list of integers.
   b. Delete a given integer from the above linked list.
   c. Display the contents of the above list after deletion.

2. Write a C program that uses functions to perform the following:
   a. Create a doubly linked list of integers.
   b. Delete a given integer from the above doubly linked list.
   c. Display the contents of the above list after deletion.

3. Write a C program to implement Polynomial addition and Polynomial multiplication using Linked List.

4. Write a C program that uses stack operations to convert a given infix expression into its postfix Equivalent, Implement the stack using an array.

5. Write C programs to implement a queue ADT using i) array and ii) doubly linked list respectively.

6. Write a C program that uses functions to perform the following:
   a. Create a binary search tree of characters.
   b. Traverse the above Binary search tree recursively in Post order.

7. Write a C program that uses functions to perform the following:
   a. Create a binary search tree of integers.
   b. Traverse the above Binary search tree non recursively in order.

8. Write C programs for implementing the following sorting methods to arrange a list of integers in ascending order:
   a. Insertion sort.
   b. Merge sort.

9. Write C programs for implementing the following sorting methods to arrange a list of integers in ascending order:
   a. Quick sort.
   b. Selection sort.

10. Write C programs for implementing the following searching methods:
    a. Linear Search.
    b. Binary Search.

11. Write a C program to implement all the functions of a dictionary (ADT) using hashing.

12. Write C programs for implementing the following graph traversal algorithms:
    a. Depth first search.
    b. Breadth first search.

CO-PO Mapping:

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	2	2	3	2	2	3	3	3	2	3
CO2	3	2	2	2	2	2	3	2	2	3	3	2
CO3	3	3	3	2	3	3	3	2	2	3	3	2
CO4	3	1	3	2	2	1	2	2	3	1	-	2

Weightage Values: (3) Strongly matched, (2) Moderately matched, (1) Weakly matched, (-) Not matched.

CO-PSO mapping

COs/POs	**PSO1**	**PSO2**	**PSO3**
CO1	-	2	3
CO2	-	2	3
CO3	-	2	3
CO4	-	2	3
CO5	-	2	3

Course Name: Circuit Theory and Networks Lab
Course Code: EC 392
Contact: 0:0:3
Credit: 1.5

Prerequisites: Concept of series and parallel connections, concept of KCL, KVL, circuit withelectrical components, DC, and AC source

Course Outcomes: The Graduates of the ECE program will be able to:

CO1: Determine current, voltage and power in a DC and AC circuit with the help of network Theorems, Superposition theorem, Thevenin's & Norton's theorem, Maximum power transfertheorem, Compensation theorem and Millman'stheorem.

CO2: Measure Z, Y, h & ABCD parameters of a two-port network following open circuit and short circuit test and conclude whether the network is symmetrical or reciprocal or both.

CO3: Construct RLC series & parallel resonance circuit and analyze its performance though the determination of resonance frequency, bandwidth, upper& lower cut-off frequency,quality factor and impedance at audio frequency range.

CO4: Estimate transient & steady state value of current & voltage in RC, RL & RLC circuitwith DC excitations range up to 25 V from the transient response curve.

List of Experiments:

1. Verification of Superposition theorem, Thevenin's Theorem, Norton' sTheorem. [6P]
2. Study of maximum power transfer theorem [3P]
3. Study of Compensation theorem and Millman's theorem. [3P]
4. Determination of Z & Y parameters of a two-port network. [3P]
5. Determination of h & ABCD parameters of two port networks. [6P]
6. Study of series RLC resonance circuit. [3P]
7. Study of Parallel RLC resonance circuit. [3P]8. Transientresponse in RC circuit. [3P]
8. Transient response in RL circuit. [3P]
9. Transient response in RLC circuit.[3P]
10. Innovative experiment.

CO-PO Mapping:

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	3	2	3	-	-	2	3	3	2	3
CO2	3	3	3	2	3	-	-	2	3	3	2	3
CO3	3	3	3	2	3	-	-	2	3	3	2	3
CO4	3	3	3	2	3	-	-	2	3	3	2	3

Weightage Values: 3 = Strongly matched, 2 = Moderately matched, 1 = Weakly matched, (-) = Not matched.

CO-PSO mapping

COs/POs	PSO1	PSO2	PSO3
CO1	3	3	3
CO2	3	3	3
CO3	3	3	3
CO4	3	3	3
CO5	3	3	3

Course Name: Electronics Devices Lab
Course Code: EC 393
Contact: 0:0:3
Credits: 1.5

Course Outcome: The Graduates of the ECE program will be able to:

CO 1: Verify the working of different diodes, transistors, CRO probes and measuring instruments. Identifying the procedure of doing the experiment.

CO 2: Understand the characteristics of BJT and FET and how to determine different parameters for designing purpose.

CO 3: Understand properties of photoelectric devices

CO 4: Measure and record the experimental data, analyze the results, and prepare a formal laboratory report.

Course Contents:

1. Identifying and study of different components like resistor, capacitors, diodes, LED, Transistors, FET (JFET & MOSFET) etc.
2. Study of different instruments used in the laboratories like, power supply, Oscilloscope, Multi- meter etc.
3. Characteristics Of PN Junction Diode:
   a) To Plot the Volt Ampere Characteristics of PN Junction Diode under Forward and Reverse Bias Conditions.
   b) To find the Cut-in voltage, Static Resistance, Dynamic Resistance for Forward Bias & Reverse Bias.
4. Characteristics Of Zener Diode & Load Regulation:
   a) To Obtain the Forward Bias and Reverse Bias characteristics of a Zener diode.
   b) Find out the Zener Break down Voltage from the Characteristics.
   c) To Obtain the Load Regulation Characteristics.
5. Common Base Bipolar Transistor Characteristics:
   To plot the Input and Output characteristics of a transistor connected in Common Base Configuration and to find the h – parameters from the characteristics.
6. Common Emitter Bipolar Transistor Characteristics:
   To plot the Input and Output characteristics of a transistor connected in Common Emitter Configuration and to find the h – parameters from the characteristics
7. Design Self Bias BJT Circuit.
8. J-FET Drain & Transfer Characteristics (Common Source):
   a) Drain characteristics
   b) Transfer Characteristics.
   c) To find rd., gm., and μ from the characteristics.
9. Study Characteristics of Photo transistor.
10. Study Characteristics of LED & LDR.

CO- PO Mapping:

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2	2	1	2	2	-	-	-	-	2	2
CO2	3	3	3	2	2	2	-	-	-	-	1	2
CO3	3	3	3	2	1	2	-	-	-	-	2	3
CO4	3	3	2	3	2	2	-	-	-	-	1	3

Weightage Values: 3 = Strongly matched, 2 = Moderately matched, 1 = Weakly matched, (-) = Not matched.

CO-PSO mapping

COs/POs	PSO1	PSO2	PSO3
CO1	2	2	2
CO2	2	2	2
CO3	2	2	2
CO4	2	2	2
CO5	2	2	2

Course Name: ENVIRONMENTAL SCIENCE
Course Code: MC 301
Contacts: 3:0:0
Total Contact Hours: 36
Credits: 0

Course Outcomes:
Graduates of the ECE program will be able to:
CO1: Understand the natural environment and its relationships with human activities.
CO2: Apply the fundamental knowledge of science and engineering to assess environmental andhealth risk.
CO3: Develop guidelines and procedures for health and safety issues obeying the environmental lawsand regulations.
CO4: Acquire skills for scientific problem-solving related to air, water, noise & land pollution.

Course Contents:

Module 1: General [11L]

Natural Resources: Forest Resource, water resource, mineral resource, energy resources: alternative source of energy
Population Growth: Exponential Growth, logistic growth, Maximum sustainable yield, demography
Disaster Management: Types of disasters (Natural & Man-made), Floods, Earthquake, Tsunamis, Cyclones, landslides (cause, effect & control)
Ecology & Ecosystem: Elements of ecology, definition of ecosystem- component types and function,Food chain & Food web, Structure, and function of the following ecosystem: Forest ecosystem, Grassland ecosystem, Desert ecosystem, Aquatic ecosystems
Environmental Management: Environmental impact assessment, Environmental laws and protection actof India (The Environment protection Act, Air pollution Act, Water Act, Wildlife Protection Act) , Hazardous waste(management and Handling) Rules.

Module 2: Air pollution and control [10L]

Sources of Pollutants: point sources, nonpoint sources and manmade sources primary & secondary pollutant
Types of air pollutants: primary & secondary pollutant; Suspended particulate matter, oxides of carbon, oxides of nitrogen, oxides of Sulphur, particulate, PAN, Smog (Photochemical smog and Londonsmog),
Effects on human health & climate: Greenhouse effect, Global Warming, Acid rain, Ozone LayerDepletion
Air pollution and meteorology: Ambient Lapse Rate, Adiabatic Lapse Rate, Atmospheric stability & Temperature inversion control of air pollution (ESP, cyclone separator, bag house, catalytic converter, scrubber (venturi).

Module 3: Water Pollution [9L]
Classification of water (Ground & surface water)
Pollutants of water, their origin and effects: Oxygen demanding wastes, pathogens, nutrients, Salts, heavy metals, pesticides, volatile organic compounds.
Surfacewater quality parameters: pH, DO, 5-day BOD test, BOD reaction rate constants, COD. Numerical related to BOD
Lake: Eutrophication [Definition, source and effect].

Ground water: Aquifers, hydraulic gradient, ground water flow (Definition only), ground waterpollution (Arsenic & Fluoride; sources, effects, control).

Quality of Boiler fed water: DO, hardness, alkalinity, TDS and Chloride.

Layout of wastewater treatment plant (scheme only).Module 4: Land Pollution [3L]
Types of Solid Waste: Municipal, industrial, commercial, agricultural, domestic, hazardous solid wastes(bio-medical), E-waste
Solid waste disposal method: Open dumping, Land filling, incineration, composting, recycling(Advantages and disadvantages).
Waste management: waste classification, waste segregation, treatment & disposal

Module 5: Noise Pollution [3L]
Definition of noise, effect of noise pollution on human health, Average Noise level of some commonnoise sources
Definition of noise frequency, noise pressure, noise intensity, noise threshold limit value, equivalentnoise level, L10 (18 hr. Index). Noise pollution control.

Textbook:
A Textbook of Environmental Studies, Shashi Chawla. Tata McGraw Hill Education Private Limited
References Books:
Environmental Studies, Dr. J P Sharma, University Science Press. Environmental Engineering, J. K. Das Mohapatra, Vikas Publication.

CO-PO Mapping:

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	2	-	-	-	2	-	-	-	-	-	-
CO2	1	2	-	-	-	2	-	-	-	-	-	1
CO3	2	2	3	1	-	2	2	-	-	-	-	-
CO4	3	1	3	1	3	3	-	-	-	-	-	-

Weightage Values: 3 = Strongly matched, 2 = Moderately matched, 1 = Weakly matched, (-) = Not matched.

CO-PSO mapping

COs/POs	PSO1	PSO2	PSO3
CO1	-	-	-
CO2	-	-	-
CO3	-	-	-
CO4	-	-	-

Curriculum for B.Tech
Under Autonomy
Electronics & Communication Engineering
(Effective From 2021-22 admission Batch)
L – Lecture; T- Tutorial; P- Practical [1L=1Cr, 1T=1Cr, 1P =0.5 Cr]

2nd Year 2nd Semester: 4th Semester

Sl. No.	Category	Course Code	Course Title	Hours per week				Credits /Unit
				L	T	P	Total	
A. THEORY								
1	PC	EC401	EM Theory & Antenna	3	0	0	3	3
2	PC	EC402	Analog Circuits	3	0	0	3	3
3	PC	EC403	Digital Electronics	3	0	0	3	3
4	PC	EC404	Analog & Digital Communication	3	0	0	3	3
5	PC	EC405	Digital Signal Processing	3	0	0	3	3
6	HSMC	HSMC 402	Gender Culture and Development	2	0	0	2	2
B. PRACTICAL								
6	PC	EC491	EM Theory & Antenna Lab	0	0	3	3	1.5
7	PC	EC492	Analog Circuits Lab	0	0	3	3	1.5
8	PC	EC493	Digital Electronics Lab	0	0	3	3	1.5
9	PC	EC494	Analog & Digital Communication Lab	0	0	3	3	1.5
10	PC	EC495	Digital Signal Processing Lab	0	0	3	3	1.5
11	PROJECT	PR 491	Theme based Project IV	0	0	1	1	0.5
12	PROJECT	PR492	Skill Development IV:Soft Skill & Aptitude	0	0	1	1	0.5
C. MANDATORY ACTIVITIES / COURSES								
13	MC	MC 481	Learning an Art Form [vocal or instrumental, dance, painting, clay modeling, etc.] OR Environmental Protection Initiatives	0	0	2	2	0
	TOTAL CREDIT WITHOUT MOOCS COURSES							25.5
D.MOOCS COURSES								
14	MOOCS COURSES	HM401	MOOCS COURSE-III	3	1	0	4	4
TOTAL CREDIT WITH MOOCS COURSES (FOR CSE, ECE, EE, EIE)								29.5

** MOOCS COURSES for HONOURS/MINOR Degree are Program specific and to be taken fromMOOCS BASKET

Course Name: EM Theory & Antenna
Course Code: EC401
Contact: 3:0:0
Total Contact Hours: 36
Credits: 3

Prerequisites:

The candidates should learn basic knowledge of vector calculus, electrostatic, magnetostatics.

Course Outcome:

Graduates of the ECE program will be able to:

CO1: Understand the knowledge of static fields and time-varying electromagnetic fields as governed by Maxwell's equations.
CO2: To understand in-depth study of transmission lines which play an important role in high-speed Digital design and signal integrity of PCBs.
CO3: To analyze the fundamentals of antenna theory.
CO4: Understand the different types of antennas and the radiation mechanism.

Course Content:

Module I: Electrodynamics [12L]

Electric & magnetic boundary conditions between media interfaces, time varying Maxwell's equation, magnetic vector potential, Helmholtz's equation, plane wave in lossy dielectric, free-space, loss-less dielectric, good conductor: skin depth, surface resistance.; Poynting theorem, reflection of plane waves at normal and oblique incidence; diffraction and scattering phenomena.

Module II: Transmission Line [12L]

Concept of lumped parameters, transmission line equation & their solution, propagation constant, characteristic impedance, wavelength, velocity of propagation for distortion less line and loss-less line; reflection and transmission coefficients, standing wave, VSWR, input impedance; Smith chart; some impedance techniques- quarter wave matching, matching with lumped elements (L-networks), T-line in time domain, lattice diagram calculation, pulse propagation on T-line.

Module III: Antenna & wave propagation [12L]

1. Antenna characteristics: radiation pattern, beam width, radiation efficiency, directivity, gain, efficiency, input impedance, polarization, effective area; Friis transmission equation.
2. Radiation characteristics of Hertzian dipole antenna.
3. Properties and typical application: - half-wave dipole, mono pole, loop antenna, parabolic & corner reflector antenna, helical antenna, pyramidal horn antenna, micro-strip patch antenna, array: Yagi- Uda, log-periodic.

Textbooks:

1. Principles of Electromagnetics, 6th Edition, Matthew O H Sadiku, Oxford University Press.
2. Antenna Theory: Analysis & Design, Constantinc A. Balanis; Willcy, 4th Edition. 3. Electromagnetics with applications, 5th ed, J. D. Kraus and D. Fleisch, McGraw Hill, 1999.

Reference Books:

1. Engineering Electromagnetics, Hayt and Buck, 7th edition, McGraw Hill.
2. Fields & Wave in Communication Electronics, S. Ramo, J. R. Whinnery & T. Van Duzer, JohnWiley.
3. Electromagnetics, 2ed Edition – J A Edminister, Tata-McGraw-Hill.
4. Engineering Electromagnetics, 2ed Edition - Nathan Ida, Springer India.

CO-PO Mapping:

COs\POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	1	2	1	2	1	-	-	2	1	2
CO2	3	3	3	2	2	1	1	-	-	1	2	1
CO3	3	2	3	2	-	1	1	-	-	3	2	2
CO4	2	2	3	3	2	1	-	-	-	3	2	1

Weightage Values: 3 = Strongly matched, 2 = Moderately matched, 1 = Weakly matched, (-) = Not matched.

CO-PSO mapping

COs/POs	**PSO1**	**PSO2**	**PSO3**
CO1	3	3	3
CO2	3	3	3
CO3	3	3	3
CO4	3	3	3

Course Name: Analog Circuits
Course Code: EC 402
Contact: 3:0:0
Total Contact Hours: 36
Credits: 3

Prerequisites: Basic knowledge about components (R, L, C). Network Theorems (Kirchhoff's law, Theremin's theorem, Norton's theorem, Miller theorem etc.). Basic knowledge about the operation of semiconductor devices (Diode, Transistor, JFET, MOSFET, etc.), Basic idea of integrated circuit, Voltage current equations. Basic knowledge of Differentiation, Integration, Differential equation, matrix etc.

Course Outcome:

Graduates of the ECE program will be able to:

CO1: Students will be able to design, construct and analyse transistor amplifier circuit in audio frequency range with the help of h-parameter model.
CO2: Students will be able to understand concept of feedback in amplifier and classify amplifiers based on feedback topology.
CO3: Students will be able to design, construct and analyse signal generator circuit in both audio frequency and radio frequency range using transistor.
CO4: Student will be able to design, construct and analyse power amplifier circuit in audio frequency range.
CO5: Students will be able to design, construct and analyse linear and nonlinear electronic circuits using OPAMP (I.C-741).

Course Content:

Module I: [11L]

RECTIFIER AND SINGLE STAGE TRANSISTOR AMPLIFIER: Rectifier and filter (Basic idea), Regulated power supply using Zener diode and IC
Transistor CE, CB, CC configuration, transistor static characteristics in CE, CB mode, junction biasing condition for active, saturation and cut-off modes, current gain α, β. Biasing techniques, Q-point & its Stability, Thermal Runaway, self-bias CE configuration, Bias Compensation techniques, h-parameter model of transistors. Expression for voltage gain, current gain, input and output impedance, power gain, Emitter follower circuit.
MULTISTAGE AMPLIFIER: Different coupling techniques, RC coupled amplifier, functions of all components, derivation of voltage gain, current gain, input impedance and output impedance, High frequency model of transistors (hybrid-π model), frequency response characteristics, bandwidth

Module II: [6L]
FEEDBACK AMPLIFIERS: Feedback concept, negative & positive feedback, Gain calculation for positive and negative feedback condition, Feedback topology.
OSCILLATORS: Barkhausen criterion, RC Oscillators-Phase shift and Wien bridge oscillators, LC Oscillator-Colpitts, Hartley's, and crystal oscillators.

Module III: [7L]
POWER AMPLIFIERS: Class A, B Conversion efficiency, Tuned amplifier.
FET AMPLIFIERS: Operating principle of JFET. drain and transfer characteristics of JFET (n-channel and p-channel), E-MOSFET (n-channel and p-channel), D-MOSFET (n-channel and p- channel), Equivalent circuit of JFET and MOSFET, Common-source, Common gate amplifiers.

Module IV: [10L]
OPERATIONAL AMPLIFIER & IT'S APPLICATIONS: Ideal & Non-Ideal OPAMP, configuration of inverting and non-inverting amplifier using Op-amp, closed loop voltage gains of inverting and noninverting amplifier, Internal block diagram of Op-amp, integrator & differentiator circuit, Log & Anti-log amplifiers Comparator & Schmitt Trigger, Low pass, high pass and band pass active filters.

Module V: [2L]

MULTIVIBRATORS: Astable and Monostable operation using I.C-555 timer.

Textbooks:

1. Sedra & Smith-Microelectronic Circuits-Oxford Up
2. Millman & Halkais- Integrated Electronics, McGraw Hill.
3. Boylested & Nashelsky-Electronic Devices and Circuit Theory-Pearson/PHI
4. Rashid-Microeletronic Circuits-Analysis and Design- Thomson (Cenage Learning).
5. Franco- design with Operational Amplifiers & Analog Integrated Circuits, 3/e, McGraw Hill.
6. Gayakwad R.A – OpAmps and Linear IC's, PHI

Reference Books:

1. Razavi- Fundamentals of Microelectronics-Wiley
2. J.B. Gupta- Electronic Devices and Circuits- S.K. Kataria & Sons
3. Malvino- Electronic Principles, 6/e, McGraw Hill

CO- PO Mapping:

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	3	3	2	-	2	-	3	1	-	2
CO2	3	3	3	3	2	-	2	-	3	-	1	3
CO3	3	2	3	3	2	-	2	-	3	-	-	3
CO4	3	3	3	3	2	-	2	-	3	1	-	3
CO5	3	3	3	3	2	-	3	-	3	-	1	3

Weightage Values: 3 = Strongly matched, 2 = Moderately matched, 1 = Weakly matched, (-) = Not matched.

CO-PSO mapping

COs/POs	**PSO1**	**PSO2**	**PSO3**
CO1	3	3	3
CO2	3	3	3
CO3	3	3	3
CO4	3	3	3
CO5	3	3	3

Course Name: Digital Electronics

Course Code: EC 403
Contact: 3:0:0
Total Contact Hours: 36
Credits: 3

Prerequisites: A basic course in Electronics and Communication Engineering Progresses from the fundamentals of electricity, direct current (DC) devices and circuits, series and parallel circuits to the study of active and passive components, Ohm's Law, Kirchhoff's Law i.e. KVL, KCL, Ampere's Law etc.

Course Outcome:

Graduates of the ECE program will be able to:

CO1: Acquired knowledge about solving problems related to number systems conversions and Boolean algebra and design logic circuits using logic gates to their simplest forms using De Morgan's Theorems; Karnaugh Maps.
CO2: Design of combinational circuits and application
CO3: Design of various synchronous and asynchronous sequential circuits using State Diagrams & Tables.
CO4: Understand DAC & ADC technique and corresponding circuits
CO5: Analyze logic family interfaces, switching circuits to Plan and execute projects.

Course Content:

Module I: [8L]
Binary, Octal and Hexadecimal number system representation and their conversions; BCD, ASCII, EBDIC, Gray codes and their conversions. Signed binary number representation with 1's, 2's, 9's and 10's complement methods, Binary arithmetic. Boolean algebra; Various Logic gates- their truth tables and circuits; Implementation of various logic Gates using Universal Logic Gate, Representation in SOP and POS forms; Minimization of logic expressions by algebraic method, K-map method, Quine-McCluskey minimization technique (Tabular Method).

Module II: [9L]
Combinational circuits- Half Adder, Full Adder, Serial & Parallel Adder, Carry Look Ahead Adder, BCD Adder, Half Subtractor, Full Subtractor circuits, Adder-Subtractor Circuit. Encoder, priority encoder, Decoder, Multiplexer, De Multiplexer, Adder & Subtractor Design using decoder & multiplexer, Boolean Function representation by MUX, Comparator and Parity Generator-Checker.

Module III: [11L]
Sequential Circuits- latch & Flip Flops-S-R, J-K, D and T, Conversion of Flip Flops, Various types of Shift Registers- SISO, PISO, SIPO, PIPO, Bidirectional & Universal Shift. Modulus Counters Synchronous, Asynchronous, Irregular, Self-Correcting Ring & Johnson Counter. Application of Counter (Stepper motor control), Finite state machine, state transition diagrams and state transition tables.

Module IV: [8L]
Parameters of D/A & A/D Converters. Different types of A/D -Flash Type, Successive Approximation and Dual Slope and D/A -R-2R Ladder & Binary Weighted Resistor Type. Logic families- TTL, CMOS, NMOS, PMOS &their operation and specifications. TTL Equivalent Circuit.

Textbooks:

1. A.Anand Kumar, Fundamentals of Digital Circuits-PHI
2. Morries Mano- Digital Logic Design- PHI
3. S.Salivahanan & S.Arivazhagan, Digital Circuit & Design- Bikas Publishing
4. A.K.Maini- Digital Electronics-Wiley-India

Reference:

1. Floyed & Jain- Digital Fundamentals-Pearson.
2. R.P.Jain—Modern Digital Electronics, 2/e , Mc GrawHill
3. H.Taub & D.Shilling, Digital Integrated Electronics- Mc GrawHill.
4. D.Ray Chaudhuri- Digital Circuits-Vol-I & II, 2/e- Platinum Publishers
5. Kharate- Digital Electronics- Oxford
6. Tocci, Widmer, Moss- Digital Systems, 9/e- Pearso

CO- PO Mapping:

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	3	1	3	1	1	1	1	1	1	3
CO2	3	3	3	1	3	1	1	1	1	1	1	3
CO3	3	3	3	3	3	2	2	1	1	1	2	3
CO4	3	3	3	3	3	2	2	1	1	2	1	3
CO5	3	3	3	3	3	1	2	1	2	2	2	3

Weightage Values: 3 = Strongly matched, 2 = Moderately matched, 1 = Weakly matched, (-) =Not matched.

CO-PSO mapping

COs/POs	**PSO1**	**PSO2**	**PSO3**
CO1	3	3	2
CO2	3	3	2
CO3	3	3	2
CO4	3	3	2
CO5	3	3	2

Course Name: Analog & Digital Communication
Course Code: EC 404
Contact: 3:0:0
Total Contact Hours: 36
Credit: 3

Prerequisite: Trigonometric Fourier series, Exponential Fourier series, Fourier transform and its properties, Energy and power signal, Probability & Statistics.

Course Outcome:

Graduates of the ECE program will be able to:

CO1: Explain the importance, Signal to Noise ratio, efficiency, and Bandwidth,of Amplitude modulation and demodulation schemes.
CO2:Analyse signal vector representation of various digitally modulated signalsby creating signal constellation.
CO3: Demonstrate the concepts of sampling, Pulse Modulation techniques andtheir comparison.
CO4: Design Optimum (Matched) filter, demonstrate the effects of Inter SymbolInterference(ISI)
CO5: Illustrate various types of coherent and non-coherent digital modulation techniques, analyse immunity parameters and calculate their error probabilities

Course Content:

MODULE I: Introduction to Analog Communication [6]:
Elements of communication system - Transmitters, Transmission channels & receivers, Concept of modulation, its needs. Review of signals and systems, Frequency domain representation of signals, Principles of Amplitude Modulation and Demodulation , Modulation index, Power content and bandwidth requirement Systems- DSB(Balanced Modulator for DSB-SC, Phase Shift method for SSB-SC), SSB and VSB modulations.(AM demodulator: Synchronous detection for DSB-SC, Super Hetero Dyne receiver, Image frequency), Angle Modulation(reactance modulator) and Demodulation Systems(PLL or frequency discriminator) - Representation of FM and PM signals, Spectral characteristics of angle modulated signals.

MODULE-II: Random Processes: [6L]

Review of probability and random process. Gaussian and white noise characteristics, Rayleigh's energytheorem, Parseval's theorem, Fourier transform pair Power spectral density vs Autocorrelation likelihood functions, Noise in amplitude modulation systems, Pre-emphasis, andDe-emphasis.

MODULE-III: Pulse modulation: [6L]

Basic block diagram of Digital Communication system, advantages of digital communication system over analog communication system, Sampling theorem. Quantization, quantization error Pulse modulation techniques PAM, PWM, PPM. Pulse code modulation (PCM), Line coding, Regenerative repeater, differential pulse code modulation. Delta modulation, Noise analysis, PCM-TDM, Time Divisionmultiplexing.

MODULE-IV: Signal Vector Representation: [8L]

Analogy between signal and vector, distinguishability of signal, orthogonality and orthonormality, basis function, orthogonal signal space, message point , signal constellation, geometric interpretation of signals, Schwartz inequality, Gram-Schmidt orthogonalization procedure, response of the noisy signal at the receiver, maximum likelihood decision rule, decision boundary, optimum correlation receiver; probability of error, error function, complementary error function, Optimum detection of signals in noise, matched Filter, Inter symbol Interferenceand Nyquist criterion.

MODULE-V: DIGITAL MODULATION TECHNIQUES: [10L]

Types of Digital Modulation, coherent and non-coherent ASK, FSK and PSK, Coherent Binary Phase Shift Keying (BPSK), geometrical representation of BPSK signal; error probability of BPSK, generation and detection of BPSK Signal, power spectrum of BPSK. DPSK and DEPSK, Concept of M-ary Communication, M-ary phase shift keying, the average probability of symbol error for coherent M-ary PSK, power spectra of MPSK, Quadrature Phase Shift Keying (QPSK), error probability of QPSK signal, generation and detection of QPSK signals, power spectra of QPSK signals, Offset (OQPSK) vs. Non-offset (NOQPSK) Quadrature Phase shift keying, Coherent Frequency Shift Keying(FSK),Binary FSK, error probability of BFSK signals, generation and detection of Coherent Binary FSK signals, power spectra of BFSK signal, QAM, Minimum Shift Keying (MSK), signal constellation of MSK waveforms, error probability of MSK signal, Gaussian Minimum Shift Keying (GMSK), basic concept of OFDM.

TEXTBOOKS:

1. Haykin S., "Communications Systems", John Wiley and Sons, 2001.
2. Principles of Communication Systems, H. Taub and D. Schilling, TMH Publishing Co.
3. Wireless Communication and Networks: 3G and Beyond, I. Asha Misra, TMH Education.
4. Communication Systems, A. Bruce Carlson, Paul B. Crilly TMH Education.

REFERENCE BOOKS:

1. Digital Communications Fundamentals and Applications, B. Sklar and P.K.Ray, Pearson.
2. Modern Digital and Analog Communication Systems, B.P.Lathi and Z.Ding, Oxford University Press.
3. Digital Communication, A. Bhattacharya, TMH Publishing Co.
4. Digital Communications by Dr. Sanjay Sharma S K Kataria and Sons

CO- PO Mapping:

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	3	-	3	1	1	1	1	1	1	3
CO2	3	3	3	1	3	1	1	-	1	-	1	3
CO3	3	3	3	-	3	2	2	1	-	1	2	3
CO4	3	3	3	-	3	2	2	1	1	2	1	-
CO5	3	3	3	3	3	1	2	1	2	2	2	3

Weightage Values: 3 = Strongly matched, 2 = Moderately matched, 1 = Weakly matched, (-) = Not matched.

CO-PSO mapping

COs/POs	**PSO1**	**PSO2**	**PSO3**
CO1	3	3	3
CO2	3	3	3
CO3	3	3	3
CO4	3	3	3
CO5	3	3	3

Course Name: Digital Signal processing
Course Code:EC405
Contacts: 3:0:0
Contact Hours: 36
Credits: 3

Course outcomes:

Graduates of the ECE program will be able to:

CO1: Define discrete-time systems in the Frequency domain using DFT
CO2: Describe the process of finding system response usingvarious method.
CO3: Discriminate the computation technique and speed of operation in FFT with respect to DFT.
CO4: Design digital filters for various applications.
CO5: Apply digital signal processing for the analysis of real-life signals.

Prerequisite:

Prerequisites for Digital signal Processing are required a thorough understanding of various signals, systems, andthe methods to process a digital signal and also the knowledge of arithmetic of complex numbers and a good grasp of elementary calculus. The questions reflect the kinds of calculations that routinely appear in Signals. The candidates are expected to have a basic understanding of discrete mathematical structures. The candidates required the concept of Z- transform, Relation between Fourier transform and Z transform, Properties of ROC and properties of Z transform, Initial value theorem and final value theorem, stability considerations for LTI systems using Z- transform, Inverse Z-transform by Residue method, power series & partial-fraction expansions.

Course Content

Module – I: Discrete Fourier Transform and Fast Fourier Transform: [12L]

Definition of DFT and IDFT, Twiddle factors and their properties, multiplication of DFTs, circular convolution, computation of circular convolution by graphical, DFT/IDFT and matrix methods, filtering of long data sequences using Overlap-Save and Overlap-Add methods. Parseval's Identity, Difference between DFT and FFT. Radix-2 algorithm, Decimation-In-Time, Decimation-In-Frequency algorithms, signal flow graphs Butterflies, Bit reversal.

Module – II: Filter Design: [17L]

Basic concepts of IIR and FIR filters: Moving average system, Autoregressive system, Pole- zero system, Non- recursive and recursive structures, Low pass FIR digital filters, High pass FIR digital filters, Band pass FIR digital filters, Notch FIR digital filters, difference equations, Realization of Filters using Direct form –I, II, transposed structure, Cascade & Parallel Form, Factors influencing choice of structure, Design of IIR Filter using impulse invariant and bilinear transforms, approximation & Design of analog Butterworth Filter, Design of Analog Low pass Chebyshev filters, Comparison between Butterworth Filter and
Chebyshev filters, Design of linear phase FIR filters, Concept of Symmetric & anti- Symmetric FIR Filter, Various kinds of Window: Rectangular , Triangular, Raised Cosine, Hanning, Hamming, Blackman and Kaiser windows.

MODULE – III: Finite word Length Effects in Digital Filters: [4L]

Input Quantization error, Product Quantization error, Coefficient, Quantization error, Zero- input Limit cycle Oscillations, Dead band, limit cycle Oscillations.

MODULE – IV: Application of DSP: [3L]

Introduction to DSP Hardware TMS320C 5416/6713 processor. Concept of Sub-band coding, Speech analysis.

Textbooks:

1. Digital Signal Processing – Principles, Algorithms and Applications, J.G.Proakis & D.G.Manolakis, Pearson Ed.
2. Digital Signal Processing, S.Salivahanan, A.Vallabraj & C. Gnanapriya, TMH Publishing Co.
3. Digital Signal Processing, P. Rameshbabu, Scitech Publications (India).
4. Digital Signal processing – A Computer Based Approach, S.K.Mitra, TMH Publishing Co.

Reference books:

1. Digital Signal Processing; Spectral Computation and Filter Design Chi-Tsong Chen, Oxford University Press
2. Texas Instruments DSP Processor user manuals and application notes

Mapping of POs with COs:

COs\POs	PO 1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	1	2	-	3	-	2	2	2	1	2
CO2	2	3	2	1	2	2	-	2	2	-	2	3
CO3	3	2	1	3	-	3	1	3	1	1	1	2
CO4	3	3	-	2	-	-	1	1	1	2	2	1
CO5	2	3	3	-	3	3	2	3	3	2	1	2

Weightage Values: 3 = Strongly matched, 2 = Moderately matched, 1 = Weakly matched, (-) = Not matched

CO-PSO mapping

COs/POs	**PSO1**	**PSO2**	**PSO3**
CO1	3	3	3
CO2	3	3	3
CO3	3	3	3
CO4	3	3	3
CO5	3	3	3

Course Name: Gender, Culture and Development
Course Code: HSMC 402
Contacts: 2:0:0
Total Contact Hours: 24
Credit: 2

Prerequisite: None

Course Outcomes:

Graduates of the ECE program will be able to:

CO1: Provide an analysis of the location of women in the processes of economic development.to understand what economic development is, the scales or levels at which it occurs, and the centrality of gender at every level.
CO2: Examine theoretical and conceptual frameworks for that analysis.
CO3: Reflect upon linkages between the global economy and the gendered macro and micro process of development and transitions from 'government' to 'governance.'
CO4: Explain the usefulness of a rights-based approach to gender justice.
CO5: Provide basis for research, practical action, and policy formulation and or evaluating for evaluating directions and strategies for social change from a gender perspective.

Course Content

Module 1: 4L

Introduction to Gender, Definition of Gender, Basic Gender Concepts and Terminology, Exploring Attitudes towards Gender, Social Construction of Gender

Module 2: 6L

Gender Roles and Relations, Types of Gender Roles, Gender Roles and Relationships Matrix, Gender-based Division and Valuation of Labour

Module 3: 5L

Gender Development Issues, Identifying Gender Issues, Gender Sensitive Language, Gender, Governance and Sustainable Development, Gender and Human Rights, Gender and Mainstreaming.

Module 4: 5L

Gender-based Violence, The concept of violence, Types of Gender-based violence, The relationship between gender, development and violence, Gender-based violence from a human rights perspective.

Module 5: 4L

Gender and Culture Gender and Film, Gender and Electronic Media, Gender and Advertisement, Gender and Popular Literature.

Textbooks:

1. Beneria, Lourdes. (2004). Gender, Development, and Globalization: Economics as if All People Mattered. Roultedge Press. (GDGE)
2. Molyneux and Razavi. (2002). Gender Justice, Development and Rights. Oxford University Press (GJDR or WGD)
3. Visvanathan, Duggan, Wiegersma and Nisonoff. (2011). The Women, Gender and Development Reader. 2nd Edition. Zed Press (WGD)

CO-PO Mapping:

COs \POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2	1	-	2	1	-	-	-	2	3	3
CO2	3	2	-	1	3	2	-	1	2	-	3	3
CO3	3	2	2	-	2	3	1	-	2	1	3	3
CO4	3	1	-	2	-	-	-	2	-	3	3	3
CO5	3	2	-	1	-	1	2	-	2	-	3	3

Weightage Values: 3 = Strongly matched, 2 = Moderately matched, 1 = Weakly matched, (-) = Notmatched.

CO-PSO mapping

COs/POs	**PSO1**	**PSO2**	**PSO3**
CO1	-	-	-
CO2	-	-	-
CO3	-	-	-
CO4	-	-	-
CO5	-	-	-

Course Name: EM theory and Antenna Lab
Course Code: EC 491
Contact: 0:0:3
Credit: 1.5

Prerequisite:

The candidates should learn basic knowledge of vector calculus, electrostatic magnetostatics.

Course Outcome:

Graduates of the ECE program will be able to:

CO1: To understand the theory of transmission lines in which EM wave propagate.
CO2: Define and identify different types of transmission line, its characteristics in various load conditions.
CO3: To realize the fundamentals of antenna theory.
CO4: Understand the different types of antennas and the radiation mechanism.

List of Experiments:

1. Familiarization of basic elements of the Transmission Line.
2. Plotting of Standing Wave Pattern along a transmission line when the line is open-circuited, short-circuited at the load end.
3. Plotting of Standing Wave Pattern along a transmission line when the line is terminated by different load at the load end.
4. Unknown load Impedance of a terminated transmission line using shift in minima technique.
5. Study of parameters transmission line using Smith chart.
6. Study of electromagnetic phenomena of transmission lines in simulation software's.
7. Familiarization with antenna parameters measurement set-up and different antenna.
8. Radiation Pattern of dipole antenna and Mono pole with ground plane.
9. Radiation Pattern of a folded-dipole antenna.
10. Radiation pattern of a Log-Periodic Antenna.
11. Beam width, gain and radiation pattern of a 3-element, 5-element, and 7-element.
12. Yagi-Uda antenna – Comparative study.
13. Radiation pattern, Gain, Directivity of a Pyramidal Horn Antenna.

CO-PO Mapping:

Cos/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	1	-	1	-	-	-	1	-	-	-	1
CO3	3	1	1	1	-	-	-	-	-	-	-	-
CO3	3	2	-	1	-	-	-	-	-	-	-	2
CO4	2	3	-	-	1	-	1	-	-	-	-	1

Weightage Values: 3 = Strongly matched, 2 = Moderately matched, 1 = Weakly matched, (-) = Not matched.

CO-PSO mapping

COs/POs	**PSO1**	**PSO2**	**PSO3**
CO1	3	3	3
CO2	3	3	3
CO3	3	3	3
CO4	3	3	3

Course Name: Analog Circuits Lab
Course Code: EC 492
Contact: 0:0:3
Credit: 1.5

Prerequisites: A basic course in Electronics and Communication engineering Progresses from the fundamentals of electricity, active and passive components, basic electronics laws like Ohm's law, Ampere's law.

Course Outcome:

Graduates of the ECE program will be able to:

CO1: Students will be able to design transistor based single stage R-C coupled voltage amplifier, differential amplifier, and different classes of power amplifier circuit with given specification.
CO2: Students will be able to design transistor-based RC oscillator (Wien bridge and RC phase shift oscillator) circuit.
CO3: Students will be able to construct astable and mono-stable mode timer circuit using IC555.
CO4: Students will be able to design Integrator, differentiator, and low pass & high pass active filter circuit using Op-Amp (I.C-741)

List of Experiments:

1. Design of voltage regulator using IC.
2. Study of input and output characteristics of CE mode BJT
3. Design of RC coupled amplifier in CE mode & study of its frequency response using BJT.
4. Design of RC Phase shift oscillator using BJT and measurement of its output frequency.
5. Design of Wien bridge oscillator using BJT and measurement of its output frequency.
6. Design of class A & class B push-pull power amplifiers and measurement of its power conversion efficiency.
7. Study of drain and transfer characteristics of single stage voltage amplifier JFET.
8. Design of Integrator using OPAMP (IC-741) and study of its frequency response.
9. Design of Differentiator using OPAMP (IC-741) and study of its frequency response.
10. Design of low pass and high pass active filter using OPAMP (IC-741) and study of its frequency response.
11. Design of Schmitt trigger circuit using OPAMP (IC-741) and study of its voltage transfer characteristic.
12. Design of astable and monostable multivibrator using timer (IC-555) and measurement of its duty cycle.
13. Innovative Experiments

Textbooks:

1. Sedra & Smith-Microelectronic Circuits-Oxford Up
2. Millman & Halkais- Integrated Electronics, McGraw Hill.
3. Boylested & Nashelsky-Electronic Devices and Circuit Theory-Pearson/PHI
4. Rashid-Microeletronic Circuits-Analysis and Design- Thomson (Cenage Learning).
5. Franco- design with Operational Amplifiers & Analog Integrated Circuits, 3/e, McGraw Hill.
6. Gayakwad R.A – OpAmps and Linear IC's, PHI

Reference Books:

1. Razavi- Fundamentals of Microelectronics-Wiley
2. J.B. Gupta- Electronic Devices and Circuits- S.K. Kataria & Sons
3. Malvino- Electronic Principles, 6/e, McGraw Hill

CO- PO Mapping:

COs\ POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	3	3	2	1	1	2	3	-	-	3
CO2	3	3	2	2	2	-	2	-	3	-	2	3
CO3	3	2	2	1	2	2	1	2	3	1	-	2
CO4	3	3	3	3	2	-	2	-	3	-	1	3

Weightage Values: 3 = Strongly matched, 2 = Moderately matched, 1 = Weakly matched, (-) = Not matched.

CO-PSO mapping

COs/POs	**PSO1**	**PSO2**	**PSO3**
CO1	3	3	3
CO2	3	3	3
CO3	3	3	3
CO4	3	3	3
CO5	3	3	3

Course Name: Digital Electronics Lab

Course Code: EC 493
Contact: 0:0:3
Credit: 1.5

Prerequisites: A basic course in Electronics and Communication engineering Progresses from the fundamentals of electricity, active and passive components, basic electronics laws like Ohm's law, Ampere's law.

Course Outcome:

Graduates of the ECE program will be able to:

CO1: Able to understand the fundamental concepts and techniques used in digital electronics.
CO2: Able to understand and examine the structure of various number system De- Morgan's law, Boolean algebra, and its application in digital design.
CO3: Able to understand, analyse the timing properties (input setup and hold times, minimum clock period, output propagation delays) and design various combinational and sequential circuits using various metrics: switching speed, throughput/latency, gate count and area, energy dissipation and power.
CO4: Able to understand different TTL logic.
CO5: Able to design digital circuits by their own.

List of Experiments:

1. Realization of basic gates using Universal logic gates.
2. Design the circuit of Grey to Binary and vice versa.
3. Design a circuit for BCD to 7-segment display.
4. Four-bit parity generator and Two-bit comparator circuits.
5. Construction of simple Encoder & Decoder circuits using logic gates.
6. Construction of simple Multiplexer & De Multiplexer circuits using logic gates.
7. Design of Half Adder & Full Adder Circuit using Logic Gates.
8. Design Half Subtractor & Full Subtractor Circuit using Logic Gates.
9. Realization of RS, D, JK and T flip-flops using logic gates.
10. Realization of Register using flip-flops and logic gates.11.Realization of Up/Down counters
12. Realization of logic gates using TTL. 13.One Innovative design of Digital Circuits.

