Electronics and Communication Engineering (ECE) Department

B.TECH. PROGRAMME

CURRICULUM STRUCTURE

RELEASE DATE:

July, 2018:Ver1.0

May, 2019: Ver: 1.1

July, 2020: Ver : 1.2

April. 2021 : Ver :1.3

1st Year 1st Semester Syllabus:

A. Theory								
Sl. No.	**Category**	**Course Code**	**Course Name**	**Contact Hours/Week**				**Credit Points**
				L	**T**	**P**	**Total**	
1	Basic Science course	**CHEM1001**	Chemistry I	3	1	0	4	4
2	Basic Science course	**MATH1101**	Mathematics I	3	1	0	4	4
3	Engg. Science course	**ELEC1001**	Basic Electrical Engineering.	3	1	0	4	4
Total Theory				9	3	0	12	**12**

B. Practical								
1	Basic Science course	**CHEM1051**	Chemistry I Laboratory	0	0	3	3	1.5
2	Engg.Science Course	**ELEC1051**	Basic Electrical Engineering Laboratory	0	0	2	2	1
3	Engg.Science Course	**MECH1052**	Engineering Graphics & Design	1	0	4	5	3
Total Practical				0	0	9	**10**	**5.5**
Total of Semester without Honours				10	3	9	**22**	**17.5**

C. Honours								
1	**Honours**	**HMTS1011**	Communication for Professionals	3	0	0	3	3
		HMTS1061	Professional Communication Laboratory	0	0	2	2	1
Total Honours				3	0	2	5	4
Total of Semester with Honours				**13**	**3**	**11**	**27**	**21.5**

1st Year 2nd Semester Syllabus:

A. Theory								
Sl. No.	**Category**	**Course Code**	**Course Name**	**Contact Hours/Week**				**Credit Points**
				L	**T**	**P**	**Total**	
1	Basic Science course	**PHYS1001**	Physics I	3	1	0	4	4
2	Basic Science course	**MATH1201**	Mathematics II	3	1	0	4	4
3	Engg. Science course	**CSEN1001**	Programming for Problem Solving	3	0	0	3	3
4	Humanities	**HMTS1201**	Business English	2	0	0	2	2
			TOTAL	11	2	0	13	13

B. Practical								
1	Basic Science Course	**PHYS1051**	Physics I Laboratory	0	0	3	3	1.5
2	Engg.Science Course	**CSEN1051**	Programming for Problem Solving Laboratory	0	0	4	4	2
3	Engg.Science Course	**MECH1051**	Workshop/ Manufacturing Practices	1	0	4	5	3
4	Humanities	**HMTS1251**	Language Laboratory	0	0	2	2	1
Total Practical				11	2	13	**14**	**7.5**
Total of Semester without Honours				12	2	13	**27**	**20.5**

C. Honours								
1	**Honours**	**ECEN1011**	Basic Electronics	3	0	0	3	3
		ECEN1061	Basic Electronics Laboratory	0	0	2	2	1
Total Honours				3	0	2	5	4
Total of Semester with Honours				**15**	**2**	**15**	**32**	**24.5**

2nd Year 1st Semester:

A. Theory								
Sl. No.	**Category**	**Course Code**	**Course Name**	**Contact Hours/Week**				**Credit Points**
				L	**T**	**P**	**Total**	
1	Professional Core Course	**ECEN2101**	Analog Circuits	3	0	0	3	3
2	Professional Core Course	**ECEN2102**	Circuit and Network Theory	3	0	0	3	3
3	Professional Core Course	**ECEN2103**	Signals and Systems	3	0	0	3	3
4	BasicScience course	**MATH2001**	Mathematical Methods	3	0	0	3	3
5	Engg.Science courses	**CSEN2004**	Data Structure and Basic Algorithms	4	0	0	4	4
6	Humanities	**HMTS2001**	Human Values and Professional Ethics	3	0	0	3	3
Total Theory				19	0	0	**19**	**19**