Textbooks:

1. A.Anand Kumar, Fundamentals of Digital Circuits-PHI
2. Morries Mano- Digital Logic Design- PHI
3. S.Salivahanan & S.Arivazhagan, Digital Circuit & Design- Bikas Publishing
4. A.K.Maini- Digital Electronics-Wiley-India

Reference:

1. Floyed & Jain- Digital Fundamentals-Pearson.
2. R.P.Jain—Modern Digital Electronics, 2/e , Mc Graw Hill
3. H.Taub & D.Shilling, Digital Integrated Electronics- Mc Graw Hill.
4. D.Ray Chaudhuri- Digital Circuits-Vol-I & II, 2/e- Platinum Publishers
5. Kharate- Digital Electronics- Oxford
6. Tocci, Widmer, Moss- Digital Systems, 9/e- Pearso

CO- PO Mapping:

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	3	1	3	1	1	1	-	-	1	3
CO2	3	3	3	1	3	1	1	-	1	1	1	3
CO3	3	3	3	3	3	2	2	1	-	1	2	3
CO4	3	3	3	3	3	2	2	1	-	2	1	3
CO5	3	3	3	3	3	1	2	1	2	2	2	3

Weightage Values: 3 = Strongly matched, 2 = Moderately matched, 1 = Weakly matched, (-) = Notmatched.

CO-PSO mapping

COs/POs	**PSO1**	**PSO2**	**PSO3**
CO1	3	3	3
CO2	3	3	3
CO3	3	3	3
CO4	3	3	3
CO5	3	3	3

Course Name: Analog & Digital Communication Systems Lab

Course Code: EC 494
Contact: 0:0:3
Credit: 1.5

Prerequisites: Knowledge of signals and systems

Course Outcomes:

Graduates of the ECE program will be able to:

CO1: Analyse the concept of analog and digital communication techniques and their applications.
CO2: Demonstrate to the practical methods of the use of generating communication signals.
CO3: Evaluate practical methods of the use of demodulation of communication signals.
CO4: Distinguish the significance of signal constellation and pectral width.
CO5: Develop insight into the relations between the input and output signals in various stages of a transmitter and a receiver.

List of Experiments:

1. Measurement of output power with varying modulation index an AM signal (for both DSB- & SSB).
2. Measurement of the demodulated output with varying modulation index of an AM signal (for both DSB- SC & SSB).
3. Measurement of power of different frequency components of a frequency modulated signal & the measurement of the bandwidth.
4. Design a PLL using VCO & to measure the lock frequency.
5. Study of pulse amplitude modulation (PAM) and demodulation.
6. Study of PCM and demodulation.
7. Study of delta modulator and demodulator
8. Study of ASK modulator and demodulator
9. Study of BPSK modulator and demodulator
10. Study of BFSK modulator and demodulator.
11. Study of QPSK modulator and demodulator.
12. Innovative project: Breadboard realization of digital communication circuit for voice communication

Textbooks:

1. Haykin S., "Communications Systems", John Wiley and Sons, 2001.
2. Principles of Communication Systems, H. Taub and D. Schilling, TMH Publishing Co.
3. Wireless Communication and Networks: 3G and Beyond, I. Asha Misra, TMH Education.
4. Communication Systems, A. Bruce Carlson, Paul B. Crilly TMH Education.

Reference books:

1. Digital Communications Fundamentals and Applications, B. Sklar and P.K.Ray, Pearson.
2. Modern Digital and Analog Communication Systems, B.P.Lathi and Z.Ding, Oxford University Press.
3. Digital Communication, A. Bhattacharya, TMH Publishing Co.

4. Digital Communications by Dr. Sanjay Sharma S K Kataria and Sons
5. Digital Communications, J.G.Proakis, TMH Publishing Co.
6. Digital Communications Fundamentals and Applications, B. Sklar and P.K.Ray, Pearson.
7. Modern Digital and Analog Communication Systems, B.P.Lathi and Z.Ding, Oxford University Press.
8. Digital Communication, A. Bhattacharya, TMH Publishing Co.
9. Digital Communications by Dr. Sanjay Sharma S K Kataria and Sons
10. Digital Communications, J.G.Proakis, TMH Publishing Co.

CO-PO Mapping:

COs\POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO8	PO9	PO10	PO11	PO12
CO1	3	3	3	-	1	1	-	-	2	-	3	3	3
CO2	3	-	-	3	3	-	2	-	-	1	3	3	3
CO3	3	3	3	3	2	2	-	-	1	-	3	3	3
CO4	3	-	3	2	3	-	2	-	-	2	3	3	3
CO5	3	2	-	3	3	2	-	-	-	-	3	3	3

Weightage Values: 3 = Strongly matched, 2 = Moderately matched, 1 = Weakly matched, (-) = Not matched.

CO-PSO mapping

COs/POs	**PSO1**	**PSO2**	**PSO3**
CO1	3	3	3
CO2	3	3	3
CO3	3	3	3
CO4	3	3	3
CO5	3	3	3

Course Name: Digital Signal Processing Lab
Course Code: EC495
Contacts: 0:0:3
Credits: 1.5

Prerequisite: Nil

Course Outcomes:

Graduates of the ECE program will be able to:

CO1: Able to compute the system output using convolution method with MATLAB Software package.
CO2: Able to verify the system characteristics.
CO3: Able to Calculate DFT, FFT, IDFT using MATLAB.
CO4: Able to analyse Magnitude and phase characteristics (Frequency response Characteristics of digital IIR Butterworth.
CO5: Able to Develop and Implement DSP algorithms in software using a computer language such as C with TMS320C6713 floating point Processor.

List of Experiments:

1. Convolution of two sequences using graphical methods and using commands- verification of the properties of convolution.
2. Systems (Causal and Non_causal, Time-Invarient and Time-varient etc.) verification using MATLAB.
3. Z-transform of various sequences – verification of the properties of Z-transform.
4. DFT using twiddle factors.
5. DFTs / IDFTs using matrix multiplication and also using commands.
6. Circular convolution of two sequences using graphical methods and using commands, differentiation between linear and circular convolutions.
7. Verifications of the different algorithms associated with filtering of long data sequences and overlap–add and Overlap-save methods.
8. Butterworth filter design with different set of parameters.
9. FIR filter design using rectangular, Hamming and Blackman windows.
10. Frequency responses of anti-imaging and anti-aliasing filters.
11. Develop and Implement DSP algorithms in software using a computer language such as C with TMS320C6713 floating point Processor, TMS 5416 kit and ASM along with C.

Textbooks:

1. Digital Signal Processing – Principles, Algorithms and Applications, J.G.Proakis& D.G.Manolakis, Pearson Ed.
2. Digital Signal Processing, S.Salivahanan, A.Vallabraj & C. Gnanapriya, TMH

Publishing Co.

3. Digital Signal Processing, P. Rameshbabu, Scitech Publications (India).
4. Digital Signal processing – A Computer Based Approach, S.K.Mitra, TMHPublishing Co.

Reference books:

1. Digital Signal Processing; Spectral Computation and Filter Design Chi-TsongChen, Oxford University Press
2. Texas Instruments DSP Processor user manuals and application notes

CO-PO Mapping:

COs\POs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO1	2	3	2	1	1	1	-	1	-	1	-	-
CO2	2	2	3	1	1	-	-	1	-	-	-	-
CO3	2	1	2	2	3	1	1	-	-	1	2	2
CO4	3	1	3	2	2	1	2	2	3	1	-	2
CO5	3	1	3	3	2	1	2	2	3	1	-	2

Weightage Values: 3 = Strongly matched, 2 = Moderately matched, 1 = Weakly matched, (-) = Not matched

CO-PSO mapping

COs/POs	**PSO1**	**PSO2**	**PSO3**
CO1	3	3	3
CO2	3	3	3
CO3	3	3	3
CO4	3	3	3
CO5	3	3	3

R21(B.Tech ECE)

Curriculum for B.Tech
Under Autonomy
Electronics & Communication Engineering
(Effective From 2021-22 admission Batch)
L – Lecture; T- Tutorial; P- Practical [1L=1Cr, 1T=1Cr, 1P =0.5 Cr]
3rd Year 1st Semester: 5th Semester

Sl. No.	Category	Course Code	Course Title	Hoursperweek				Credits / Unit
				L	T	P	Total	
A. THEORY								
1	HSMC	HSMC 505	Principles of Management	2	0	0	2	2
2	PC	EC501	Microprocessor & Micro Controller	3	0	0	3	3
3	PC	EC502	RF & Microwave Engineering	3	0	0	3	3
4	PC	EC503	Computer Network	3	0	0	3	3
5	PE	PEC 501	Professional Elective-I A: Mobile Communication & NetworkB: Fibre Optic Communication C: Electronics Measurement & Instrumentation D: Satellite Communication	3	0	0	3	3
6	PE	PEC 502	Professional Elective-II A: Computer Architecture B: Digital Image & Video ProcessingC: Embedded System D: Advanced Python Programming	3	0	0	3	3
B. PRACTICAL								
7	PC	EC591	Microprocessor & Micro Controller Lab	0	0	3	3	1.5
8	PC	EC592	RF & Microwave Engineering Lab	0	0	3	3	1.5
9	PE	PEC 591	Professional Elective-I Lab A: Mobile Communication & Network LabB: Fiber Optic Communication Lab C: Electronics Measurement &Instrumentation Lab D: Satellite Communication Lab	0	0	3	3	1.5
10	PE	PEC 592	Professional Elective-II Lab A:Computer Architecture Lab B: Digital Image & Video Processing LabC: Embedded System Lab D: Advanced Python Programming Lab	0	0	3	3	1.5
11	PROJECT	PR 591	Minor Project I	0	0	3	2	1
12	PROJECT	PR 592	Skill Development V: Soft Skill & Aptitude-II	0	0	1	1	0.5
C. MANDATORY ACTIVITIES / COURSES								
13	MC	MC 501	Constitution of India	2	0	0	2	0
	TOTAL CREDIT WITHOUT MOOCS COURSES							24.5
D. MOOCS COURSES** [For Honors/Minor]								
14	MOOCS COURSES	HM501	MOOCS COURSE-IV	3	1	0	4	4

Course Name: Principles of Management
CourseCode: HSMC 505
Contact: 2:0:0
Total contact hour-24
Credits: 2

Prerequisites: NIL

Course outcome:
On completion of the course students will be able to:

CO1: To recall and identify the relevance of management concepts.

CO2: To apply management techniques for meeting current and future management challenges faced by the organization

CO3: To compare the management theories and models critically to solve real life problems in anorganization.

CO4: To apply principles of management in order to execute the role as a manager in an organization.

Course Content:

Module-1:

Management Concepts: Definition, roles, functionsand importanceof Management, Evolution of Managementthought-contribution made by Taylor, Fayol, Gilbreth, Elton Mayo, McGregor, Maslow (4L)

Module - 2:

Planning and Control: Planning: Nature and importance of planning, -types of planning, Levels of planning - The Planning Process. –MBO,SWOT analysis,McKinsey's7S Approach. Organizing for decision making: Nature of organizing, span of control, Organizational structure line and staff authority. Basic control process -control asa feedback system – Feed Forward Control – Requirements for effective control – control (4L)

Module - 3:

Group dynamics: Types of groups, characteristics, objectives of Group Dynamics.

Leadership: Definition, styles & functions of leadership, qualities for good leadership, Theories of leadership (4L)

Module – 4:

Work Studyand work measurement: Definition of work study, Method Study Steps, Toolsand Techniques used in the Method Study and Work Measurement Time Study: Aim & Objectives,, Use of stopwatch procedure in making Time Study. Performance rating, allowances and its types. Calculation of Standard Time. Work sampling (4L)

Module - 5:

Marketing Management: Functions of Marketing, Product Planning and development, Promotional Strategy (2L)

Module - 6:

Quality management: Quality definition, Statistical quality control, acceptance sampling, Control Charts – Mean chart,range chart, cchart, pchart, np chart, Zero Defects, Quality circles, , Kaizen & Six Sigma , ISO

-9000 Implementation steps, Total quality management (6L)

Text Books:

Essentials of Management, by Harold Kooritz& Heinz Weihrich TataMcGraw

Production and Operations Management-K.Aswathapa,K .ShridharaBhat,Himalayan Publishing House References: Organizational Behavior, by Stephen Robbins Pearson Education, NewDelhi Newera

Management, Daft, 11th Edition, CengageLearning

Principles of Marketing, Kotlar Philip and Armstrong Gary, Pearsonpublication CO-CO-PO Mapping:

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	-	-	-	-	-	-	-	-	3	-	3	-
CO2	-	-	-	-	-	2	-	3	3	-	3	3
CO3	-	-	-	-	-	-	-	-	2	-	3	3
CO4	-	-	-	-	-	2	-	-	3	-	3	-

Weightage Values: 3 = Strongly matched, 2 = Moderately matched, 1 = Weakly matched, (-) = Not matched.

COs/PSOs	PSO1	PSO2	PSO3
CO1	-	-	2
CO2	-	-	2
CO3	-	-	2
CO4		-	2
CO5	-	-	2

Course Name: Microprocessor and Microcontroller
Course Code: EC 501
Contacts: 3:0:0
Total Contact Hours: 36Credit:3

Prerequisite: Knowledge in Digital Electronics.

Course Outcomes:

Graduates of the ECE program will be able to:

CO1: To explain the architecture instructions, timing diagrams, addressing modes, memory interfacing, interrupts, data communication of 8085,8086 microprocessors and 8051 microcontrollers.
CO2: Able to interpret the 8086 microprocessor-Architecture, Pin details, memory segmentation, addressing modes, basic instructions, interrupts.
CO3: Recognize 8051 micro controller hardware, input/output pins, ports, external memory, counters and timers, instruction set, addressing modes, serial data i/o, interrupts.
CO4: Apply instructions for assembly language programs of 8085, 8086 and 8051.
CO5: Design peripheral interfacing model using IC 8255, 8253, 8251 with IC 8085, 8086 and 8051.

Course Content:

Module 1: 8085 Microprocessor: [6L]
Introduction to Microcomputer based system, Evolution of Microprocessor and microcontrollers and their advantages and disadvantages, Architecture of 8085 Microprocessor, Address / Data Bus Memory interfacing, IO interfacing, ADC /DAC interfacing, Stack and Subroutine, Delay Calculation, Interrupts of 8085 processor, classification of interrupts.

Module 2: Assembly language programming with 8085: [4L]
Addition, Subtraction, Multiplication, Block Transfer, ascending order, descending order, Finding largest & smallest number, Look-up table etc. Programming using interrupts (programming using INTR is not required). Instruction set, Addressing mode, Timing Diagram.

Module 3: 8086 Microprocessor: [6L]
8086 Architecture, Pin details, memory segmentation, addressing modes, Familiarization of basic Instructions, Interrupts& Direct Memory Access, Memory interfacing, ADC / DAC interfacing, Pipeline Architecture, Minimum and Maximummode of addressing, Que operation.

Module 4: Assembly language programming with 8086: [3L]
Addition, Subtraction, Multiplication, Block, Transfer, ascending order, descending order, Finding largest &smallest number etc.

Module5: 8051Microcontroller: [6L]
Difference between processor and controller, Features of 8051 microcontroller ,8051 architecture & Pin diagram, Memory organization, Direct and indirect Access of memory, SFR, PCON, SCON,

TCON,TMOD,IE,IP,SBUFFserialdatai/o,interrupts,Memoryinterfacing,ADC/DACinterfacing

Module 6: Assembly language Programming using 8051: [5L]
Moving data: External data moves, code memory read only datamoves, PUSH and POP opcodes, data exchanges;
Logical operations: Byte-level, bit-level, rotate and swap operations;
Arithmetic operations: Flags, incrementing and decrementing, addition, subtraction, multiplication anddivision, decimal arithmetic; Jump and call instructions: Jump and call program range, jumps, callsand subroutines, interrupts and returns, Instruction &addressing.

Module 7: Support IC chips: [6L]
8255, 8253 and 8251: Block Diagram, Pin Details, Modes of operation, control word(s) format. Interfacing ofsupportIC chips with 8085, 8086 and 8051.

Textbooks:

1. Microprocessor architecture, programmingand application with 8085 – R. Gaonkar, Penram International
2. The 8051 microcontroller - K. Ayala, Thomson
3. Microprocessors & interfacing – D. V. Hall, Tata McGraw-hill
4. Ray & Bhurchandi, Advanced Microprocessors & Peripherals, TMH
5. The 8051 microcontroller and Embedded systems - Mazidi, Mazidi and McKinley, Pearson
6. An Introduction to Microprocessor and Applications –Krishna Kant,Macmillan

Reference Books:

1. Microprocessors and microcontrollers - N. Senthil Kumar, M. Saravanan and Jeevananthan, Oxforduniversity press
2. 8086 Microprocessor –K Ayala, Cengage learning
3. The 8051 microcontrollers – Uma Rao and Andhe Pallavi, Pearson

CO-PO Mapping:

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	3	1	2	-	-	2	2	2	1	3
CO2	3	3	3	1	2	-	-	2	2	2	1	3
CO3	3	3	3	1	2	-	-	2	2	2	1	3
CO4	3	3	3	2	2	-	1	2	2	2	2	3
CO5	3	3	3	2	2	-	-	2	2	2	1	3

Weightage Values: 3 = Strongly matched, 2 = Moderately matched, 1 = Weakly matched, (-) = Notmatched.

COs/PSOs	PSO1	PSO2	PSO3
CO1	-	-	2
CO2	-	-	2
CO3	-	-	2
CO4		-	2
CO5	-	-	2

Course Name: RF & Microwave EngineeringCourse
Code: EC502
Contacts: 3:0:0
Total Contact Hours: 36
Credit: 3

Prerequisite: EM Theory & Antenna, Field theory, Analog Electronics

Course Outcomes:

Graduates of the ECE program will be able to:

CO1: Understand the Microwave Frequency range and their application.
CO2: Develop fundamental understanding of the Two –port RF network and matching techniques.
CO3: Learn the Scattering matrix for microwave passive components
CO4: Understand the Microwave tubes and devices along with their fundamental principle of Operation.
CO5: Learn the microwave measurements techniques.

Course Content:

Module 1: Introduction [2L]
Introduction RF& Microwave Spectrum, Applications of Microwaves: Civil and Military, Medical, EMI/EMC, Safety considerations

Module 2: Microwave Waveguides [10L]
Mathematical Model of Microwave Transmission in Parallel Plate Waveguide. Concept of Mode, Features of TEM, TE and TM Modes. Rectangular waveguide - TE10 mode analysis, cut-off frequency, propagation constant, intrinsic wave impedance, phase and group velocity, power transmission, attenuation, waveguide excitation, wall current. Concept of propagation constant, intrinsic wave impedance, phase and group velocity, power transmission, attenuation. Circular waveguide, Transmission line - Coaxial line, Planar Transmission line- Micro-strip lines, Coplanar waveguide, Slot line-design consideration, field patterns, propagation characteristics, Comparison for different characteristics of the above- mentioned lines.

Module 3: Microwave Network Analysis of Passive Components [10L]
Realization of reactive elements as Waveguide and Planar Circuit components. Equivalent voltages and currents, Network parameters for microwave circuits, Scattering Parameters, Waveguide Passive Components and their S-matrix Representation N- port networks-Properties of S matrix, Transmission matrix & their relationships; Microwave passive components and their S matrix representation: Attenuators, Phase shifter, Directional coupler, Bethe-hole coupler, Magictee, hybrid ring, Circulators, Isolators; Microwave filter

Module 4: Microwave Active Devices [10L]
Microwave active components: Diodes, Transistors, Amplifiers, Oscillators, Mixers. Microwave Semiconductor Devices: Gunn Diodes, Transit Time diodes, Schottky Barrier diodes, PIN diodes. Microwave Tubes: Klystron, Reflex Klystron, Magnetron, TWT.
Brief introduction to NBA, LNA

Module 5: Microwave Measurement [4L]
Typical Microwave Test Bench & measurement VSWR meter, Tunable detector, Slotted line and Probe detector, Frequency meter, Network analyzer, Measurement of VSWR – low, medium and high, Measurement of power: low, medium and high, Frequency measurement.

Textbooks:

1. Samuel Y Liao, "Microwave Devices & Circuits" , Prentice Hall of India, 2006.
2. Susrut Das, "Microwave Engineering", Oxford University Press, 2014.
3. Annapurna Das and Sisir Kumar Das, "Microwave Engineering", Tata Mc GrawHill Inc., 3rd Edn.2015.

Reference Books:

1. D. M.Pozar, "Microwave Engineering.", John Wiley & sons, Inc., 2006.
2. R.E. Collins, Microwave Circuits, McGraw Hill
3. M. L. Sosodia, G. S. Raghuvanshi, "Microwave Circuits and Passive Devices", 2010

CO-PO Mapping:

Cos\POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO 1	3	3	3	1	2	2	1	1	1	2	1	2
CO 2	3	3	3	2	2	2	2	1	1	1	2	1
CO 3	3	3	3	2	2	2	2	1	1	1	1	1
CO 4	3	3	3	2	2	2	2	1	1	1	2	1
CO 5	3	3	3	2	2	2	2	1	2	2	1	1

Weightage Values: 3 = Strongly matched, 2 = Moderately matched, 1 = Weakly matched, (-) = Not matched.

COs/PSOs	PSO1	PSO2	PSO3
CO1	3	3	3
CO2	3	2	3
CO3	3	3	3
CO4	3	3	3
CO5	2	3	2

Course Name: Computer NetworkCourse
Code: EC 503
Contacts: 3:0:0
Total Contact Hours: 36
Credit: 3

Prerequisite: Digital Communication

Course Outcomes:

CO1: Analyze various protocols in Data Communication
CO2: Analyze error control and flow control in Data Communication
CO3: Design Networking structure in Data communication
CO4: Analyze various encryption techniques, identify some of the factors driving the need for networkSecurity.

Course Content:

Module 1:

Overview of Data Communication: [3L]
Introduction; physical structure (type of connection, topology), categories of network (LAN, MAN, WAN); Internet: brief history, Protocols and standards; Reference models: OSI reference model, TCP/IP reference model, their comparative study.

Module 2:

Data Link Layers: [7L]
Physical Level: Transmission media (guided & unguided); Circuit switching time division & spacedivision switch, TDM bus
Data link Layer: Types of errors, framing (character and bit stuffing), error detection & correction methods; Flow control; Protocols: Stop & wait ARQ, Go-Back-N ARQ, Selective repeat ARQ, HDLC Medium Access sub layer: Point to Point Protocol, Token Ring; Multiple access protocols: Pure ALOHA, Slotted ALOHA, CSMA, CSMA/CD, CSMA/CA Traditional Ethernet, fast Ethernet (in brief)

Module 3:

Network Layers: [10L]

Network layer: Internetworking & devices: Hubs, Bridges(Basic Idea), Switches, Router, Gateway; Addressing
: IP addressing, subnetting; Routing : techniques, static vs. dynamicrouting, Source and Hop-by- Hop routing (Dijkastra,),Unicast Routing Protocols: RIP, OSPF, Other Protocols: ARP, IP, ICMP, IPV6
Transport layer: Processto Processdelivery; UDP; TCP; Congestion Control: Open Loop, Closed Loopchoke packets (Concept); Leaky bucket algorithm, Token bucket algorithm, WLAN (BasicIdea)

Module 4:

Application Layers: [4L]

Application Layer: Introduction to DNS, SMTP, FTP, HTTP & WWW, Bluetooth (Basic Idea)

Module 5:

Security in Networking: [12L]

Need for Security, Security Attack, Security Services, Information Security, Methods of Protection.

Symmetric Key Encryption: Data Encryption Standard (DES) Algorithm, Double and Triple DES, Securityof the DES, Advanced Encryption Standard (AES) Algorithm, DES and AES Comparison. Public Key Encryption: Characteristics of Public Key System, RSA Technique, Cryptographic Hash Functions, Digital Signature Threats to E-Mail, Requirements and Solutions, Encryption for Secure E-Mail, Secure E-Mail System.

Firewalls – Types, Comparison of Firewall Types, Firewall Configurations.

Text Books:

1. B.A.Forouzan–"Data Communicationsand Networking (3rd Ed.)"–TMH
2. A. S. Tanenbaum – "Computer Networks (4th Ed.)" – Pearson Education/PHI
3. W. Stallings – "Data and Computer Communications (5th Ed.)" – PHI/ Pearson Education
4. Zheng & Akhtar, Network for Computer Scientists & Engineers, OUP
5. Black, Data & Computer Communication, PHI
6. Shay, Understanding Data Communication & Network, Vikas

Reference Books:

1. Kurose and Rose – "Computer Networking -A top down approach featuring the internet" –Pearson Education
2. Leon, Garica, Widjaja – "Communication Networks" – TMH
3. Walrand – "Communication Networks" – TMH.
4. Warwick Ford, Michael S. Baum, " Secure Electronic Commerce: Building the Infrastructure forDigital

CO-PO Mapping:

COs\ POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2	1	-	1	-	1	-	-	-	-	-
CO2	2	2	3	1	-	1	-	1	-	-	-	-
CO3	2	2	2	1	1	1	-	-	-	-	-	-
CO4	3	1	1	2	2	-	1	-	-	-	-	-

Weightage Values: 3 = Strongly matched, 2 = Moderately matched, 1 = Weakly matched, (-) = Notmatched

COs/PSOs	PSO1	PSO2	PSO3
CO1	3	3	3
CO2	3	2	3
CO3	3	3	3
CO4	3	3	3

Course Name: Mobile Communication and Network
Course Code: PEC501A
Contacts: 3:0:0
Total Contact hours: 36
Credits: 3

Prerequisite: Analog & Digital Communication

Course Outcomes:

Graduates of the ECE program will be able to:

CO1: Describe the evolution and History of Wireless Technology.
CO2: Explain cellular concept for mobile communication.
CO3: Learn radio signal propagation issues and different technological advancement of mobile communication, Wireless and Radio channels.
CO4: Compare 3G Cellular telephone data transfer rates with those over Wireless LAN and core networks associated with 3G Cellular networks.
CO5: Describe mobile IP allocation and function of the station roaming. and describe the new key technologies related to 5G.

Course Content:

Module I: INTRODUCTION [3L]

Evolution of mobile radio communications, mobile radio systems around the world, trends in cellular radio and personal communication, first generation (1G), second generation (2G), third generation (3G), Fourth Generation (4G) mobile cellular, 5G mobile cellular-Its use and underlying technologies to make up 5G, differences between the previous generations of mobile networks and 5G? How fast is 5G? Do I need a new phone if I want 5G? introduction to 6G Key enablers

Module II: CELLULAR CONCEPT [9L]

Limitations of conventional mobile system, Introduction to mobile cellular communication, concept of frequency reuse, cluster size, cellular system architecture, channel assignment strategies, call handoff strategies - hard handoff and soft handoff, prioritizing handoff; interference and system capacity, improving capacity in cellular systems – cell splitting, sectoring, microcell zone concept, Co-channel interference, Propagation effects - scattering, ground reflection, fading

Module III: DIFFERENT MOBILECOMMUNICATION SYSTEMS [6L]

GSM services and features, system architecture, GSM radio subsystem, GSM channel types, location updating and call setup, WAP, SCSD, GPRS, EDGE, 3G W-CDMA; CDMA digital cellular standard

Module IV: WIRELESS NETWORKS [8L]

Advantages and applications of Wireless LAN, WLAN technology – RF and IR wireless LAN, diffuse, quasi diffuse and point-to point IR wireless LAN, IEEE802.11, IEEE802.11 architecture, Introduction to WI-FI,

HIPERLAN2, Bluetooth – Bluetooth architecture

Module V: MOBILE NETWORK [6L]

Introduction to Mobile IP, requirements, IP packet delivery, Agent discovery, Registration, Tunneling and encapsulation, Optimization, Reverse tunneling; Mobile ad-hoc networks – Routing, Destination sequence distance vector, Dynamic source routing and Alternative metrics, 4G Introduction and vision, Multi antenna Technologies: MIMO; software defined radio, adaptive multiple antenna techniques, radio resource management, QOS requirements.ATM and SONET

Module VI: 5G-KEY TECHNOLOGIES: [4L]

Small cells: Past, present, and future trends of cellular networks coverage and capacity of small cellnetworks Interference management, D2D architecture Towards IoT Spectrum sharing.

Massive MIMO: Point-to-point MIMO, Virtual MIMO (relaying), multiuse MIMO Massive MIMO

Textbooks:

1. Theodore S. Rappaport, Wireless communications: principles and practice, PHI / Pearson education.

2. J. Schiller, Mobile communications, Addison-Wesley.

3. William C. Y. Lee, Mobile cellular telecommunication – analog and digital systems, McGraw Hill,2nded.

Reference Books:

1.Wang, Wireless communication System, Pearson Education 2. Talukdar, Mobile computing, TMH

3.J.W. Mark, W. Zhuang, Wireless Communication and Networking, PHI

4.A. Santamaria et al, Wireless LAN systems, Artech House. 5.Stallings, Wireless Communication& Networks, Pearson Education.

CO-PO mapping:

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2	-	-	1	3	2	2	2	3	2	1
CO2	2	-	2	-	3	2	2	2	3	2	3	2
CO3	2	-	3	3	3	2	1	2	3	1	3	1
CO4	2	2	1	-	2	3	2	2	3	2	3	-
CO5	2	-	3	3	3	2	2	2	3	1	3	1

Weightage Values: 3 = Strongly matched, 2 = Moderately matched, 1 = Weakly matched, (-) = Not matched.

COs/PSOs	PSO1	PSO2	PSO3
CO1	-	-	-
CO2	-	-	-
CO3	-	-	-
CO4	-	-	-
CO5	-	-	-

Course Name: Fiber Optic Communication
Course Code: PEC 501B
Contacts: 3:0:0
Total Contact Hours: 36
Credit: 3

Pre-requisite:

Basic Concepts of communication, basic concepts of solid-state device and band theory (direct- indirectsemiconductor, degenerate semiconductor), basics of Physics, Photodiode, LED etc.

Course Outcomes:

Graduates of the ECE program will be able to:

CO1: Recognize and classify the structures of Optical fiber and types.

CO2: Discuss the channel impairments like losses and dispersion.

CO3: Classify the Optical sources and detectors and to discuss their principle.

CO4: Familiar with Design considerations of fiber optic systems and to define the Wavelength Division Multiplexing.(WDM) principles and concepts and to perform characteristics of optical fiber, sources and detectors.

CO5: To analyze optical fiber measurement systems.

Course Content:

Module 1:

Introduction to communication systems: Principles,components ,

Different forms of communications in brief, advantages of optical fiber communication, Transmission Characteristics. Brief about current Industry trends in optical communication system.
Types of losses-Absorption losses, linear and nonlinear scattering losses, fiber bend losses, attenuation losses Optical Fiber wave guide: Structure, Single and Multimode operation: basic concept with mathematical expression (no derivation is needed)

Attenuation, Material and wave guide dispersion.

Module 2: [8]
Components of Optical fiber communication systems- fiber connector and splicer, different types of fibers; Couplers- three and four port couplers-star couplers-optical fiber directional coupler; optical isolators, circulators, beam splitters and optical modulators.
Optical Sources: Light Emitting Diode; principle, structures, powerand efficiency, coupling to fibers. Laser diodes: principle, double heterostructure, gain and index guiding, distributed lasers. Quantum Well Lasers; Modes and narrow linewidth lasers.Modulation; Bandwidthformodulation, Opticaltransmitters: component. Optical Detectors: Device types,optical detection principles, efficiency, responsivity, bandwidth.Preamplifiers; noisesources, signaltonoise ratio.

Module 3: [11L]

Point-to-point link and Wavelength Division Multiplexing: Building blocks; Multiplexing; Intensity Modulation/Direct Detection system; Principle of Regeneration; WDM link, Optical amplifiers; EDFA, SOA, Ramanamplifier.

Dispersion compensation and management.
Optical Network: LAN, MAN, WAN; Topologies: bus, star, ring; Ethernet; FDDI; Telecom networking: SDH/SONET.
Different forms ofaccess networks: Telephony; ISDN; Cable TV; Broadcast and Switched Networks; HFC networks; FTTC, FTTH and FTTN networks.

Module 4: [9L]

Correlation of NA aperture measurements and mode field diameter. Measurements of distance using phase measurement, Displacement measurement, Optical disks, recording of audio & video signals on optical disks, mass replication byopticaldisk, direct read after write (DRAW), data read out, erasable opticaldisk, Holography, Attenuation measurements, Dispersion measurements, Refractive Index Profile Measurements, NA measurements, Polarization Depression Measurements, BER Measurements

Textbooks:

1. Optical Networks –Rajiv Ramaswami, K. N. Sivarajan, Galen H. Sasaki (Morgan-Kaufman)2.Optical Fibre Communication : John M. Senior (Pearson)

3.Optical Communications: N. Bala Saraswathi, I. Ravi Kumar (LaxmiPublications)

Reference Books

1.Optical Communication Systems: John Gawar (PHI)2.Optical Fibre Communication: Gerd Kaiser (TMH)

3. Fiber optics communication by G.P Agrawal.
4. Raman Amplifiers for communications by M.N. Islam(Ed).

CO-PO Mapping:

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	P0 12
CO1	3	3	2	2	2	1	-	-	-	-	-	-
CO2	3	2	3	1	2	-	-	-	-	-	-	1
CO3	3	3	2	1	1	-	-	1	-	1	-	-
CO4	3	3	2	1	2	1	1	-	1	-	1	-
CO5	3	2	3	1	2	1	-	1	-	1	2	1

Weightage Values: 3 = Strongly matched, 2 = Moderately matched, 1 = Weakly matched, (-) = Not matched.

COs/PSOs	PSO1	PSO2	PSO3
CO1	3	3	3
CO2	3	3	3
CO3	3	3	3
CO4	3	3	3
CO5	3	3	3

Course Name: ELECTRONICS MEASUREMENT & INSTRUMENTATION
Course Code: PEC501C
Contact: 3:0:0
Total Contact Hours: 36
Credit: 3

Prerequisites: Basic analog and digital electronic circuits and principles. Basic electronics engineering, Basic electricalengineering,

Course Outcomes:

Graduates of the ECE program will be able to:

CO1: Students able to explain the characteristics, construction and working principle analog instruments like PMMC, MI, Electrodynamometer type and Energy meter.
CO2: Studentsableto demonstrate theprincipleto measure resistance, capacitance, inductance withthehelp of Bridge balancing technique
CO3: Students able to describe the construction and working principle of electronic instrument like: DSO, DMM,spectrum analyzer, distortion meter
CO4: Student able to illustrate the functionality of sensor and transducer element
CO5: Student able to demonstrate the principle of working of Telemetry System Display device, Interface Standard, Data Acquisition system, Advanced Instruments Like OTDR, virtual instrument and PLC.

Module 1: [3L]
Characteristics of Instruments, Errors in Measurement, Units: Measurement Methods: Direct and Indirect Characteristics of Instrument &Measurement System: Static and dynamic, accuracy, precision, sensitivity, resolution,dynamic range, linearity, Hysteresis, repeatability, loading effect. Types of Error (concept): Gross Errors, Systematic Errors, Random ErrorUnits and Standard in measurements– Concept of Calibration

Module 2: [6L]
Analog Instruments: Constructionand operation of PMMC and Moving Iron type Instrument: Itsapplicationto measure current, voltage and resistance. Basic Construction and operation of Electrodynamometer type, rectifier type, thermocouple type instrument Construction and operation of Electrodynamometer type wattmeter and single-phase induction type energy meter

Module 3: [6L]
Measurement of resistance and AC Bridges: Wheatstone bridge, Kelvin double bridge, measurement of high resistance , Earth resistance measurement , localizing ground and short circuit fault . Potentiometer A.C. Bridges: Maxwell's Bridge – inductance, inductance – capacitance, Anderson's Bridge ,De Sauty's Bridge ,Schering Bridge ,Wien's Bridge

Module 4: [6L]
Electronic Instrument: Construction and operation of DMM, Function Generator, DSO, Frequency Counter, L-C-R. and Q- Meter, Distortion Meter, Spectrum Analyzer, resolution, sensitivity, and accuracy specification of digital meters.

Module 5: [5L]
Sensing Element and Transducer: Components of transducer, Classification of electrical transducer with example, Workingand application: Strain Gauges, Pirani Gauges, Semiconductor strain gauges, Thermistors, Thermocouple, IC temperature sensor, Inductive transducer, LVDT, Capacitive transducer, Piezo-electric transducer, LDR.

Module 6: [5L]
Telemetry System, Display, Interface Standard: block diagram –land and R.F telemetry., Display Devices-Application ofLED in display system, Fourteen Segment Display, Dot Matrix Display-3×5 dot ,27 dot ,5×7 dot, Application LCD in display system, Bus interface standard –GPIB interface bus (IEEE488)

Module 7: [5L]
Data Acquisition and Advanced Instruments: Components of modern digital data acquisition system, Basic concept ofPLC& Virtual Instrument, Fibre Optic Measurement –Splicing, OTDR, end to end loss measurement.

Textbook:

1. A.k. Sawhney, Electrical and Electronic Measurements and Measuring Instruments, Dhanpat Rai & Sons.
2. Helfrick, Cooper, Modern Electronic Instrumentation and Measurement Techniques, PHI Publication.

Reference Book:

1. J.B. Gupta , Electrical & Electronics Measurement and Instrumentation, SK Kataria Sons Kalsi Electronic Instrumentation , Tatta McGraw-Hill

CO-PO Mapping:

COs\POs	PO1	PO2	PO3	PO 4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	1	2	2	2	-	-	-	1	1	1	2
CO2	3	2	1	2	1	-	-	-	1	2	1	2
CO3	3	3	3	2	3	-	-	-	1	2	2	3
CO4	3	3	3	3	3	2	2	2	2	2	1	3
CO5	3	2	2	2	3	2	2	2	3	2	3	3

Weightage Values: 3 = Strongly matched, 2 = Moderately matched, 1 = Weakly matched, (-) = Not matched.

COs/PSOs	PSO1	PSO2	PSO3
CO1	3	3	3
CO2	3	3	3
CO3	3	3	3
CO4	3	3	3
CO5	3	3	3

Course Name: Satellite Communication
Course Code: PEC501D
Contact: 3:0:0
Total Contact Hours: 36
Credit: 3

Course Outcomes:

Graduates of the ECE program will be able to:

CO1: Able to learn the orbital aspects of the satellite and the design of satellite links.

CO2: Able to understand the Satellite transponder and Earth Station Design

CO3: Able to understand Multiple Access Techniques used in satellite communication

CO4: Able to realize the various Propagation impairments on satellite communication

CO5: Able to comprehend satellite Navigation and the GPS, GI S and remote sensing Course

Content:

Module 1: Satellite Orbital Mechanics Launcher and Subsystems [8L]

Origin of Satellite communication, Current state of satellite communication. Orbital aspect of satellite communication: Orbital mechanism, equation of orbit, locating satellite in orbit, orbital elements, orbital perturbation, look angle,orbital period and velocity, azimuth and orbital inclination, coverage angle slant range, placement of satellite in geostationary orbit. Space craft subsystem: Attitude and orbit control system, Telemetry tracking and command system, power system, communication subsystem, antenna subsystems.

Module 2: Satellite Link Design [5L]

Basic link analysis, interference analysis, attenuation due to rain, link with and without frequency reuse. System noise temperature and G/ T ratio, uplink design, down link design, , design of satellite link for specified C / N.

Module 3: Satellite Transponder and Earth Station Design [6L]

Transponder model, transponder channelization, frequency plans, processing transponders. Earth Station Technology: Earth Station design; Earth station antenna, gain, pointing loss, G/T variation and it's measurement, antenna tracking, LNA, HPA, RF multiplexing, up converter, down converter, transponder hopping, polarization hopping, redundancy configuration, factors affecting orbit utilization, tracking, equipment for earth station.

Module 4: Multiple Access Techniques [6L]

Frequency Division Multiple Accesses: SPADE, FDM-FM-FDMA, Commanded FDM-FM-FDMA and SSB- AM-FDMA, inter modulation products in FDMA, optimized carrier-to-inter modulation plus noise ratio. Time division Multiple Access: Principle, TDMA frame structure, TDMA Burst structure, TDMA Super
frame structure, Frame acquisition and synchronization. TDMA timing. Demand Assignment Multiple Access and Digital Speech interpolation. Type of demand assignment, DAMA characteristics, Real time frame reconfiguration, DAMA interfaces, SCPC-DAMA, CDMA,SDMA

Module 5: Propagation Effects on Satellite,Earth's path – propagation effects, atmospheric absorption, Scintillation effects, Land and Sea multipath, Rain and ice effects, Rain drop distribution, calculation of attenuation. Rain effects on Antenna noise temperature. Encoding and forward error correction: Error detection and correction, channelcapacity, error detectingcodes- linear block codes,cyclic codes. Introduction to VSAT systems: Low earth orbit and non-geostationary satellite systems. Network error control poling VSAT network. Mobile satellite network: Operating environment. MSAT network concept, CDMA MSAT relink. Worldwide timing by satellite relay. Direct broadcast Television DTH and Radio, Satellite Phone

Module 6: Satellite Navigation and Remote Sensing [4L]

Global Positioning System (GPS), Global Navigation Satellite Systems (GNSS), Basic concept of Geographic Information Systems (GIS), Idea of Remote Sensing

Text Books:

1. Timothy Pratt, Charles Bostian, Teremy Allnutt, Satellite Communication, John Wiley & Sons.
2. "Satellite Communication", D. C. Agrawal, Khanna Publishers
3. "Satellite Communication", Dennis Roddy , 4th Edition, McGraw- Hill International edition, 2006
4. Monojit Mitra : Satellite communications , Prentice Hall of India

Reference Books:

1. "Satellite Communication", T. T. Hai., Mc.Graw Hill Publications
2. Satellite Communication Systems Engineering, W. L. Pitchand, H. L. Suyderhoud, R. A. Nelson, 2nd Ed., Pearson Education, 2007.
3. Satellite Communication, Mark R Chartrand, Cenage Learning
4. J. J. Spilker, Jr., Digital Communication by Satellite, Prentice Hall.
5. Bruce R. Elbert, Satellite Communication Applications Hand Book, Artech House.

CO-PO Mapping:

Cos\POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2	1	-	-	2	-	2	-	1	-	3
CO2	-	3	-	2	-	1	2	-	1	-	-	3
CO3	2	-	2	-	1	-	3	-	2	-	-	3
CO4	3	-	1	-	2	-	2	-	-	1	1	3
CO5	2	3	-	2	-	1	2	-	1	-	-	3

Weightage Values: 3 = Strongly matched, 2 = Moderately matched, 1 = Weakly matched, (-) = Not matched.

COs/PSOs	PSO1	PSO2	PSO3
CO1	3	3	3
CO2	3	3	3
CO3	3	3	3
CO4	3	3	3
CO5	3	3	3

Course Name: Computer ArchitectureCourse
Code: PEC502A
Contacts: 3:0:0
Total Contact Hours: 36
Credit: 3

Prerequisite: Digital Electronics, Analog Electronics, Microprocessor and Microcontroller, Sensors

Course Outcomes:

Graduates of the ECE program will be able to:

CO1: learn how computers work
CO2: know basic principles of computer's working
CO3: analyze the performance of computers
CO4: know how computers are designed and built
CO5: understand issues affecting modern processors (caches, pipelines etc.)

Course Content:

Module 1: [6L]
Basic Structure of Computers, Functional units, software, performance issues software, machine instructions and programs, Types of instructions, Instruction sets: Instruction formats, Assembly language, Stacks, Ques, Subroutines.
Module 2: Processor organization, Information representation, numberformats. [4L]

Module 3: [10L]
Multiplication & division, ALU design, Floating Point arithmetic, IEEE 754 floating point formats, Control Design, Instruction sequencing, Interpretation, Hard wired control - Design methods, and CPU control unit. Microprogrammed Control - Basic concepts, minimizing microinstruction size, multiplier control unit. Microprogrammed computers - CPUcontrolunit
Module 4: [6L]
Memoryorganization, devicecharacteristics, RAM, ROM, Memorymanagement, Concept of Cache & associative memories, Virtual memory, System organization, Input - Output systems, Interrupt, DMA, Standard I/Ointerfaces

Module 5: Concept of parallel processing, Pipelining, Forms of parallel processing, interconnect network [4L]

Module 6: VHDL basics programming concept, Structural, dataflow, behavioral & mixed style modeling techniques.[6L]

Text/ Reference Books:

1. V.Carl Hammacher, "Computer Organisation", Fifth Edition.
2. A.S.Tanenbum, "Structured Computer Organisation", PHI, Third edition
3. Y.Chu, "Computer Organization and Microprogramming", II, Englewood Chiffs, N.J., Prentice Hall Edition
4. M.M.Mano, "Computer System Architecture",Edition
5. C.W.Gear, "Computer Organization and Programming", McGraw Hill, N.V. Edition
6. Hayes J.P, "Computer Architecture and Organization", PHI, Second edition

CO-PO Mapping:

Cos\POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	-	1	2	-	2	-	-	-	-	-	3
CO2	-	2	-	3	-	1	-	-	-	-	-	3
CO3	2	-	-	-	2	-	3	-	-	-	-	3
CO4	3	-	1	-	-	-	2	-	-	-	-	3
CO5	3	-	2	-	-	2	1	-	-	-	-	3

Weightage Values: 3 = Strongly matched, 2 = Moderately matched, 1 = Weakly matched, (-) = Not matched.

CO/PSO Mapping

COs/PSOs	PSO1	PSO2	PSO3
CO1	-	-	-
CO2	-	-	-
CO3	-	-	-
CO4	-	-	-
CO5	-	-	-

Module [4L]
Course Name: Digital Image & Video ProcessingCourse
Code: PEC 502B
Contact: 3:0:0
Total contact hour: 36
Credits: 3

Course Outcome:

Graduates of the ECE program will be able to:

CO1: Have a clear idea on Digital Imaging fundamentals and Importance of Digital Image Transform.
CO2: Understanding the importance of Digital Image enhancement in spatial and frequency domain andfiltering techniques.
CO3: Explaining the requirements and types of Image Compression and its standards.
CO4: Demonstrate the basic concepts of Digital Image Segmentation and Edge detection of DigitalImages.
CO5: Familiarize with Security in Digital Image Processing and Basic Steps of Video Processing and its 2 Dmodeling.

Course Content:

Module 1: [7L]
Digital Imaging Fundamentals: Basic idea of Digital image, Pixel, Mathematical operation of Digital Image, Sampling, Quantization, application of digital Image Processing Application of Artificial Intelligence/ Machine Learning in Imageand Video Processing [3]

Transform of Digital Images: Importance of Digital Image Transform, Fourier Transform of Digital Image (DFT), Inverse Fourier Transform (IDFT), Fast Fourier Transform, Inverse Fast Fourier Transform, Applicationof Digital Image Transform in different area[4]

Module 2: [5L]
Digital Image Enhancement: Importanceof Digital Image enhancement, enhancement inspatial andfrequencydomain, Bit planeslicing, Histogram,HistogramEqualization,MeanandMedianfilteringinDigitalImages,Frequencydomain filtering in Digital Images – LPF, HPF and BPF

Module 3: [5L]
Digital Image Compression: Importance of Digital Image Compression, Types of Image Compression, example of lossless and lossy compression, Image compression standards, Compression in spatial domain, Wavelet based Digital imagecompression

Module 4: [8L]
Segmentation of Digital Images: Importance andapplications of Digital Image Segmentation, Detection of discontinuities, Segmentation based on Thresholding and Region Growing [4]

Edge detection in Digital Image Processing: Importance of Edge detection in Digital Image Processing, Types of Edge Detection- sobel, canny and prewitt edge detection techniques and mathematical Equation of each operator. [4]

Security in Digital Image Processing: Introduction to Digital Image Security and its application, Image encryption inspatial and frequency domain

Basic idea on Cryptography Steganography and Watermarking for digital image.

Module 6: [3L]

Introduction of Video Processing: Basic Steps of Video Processing: Analog video, Digital Video, Time varying Image Formation models, Geometric Image formation, filtering operations.

Module 7: [4L]

2-D Motion Estimation: Optical flow, general methodologies, pixel-based motion estimation, Mesh based motion Estimation, global Motion Estimation, Region based motion estimation, multi resolution motion estimation. Waveform based coding, Application of motion estimation in video coding.

Textbooks:

1. Rafael C. Gonzales, Richard E. Woods, "Digital Image Processing", Third Edition, Pearson Education, 2010.
2. S. Annadurai,R. Shanmugalakshmi, "Fundamentals of Digital Image Processing", Pearson Education, 2006
3. Yao wang, Joem Ostarmann and Ya–quin Zhang,"Video processing and communication",, PHI

References:

1. Rafael C. Gonzalez, Richard E. Woods, Steven L. Eddins, "Digital Image Processing Using MATLAB", Third Edition Tata Mc Graw Hill Pvt. Ltd., 2011.
2. Anil Jain K. "Fundamentals of Digital Image Processing", PHI Learning Pvt. Ltd., 2011.
3. Willliam K Pratt, "Digital Image Processing", John Willey, 2002.
4. Malay K. Pakhira,"Digital Image Processing and Pattern Recognition", First Edition, PHI Learning Pvt. Ltd.,2011.
5. M. Tekalp ,"Digital video Processing", Prentice Hall International

CO-PO Mapping:

COs\POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	-	1	-	-	2	-	-	-	-	-	3
CO2	-	3	-	2	-	1	-	-	-	-	-	3
CO3	2	-	-	-	1	-	3	-	-	-	-	3
CO4	3	-	1	-	-	-	2	-	-	-	-	3
CO5	2	-	2	-	-	3	1	-	-	-	-	3

Weightage Values: 3 = Strongly matched, 2 = Moderately matched, 1 = Weakly matched, (-) = Not matched.

COs/PSOs	PSO1	PSO2	PSO3
CO1	3	3	3
CO2	3	3	3
CO3	3	3	3
CO4	3	3	3
CO5	3	3	3

Course Name: Embedded System

Course Code: PEC502C

Contacts: 3:0:0

Total Contact Hours: 36

Credit: 3

Prerequisite: Digital Electronics, Analog Electronics, Microprocessor and Microcontroller, Sensors,Actuators

Course Outcomes:

Graduates of the ECE program will be able to:

CO1: Know the overview of embedded processors

CO2: Interface the memories with the embedded processors

CO3: Interface sensors and actuators with the processors

CO4: Establish parallel and serial communication with the processorsthrough high speedwirelessdeviceslike Zigbee, Bluetooth, GSM modulesetc.

CO5: Perform real time projects which may be beneficial to the society

Course Content:

Module 1: [5L]

Introduction to embedded systems: concept, general purpose processors, Microprocessor and Microcontroller, RISC and CISC processors, ALU, Von-Neumann and Harvard architecture, watchdog timer, real time clock

Module 2: [10L]

Overview of Embedded Processors and RTOS: Classification: GPP, SPP, MULTI- CORE, Popular Microcontrollers used in embedded systems- Atmega8/16/328P processor, ARM Cortex-III processor, Microcontrollers Data sheet study,CPLD, FPGA, Embedded programming concepts in C, C ++, JAVA,Hardware software co-design, Introduction to RTOS, Scheduling Techniques.

Module 3: [5L]

Overview of Embedded Networking & Standards: RS232, RS485, SPI, I2C, U S B , PCI, , CAN, Bluetooth, Zigbee

Module 4: [6L]

Overview of Embedded Sensors and Transducers: Pressure, Temperature, Acceleration, Image, Rain,Proximity,Hall-effect, Ultra-sonic

Module 5: [4L]

Overview of I/P-O/P devices & Interfacing: Keypad, TWS, JoyStick, SSL, LCD, VGA.

Module 6: [6L]

Examples of Embedded System (Case Study): Mobile phones, IoT, RFID, WSN, Robotics, Biomedical Applications.

Textbooks:

1. Embedded Systems Architecture, Programming and Design, Ral Kamal, TMH, 2008.
2. Introduction to Embedded Systems : Shibu K. V. (TMH)
3. An Embedded Software Primer, D.E. Simon., Pearson Education, 1999.
4. Embedded Systems ,Santanu Chattopadhaya,Pearson
5. Embedded Systems : L. B. Das, Pearson

Reference Books:

1. Embedded Systems Design, Heath Steve, Second Edition-2003, Newnes,
2. Computers as Components; Principles of Embedded Computing System Design, Wayne WolfHarcourtIndia, Morgan Kaufman Publishers, First Indian Reprint. 2001.
3. Embedded Systems Design – A unified Hardware /Software Introduction, Frank Vahid and Tony Givargis, John Wiley, 2002.
4. Design with PIC Microcontrollers, J.B. Peatman, Pearson Education, 1998

CO-PO Mapping:

COs\POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	-	1	-	-	2	-	-	-	-	-	3
CO2	-	3	-	2	-	1	-	-	-	-	-	3
CO3	3	-	-	-	1	-	3	-	-	-	-	3
CO4	3	-	1	-	-	-	2	-	-	-	-	3
CO5	2	-	2	-	-	3	1	-	-	-	-	3

Weightage Values: 3 = Strongly matched, 2 = Moderately matched, 1 = Weakly matched, (-) = Not matched.

COs/PSOs	PSO1	PSO2	PSO3
CO1	3	3	3
CO2	3	3	3
CO3	3	3	3
CO4	3	3	3
CO5	3	3	3

Course Name: Advanced Python Programming
Course Code: PEC 502D
Contacts: 3:0:0
Total Contact Hours: 36
Credit: 3

Perquisite: Basic knowledge of Python.

Course outcome:

Graduates of the ECE program will be able to:

CO1: Able to understand Basic data types and variables, Basic operators, control statement, stringoperations, idea of list, tuples & dictionary, functions in Python.
CO2: Able to understand class, objects, Inheritance and Polymorphism using Python.
CO3: Able to illustrate exceptions, threads in Python.
CO4: Able to describe GUI using Python.
CO5: Able to understand networking and database handling using Python.

Course Content:

Module-1: Introduction to Python [4L]
Use IDLE to develop programs, Basic data types and variables, Basic operators, control statement, string operations, idea of list, tuples & dictionary, functions.

Module-2: Classes and objects: [4L]
Creating a class, self-variable, constructor, type of variables, namespace, instance method, class method, static method, passing member to one class to another class, inner class, descriptors and meta classes.

Module-3: Inheritance and Polymorphism: [5L]
Constructors in inheritance, overriding super class constructors and methods, the super() method, single andmultiple inheritance, method resolution order, polymorphism, operator overloading, methodoverloading.

Module-4: Exceptions: [3L]
Errors in python, compile time, run time error & logical error, exceptions, exception handling, types of exceptions, except block, assertstatement, user defined exceptions, logging the exceptions.

Module-5: Files: [4L]
File descriptors, reading and writing files, working with text files, working with binary files, the “with” statement, pickle in python, seek() and tell() method, random accessing binary files using mmap, zipping and unzipping files, working with directories.

Module-6: Threads: [4L]
Single and multi-tasking, difference between process and thread, concurrent programming and GIL, uses of threads, creating a threads without using a class, creating a thread by creating a sub class to thread class,creating a thread without creating a sub class to thread class, thread class method, single tasking using a thread, thread synchronization, locks, semaphore, deadlock, communicating between threads.

Module-7: Graphical user interface: [4L]

Root window, fonts and colours, working with containers, canvas, frame, widgets, arranging widgets in the frame,

label widget, message widget, text, widget, scrollbar widget, checkbutton widget, entry widget, spinbox widget, listbox widget, menu widget.

Module-8: Networking: [4]L

TCP/IP protocol, user datagram protocol, sockets, knowing IP address, URL, reading the source code of a web page, downloading a webpage from internet, downloading an image from internet, TCP/IP server, TCP/IP client, UDP server, File server, File client, two way communication between server andclient, sending mail.

Module-9: Database connectivity [4L]

Types of databases used in Python, Overview of MySQL , setting the path to MySQL server, Installing MySQL connector, retrieving all rows from a table, inserting rows into table, deleting rows from table and updatingrows in a table using Python, creating database table using Python.

Text Books:

1. Python: The Complete Reference by Martin C Brown
2. Advanced Python Programming by Lanaro Dr. Gabriele
3. Expert Python Programming by Michal Jaworski and Tarek Ziade.

Reference books:

1. Allen Downey, Jeff Elkner and Chris Meyers, (2017), How To Think Like A Computer Scientist:Learning With Python,DreamTech
2. Wesley J Chun, (2018), Core Python Programming, Prentice Hall

CO-PO Mapping:

COs\POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	-	1	-	-	2	-	-	-	-	-	3
CO2	-	3	-	2	-	1	-	-	-	-	-	3
CO3	3	-	-	-	1	-	3	-	-	-	-	3
CO4	3	-	1	-	-	-	2	-	-	-	-	3
CO5	2	-	2	-	-	3	1	-	-	-	-	3

Weightage Values: 3 = Strongly matched, 2 = Moderately matched, 1 = Weakly matched, (-) = Not matched.

COs/PSOs	PSO1	PSO2	PSO3
CO1	3	3	3
CO2	3	3	3
CO3	3	3	3
CO4	3	3	3
CO5	3	3	3

Course Name: Microprocessor and Microcontroller Lab
Course Code: EC591
Contact: 0:0:3
Credits: 1.5

Prerequisites: Knowledge in Digital Electronics

Course Outcome:

Graduates of the ECE program will be able to:

CO1: Able to solve small assignments using the 8085 basic instruction sets and memory mapping throughtrainer kit and simulator.
CO2: Able to write 8085 assembly language programs like Addition, Subtraction, Multiplication, Square, Complement, look up table, copying a block of memory, Shifting, Packing and unpacking of BCD numbers, Ascending order, Descending order etc. using trainer kit.
CO3: Able to validate the interfacing technique using 8255 trainer kits through subroutine calls andIN/OUT instructions like glowing LEDs accordingly, stepper motor rotation etc.
CO4: Able to test fundamental of 8051 programs using the trainer kit.

List of Experiments:

1. Familiarization with 8085 register level architecture, the basic instruction sets (data transfer, arithmetic, logical, branching) and the trainer kit components including the memorymap.
2. Familiarization with the process of storing, executing, and viewing the contentsof memoryas well asregisters in the trainer kit 8085 and simulator through small assignments.
3. Programming using 8085 kit and simulator for: Addition, Subtraction, Multiplication by repeated addition method, Square, Complement, look up table, Copying a block of memory, Shifting, Packingand unpacking of BCD numbers, Addition of BCD numbers, Binary to ASCII conversion, smallest andlargest number from an array of numbers, Ascending order, Descending Order, String Matching, Multiplication using shift and add method.
4. Program using subroutine calls and IN/OUT instructions using 8255 PPI on the trainer kit e.g. subroutine for delay, reading switch state and glowing LEDs accordingly, glowing of seven segment display.
5. Program for serial communication between two trainer kits.
6. Interfacing of 8255: Keyboard, Stepper motor rotation.
7. Study of 8051 Micro controller kit and writing programs.

Textbooks:

1. Microprocessor architecture, programming and application with 8085 – R. Gaonkar, Penram International
2. The 8051 microcontroller - K. Ayala, Thomson
3. Microprocessors & interfacing – D. V. Hall, Tata McGraw-hill
4. Ray & Bhurchandi, Advanced Microprocessors & Peripherals, TMH

5. The 8051 microcontroller and Embedded systems - Mazidi, Mazidi and McKinley, Pearson
6. An Introduction to Microprocessor and Applications –Krishna Kant,Macmillan.

Reference Books:

1. Microprocessors and microcontrollers - N. Senthil Kumar, M. Saravanan and Jeevananthan, Oxford university press
2. 8086 Microprocessor –K Ayala, Cengagelearning
3. The 8051 microcontrollers – Uma Rao and Andhe Pallavi, Pearson

CO-PO Mapping:

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	3	1	2	-	-	2	2	2	1	3
CO2	3	3	3	1	2	-	-	2	2	2	1	3
CO3	3	3	3	1	2	-	-	2	2	2	1	3
CO4	3	3	3	2	2	-	1	2	2	2	2	3

Weightage Values: 3 = Strongly matched, 2 = Moderately matched, 1 = Weakly matched, (-) = Not matched.

COs/PSOs	PSO1	PSO2	PSO3
CO1	3	3	3
CO2	3	3	3
CO3	3	3	3
CO4	3	3	3

Course Name: RF & Microwave Engineering Lab

Course Code: EC 592
Contacts: 0:0:3
Credits: 1.5

Course Outcome:

Graduates of the ECE program will be able to:

CO1: Able to define, identify and list out special type transmission line, its characteristics in microwave frequencies and concept of load.
CO2: Able to recognize, memorize, categorize, arrange and implement suitably the various microwave passive devices with the utilization of engineering mathematics.
CO3: Able to analyses and use the various sources of microwave energy and the characters of its operation.
CO4: Able to use, compute, solve, demonstrate and apply various hardware, software tools and measuring instruments in the field of Radio Frequencies, for the betterment of communication engineering, medical science and various domestic and commercial engineering.

List of Experiments:

1. Determination of phase and group velocities in a waveguide carrying TE10 Wave from Dispersion diagram[$\omega-\beta$ Plot].
2. Measurement of unknown impedance using shift in minima technique using a waveguide test bench/ Measurement of the susceptance of an inductive and or a capacitive window using shift in minima technique using a waveguide test bench
3. Study of the characteristics of a Reflex Klystron oscillator
4. Study of Gunn-oscillator Characteristics using X-band waveguide test bench.
5. Measurement of coupling factor, Directivity, Insertion loss and Isolation of a Directional coupler using X-band waveguide test bench set up.
6. Scattering matrix of a magic tee / E-plane tee / H-plane tee using waveguide test bench at X-band.
7. Experimental/Simulation Study of filter (LPF, HPF, BPF) response.
8. Measuring of dielectric constant of a material using waveguide test bench at X-band.

Reference Books:

1. ML Sisodia & GS Raghuvanshi Basic Microwave Techniques and Laboratory Manual; Wiley Eastern Limited 1987
2. EL Gintzton Microwave Measurements, McGraw-Hill Book Co.
3. M Sucher and J Fox, Handbook of Microwave Measurements, Vol I, Wiley-Interscience Inc.

CO- PO Mapping:

COs/ POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	3	3	2	-	2	-	3	-	-	3
CO2	3	3	3	3	2	-	2	-	3	-	-	3
CO3	3	3	3	3	2	-	2	-	3	-	-	3
CO4	3	3	3	3	2	-	2	-	3	-	-	3

Weightage Values: 3 = Strongly matched, 2 = Moderately matched, 1 = Weakly matched, (-) = Not matched

COs/PSOs	PSO1	PSO2	PSO3
CO1	3	3	3
CO2	3	3	3
CO3	3	3	3
CO4	3	3	3
CO5	3	3	3

.

Course Name: Mobile Communication and Network Lab
Course Code: PEC591A
Contacts: 0:0:3
Credits: 1.5

Course Outcome:

Graduates of the ECE program will be able to:

CO1: Understand the path Loss.
CO2: Analyze the Horizontal & vertical Beam Pattern of a Base station Antenna.
CO3: Understand the concept of co-channel interference and hence Signal to Interference andNoise Ratio.
CO4: Understand the impact of many different parameters influence the downlink C/I ratio like Cell radios, Tx power of B.S, Frequency reuse, Sectoring, Shadowing effect, B.S. height, Path lossexponent, Vertical beam tilt.
CO5: Study the effect of handover threshold and margin on SINR and call drop probability andhandover probability.

List of experiments:

1. Calculation of received signal strength as a function of distance of separation, antenna height and carrierfrequency.
2. To understand the impact of: -Transmitter Power, Pathloss exponent, Carrierfrequency, Receiver antennaheight,Transmitter antenna height.
3. To calculate pathloss exponent and variance of shadow fading from measurements and hence find the large- scale propagation's statistical characteristics.
4. To find the 3dB Bandwidth of a Base station Antenna.
5. To calculate the probability that the received signal level crosses a certain sensitivity level.
6. To understand the concept of co-channel interference and hence Signal to Interference and Noise Ratio:Downlink: To calculate & plot SINR vs. distance at the MS for adaptation of the following parameters: Shadowing effect, Vertical Beam Pattern, Tilt Anglevariation.
   Uplink:
   To calculate & plot SINR vs. distanceat the MSforadaptationof thefollowingparameters: Shadowing effect, Vertical Beam Pattern, Tilt Anglevariation.
7. Tounderstand thecellular frequency reuse conceptfulfillingthefollowingobjectives:Finding theco-channelcells for a particular cell, Finding the cell clusters within certain geographic area.
8. To study the effect of handover threshold and margin on SINR and call drop probability and handoverprobability
9. To study the outage probability, LCR & ADF in SISO for Selection Combining and MRC.
10. To study the effect of delay spread on frequency selectivity.
11. Evaluate (by computer simulations) and make analysis of the performance of variousdigital modulations asfollows:
12. Design cellular FDMA/TDMA systemstoachieve acertaingradeofservice in termsofcoverageand blocking probability.
13. design cellular FDMA/TDMA systemsto achieve acertain gradeofservice in termsof coverageand blocking probability.
14. Characterization of radio Attenuation by means of propagation Models.

Textbooks:

1.Theodore S. Rappaport, Wireless communications: principles and practice, PHI / Pearson education.

2.J. Schiller, Mobile communications, Addison-Wesley.

3.William C. Y. Lee, Mobile cellular telecommunication – analog and digital systems, McGraw Hill,2nded.

Reference Books:

1.Wang, Wireless communication System, Pearson Education 2.Talukdar, Mobile computing, TMH3.J.W.Mark, W. Zhuang, Wireless Communication and Networking, PHI

4.A. Santamaria et al, Wireless LAN systems, Artech House. 5.Stallings, Wireless Communication& Networks, Pearson Education.

CO-PO Mapping:

COs\POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2	-	-	1	3	2	2	2	3	2	1
CO2	2	-	2	-	3	2	2	2	3	2	3	2
CO3	2	-	3	3	3	2	1	2	3	1	3	1
CO4	2	2	1	-	2	3	2	2	3	2	3	-
CO5	2	-	3	3	3	2	2	2	3	1	3	1

Weightage Values: 3 = Strongly matched, 2 = Moderately matched, 1 = Weakly matched, (-) = Not matched.

COs/PSOs	PSO1	PSO2	PSO3
CO1	3	3	3
CO2	3	3	3
CO3	3	3	3
CO4	3	3	3
CO5	3	3	3

Course Name: Fiber Optic Communication Laboratory
Course Code: PEC 591B
Contacts: 0:0:3
Credits: 1.5

Course Outcome:

Graduates of the ECE program will be able to:

CO1: Basic knowledge about the input output characteristics.
CO2: Able to define and analyze the attenuation constant, bending loss.
CO3: Able to define, analyze and draw V-I characteristics of optical fiber.
CO4: Able to define, analyze and draw P-I characteristics of optical fiber.

List of Experiments:

1. Demonstrate and study of different types of Optical fibers and connectors.
2. To establish and study of a 650nm fiber optic analog link and digital link.
3. Input-outputcharacteristics usinglongopticalfiber. Calculationofattenuationperunitlengthof optical fiber
4. To calculate attenuation constant, bendingloss.
5. I-V characteristics of LED (i) using optical fiber between LED and power meter and (ii) withoutusing optical fiber.
6. P-I characteristics of LED (i) using optical fiber between LED and power meter and (ii) withoutusing optical fiber.
7. To measure propagation loss in optical fibre using optical power meter.
8. To measure the Numerical Aperture (NA) of the fibre

Textbook

1. Optical Networks –Rajiv Ramaswami, K. N. Sivarajan, Galen H. Sasaki (Morgan-Kaufman)2.Optical Fibre Communication : John M. Senior (Pearson)

3.Optical Communications: N. Bala Saraswathi, I. Ravi Kumar (LaxmiPublications)

Reference Books

1.Optical Communication Systems : John Gawar (PHI)2.Optical Fibre Communication : Gerd Kaiser (TMH)

3. Fiber optics communication by G.PAgrawal.

4. Raman Amplifiers for communications by M.N. Islam(Ed).

CO-PO Mapping

COs\ POs	P O1	P O2	P O3	P O4	P O5	P O6	P O7	P O8	P O9	PO10	PO11	PO12
CO1	3	3	2	2	2	1	-	-	-	-	-	-
CO2	3	2	3	1	2	-	-	-	-	-	-	1
CO3	3	3	2	1	1	-	-	1	-	1	-	-
CO4	3	3	2	1	2	1	1	-	1	-	1	-

Weightage Values: 3 = Strongly matched, 2 = Moderately matched, 1 = Weakly matched, (-) = Not matched.

COs/PSOs	PSO1	PSO2	PSO3
CO1	3	3	3
CO2	3	3	3
CO3	3	3	3
CO4	3	3	3

Course Name: Measurement and Instrumentation Laboratory

Course Code: PEC591C
Contact: 0:0:3
Credit: 1.5

Prerequisites: Concepts of different measuring system.

Course Outcome:

Graduates of the ECE program will be able to:

CO1: Conduct experiment to measure of Resistance, Inductance, Capacitance, Power and Energy.
CO2: Students able to demonstrate the principle to measure resistance, capacitance, inductance with the help of Bridge balancing technique
CO3: Students able to describe the construction and working principle of electronic instrument like:DSO, DMM, spectrum analyzer, distortion meter
CO4: Student able to illustrate the functionality of sensor and transducer element
CO5: Student able to demonstrate the principle of working of Telemetry System Display device,Interface.

List of Experiment:

1. Measurement of power in polyphase circuit.
2. Measurement of power using instrumenttransformer.
3. Measurement of capacitance using Schering Bridge technique as well as LCR meter.
4. Calibration of Digital Energy Meter.
5. Testing of energy Meter
6. Measurement of capacitance using Anderson Bridge technique as well as LCR meter.
7. Measurement of low resistance using Kelvin Double bridge.
8. Measurement of high resistance and insulation resistance using Megger.
9. Usage of DSO to capture transient like step change in R-L-C circuit.
10. Current measurement using shunt, CT and Hall Sensor
11. Measurement of capacitance by De sauty bridge
12. Measurement of frequency by Wien Bridge.
13. Innovative Experiment

Text Book :

1. A.k. Sawhney, Electrical and Electronic Measurements and Measuring Instruments ,DhanpatRai& Sons.
2. Helfrick, Cooper, Modern Electronic Instrumentation and Measurement Techniques, PHI Publication.

Reference Book :

1. J.B. Gupta ,Electrical & Electronics Measurement and Instrumentation ,SK Kataria Sons Kalsi
,Electronic Instrumentation , Tatta McGraw-Hill

CO-PO Mapping:

COs\ POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	1	2	2	2	-	-	-	1	1	1	2
CO2	3	2	1	2	1	-	-	-	1	2	1	2
CO3	3	3	3	2	3	-	-	-	1	2	2	3
CO4	3	3	3	3	3	2	2	2	2	2	1	3
CO5	3	2	2	2	3	2	2	2	3	2	3	3
CO6	3	2	2	2	2	2	2	2	2	2	2	2

Weightage Values: 3 = Strongly matched, 2 = Moderately matched, 1 = Weakly matched, (-) = Not matched.

COs/PSOs	PSO1	PSO2	PSO3
CO1	3	3	3
CO2	3	3	3
CO3	3	3	3
CO4	3	3	3
CO5	3	3	3

Course Name: Satellite Communication Laboratory
Course Code: PEC591D
Contacts: 0:0:3
Credit: 1.5

Course Outcomes:

On completion of the course students will be:

CO1: Able to learn the orbital aspects of the satellite and the design of satellite links.

CO2: Able to understand the Satellite transponder and Earth Station Design.

CO3: Able to understand Multiple Access Techniques used in satellite communication.

CO4: Able to realize the various Propagation impairments on satellite communication.

CO5: Able to comprehend satellite Navigation and the GPS, GIS and remote sensing.

List of Experiments:

1. To Study Satellite Trainer kit.
2. To set up an active satellite link and demonstrate link fail operation.
3. To communicate voice signal through satellite link.
4. To establish analog /digital Communication link and transmit and receive three Signals (audio, video, tone) simultaneously using satellite communication trainer.
5. To transmit and receive PC data through satellite link.
6. To find the link C/N Ratio
7. Evaluation of SNR in Satellite Links
8. To observe effect of Fading margin of received signal in satellite link
9. To Study Analysis of Link Power Budget Equation.
10. To study any software simulation tool for satellite Navigation and remote sensing.

Textbooks:

1. Timothy Pratt, Charles Bastian, Tarmey All Nutt, Satellite Communication, John Wiley &Sons.
2. "Satellite Communication", D. C. Agrawal, Khanna Publishers
3. "Satellite Communication", Dennis Roddy, 4th Edition, McGraw- Hill International edition, 2006
4. Monojet Mitra: Satellite communications, Prentice Hall of India

Reference Books:

1. "Satellite Communication", T. T. Hai., McGraw Hill Publications
2. Satellite Communication Systems Engineering, W.L. Pitch and, H. L. Suyderhoud, R. A. Nelson, 2nd Ed., Pearson Education, 2007.
3. Satellite Communication, Mark R Chartrand, Cenage Learning
4. J. J. Spilker, Jr., Digital Communication by Satellite, Prentice Hall.
5. Bruce R. Elbert, Satellite Communication Applications Handbook, Artech House.

CO-PO Mapping:

COs\POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2	1	-	-	2	-	1	-	2	-	3
CO2	-	3	-	2	-	1	2	-	2	-	-	3
CO3	2	-	-	-	1	-	3	-	1	-	-	3
CO4	3	-	1	-	2	-	2	-	-	-	2	2
CO5	2	1	-	-	1	-	3	-	1	-	-	3

Weightage Values: 3 = Strongly matched, 2 = Moderately matched, 1 = Weakly matched, (-) = Not matched.

COs/PSOs	PSO1	PSO2	PSO3
CO1	3	3	3
CO2	3	3	3
CO3	3	3	3
CO4	3	3	3
CO5	3	3	3

Course Name: Computer Architecture Lab

Course Code: PEC592A

Contacts: 0:0:3

Credit: 1.5

Prerequisite: Digital Electronics, Analog Electronics, Microprocessor and Microcontroller, Sensors, C/C++programming, Python/ JavaScript programming

Course Outcomes:

Graduates of the ECE program will be able to:

CO1: learn VHDL programming

CO2: implement arithmetic circuits using VHDL programming

CO3: implement RAM and ROM architectures

CO4: design register, counter and control unit

CO5: implement complex projects related to computer architecture

Course Content

1. Introduction to HDL programming (includes different modeling styles and programming structure)
2. Programming of basic gates (AND, OR, NAND, NOR, XOR, XNOR) with HDL
3. Design of half adder, half subtractor, full adder and full subtractor
4. 8-bit Adder (Parallel Adder), Subtraction (Parallel Subtractor/ 1's complement/ 2'scomplement technique)
5. Multiplication (Array based design/ Radix-2 Booth's algorithm/ Karatsuba technique), Division (Restoring/ Non-Restoring algorithm)
6. Design of flipflops (D, Tand JK)
7. 8-bit Register design (with left and right shift feature)
8. 8-bit RAM design with opcode fetching and data fetching
9. 8-bit simple ALU design
10. 8-bit simple CPU design

Text/ Reference Books:

1. V.Carl Hammacher, ‘‘Computer Organisation’’, Fifth Edition.
2. A.S.Tanenbum, ‘‘Structured Computer Organisation’’, PHI, Third edition
3. Y.Chu, "Computer Organization and Microprogramming’’, II, Englewood Chiffs, N.J., PrenticeHall Edition
4. M.M.Mano, ‘‘Computer System Architecture’’, Edition
5. C.W.Gear, ‘‘Computer Organization and Programming’’, McGraw Hill, N.V. Edition
6. 6. Hayes J.P, ‘‘Computer Architecture and Organization’’, PHI, Second edition

CO-PO Mapping:

COs\POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	-	1	-	-	3	-	2	-	1	-	3
CO2	-	3	-	2	-	1	-	-	2	-	2	3
CO3	3	-	-	-	1	-	3	1	-	1	-	3
CO4	2	-	1	-	3	-	2	-	2	-	2	3
CO5	3	-	1	-	-	3	2	-	-	-	-	3

Weightage Values: 3 = Strongly matched, 2 = Moderately matched, 1 = Weakly matched, (-) = Not matched.

COs/PSOs	PSO1	PSO2	PSO3
CO1	3	3	3
CO2	3	3	3
CO3	3	3	3
CO4	3	3	3
CO5	3	3	3

Course Name: Digital Image & Video Processing LabCourse

Code: PEC 592 B
Contact hour: 0:0:3
Credits: 1.5

Course Outcome:

Graduates of the ECE program will be able to:

CO1: Build knowledge on Digital Imaging fundamentals and Digital Image Transform.
CO2: Understanding Digital Image enhancement techniques in spatial and frequency domain.
CO3: Explain in gthe requiements and types of Image Compression and its standards.
CO4: Demonstrate the Segmentation and Edge detection techniques of Digital Images
CO5: Build ideas on Digital Image security and Basic Steps of Video Processing

List of Experiments:

1. Convert RGB Digital Images into Grayscale Images and show result.
2. Transform a grayscale image into frequency domain and show its magnitude and phase angle.
3. Display histogram of a digital image and equalized the image.
4. Apply LPF and HPF in a Grayscale Digital Image and display result.
5. Apply Mean and Median filtering in a Grayscale Digital Image and display result.
6. Compress and reconstruct a Grayscale Digital Images in spatial domain.
7. Compress and reconstruct a Grayscale Digital Image in frequency domain.
8. Apply segmentation technique (anyone) in a Digital Image and display result.
9. Apply Edge detection technique in a Digital Image and display result.
10. Apply any cryptography or watermarking technique for image encryption and display result.
11. Experiment of division of a video into frames
12. Experiment on Frequency domain motion estimation
13. Experiment on Kernelbased tracking
14. Experiment on video short boundary detection
15. Innovative experiment

Textbooks:

1. Rafael C. Gonzales, Richard E. Woods, "Digital Image Processing", Third Edition, Pearson Education, 2010.
2. S. Annadurai,R. Shanmugalakshmi, "Fundamentals of Digital Image Processing", Pearson Education, 2006
3. Yao wang, Joem Ostarmann and Ya–quin Zhang,"Video processing and communication",, PHI

References:

1. Rafael C. Gonzalez, Richard E. Woods, Steven L. Eddins, "Digital Image Processing Using MATLAB", Third Edition Tata Mc Graw Hill Pvt. Ltd., 2011.
2. Anil Jain K. "Fundamentals of Digital Image Processing", PHI Learning Pvt. Ltd., 2011.
3. Willliam K Pratt, "Digital Image Processing", John Willey, 2002.
4. Malay K. Pakhira, "Digital Image Processing and Pattern Recognition", First Edition, PHI Learning Pvt. Ltd., 2011.
5. M. Tekalp , "Digital video Processing", Prentice Hall International

CO-PO Mapping:

COs\ POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	-	1	-	-	2	-	2	-	-	-	3
CO2	-	3	-	2	-	1	-	-	2	-	-	3
CO3	2	-	1	-	1	-	3	-	-	2	-	3
CO4	3	-	1	-	-	-	2	1	-	-	-	3
CO5	2	-	2	-	-	3	1	-	-	2	-	3

Weightage Values: 3 = Strongly matched, 2 = Moderately matched, 1 = Weakly matched, (-) = Not matched.

COs/PSOs	PSO1	PSO2	PSO3
CO1	3	3	3
CO2	3	3	3
CO3	3	3	3
CO4	3	3	3
CO5	3	3	3

Course Name: Embedded System Lab
Course Code: PEC592C
Contacts: 0:0:3
Credit: 1.5

Prerequisite: Digital Electronics, Analog Electronics, Microprocessor and Microcontroller, Sensors, C/C++programming, Python/ JavaScript programming

Course Outcomes:

Graduates of the ECE program will be able to:

CO1: To program embedded processors
CO2: Interface the memories with the embedded processors
CO3: Interface sensors and actuators with the processors
CO4: Establish parallel and serial communication with the process or sthroughhigh speed wireless devices like Zigbee, Bluetooth, GSM modules etc.
CO5: Perform real time projects which may be beneficial to the society

Course Content

1. Programming with ARM processor/ Raspberry Pi/Arduino:
   - i) Introduction to Raspberry Pi and Arduino programming
   - ii) LED interfacing with RaspberryPi/Arduino
   - iii) Proximity sensor interfacing with Raspberry Pi/Arduino
   - iv) Ultrasonic sensor interfacing with Raspberry Pi/Arduino
   - v) Servo motor interfacing with Raspberry Pi/Arduino
   - vi) Seven segment display interfacing with Raspberry Pi/Arduino
   - vii) ADC and DAC interfacing with Raspberry Pi/Arduino
   - viii) Traffic light management with Raspberry Pi/Arduino
   - ix) Any innovative experiments
2. Programming with Atmega8/16/328P processor:
   - i) LED interfacing with Atmega8/16/328P
   - ii) Proximitysensorinterfacingwith Atmega8/16/328P
   - iii) Ultrasonic sensor interfacing with Atmega8/16/328P
   - iv) Temperature and Humidity sensor interfacing with Atmega8/16/328P
   - v) Servo motor interfacing with Atmega8/16/328P
   - vi) Seven segment display interfacing with Atmega8/16/328P
   - vii) Serial communication with Atmega8/16/328P
   - viii) Bluetooth interfacing with Atmega8/16/328P
   - ix) GSM interfacing with Atmega8/16/328P
   - x) Any innovative experiments

3. Programming with FPGA:
   i) Introduction to VHDL programming
   ii) Data type and librarydeclaration
   iii) Different styles of programming: Data flow, Behavioral and Structural
   iv) Loop concepts and arraydeclaration
   v) Combinational circuits design
   vi) Sequential circuits design
   vii) FSM implementation
   viii) Interfacing FPGA board withsensors

Textbooks:

1. An Embedded Software Primer, D.E. Simon., Pearson Education, 1999.
2. Design with PIC Microcontrollers, J.B. Peatman, Pearson Education, 1998
3. VHDL Primer, J. Bhaskar, Pearson Education, 3rd Edition

Reference Books:

1. Digital Systems Design Using VHDL, Charles H. Roth, Jr., PWS Publishing Company
2. ComputersasComponents; Principles of Embedded Computing System Design, Wayne Wolf Harcourt India, Morgan Kaufman Publishers, First Indian Reprint. 2001.

CO-PO Mapping:

COs\POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	-	1	-	-	3	-	-	-	-	-2	3
CO2	-	3	-	3	-	1	-	-	-1	2	-	3
CO3	3	-	-	-	1	-	3	2	-	-	-	3
CO4	2	-	1	-	3	-	2	-	-	1	-2	3
CO5	3	-	2	-	-	3	1	-	2	-	-	3

Weightage Values: 3 = Strongly matched, 2 = Moderately matched, 1 = Weakly matched, (-) = Not matched.

COs/PSOs	PSO1	PSO2	PSO3
CO1	3	3	3
CO2	3	3	3
CO3	3	3	3
CO4	3	3	3
CO5	3	3	3

Course Name Advanced Python Programming Lab
Course Code: PEC 592D
Contact: 0:0:3
Credits: 1.5

Course outcome:

Graduates of the ECE program will be able to:

CO1: Able to apply class and objects
CO2: Able to analyze exceptions and threads
CO3: Able to evaluate polymorphism
CO4: Able to apply GUI using Python
CO5: Able to apply networking and database using Python

List of Experiments:

1. Write a Python program to import built-in array module and display the namespace of the saidmodule.
2. Write a Python program to create a class and display the namespace of the said class.
3. Write a Python program to create an instance of a specified class and display the namespace of thesaidinstance.
4. Using init method implement a constructor.
5. Write Python program to implement inheritance.
6. Create a Python class named Circle constructed by a radius and two methods which will compute theareaand the perimeter of acircle.
7. Insert and delete data from a linked list using Insert and Delete class.
8. Write Python program to implement Polymorphism.
9. Write Python program to override Magic Methods.
10. Write Python program to create a simple calculator, where the user will enter a number in a textfield, andeither add it to or subtract it from a running total, which we will display. We will also allow the user to reset the total.
11. Implement thread-based parallelism using Python
12. Networking using socket module implementing a server and client.
13. Create MySQL databaseand retrieving all rowsfroma table, inserting rowsinto table, deleting rowsfrom table and updating rows in a table using Python.

Textbooks:

1. Python: The Complete Reference by Martin C Brown
2. Advanced Python Programming by Lanaro Dr. Gabriele
3. Expert Python Programming by Michal Jaworski and Tarek Ziade.

Reference books:

1. Allen Downey, Jeff Elkner and Chris Meyers, (2017), How To Think Like A Computer Scientist:Learning With Python,DreamTech
2. Wesley J Chun, (2018), Core Python Programming, Prentice Hall

CO-PO Mapping:

COs\POs	PO 1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	-	1	-	-	2	-	-	-	-	-	3
CO2		3	-	2	-	1	-	-	-	-	-	3
CO3	3	-	-	-	1	-	3	-	-	-	-	3
CO4	3	-	1	-	-	-	2	-	-	-	-	3
CO5	2	-	2	-	-	3	1	-	-	-	-	3

Weightage Values: 3 = Strongly matched, 2 = Moderately matched, 1 = Weakly matched, (-) = Not matched.

COs/PSOs	PSO1	PSO2	PSO3
CO1	3	3	3
CO2	3	3	3
CO3	3	3	3
CO4	3	3	3
CO5	3	3	3

Course Name: Constitution of India
Course Code: MC 501
Contacts: 2:0:0
Total Contact Hours: 24
Credit: 0

Prerequisite: None

Course Outcomes:

Graduates of the ECE program will be able to:

CO1: Identify and explore the basic features and modalities of Indian constitution.

CO2: Differentiate and relate the functioning of Indian parliamentary system at the centre and state level.

CO3: Differentiate the various aspects of Indian Legal System and its related bodies.

CO4: Understand the structure and composition of Indian constitution.

Course Content

Module 1: Introduction: [4]
"Constitution"- Historical Background of the Constituent Assembly, Indian Constitution and its Salient Features, the Preamble of the Constitution.

Module 2: Fundamental Rights, Fundamental Duties, Directive Principles of State Policy: [8]
The Right to Equality
The Right to Freedom: I (Article 19)
The Right to Freedom: II (Articles 20, 21 and 22)The Right against Exploitation
The Right to freedom of ReligionCultural and Educational rights The Right to PropertyThe Right to Constitutional RemediesThe Directive Principles Fundamental Duties

Module 3: Union Government and its Administration [6]
Structure of the Indian Union, Parliamentary System, Federal System, Centre-State Relations, Amendment of the Constitutional Powers and Procedure, The historical perspectives of the constitutional amendments in India, Emergency Provisions: National Emergency, President Rule, Financial Emergency, and Local Self Government – Constitutional Scheme in India.

Module 4: The Machinery of Government in the State [6]
Powers of Indian Parliament Functions of Rajya Sabha, Functions of Lok Sabha, Powers and Functions of the President, Comparison of powers of Indian President with the United States, Powers and Functions of the Prime Minister, Judiciary
– The Independence of the Supreme Court, Appointment of Judges
State Executives – Powers and Functions of the Governor, Powers and Functions of the Chief Minister, Functions ofState Cabinet, Functions of State Legislature, Functions of High Court and Subordinate Courts.