B. Practical								
1	Professional Core Course	**ECEN2151**	Analog Circuits Laboratory	0	0	2	2	1
2	Professional Core Course	**ECEN2152**	Circuit and Network Theory Laboratory	0	0	3	3	1.5
3	Professional Core Course	**ECEN2153**	Signals and Systems Laboratory	0	0	2	2	1
4	Engg.Sciencecourses	**CSEN2054**	Data Structure and Basic Algorithms Laboratory	0	0	3	3	1.5
Total Practical				0	0	10	**10**	**5**
Total of Semester							**29**	**24**

2nd Year 2nd Semester:

A. Theory								
Sl. No.	**Category**	**Course Code**	**Course Name**	**Contact Hours/Week**				**Credit Points**
				L	**T**	**P**	**Total**	
1	Professional Core Course	**ECEN2201**	Analog Communication	3	0	0	3	3
2	Professional Core Course	**ECEN2202 ***	Digital Systems Design	3	0	0	3	3
3	Professional Core Course	**ECEN2203**	EM Theory & Transmission Lines	3	0	0	3	3
4	Professional Core Course	**ECEN2204**	Electronic Devices	3	0	0	3	3
5	Basic Science Course	**MATH2202**	Advanced Numerical Methods	3	0	0	3	3
Total Theory				15	0	0	**15**	**15**

B. Practical								
1	Professional Core Course	**ECEN2251**	Analog Communication Laboratory	0	0	2	2	1
2	Professional Core Course	**ECEN2252 ***	Digital Systems Design Laboratory	0	0	2	2	1
3	Professional Core Course	**ECEN2253**	EM Theory & Transmission Lines Laboratory	0	0	2	2	1
4	Basic Science courses	**MATH2253**	Advanced Numerical Methods Laboratory	0	0	2	2	1
Total Practical				0	0	8	**8**	**4**

Note:

* Upto Ver 1.1, the codes were ECEN 2002 & ECEN 2052, modified in Ver 1.2 (Subject name remains same). The codes ECEN 2202 & ECEN 2252 are applicable from 2023 pass out students.

C. Mandatory Course(non-credit)								
1	Mandatory	**EVSC2016**	Environmental Sciences	2	0	0	2	0
Total of Semester without Honours				**17**	**0**	**8**	**25**	**19**

C. Honours								
1	**Honours**	**ECEN2211**	Control Systems	3	0	0	3	3
		ECEN2261	Control Systems Laboratory	0	0	2	2	1
Total Honours				3	0	2	5	4
Total of Semester with Honours				**20**	**0**	**10**	**30**	**23**

3rd. Year, 1st. Semester

A. Theory								
Sl. No.	**Category**	**Course Code**	**Course Name**	**Contact Hours/Week**				**Credit Points**
				L	**T**	**P**	**Total**	
1	Professional Core Course	**ECEN3101**	Digital Communication	3	0	0	3	3
2	Professional Core Course	**ECEN3102**	Digital Signal Processing	3	0	0	3	3
3	Professional Core Course	**ECEN3103**	Microwave Engineering	3	0	0	3	3
4	Professional Core Course	**ECEN3104**	Microprocessors and Microcontrollers	3	0	0	3	3
5	Professional Core Course	**ECEN3105**	Information Theory and Coding	3	0	0	3	3
6	Professional Elective-1	**ECEN3131**	Telecommunication Systems	3	0	0	3	3
		ECEN3132	Computer Networks					
		ECEN3133	Speech and Audio Processing					
Total Theory				18	0	0	18	**18**

B. Practical								
1	Professional Core Courses	**ECEN3151**	Digital Communication Laboratory	0	0	2	2	1
2	Professional Core Courses	**ECEN3152**	Digital Signal Processing Laboratory	0	0	2	2	1
3	Professional Core Course	**ECEN3153**	Microwave Engineering Laboratory	0	0	2	2	1
4	Professional Core Course	**ECEN3154**	Microprocessors and Microcontrollers Laboratory	0	0	2	2	1
Total Practical				0	0	8	**8**	**4**
Total of Semester							**26**	**22**

3rd Year 2nd Semester:

A. Theory								
Sl. No.	**Category**	**Course Code**	**Course Name**	**Contact Hours/Week**				**Credit Points**
				L	**T**	**P**	**Total**	
1	Professional Core Courses	**ECEN3201**	Digital VLSI Design	3	0	0	3	3
2	Engineering Science Course	**CSEN3208**	Object Oriented Programming Concept by using C++	3	0	0	3	3
3	HU	**HMTS3201**	Economics for Engineers	3	0	0	3	3
4	Professional Elective-2	**ECEN3231**	Digital Image Processing & Pattern recognition	3	0	0	3	3
		ECEN3232	IoT for Communication					
		ECEN3233	Power Electronics					
		ECEN 3234	Network Security					
		ECEN 3235	Advanced Digital Communication					
5	Open Elective - 1	**ECEN3221**	Artificial Intelligence in Radio Communication	3	0	0	3	3
		AEIE3221	Fundamentals Of Sensors And Transducers					
		CSEN3221	Fundamentals of RDBMS					
		MATH3221	Computational Mathematics					
		MATH3222	Advanced Probability and Information Theory					
		MATH3223	Scientific Computing					
Total Theory				15	0	0	**15**	**15**

B. Practical								
1	Professional Core Course	**ECEN3251**	Digital VLSI Design Laboratory	0	0	2	2	1
2	Engineering Science Course	**CSEN3258**	Object Oriented Programming Concept by using C++ Laboratory	0	0	3	3	1.5
Total Practical				0	0	5	**5**	**2.5**

C. Sessional								
1	Professional Core Courses	**ECEN3252**	Mini Project/Electronic Design workshop	0	0	3	3	1.5
2	Project Work ,Seminar, Internship etc	**ECEN3293**	Term paper with Seminar	0	0	4	4	2
Total Sessional				0	0	7	**7**	**3.5**

D. Mandatory Course(non-credit)								
1	Mandatory	**INCO3016**	Indian Constitution and Civil Society	2	0	0	2	0
Total of Semester without Honours				**17**	**0**	**12**	**29**	**21**

E. Honours								
1	**Honours**	**ECEN3211**	Wireless and Cellular Communication	3	0	0	3	3
		ECEN3261	Wireless and Cellular Communication Laboratory	0	0	2	2	1
Total Honours				3	0	2	5	4
Total of Semester with Honours				**20**	**0**	**14**	**34**	**25**

Open Elective -1	**i) ECEN3221** **ii) ECEN3222** **iii) ECEN3223**	i) Artificial Intelligence in Radio Communication ii) Designing with Processors and Controllers iii) Analog and Digital Communication

Open Elective -1 (to be offered by ECE Department)

4th Year 1st Semester:

A. Theory								
Sl. No.	**Category**	**Course Code**	**Course Name**	**Contact Hours/Week**				**Credit Points**
				L	**T**	**P**	**Total**	
1	Professional Elective-3	**i) ECEN4141**	i) Adaptive Signal Processing	3	0	0	3	3
		ii)ECEN4142	ii)Fiber Optic Communication					
		iii)ECEN4143	iii) Electromagnetic Interference and Compatibility					
		iv)ECEN4144	iv) Ad Hoc networks and security					
2	Open Elective-2	i**) INFO4121**	i) Fundamentals of Cloud Computing	3	0	0	3	3
		ii)ECEN4121	ii) Software Defined Radio					
		iii)AEIE4122	iii)Linear Control Systems and Applications					
		iv)CSEN4121	iv)Fundamentals of Operating Systems					
		v)MATH4121	v)Methods in Optimization					
		vi)MATH4122	vi)Advanced Linear Algebra					
3	Open Elective- 3	**i)AEIE4126**	i)Optical Instrumentation	3	0	0	3	3
		ii)AEIE4127	ii) Introduction to Embedded System					
		iii)CSEN4126	iii) Intelligent Web and Big Data					
		iv) CHEN4126	v)Industrial Total Quality Management					
		v) ECEN4126	vi)Principles of Radar					
4	HU	**HMTS4101**	Principles of Management	3	0	0	3	3
Total Theory				12	0	0	**12**	**12**