Text / Reference Books:

1. Indian Constitution by D.D.Basu, The Publisher, LexisNexis
2. Constitution of India by Subhas C Kasyap, Vitasta Publishing
3. The Constitution of India, P.M Bakshi, Universal Law Publishing Co.Ltd, New Delhi, 2003.
4. Indian Constitution Text Book - Avasthi, Avasthi, Publisher: LAKSHMI NARAIN AGARWAL

CO-PO Mapping:

COs\POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	-	2	2	-	2	-	3	-	1	3	3
CO2	3	2	-	1	-	1	-	2	2	3	3	3
CO3	3	-	1	-	-	3	-	2	-	1	3	3
CO4	2	2	-	1	-	1	-	2	2	3	3	3

Weightage Values: 3 = Strongly matched, 2 = Moderately matched, 1 = Weakly matched, (-) = Not matched.

COs/PSOs	PSO1	PSO2	PSO3
CO1	-	-	-
CO2	-	-	-
CO3	-	-	-
CO4	-	-	-
CO5	-	-	-

Curriculum for
B.TechUnder
Autonomy
Electronics & Communication Engineering(Effective From 2021-22 admission Batch)

L – Lecture; T- Tutorial; P- Practical [1L=1Cr, 1T=1Cr, 1P =0.5 Cr]

3rd Year 2nd Semester: 6th Semester

Sl. No.	Category	Course Code	Course Title	Hours per week				Credits /Unit
				L	T	P	Total	
A. THEORY								
1	HSMC	HSMC 604	Economics for Engineers	2	0	0	2	2
2	PC	EC601	VLSI & Microelectronics	3	0	0	3	3
3	PC	EC602	Control System	3	0	0	3	3
4	PE	PEC602	Professional Elective-III A: Information Theory & Coding B: Renewable Energy Sources & Applications C: Nano Technology D: Remote Sensing & GIS	3	0	0	3	3
5	OE	OEC 601	Open Elective-I A: Object Oriented Programming using JAVA. B: Fundamentals of Sensors & Transducers C: Introduction to Quantum Computing D: Fundamentals of Operating System	3	0	0	3	3
6	OE	OEC 602	Open Elective-II A: Database Management System B: 3D Printing and Design C: Web Intelligence & Big Data D: Scientific Computing	3	0	0	3	3
B. PRACTICAL								
7	PC	EC691	VLSI & Microelectronics Lab	0	0	3	3	1.5
8	PC	EC692	Control System Lab	0	0	3	3	1.5
9	OE	OEC 691	Open Elective-I Lab A: Object Oriented Programming using JAVA Lab B: Fundamentals of Sensors & Transducers Lab C: Quantum Computing Lab D: Fundamentals of Operating System Lab	0	0	3	3	1.5
10	OE	OEC 692	Open Elective-II Lab A: Database Management System Lab B: 3D Printing and Design Lab C: Web Intelligence & Big Data Lab D: Scientific Computing Lab	0	0	3	3	1.5
11	PROJECT	PR 691	Minor Project II	0	0	3	2	1
12	PROJECT	PR 692	Skill Development VI: Soft Skill & Aptitude-III	0	0	1	1	0.5
C. MANDATORY ACTIVITIES / COURSES								
13	MC	MC 601	Intellectual Property Right	2	0	0	2	0
	TOTAL CREDIT WITHOUT MOOCS COURSES							24.5
D.MOOCS COURSES**								
14	MOOCS COURSES	HM601	MOOCS COURSE-V	3	1	0	4	4
TOTAL CREDIT WITH MOOCS COURSES								28.5

** MOOCS COURSES for HONOURS/MINOR Degree are Program specific and to be taken from MOOCS BASKET

Course Name: Economics for Engineers

Course Code: HSMC 604
Contact: 2:0:0
Total Contact Hours: 24
Credits: 2

Prerequisites: NIL

Course Outcome:

Graduates of the ECE program will be able to:

CO1: To Identifyvarioususes for scares resources
CO2: To understand key economic concepts and implement in real world problems
CO3: To apply critical thinking skills to analyze financial data and theirimpacts.
CO4: To evaluate business performance through cost accounting principles

Course contents:

Module - 1. Introduction to Economics: [2L]

Meaning, Nature and Scope of Economics

Module - 2. Theory of Demand and Supply: [4L]
Concept of demand, Determinants of demand, Individual and Market Demand, Exception to the law ofdemand. Concept of Supply, Shift in Demand and Supply Curve, Movement along the demand and supply curve, Determinants of equilibrium price and quantity, Elasticity of Demandand Supply.

Module - 3. Theory of Production and Costs: [6L]
concept of Production function, types of pf Production function, Laws of return to scale and variable Proportion, Cost Function, Types of Cost Function, Different Costcurves, Relation between Average and marginal cost, Relationship between

Short Run costs and Long Run costs, Profit maximization

Module-4. Macroeconomic Aggregates and Concepts: [3L]

GDP, GNP. Concepts of National Income. Concept of Business Cycle.

Module -5. Inflation [2L]

Concept, Causes and Remedies of Inflation.

Module -6. Accounting: [4L]

Basic concept of Journal, Preparation of Income Statement, and Balance Sheet.

Module – 7. Cost Volume Profit Analysis: [3L]
Contribution, P/V Ratio, Break-Even Point, Margin of Safety, Short term decision making: Makeor Buy, Shut-down point, Export Pricing, Opportunity and Sunk cost.

Reference Books:

1. Economics by Lipsey and Chrystal
2. Modern Economic Theory by K.K. Dewett.
3. Principle of Economics by H.L. Ahuja
4. Engineering Economics byR.PaneerSeelvan:
5. Modern Accountancy by Hanif &Mukherjee

CO-PO mapping

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO8	PO9	PO10	PO11	PO12
CO1	-	3	-	1	-	-	-	2	-	1	-	2	-
CO2		-		-	-	-	3	-	-	-	-	2	-
CO3	-	1	-	2	2	3	-	-	1	-	1	2	2
CO4	1	-	-	3		-	-	2	-	-	-	3	2

Weightage Values: 3= Strongly matched, 2= Moderately matched, 1= Weakly matched, (-)= Not matched.

COs/PSOs	PSO1	PSO2	PSO3
CO1	-	-	-
CO2	-	-	-
CO3	-	-	-
CO4	-	-	-
CO5	-	-	-

Course Name: VLSI & Microelectronics

Course Code: EC601

Contact: 3:0:0
Total Contact Hours: 36
Credits: 3

Prerequisite: Basic concept of Electronic Devices, Analog & Digital ElectronicCircuits

Course Outcomes

CO1: Able to illustrate scale of integration – SSI, MSI, LSI, VLSI, Moor's Law, scaling, short channel effect,VLSI design flow, FPGA architecture, classify Standard IC & ASIC, and construct gate level circuit with the help of PAL & PL Aarchitecture.
CO2: Able to analyze CMOS inverter voltage transfer characteristics with the parameters – VIL , VIH , VOL , VOH , Vth and based on the knowledge of digital circuit design methodology like – CMOS , Pass transistor ,TG , DCVSL , dynamic logic , NORA , able to construct schematic of simple and complex combinational circuit, sequential circuit(SR flip-flop , JK flip-flop , D flip flop) , 6 T - SRAM Cell , 3T- DRAM cell using MOSFET.
CO3: Able to estimate the value of resistance of current source/sink, MOS diode , current of current mirror circuit , voltage of reference circuits (voltage divider , threshold voltage references and band gap reference), value of parameters to design CMOS differential amplifier , resistance of switch capacitor circuit , gain of switch capacitor integrator and 1st order switch capacitor filter based on the concept of small signal model & switching characteristics of MOSFET.
CO4: Able to describe thefabrication steps of ICsandconstruct the stick diagram & layout of CMOS inverter& basic gates based on lambda and micron design rules.
CO5: Able to estimate the gate delay, dynamic power, short circuit power and leakage power and total power consumption across CMOS inverter circuit with the help of switching activity, saturation & linear region current equations of MOSFETs and principle of charging & discharging of capacitor.

Course Content

Module 1: Introduction to IC [5L]

Integrated Circuits – Advantages, disadvantages, limitations; Scale of Integration – SSI, MSI, LSI, VLSI, ULSI; Moor's Law; Scaling of MOSFET-Constant field scaling and constant voltage scaling, Short Channel Effects; VLSI design flow, Y- Chart, IC Classification –Standard IC and ASIC, PAL, PLA, FPGA Architecture.

Module 2: Digital VLSI Circuit Design [11L]Inverter Characteristics [2L]

Resistive loadinverter – Voltage transfer characteristics (VTC, significance of parameters (onlyexpression, no derivation) –VIL, VIH, VOL, VOH, Vth; CMOS inverter - VTC, Noise margin and aspect ratio of symmetric CMOS inverter.

Combinational Logic Circuit Design [6L]

Circuit design using Static CMOS style – basic gates, design of circuit for product of sum (POS) and sum of product (SOP) expression, Complex logic circuit, full adder; Circuit design using pseudo NMOS logic, DCVSL Logic, TG Logic, Pass Transistor Logic, Complementary pass transistor logic, Dynamic logic, domino logic, NORAlogic.

Sequential Circuit and Semiconductor Memory Design [3L]

Bistable Circuit -Design of CMOS S-R & J-K Latch, CMOS Clocked SR & JK Latch/Master–slave JK Flip- flop, CMOS D Flip-flop; 6T SRAM cell and 3T DRAM cell design.

Module 3: Analog VLSI Circuit Design [9L]

Small Signal model of MOSFET; Analog sub-circuits -MOS Switch, Active resistors/MOS Diode , Current source and Sink ,Current Mirror ; Current andvoltage references-voltage divider , MOS equivalent of P-Njunction Voltage reference , Threshold voltage reference , Band gap reference (Basic Principle) ; Switch- Capacitor Circuit

– resistance emulation of series , parallel and series-parallel circuit , Switch capacitor integrator and filter (1st order only) ;CMOS differential amplifier – design parameters ; Output amplifier (basic circuit); Block diagram of two- stage CMOS OP-AMP (description only)

Module 4: Layout Design Rules and Fabrication Steps of ICs [6L]

Micron and lambda design rules; Stick diagram and Layout - CMOS Inverter, NAND and NOR gate; Fabrications steps of IC – Wafer preparation, Oxidation, photolithography, etching, diffusion, ion-implantation, metallization, and packaging. CMOS N-Well Process, overview of P-well and twin-tub process.

Module 5: Introduction to Low Power and High-Speed VLSI Circuit Design [5L]

Dynamicpower, short circuit power andleakage power in CMOSInverter; Switchingactivity& Logical effort of basic gates; Timing parameters (concept only) –Critical path, arrival time, slack, skew, set-up time, hold time, gate delay and path delay, delay time expression of CMOS inverter (expression only), Adiabatic logic (basic concept)

Text Books:

1. Digital Integrated Circuit , J.M.Rabaey, Chandrakasan, Nicolic, Pearson Education.
2. CMOS Digital Integrated Circuits Analysis and Design , S.M.Kang & Y.Leblebici,TMH.
3. CMOS Analog Circuit Design , Allen & Holberg , Oxford
4. Design of Analog CMOS Integrated Circuits, Behzad Razavi , TMH .

Reference Books:

1. Microelectronic Circuits, Sedra & Smith, Oxford
2. Introduction to VLSI Circuits and System, Uyemura , Wiley
3. VLSI Design, Debaprasad Das, Oxford
4. VLSI Design and EDA Tools , Angsuman Sarkar , Swapnadip De , C.K. Sarkar , Scitech
5. VLSI Design Techniques for Analog and Digital Circuits , Geiger , Allen , Strader , TMH

6. CO/PO Mapping
7.
8.
9.

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	2	3	1	2	-	-	2	2	3	2	3
CO2	3	3	3	3	2	-	-	1	2	2	3	3
CO3	3	3	3	2	2	-	-	2	2	2	3	3
CO4	3	3	3	1	2	-	-	1	2	2	3	3
CO5	3	3	3	2	2	-	-	2	3	2	3	2

C O - P S O Mapping

COs/PSOs	PSO 1	PSO 2	PSO 3
CO1	3	3	3
CO2	3	3	3
CO3	3	3	3
CO4	3	3	3
CO5	3	3	3

Course Name: Control SystemsCourse Code: EC602

Contact: 3:0:0

Total Contact Hours: 36Credits: 3

Prerequisite: Conceptsinelectricalcircuits(StudiedinBasicElectrical),Fundamentalconceptson Laplace Transformation (studied inMathematics)

Course Outcome:

After completing the course the student will be able to:

CO1: Apply modelling techniques to represent physical systems and distinguish betweenopen loop and closed loop control systems.
CO2: Determine the time responses of different type of systems and compute time domain specifications.
CO3: Analyze the stability of control systems using root-locus.
CO4: Examine the relative stability of control systems using frequency domain analysis.
CO5: Design controllers according to desired performance specifications.

Module I INTRODUCTION TO CONTROL SYSTEMS &MODELLING [7L]

Basic Elements of Control System, Linear, Non-Liner and Discrete Time System(Introduction &Concept) Open loop and Closed loop systems – Differential equation on control system – Abouttransfer function and its generation technique, Modelling of Electricaland mechanical systems - Block diagram reduction techniques - Signal flow graph, mason's gain formula.

Module II TIME RESPONSE ANALYSIS [5L]

Time response analysis –Different input deterministic test response – Order and Type of the systems incorporation with time response-First Order Systems - Impulse and Step Responseanalysis of second order systems - Steady state errors and error constants.

Module IIISTABILITY ANALYSIS [6L]

Routh -Hurwitz Criterion, Root Locus Algorithm, Construction of Root Locus, Effect of addition of pole and zero on the root locus, Application of Root Locus Diagram.

Module IV FREQUENCY RESPONSE ANALYSIS [6L]

Concept of Frequency Response of a system, Bode Plot Computational Algorithm, Construction of Bode diagram, Polar Plot, Phase and gain margin Nyquist Plot, Interpretationof Bode andNyquist plot, Stability analysis using frequency domain specifications. Correlation between time & frequency response in control system.

Module V CLASSICAL CONTROL DESIGN TECHNIQUES [4L]

Introduction to PI, PD and PID Controllers, Tuning of PID controller using Ziegler-Nichols methods, Introduction to lead, lag and lead- lag compensator.

Module VI STATE SPACE ANALYSIS OF CONTINUOUS TIME SYSTEMS [6L]

Concepts of state, state variables and state model, derivation of state models from block diagrams, Diagonalization- Solving the Time invariant state Equations- State Transition Matrix and it's Properties – Concepts of Controllability and Observability. Concept of state feedback.

Module VII ADVANCED CONTROL SYSTEM AND ITS APPLICATION [2L]

Concept of Robust Control, Adaptive Control and Model Predictive Control. Application ofadvanced control system (Robotics, Traffic system and radar tracking) in different fields.

Text Books:

1. Automatic Control Systems 8th edition– by B. C.Kuo 2003– John Wiley and son's,
2. Control Systems Engineering – by I. J. Nagrath and M. Gopal, New Age International (P) Limited, Publishers, 2nd edition.
3. Control Systems –by Ramesh Babu

Reference Books:

1. Modern Control Engineering – by Katsuhiko Ogata – Prentice Hall of India Pvt. Ltd., 3rdedition, 1998.

CO-PO mapping:

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	P10	P11	P12
CO1	3	3	2	-	-	-	-	-	1	1	-	1
CO2	3	2	2	-	-	-	-	-	2	1	-	1
CO3	3	2	1	2	1	1	-	-	2	1	-	-
CO4	3	1	-	-	1	1	-	-	2	1	-	1

CO/PSO Mapping

COs/PSOs	**PSO 1**	**PSO 2**	**PSO 3**
CO1	3	3	3
CO2	3	3	3
CO3	3	3	3
CO4	3	3	3

Course Name: Information Theory & Coding
Course Code: PEC 602A
Contact: 3:0:0
Total Contact Hours: 36
Credits: 3

Prerequisite: Digital Eelctronics, probability

Course Outcomes:

CO1: Understand theconcepts of information, mutual information and entropy and various source coding techniques.
CO2: Analyse the need for error control techniques in a digital communication system channel models,channel capacity and channel coding techniques.
CO3: Applylinear algebra, concept of Galois field, conjugate roots, minimal polynomial in channel coding techniques for error control.
CO4: Generate different error controlcodes like linear blockcodes, cycliccodes, BCHcodes, and perform error detection and correction.
CO5: Design the circuit for different error control coding techniques.

Course Content

Module 1: Source Coding [6L]

Uncertainty and information, average mutual information and entropy, information measures for continuousrandom variables, sourcecodingtheorem, Huffmancodes. Shannon - Fano Coding.

Module 2: Channel Capacity and Coding [4L]

Channel models, channelcapacity, channelcoding, information capacity theorem, The Shannon limit.

Module 3: Linear and Block Codes for Error Correction [6L]

Matrix description of linear block codes, equivalentcodes, parity check matrix, decoding of alinear block, Standard array and syndrome detection code, perfect codes, Hamming codes.

Module 4: Cyclic Codes [6L]

Polynomials, division algorithm for polynomials, a method for generating cyclic codes, matrix description of cyclic codes, decoding cyclic codes, Encoding and Decoding circuit

Module 5: BCH Codes [6L]

Set, group, fields, Galois field Primitive elements, minimal polynomials, generator polynomials interms of minimal polynomials, examples of BCH codes.

Module 6: Other Codes: [8L]

Convolutional Codes: Encoding, state diagram,
Tree codes, trellis codes, polynomial description of convolutional codes, distance notions for convolutional codes, the generating function, matrix representation of convolutional codes, decoding of convolutional codes, Viterbi decoding, examples of convolutional codes, Turbo codes, Turbo decoding.

Application of Information Theory and Coding in Cyber Security, Signal ProcessingApplication of Information Theory and Coding in Machine Learning

Text Books:

1.Information theory, coding and cryptography - Ranjan Bose; TMH.2.Introduction to Error Control Codes

- Salvatore Gravano, Oxford

3. Information theory, coding and cryptography – A Saha , S Mondal ; Pearson

Reference Books:

1.Informationand Coding-NAbramson;McGrawHill.2.IntroductiontoInformationTheory-M Mansurpur; McGraw Hill.3.Information Theory - R B Ash; Prentice Hall.
4. Error Control Coding - Shu Lin and D J Costello Jr; Prentice Hall.
5. Todd K Moon,- Error Correction Coding: Mathematical Methods and Algorithms, John Wiley &Sons

CO-PO Mapping:

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2	1	-	1	-	1	-	-	-	-	-
CO2	3	2	3	2	-	1	-	1	-	-	-	1
CO3	2	2	2	1	2	1	-	-	-	-	-	-
CO4	3	3	1	2	2	-	2	1	-	-	-	1
CO5	3	2	1	-	1	-	1	-	-	-	-	-

COs/PSOs	PSO1	PSO2	PSO3
CO1	3	3	3
CO2	3	3	3
CO3	3	3	3
CO4	3	3	3
CO5	3	3	3

Course Name: Renewable Energy Sources & Applications

Course Code: PEC602B
Contact: 3:0:0
Total Contact Hours:36
Credit:3

Prerequisite: Renewable Energy Sources & Applications

Course Outcomes:

CO1: Explain the importance of Renewable energy over conventional process

CO2: Describe different methods of Power generation from the Non- conventional sources like Solar, Wind Energy, Biomass, Geothermal energy, OTEC, Tidal energy, MHD Power generation schemes.

CO3: Analyze the different techniques of grid integration of the power generated from renewable energy sources with the initiation of power electronic converters and drives.

CO4: Design different hybrid energy systems and energy storage systems.

Course Content

Module 1: [2L]
Renewable and non-renewable energy sources, energy consumption as a measure of Nation's development & economic growth; strategy for meeting the future energy requirements Globaland National scenarios, Prospects of renewable energy sources. Impact of renewable energy generation on environment, Kyoto Protocol.

Module 2: [9L]
SOLAR ENERGY: Solar radiation - beam and diffuse radiation, solar constant, earth sun angles, attenuation and measurement of solar radiation, local solar time, derived solar angles, sunrise, sunsetand day length.

SOLAR THERMAL COLLECTORS & HEATING: Flat plate collectors, Concentrating collectors, Solar airheaters-types, storage of solar energy-thermal storage, solar water heaters, solar distillation, solar cooker, solar heating & cooling of buildings.

SOLAR PHOTOVOLTAIC SYSTEMS: Theory of solar cells, different types of PV Cells, Mono- poly Crystalline and amorphous Silicon solar cells. Concept of module, array.Classification of PV systems,Advantages and disadvantages. Efficiency and cost of PV systems & its applications.

Module 3: [5L]

Principle of wind energy conversion; Basic components of wind energy conversion systems;

wind mill components, various types and their constructional features; design considerations of horizontal and vertical axis wind machines: analysis of aerodynamic forces acting on wind millblades and estimation of power output from wind turbine; wind data and importance of site selection, characteristics of different types of wind, generators used with wind turbines. Merits &demerits.

Module 4: [2L]
HYDEL ENERGY
Electricity generation from micro hydel plants, location, auxiliaries and associated problems. Advantages & disadvantages.

Module 5: [6L]
BIOMASS ENERGY
Characteristics and Properties of Biomass, Structural components of Biomass, Biomass conversion technologies- Biomass conversion routes, Bio chemical and Thermo –chemical routes, IndustrialBiogas

generation plants- Transformation of Biomass to Biogas, classification, advantages and disadvantages, constructional details, site selection, digester design consideration, filling a digester for starting, maintaining biogas production, Fuel properties of bio gas, utilization of biogas,Biodiesel.

Module 6: [2L]

GEOTHERMAL ENERGY

Estimation and nature of geothermal energy, geothermal sources and resources like hydrothermal, geo-pressured hot dry rock, magma. Advantages, disadvantages and application ofgeothermal energy, prospects of geothermal energy in India.

Module 7: [2L]

ENERGY FROM OCEAN

Ocean Thermal Electric Conversion (OTEC) systems like open cycle, closed cycle, Hybrid cycle, prospects of OTEC in India. Ocean Energy from tides, basic principle of tidal power,single basin and double basin tidalpower plants, advantages, limitation and scope of tidal energy. Wave energy and power from wave, wave energy conversion devices, advantages and disadvantages of waveenergy.

Module 8: MAGNETO HYDRODYNAMIC POWER GENERATION: [2L]

Principle of MHD power generation, Classification of MHD system, Design problems and developments, gas conductivity, materials for MHD generators and future prospects.

Module 9: HYDROGEN ENERGY: [2L]

Introduction, Hydrogen Production methods, Hydrogen storage, hydrogen transportation,utilization of hydrogen gas, hydrogen as alternative fuel for vehicles.

Module 10: FUEL CELL: [2L]

Introduction, principle of operation of fuel cell. Types of fuel cells, efficiency of fuel cell, application of fuel cells, limitations.

Module 11: HYBRID SYSTEMS: [2L]

Introduction to hybrid systems, Need for Hybrid Systems, Different type of Hybrid systems like Diesel-PV,Wind-PV, Microhydel-PV, Biomass-Dieselsystems.

Text Books:Non Conventional Energy Resources, Shobh Nath Singh , PEARSON.

1. Non Conventional Energy Resources by S Hasan Saeed, D K Sharma, S.k. Kataria & Sons
2. NON CONVENTIONAL RESOURCES OF ENERGY, G. S. SAWHNEY, EasternEconomy Edition
3. Non Conventional Energy Resources, B.H Khan, McGraw Hill Education(Chennai)

Reference Books:

1. Non Conventional Energy Resources, N.K.Bansal , Vikas.

2. Non Conventional Energy Resources AndUtilisation. Er R.K Rajput, SChand Publishers.3.Rai G.D., "Non – Conventional Energy Sources", Khanna Publishers, 1993.

4.Rai G.D., "Solar Energy Utilisation", Khanna Publishers, 1993.

CO-PO Mapping:

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	1	1	-	2	-	2	2	2	2	3
CO2	3	2	2	1	2	3	-	2	2	1	2	3
CO3	3	2	1	3	-	3	1	3	1	1	1	3
CO4	3	2	2	1	2	3	-	2	2	1	2	3

COs/PSOs	PSO1	PSO2	PSO3
CO1	3	3	3
CO2	3	3	3
CO3	3	3	3
CO4	3	3	3

Course Name: Nano Electronics
Course Code: PEC602C
Contact: 3:0:0
Total Contact Hours:36
Credit:3

Course Outcome:

After successful completion of this course, students should be able to:CO1:

Explain the fundamental science and quantum mechanics.

CO2: comprehendthe basics of nano-electronicsandthe phenomenainvolvedinthe operation of nano-devices.
CO3: explain the fabrication details and analytical techniques of nanomaterials.
CO4: realize the advantages of the nano-materials and its appropriate use in solving practical problems.

Prerequisite:

The candidates should have the basic knowledge of materials physics and charge transport phenomena in electronic devices.

Course Content:

Module I: Introductionand Background [8L]

Introduction to nano-electronics, Limitations of conventional microelectronics, Trends in microelectronics and optoelectronics. Mesoscopic physics, characteristic lengths in mesoscopic systems. Basics of Quantum Mechanics: Schrodinger equation, Density of States. Particle in a box concepts, Degeneracy. Band theory of solids, Kronig-Penney Model, Brillouin zones, Quantum mechanical coherence

Module II: Fabrication [10L]

Introduction to methods for fabrication of nano-layers, different approaches, physical vapour deposition, chemical vapour deposition. Molecular Beam Epitaxy, Ion Implantation, Formation of Silicon Dioxide- dry andwetoxidation methods. Fabrication of nanoparticles- grindingwithiron balls, laser ablation, reduction methods, sol-gel, self-assembly, precipitation of quantum dots. MEMS/NEMS design, processing, Oxidation, Sputter deposition, Evaporation, Chemical vapor deposition etc.

Module III : Nano Devices [10L]

Classification of Nanostructures, Low dimensional structures: Quantum wells, wires and dots, Density of states and dimensionality. Basic properties of two dimensional semiconductor nanostructures, carbon nanotube and graphene

Introduction to scaling – Scaling of physical systems – Geometric scaling & Electrical system scaling, The Single-Electron Transistor: Single-Electron Transistor Logic, Other SET and FET Structures, Carbon Nanotube Transistors (FETs and SETs), Semiconductor Nanowire FETs and SETs, Coulomb Blockade in a Nanocapacitor, Hot electro transistors, Molecular SETs and Molecular Electronics. Resonant Tunneling Diode, Coulomb dots, Quantum blockade

Module IV: Characterization [8L]

Introduction to characterization, characterization tools used for nanomaterials, Microscope and its types- optical and electron microscope. Principle of operation of Scanning Tunneling Microscope, Atomic Force Microscope, Scanning Electron microscope, Specimen interaction. Transmission Electron Microscope, X-Ray Diffraction analysis, UV-Vis spectroscopy, Particle size analyzer

Text Books

1. David J. Griffiths, Introduction to Quantum Mechanics, Cambridge India
2. V.V. Mitin, V.A. Kochelap & M. Stroscio, Introduction to Nanoelectronics, Cambridge India
2. K.K. Chattopadhyay, Introduction to Nanoscience and Nanotechnology, PHI
3. S. Krishnamoorthy, Nanomaterials: A Guide to Fabrication and Applications, CRC Press

Reference Books

1. Nano Technologyand Nano Electronics– Materials, devices and measurement Techniquesby WR Fahrner – Springer
2. Nano: The Essentials – Understanding Nano Science and Nanotechnology by T. Pradeep, Tata McGraw Hill.
3. Introduction to Nano – Basics to Nanoscience and Nanotechnology by Sengupta & Sarkar – Springer

CO-PO Mapping:

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	1	1	2	1	3	2	1	2	1	2	1
CO2	3	2	3	2	1	3	2	3	2	2	1	2
CO3	2	3	2	2	2	1	3	1	2	1	3	1
CO4	3	2	2	2	-	3	2	3	2	1	1	1

COs/PSOs	PSO1	PSO2	PSO3
CO1	3	3	3
CO2	3	3	3
CO3	3	3	3
CO4	3	3	3
CO5	3	3	3

interpretation of images. Tropical rainfall measurements; Microwave sensing of sea surface. GIS Software

Course Name: Remote Sensing & GIS

Course Code: PEC602D

Contact: 3:0:0

Total Contact Hours: 36

Credits: 3

Pre-Requisite: Analog & Digital Communication, EM Theory & Antenna

Course Outcomes:

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

CO1: Interpret the basic concept of remote sensing and GIS.

CO2: Recognize the principles of aerial and satellite remote sensing.

CO3: Describe different types of sensors in remote sensing and data representation in GIS.

CO4: Explain the about the different kinds of radar for atmospheric remote sensing.

CO5: Apply knowledge of GIS software and able to work with GIS software in various application fields.

Course Content:

Module I: Introduction [2L]

Concept of Remote Sensing: Remote Sensing, Data, Sources of Energy, Interaction with Atmosphere and Target, Recording of Energy, Concept of GIS, types of GIS data: Civilian & Military, commercial GIS softwares

Module II: Radio Wave Propagation [10L]

Basic Radio propagation mechanism: Short distance & long distance propagation cases. Free space Propagation models. Diffraction, Reflection and Scattering. Variation of the earth's reflectivity with angle ofincidence, wavelength and geographical location; Seasonal variation of reflectivity; Effects of Solar radiation, Earth's thermal radiation, atmospheric radiation, cosmic backgroundnoise & atmospheric variation.

Module III: Remote Sensing [12L]

Sensors and Cameras: optical and infrared detectors and filters, optical and infrared cameras; microwave and millimeter wave radiometers; scanning systems, mechanical and electronic systems; scatter meter; altimeter. Radar Imaging GPS: Calibration, Requirement of Ground Truth Data, Parameters of Ground Truthing Atmospheric Condition, Surface Water, Factors of Special Measurement—Sun Angle, Aerosol, Haze, Water Vapor. Remote Sensing of Atmosphere and Sea State: Passive and active remote sensing; Side Looking Airborne Radar (SLAR); Synthetic Aperture Radar (SAR); Along Track Scanning Radiometer (ATSR), Laboratory measurements of remote sensingparameters.

Module IV: Geographic Interpretation System [12L]

Interpretation of Sensing Data: Photo-interpretation, image and pattern recognition; Spectral interpretationof remote sensing imagery; Interpretation of thermal maps; Color coding and enhancement; Computer

features, user-based updation of information system

Text Books:

1. R.P.Gupta, "Remote Sensing Geology", 2nd Edition. 2003, Springer
2. J.R. Jensen, 2014, "Remote Sensing of the Environment: An Earth Resource Perspective", 2nd Edition. 2014, Pearson Education Limited.
3. Anji Reddy,M., "Geoinformatics for Environmental Management", 2004. B.S. Publications.

Reference Books:

1.N. A. Armand, V. M. Polyakov, "Radio Propagation and Remote Sensing of the Environment", 2005. CRC Press.

2. Joseph George, 2003: Fundamentals of Remote Sensing. Universities Press.

3. Satellite Communication, D. C. Agarwal, and Khanna publisher.

CO-PO Mapping:

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3		3	-	-	-	-	-	3	-	3	-
CO2	-	-	-	-	-	2		3	3	-	3	3
CO3	3	-	-	-	-	-	-	-	2	-	3	3
CO4	-	-	-	-	-	2	-	-	3	-	3	-
CO5	-	2	-	2	-	-	-	2	3	-	3	-

COs/PSOs	PSO1	PSO2	PSO3
CO1	3	3	3
CO2	3	3	3
CO3	3	3	3
CO4	3	3	3
CO5	3	3	3

Course Name: OBJECT ORIENTED PROGRAMMING USING JAVA

Course Code: OEC 601A

Contact: 3:0:0

Total Contact Hours: 36

Credits: 3

Prerequisite:

Basic knowledge of computers, basic knowledge of programming.

Course Outcomes:

After successfully completing the course the Undergraduate students will be able to: CO1: Understand the key concepts of object-oriented programming and have an ability to design Object Oriented programs and appreciate the techniques of good design.
CO2: Understand advanced features of Java.
CO3: Analyze complex programming problems and optimize the solutions.
CO4: Apply an understanding of ethical principles to problems which commonly arise in the Information Technology Industry.

Course Content:

MODULE I: Object oriented design [2L]

Concepts of object-orientedprogramming language, Object, Class, relationshipsamongobjects, aggregation, links, relationships among classes-association, aggregation.

MODULE II: Object oriented concepts [2L]

Class, object, message passing, inheritance, encapsulation, polymorphism, Difference between OOP and other conventional programming – advantages and disadvantages.

MODULE III: Understanding Java programming language [2L]

History of Java Programming languages, Purpose of invention of Java. Structure of a basic Java Program, Component of Java Development Kit-API, JRE, Understanding the steps to run a complete Java Program.

MODULE IV: Basic Components of Java Program [2L]

Java Tokens-Literals, identifier, keywords, operator, separator, Data types, variables, constant, Type casting-defining type casting, requirement of type casting, implicit and explicit type casting. Controlstructure. Accessspecifier.

MODULE V: Class & Object proprieties [6L]

Defining class and object, Class Members-Local variable, instance variable, class variable, Primitive and

Reference variable, Constructor, this keyword, finalize and garbage collection, Array-Declaring and defining array, accessing array elements, length properties, 2D array, anonymous array, array of Objects. Understanding method- method returning object, passing objects, method passing and returning arrays,

use of method overloading. Static-Static block and non static block, static variable, static method. nested &inner classes.

MODULE VI: Reusability properties [6L]

Super class & subclasses including multilevel hierarchy, process of constructor calling in inheritance, use of super and final keywords with super() method, dynamic method dispatch, use of abstract classes & methods, interfaces. Creation of packages, importing packages, member access for packages.

MODULE VII: String Handling [3L]

Basic string handling concepts- String (discuss charAt() , compareTo(),equals(), equalsIgnoreCase(), indexOf(), length(), substring(), toCharArray() , toLowerCase(), toString(), toUpperCase() ,trim() , valueOf() methods) & StringBuffer classes (discuss append(), capacity(), charAt(), delete(), deleteCharAt(),ensureCapacity(), getChars(), indexOf(), insert(),length(), setCharAt(), setLength(), substring(), toString() methods),concept of mutable and immutable string, command line arguments.

MODULE VIII: Exception handling & Multithreading [5L]

Exception handling basics, different types of exception classes, use of try & catch with throw, throws & finally, creation of user defined exception classes. Basics of multithreading, main thread, thread life cycle, creation of multiple threads, thread priorities, thread synchronization, inter-thread communication,deadlocks for threads, suspending & resuming threads.

MODULE IX: Basic IO Operation and File Handling [2L]

Understanding unformatted and formatted IO. Reading and writing files.

MODULE X: Swing Programming [3L]

Swing Origins, Components and containers, Difference between AWT and swing, small swing programs, swing apps, concept of delegation event model and listener.

MODULE XI: Applet Programming (using swing) [3L]

Basics of applet programming, applet life cycle, difference between application & applet programming,parameter passing in applets, concept of delegation event model and listener, I/O in applets.

TextBooks:

1. Rambaugh, James Michael, Blaha – "Object Oriented Modelling and Design" – Prentice Hall, India
2. Ali Bahrami – "Object Oriented System Development" – Mc Graw Hill
3. Patrick Naughton, Herbert Schildt – "The complete reference-Java2" – TMH

Reference Books:

4. R.KDas–"CoreJava For Beginners" – VIKASPUBLISHING
5. Deitel and Deitel – "Java How to Program" – 6th Ed. – Pearson
6. Ivor Horton's Beginning Java 2 SDK – Wrox
7. E. Balagurusamy – " Programming With Java: A Primer" – 3rd Ed. – TMH

CO-PO Mapping:

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	2	2	2	2	-	-	-	-	-	2
CO2	3	2	2	2	3	2	-	-	-	-	-	2
CO3	3	3	3	3	2	2	-	-	-	-	-	2
CO4	3	3	3	2	3	2	-	-	3	-	3	2

COs/PSOs	PSO1	PSO2	PSO3
CO1	3	3	3
CO2	3	3	3
CO3	3	3	3
CO4	3	3	3
CO5	3	3	3

Course Name: Fundamentals of Sensor and Transducers

Course Code: OEC 601B

Contact: 3:0:0

Total Contact Hours: 36

Credits: 3

Prerequisite:

Students should have basic knowledge of Basic Electrical and Electronics as they are enableto design different instruments as per their requirements in Industrial purpose.

Course Outcome:

After successfully completing this course, the student will be able to:

CO1. Familiar with the basics of measurement system and its input, output configuration ofmeasurement system

CO2. Familiar with both static and dynamic characteristics of measurement system

CO3. Familiar with the principle and working of various sensors and transducers

CO4. Able to design signal conditioning circuit for various transducers

CO5. Able to identify or choose a transducer for a specific measurement application

Course contents:

Module I

Introduction & Characteristics of Transducers [4L]

Introduction to sensors and transducers, Measurement system, Principles of sensing & transduction, Classification of sensors, Static characteristics and Dynamic characteristics: Zero, first order and second order measurement system, Response to impulse, step, ramp and sinusoidal inputs, sensitivity calculation, error estimation, Types of errors, Limiting error with examples, Principle of sensing & transduction, transducer classification, emerging fields ofsensor technologies

Resistive Sensing Element [3L]

Potentiometer: Loading effect, Strain gauge: theory, types, temperature compensation,applications: force, velocity and torque measurements.

Inductive Sensing Element [3L]

Self-inductive transducer, Mutual inductive transducers, Variable Reluctance type, Linear Variable Differential Transformer (LVDT): construction, Characteristic Curve, application: LVDT Accelerometer, LVDT displacement sensors.

Module II

Capacitive Sensing Element [3L]

Capacitive transducer: Variable Area Type, Variable distance type, Variable Permittivity type, calculation of sensitivities, applications.

Piezoelectric & Piezoresistive Sensing Element [5L]

Piezoelectric effects, charge and voltage coefficients, crystal model, materials, natural and synthetic types – their comparison, force and stress sensing, piezoelectric accelerometer, piezo- resistive sensor.

Tachometers [2L]

Stroboscopes, Encoders, seismic accelerometer, Measurement of vibration, Proximity switches, Load cells: pneumatic, piezoelectric, elastic and magneto-elastic types - their mounting.

Module III

Optical Sensors [3L]

Light Dependent Resistor, Photodiode, Phototransistor, Photomultiplier tube, Optocoupler, solar cell

Magnetic Sensors [4L]

Sensors based on Villari effect for assessment of force, torque, rpm meters, Hall Effect and Hall drive, and performance characteristics, Magnetostrictive transducers, Seismic instrument

Radioactive sensors [3L]

Gieger counter, proportional counter, Scintillation detection, Ionization chamber.

Module IV

Micro-sensors and smart sensors [3L]

Construction, characteristics and applications. Standards for smart sensor interface.

Recent Trends in Sensor Technologies [3L]

IC temperature Sensor, Electrochemical Gas sensors, Fibre optic sensors - Thick film technology - MEMS sensors.

Text Books:

1. Patranabis, “Sensors and Transducers”, 2nd Edition, Prentice Hall India Pvt. Ltd

2. Murthy D. V. S, "Transducers and Instrumentation", Prentice Hall, New Delhi. .

3. Doebelin E.O, "Measurement Systems - Application and Design", 4th Edition, McGraw-Hill, New York, 2003

Reference Books:

1. Neubert H.K.P, "Instrument Transducers - An Introduction to their Performance and Design", 2nd Edition, Oxford University Press, Cambridge.

2. Waldemar Nawrocki, "Measurement Systems and Sensors", Artech House.

3. S.M. Sze, "Semiconductor sensors", John Wiley & Sons Inc., Singapore.

4. John Brignell,"Intelligent Sensor Systems", CRC Press; 2nd Revised edition edition,1996

CO-PO Mapping:

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2	3	2	1	-	1	2	2	1	1	2
CO2	3	1	2	-	2	-	-	-	1	-	1	-
CO3	3	2	3	1	2	2	1	-	-	-	-	-
CO4	3	1	3	2	2	1	-	-	-	-	-	-
CO5	3	2	3	2	3	2	-	-	-	-	-	-

COs/PSOs	PSO1	PSO2	PSO3
CO1	3	3	3
CO2	3	3	3
CO3	3	3	3
CO4	3	3	3
CO5	3	3	3

Course Name: Introduction to Quantum Computing

Course Code: OEC601C
Contact: 3:0:0
Total Contact Hours: 36
Credits: 3

Prerequisite: Data Structure and Algorithm, Programming in Python/C#

Linear Algebra (Matrix and Determinant), Fourier Transform, quantum physics and mechanics

Course Outcomes: After this course students will be able to

CO1: Develop quantum logic gate and circuits
CO2: Explain the working of a Quantum Computing program, its architecture and program model CO3: Design error correction circuits using quantum gates
CO4: Develop quantum algorithm program on major toolkits
CO5: Conceptualize thebasic modelsof quantum cellular automata and partitioned quantum cellular automata.

Course Content

Module 1: Motivation for studying Quantum Computing: 8L

Major players in the industry (IBM, Microsoft, Rigetti, D-Wave etc.), Origin of Quantum Computing, Overview of major concepts in Quantum Computing, Qubits and multi-qubits states, Bra-ket notation. Quantum Superposition, Quantum Entanglement, quantum mechanics of qubits, quantum states, superposition.

Mathatmetical Foundation for Quantum Computing: Matrix Algebra: basis vectors and orthogonality, inner product and Hilbert spaces, matrices and tensors, unitary operators andprojectors, Dirac notation, Eigen values and Eigen vectors. tensor product;

Module 2: Introduction to reversible logic and quantum gates: 10L
Basic definition, Toffoligate, Peresgate, Double Peresgate,Fredkin gate,Swapgate; simpleAND, OR, NOR, NAND, gate design using reversible logic; Introduction to RC Viewer simulator; Half and Full adder/ subtractor using reversiblelogic; Implementation of NOTgate using Vand V+gate, reversible circuit implementation and matrix representation.

Quantum NOT gate and its matrix model, CNOT gate (Feynman gate), Pauli matrices, Conjugate Transpose matrix representationandits conditions, X, Y, Z, Phasegate, Hadamard gate Unitary and Identity gates; implementation of CNOT, Toffoli, Peres and Double Peres gates using CV and CV+ gates; Decomposition of OR gate, adders and subtractors into quantum gates andsimulation using RC Viewer/ RC Viewer plus.

Module 3: Building Blocks for Quantum Program 8L
Architecture of a Quantum Computing platform, Details of q-bit system of information representation:

- Block Sphere
- Multi-qubits States
- valid and invalid superposition
- Quantum Entanglement
- Useful states from quantum algorithmic perceptive e.g. Bell State
- Operation on qubits: Measuring and transforming using gates.
- Quantum Logic gates and Circuit: Pauli, Hadamard, phase shift, controlledgates, Ising, Deutsch, swap etc.

Programming model for a Quantum Computing Program

- Steps performed on classicalcomputer
- Steps performed on QuantumComputer
- Moving data between bits and qubits.

Quantum programming languages, introduction to quantum cryptography and quantum information theory.

Module 4: Quantum transformation, searching, Quantum error correction: 4L quantum Fourier transform and quantum search algorithm, phase estimation, entanglement, teleportation,3 qubit systemforerror correction, Shor code, degerate codes, generator and parity check matrices, entropy (self and mutual), Von Neumann entropy

Module 5 :Basics of Quantum Computer and Quantum Algorithms: 6

LBasic techniquesexploited by quantumalgorithms.

- Amplitude amplification
- Quantum WalksMajor Algorithms
- Shor's Algorithm
- Grover's Algorithm
- Deutsch's Algorithm
- Deutsch -Jozsa Algorithm

OSS Toolkits for implementing Quantum program

- IBM quantum experience
- Microsoft Q

Text Books:

1. "Quantum Computation and Quantum Information", Michael A. Nielsen & Isaac L. Chuang, Cambridge University Press
2. Quantum computing for computer scientists, Noson S. Yanofsky, Mirco A. Mannucci, Cambridge University Press 2008

References :

1. Quantum computing explained, David McMahon, Wiley-interscience, John Wiley & Sons, Inc. Publication 2008
2. Riley Tipton Perry, "Quantum Computing from the Ground Up", World Scientific Publishing

Ltd (2012).

3. P. Kok, B. Lovett, "Introduction to Optical Quantum Information Processing", Cambridge (2010).
4. Scott Aaronson, "Quantum Computing since Democritus", Cambridge (2013).
5. Introduction to Quantum Mechanics, 2nd Edition, David J. Griffiths, Prentice Hall New Jersey 1995
6. Online math tutorial: http://patrickjmt.com/
7. https://www.coursera.org/learn/quantum-computing-algorithms
8. IBM Experience: https://quantumexperience,ng,bluemix.net
9. Microsoft Quantum Development Kit
https://www.microsoft.com/en- us/quantum/development-kit
10. Forest SDKPyQuil: https://pyquil.readthedocs.io/en/stable/

CO-PO Mapping:

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	-	2	-	-	-	-	-	-	-	-	-
CO2	-	-	3	2	-	-	-	-	-	-	-	-
CO3	-	2	-	3	1	-	-	-	-	-	-	-
CO4	2	1	3	-	2	1	-	-	-	-	-	-
CO5	3	-	2	3	-	2	3	-	2	3	-	1

COs/PSOs	PSO1	PSO2	PSO3
CO1	3	3	3
CO2	3	3	3
CO3	3	3	3
CO4	3	3	3
CO5	3	3	3

Course Name: Fundamentals of Operating SystemCourse

Code: OEC 601D

Contact: 3:0:0
Total Contact Hours: 36Credits: 3

Prerequisites:

Computer organization,Computer Architecture,Data Structures,Algorithms & ProgrammingConcept

Course Outcomes:

CO1: Describe how computing resources (such as CPU,memory and I/O) are managed bytheoperating system.
CO2: Analyze kernel and user mode in an operating system.
CO3: Solve different CPU scheduling problem to achieve specific scheduling criteria. CO4: Apply the knowledge of process management, synchronization, deadlock to solve basicproblems.

CO5: Evaluate and report appropriate design choices when solving real-world problems

Course Contents:

Module – 1: [3L]

Functionalities of Operating System, Evolution of Operating System.
Types of Operating System: batch, multi-programmed, time-sharing, real-time, distributed,parallel, Structural overview, Protection & Security.

Module – 2: [10L]

Processes: Concept of processes, process states, PCB, process scheduling, co-operating processes, independent process, suspended process, Interaction between processes and OS, Inter-process communication: Message passing. [3L]

Threads: overview, benefits of threads, user and kernel level threads, Thread models. [2L]

CPU scheduling: scheduling criteria, preemptive & non-preemptive scheduling, scheduling algorithms (FCFS, SJF, SRTF, RR, priority, multilevel queue, multilevel feedback queue scheduling)[5L]

Module – 3: [11L]

Process Synchronization: background, critical section problem, synchronization hardware, classical problems of synchronization(producer-consumer, readers-writer, dining philosophers, etc), semaphores, monitors. [6L]
Deadlocks: deadlock characterization, methods for handling deadlocks, deadlock prevention, deadlock avoidance, deadlock detection, recovery from deadlock.

[5L]

Module – 4: [6L]

Background, logical vs. physical address space, swapping, contiguous memory allocation, paging, Segmentation,TLB. [3L]
Virtual Memory: background, demand paging, page replacement algorithms (FCFS, LRU, Optimal), thrashing, Working set model. [3L]

Module – 5: [6L]

Disk structure, disk scheduling (FCFS, SSTF, SCAN,C-SCAN,LOOK,C-LOOK etc),disk reliability, disk formatting, boot block, bad blocks. [2L]
File:Fileconcept,accessmethods, directory structure,file system structure, UNIXfilestructure, allocation methods(contiguous, linked, indexed), free-space management(bit vector) [2L]

I/O: I/O hardware, polling, interrupts, DMA, caching, buffering, blocking-non blocking I/O. [2L]

Text Books:

1. Abraham Silberschatz, Peter B. Galvin, Greg Gagne, Operating System Concepts.

2. Operating Systems & Systems Programming by P Balakrishna Prasad

Reference Books:

1. Dietel H. N., "An Introduction to Operating Systems", Addison Wesley.
2. Andrew Tanenbaum, Modern Operating Systems, Prentice Hall.
3. William Stallings, Operating Systems, Prentice Hall.

CO-PO Mapping:

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	-	-	3	-	-	-	-	-	-	3
CO2	3	3	-	-	-	-	-	-	-	-	-	2
CO3	2	2	-	-	-	-	2	-	-	-	-	3
CO4	3	2	-	-	-	-	3	-	-	-	-	2
CO5	3	2	-	-	-	-	-	-	-	-	-	2

COs/PSOs	PSO1	PSO2	PSO3
CO1	3	3	3
CO2	3	3	3
CO3	3	3	3
CO4	3	3	3
CO5	3	3	3

Course Name: DATABASE MANAGEMENT SYSTEM
Course Code: OEC602A
Contact: 3:0:0
Total Contact Hours: 36
Credits: 3

Prerequisite:

Logic of programming language

Basic concepts of data structure and algorithms

Course Outcomes:

CO1: To learn the data models, conceptualize and depict a database system

CO2: To design system using E-R diagram.

CO3: To learn SQL& relational database design.

CO4: To understand the internal storage structures using different file and indexing techniques.CO5: To know the concepts of transaction processing, concurrency control techniques and recovery procedure.

Course Content

Module 1: Introduction [3L]

Concept & Overview of DBMS, Data Models, Database Languages, DatabaseAdministrator, DatabaseUsers, Three Schema architecture of DBMS.

Module 2: Entity-Relationship and Relational Database Model [11 L] Basic concepts, Design Issues, Mapping Constraints, Keys, Entity-Relationship Diagram, Weak Entity Sets, Extended E-R features, case study on E-R Model. Structure of relational Databases, Relational Algebra, Relational Calculus, Extended Relational Algebra Operations, Views, Modifications Of the Database.

Module 3: SQLand Integrity Constraints [6L]

Concept of DDL, DML, DCL. Basic Structure, Set operations, Aggregate Functions, Null Values, Domain Constraints, Referential Integrity Constraints, assertions, views, Nested Subqueries, Database security application development using SQL, Stored procedures and triggers.

Module4: RelationalDatabaseDesign [8L]

Functional Dependency, Different anomalies in designing a Database., Normalizationusing

functional dependencies, Decomposition, Boyce-Codd Normal Form, 3NF, Normalizationusing multi-valued dependencies, 4NF, 5NF , Case Study

Module 5: Internals of RDBMS [9L]

Physical data structures, Query optimization: join algorithm, statistics and cost bas optimization. Transaction processing, Concurrency control and Recovery Management: transaction model properties, state serializability, lock base protocols; two phase locking, Dead Lock handling.

Module 6: File Organization & Index Structures [6L]

File & Record Concept, Placing file records on Disk, Fixedand Variable sized Records, Types of Single-Level Index (primary, secondary, clustering), Multilevel Indexes

TextBooks:

1. Henry F. Korth and Silberschatz Abraham, "Database System Concepts",
2. Mc.GrawHill. ElmasriRamez and NovatheShamkant, "Fundamentals of Database Systems", Benjamin CummingsPublishing. Company.
3. Ramakrishnan: Database Management System ,McGraw-Hill
4. Gray Jim and Reuter Address, "Transaction Processing : Concepts and Techniques", Moragan KauffmanPublishers

.5.Ullman JD., "Principles of Database Systems", GalgottiaPublication.

Reference Books:

1. Jain: Advanced Database Management SystemCyberTech
2. Date C. J., "Introduction to Database Management", Vol. I, II, III, AddisonWesley.
3. "Fundamentals of Database Systems", RamezElmasri, ShamkantB.Navathe, Addison Wesley PublishingEdition
4. "Database Management Systems", Arun K.Majumdar, Pritimay Bhattacharya, Tata McGraw Hill

CO-PO Mapping:

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	2	2	2	3	2	1	1	2	2	3	3
CO2	2	3	3	3	3	1	1	1	2	2	3	3
CO3	3	3	2	3	3	2	2	2	3	3	3	3
CO4	3	3	2	2	2	1	1	1	1	1	2	3
CO5	3	3	3	3	3	2	2	2	3	3	3	3

COs/PSOs	PSO1	PSO2	PSO3
CO1			
CO2			
CO3			
CO4			
CO5			

Course Name: 3D Printing & Design
Course Code: OEC602B
Contact: 3:0:0
Contact Hours: 36
Credits: 3

Prerequisite: Computer Aided Design & Drafting, Engineering Materials

Course Outcomes:

CO1: Develop CAD models for 3D printing.

CO2: Import and Export CAD data and select a specific material for the given application. CO3: Select a 3D printing process for an application.

CO4: Produce a product using 3D Printing or Additive Manufacturing (AM).

Course Contents:

Module 1: 6L

Introduction:

Introduction to 3D Printing, Overview of additive manufacturing techniques, Additive v/s Conventional Manufacturing processes, Applications.

Module 2: 5L

CAD for Additive Manufacturing: CAD Data formats, Slicing, Data translation, Data loss, STL format

Module 3: 10L

3D Printing: Process, Equipment, Process parameter, Process Selection for various applications. Application Domains: Aerospace, Electronics, Health Care, Defence,

Automotive, Construction, Food Processing, Machine Tools

Module 4: 5L

Materials: Polymers, Metals, Non-Metals, Process parameter, Process Selection for various applications. Various forms of raw material and their desired properties, Support Materials

Module 5: 5L

Core issues in 3D Printing:

Design and process parameters, Governing Bonding Mechanism, Common faults and troubleshooting

Module 6: 5L

Post Processing: Requirement and Techniques

Support Removal, Sanding, Acetone treatment, polishing, Inspection and testing, Defects and their causes

Text Books:

1. Khanna Editorial, "3D Printing and Design", Khanna Publishing House, Delhi.

2. Andreas Gebhardt, "Understanding Additive Manufacturing: Rapid Prototyping, Rapid Tooling, Rapid Manufacturing", Hanser Publisher, 2011.

3. Amitava Ghosh, Rapid Prototyping, McGrawhill Publishers.

4. J.D. Majumdar and I. Manna, "Laser-Assisted Fabrication of Materials", Springer Series in Material Science, 2013.

5. Lan Gibson, David W. Rosen and Brent Stucker, "Additive Manufacturing Technologies:Rapid Prototyping to Direct Digital Manufacturing", Springer, 2010

CO – PO Mapping

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	2	3	-	3	-	-	-	-	-	1	1
CO2	2	2	3	-	3	-	-	-	-	-	1	1
CO3	2	2	3	-	3	2	2	-	-	-	1	1
CO4	3	2	3	2	3	-	2	-	-	-	2	1

COs/PSOs	PSO1	PSO2	PSO3
CO1	3	3	3
CO2	3	3	3
CO3	3	3	3
CO4	3	3	3

Course Name: WEB INTELLIGENCE & BIG DATA
Course Code: OEC 602C
Contact: 3:0:0
Total Contact Hours: 36
Credits: 3

Prerequisite:
Probability and Statistics, Database Management System (SQL- Queries andSubqueries) , Knowledgein C, Python, R, Proficiency in Algorithm, LINUX

Course Outcomes:
After successfully completing the course the Undergraduate students will be ableto: CO1: Understand Web Intelligence and Big datafundamentals.CO2: Investigate various Data Analysis Techniques.
CO3: Analyze Machine Learning Algorithms using R.
CO4: Implement Hadoop, Map Reduce and NO SQL in big data analytics.
CO5: Apply Hadoop ecosystem components for business and scientific computing.

Course Content:

Module 1: [3L]
WEB INTELLIGENCE
Concepts of Web Intelligence: benefits, ingredients and related technologies.

Module 2: [3L]
WEB MINING

Web Usage Mining, Web Content Mining, Web Structure Mining

Module 3: [7L]
INTRODUCTION TO BIG DATA WITH HADOOP
Introduction to Big Data – Types of digital data and challenges of conventional data , Big Data Analytics- Analysis and Reporting, Concept of Hadoop, Apache Hadoop, Modern data analytic tools- Data analysis with Unix tools, Analysis of Data with Hadoop, Data Analysis with Sperkand Impala, Introduction to Hadoop Streaming, Hadoop Echo System, IBM Big Data.

Module 4: [7L]
STATISTICS AND DATA ANALYTICS
Stastical concepts : Sampling, Resampling, Statistical inference, Statistical hypothesis generation and testing, Chi-square test,t-Test, Analysis of variance, Prediction error, Regression modeling, Multivariate analysis, Bayesian modeling , inference and Bayesian networks .

Module 5: [5L]

R MACHINELEARNING

Introduction to Supervised Learning-Classification, Support vector and Kernel methods, Unsupervised Learning- Clustering, Big Data Association Rule Analysis- Neural networks, Fuzzy Logic : extracting fuzzy models from data ,fuzzy decision trees, Stochastic search methods, Data analysis with R

Module 6: [4L]

INTRODUCTION TO HDFS (HADOOP DISTRIBUTED FILE SYSTEM)

Introduction to HDFS, Command Line Interface, Hadoop file system interfaces, Data flow, Data Ingest - Flume , Scoop and Hadoop archives, Hadoop I/O: Compression and Serialization. Avro and File-Based Data structures.

Module 7: [3L]

MAP REDUCE

Map Reduce Types and Formats, Map Reduce Features, Anatomy of Map Reduce Job Run, Failures, Job Scheduling, Shuffle and Sort, Task Execution, NO-SQL.

Module 8:

HADOOP ECO SYSTEM [4L]

Hadoop ecosystem components - Schedulers , Fair and Capacity, HDFS Federation, MRv2, YARN, , Hive Architecture and Installation, Comparison of HIVE with Traditional Database, HiveQL - Querying Data and user defined functions, Introduction to Hbase,Clients concept and Example, Hbase Versus RDBMS, Introduction to PIG, Zookeeper

TextBooks:

1. Akerkar, R. & Lingras, P. (2008). Building an Intelligent Web: Theory and Practice. Jonesand Bartlett Publishers, Sudbury, Massachusetts. ISBN- 13: 978-0-7637-4137-2
2. Chris Eaton, Dirk deroos et al. , "Understanding Big data ", McGraw Hill, 2012.
3. Tom White, "HADOOP: The definitive Guide" , O Reilly 2012.
4. Seema Acharya, Subhasini Chellappan, "Big Data Analytics" Wiley 2015.

Reference Books:

5. Witten, Ian H. & Frank, E. (2005). Data Mining: Practical Machine Learning Tools and Techniques. 2nd Edition, Morgan Kaufman. ISBN 0120884070, 9780120884070
6. Michael Berthold, David J. Hand, "Intelligent Data Analysis", Springer, 2007.
7. Glenn J. Myatt, Making Sense of Data, John Wiley & sons, 2007 PeteWarden, Big Data Glossary, O'Reilly, 2011.
8. Vignesh Prajapati, "Big Data Analytics with R and Haoop", Packet Publishing 2013.
9. Jy Liebowitz, "Big Data and Business analytics",CRC press, 2013.
10. Anand Rajaraman and Jef rey David Ulman, "Mining of Massive Datasets", Cambridge University Press, 2012.

CO-PO Mapping:

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	2	2	2	2	-	-	-	-	2	2
CO2	3	2	2	2	3	2	-	-	-	-	2	2
CO3	3	3	3	3	2	2	-	-	-	-	2	2
CO4	3	3	3	2	3	2	-	-	-	-	2	2
CO5	3	3	3	2	3	2	-	-	-	-	2	2

COs/PSOs	PSO1	PSO2	PSO3
CO1	3	3	3
CO2	3	3	3
CO3	3	3	3
CO4	3	3	3
CO5	3	3	3

Course Name: SCIENTIFIC COMPUTING
Course Code: OEC 602D
Contact: 3:0:0
Total Contact Hours: 36
Credits: 3

Prerequisite:

Basic Knowledge of Engineering Mathematics

Course Outcomes:

After successfully completing the course the Undergraduate students will be ableto:CO1: Understand the different algorithms and their solutions in mathematics.
CO2: Investigate various cryptography Techniques.
CO3: Analyze various sorting algorithms.
CO4: Implement mathematics for finding solution of various scientific computions.

Course Content:

Module 1: [10L]
Euclidean Algorithm, Fast Fourier Transform, Integer and Polynomial arithmetic,Polynomial Equation- solution of systems.

Module 2: [10L]
Coding and cryptography techniques, Matrix manipulation, Fast algorithms formatrix, series etc.Modern Applications in cryptography.

Module 3: [9L]

Modern Sorting algorithms, Solution of differential equations, Symbolic integration

Module 4: [7L]

Control Theory, Stability , Applications

Text Books:

1. Akerkar, R. & Lingras, P. (2008). Building an Intelligent Web: Theory and
   1. T. M. Apostol. Calculus, Vol. 1: One-Variable Calculus with an Introduction to Linear Algebra. John Wiley & Sons, Inc., ISBN 0471000051
2. 2. T. M. Apostol. Calculus, Vol. 2: Multi-Variable Calculus and Linear Algebra, with Applications to Differential Equations and Probability. John Wiley & Sons, Inc., ISBN 9780471000075.

Reference Books:

1. J. von zur Gathen and J. Gerhard. Modern Computer Algebra. Cambridge University Press, 3rd ed., 2013. ISBN 9781107039032

2. J.A. Storer. An Introduction to Data Structures and Algorithms. Springer, 2002 ISBN 978-1-4612-0075-8

3. D.Sankoff, J.Kruskal. Time Warps, String Edits, and Macromolecules.. The Theory and Practiceof Sequence Comparison (CSLI Pub., 1999) ISBN 9781575862170

4. A.Masoudi-Nejad, Z.Narimani, N.Hosseinkhan. Next Generation Sequencing and Sequence Assembly: Methodologies and Algorithms. Springer, 2013, ISBN 978-1-4614-7725-9.

CO-PO Mapping:

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	2	2	2	2	-	-	-	-	2	2
CO2	3	2	2	2	3	2	-	-	-	-	2	2
CO3	3	3	3	3	2	2	-	-	-	-	2	2
CO4	3	3	3	2	3	2	-	-	-	-	2	2

COs/PSOs	PSO1	PSO2	PSO3
CO1	3	3	3
CO2	3	3	3
CO3	3	3	3
CO4	3	3	3

Course Name: VLSI & Microelectronics Lab

Course Code: EC 691

Contact: 0:0:3

Credit: 1.5

CourseOutcome:

CO1: Able to measure & analyse VIL, VIH, VOL, VOH, noise margin, gate delay and average power consumption of CMOS inverter for VDD in between 0.5V - 1.2 V using nano dimensional channel length of MOS transistor following DC & transient analysis with the help of SPICE tools.

CO2: Able to design & explaintheworking of basicgates-AND/NAND, OR/NOR, XOR/XNORgate; full adder circuit; sequential circuit -SR latch, clocked SR latch & D flip-flop using CMOS designmethod at schematic level for the VDD range 0.5 V to 1.2 V at nano dimensional channel length withthe help of SPICE tools.

CO3: Able to construct the layout & examine the functionality of CMOS inverter, CMOS NAND, CMOS NOR gate using SPICE layout design tools based on design rules for VDD 0.5 V to 1.2 V.

CO4: Able to design combinational circuits - logic gates, half adder, full adder, 4:1 MUX using 2:1MUX ; sequential circuits-S-R flip-flop, 8-bit synchronous counter, 8-bit bi-directional register with help of behavioural , dataflow , structural & mixed modelling style through VHDL code and able to demonstrate system design using FPGA at prototype level .

CO5: Able to design CMOS differential amplifier with active load and biased with current mirror using nano dimensional channel length of MOS transistors with the help of SPICE tools at schematic level.

List of Experiments:

1. Simulation of CMOS inverter to plot voltage transfer characteristics (VTC) for different values of kn/kp ratio for V_{DD}=1 V and nano dimensional channel length using SPICE.
    a. Measurement of critical voltages V_{IL}, V_{IH}, V_{OL}, V_{OH} from VTC .
    b. Calculation of noise margin from critical voltages.
2. Functional verification, measurement of gate delay and average power consumption of CMOS inverter circuit for V_{DD} range 0.5 V to 1.2 V and with the nano dimensional channel length of MOS transistor using SPICE tools.
3. Design and testing of functionality of the following gate and combinational circuit with the help of SPICE tools at schematic level.
    a. CMOS AND/NAND, OR/NOR, XOR/XNORgate
    b. CMOS full adder circuit .
4. Layout design and functional verification of CMOS inverter, CMOS NAND , CMOS NOR gate using layout design tools of SPICE based on design rules.

5. Designandexamination of functionality of the sequential circuits - CMOS SRlatch, clocked SRlatch & D flip-flop at schematic level using SPICE tools.
6. Design and simulation of a) Logic gates b) Full adder using half adder c) 4:1 MUX using 2:1 MUXwith the help of VHDL following suitable modelling style (structural ,behavioral , dataflow , mixed).
7. Design of the following Sequential circuits using VHDL
   a. S-R Flip-Flop
   b. 8 bit synchronous counter
   c. 8 Bit bi-directional register with tri-stated input output.
8. Familiarity with FPGA based system design. Design and realization of 4:1 Mux using FPGA.
9. Design of CMOS differential amplifier at schematic levelwith active load and current mirror biascircuit for given specifications using SPICE tools .
10. Innovative experiment.

CO-PO Mapping:

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	3	3	3	-	-	1	3	3	3	3
CO2	3	2	3	3	3	-	-	1	3	3	3	3
CO3	3	3	3	3	3	-	-	1	3	3	3	3
CO4	3	2	3	3	3	-	-	1	3	3	3	3
CO5	3	3	3	3	3	-	-	1	3	3	3	3

COs/PSOs	PSO1	PSO2	PSO3
CO1	3	3	3
CO2	3	3	3
CO3	3	3	3
CO4	3	3	3
CO5	3	3	3

Course Name: Control Systems Lab

Course Code: EC 692

Contacts: 0:0:3

Credit: 1.5

Course Outcomes:

After completing the following experiments, students will be able to

CO1: Analyze different types of electrical, mechanical and electromechanical systems.
CO2: Determine transient and steady state behaviour of different types of systems usingstandard test signals.
CO3: Determine the importance of gain, location of poles and zeros to design asystem. CO4: Checkthe stabilityofthesystemsusingtheconceptofdifferentstabilitycriterion.
CO5: Design the systems according to the desired specifications or requirements usingdifferent types of controller andcompensator.

List of Experiments:

1. Familiarization with MATLAB Control System Toolbox and SIMULINK.
2. Study of the effect of feedback on systems.
3. Study of first order systems having different time constants.
4. Study of second order systems having different damping ratios.
5. Study of time response of different electrical and mechanical system.
6. Verification and validation of time domain specifications of second order systems.
7. Study of steady state errors for different 'types' of systems.
8. Study of system stability using Root locus technique.
9. Determination of Bode-plot and computation of gain crossover frequency, phase cross over frequency, gain margin and phase margin using MATLAB.
10. Study of closed loop stability using Nyquist plot.
11. Study of system representation using State Model.
12. Determination of PI, PD and PID controller action on first order simulated process.
13. Evaluation of steady-state error, setting time, percentage peak overshoots, gain marginand phase margin with addition of lead compensator/lag compensator in forward pathtransfer function using MATLAB.
14. Tuning of PID Controller.

Mapping of POs with COs:

CO	PO 1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	P10	P11	P12
CO1	3	3	2	-	-	-	-	-	1	1	-	1
CO2	3	2	2	-	-	-	-	-	2	1	-	1
CO3	3	2	1	2	1	1	-	-	2	1	-	-
CO4	3	1	-	-	1	1	-	-	2	1	-	1
CO5	1	1	3	2	1	1	-	-	2	1	-	1

COs/PSOs	PSO1	PSO2	PSO3
CO1	3	3	3
CO2	3	3	3
CO3	3	3	3
CO4	3	3	3
CO5	3	3	3

Course Name: Object Oriented ProgrammingLabCourse

Code: OEC 691A
Contact: 0:0:3
Credits: 1.5

Prerequisites:

1. Computer Fundamentals
2. Basic understanding of Computer Programming and related Programming Paradigms
3. Problem Solving Techniques with proper logic Implementation.

Course Outcomes:

CO1: Create the procedure of communication between Objects, classes & methods.
CO2: Understand the elementary facts of Object Orientation with various characteristics as well as several aspects of Java.
CO3: Analyze distinct features of different string handling functions with various I/O operations.
CO4: Discuss simple Code Reusability notion w.r.t. Inheritance, Package and Interface.
CO5: Apply Exception handling, Multithreading and Applet (Web program in java) programming concept in Java.

Course Contents:
Module 1: Java Basics:

1. Simple Java programming using operators, control statements & loops, array.
2. Programming on class, object, and method, access specifier.
3. Programming on constructor, method/constructor overloading.
4. Programming onthis keyword, callbyvalue & callbyreference, static variables & methods, inner classes.

Module 2: Basic String handling & I/O:

1. Programming to show the use of String class methods - charAt(), compareTo(), equals(), equalsIgnoreCase(), indexOf(), length() , substring(), toCharArray(), toLowerCase(), toString(), toUpperCase(), trim(), valueOf() methods.
2. Programming to show the use of StringBuffer class methods - append(), capacity(), charAt(), delete(), deleteCharAt(),ensureCapacity(), getChars(), indexOf(), insert(), length(), setCharAt(), setLength(), substring(), toString() methods.
3. Programming on Command linearguments.
4. Programming using keyboard input by implementing BufferedReader& Scanner classes.

Module 3: Inheritance, Interface and Java Packages:

1. Programming on Simple Inheritance, super and final keywords, super() method.
2. Programming on method overriding, dynamic method dispatch,abstract classes & methods, multiple inheritance by using interface.
3. Programming on importing system package, creating user-defined package, importing user- defined package, using protected access specifier, subclassing an imported class of a package, using same names for classes of different packages, adding multiple public classes to a package.

Module 4: Exception handling, Multithreading and Applet Programming:

1. Programming on exception handling using try-catch block, implementing throw and throws keywords, using finally block, creating user-defined exception.
2. Programming on creating child threads i) by extending thread class ii) by implementing runnable interface, creating child threads by assigning thread priorities.
3. Programming on creating simple applet to display some message, creating applet two add 2integers, creating applet to do GUI based programming.

Textbooks:

1. Herbert Schildt – "Java: The Complete Reference " – 9th Ed. – TMH
2. E. Balagurusamy – " Programming With Java: A Primer " – 3rd Ed. – TMH.

Reference Books:

1. R.K Das – " Core Java for Beginners " – VIKAS PUBLISHING.
Rambaugh, James Michael, Blaha – " Object Oriented Modelling and Design " – Prentice Hall,India

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	3	3	2	-	-	-	1	-	-	1
CO2	3	2	2	-	1	-	-	-	1	-	-	2
CO3	2	3	2	3	-	-	-	-	2	-	-	-
CO4	1	-	-	-	-	-	-	-	1	2	-	2
CO5	2	1	1	-	1	-	-	-	2	-	-	2

COs/PSOs	PSO1	PSO2	PSO3
CO1	3	3	3
CO2	3	3	3
CO3	3	3	3
CO4	3	3	3
CO5	3	3	3

Course Name: Fundamentals of Sensors and Transducers Lab

Course Code: OEC 691B
Contact: 0:0:3
Credits: 1.5

Course Outcome:

Graduates of the ECE program will be able to:

CO1:	Illustrate the working of transducers and various transducers used for the measurement of various physical variables.
CO2:	Analyze the characteristics of the transducers.
CO3:	Design sensor based on the real time application.
CO4:	Estimate the design specifications of different transducers.

List Of Experiment:

1. Displacement measurement by using a capacitive transducer.
2. Pressure and displacement measurement by using LVDT.
3. Study of a load cell with tensile and compressive load.
4. Torque measurement Strain gauge transducer.
5. Speed measurement using magnetic proximity sensor.
6. Speed measurement using a Stroboscope.
7. Study of the characteristics of an LDR.
8. Pressure measurement using Piezo-electric transducer
9. Study of the Characteristics of Hall-effect transducer
10. Innovative experiment

Textbooks:

1. Patranabis, "Sensors and Transducers", 2nd Edition, Prentice Hall India Pvt. Ltd
2. Murthy D. V. S, "Transducers and Instrumentation", Prentice Hall, New Delhi..
3. Doebelin E.O, "Measurement Systems - Application and Design", 4th Edition, McGraw-Hill, New York, 2003

Reference Books:

1. Neubert H.K.P, "Instrument Transducers - An Introduction to their Performanceand Design", 2ndEdition, Oxford University Press, Cambridge.
2. Waldemar Nawrocki, "Measurement Systems and Sensors", Artech House.
3. S.M. Sze, "Semiconductor sensors", John Wiley & Sons Inc., Singapore.
4. John Brignell,"Intelligent Sensor Systems", CRC Press; 2nd Revised edition edition,1996

CO-PO Mapping:

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2	-	-	1	-	-	-	2	-	1	1
CO2	1	2	-	3	-	1	-	1	-	2	-	1
CO3	1	2	1	-	2	-	1	-	3	-	-	2
CO4	1	2	-	1	-	1	-	-	-	3	-	1

COs/PSOs	PSO1	PSO2	PSO3
CO1	3	3	3
CO2	3	3	3
CO3	3	3	3
CO4	3	3	3

Course Name: Introduction to Quantum Computing LabCourse

Code: OEC691C
Contacts: 0:0:3
Credit: 1.5

Prerequisite: Linear Algebra (Matrix and Determinant), Tensor product, C programming, DataStructureand Algorithm, Programming in Python/C#, quantum physics and mechanics

Course Outcomes:
Graduates of the ECE program will be able to:

CO1: Identify quantum gates and circuits
CO2: Explain the working of a Quantum Computing program, its architecture and programmodel CO3: Design error correction circuits using quantum gates
CO4: Develop quantum algorithm program on major toolkits
CO5: Handle complex projects on quantum circuits

Course Content: Any 8 Experiments.

Experiment 1: Write a C program to implement |0> and |1>.
Experiment 2: Write a C program to implement |00>, |01>, |10> and |11>.
Experiment 3: Write a C program to verify a complex element matrix to be Hermitian. Experiment 4: Write a C program to implement V and V+ gates using matrix representation.
Experiment 5: Experimentally prove that V^2 or V^{+2} = CNOT using matrix algebra.Experiment 6: Write a C program to implement 2-input Toffoli gate using matrix algebra. Experiment 7: Using C program, implement Hadamard gate.
Experiment 8: Experimentally prove that VV+ = I where I is an identity matrix.
Experiment 9: Write a C program to implement a Peres gate using matrix algebra.
Experiment 10: Using RC viewer or RC viewer+, design a half adder and a full adder anddecomposeinto quantum circuits.
Experiment 11: Using RC viewer or RC viewer+, design a 4 to 1 multiplexer using fredkingate anddecompose into quantum circuits.
Experiment 12: Using RC viewer or RC viewer+, design a full adder using fredkin gateanddecompose into quantumcircuits.
Experiment 13: Building Quantum dice
Experiment 14: Building Quantum Random No. Generation
Experiment 15: Composingsimple quantum circuits withq-gates andmeasuring theoutputinto classical bits.
Experiment 16: Implementation of Shor'sAlgorithms

Textbooks:

1. "Quantum Computation and Quantum Information", Michael A. Nielsen & Isaac L. Chuang,Cambridge University Press
2. Quantum computing for computer scientists, Noson S. Yanofsky, Mirco A. Mannucci,Cambridge University Press 2008

References:

1. Quantum computing explained, David McMahon, Wiley-interscience, John Wiley & Sons, Inc. Publication 2008
2. Riley Tipton Perry, "Quantum Computing from the Ground Up", World ScientificPublishing Ltd (2012).
3. P. Kok, B. Lovett, "Introduction to Optical Quantum Information Processing", Cambridge(2010).
4. Scott Aaronson, "Quantum Computing since Democritus", Cambridge (2013).
5. Introduction to Quantum Mechanics, 2nd Edition, David J. Griffiths, Prentice Hall New Jersey1995
6. Online math tutorial: http://patrickjmt.com/
7. https://www.coursera.org/learn/quantum-computing-algorithms
8. IBM Experience: https://quantumexperience,ng,bluemix.net

9. Microsoft Quantum Development Kit https://www.microsoft.com/en- us/quantum/development-kit
10. Forest SDK PyQuil:https://pyquil.readthedocs.io/en/stable/

CO-PO Mapping:

CO	PO1	PO2	PO3	PO4	PO5	PO 6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	-	-	-	-	2	-	-	1	-	-	-1
CO2	-	-	3	2	-	-	-	1	-	1	-	-
CO3	2	2	-	3	-	1		-	-	-	1	-
CO4	-	-	-	-	2	-	1	-	-	-1		-
CO5	3	-	2	-	1	-	-	-	1	-	1	-

COs/PSOs	PSO1	PSO2	PSO3
CO1	3	3	3
CO2	3	3	3
CO3	3	3	3
CO4	3	3	3

Course Name: Operating Systems Lab

Course Code: OEC 691D
Contacts: 0:0:3
Credits: 1.5

Prerequisites:

1. Computer organization
2. Computer Architecture
3. Data Structures
4. Algorithms & Programming Concept

Course Outcomes:
Graduates of the ECE program will be able to:

CO1: To Analyze different aspects of Linux.
CO2: To Create or design different scripts using shellprogramming.
CO3: To implement process, thread, semaphore concept of operatingsystem.
CO4: Create shared memory with the implementation of reading from, write into shared memory.

List of Experiments:

1. Essential Linux Commands [9P]:
   Commands for files and directories cd, cp, mv, rm, mkdir, more, less, creating and viewing files, using cat, file comparisons, View files, kill, ps, who, sleep, grep, fgrep, find, sort, cal,banner, touch, file related commands – ws, sat, cut, grep etc. Mathematical commands – expr, factor, units, Pipes (use functions pipe, popen, pclose), named Pipes (FIFOs, accessing FIFO)

2. Shell Programming [6P]:
   Creating a script, making a script executable, shell syntax (variables, conditions, control structures, functions, and commands).

3. Process [3P]:
   Starting new process, replacing a process image, duplicating a process image.

4. Semaphore [3P]:
   Programming with semaphores (use functions semget, semop, semaphore_p,semaphore_v).

5. POSIX Threads [6P]:
   Programming with pthread functions (viz. pthread_create, pthread_join, pthread_exit,pthread_attr_init, pthread_cancel)

6. Shared Memory [9P]:
   Create the shared memory, Attach the shared memory segment to the address space of the calling process, read information from the standard input and write to the shared memory, Read the content of the shared memory and write on to the standard output Delete the shared memory

Textbooks:

Yashavant P. Kanetkar, UNIX Shell Programming, 1st edition, BPB Publications Beej's Guideto Unix IPC

Reference Books:

W. Richard Stevens, UNIX Network Programming, 2nd edition, Prentice Hall

CO-PO Mapping:

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	-	-	-	1	1	-	2	-	-	-	3
CO2	-	3	3	3	-	-	-	-	1	-	1	3
CO3	2	-	-	2	-	1	-	1	-	1	-	-
CO4	-	3	3	-	-	-	3	-	2	-	-	1

COs/PSOs	PSO1	PSO2	PSO3
CO1	3	3	3
CO2	3	3	3
CO3	3	3	3
CO4	3	3	3
CO5	3	3	3

Course Name: DATABASE MANAGEMENT SYSTEM LAB
Course Code: OEC692A
Contact: 0:0:3
Credits: 1.5

Prerequisite:

Logic of programming language

Basic concepts of data structure and algorithms

Course Outcomes:
Graduates of the ECE program will be able to:

CO1: Understand the basic concepts regarding database, know about query processing and techniques involved in query optimization and understand the concepts of database transaction and related database facilities including concurrency control, backup, andrecovery.
CO2: Understand the introductory concepts of some advanced topics in data management likedistributeddatabases, data warehousing, deductive databases and be aware of some advanced databases like partial multimedia and mobile databases.
CO3: Differentiate between DBMS and advanced DBMS and use of advanced database conceptsand becomeproficient in creating databasequeries.
CO4: Analyze database system concepts and apply normalization to thedatabase.
CO5: Apply and create different transaction processing and concurrency control applications.

Experiment Details:

1. Structured Query Language
2. Creating Database Creating a Database
3. Creating a Table Specifying Relational Data Types Specifying Constraints
4. Creating Indexes Table and Record Handling INSERT statement
5. Using SELECT and INSERT together DELETE, UPDATE, TRUNCATE statementsDROP, ALTER statements
6. Retrieving Data from a Data base the SELECT statement Using the WHERE clause.
7. Using Logical Operators in the WHERE clause
8. Using IN, BETWEEN, LIKE, ORDER BY, GROUP BY and HAVING Clause UsingAggregate Functions
9. Combining Tables Using JOINS Sub-queries Database Management Creating Views
10. Creating Column Aliases Creating Database Users Using GRANT and REVOKEPL/SQL
11. Database design using E-R model and Normalization
12. Design and implementation of some online system [Library Management System]

Textbook:

1. SQL, PL/SQL by Ivan Bayross, BPB Publications
2. Oracle PL/SQL Programming, 6th Edition - O'Reilly Media By Steven Feuerstein, Bill Pribyl

CO/PO Mapping :

COs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO11	PO12
CO1	2	2	2	2	3	2	1	1	2	2	3	3
CO2	2	3	3	3	3	1	-	1	2	2	2	3
CO3	3	3	2	-	3	2	2	2	3	3	3	1
CO4	3	2	2	2	2	1	1	1	1	1	-	3
CO5	3	3	3	3	3	2	2	2	3	3	3	3

COs/PSOs	PSO1	PSO2	PSO3
CO1	3	3	3
CO2	3	3	3
CO3	3	3	3
CO4	3	3	3
CO5	3	3	3

Course Name: 3D Printing & Design LabCourse

Code: OEC 692B
Contacts: 0:0:3
Credit: 1.5

Prerequisite:

Knowledge of computer and mathematics.

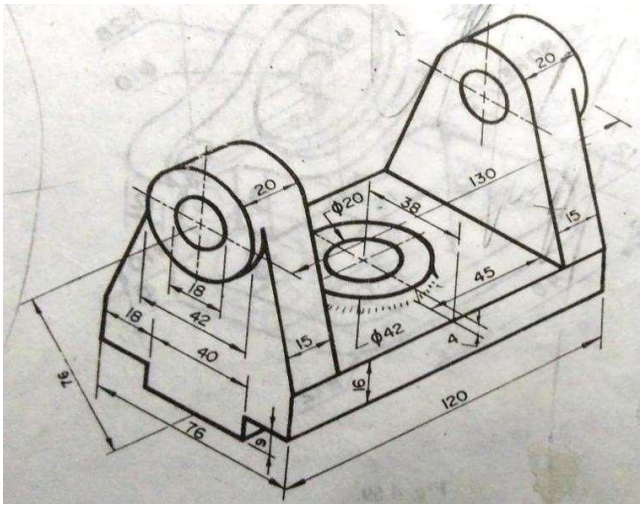
Course Outcomes:

Graduates of the ECE program will be able to:

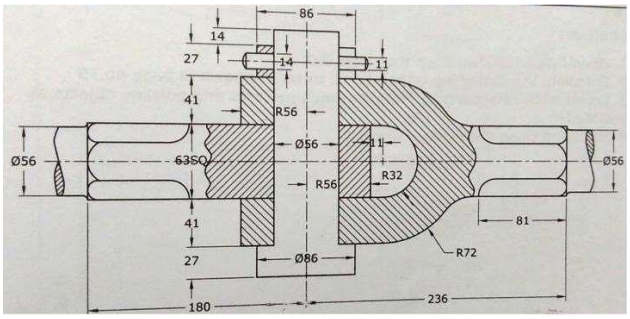
CO1: Analyze CAD tools for different design.
CO2: Apply 2D model using CAD tools.
CO3: Apply 3D model using CAD tools.
CO4: Conceptualize and visualize their designs

Experiment Details:

1. Introduction to the different features of CAD softwares.
2. To make a given 2-D drawing using CAD software.
3. Make a 3-D drawing using CAD software
4. Make a 3-D drawing using CAD software as per the figure below:



5. Editing a drawing using feature modification and Manipulation
6. Draw a detailed drawing as given below



7. To make an object using Sheet metal.

   Make a box of given dimensions using a sheet of 0.5 mm thickness. Length = 60 mm Width = 40 mm Height = 50 mm

8. To make a hollow cylindrical object of the given dimensions.Length: 50 mm Outer Día: 25 mm inner Día: 20 mm
9. To solve a one-dimensional problem on finite element method.

Textbooks:

Auto CAD for dummies by Bill Fane, Wiley.

CO-PO Mapping

COs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO 1	2	2	2	2	3	2	1	1	2	2	3	3
CO 2	2	3	3	3	3	1	1	1	2	2	3	3
CO 3	3	3	2	3	3	2	2	2	3	3	3	3
CO4	3	2	2	3	3	2	2	2	2	3	-	2

COs/PSOs	PSO1	PSO2	PSO3
CO1	3	3	3
CO2	3	3	3
CO3	3	3	3
CO4	3	3	3

Course Name: WEB INTELLIGENCE & BIG DATA LABORATORY
Course Code: OEC 692C
Contacts: 0:0:3 Credit:1.5

Prerequisite: Knowledge in C, Python, R, Proficiency in LINUX, SQL

Course Outcomes:
Graduates of the ECE program will be able to:

CO1: Able to configure and run Hadoop and HDFS
CO2: Able to apply Map Reduce in practical problems
CO3: Implement Hadoop, Map Reduce and NO SQL in big data analytics.
CO4: Apply Hadoop ecosystem components for business and scientific computing.

LIST OF EXPERIMENTS

1. Familiarization and install, configure, and run Hadoop and HDFS.
2. Implement word count / frequency programs using MapReduce.
3. Implement an MR program that processes a weather dataset.
4. Study on Linear and logistic Regression.
5. Implement SVM / Decision tree classification techniques.
6. Study of clustering techniques.
7. Study of data using any plotting framework.
8. Write a program that stores big data in Hbase / MongoDB / Pig using Hadoop /R.

TextBooks:

1. Akerkar, R. & Lingras, P. (2008). Building an Intelligent Web: Theory and Practice. Jonesand Bartlett Publishers, Sudbury, Massachusetts. ISBN- 13: 978-0-7637-4137-2
2. Chris Eaton, Dirk deroos et al., "Understanding Big data", McGraw Hill,2012.
3. Tom White, "HADOOP: The definitive Guide", O Reilly 2012.
4. Seema Acharya, Subhasini Chellappan, "Big Data Analytics" Wiley 2015.

Reference Books:

1. Witten, Ian H. & Frank, E. (2005). Data Mining: Practical Machine Learning Tools andTechniques. 2nd Edition, Morgan Kaufman. ISBN 0120884070, 9780120884070
2. Michael Berthold, David J. Hand, "Intelligent Data Analysis", Springer,2007.
3. Glenn J. Myatt, Making Sense of Data, John Wiley & sons, 2007 PeteWarden, Big Data Glossary, O'Reilly, 2011.
4. Vignesh Prajapati, "Big Data Analytics with R and Haoop", Packe Publishing 2013.
5. Jy Liebowitz, "Big Data and Business analytics",CRC press, 2013.
10. Anand Rajaraman and Jefrey David Ulman,"Mining of Massive Datasets", CambridgeUniversity Press, 2012.

CO-PO Mapping:

Cos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	2	2	2	2	-	-	-	-	2	2
CO2	3	2	2	2	3	2	-	1	-	1	2	2
CO3	3	3	3	3	2	2	1	-	1	-	2	2
CO4	3	3	3	2	3	2	-	-	-	-	2	2

Weightage Values: 3 = Strongly matched, 2 = Moderately matched, 1 = Weakly matched, (-) = Notmatched.

COs/PSOs	PSO1	PSO2	PSO3
CO1	3	3	3
CO2	3	3	3
CO3	3	3	3
CO4	3	3	3

Course Name: SCIENTIFIC COMPUTING LAB
Course Code: OEC 692D
Contact: 0:0:3 Credits:1.5

Prerequisite: Basic Knowledge of Engineering Mathematics

Course Outcomes:
Graduates of the ECE program will be able to:

CO1: Analyze the various computing tools.
CO2: Apply the computation techniques for complex mathematical problem solving.
CO3: Create the solution for a given problem using the techniques of scientific computing.
CO4: Apply the various scientific computing tools for problem solving.

LIST OF EXPERIMENTS

1. Familiarization of the various Computing Tools
2. Basic requirements in scientific computing
3. Familiarization with a programming language for scientific computing
4. To be familiarized with data types in the language used.
5. To be familiarized with the syntax.
6. Understanding the basic syntax and execution of programs.
7. Basic arithmetic functions such as abs, sine, real, imag, complex, sinc etc.
8. Applications in fast scientific areas.
9. Problem solving using mathematical functions and tools.

TextBooks:

1. Akerkar, R. & Lingras, P. (2008). Building an Intelligent Web: Theory and
1. T. M. Apostol. Calculus, Vol. 1: One-Variable Calculus with an Introduction to Linear Algebra. John Wiley & Sons, Inc., ISBN 0471000051
2. 2. T. M. Apostol. Calculus, Vol. 2: Multi-Variable Calculus and Linear Algebra, with
3. Applications to Differential Equations and Probability. John Wiley & Sons, Inc., ISBN9780471000075.

Reference Books:

1. J. vonzur Gathen and J. Gerhard. Modern Computer Algebra. Cambridge University Press,3rd ed., 2013.ISBN 9781107039032
2. J.A. Storer. An Introduction to Data Structures and Algorithms. Springer, 2002 ISBN 978-1-4612-0075-8
3. D.Sankoff, J.Kruskal. Time Warps, String Edits, and Macromolecules. The Theory and Practice of Sequence Comparison (CSLI Pub., 1999) ISBN 9781575862170
4. A.Masoudi-Nejad, Z.Narimani, N.Hosseinkhan. Next Generation Sequencing and Sequence Assembly: Methodologies and Algorithms. Springer, 2013, ISBN 978-1-4614- 7725-9.

CO-PO Mapping:

CO	PO1	PO2	PO3	PO 4	PO5	PO 6	PO7	PO8	PO 9	PO10	PO11	PO12
CO1	3	3	2	2	2	2	1	-	1	-	2	2
CO2	3	2	2	2	3	2	-	1	-	-	2	2
CO3	3	3	3	3	2	2	1	-	1	-	2	2
CO4	3	3	3	2	3	2	-	1	-	1	2	2

Weightage Values: 3 = Strongly matched, 2 = Moderately matched, 1 = Weakly matched, (-) = Notmatched.

COs/PSOs	PSO1	PSO2	PSO3
CO1	3	3	3
CO2	3	3	3
CO3	3	3	3
CO4	3	3	3

Course Name: Intellectual Property RightCourse
Code: MC 601
Contact: 2:0:0
Total Contact Hours: 24
Credit: 0

Prerequisite: None

Course Outcomes:
Graduates of the ECE program will be able to:

CO1: Explain fundamental aspects of Intellectual property Rights to students
CO2: Apply knowledge on patents, patent regime in India and abroad and registrationaspects CO3: Disseminate knowledge on copyrights and its related rights and registration aspects CO4: Disseminate knowledge on trademarks and registration aspects
CO5: Understand knowledge on Design, Geographical Indication(GI), Plant Variety andLayout Design Protection and their registration aspects

Course Content

Module 1: 4L

Overview of the IPR: Introduction andtheneed for intellectual property right (IPR)- Kinds of IntellectualProperty Rights: Patent, Copyright, Trade Mark, Design, Geographical Indication, Plant Varieties and Layout Design – Genetic Resources and Traditional Knowledge – Trade Secret - IPR in India : Genesis and development – IPR in abroad - International organizations. agencies and treaties,

Module 2: 4L

Patents- Trips Definition, kind of inventions protected by patent-Patentable and Non patentable inventions. Elements of Patentability: Novelty , Non Obviousness (Inventive Steps), Legal requirementsfor patents — Granting of patent - Rights of a patent-exclusive right. Patent application process: Searching a patent- Drawing of a patent- Filing of a patent- Types of patent applications- Parent document:specification and Claims.
Registration Procedure, Rights and Duties of Patentee, Restoration of lapsed Patents, Surrender and Revocation of Patents, Infringement, Remedies & Penalties

Module 3: 4L

Trademarks- Concept of Trademarks - Different kinds of marks (brand names, logos, signatures, symbols, well known marks, certification marks and service marks) - Non Registrable Trademarks - Registration of Trademarks -Rights ofholder andassignment andlicensingof marks -Infringement,Remedies &Penalties
- trade mark registration processes.

Module 4: 4L

Copyrights-

Right and protection covered by copyright - Law of copy rights: Fundamental of copyright law. originality of material, rights of reproduction, rights to perform the worth publicly, copy right ownership issues, obtaining copy right registration, notice of copy right. International copy right law.Infringement of Copyright under Copyright Act

The Role arid Liabilities of lPRs in India - Cyberlaw issues: Criminal law. data safety, online privacy.Health privacy, Freedom of expression and human rights, net neutrality, national security.

Module 5: 4L

Geographical Indication of Goods: Types, why and how GIneed protection and GI laws. Indian GIact.IndustrialDesigns: protection. Kind of protection provided by industrial designs. Integrated Circuits

Module 6: 4L

India`s New National IP Policy, 2016 – Govt. of India step towards promoting IPR – Govt. Schemes IPR

– Career Opportunities in IP - IPR in current scenario with case studies

Text book:

1. Fundamentals oflP for Engineers: K.Bansl& P.Bansal
2. Nithyananda, KV.(2019). Intellectual Property Rights: Protectionand Management. India, IN: CengageLearning India Private Limited.
3. Neeraj, P., & Khusdeep, D. (2014). Intellectual Property Rights. India, IN: PHI learning Private Limited.

Reference book:

1. Ahuja, V K. (2017). Law relating to Intellectual Property Rights. India, IN: Lexis Nexis.

CO-PO Mapping:

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	-	1	2	3	-	-	2	-	2	3	3
CO2	3	1	-	1	-	-	1		1	-	3	2
CO3	3		1	2	3	-		2		2	2	3
CO4	3	1	-	1	-	-	1	-	1		3	3
CO5	3	-	2	-	2	3	-	-	-	2	3	2

Weightage Values: 3 = Strongly matched, 2 = Moderately matched, 1 = Weakly matched, (-) = Notmatched.

COs/PSOs	PSO1	PSO2	PSO3
CO1	3	3	3
CO2	3	3	3
CO3	3	3	3
CO4	3	3	3
CO5	3	3	3

Curriculum for B.Tech Under Autonomy
Electronics & Communication Engineering
(Effective From 2021-22 admission Batch)
L – Lecture; T- Tutorial; P- Practical [1L=1Cr, 1T=1Cr, 1P =0.5 Cr]

4th Year 1st Semester: 7th Semester

Sl. No	Course Code	Paper Code	Theory	Contact Hours /Week				Credits/ Unit
				L	T	P	Total	
A. THEORY								
1	PE	PEC701	Professional Elective-IV A: Internet of Things B: Artificial Intelligence C: Digital Control System D: Cloud Computing(AWS)	3	0	0	3	3
2	PE	PEC702	Professional Elective-V A: Biomedical Electronics & Imaging B: Introduction to EDA tool C: Radar & Missile Communication D: Introduction to MEMS	3	0	0	3	3
4	OE	OEC 702	Open Elective-III A: Data Science B: Machine Learning C: Cyber Security & Cryptography D: Advanced Bio Signal Processing E: Mixed signal Design	3	0	0	3	3
B. PRACTICAL								
5	PE	PEC 791	Professional Elective-IV lab A: Internet of Things Lab B: Artificial Intelligence Lab C: Digital Control System Lab D: Cloud Computing (AWS) Lab	0	0	0	3	1.5
6	OE	OEC 792	Open Elective-III Lab A: Data Science Lab B: Machine Learning Lab C: Cyber Security & Cryptography Lab D: Advanced Bio Signal Processing Lab E: Mixed signal Design Lab	0	0	3	3	1.5
7	PROJECT	PR 791	Major Project-I	0	0	0	4	2
8	PROJECT	PR 792	Skill Development VII: Seminar & Group Discussion	0	0	1	1	0.5
9	PROJECT	PR 793	Industrial Training / Internship	0	0	0	0	1
C. MANDATORY ACTIVITIES / COURSES								
10	MC	MC 701	Entrepreneurship & Innovation Skill	2	0	0	2	0
TOTAL CREDIT WITHOUT MOOCS COURSES								15.5
D.MOOCS COURSES**								
11	MOOCS COURSES	HM701	MOOCS COURSE-VI	3	1	0	4	4
TOTAL CREDIT WITH MOOCS COURSES								19.5

*Collective Data from 3rd to 6th Semester (Summer/Winter Training during SemesterBreak & Internship should be done after 5th Semester or 6th Semester). All related certificates to be collected by the training/internship coordinator(s)

** MOOCS COURSES for HONOURS/MINOR Degree are Program specific and to be taken from MOOCS BASKET

Course Name: Internet of Things

Course Code: PEC701A

Contacts: 3:0:0
Total Contact Hours: 36
Credits:3

Prerequisite: Sensors, Actuators, Microcontroller, Computer Networks

Course Objectives: The purpose of this course is to gather knowledge about Iot, its architecture different software and hardware components of IoT. Finally students will apply such knowledge to design some hands-on models showcasing different IoT applications.

Course Outcomes:
Graduates of the ECE program will be able to

CO1: understand Internet of Things and its hardware and softwarecomponents
CO2: interface I/O devices, sensors & communication modules
CO3: remotely monitor data and control devices
CO4: develop real life IoT based projects

Course Content

Module 1: Introduction to IoT: Architectural Overview, IoT Enablers, IoT Applications, Sensing, Actuation, Basics of Networking, M2M and IoT Technology Fundamentals- Devices and Gateways, Data management, Idea of Cloud, Edge and Fog computing, Role of Cloud in IoT, Services offered by Cloud.

10L

Module 2: Elements of IoT: Hardware Components- Arduino, Raspberry Pi development board, Communication, Sensing, Actuation, I/O interfaces. Software Components- Programming API's (using Embedded C/Python/Node.js) for Communication and Network Protocols- RFID, ZigBee, Bluetooth, BLE, MQTT, CoAP, TCP/IP, UDP 10L

Module3: It Application Development: Solution framework for IoT applications- Implementationof Device integration, Data acquisition and integration, Device data storage- Unstructured data storage on cloud/local server, Authentication, authorization of devices. Use of AI and ML in IoT

10L

Module 4: IoT Case Studies 'case studies and mini projects based on Industrial Automation, Transportation, Agriculture, Healthcare, Home Automation. 6L

Textbooks and Reference Books:

1. Introduction to IoT by Sudip Misra, Anandarup Mukherjee, Arijit Roy, 1st Edition Cambridge University Press.

2. Vijay Madisetti, Arshdeep Bahga, Ïnternet of Things, "A Hands onApproach", University Press
3. Raj Kamal, "Internet of Things: Architecture and Design", McGraw Hill

4. Pethuru Raj and Anupama C. Raman, "The Internet of Things: Enabling Technologies, Platforms, and Use Cases", CRC Press
5. Jeeva Jose, "Internet of Things", Khanna Publishing House, Delhi 6.Adrian McEwen, "Designing the Internet of Things", Wiley
7.Cuno Pfister, "Getting Started with the Internet of Things", O ReillyMedia 8.Dr. SRN Reddy, Rachit Thukral and Manasi Mishra, "Introduction to Internet of Things: A practical Approach", ETI Labs

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2	2	-	-	2	-	-	1	1	1	3
CO2	-	3	-	2	-	1	2	1	-	-	-	2
CO3	2	-	-	-	1	-	3	1	2	2	1	3
CO4	3	-	1	-	2	-	2	-	-	1	-	2

Weightage Values: 3 = Strongly matched, 2 = Moderately matched, 1 = Weakly matched, (-) = Not matched.

CO-PSO Mapping:

COs/PSOs	**PSO1**	**PSO2**	**PSO3**
CO1	3	3	3
CO2	3	3	3
CO3	3	3	2
CO4	3	3	3

Course Name: **Artificial Intelligence**

Course Code: PEC701B

Contacts: 3:0:0
Total Contact Hours: 36
Credits:3

Prerequisites:

- Strong knowledge of mathematics
- Good command over programming languages
- Good Analytical Skills
- Ability to understand complex algorithms

Course outcome:
Graduates of the ECE program will be able to

CO-1: Understand the concept of AI .
CO-2: Illustrate searching algorithms.
CO-3: Analyze the representation of knowledge.
CO-4: Demonstrate the learning methods.

Module-I [2L]
Introduction:
What is AI, Agents and environment, concept of rationality, nature of environment and structure ofagents.

Module-I [8L]
Searching and Problem Solving:
Well defined problems and solutions, formulating problems, 8 puzzle problem, Tower of Hanoi, Datadriven and goal driven search, Breadth-first search, Depth first search, Bidirectional search, Hill climbing, simulated annealing.

Module-III [10L]
Knowledge Representation and Reasoning: Knowledge based agents, The Wumpus world, Logic, Propositional logic, first order predicate logic (FOPL), Rule of inference, Forward and Backward chaining, Algorithms for planning as State-Space search, Planning graphs, Bayes' rule, and Bayesian Networks.

Module-IV [13L]
Learning: Supervised learning, learning decision trees, Evaluating the best hypothesis, the theoryof learning, Neural Networks (Network structures, Single layer feed-forward neural network, Multilayer feed- forward neural network, learning weights), Nonparametric model, Ensemble learning, learning with relevance information, learning with complete data, learning with hidden variables, passive and active reinforcement learning, policy search.

Module-V [3L]
Natural Language Processing: Language models, Text classification, Information retrieval,Information extraction.

Text Books:
1. Artificial Intelligence: A Modern Approach, Russell & Norvig, Prentice Hall.
3. Artificial Intelligence, Elain Rich and Kevin Knight, TMH.

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2	1	-	-	2	-	-	1	-	1	2
CO2		3	-	2	-	1	2	-	-	2	-	3
CO3	2	-	-	-	1	-	3	-	2	-	2	2
CO4	3	-	1	-	2	-	2	-	-	1	1	3

Weightage Values: 3 = Strongly matched, 2 = Moderately matched, 1 = Weakly matched, (-) = Notmatched.

CO-PSO Mapping

COs/PSOs	**PSO1**	**PSO2**	**PSO3**
CO1	3	3	3
CO2	3	2	3
CO3	3	3	3
CO4	3	3	3
CO5	2	3	2

Course Name: Digital Control System
Course Code: PEC701C
Contacts: 3:0:0
Total Contact Hours: 36
Credit:3

Prerequisite: Knowledge about Basic Control System

Course Outcomes:
Graduates of the ECE program will be able to

CO1: Obtain an overview on Digital Control System and Modelling of System in sampleddomain.

CO2: Design of any system in digital domain and analysis its stability.
CO3: Obtain concept of Advanced Digital Control System Design and application of its inindustry.
CO4: Obtain the concept of Digital Stability of the system.

Course Content

Module 1: Introduction: Control System Terminology, Computer-Based Control: History and Trends, Control Theory: History and Trends, An Overview of the Classical Approach to Analog Controller Design ,Review: System modelling, Review: Actual and desired dynamic response. Review: Feedback control, Review: Frequency response. [5L]

Module 2: Discrete-Time Systems: Difference equations, z-transform, z-transform solution of difference equations, Time response of discrete-time systems, Frequency response of discrete-time systems, The sampling theorem [4]L

Module 3: Modelling Digital Control Systems: ADC model, DAC model, Transfer function of aZOH, Transfer function of DAC, analog system, and ADC combination, Systems with transport lag, The closed- loop transfer function, Steady-state error and error constants. [6L]

Module 4: Digital Control System Design: Digital implementation of analog controllers, D i r e c t z- plane root locus design Loop shaping (frequency response) design, Optimal Control, Optimal linear quadratic regulator design, Kalman filter design, LQG optimal control. [5L]

Module 5: Stability Analysis: Mapping between the S-Plane and the Z-Plane – Primary stripsand Complementary Strips–Constant, frequencyloci, Constantdampingratioloci, StabilityAnalysisofclosedloop systemsin the Z-Plane. Jury stability test – Stability Analysis by use of theBilinear Transformation and Routh Stability criterion. [5L]

Module 6: Design of discrete time control system by conventional methods: Transientand steady, State response Analysis, Design based on the frequency response method, Bilinear Transformation and Design procedure in the w-plane, Lead, Lag and Lead-Lag compensators and digital PID controllers. [5L]

Module 7: State feedback controllers and observers Design of state feedback controller through pole placement, Necessary and sufficient conditions, Ackerman's State Observers – Full order and Reduced order observers. [6L]

Textbooks:

1. Discrete-TimeControl systems–K. Ogata, Pearson Education/PHI, 2nd EditionReference Books:

1. DigitalControl Systems, Kou, OxfordUniversityPress,2nd Edition,2003. 2.Digital Control and StateVariable Methods by M. Gopal,TMH

CO-PO Mapping:

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	1	2	-	-	-	-		3	-	2	1
CO2	-	-	-	-	2	2	1	3	2	-	3	2
CO3	2	2	2	-	2	3	-	2	3	-	2	3
CO4	3	-	3	-	1	3	2	3	2	-	2	3

Weightage Values: 3 = Strongly matched, 2 = Moderately matched, 1 = Weakly matched, (-) = Notmatched.

CO-PSO Mapping

COs/PSOs	**PSO1**	**PSO2**	**PSO3**
CO1	3	3	3
CO2	3	2	3
CO3	3	3	3
CO4	3	3	3
CO5	3	3	3

Paper Code: PEC701D
Paper Name: Cloud Computing
Contact: 3:0:0
Total Contact Hours:36
Credits: 3

Prerequisites:

- Should have the basic knowledge of Operating Systems and VirtualizationTechnologies
- Should be aware of the fundamental concepts of Networking
- Should have knowledge of heterogeneous systems and resource management.

Course Outcome:

CO1: Articulate the business model concepts, architecture and infrastructure of cloud computing,including cloud service models and deploymentmodels.
CO2: Applyanddesign suitable Virtualization concept, Cloud Resource Management, anddesignscheduling algorithms.
CO3: Explore some important cloud computing driven commercial systems such as Google Apps,Microsoft Azure and Amazon Web Services and other businesses cloud applications.
CO4: Analyze the core issues of cloud computing such as security, privacy, interoperability, and its impact on cloud application.

Module 1: Definition of Cloud Computing and its Basics [9L]
1. Definition of Cloud Computing: Defining a Cloud, Cloud Types – NIST model, Cloud Cube model, Deployment models (Public, Private, Hybrid and Community Clouds), Service models – Infrastructure as a Service, Platform as a Service, Software as a Service with examples of services/ service providers, Cloud Reference model, Characteristics of Cloud Computing – a shift in paradigm Benefits and advantages of Cloud Computing [4]
2. Cloud Architecture: Cloud Infrastructure, Architecture of each component, Virtualization versus Traditional Approach, Virtualization Model for Cloud Computing.[2]
3. Services and Applications by Type [3]
IaaS – Basic concept, Workload, partitioning of virtual private server instances, Pods,aggregations, silos PaaS – Basic concept, tools and development environment with examples
SaaS - Basic concept and characteristics, Open SaaS and SOA, examples of SaaS platform Identityas a Service (IDaaS) Compliance as a Service (CaaS)

Module 2: Use of Platforms in Cloud Computing [6L]
1. Concepts of Abstraction and Virtualization[2]
Virtualization technologies: Types of virtualizations, Load Balancing and Virtualization: Basic Concepts, Network resources for load balancing; Classification of Virtualization Environment: Scheduling-based Environment, Load-Distribution-Based Environment, Energy Aware-Based Environment, Operational-Based Environment, Distributed Pattern-Based Environment, Transactional- Based Environment
2. Mention of The Google Cloud as an example of use of load balancing Hypervisors: Virtual machine technology and types, VMware vSphere Machine imaging (including mention of Open Virtualization Format – OVF) [2] Porting of applications in the Cloud: The simple Cloud API and AppZero Virtual Application appliance
3. ConceptsofPlatformasaService[2]
Definition of services, Distinction between SaaS, and PaaS (knowledge of Salesforce.com and Force.com), Application development. Use of PaaS Applicationframeworks

Module 3: Cloud Service Models [6L]

1. Use of Google Web Services [2L]
Discussion of Google Applications Portfolio – Indexed search, Dark Web, Aggregation and disintermediation, Productivity applications and service, Adwords, Google Analytics, Google Translate, a brief discussion on Google Toolkit (including introduction of Google APIs in brief), major features of Google App Engine service.
2. Use of Amazon Web Services [2L]
Amazon Web Service components and services: Amazon Elastic Cloud, Amazon Simple Storage system, Amazon Elastic Block Store, Amazon Simple DB and Relational Database Service
3. Use of Microsoft Cloud Services [2L]
Windows Azure platform: Microsoft's approach, architecture, and main elements, overview of Windows Azure AppFabric, Content Delivery Network, SQL Azure, and Windows Live services

Module 4: Cloud Infrastructure [10L]
Types of services required in implementation – Consulting, Configuration, Customization and Support
1. Cloud Management [3L]
An overview of the features of network management systems and a brief introduction of related products from large cloud vendors, Monitoring of an entire cloud computing deployment stack – an overview with mention of some products, Lifecycle management of cloud services (six stages of lifecycle)
2. Live Migration of Virtual Machines: [2L]
Need of Live Migration of Virtual Machine, A Designing Process of Live Migration, and Security Issues during live migration
3. Concepts of Cloud Security [3L]
Infrastructure Security, Infrastructure Security: The Network Level, The Host Level, The Application Level, Data Security and Storage, Aspects of Data Security, Data Security Mitigation Provider Data and Its Security, Identity and Access Management
4. Auditing and Compliance in Cloud Environment: [2L]
Data Security in Cloud Computing Environment, Need for Auditing in Cloud Computing Environment, Third Party Service Provider, Cloud Auditing Outsourcing Lifecycle Phases, Auditing Classification.

Module 5 : Concepts of Services and Applications [5L]
1. Service Oriented Architecture: Basic concepts of message-based transactions, Protocol stack for an SOA architecture, Event-driven SOA, Enterprise Service Bus, Service catalogs [1]
2. Applications in the Cloud: Concepts of cloud transactions, functionality mapping, Application attributes, Cloud service attributes, System abstraction and Cloud Bursting, Applications and Cloud APIs [2]
3. Cloud-based Storage: Cloud storage definition – Manned and Unmanned. [1]
4. Webmail Services: Cloud mail services including Google Gmail, Mail2Web, Windows Live Hotmail, Yahoo mail, concepts of Syndication services [1]

Textbooks:
1. Mastering Cloud Computing by Rajkumar Buyya, Christian Vecchiola, S.Thamarai Selvi, Mc Graw Hill Education (India) Private Limited, 2013
2. Fundamentals of Cloud Computing by P. K. Pattnaik, S. Pal, M. R. Kabat, Vikas Publications, 2014.

Reference Books:

1. Cloud Computing Bible by Barrie Sosinsky, Wiley India Pvt. Ltd,2013
2. Cloud computing: A practical approach, Anthony T. Velte, TataMcgraw-Hill

CO- PO Mapping:

CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO 1	3	2	2	2	2	-	-	1	-	-	2	2
CO 2	2	3	3	3	1	-	1	-	-	1	3	3
CO 3	3	2	2	2	2	2	-	-	2	-	2	2
CO 4	2	3	3	3	-	-	-	2	1	2	3	3

Weightage Values: 3 = Strongly matched, 2 = Moderately matched, 1 = Weakly matched, (-) = Notmatched.

CO-PSO mapping

COs/POs	**PSO1**	**PSO2**	**PSO3**
CO1	-	3	3
CO2	-	3	3
CO3	-	3	3
CO4	-	3	3
CO5	-	3	3

Course Name: Biomedical Electronics and Imaging
Course Code: PEC702A
Contacts: 3:0:0
Total Contact Hours: 36
Credit:3

Pre-requisite:
Concepts in Analog Electronics (Studied in Basic Electronics Engineering).Fundamental concepts on mathematics. Concepts in Digital signal Processing.

Course Outcomes:
Graduates of the ECE program will be able to

CO1: Explain Bioelectric signals, human physiological system, and different types of transducers
CO2: Understand different types of medical measurement system.
CO3: Able to understand deferent types of biomedical signal acquisition electrodes and different types of signal amplification techniques and able to design the amplifiers.
CO4: Able to examine the data handling, filtering techniques of bio-medical signals and able to analysis of time and frequency domain.
CO5: Able to understand medical imaging techniques and implement different algorithms to feature extract the signals.

Course Content:

Module I: Introduction of Medical Electronics: [6L]
Origins of Bioelectric signals, Electrocardiogram (ECG), Electromyogram (EMG), Recording Electrodes- Silver-silver Electrodes, Electrodes for ECG, EEG and EMG, Physiological Transducers- Pressure Transducers, Temperature sensors, Pulse sensors; Sources of bioelectric potential, resting potential, action potential, propagation of action potentials in nerves, Artificial heart (Basic Idea)

Module II: Medical Measurement systems: [8L]

Specifications of instruments, static & dynamic characteristics, classification of errors, statistical analysis. Introduction to reliability, accuracy, fidelity, speed of response, Impedance,and current distribution, bipolar and tetra polar circuits, skin impedance, galvanic skin response measurement, total body impedance, cardiac output, neural activity, respiratory activity, impedance plethysmography-resistance and capacitance type.

Brain-computer interface, Neural implants, Retinal Implants

Module III: Bio-amplifier and Bio-potential electrodes [8L]
Need for bio-amplifier -single ended bio-amplifier, differential bio-amplifier –right leg driven ECG amplifier. Band passes filtering, isolation amplifiers –transformer and optical isolation -isolated DC amplifier and AC carrier amplifier. Types of electrodes -surface, needle and micro electrodes and their equivalent circuits. Recording problems - measurement with two electrodes.
Patch clamp amplifier -the electronics of low noise current detection

Module IV: Medical Signal Processing [8L]
Biomedical signal origin & dynamics (ECG), Biomedical signal origin & dynamics (EEG, EMG etc.), Filtering for Removal of artifacts Illustrations of problem with case studies Morphological Analysis of ECG Correlation coefficient The Minimum phase correspondent and Signal Length.
EMG Signal and its Processing: EMG Signal Filtering & Noise Removal, Detection of Flexion andextension.

Module V: Medical Imaging Techniques [6L]

CT scan, ultrasound, NMR and PET, Implementation of algorithms covered in the course tocharacterize these signals.

Computer aided diagnosis (CAD) and advanced diagnostic image processing

Reference Books:

Wavelets and Time frequency methods for Biomedical signal Processing- M. Akay,IEEE Press, Digital Processing of speech signals- L. Rabinar, Pearson Education Biomedical Instrumentation and Measurements- Cromwell, Weibell and Pfeiffer, PHI

Mapping of POs with COs:

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	P10	P11	P12
CO1	2	3	2	-	2	1	1	1	1	1	1	2
CO2	3	2	2	-	-	-	-	-	2	2	-	1
CO3	3	2	1	2	1	1	2	-	2	1	2	-
CO4	3	1	-	-	1	2	-	2	1	2	-	1
CO5	1	1	3	2	1	1	-	-	2	1	-	2

Weightage Values: 3 = Strongly matched, 2 = Moderately matched, 1 = Weakly matched, (-) = Notmatched.

CO-PSO mapping

COs/POs	**PSO1**	**PSO2**	**PSO3**
CO1	3	3	3
CO2	3	3	3
CO3	3	3	3
CO4	3	3	3
CO5	3	3	3

Course Name: Introduction to EDA Tools
Course Code: PEC 702B
Contact: 3:0:0
Total Contact Hours: 36
Credits: 3

Prerequisites: Basic Concepts of Digital Electronics

Course Outcomes:

CO1: Able to originate optimize model of IC with help of high level and logic level synthesis indigital domain

CO2: Able to build and analyse VLSI Circuits in physical design phase with the help ofpartitioning , flooring , placement and routing

CO3: Able to elaborate and estimate the delay of a IC in design phase with the help of logical effort ,electrical effort , Elmore delay model , Directed Acyclic Graph (DAG).

CO4: Able to predict fault in digital IC with the help of different fault model and D-algorithmand develop test pattern with the help of ATPG algorithm for BIST

CO5 : Able to design system with the help of Verilog HDL for the application in combinationaland sequential domain .

Course Content:

Module 1: Introduction to Synthesis [6L]

Introduction – Electronic Design Automation for Integrated Circuits; High level synthesis – Control and Data flow graph, scheduling, allocation & binding, Logic synthesis -gate level optimization, technology mapping , BDD ,ROBDD

Module II: Physical Design Automation [10L]

Partitioning -level of portioning , partitioning algorithm ; Floorplanning – input ,output & objectives with example, cost estimation of floorplan, dead space, slicing & non-slicing floorplan, hierarchical floorplan, polar graph, Floorplanning algorithm, pin assignment ; Placement – objectives , placementproblem at different levels (system , board&chip),estimation of wirelength(multi terminal), placement algorithm – simulation based ; Routing – grid , global & detailed routing , Maze running algorithm
,Lee's algorithm, line search algorithm , Steiner tree algorithm .

Module III: Timing Analysis [4L]

Slew balancing , transistor equivalency , design of basic gates for equal rise and fall time , intrinsic delay , parasitic delay ,logical effort ,electrical effort , Interconnect delay -Elmore Delay Model , StaticTiming Analysis using Directed Acyclic Graph (DAG) , false path , timing driven routing

Module IV: Testing of VLSI Circuit [8L]

Types of Faults in ASIC Design, Fault Models, Faults detection - Rauth's Algorithm /

D-Algorithm; Fault Simulation- Serial, Parallel, Deductive & Concurrent Fault Simulation.

Test pattern Generation- Boundary Scan, Built-In-Self-Test (BIST), Automatic Test Pattern Generation(ATPG), Design for Testability (DFT).

Module V: Design using Verilog [8L]

Operators , data types , numbers , logic , Modeling using Verilog ,statements (assignment , wait ,control) , test bench , FSM , design example – combinational and sequential.

Textbooks:

1. Algorithm for VLSI Physical Design Automation , Naveed A. Sherwani
2. VLSI Design and EDA Tools , Angsuman Sarkar , Swapnadip De , C.K. Sarkar , Scitech
3. VLSI Design, Debaprasad Das, Oxford
4. Digital Integrated Circuit , J.M.Rabaey, Chandrakasan, Nicolic, Pearson Education.
5. CMOS Digital Integrated Circuits Analysis and Design , S.M.Kang & Y.Leblebici,TMH.

Reference Books:

1. G. De Micheli. Synthesis and optimization of digital circuits,
2. S. Palnitkar, Verilog HDL: A Guide to Digital Design and Synthesis, Prentice Hall,

CO-PO Mapping

COs	PO 1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO1 0	PO11	PO12
CO1	2	2	3	1	2	1	-	1	2	2	2	3
CO2	3	3	3	3	2	1	-	1	2	2	3	3
CO3	3	3	3	2	2	-	1	1	2	2	3	3
CO4	3	3	3	1	2	1	1	1	2	2	3	3
CO5	3	3	3	2	3	1	1	1	2	2	3	2

Weightage Values: 3 = Strongly matched, 2 = Moderately matched, 1 = Weakly matched, (-) = Notmatched

CO-PSO Mapping:

COs/PSOs	**PSO1**	**PSO2**	**PSO3**
CO1	3	3	3
CO2	3	3	3
CO3	3	3	2
CO4	3	3	3
CO5	3	3	2

Course Name: Radar & Missile Communication

Course Code: PEC702C
Contact: 3:0:0
Total Contact Hours: 36
Credits: 3

Prerequisite: Fundamental knowledge of electronics, measuring instruments, electromagnetic, antenna and wave propagation is required. Communication Systems.

The main objective of the course is to provide knowledge to the students on the fundamental concepts of RADAR, types, and measurements. The students will also learn about missile system, classification of missiles, aerodynamics of missiles, subsystems, and missile trajectory.

Course Outcomes:
Graduates of the ECE program will be able to
At the end of the course the student should be able to
CO1Understand the Fundamentals of Radar and Different types of Radar andtheir working
CO2: Analyze the Radar signal measurement and detection of target inclutter
CO3: Understand basics of missile design and the engineering aspects of missile integration.
CO4: Demonstrate the concept of guided missiles and aero dynamics ofmissiles.
CO5: Illustrate the various sub-systems used in missiles

Course Content:

Module –I: Introduction to Radar [5L]
Historical background, radar terminology, radar band designations, Radar block diagram, radar equation: detection of signals in noise and signal-to- noise ratio, Probabilities of detection & False alarm, integration of radar pulses, radar cross section, distributed targets, Transmitted power, pulse- repetition frequency, antenna parameters & system losses, introduction to radarclutter.

Module – II: Radar Types [5L]
Pulse radars and CW radars, Advantages of coherent radar, Doppler radar, and MTI: Doppler effect, delay-line cancellers, blind speeds, staggered PRFs, Digital filter bank, Moving Target Detector, limitations of MTI, tracking with radar, monopoles tracking, conical scan, limitation to tracking accuracy

Module –III: Radar signals & clutter and its application: [8L]
Basic radar measurement, theoretical accuracy of radar measurements, Range and velocity ambiguities, the ambiguity diagram, Descriptions of l a n d & sea clutter, statistical models for surface clutter, detection of targets in clutter. Applications: Electronic Warfare: ESM, ECM, ECCM; super resolution, IFM, types of jammers,

MISSILE TECHNOLOGY

Module –IV Introduction to Guided Missiles: [5L]

Classification of Missiles, Overview of missile design process. Examples of system integration. Configuration sizing parameters. Conceptual design process. Examples of mission requirements. Example of sensitivity analysis.

Module –V: Aerodynamics in Missile Design, Development, and System Engineering: [6L]

Introduction to Missile System, Interrelationship between various Missile Sub-Systems. Optimizing missile aerodynamics. Shapes for low observables. Configuration layout options.Selecting flight control alternatives. Wing and tail sizing. Predicting normal force, drag, pitchingmoment, stability, flight control effectiveness and divert maneuveringalternatives.

Module –VI: Flight Performance in Missile Design, Development, and System Engineering : [7L] Flight envelope limitations. Aerodynamic sizing-equations of motion. Accuracy of simplified equations of motion. Maximizing missile flight performance. Benefits of flight trajectory shaping. Flight performance prediction of boost, climb, cruise, coast, steady descent, ballistic, maneuvering, divert, and homing flight. Automatic target recognition.

Books:

1. "Understanding of Radar Systems", Simon Kingsley and Shaun Quegan,McGraw Hill, 1993.
2. Introduction to Radar Systems by Skolnik , McGraw-Hill, 2001
3. "Microwave and Radar Engineering" by Gottapu Sasi Bhushana Rao, ISBN – 978813179944 Pearson Education 2013.
4. "Fundamentals of Guided Missiles",by S. R. Mohan. Publisher : Defence Re-search and Development Organisation.
5. "Estimation and Prediction of Ballistic Missile Trajectories" by Jeffrey A.Isaac-son, David R. Vaughan.Publisher : RAND (29 May 1996)
6. "Introduction to Modern Algebra and Matrix Theory", by O. Schreier, E.Sperner, Martin David, Melvin Hausner. Publisher : Dover Publications.

CO-PO Mapping:

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	3	-	1	1	-	-	2	-	-	3
CO2	2	3	-	3	2	-	2	-	-	1	3	3
CO3	3	2	3	3	2	2	-	-	2	-	-	2
CO4	3	3	3	2	2	-	2	-	-	3	2	3
CO5	3	3	-	3	3	2	-	-	-	-	-	3

Weightage Values: 3 = Strongly matched, 2 = Moderately matched, 1 = Weakly matched, (-) = Notmatched.

CO-PSO Mapping:

COs/PSOs	**PSO1**	**PSO2**	**PSO3**
CO1	3	3	3
CO2	3	3	3
CO3	3	3	2
CO4	3	3	3
CO5	3	3	2

Course Name: Introduction to MEMS
Course Code: PEC702D
Contact: 3:0:0
Total Contact Hours: 36
Credits: 3

Prerequisites:

The students to whom this course will be offered must have the concept of VLSI and Microelectronics.

Course Outcomes:

Graduate of the ECE program will be able to:

CO1: Demonstrate the clean room concept
CO2: Implement the Substrate for MEMS
CO3: Conceptualize the deposition and photolithography process thoroughly.
CO4: Fabricate the MEMS devices through bulk micromachining techniques.
CO5: Explain the design, analysis and testing of MEMS.

Course Content:

Module 1: Introduction 6L

Clean room Technology
Microelectromechanical System (MEMS) – History, Definitions and Classifications, Market and Application, Materials for MEMS, Significance of MEMS

Module 2: Substrate for MEMS 6L

Introduction
Silicon – the base- Silicon as a semiconductor, Surface contamination, Cleaning & etching
Dielectrics- Silicon Dioxide (SiO_2), Silicon Nitride (Si_3N_4), Low temperature oxidation, Oxide properties

Module 3: Deposition 6L

Physical Vapour deposition- Vacuum fundamentals, e-beam evaporation, Thermal evaporation, Sputtering, Moleculer beam epitaxi (MBE),
Chemical Vapour deposition-APCVD, Plasma CVD, MOCVD
Metallization - Different types of metallization, Uses, Fusion Bonding

Module 4: Photolithography - Pattern transfer 6L

Introduction sequence - Photoresist (PR) for structuring, Positive PR, Negative PR
Designing of Mask layout using Clewin software
Photolithography Process- Application of photoresist and prebake, Alignment, Exposure and pattern formation, PR developer and Post bake, Some Advanced lithographic techniques

Module 5: Structuring MEMS – Micromachining 6L

Introduction
Bulk micromachining - Wet etching
Isoptropic and anisotropic – Impirical observations
Convex and Concave corner Compensations
Dry etching
Surface micromachining- Processes, Hurdles, Lift-off vs Etch back, Etch stop technique
Boron Etch Stop, Electrochemical Etch-Stop, Photo-Assisted Electrochemical Etch Stop (for n-Type Silicon), Etch Stop at Thin Films-Silicon on Insulator

High aspect ratio micromachining (HARM) – LIGA,Laser Micromachining

Module 6 MEMS and Nanotechnology enabled sensor applications 6L

Everyday Nanotechnology,Automotive applications- an elaborated study,Home appliances,Aerospace Environmental monitoring,Process Engineering,Medical Diagnostic

Text Books:

1. MEMS and Nanotechnology for Gas Sensor – Sunipa Roy, Chandan Kumar Sarkar
2. Microsystem Design, Stephen D. Senturia, Kluwer Academic Publishers, 2001,
3. Fundamentals of Microfabrication, Marc J. Madou, CRC Press LLC, 2002.
4. Chang Liu, "Foundations of MEMS", Pearson International Edition, 2006

Reference Books:

[1].Gaberiel M.Rebiz, "RF MEMS Theory,Design and Technology", John Wiley & Sons,2003 [2].Charles P.Poole, Frank J.Owens, "Introduction to nanotechnology" John Wiley & sons, 2003. [3].Julian W.Gardner, Vijay K Varadhan, "Microsensors, MEMS and Smart devices", John Wiley & sons, 2001.

CO- PO Mapping:

CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO9	PO1 0	PO1 1	PO1 2
CO1	2	3	3	2	2	-	2	-	3	1	1	3
CO2	3	3	2	3	2	-	2	-	3	-	-	2
CO3	2	3	3	3	2	-	2	-	3	1	2	3
CO4	3	3	2	2	2	-	2	-	3	-	-	3
CO5	3	3	3	3	2	-	2	-	3	2	2	2

Weightage Values: 3 = Strongly matched, 2 = Moderately matched, 1 = Weakly matched, (-) = Notmatched.

CO-PSO Mapping:

COs/PSOs	**PSO1**	**PSO2**	**PSO3**
CO1	3	3	3
CO2	3	3	3
CO3	3	3	2
CO4	3	3	3
CO5	3	3	2

Course Name: Data Science
Course Code: OEC702A
Contact: 3:0:0
Total Contact Hours: 36
Credits: 3

PRE-REQUISITES: Introduction to Programming, Probability

Course Outcome:

Graduates of the ECE program will be able to

CO1: Describe the basic and intermediate concepts of probability, statistics, and distributions.
CO2: Able to Apply regression, ANOVA, and goodness of fit test to construct model and inferconclusions about population/sample.
CO3: Able to Analyze hypothesis to accept/reject alternative hypothesis based on statisticalevidence available.
CO4: Able to learn Programming Tools for Data Science

CO5: Solve real-world machine learning tasks from data to inference

Course Content:

Module-I: 10L

Introduction to Data Science:
Concept of Data Science, Sample, Population, Measures of Central Tendency: Mean, median, mode, Range, Inter Quartile range, Cumulative frequency distribution, Traits of Big data, Web Scraping, Analysis vs Reporting 3L

Introduction to Programming Tools for Data Science

Toolkits using Python: Matplotlib, NumPy, Scikit-learn, NLTK, Panda. 3L

Tabular and Graphical Descriptive Techniques, Bar Charts, Line Charts, Scatterplots, 1L

Working with data: Reading Files, Scraping the Web, Using APIs (Example: Using the Twitter APIs), Cleaning and Munging, Manipulating Data, Rescaling, DimensionalityReduction 3L

Module II: Statistics for data science 12L
Measures of Dispersion: Meaning, Quartile deviation, Standard Deviation, Variance, Moments, Skewness, Kurtosis, Numerical Problem. 2L

Probability: Dependence and Independence, Conditional Probability, Bayes Theorem, Random Variables, Continuous Distributions, Binomial, Poisson, Normal Distribution, The Central Limit Theorem, Standard error, Numerical Problem 4L

Correlation and Regression: Bivariate Data, Correlation, Covariance, Correlation coefficient, Regression, Numerical Problem 2L

Hypothesis and Inference: Hypothesis Testing, Inference about a population, Confidence Intervals, Theory of Test of significance, z-statistics and z score, t- statistics, Degrees of Freedom, Type I & Type II error, P- values, Chi square test, Bayesian Inference, Numerical Problem 8L

Module-III: 10L

Machine Learning :
Overview of Machine learning concepts – Over fitting and train/test splits, Types of Machine learning – Supervised, Unsupervised, Reinforced learning, Introduction to Bayes Theorem, Linear Regression- model assumptions, regularization (lasso, ridge, elastic net), Classification and Regression algorithms- Naïve Bayes, K- Nearest Neighbors, logistic regression, support vectormachines (SVM), decision trees, and random forest, Classification Errors, Analysis of Time Series- Linear Systems Analysis, Nonlinear Dynamics, Rule

Induction, Neural Networks- Learning
And Generalization, Overview of Deep Learning. 6L

Module IV: 4L

Case Studies of Data Science Application (Any four)

Weather forecasting, Stock market prediction, Object recognition, Real Time Sentiment Analysis. Image visibility improvement through statistical model. 4L

LIST OF SUGGESTED BOOKS

1. N.G. Das "Statistical Methods",Mc Graw Hill
2. Joel Grus, "Data Science from Scratch: First Principles with Python", O'Reilly Media
3. Jain V.K., "Data Sciences", Khanna Publishing House, Delhi.
4. Jain V.K., "Big Data and Hadoop", Khanna Publishing House, Delhi.
5. Jeeva Jose, "Machine Learning", Khanna Publishing House, Delhi.
6. Chopra Rajiv, "Machine Learning", Khanna Publishing House, Delhi.
7. Ian Goodfellow, YoshuaBengio and Aaron Courville, "Deep Learning", MITPress http://www.deeplearningbook.org

CO-PO mapping:

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO1 0	PO1 1	PO1 2
CO 1	2	2	3	1	1	1	2	1	2	1	1	1
CO 2	3	3	2	3	2	2	1	2	2	2	2	3
CO 3	2	3	3	2	1	1	-	1	2	1	1	2
CO 4	3	2	2	2	2	2	1	2	2	2	1	3
CO 5	2	3	3	2	1	1	-	1	2	1	3	2

Weightage Values: 3 = Strongly matched, 2 = Moderately matched, 1 = Weakly matched, (-) = Notmatched

CO-PSO Mapping:

COs/PSOs	**PSO1**	**PSO2**	**PSO3**
CO1	3	3	3
CO2	3	3	3
CO3	3	3	3
CO4	3	3	3
CO5	3	3	3

Course Name: Machine Learning

Course Code: OEC 702B
Contact: 3:0:0
Total contact hours: 36
Credits: 3

Course outcomes:
Graduates of the ECE program will be able to

CO1: Able to demonstrate the linear and logistic regression model CO2:
Able to describe the curse of dimensionality.
CO3: Able to identify the model of supervised learning.
CO4: Able to illustrate the artificial neural network to find the pattern in data.
CO5: Able to identify the model of unsupervised learning.

Prerequisite:

- Knowledge of basic computer science principles and skills
- Familiarity with the basic probability theory
- Familiarity with the basic linear algebra

Module-I

(Introduction) [1L]
Overview of the application of machine learning, Concept of error function and optimization,Concept of supervised, unsupervised and reinforcement learning.

Module-II (Regression) [5L]
Linear regression model with single and multiple variables, Gradient descent algorithm, least square method, Weighted Least Squares method, Sum of squared errors, , Effect of bias and variance, Overfitting, underfitting and just fitmodel.

Module-III(Dimensionality reduction)

[10L]
Concept of dimension, Curse of dimensionality, Lasso and Ridge regression to reduce dimension, Application of elastic net over Lasso and Ridge, Principal component analysis, Linear discriminant analysis, Sammon mapping, Filter method, wrapper method

Module-IV(Classifier) [16L]
Logistic regression and Linear discriminant functions for binary classification, Naïve BayesClassifier, K- Nearest Neighbor.
Decision trees: measures of impurity, information gain/entropy reduction, Gini index. SupportVector Machine: Developing the objective function and the effect of hyper parameter,
concept of Kernel-SVM.
Artificial Neural Network: Compare Biological Neurons and Artificial neurons, Sigmoidal activation function,McCulloch-Pitts model, Feed forward & Feedback network, Single layer perceptron, Implementation of logical AND & OR , Effect of Multilayer perceptron over single layer, Implementation of XOR, Back propagation algorithm, Radial Basis Functions Network, Hebb rule, Importance of training and test accuracy to learn the ANN.

Module-V(Clustering)

[4L]
Kmeans algorithm, Hierarchical clustering, Gaussian mixture density estimation,Fuzzy-C-Means, Silhouette and Dunn cluster validationindex.

Text books:

- Pattern recognition and machine learning by Christopher M. Bishop, Springer
- Understanding Machine Learning by Shai Shalev-Shwartz and Shai Ben- David, Cambridge University Press
- Pattern Classification by Richard O Duda, Peter E. Hart & David G. Stock, John Wiley.
- Pattern Recognition by Konstantinos Koutroumbas, Sergios Theodoridis, Elsevier

CO PO Mapping

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	2	3	2	2	1	1	1	1	1	3	3
CO2	3	3	2	1	3	2	-	-	1	1	3	3
CO3	1	3	3	3	2	1	2	2	-	2	3	3
CO4	3	3	2	2	3	2	-	1	2	1	3	3
CO5	2	3	2	3	1	1	1	1	-	2	3	3

Weightage Values: 3 = Strongly matched, 2 = Moderately matched, 1 = Weakly matched, (-) = Notmatched

CO-PSO Mapping:

COs/PSOs	**PSO1**	**PSO2**	**PSO3**
CO1	3	3	3
CO2	3	3	3
CO3	3	3	2
CO4	3	3	3
CO5	2	3	2

Course Name: Cyber Security &Cryptography
Course Code: OEC 702C
Contact: 3:0:0
Total Contact Hours: 36
Credits: 3

Prerequisites

1. Knowledge of Computer Networks and Operating Systems fundamentals
2. Understanding of Discreet Mathematics concepts

Course Outcome(s):

Graduates of the ECE program will be able to

CO1 Acquire fundamental knowledge and compare different cryptographic techniques.
CO2 Develop and design various block cipher and stream cipher models
CO3 Demonstrate the principles of public key cryptosystems, hash functions and digitalSignature.
CO4 Analyze varied network security tools and authentication applications
CO5 Develop and apply email security, IP security, web security services and mechanisms

Course Contents Module-1 [7L]
Introduction - Services, Mechanisms, and Attacks, OSI security architecture, Network security mode, Classical Encryption techniques (Symmetric cipher model, substitution techniques, transposition techniques, steganography), Finite Fields and Number Theory: Groups, Rings, Fields,Modular arithmetic, Euclid's algorithm, Polynomial Arithmetic, Prime numbers, Fermat's and Euler's theorem, Testing for primality -The Chinese remainder theorem - Discrete logarithms.

Module-2 [9L]
Data Encryption Standard- Block cipher principles, block cipher modes of operation, Advanced Encryption Standard (AES), Triple DES, Blowfish, RC5 algorithm, Public key cryptography: Principles of public key cryptosystems, The RSA algorithm, Key management - Diffie Hellman Key exchange, Elliptic curve arithmetic, Elliptic curve cryptography.

Module-3 [6L]
Authentication requirement, Authentication function, MAC, Hash function, Security of hash function and MAC, MD5, SHA, HMAC, CMAC, Digital signature and authentication protocols, DSS, ElGamal, Schnorr.

Module-4 [7L]
Authentication applications, Kerberos, X.509, Internet Firewalls for Trusted System: Roles of Firewalls, Firewall related terminology- Types of Firewalls, Firewall designs principles, SET for E- Commerce Transactions, Intruder, Intrusion detection system, Virus and related threats, Countermeasures, Trusted systems, Practical implementation of cryptography and security.

Module-5 [7L]
E-mail Security: Security Services for E-mail-attacks possible through E-mail, Establishing keys privacy, authentication of the source, Message Integrity, Non-repudiation, Pretty Good Privacy, S/MIME, IP Security: Overview of IPSec, IPv4 and IPv6-Authentication Header, Encapsulation Security Payload (ESP), Internet Key Exchange (Phases of IKE, ISAKMP/IKE Encoding), Web Security: SSL/TLS Basic Protocol, computing the keys, client authentication, PKI as deployed by SSL Attacks fixed in v3, Exportability, Encoding, Secure Electronic Transaction.

Textbooks

[1] Kahate, A. (2013). Cryptography and network security. Tata McGraw-Hill Education.
[2] Forouzan, B. A., & Mukhopadhyay, D. (2015). Cryptography and network security. New York,NY: Mc Graw Hill Education (India) Private Limited.
[3]

Reference Books

[1] Stallings, W. (2006). Cryptography and network security, 4/E. Pearson Education India.
[2] Daras, N. J., &Rassias, M. T. (Eds.). (2015). Computation, cryptography, and network security(pp. 253- 287). Springer.
[3] Kumar, A., & Bose, S. (2017). Cryptography and network security. Pearson Education India.

CO-PO mapping:

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO1 0	PO1 1	PO1 2
CO 1	2	2	3	1	3	1	1	1	2	1	1	1
CO 2	2	2	3	3	1	-	-	1	2	1	1	3
CO 3	2	3	3	2	2	2	2	1	2	2	1	3
CO 4	3	2	3	2	1	-	-	1	2	1	1	3
CO 5	1	3	3	2	1	1	-	1	2	1	2	2

Weightage Values: 3 = Strongly matched, 2 = Moderately matched, 1 = Weakly matched, (-) = Notmatched

CO-PSO Mapping:

COs/PSOs	**PSO1**	**PSO2**	**PSO3**
CO1	3	3	3
CO2	3	3	3
CO3	3	3	3
CO4	3	3	3
CO5	3	3	3

Course Name: Advanced Bio Signal Processing
Course Code: OEC702D
Contact: 3:0:0
Total Contact Hours: 36
Credits: 3

Prerequisite: Concept of signal and systems and Digital signal Processing

Course Outcomes

Graduates of the ECE program will be able to

CO1: Able to illustrate filtering of biomedical signals, classify Time domain filtering,and design different types of filters.
CO2: Able to analyze different component of ECG and EEG signals.
CO3: Able to estimate the value of the transformation using wavelet transform.
CO4: Able to describe the neurological signal processing and also describe adaptive interfaceand noise cancellation techniques.
CO5: Able to estimate modeling of Biomedical systems.

Course Content

Module 1: 2L

Introduction: Biomedical signal origin & dynamics (ECG), Biomedical signal origin& dynamics (EEG, EMG etc.)

Module 2: 5L

Filtering for Removal of artifacts: 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. Optimal Filtering: The Weiner Filter, Adaptive Filtering Selecting Appropriate Filter.

Module 3: 5L

Event Detection: Example events (viz. P, QRS and T wave in ECG), Derivative based Approaches for QRS Detection Pan Tompkins Algorithm for QRS Detection, Dicrotic NotchDetection Correlation Analysis of EEG Signal.

Module 4: 8L

Waveform Analysis: Illustrations of problem with case studies, Morphological Analysis of ECG, Correlation coefficient, The Minimum phase correspondent. Signal length, Envelop Extraction, Amplitude demodulation, The Envelogram, Analysis of activity, Root Mean Square value, Zero-crossing rate, Turns Count, Form factor.

Module 5: 3L

Frequency-domain Analysis: Periodogram, Averaged Periodogram, Blackman-Tukey Spectral Estimator, Daniell's Spectral Estimator, Measures derived from PSD.

Module 6: 6L

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. ARMA model, Sequential estimation of poles and zeros,

Module 7: 3L

Neurological signal processing: EEG analysis, Parametric modelling, Linear prediction theory; Autoregressive (AR) method; Recursive estimation of AR

parameters. Cardiological signal processing: ECG parameters and their estimation - Arrhythmia analysis monitoring - ECG data reduction techniques

Module 8: 4L

Adaptive interference / Noise cancellation: Types of noise in biosignals; Digital filters - IIR and FIR - Notch filters - Optimal and adaptive filters. Weiner filters - steepest descent algorithm - LMS adaptive algorithm - Adaptive noise canceller - cancellation of 50 Hz signal in ECG - Cancellation of maternal ECG in foetal electrocardiography.

Text Books:

1. John G, Proakis and Dimitris Manolakis G. "Digital Signal Processing, Algorithms and Applications", PHI of India Ltd., New Delhi, fourth Edition, 2007.
2. Rangaraj M Rangayyan, "Biomedical signal processing", IEEE press, firstedition, 2002.

Reference Books:

1. Reddy D.C, "Biomedical Signal Processing: Principles and Techniques", TataMcGraw-Hill, New Delhi, 2nd edition, 2005.
2. Sanjit. K, Mitra "Digital Signal Processing", A Computer BasedApproach", Tata McGraw-Hill, New Delhi, fourth edition 2011.

CO-PO mapping:

COs \POs	PO 1	PO2	PO 3	PO4	PO 5	PO6	PO7	PO 8	PO9	PO1 0	PO1 1	PO1 2
CO1	2	2	2	1	3	1	2	2	3	3	2	2
CO2	3	3	3	3	2	1	1	1	2	2	3	3
CO3	3	2	2	2	1	1	3	1	3	1	3	1
CO4	3	3	3	1	2	1	1	3	2	2	2	3
CO5	2	3	2	2	2	1	1	1	2	3	3	2

Weightage Values: 3 = Strongly matched, 2 = Moderately matched, 1 = Weakly matched, (-) = Notmatched

CO-PSO Mapping:

COs/PSOs	**PSO1**	**PSO2**	**PSO3**
CO1	3	3	3
CO2	3	3	3
CO3	3	3	2
CO4	3	3	3
CO5	3	3	2

Course Name: Mixed Signal Design
Course Code: OEC 702E
Contact: 3:0:0
Total Contact Hours: 36
Credits: 3

Prerequisite: EC304 Signals and Systems,EC601 VLSI and Microlectronics

Course Outcomes:
After the successful completion of this course students will be able to
CO1: Apply the concepts for mixed signal MOS circuit.
CO2: Demonstrate in-depth knowledge in Switched Capacitor Circuits, Data Converters – ADCand DAC, Filter and PLL.
CO3: Analyze the signal to noise ratio and modeling of mixed signals
CO4: Solve engineering problems responsibly with wide range of solutions to increase Data Rateof ADC and DAC for addressing social issues.
CO5: Contribute positively to society with multidisciplinary scientific research in design anddevelopment of Mixed Integrated Circuits suited for wide range of applications.

Course Content

Module 1: Introduction to Mixed Signal Design [3L]

Introduction: Introduction to analog VLSI and mixed signal issues in CMOS technologies. MOStransistor: Introduction, Short channel effects, current source and current mirror, C-MOS circuit.

Module 2: Switched Capacitor Circuits [8L]
Introduction to Switched Capacitor circuits- basic building blocks, Operation and Analysis, Non- ideal effects in switched capacitor circuits, Switched capacitor integrators first order filters, Switch sharing, Biquad filters.

Module 3: Data Converter Fundamentals [8L]
Sampling and Aliasing:, Data convertor circuits Analog versus discrete time signals.
DC and dynamic specifications, Quantization noise, Nyquist rate D/A converters- Decoder basedConverters, Binary-Scaled converters, Thermometer-code converters, Hybrid converters

Module 4: Data Converter Architectures [9L]
ADC and DAC specifications. DAC architectures. ADC architectures. Sampling and aliasing, Quantization noise & Data converter SNR ramp,tracking, dual slope, successive approximation and flash types, Multi-stage flash type ADCs.

Module 5: Integrator Based CMOS Filter and PLL [8L]
Integrator Building Blocks , Lowpass Filters , Active-RC Integrators Effects of Finite Op-Amp Gain Bandwidth Product ,Active-RC SNR , Why use an Active Circuit (an Op-Amp) ,PLL, Applications

Text Books:

1. R.J. Baker, CMOS Mixed-Signal Circuit Design
2. B. Razavi. Principles of Data Conversion System Design.
3. Behzad Razavi, "Design of Analog CMOS Integrated Circuits", TMH Edition, 2002
4. Richard Schreier, "Understanding Delta-Sigma Data converters", WileyInterscience, 2005.

Reference Books:

1. Rudy Van De Plassche, "CMOS Integrated Analog-to-Digital and Digital-toAnalogconverters", Kluwer Academic Publishers, 2003
2. Philip E. Allen and Douglas R. Holberg, "CMOS Analog Circuit Design", OxfordUniversity Press, International 2nd Edition/Indian Edition, 2010.
3. David A. Johns,Ken Martin, "Analog Integrated Circuit Design", Wiley StudentEdition, 2013.

CO-PO Mapping:

	PO 1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2	3	2	3	3	1	1	2	2	1	3
CO2	3	1	2	2	3	2	2	-	2	1	2	2
CO3	2	2	1	2	2	1	1	-	3	2	3	3
CO4	2	2	2	2	3	2	2	3	2	1	2	1
CO5	3	3	3	2	2	2	1	3	2	1	1	3

Weightage Values: 3 = Strongly matched, 2 = Moderately matched, 1 = Weakly matched, (-) = Notmatched

CO-PSO Mapping:

COs/PSOs	**PSO1**	**PSO2**	**PSO3**
CO1	3	3	3
CO2	3	3	3
CO3	3	3	2
CO4	3	3	3
CO5	3	3	2

Course Name: Internet of Things Lab
Course Code: PEC791A
Contacts: 0:0:3
Credit: 1.5

Course Outcomes: After this course students will be able to

CO1: understand internet of Things and its hardware and software components
CO2: interface I/O devices, sensors actuators and communication modules

CO3: Remotely monitor data and control devices
CO4: Develop real life IoT based projects

Lab Experiments:

1. Familiarize with Arduino and Raspberry pi with necessary installations
2. To interface LED or buzzer with Arduino and Raspberry pi and turn on and off every onesecond.
3. Design of Traffic Management system with Arduino and Raspberry pi
4. To interface DHT11 sensor with Arduino and Raspberry pi and display temperature andhumidity readings.
5. To interface motor or relay as actuator with Arduino and Raspberry pi
6. Installation of Wireshark network protocol analyser and capture network traffic
7. Find machine IP address and packets sent using Wireshark capture
8. Implement MQTT protocol installing Node.js andNode-RED
9. Install Blynk App in mobile and control LED on /off remotely by mobile button
10. Set up an experiment for Ultrasonic Distance Measurement
11. Set up an experiment for Think Speak based DHT Sensor Monitoring
12. Any other innovative experiments

Books
1.21 Iot Experements,Yashavant Kanetakr,Shrirang Korde, BPB
2. IoT based Projects: Realization with Raspberry Pi, NodeMCU, Rajesh Singh Anita Gehlot,BPB

CO-PO Mapping:

	PO1	PO 2	PO3	PO 4	PO 5	PO6	PO 7	PO 8	PO 9	PO1 0	PO1 1	PO12
CO1	3	2	1	-	-	2	-	1	1	1	1	3
CO2	-	3	-	2	-	1	2	-	-	-	-	2
CO3	2	-	-	-	1	-	3	1	2	-	2	3
CO4	3	-	1	-	2	-	2	2	-	-	-	3

Weightage Values: 3 = Strongly matched, 2 = Moderately matched, 1 = Weakly matched, (-) = Notmatched

CO-PSO Mapping:

COs/PSOs	**PSO1**	**PSO2**	**PSO3**
CO1	3	3	3
CO2	3	3	3
CO3	3	3	2
CO4	3	3	3
CO5	2	3	2

Course Name: Artificial Intelligence Lab
Course Code: PEC 791B
Contacts: 0:0:3
Credit: 1.5

Course outcome:
Graduates of the ECE program will be able to

CO-1: Apply PRPLOG to implement logic
CO-2: Analyze searching algorithm
CO-3: Apply ANN for classification
CO-4: Apply NLP using AI.

Experiments:

A. Using Prolog

1. Familiarization of Prolog
2. Study of facts, objects, predicates and variables in PROLOG.
3. Study of Rules and Unification in PROLOG.
4. Study of "cut" and "fail" predicate in PROLOG.
5. Write a Prolog program to maintain family tree.
6. Write predicates One converts centigrade temperatures to Fahrenheit, the other checks if atemperature is below freezing.

B. Using any programming language

7. Write a program to solve the Tower of Hanoi problem.
8. Write a program to solve 4-Queen problem.
9. Write a program to solve 8-puzzle problem.
10. Write a program to solve traveling salesman problem.
11. Write a program to solve water jug problem
12. Write a program to implement hill climbing algorithm
13. Write a program to implement simulated annealing algorithm
14. Write a program to simulate breadth first search and depth first search
15. Write a program to solve the Monkey Banana problem.
16. Write a program to simulate hill climbing and simulated annealing
17. Write a program to implement Perceptron.
18. Write a program to implement AND , OR gates using Perceptron.
19. Write a program to implement Iris data classification using Back Propagation.
20. Write a program to implement a Chatbot
21. One experiment on NLP

Text Books:

1. Artificial Intelligence: A Modern Approach, Russell & Norvig, Prentice Hall.
3. Artificial Intelligence, Elain Rich and Kevin Knight, TMH.

CO-PO Mapping:

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2	1	-	-	2	-	1	1	1	1	3
CO2	-	3	-	2	-	1	2	-	2	1	-	2
CO3	2	-	-	-	1	-	3	2	1	2	2	3
CO4	3	-	1	-	2	-	2	-	-	-	-	3

Weightage Values: 3 = Strongly matched, 2 = Moderately matched, 1 = Weakly matched, (-) = Notmatched

CO-PSO Mapping:

COs/PSOs	**PSO1**	**PSO2**	**PSO3**
CO1	-	-	-
CO2	-	-	-
CO3	-	-	-
CO4	-	-	-
CO5	-	-	-

Course Name: Digital Control System Lab
Course Code: PEC 791C
Contact: 0:0:3
Credit: 1.5

Prerequisites: Knowledge of MATLAB.

Course Outcomes:
On completion of the course students will be able to

- CO1. Conduct experiments on Position Control with proper tuning of P, PI and PID controller.
- CO2. Demonstrate Lead-Lag Compensators.
- CO3. Investigate the response of a Real Time System using State Variable Analysis.
- CO4. Analyze Performance of Discrete-Time System a Non-Linear System.

List of Experiment:

1. Study of a Practical Position Control System:
   Obtaining closed step responses for gain setting corresponding to over-damped and under- damped responses. Determination of rise time and peak time using individualized components in SIMULINK. Determination of un-damped natural frequency and damping ratio from the experimental data.

2. Tuning of P, PI and PID Controller for First Order Plant with Dead Time using Z-N Method:
   Process parameters (time constant and delay/lag) will be provided, the students would compute controller gains by using Z-N method. Steady state and transient performance of the closed loop plant with and without steady disturbances will have to benoted. Theoretical phase and gain margins will have to be manually computed for each gain settings.

3. Design of Lead and Lag Compensation Using Cacsad Tools:
   Plant transfer function will be provided. Step response is to be obtained. (PSPICE, MATLAB, SciLab may be used).

4. State Variable Analysis using Cacsad Command Tool:
   Familiarization and use of CACSAD command for state variable analysis. Obtaining transfer function from SV model and vice versa. Obtaining step response for a SISO system given in SV form. (PSPICE, MATLAB, SciLab may be used).

5. State Variable Analysis using Cacsad Block Diagram Tool:
   Familiarization and use of CACSAD BLOCK DIAGRAM TOOL for state variable analysis. Obtaining step response and initial condition response for a single input, two output system given in SV form. (PSPICE, MATLAB, SciLab may be used).

6. Performance Analysis of a Discrete Time System using Cacsad Tool:
   Familiarization and use of CACSAD block diagram tool for Digital Control System. Study of closed response of a continuous system with a digital controller with sample and hold. (PSPICE, MATLAB, SciLab may be used).

7. Studying The Effects of Nonlinearity in a Feedback Controlled System using Time Response:

Determination of step response with a limiter nonlinearity introduced into the forwardpath of 2nd order unity feedback control systems. The open loop plant will have one pole at the origin and the other pole will be in LHP or RHP. To verify that (i) with openloop stable pole, the response is slowed down for larger amplitude input and (ii) for unstable plant, the closed loop system may become oscillatory with large input amplitude. (PSPICE, MATLAB, SciLabmay be used).

8. Studying The Effects of Nonlinearity in a Feedback Controlled System using Phase Plane Plots:
Determination of phase plane trajectory and possibility of limit cycle of common nonlinearities. CACSAD block diagram tool will be used (PSPICE, MATLAB,SciLab may be used).

Note: From the list of experiments a minimum of 7 (seven) experiments shall have to be performed by each student.

Reference Books:

1. Herniter, Programming in MATLAB, Vikas
2. Ogata K : Modern Control Engg. 4e,Pearson/PHI

CO-PO Mapping:

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	3	3	2	2	2	2	1	2	1	3	3
CO2	3	2	2	3	2	1	-	-	2	-	1	2
CO3	3	3	3	3	3	2	1	-	2	-	1	2
CO4	2	3	2	2	3	2	-	2	2	2	3	3

Weightage Values: 3 = Strongly matched, 2 = Moderately matched, 1 = Weakly matched, (-) = Not matched

CO-PSO Mapping

COs/PSOs	**PSO1**	**PSO2**	**PSO3**
CO1	3	3	3
CO2	3	3	3
CO3	3	3	3
CO4	3	3	3

Course Name: Cloud Computing (AWS) Lab
Course Code: PEC 791D
Contact: 0:0:3
Credits: 3

Prerequisite:

1. Should have basic knowledge on C and JAVA programming.
2. Prior knowledge on Operating System

Course Outcome (s):

On completion of this course, the students will be able to:

CO1: Configure various virtualization tools such as Virtual Box, VMware workstation.
CO2: Design and deploy a web application in a PaaS environment.
CO3: Learn how to simulate a cloud environment to implement new schedulers.
CO4: Install and use a generic cloud environment that can be used as a private cloud.

Experiments:

1. Installation of VMware Workstation on windows OS (version windows 7 to 10).
2. Installation of C compiler and execute simple programs of C using virtual machine.
3. Create a hello world application and other simple web applications using python/java in Google App Engine.
4. Launching of web applications using GAE launcher.
5. Creating a cloud environment using CloudSim and run a scheduling algorithm that is not present in CloudSim.
6. Transferring the files from one virtual machine to another virtual machine.
7. Find a procedure to launch virtual machine using try stack (Online Open stack Demo Version)
8. Install Hadoop single node cluster and run simple applications like word count.

Text Books:

1. Mastering Cloud Computing by Rajkumar Buyya, Christian Vecchiola, S. Thamarai Selvi, McGrawHill Education (India) Private Limited, 2013
2. Fundamentals of Cloud Computing by P. K. Pattnaik, S. Pal, M. R. Kabat, Vikas Publications, 2014.

Reference Books:

1. Cloud Computing Bible by Barrie Sosinsky, Wiley India Pvt. Ltd,2013
2. Cloud computing: A practical approach, Anthony T. Velte, TataMcgraw-Hill

CO- PO Mapping:

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO 1	3	2	3	2	2	-	-	-	-	-	2	2
CO 2	2	3	3	2	1	-	1	-	-	-	3	3
CO 3	3	2	3	2	2	2	-	-	2	-	2	2
CO 4	2	3	3	2	-	-	-	2	1	-	3	3

Weightage Values: 3 = Strongly matched, 2 = Moderately matched, 1 = Weakly matched, (-) = Not matched.

CO-PSO Mapping:

COs/PSOs	**PSO1**	**PSO2**	**PSO3**
CO1	3	3	3
CO2	3	3	3
CO3	3	3	3
CO4	3	3	3

Course Name: DATA SCIENCE LAB
Course Code: OEC 792A
Contacts: 0:0:3
Credit: 1.5

Course Outcome:
Students of ECE program will be able to:

CO1: Understand the Python Programming Language.
CO2: Expose themselves on solving of data science problems. CO3: Understand the classification and Regression Model.
CO4: Understand and apply principles of data visualization.
CO5: Set up Anaconda and Jupyter notebooks

Experiments:

1. Setting Up Anaconda and Jupyter Notebook.
2. DESCRIPTIVE STATISTICS IN JupitarHandbook

a. Write an R script to find basic descriptive statistics using summary, str, quartile functionon mtcars & cars datasets.
b. Write an R script to find subset of dataset by using subset (), aggregate () functions oniris dataset

3. READING AND WRITING DIFFERENT TYPES OF DATASETS

a. Reading different types of data sets (.txt, .csv) from Web and disk and writing in file in specific disk location.
b. Reading Excel data sheet in Jupiter. c. Reading XML dataset in Jupiter

4. Visualization
   a. Find the data distributions using box and scatter plot. b. Find the outliers using plot.
   c. Plot the histogram, bar chart and pie chart on sample data.
5. Statistics and NumPy
   Introduction to StatisticsDistribution
   Standardization in Data ScienceWorking with Numpy
6. Working WithPANDASArrays
   Working With Queries Working With Data FramesUsing GROUP BY Merging and Joining
7. CORRELATION AND COVARIANCE

a. Find the correlation matrix.
b. Plot the correlation plot on dataset and visualize giving an overview of relationships among data on iris data.

Analysis of covariance: variance (ANOVA), if data have categorical variables on iris data.

8. REGRESSION MODEL

Import a data from web storage. Name the dataset and now do Logistic Regression to findout relation between variables that are affecting the admission of a student in a institute based on his or her GRE score, GPA obtained and rank of the student. Also check the model is fitor not.
Require (foreign), require (MASS).

9. CLASSIFICATION MODEL

a. Install relevant package for classification. b. Choose classifier for classification problem.
c. Evaluate the performance of classifier.

Reference Books:

Yanchang Zhao, "R and Data Mining: Examples and Case Studies", Elsevier, 1st Edition, 2012 Web References:

1. http://www.r-bloggers.com/how-to-perform-a-logistic-regression-in-r/
2. http://www.ats.ucla.edu/stat/r/dae/rreg.htm
3. http://www.coastal.edu/kingw/statistics/R-tutorials/logistic.html
4. http://www.ats.ucla.edu/stat/r/data/binary.csv

SOFTWARE AND HARDWARE REQUIREMENTS FOR 18 STUDENTS:

SOFTWARE: R Software , R Studio Software

HARDWARE: 18 numbers of Intel Desktop Computers with 4 GB RAM

CO- PO Mapping

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2	1	1	-	-	-	1	2	2	1	2
CO2	3	2	1	2	2	-	-	1	2	2	1	2
CO3	3	3	1	1	2	-	-	1	2	1	1	2
CO4	3	3	3	2	2	1	1	1	3	2	2	3
CO5	3	2	1	1	-	-	-	-	1	1	1	2

Weightage Values: 3 = Strongly matched, 2 = Moderately matched, 1 = Weakly matched, (-) = Not matched

CO-PSO Mapping:

COs/PSOs	**PSO1**	**PSO2**	**PSO3**
CO1	3	3	3
CO2	3	3	3
CO3	3	3	3
CO4	3	3	3
CO5	3	3	3

Course name: Machine Learning Lab

Course Code: OEC792B

Contact: 0:0:3
Credits: 3

Prerequisites:

- Basic programming knowledge and algorithm

Graduates of the ECE program will be able to Course outcomes:

CO1: Able to analyze linear regression model.
CO2: Able to evaluate the important features from data CO3:
Able to apply classifier to find the pattern from data. CO4:
Able to evaluate models generated from data.
CO5: Able to demonstrate the curse of dimensionality.

To perform the following experiments, it is recommended to get the data from the open-source UCI Machine Learning Repository.
Link: https://archive.ics.uci.edu/ml/index.php

1. Take a suitable dataset and study the linear regression with one variable and multiple variables.
2. Study the effect of bias and variance in linear regression.
3. Take a suitable dataset and select the good features using filter and wrapper method. Take a suitable dataset and extract the features using PCA and LDA
4. Take a suitable dataset and design a classifier using
   - Logistic regression
   - Decision trees
   - Naïve Bayes Classifier
   - KNN
   - SVM
5. Take a suitable dataset and cluster the data using
   - K-means
   - Hierarchical clustering
6. In a given dataset, estimate the number of possible clust using Silhouette method
7. Take a suitable dataset, design ANN based classifier and study the followings:
   - effect of single layer, multilayer
   - effect of number of nodes in a layer

9. Take a suitable dataset to illustrate the importance of training and test accuracy in case of supervised learning.

10. Take a suitable dataset to show the curse of dimensionality and its solution using Sammon mapping.

Textbooks:

1. Pattern recognition and machine learning by Christopher M. Bishop, Springer
2. Understanding Machine Learning by Shai Shalev-Shwartz and Shai Ben- David, CambridgeUniversity Press
3. Pattern Classification by Richard O Duda, Peter E. Hart & David G. Stock, John Wiley.4.Pattern Recognition by Konstantinos Koutroumbas, Sergios Theodoridis, Elsevier

C0-PO Mapping

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2	2	3	2	2	-	1	1	2	3	2
CO2	2	3	3	2	3	1	1	-	-	1	2	3
CO3	3	3	3	2	3	2	-	-	1	1	3	2
CO4	2	2	2	3	2	1	2	2	-	2	2	3
CO5	3	3	3	3	3	2	-	-	2	1	3	3

Weightage Values: 3 = Strongly matched, 2 = Moderately matched, 1 = Weakly matched, (-) Not matched

CO-PSO Mapping:

COs/PSOs	**PSO1**	**PSO2**	**PSO3**
CO1	-	3	3
CO2	-	3	3
CO3	-	3	2
CO4	-	3	3
CO5	-	3	2

Course Name: Cyber Security & Cryptography Lab

Course Code: OEC792C
Contacts: 0:0:3
Credits: 1.5

Course outcome:
CO1: Able to analyze the cipher technique
CO2: Able to apply Hashfunctions
CO3: Able to apply AES, DES algorithm
CO4: Able to analyze RSAalgorithm.
Experiments:

1. Breaking the Shift Cipher
2. Breaking the Mono-alphabetic Substitution Cipher
3. One-Time Pad and Perfect Secrecy
4. Message Authentication Codes
5. Cryptographic Hash Functions and Applications
6. Symmetric Key Encryption Standards (DES)
7. Symmetric Key Encryption Standards (AES)
8. Diffie-Hellman Key Establishment
9. Public-Key Cryptosystems (PKCSv1.5)
10. Implementation of RSA algorithm.

Textbooks

[1] Kahate, A. (2013). Cryptography and network security. Tata McGraw-Hill Education.
[2] Forouzan, B. A., & Mukhopadhyay, D. (2015). Cryptography and network security. New York,NY: Mc Graw Hill Education (India) Private Limited.

Reference Books

[1] Stallings, W. (2006). Cryptography and network security, 4/E. Pearson Education India.
[2] Daras, N. J., &Rassias, M. T. (Eds.). (2015). Computation, cryptography, and network security(pp. 253-287). Springer.
[3] Kumar, A., & Bose, S. (2017). Cryptography and network security. Pearson Education India.

CO-PO mapping:

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO1 0	PO1 1	PO1 2
CO 1	2	2	3	1	3	1	1	1	2	1	1	1
CO 2	2	2	3	3	1	-	-	1	2	1	1	3
CO 3	2	3	3	2	2	2	2	1	2	2	1	3
CO 4	3	2	3	2	1	-	-	1	2	1	1	3

Weightage Values: 3 = Strongly matched, 2 = Moderately matched, 1 = Weakly matched, (-) = Not matched

CO-PSO Mapping:

COs/PSOs	**PSO1**	**PSO2**	**PSO3**
CO1	3	3	3
CO2	3	3	3
CO3	3	3	3
CO4	3	3	3
CO5	3	3	3

Course Name: Advanced Bio Signal ProcessingLab
Course Code: OEC792D
Contacts: 0:0:3
Credit: 1.5

Prerequisite: Digital Electronics, Analog Electronics, Microprocessor and Microcontroller,Sensors, C/C++ programming, Python programming

Course Outcomes:
Graduates of the ECE program will be able to

CO1: Analyze Bioelectric signals, human physiological system, and different types of transducers.

CO2: Design different types of medical measurement system.

CO3: Able to examine the data handling, filtering techniques of bio-medical signals and able to analysis of time and frequency domain.

CO4: Able to simulate medical imaging techniques and implement different algorithms to feature extract the signals.

Experiments

1. To simulate Electrocardiogram Waveform
2. To simulate Electroencephalogram Signal
3. To simulate Electromyogram Signal
4. To Simulate Defibrillator
5. To simulate Pacemaker
6. To simulate Hemodialysis Machine
7. To simulate Biopotential Amplifier
8. To simulate ECG Pulse missing detector
9. To simulate 12 Lead ECG Signals

Reference:

1. Wavelets and Time frequency methods for Biomedical signal Processing- M. Akay, IEEE Press, Digital Processing of speech signals- L. Rabinar, Pearson Education.
2. Biomedical Instrumentation and Measurements-Cromwell, Weibell and Pfeiffer, PHI
3. https://bmsp-coep.vlabs.ac.in

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	-	1	-	-	3	-	1	1	1	1	3
CO2	-	3	-	2	-	1	-	-	-	-	-	2
CO3	3	-	-	-	1	3	3	-	2	2	2	3
CO4	2	-	1	3	3	-	2	1	-	-	1	2

Weightage Values: 3 = Strongly matched, 2 = Moderately matched, 1 = Weakly matched, (-) = Not matched

CO-PSO Mapping:

COs/PSOs	PSO1	PSO2	PSO3
CO1	3	3	3
CO2	3	3	3
CO3	3	3	2
CO4	3	3	3

Course Name: Mixed Signal Design Lab

Course Code: OEC 792E

Contacts: 0:0:3

Credits: 1.5

Prerequisite: EC304 Signals and Systems, EC601 VLSI and Microelectronics

Course Outcomes: After the successful completion of this course students will be ableto

CO1: Design and operation of the CMOS basic logic element and understanding of basic DC characteristics of the CMOS integrated circuits

CO2: Design of Switched Capacitor Circuits, Data Converters – ADC and DAC, Filterand PLL

CO3: Apply the knowledge of dc testing in MOS circuits, determination of signal tonoise ratio and modeling of mixed signals

CO4: Solve engineering problems responsibly with wide range of solutions to increaseData Rate of ADC and DAC for addressing social issues.

CO5: Design of low pass and high pass active filters and study of its frequency response

Course Content:

1. Design and operation of the CMOS basic logic element to understand basic DC characteristics of the CMOS integrated circuits, as well as their dynamic properties during switching processes.
2. DC testing of n-channel and p-channel enhancement mode MOSFETs and measure the Current flowing through the transistor.
3. Verify the operation of basic switched capacitor filter
4. Design an ADC circuit that converts Analog input signals to corresponding binary output values and build, test, and troubleshoot an ADC circuit using Spice.
5. To Design and Simulate Binary to Gray, Gray to Binary, BCD to Excess 3, Excess 3 to BCD code converters.
6. Design of low pass and high pass active filter using OPAMP and study ofits frequency response.
7. Verify the validity of the theory behind sampling and quantization.
8. Design and construct RC integrator circuit and study its pulse response.
9. Experiment to observe the operation of the PLL subsystem and recognize the three PLL states in actual circuits, and you will also gain some insight into how circuit values affect PLLoperation.

CO-PO Mapping:

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2	3	3	2	1	1	-	2	2	2	2
CO2	3	2	2	2	3	2	2	-	2	1	3	3
CO3	2	2	1	2	2	1	1	-	2	2	2	2
CO4	2	2	2	3	3	2	2	3	2	1	3	3
CO5	3	2	2	2	2	2	1	3	2	1	2	1

Weightage Values: 3 = Strongly matched, 2 = Moderately matched, 1 = Weakly matched, (-) = Notmatched

CO-PSO Mapping:

COs/PSOs	**PSO1**	**PSO2**	**PSO3**
CO1	3	3	3
CO2	3	3	3
CO3	3	3	2
CO4	3	3	3
CO5	3	3	2

Course Name: Entrepreneurship & Innovation skill

Course Code: MC701
Contact: 2:0:0
Total Contact Hours: 24
Credit: 0

Prerequisite: None

Course Outcomes: Graduates of the ECE program will be able to

CO1: Comprehend the role of bounded rationality, framing, causation and effectuation in entrepreneurial decision making.
CO2: Demonstrate an ability to design a business model canvas.
CO3: Evaluate the various sources of raising finance for startup ventures.
CO4: Explain the fundamentals of developing and presenting business pitching to potential investors.

Course Content

Module 1: 4 L
Introduction to Entrepreneurship: Entrepreneurs; entrepreneurial personality and intentions - characteristics, traits and behavioral; entrepreneurial challenges. Entrepreneurial Opportunities: Opportunities. discovery/ creation, Pattern identification and recognition for venture creation: prototype and exemplar model, reverse engineering.
Module 2: 4 L
Entrepreneurial Process and Decision Making: Entrepreneurial ecosystem, Ideation, development and exploitation of opportunities; Negotiation, decision making process and approaches, Effectuation and Causation; Advantage and Limitations of Entrepreneurship; Process of Entrepreneurship.
Module 3: 4 L
Crafting business models and Lean Start-ups: Introduction to business models; Creating value propositions-conventional industry logic, value innovation logic; customer focused innovation; building and analyzing business models; Business model canvas, Introduction to lean startups, Business Pitching. Module 4: 4 L
Organizing Business and Entrepreneurial Finance: Forms of business organizations; organizational structures; Evolution of Organisation, sources and selection of venture finance options and its managerial implications. Policy Initiatives and focus; role of institutions in promoting entrepreneurship.
Module 5: 4 L
Entrepreneurs as problem solvers: Innovations and Entrepreneurial Ventures – Global and Indian; Role of Technology – E-commerce and social media; Social Entrepreneurship – Concept; Entrepreneurship – The Indian Scenario
Module 6: 4L
Project/Case Study: (Any One)
1. Visit of the District Industries Centre and prepare a report of activities and programs undertaken by them
2. Conduct a case study of any entrepreneurial venture in your nearby area.
3. Field Visit: Visit any business firm near your locality; interact with the owner of the business firm and prepare a field report on parameters like: type of business, scale of business, product/service dealing in, target customer, problems faced and measures to solve the faced challenges. 4. Know your State Handicraft and Handlooms as a means of economic activity

Text Books:

1. Bessant, J. (2003) High Involvement Innovation: Building and Sustaining Competitive Advantage Through Continuous Change. Chicester: John Wiley & Sons.
2. Bygrave, W and Zackarakis, A (2013) Entrepreneurship, 3rd Edition, John Wiley and Co. Drucker, P. (1999) Innovation and Entrepreneurship, Butterworth Heinemann, Oxford.
3. Fagerberg, J, Mowery, DC and Nelson, RR (2005) The Oxford Handbook of Innovation, Oxford University Press, NY.
4. Hisrich, R.D., Peters, M.P., and Shepherd, D. (2013) Entrepreneurship, McGraw-Hill Irwin, Boston.
5. Kuratko, D. (2013) Entrepreneurship: Theory, Process, and Practice, 9th Edition, Wileyonline library.
6. Moore, Geoffrey, (1999) Crossing the Chasm, Harper & Collins.
7. Porter, ME, Competitive Advantage: Creating and Sustaining Superior Performance, Free Press, New York, NY, 1985

CO-PO Mapping:

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	-	1	2	3	1	-	2	-	2	3	3
CO2	2	1	-	1	-	-	1	-	1	-	2	2
CO3	3	-	2	-	2	3	-	1	-	2	3	3
CO4	2	2	-	1	-	1	-	2	2	1	2	2

Weightage Values: 3 = Strongly matched, 2 = Moderately matched, 1 = Weakly matched, (-) = Not matched

CO-PSO Mapping:

COs/PSOs	**PSO1**	**PSO2**	**PSO3**
CO1	3	3	3
CO2	3	3	3
CO3	3	3	3
CO4	3	3	3

Curriculum for B.Tech
Under Autonomy
Electronics & Communication Engineering
(Effective From 2021-22 admission Batch)
L – Lecture; T- Tutorial; P- Practical [1L=1Cr, 1T=1Cr, 1P =0.5 Cr]

4th Year 2nd Semester: 8th Semester

SL. No.	Course Code	Paper Code	Theory	Contact Hours /Week				Credits /Unit
				L	T	P	Total	
A. THEORY								
1	PE	PEC801	Professional Elective-VI A: Industrial Automation & Robotics B: Electronic System Design C: Automotive Electronics D: Adaptive Signal Processing	3	0	0	3	3
2	OE	OEC801	Open Elective-IV A: Block Chain B: Deep Learning C: Biology for Engineers D: Foreign Language E: Product Design & Manufacturing Processes F: Business Research Method	3	0	0	3	3
B. PRACTICAL								
4	PROJECT	PR 891	Major Project-II	0	0	0	12	6
5	PROJECT	PR 892	Grand Viva	0	0	0	0	1
C. MANDATORY ACTIVITIES / COURSES								
8	MC	MC 801	Essence of Indian Knowledge Tradition	0	0	3	3	3
TOTAL CREDIT Units								13

Course Name: Industrial Automation & Robotics

Course Code: PEC801A
Contact: 3:0:0
Total Contact Hours: 36
Credits: 3

Prerequisite: Electrical Networks & Control System
Linear algebra and probability theory. Basic understanding of control systems and computing.

Course Outcomes:
The Graduates of the ECE program will be able to:
CO1: Identify different components of an automation system.
CO2: Interface the given I/O device with appropriate PLC CO3:
Prepare a PLC ladder program for the given application. CO4: Gain
knowledge of Elements of robots.
CO5: Calculate the forward kinematics and inverse kinematics of serial and parallel robots.
CO6: Able to do the motion planning & control for a robotic system.

Course Content:

Module 1: [6L]
Introduction:
Architecture of Industrial Automation Systems, Measurement Systems Characteristics, Data Acquisition Systems, Types of Sensors and Transducers.

Module 2: [8L]
Introduction to Programmable Logic Controllers: advantages & disadvantages of PLC with respect to relay logic, PLC architecture, Input Output modules, PLC interfacing with plant, memory structure of PLC.
PLC programming methodologies: ladder diagram, PLC functions: bit logic instructions, ladder diagram examples, interlocking, latching, inter dependency and logical functions, PLC Timer & Counter functions on-delay timer, off- delay timers, retentive on-delay timers, pulse timers, timer examples, up-counter, down-counter and up-down counter, counter examples, register basics.

Module 3: [4L]
PLC Data Handling: data move instructions, table and register moves, PLC FIFO & LIFO functions. PLC arithmetic and logical functions: addition, subtraction, multiplication, division instructions, increment decrement, trigonometric and log functions, AND, OR XOR, NOT functions, PLC compare and convert functions.
PLC program control and interrupts: jumps, subroutine, sequence control relay, watchdog. PID Control of Continuous process.

Module 4: Elements of robots: [6L]
Position and orientation of a rigid body, Homogeneous transformations, Representation of joints, link representation using D-H parameters, Examples of D-H parameters and link transforms, different kinds of actuators – stepper, DC servo motors, Purpose of sensors– tachometers, strain gauge-based force-torque sensors, proximity sensors and vision.

Module 5: Kinematics of robots: [8L]

Direct and inverse kinematics problems, Examples of kinematics of common serial manipulators, workspace of a serial robot, Inverse kinematics of constrained and redundant robots, Degrees of- freedom of parallel mechanisms and manipulators, Active and passive joints, Constraint and loop-closure equations, Direct kinematics problem, Mobility of parallel manipulators.

Module 6: Motion planning and control: [4L]

Joint and Cartesian space trajectory planning and generation, Classical control concepts using the example of control of a single link, Independent joint PID control, Control of a multi-link manipulator, Non-linear model- based control schemes.

Textbooks:

1. T. A. HUGHES: Programmable Controllers.
2. C. D. JOHNSON: Process Control Instrumentation.
3. Robotics: Fundamental Concepts and Analysis, Ashitava Ghosal, OXFORD University Press.

Reference Books:

1. JOHN WEBB: Programmable Logic Controllers Principles & applications, PHI
2. Industrial Instrumentation, Control and Automation, S. Mukhopadhyay, S. Sen and A. K. Deb, Jaico Publishing House, 2013.
3. S.R. Deb, Robotics Technology and flexible automation, Tata McGraw-Hill Education.

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	3	1	3	1	1	1	1	1	1	3
CO2	3	3	3	1	3	1	1	1	1	1	1	3
CO3	3	3	3	3	3	2	2	1	1	1	2	3
CO4	3	3	3	3	3	2	2	1	1	2	1	3
CO5	3	3	3	3	3	1	2	1	2	2	2	3
CO6	3	3	3	3	3	2	2	1	1	2	1	3

Weightage Values: 3 = Strongly matched, 2 = Moderately matched, 1 = Weakly matched, (-) = Not matched.

CO-PSO Mapping:

COs/PSOs	**PSO1**	**PSO2**	**PSO3**
CO1	3	3	3
CO2	3	3	3
CO3	3	3	2
CO4	3	3	3
CO5	3	3	2
CO6	3	3	3

Course Name: Electronic System Design

Course Code: PEC801B

Contact: 3:0;0
Total Contact Hours: 36
Credits: 3

Prerequisite: Knowledge of Analog Electronic Circuit, Digital Electronic Circuit, Microprocessor & Microcontroller.

Course objectives: Graduates will have to gather the conceptual and practical understanding of Electronic Systems and their design perspective.

Course Outcome:
CO-1: Graduates will be able to design and analyze Analog Electronic Systems. CO-2: Graduates will be able to design and analyze Digital Electronic Systems. CO-3: Graduates will be able to design PCB for various Electronic Circuits.
CO-4: Graduates will be able to find fault and test Electronic Systems.

Course Content:

1. Introduction: [8L]

Different Stages in product design- Market Survey, Product Specifications, R&D and Prototypes, Batch processing, Environmental testing, Manufacturing.
Electronic Products Classification: Consumer, Industrial and Military, Comparative study in terms of reliability. Bathtub curve, Measures taken (at Component and Product level) to improve reliability.
Various soldering techniques including Surface Mount Technology.

1. Analog Design: [8L]

Analog signal conditioning: Op-Amps for signal conditioning and applications, Instrumentation Amplifier design using discrete components and special purpose IC. Amplification of Low-level signals, Grounding, Shielding and Guarding techniques. Design of Data Acquisition Systems- Interpretation of A/D and D/A specifications from design viewpoint, Dual slope, Quad slope and high-speed A/D converters, Microprocessors Compatible A/D converters, Sample and Hold Circuit, considerations in selecting references for data converter

2. Digital Design: [8L]

Interfacing of LED, LCD, Keyboard, Relays (Electromagnetic and Solid State) with Microcontrollers. Microcontroller specifications and performance determining factors, Comparative study of different Microcontroller architectures, Comparison of buses and protocols used in electronic products- I2C, SPI, CAN, LIN, Flexray.

3. Software Design and Testing: [7L]

Different approaches for development of application software for Electronic Product. Assemblers, Assembly language and High-level language, debugging tools and techniques for software, Features of Simulators, ICE, IDE

4.PCB Design: [6L]

PCB Design practices for Analog and Mixed signal circuits: Ground Loops, Precision circuits, shielding and guarding. PCB Design Practices for High-speed digital circuits, Signal integrity and EMI/EMC for PCB design

5. Fault Finding and Testing: [7L]

Analyses- DC/ Operating Point Analysis, AC (Frequency Response), Transient, Sensitivity, Monte Carlo. Debugging/ Fault finding- Features and limitations of Analog CRO, DSO, Spectrum analyzer, Logic Analyzer and Mixed Signal Oscilloscopes in finding hardware/software faults. Environmental Testing: Need for Environmental Testing, Temperature, Humidity Tests, EMI/EMC testing standards and compliance

Textbooks:

Bernhard E. Bürdek, "History, Theory and Practice of Product Design", Springer Science, 2005 Paul Horowitz, "Art of Electronics", Cambridge University Press

Howard Johnson, Martin Graham, "High-speed Digital design- A Handbook of BlackMagic", Prentice Hall Publication
G. Pahl and W. Beitz J. Feldhusen and K.-H. Grote, "Engineering Design - A Systematic Approach", Springer, 2007
Tim Williams, "EMC for Product Designers", Elsevier, Fourth edition 2007

References:
Jerry C Whitaker, "The Electronics Handbook", CRC Press, IEEE Press, ISBN 0- 8493-8345-5 David Bailey, "Practical Radio Engineering and Telemetry for Industry", Elsevier, ISBN 0750658037 Pressman, "Software Engineering - A Practitioner's Approach"

Domine Leenaerts, Johan van der Tang, Cicero S. Vaucher, "Circuit Design for RF Transceivers", Kluwer Academic Publishers, 2003.

CO-PO Mappings:

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2	2	1	1	2	1	3	1	2	1	2
CO2	2	3	1	3	2	3	3	2	3	1	3	1
CO3	2	3	2	-	1	2	2	-	1	2	2	3
CO4	1	-	1	1	1	-	1	3	1	1	1	1

Weightage Values: 3 = Strongly matched, 2 = Moderately matched, 1 = Weakly matched, (-) = Notmatched.

CO-PSO Mapping:

COs/PSOs	**PSO1**	**PSO2**	**PSO3**
CO1	3	3	3
CO2	3	3	3
CO3	3	3	2
CO4	3	3	3

Course Name: Automotive Electronics
Course Code: PEC801C
Contact: 3:0:0
Total Contact Hours:36
Credits:3

Prerequisite: Require the primary knowledge about Automotive Electrical & Electronic System.

Course Outcomes:
The Graduates of the ECE program will be able to:

CO1: Obtain an overview of automotive components, subsystems, design cycles, communication protocols and safety systems employed in today's automotive industry.
CO2: Interface automotive sensors and actuators with microcontrollers.

CO3: Develop, Simulate and Integrate control algorithms for ECUs with hardware.

CO4: Understand and explain fundamentals of automotive electrical and electronics systems.

CO5: Apply the various concepts of electrical and electronics to small vehicle system.

CO6: Analyze the design considerations of various engine control systems in automotive electricaland electronics.

Course Content:

Module 1: [8L]
Overview of Automotive Industry: Leading players, Automotive supply chain, Global challenges, Role of technology in Automotive Electronics and inter disciplinary design, Tools and processes.
Current trends in modern automobiles:

A. Open and close loop Systems-Components for electronic engine management.
B. Electronic management of chassis system.
C. Vehicle motion control.

Introduction to Modern Automotive Systems and need for electronics in automobiles and application areas of electronic systems in modern automobiles:
Spark and Compression Ignition Engines: Ignition systems, Fuel delivery systems, Engine controlfunctions, Fuel control, electronic systems in engines.
Vehicle Braking Fundamentals: Vehicle dynamics during braking, Hydraulic brake system components, Introduction to antilock braking systems.
Batteries: Principles and construction of lead-acid battery. Characteristics of battery, rating capacity and efficiency of batteries.
Steering Control: Steering system basics, Fundamentals of electronically controlled power steering, electronically controlled hydraulic systems and electric power steering systems, Passenger safety and convenience.
Occupant protection systems: Tyre pressure monitoring systems.

Module 2: [8L]

Introduction to Electronic systems in Automotive: Sensors and Actuators for body electronics, power train and chassis systems. Body electronics domain- Automotive alarms, Lighting, Central locking and electric windows, Climatic Control, Driver information, Parking, etc.

Examples of Sensors: Accelerometers, Wheel speed, Brake pressure, Seat occupancy, Engine speed, Steering wheel angle, Vehicle speed, Throttle position, Turbine speed, Temperature, Mass air flow (MAF) rate, Exhaust gas oxygen concentration, Throttle plate angular position, Crankshaft angular position/RPM, Manifold Absolute Pressure (MAP), Differential exhaust gas pressure and Air bag sensors.

Examples of Actuators: Relays, Solenoids and motors. Chassis control systems and Automatic transmission control systems.

Module 3: [8L]

Communication protocols: Overview of automotive communication protocols, CAN, LIN, Flex Ray, MOST, Ethernet, D2B and DSI, Communication interface with ECUs, Interfacing techniques and Interfacing with infotainment gadgets, Relevance of Protocols such as TCP/IP for automotive applications, Wireless LAN standards such as Bluetooth, IEEE 802.11x communication protocols for automotive applications.

Module 4: [12L]

Active Safety Systems: ABS, TCS, ESP, Brake assist, etc. Passive Safety Systems: Airbag systems, Advanced Driver Assistance Systems (ADAS): Combining computer vision techniques as pattern recognition, feature extraction, learning, tracking, 3D visions etc. to develop real-time algorithms able to assist the driving activity. Examples of Assistance Applications: Lane Departure Warning, Collision Warning, Automatic Cruise Control, Pedestrian Protection, Headlights Control, Connected Cars technology and trends towards Autonomous vehicles.

Functional Safety: Need for safety systems, Safety concept, Safety process for product life cycle, Safety by design, Validation.

Diagnostics: Fundamentals of Diagnostics, Basic wiring system and Multiplex wiring system, Preliminary checks and adjustments, Self-diagnostic system.

Textbooks:

1. Williams. B. Ribbens: “Understanding Automotive Electronics” 6thEdition, Elsevier Science, Newestpublication, 2003.
2. Robert Bosch: “Automotive Electronics Handbook”, John Wileyand Sons,2004.

Reference Books:

1. Ronald K. Jurgen: “AutomotiveElectronicsHandbook”,2nd Edition, McGraw-Hill,1999. James D. Halderman:
“Automotive Electricity and Electronics", PHI Publication.
2. Terence Rybak &Mark Stefika: “Automotive Electromagnetic Compatibility (EMC)”, Springer 2004.
3. Allan Bonnick: “Automotive Computer Controlled Systems, Diagnostic Tool and Techniques”,Elsevier Science, 2001.
4. Bosch, “Automotive Electrics and Automotive Electronics. System and components, Networking and Hybrid drive”, Fifth edition, Springer view2014.
5. Najamuzzaman, “Automotive Electronics Design Fundamental’’ first edition, Springer 2015.

CO-PO Mapping:

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	1	2	3	2	1	2	3	2	1	1	1
CO2	3	2	1	2	3	3	2	1	2	1	2	2
CO3	2	3	2	3	2	1	1	2	3	2	1	1
CO4	3	2	2	3	1	1	-	2	2	-	-	2
CO5	3	2	3	1	3	1	1	-	-	1	2	3
CO6	2	1	1	1	3	2	-	-	3	-	-	1

Weightage Values: (3) = Strongly Matched; (2) = Moderately Matched; (1) = Weakly Matched; (-) = Not Matched.

CO-PSO Mapping:

COs/PSOs	**PSO1**	**PSO2**	**PSO3**
CO1	3	3	3
CO2	3	3	3
CO3	3	3	2
CO4	3	3	3
CO5	3	3	2
CO6	3	3	3

Course Name: Adaptive Signal Processing
Course Code: PEC801D
Contact: 3:0:0
Total Contact Hours: 36
Credit: 3

Course Objectives: The aim of the Adaptive Signal Processing course is to present its algorithms and architectures and explain their use in real world applications. As prerequisites it is assumed that students have studied discrete and continuous signals and systems, and introductory linear algebra.

Course Outcomes:
Graduates of the ECE program will be able to:

CO-1: Learn the concept of adaptive signal processing and its applications.
CO-2: Understand the idea of Weiner filter. CO-
3: Understand LMS and RLS algorithm. CO-4:
Realize Lattice Filters and its realization.
CO-5: Comprehend Kalman Filtering and its applications.

Course Content:

Module-1: Adaptive Filter and Applications: [8L]

Adaptive Systems: Definition and characteristics – Properties, Correlation matrix, Applications and examples of an adaptive system - Adaptive Modelling and System Identification, Inverse Adaptive Modelling, Adaptive Interference Cancelling, telecommunications adaptive equalization, Adaptive Arraysand Adaptive Beamforming.

Module-2: Wiener Filter: [6L]

Wiener filters - Linear optimum filtering - Minimum mean-square error - Wiener-Hopf equations - Multiplelinear regression model - Steepest-descent algorithm - Linear prediction -Forward linear prediction, Levinson-Durbin algorithm.

Module-3: LMS and RLS algorithm: [8L]

Least-Mean-Square (LMS) adaptive filters - LMS algorithm, LMS adaptation algorithm, method of steepestdescent and its convergence criteria, LMS versions: normalized LMS, leaky, sign, variable step size, transform domain LMS algorithm using DFT and DCT. Block LMS (BLMS) algorithm: frequency domain BLMS (FBLMS), Method of Least Squares - Normal equations and linear least square filters, Recursive least squares (RLS) algorithm.

Module-4: Lattice Filters: [6L]
Forward Linear Prediction, Backward Linear Prediction, Prediction Error Filters, derivation of the Lattice Structure, All-pole Lattice Structure, Pole-Zero Lattice Structure, Adaptive Lattice Structure, Autoregressivemodelling.

Module-5: Kalman Filtering: [6L]
Statement of Kalman Filtering Problem, Estimation of State Using Innovation, Variance of Kalman Filtering, Extended Kalman Filtering.

TEXTBOOKS:

1. Simon Haykin, “Adaptive Filter Theory”, Pearson Education, Fifth Edition, 2013.
2. Bernard Widrow and Samuel. D. Stearns, “Adaptive Signal Processing”, Pearson Education, 2001.

REFERENCE BOOKS:

1. Farhang-Boroujeny B.", Adaptive Filters Theory and Applications", John Wiley & Sons, 1st Ed.,1998.
2. John. R. Triechler, C. Richard Johnson (Jr), Michael. G. Larimore, “Theory and Design of AdaptiveFilters”, Prentice Hall India Private Limited, 2004.
3. Ali H. Sayed,"Fundamentals of Adaptive Filtering", Wiley, 1st Ed., 2003.
4. Todd K. Moon, Wynn C. Stirling, “Mathematical Methods and Algorithms for Signal Processing”Prentice Hall, First edition, 1999.

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2	1	-	-	2	-	-	-	-	1	3
CO2	1	3	-	2	-	1	2	1	1	-	-	3
CO3	2	-	-	1	1	-	3	-	-	1	2	3
CO4	3	-	1	-	2	-	2	1	2	-	-	3
CO5	2	3	-	2	-	1	2	1	1	-	-	3

Weightage Value: (3) = Strongly matched; (2) = Moderately matched; (1) = Weakly matched; (-) = Not matched.

CO-PSO Mapping:

COs/PSOs	**PSO1**	**PSO2**	**PSO3**
CO1	3	3	3
CO2	3	3	3
CO3	3	3	2
CO4	3	3	3
CO5	3	3	2

Course Name: Block Chain
Course Code: OEC801A
Contact: 3:0:0
Total Contact Hours: 36
Credits: 3

Prerequisite: Cryptography, Data Structure, Advanced Data Structure, Algorithms.

Course Outcomes:
Graduates of the ECE program will be able to:
CO1: Define Block Chain Fundamentals.
CO2: Analyze Blockchain applications in a structured manner
CO3: Create own Crypto token.
CO4: Apply cryptocurrency exchanges and wallets safely.
CO5: Explain latest advances and its applications in Block Chain Technology.

Course Content:

Module-1: BLOCKCHAIN INTRODUCTION [4L]

Blockchain Technology Mechanisms &Networks. Blockchain Origins. Blockchain Objectives, Blockchain Users and Adoption, Blockchain Challenges, Transactions and Blocks, P2P Systems, Keys as Identity, Digital Signatures, Hashes as Addresses, Hash Pointers and Data Structures, Blockchain Transactions.

Module-2: BITCOIN & CRYPTOCURRENCY [5L]

Bitcoin Fundamentals, The Bitcoin Network. The Bitcoin Mining Process. Mining Developments, Bitcoin Wallets, Decentralization and Hard Forks, Alternative Blockchains/Alt-chains, Ethereum Consensus Mechanisms,How Smart Contracts Work, Difference Between Private Consortium and Public Networks, Ethereum Virtual Machine (EVM), Merkle Tree, Double-Spend Problem, New Developments in Blockchain, Ethereum's Ecosystem and DAPPS (Decentralized applications), Blockchain and Digital Currency, Transactional Blocks, Impact of Blockchain Technology on Cryptocurrency, Cryptography.

Module 3: ETHEREUM [5L]

Introduction to Ethereum, History of Ethereum, Interfacing with Ethereum Networks, Meta mask Setup. Ethereum Accounts. Receiving Ether, Transaction- Smart Contracts, Our First Contract, Contract Structure, Function Declarations, Testing with Remix, Redeploying Contracts, Behind the Scenes of Deployment, More onRunning Functions Than You Want to Know, Gas and Transactions, Mnemonic Phrases, Getting More Ether.

Module 4: SOLIDITY PROGRAMMING [6L]

Solidity - Language of Smart Contracts, Installing Solidity & Ethereum Wallet, Basics of Solidity by Example: Sub coin Smart Contract, Layout of a Solidity Source File & Structure of Smart Contracts, General Value Types(Int, Real, String, Bytes, Arrays, Mapping, Enum, address), Ether Units, Time Units.

Module 5: ETHEREUM CODING FOR BLOCKCHAIN [6L]

Globally Available Variables & Functions, Operators: Arithmetic, Logical & Bitwise Operators, Control Structure (if-else, for, while, Do-While), Scoping and Declarations, Input Parameters and Output Parameters, Function Calls & Return Types, Function Modifiers, Fallback Function, Abstract Contract, Creating Contracts via "new" Operator. Inheriting Smart Contracts. Importing Smart Contracts & Compiling Contracts, Events Logging, Exceptions.

Module 6: CONTRACT DEPLOYMENT FOR BLOCKCHAIN ENVIRONMENT [6L]

Boilerplate Requirements, Project File Walkthrough, Syntax Highlighters, Compiling Solidity, The Compile Script, Testing Architecture, Fetching Accounts from Ganache, Deployment withWeb3, Deployed Inbox Overview, Asserting Deployment, Web3Version Fix, Verifying the Initial Message, Testing Message Updates, Deployment with INFURA, Wallet Provider Setup, Deployment to Rinke by, Observing Deployment on Etherscan, Deployed Contracts in Remix, Complete Example: Crowd Funding Smart Contract, Complete Example: Voting Ballot Smart Contract.

Module 7: INTRODUCTION TO HYPER LEDGER [4L]

Hyperledger- Distributed Ledger Technology & its Challenges, Hyperledger & Distributed Ledger Technology,Hyperledger Fabric, Hyperledger Composer.

Textbooks:

1. Antony Lewis, "The Basics of Bitcoins and Blockchains: An Introduction to Cryptocurrenciesand the Technology that Powers Them (Cryptography, Crypto Trading, Derivatives, Digital Assets)", Publisher - Mango, September 15, 2018.

2. Daniel Drescher, "Block Chain Basics", Apress; 1st edition, 2017

3. Anshul Kaushik, "Block Chain and Crypto Currencies", Khanna Publishing House, Delhi.

4. Imran Bashir, "Mastering Block Chain: Distributed Ledger Technology, Decentralization and SmartContracts Explained", Packt Publishing, first edition –2012.

Reference Books:

1. Ritesh Modi, "Solidity Programming Essentials: A Beginner"s Guide to Build Smart Contracts for Ethereum and Block Chain", Packt Publishing.

CO-PO Mapping:

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2	1	-	-	-	-	-	-	-	-	-
CO2	3	3	3	2	2	1	-	-	-	-	-	-
CO3	3	3	3	3	3	2	-	-	-	-	-	-
CO4	3	3	3	3	3	2	-	-	-	-	-	-
CO5	3	3	3	3	3	3	-	-	-	-	-	-

Weightage Value: (3) = Strongly matched; (2) = Moderately matched; (1) = Weakly matched; (-) = Notmatched.

CO-PSO Mapping:

COs/PSOs	**PSO1**	**PSO2**	**PSO3**
CO1	3	3	3
CO2	3	3	3
CO3	3	3	3
CO4	3	3	3
CO5	3	3	3

Course Name: Deep Learning
Course Code: OEC801B
Contact: 3:0:0
Total Contact Hours: 36
Credits: 3

Prerequisite:
Solid background in Statistics, Calculus, Linear Algebra and Probability.
Good Exposure of Python packages like, Numpy, Pandas, Matplotlib, Scikit-learn

Course Outcome(s):
On completion of the course Graduates of the ECE program will be able to:

CO1. Understand the basic concepts in Neural Networks and Deep Learning and applications.
CO2. Understand the Shallow & Deep Neural Networks.
CO3. Understand the Convolutional Neural Network models for Images.
CO4. Understand the Recurrent Neural Network models for Sequence data.

Course Content:

Module 1: Introduction to Neural Networks and Deep Learning [9L]
Neural Network, Supervised Learning with Neural Networks, Deep Learning, Binary Classification, Logistic Regression, Gradient Descent, Derivatives, Computation Graph, Derivatives with a Computation Graph, Vectorization, Vectorizing Logistic Regression, Vectorizing Logistic Regression's Gradient Output.

Module 2: Shallow Neural Network & Deep Neural Network [9L]
Neural Networks Overview, Neural Network Representation, computing a Neural Network's Output, Vectorizing Across Multiple Examples, Activation Functions, Gradient Descent for Neural Networks, Backpropagation Intuition, Random Initialization, Deep L-layer Neural Network, Forward Propagation in a Deep Network, Building Blocks of Deep Neural Networks, Forward and Backward Propagation, Parameters vs Hyperparameters.

Module 3: Foundations of Convolutional Neural Networks [9L]
The Basic Structure of a Convolutional Network, The Convolution Operation, Motivation, Pooling, Convolution and Pooling as an Infinitely Strong Prior, Variants of the Basic Convolution Function, Structured Outputs, Data Types, Random or Unsupervised Features, Training a Convolutional Network, Object Localization and Object Detection, YOLO Algorithm, Case Studies of Convolutional Architectures-Alex Net, VGG, Google Net, Res Net, Applications of Convolutional Networks.

Module 4: Sequence Models [9L]
Unfolding Computational Graphs, Recurrent Neural Networks, Bidirectional RNNs, Encoder-Decoder Sequence-to-Sequence Architectures, Deep Recurrent Networks, Recursive Neural Networks, The Challenge of Long-Term Dependencies, Echo State Networks, Long Short-Term Memory (LSTM), Gated Recurrent Units (GRUs), Optimization for Long-Term Dependencies, Explicit Memory, Applications of Recurrent Neural Networks

CO-PO Mappings:

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	1	2	3	3	3	-	-	-	-	1	2	1
CO2	-	2	2	2	1	-	-	-	-	-	1	-
CO3	1	2	3	3	3	1	-	-	-	2	-	1
CO4	3	2	2	2	1	1	-	-	-	3	2	3

Weightage Value: (3) = Strongly matched; (2) = Moderately matched; (1) = Weakly matched; (-) =Not matched.

CO-PSO Mapping:

COs/PSOs	**PSO1**	**PSO2**	**PSO3**
CO1	3	3	3
CO2	3	3	3
CO3	3	3	3
CO4	3	3	3

Course Name: Biology for Engineers
Course Code: OEC 801C
Contact: 3:0:0
Total Contact Hours:36
Credits:3

Course Outcomes:
Graduates of the ECE program will be able to:

CO1: Understand the biological concepts from an engineering point of view.
CO2: Understand the concepts of biological sensing and its challenges.
CO3: Understand the process of human physiological system.
CO4: Integrate biological principles for developing next generation technologies.
CO5: Understand the Design of modern equipment and devices in bioengineering.
CO6: Understand the application of engineering principles and design concepts to medicine and biology for healthcare purposes.

Course Contents:

MODULE 1: [8L]

What is the need to study Biology – Significance of Life Science Studies - Different Inventions inspired by Biology - In Next Generation Technology Development importance of Biology – Cell: Structure, Potential-Action Potential – ECG, EMG, EEG, EOG and other common signals – concept of Ergonomics.

MODULE 2: [5L]
Biomechanics: What is the Terminology, Anthropometry, Skeletal Mechanics: Concept of Structure of bones, Different properties and compassions of bones and relationship with the structure, Properties of bones: Elastic, Biomechanical activity: Mathematical modelling.

MODULE 3: [3L]
Active muscle: Mechanics, Details of force production and transmission of Muscle, Functional relations between Force length and Force Velocity curves.

MODULE 4: [3L]
Potassium channels, Function of Neuron, Concept of Central Nervous Systems, Artificial Neural Networks, techniques of Machine Learning.

MODULE 5: [4L]
Different Sensing Techniques: Working principle of Sense organs, Mechanisms of Sensing Issues on Sensor Development, Discussion on Digital Camera: Eye Comparison, electronic nose, electronic tongue,electronic skin.

MODULE 6: [3L]

Devices on Physiological Assist: Different Artificial Organ Development like Kidney, Liver, Pancreas, heart valves – What are the design Challenges and Developments in technology.

MODULE 7: [10L]

Health Care 4.0 - Biology oriented research and development in engineering domain, Discussion on different topics: The Internet of Medical Things (IoMT) & Bio Machine Learning. Artificial Intelligence and Bio Intelligence, Modern Biomedical Sensors and Biochip, Biomedical Control System & Robotics, Bio Big Data, In Biomedical field the process of Product Design & Commercialization.

Textbooks/ References:

1. Leslie Cromwell, Biomedical Instrumentation, Prentice Hall 2011.
2. Thyagarajan S., Selvamurugan N., Rajesh M.P., Nazeer R.A., Thilagaraj W., Barathi S., andJaganthan M.K., Biology for Engineers, Tata McGraw-Hill, New Delhi, 2012.
3. Fanwen Meng, Albert Tan, Janya Chanchaichujit, Sarayoot Eaimkhong, Healthcare 4.0: NextGeneration Processes with the Latest Technologies, Springer, 23-Jul-2019 - Science.
4. Jeremy M. Berg, John L. Tymoczko and Lubert Stryer, "Biochemistry", W.H. Freemanand Co. Ltd., 6th Ed., 2006.
5. Eric R. Kandel, James H. Schwartz, Thomas M. Jessell, "Principles of Neural Science",McGraw-Hill, 5th Edition, 2012.

CO-PO Mapping:

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	2	-	-	-	2	-	-	-	-	-	-
CO2	1	2	-	-	-	2	-	-	-	-	-	1
CO3	2	2	3	1	-	2	2	-	-	-	-	-
CO4	3	1	3	1	3	3	-	-	-	-	-	-
CO5	2	2	2	1	3	2	-	-	-	-	-	-
CO6	3	2	2	1	-	2	2	-	-	-	-	-

Weightage Value: (3) = Strongly matched; (2) = Moderately matched; (1) = Weakly matched; (-) = Notmatched.

CO-PSO Mapping:

COs/PSOs	**PSO1**	**PSO2**	**PSO3**
CO1	3	3	3
CO2	3	3	3
CO3	3	3	3
CO4	3	3	3
CO5	3	3	3
CO6	3	3	3

Course Name: Foreign Language
Course Code: OEC 801D
Contact: 3:0:0
Total Contact Hours:36
Credits:3

French (Open Elective)

Pre-requisites: Basic high school level reading, writing and communication skills in English.

Course outcomes: By the end of the course the students will be able to
CO1: Read basic French and interpret the meaning
CO2: Construct simple sentences in French
CO3: Interact with others and hold simple conversations in French
CO4: Demonstrate a basic knowledge of French culture, manners, geography and world view

Course Content

Unit1 6L

Vocabulaire

- L' alphabet français (The Alphabets)
- Les nombres (cardinaux et ordinaux) (Numbers)
- Les mois de l'année (The Months of the Year)
- Les saisons (The Seasons)
- Les jours de la semaine (The Days of the Week)
- Les couleurs (The Colours)
- La famille (The Family)
- Les nationalités (The Nationalities)

Grammaire

- Les Verbes—être, avoir et aller
- Nouns—Gender and Number
- Les articles (définis, indéfinis, contracté et partitif)
- Les adjectifs—possessifs et demonstraifs

Français Intéractif (Listening and Speaking)

- Les salutations
- Les forms de politesse
- Présentez-vous (About Yourself)

Unit 2 6L

Vocabulaire

- L'heure (the time)
- La maison (the house)

- Le corps (the body)
- Les vêtements (clothes)
- Les professions (professions)
- Les loisirs (pastimes)
- Le sport (Sports)

Grammaire

- Le Verbes—voir, savoir, venir, aller, sortir, connaître, partir.
- Les négations
- Le futur
- Les interrogatifs

Français Intéractif (Listening and Speaking)

- Décrivez les images
- La dictée
- Liséz le journal

Unit3 6L

Vocabulaire

- La nourriture (Food)
- Les repas (Meals)
- Les légumes (Vegetables)
- Les fruits (Fruits)
- Les fleurs (Flowers)
- Les animaux (Animals)
- Les oiseaux (Birds)

Grammaire

- Les adverbes
- Les adjectifs
- Les prépositions

Français Intéractif (Listening and Speaking)

- Ecoutez la radio/la télévision
- Dialogues—À la médecin, au café, a la gare

Unit 4 6L

Vocabulaire

- Le jardin (The Garden)
- Le temps (the weather)
- Les voyages (Travel)
- La ville (the City)
- Les vacances (Holidays)

Grammaire
- Pronoms interrogatifs
- Mood—subjonctif et l'impératif

Français Intéractif (Listening and Speaking)
- Se présenter (expressing ideas/opinions on general topics)
- Ecoutez le programme sur la radio/la télévision

Unit 5 6L

Vocabulaire
- Les modes de transport (Transport)
- L'Ecole (the School)
- À la Campagne (in the Country)
- À la restaurant (at the Restaurant)
- Le Cinema (at the Cinema)
- La Marché (at the Market)

Grammaire
- Passé Composé
- Passé Récent

Ecrivez en Françáis (Writing)
- Decrivez votre ville
- Decrivez votre maison/appartement
- Qu'est que son métier?

Unit 6 6L

En France

- Les villes de France (the Cities of France)
- Les montagnes et rivières de France (Mountains and Rivers)
- La geographie de France (Geography of France)
- La gastronomie françáise (French Food and Gastronomy)
- Le fêtes (Festivals of France)

Grammaire
- Les Verbes Pronominaux
- Les Pronoms Personnels

Ecrivez en Françáis (Writing)
- Decrivez votre vacation à l'mer
- Quels sont les loisirs préféres?
- Les magazins de supermarché

Text Books:

1. Le Nouveau Sans Frontières-1 (Paris: CLE International, 1999)
2. Dondo, Modern French Course (1930, Oxford:Oxford UP, 1999)
3. Dictionnaire Larousse

Mapping of Course:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	P10	P11	P12
CO1	2	-	-	3	-	3	2	2	3	3	-	3
CO2	2	3	3	3	-	3	3	3	2	3	-	3
CO3	1	3	3	3	-	2	2	2	2	3	-	2
CO4	1	-	-	-	-	2	2	2	2	3	-	3

CO-PSO Mapping:

COs/PSOs	**PSO1**	**PSO2**	**PSO3**
CO1	3	3	3
CO2	3	3	3
CO3	3	3	3
CO4	3	3	3

Course Name: Product Design & Manufacturing Processes
Course Code: OEC801E
Contact: 3:0:0
Total Contact Hours:36
Credits:3

Prerequisite: The student should have completed two semesters of UG Engineering or Science program. Awareness of tools and methods for product design and development.

Industry Support: All the industries involved in product conceptualization, design and development like MSME, HAL, SAIL, ISRO etc.

Course Outcomes:
Graduates of the ECE program will be able to:

CO1. Understand the product design and development process.
CO2. Apply creative thinking skills for idea generation.
CO3. Translate conceptual ideas into products.
CO4. Present ideas using various types of models.

Course Content:

Module 1: [9L]

Introduction to product design and Manufacturing, Fundamentals of Manufacturing towards Product Development, Engineering Design, Process Product design morphology and Characteristics of successful product development, Design and development of products, duration and cost of product development, the challenges of product development. Development Processes and Organizations, the front-end process, adopting the generic product development process, the AMF development process, product development organizations, the AMF organization.

Module 2: [8L]

Product Planning: The product planning process, identify opportunities. Evaluate and prioritize projects, allocate resources and plan timing, complete pre project planning, reflect all the results and the process.

Identifying Customer Needs: Translating Customer Needs, gather raw data from customers, interpret raw data in terms of customer needs, organize the needs into a hierarchy, establish the relative importance of the needs and reflect on the results and the process. Value Engineering, an introduction

Module 3: [6L]

Product Specifications: What are specifications, when are specifications established, establishing target specifications, setting the final specifications.

Concept Generation: The activity of concept generation, clarify the problem, search externally, search internally, explore systematically, reflect on the results and the process. Concept Selection,Overview of methodology, concept screening, and concept scoring,

Module 4: [7L]

Concept Testing: Define the purpose of concept test, choose a survey population, choose a survey format, communicate the concept, measure customer response, interpret the result, reflect on the results and the process.

Industrial Design: Assessing the need for industrial design, the impact of industrial design, industrial design process, managing the industrial design process and assessing the quality of industrial design.

Module 5: [6L]

Visual Design, Elements of Visual Design and Quality Function Deployment (QFD), Quality Control, Quality Assurance.
Design for Manufacturing: Definition, estimation of manufacturing cost, reducing the cost of components,assembly, supporting production, impact of DFM on other factors. Prototyping, Prototyping basics,principles of prototyping, technologies, planning for prototypes.

Textbooks:

1. Eppinger, S. and Ulrich, K., 2015. Product design and development. McGraw-Hill HigherEducation.
2. Magrab, E.B., Gupta, S.K., McCluskey, F.P. and Sandborn, P., 2009. Integrated productandprocess design and development: the product realization process. CRC Press.
3. Product Design and Manufacturing - A C Chitale and R C Gupta, PH1, - 3rd Edition, 2003.
4. Product Design for Manufacture and Assembly, G. Boothroyd, P. Dewhurst, W. Knight, Marcel Dekker, University of Rhode Island Kingston, New York, USA

Reference Books and materials:

1. Boothroyd, G., 1994. Product design for manufacture and assembly. Computer-Aided Design,2. 26(7).
2. Product Design and Development, Karl T. Ulrich, Steven D. Eppinger, McGraw-Hill companies, New York, USA.
3. Design for Manufacturability Handbook, James G. Bralla, McGraw-Hill companies, New York, USA.
4. Manufacturing Processes: Casting, Forming and Welding: H. S. Shan, Cambridge University Press.
5. https://ocw.mit.edu/courses/mechanical-engineering/2-008-design-and-manufacturing-ii-spring-2004/lecture-notes/
6. New Product Development - Timjones. Butterworth Heinmann - Oxford. UCI -1997

CO-PO Mapping:

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	3	1	-	-	-	-	-	-	-	-	-
CO2	3	2	1	2	2	2	-	-	-	-	-	-
CO3	2	3	3	3	2	1	-	-	-	-	-	-
CO4	3	2	3	2	3	2	-	-	-	-	-	-

Weightage Value: (3) = Strongly matched; (2) = Moderately matched; (1) = Weakly matched; (-) = Not matched.

CO-PSO Mapping:

COs/PSOs	PSO1	PSO2	PSO3
CO1	3	3	3
CO2	3	3	3
CO3	3	3	2
CO4	3	3	3

Course Name: Business Research Method
Course code: OEC 801F
Contact: 3:0:0
Total Contact Hours: 36
Credit: 3

Prerequisite:
Reasoning and analytical ability.

Course outcomes:
The Graduates of the ECE program will be able to:
CO1: Understand various kinds of research, objectives of doing research, research processresearch designs and sampling.
CO2: Formulate research problem and develop a sufficiently coherent research design.
CO3: Develop basic knowledge on qualitative, quantitative as well as measurement &scaling techniques.
CO4: Capable of writing and developing independent thinking for critically analyzing research reports.

Course Contents:

Module-1: Introduction 2L
Research: – Definition, Meaning, Importance, Research Process

Module-2: Research Design 4L
Research design: Concept, Features of a good research design, Concept of Cross-sectional and Longitudinal Research. Experimental Design: Concept of Cause, Causal relationships, Concept of Independent & Dependent variables, extraneous variable, Treatment, Control group.

Module-3: Data collection and Presentation 4L

Primary Data-observational method, Interview, Questionnaire, Survey; Secondary data-internal and external sources, Questionnaire Construction, Validity, and reliability test. Data presentation-Frequency Distribution Charts.

Module-4: Review of statistical Measures: 4L
Measures of Central Tendency, Dispersion. Skewness, Correlation and regression

Module-5: Scaling & measurement techniques 6L
Concept of Measurement: Need of Measurement Problems in measurement in management research – Validity and Reliability. Levels of measurement – Nominal, Ordinal, Interval, Ratio. Concept of Scale – Rating Scales viz. Likert Scales, Semantic Differential Scales, Constant Sum Scales, Graphic Rating Scales – Ranking Scales – Paired comparison & Forced Ranking – Concept and Application.

Module-6: Sampling Methods & Distributions 4L
Sampling and sampling distributions: Sampling methods, sampling distribution, Central limit theorem, Confidence Interval Estimation, Determination of sample size

Module-7: Hypothesis testing 8L
Concept of Hypothesis & Hypothesis Testing (one sample test and two sample tests). Test of Significance: Small sample tests: t (Mean, proportion) and F tests, Z test, Analysis of Variance: Oneway and two-way Classifications, Chi-square test; Interpretation of the given data and report preparation.

Module-8 4L
Multivariate Data Analysis: Factor Analysis, Multi- Dimensional Scaling.

References:

1. C.R Kothari, "Research Methodology, Methods & Technique"; New Age International Publishers, 2004.
2. R. Ganesan, "Research Methodology for Engineers", MJP Publishers, 2011.
3. Y.P. Agarwal, "Statistical Methods: Concepts, Application and Computation", SterlingPubls., Pvt., Ltd., New Delhi, 2004.
4. D.R. Cooper and P.S. Schindler: Business Research Methods, Tata McGraw –Hill.
5. J. K. Das: Business Mathematics and Statistics: Academic Publishers.
6. P Mishra: Business Research Methods, Oxford University Press.

CO-PO Mapping:

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	-	-	-	-	2	2	3	-	3	-	3	3
CO2	-	-	-	-	-	2	-	2	3	3	-	3
CO3	-	-	-	-	2	3	-	-	3	3	-	2
CO4	-	-	-	-	-	3	2	-	3	3	-	2

Weightage Values: 3 = Strongly matched, 2 = Moderately matched, 1 = Weakly matched, (-) = Not matched.

CO-PSO Mapping:

COs/PSOs	**PSO1**	**PSO2**	**PSO3**
CO1	3	3	3
CO2	3	3	3
CO3	3	3	2
CO4	3	3	3

Course Name: Essence of Indian Knowledge Tradition
Course Code: MC801
Contacts: 3:0:0
Total Contact Hours: 36
Credits: 3

Prerequisite:

The students to whom this course will be offered must have the knowledge about Indian history, culture and sociological structure.

Course Outcomes:

The Graduates of the ECE program will be able to:

CO 1: Identify the concept of Traditional knowledge and its importance.

CO 2: Explain the connection between Modern Science and Indian Knowledge System.

CO 3: Understand the importance of Yoga for health care.

CO 4: Interpret the effect of traditional knowledge on environment.

Course Contents:

Module-1: Basic structure of Indian Knowledge System: [8L]
Define traditional knowledge, nature and characteristics, scope and importance, kinds of traditional knowledge, Indigenous Knowledge (IK), characteristics, traditional knowledge vis-a-vis indigenous knowledge, traditional knowledge Vs western knowledgetraditional knowledge

Module-2: Modern Science and Indian Knowledge System: [8L]
Systems of traditional knowledge protection, Legal concepts for the protection of traditional knowledge, Patents and traditional knowledge, Strategies to increase protection of traditional knowledge

Module-3: Yoga and HolisticHealth care: [4L]
Yoga for positive health, prevention of stress related health problems and rehabilitation, Integral approach of Yoga Therapy to common ailments.

Module-4: Traditional Knowledge and Environment: [4L]
Traditional knowledge and engineering, Traditional medicine system, Importance of conservation and sustainable development of environment, Management of biodiversity

Textbooks:

1. V. Sivaramakrishnan (Ed.), Cultural Heritage of India-coursematerial, Bharatiya Vidya Bhavan, Mumbai. 5th Edition, 2014
2. Swami Jitatmanand, Modern Physics and Vedant, Bharatiya Vidya Bhavan.
3. Swami Jitatmanand, Holistic Science and Vedant, Bharatiya Vidya Bhavan.
4. Fritzof Capra, The Wave of life.
5. VN Jha (Eng. Trans.), Tarkasangraha of Annam Bhatta, International Chinmay Foundation, Velliarnad, Arnakulam.
6. Yoga Sutra of Patanjali, Ramakrishna Mission, Kolkata.
7. RN Jha, Yoga-darshanam with Vyasa Bhashya, Vidyanidhi Prakashan, Delhi 2016 RN Jha, Science of Consciousness Psychotherapyand Yoga Practices, Vidyanidhi Prakashan, Delhi 2016.

CO-PO Mapping:

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2	1	-	2	1	-	-	-	2	3	3
CO2	3	2	-	1	3	2	-	1	2	-	3	3
CO3	3	2	2	-	2	3	1	-	2	1	3	3
CO4	3	1	-	2	-	-	-	2	-	3	3	3

Weightage Values: 3 = Strongly matched, 2 = Moderately matched, 1 = Weakly matched, (-) = Notmatched.

CO-PSO Mapping:

COs/PSOs	**PSO1**	**PSO2**	**PSO3**
CO1	-	-	-
CO2	-	-	-
CO3	-	-	-
CO4	-	-	-