B. Sessional								
5	Project Work.	**ECEN4195**	Project Stage – I	0	0	8	8	4
6	Industrial Training/ Internship	**ECEN4191**	Industrial Training/Internship	-	-	-	-	2
Total Sessional				0	0	8	**8**	**6**
Total of Semester without Honours				12	0	8	**20**	**18**

C. Honours								
1	**Honours**	**ECEN4111**	Microelectronics and Analog VLSI design	3	0	0	3	3
		ECEN4161	Microelectronics and Analog VLSI design Laboratory	0	0	2	2	1
Total Honours				3	0	2	5	4
Total of Semester with Honours				**15**	**0**	**10**	**25**	**22**

Open Elective -2	**i)ECEN4121** **ii) ECEN4122** **iii) ECEN4123**	i) Software Defined Radio ii)Introduction to Machine Learning iii) Error Control Coding for Secure Data Transmission

Table 2: Open Elective 2 (to be offered by ECE department)

Open Elective -3	**i)ECEN4126** **ii)ECEN4127** **iii) ECEN4128**	i) Principles of Radar ii) Ad Hoc Wireless Networks iii)Introduction to VLSI Design

Table 3: Open Elective 3 (to be offered by ECE department)

4th Year 2nd Semester:

A. Theory								
Sl. No.	**Category**	**Course Code**	**Course Name**	**Contact Hours/Week**				**Credit Points**
				L	**T**	**P**	**Total**	
1	Professional Elective - 4	**i)ECEN4241**	i) Introduction to MEMS	3	0	0	3	3
		ii)ECEN4242	ii) Satellite Communication & Remote Sensing					
		iii)ECEN4243	iii) Digital Beam forming Techniques					
		iv) ECEN 4244	iv)Nanoelectronics & Nanophotonics					
		v) ECEN 4245	v) Cognitive Radio - Deployment Strategy & Applications					
2	Professional Elective-5	i**)ECEN4246**	i) Wireless Sensor Networks	3	0	0	3	3
		ii)ECEN4247	ii) Mobile Communication – 3G and above					
		iii)ECEN4248	iii) Machine Intelligence and Introduction to Python					
3	Open Elective -4	**i) INFO4221**	i) Fundamentals of Cryptography	3	0	0	3	3
		ii)AEIE4221	ii) Process Instrumentation					
		iii)ELEC4221	iii)Applied Illumination Engineering					
		iv) BIOT4222	iv) Non-conventional Energy					
		v)BIOT 4223	v) Biology for Engineers					
		vi)ECEN 4221	vi) Low Power High Performance Digital VLSI Circuit Design					
Total Theory				9	0	0	**9**	**9**

B. Sessional								
4	Project Work	**ECEN4295**	Project Work II & Dissertation	0	0	16	16	8
5	Viva Voce.	**ECEN4297**	Comprehensive Viva Voce	-	-	-	-	1
Total Sessional				0	0	16	**16**	**9**
Total of Semester							**25**	**18**

Open Elective -4	i)**ECEN4221** **ii)ECEN4222** **iii) ECEN4223**	i) Low Power High Performance Digital VLSI Circuit Design ii) Cellular and Mobile communication ii) Optical Fiber Communication

Table 4: Open Elective 4 (to be offered by ECE Department)

Honours Courses

Honours Credit Chart (ECE)

Sl. No.	Semester	Paper Code	Course Name	Contact Hours / Week			Credit Points
				L	T	P	
1	1st	HMTS1011	Communication for Professionals	3	0	0	3
		HMTS1061	Professional Communication Laboratory	0	0	2	1
2	2nd	ECEN1011	Basic Electronics	3	0	0	3
		ECEN1061	Basic Electronics Laboratory	0	0	2	1
3	4th	ECEN2211	Control Systems	3	0	0	3
		ECEN2261	Control Systems Laboratory	0	0	2	1
4	6th	ECEN3211	Wireless and Cellular Communication	3	0	0	3
		ECEN3261	Wireless and CellularCommunication Laboratory	0	0	2	1
5	7th	ECEN4111	Microelectronics andAnalog VLSI design	3	0	0	3
		ECEN4161	Microelectronics andAnalog VLSI design Laboratory	0	0	2	1
Grand Total							20

Definition of Credit (as per AICTE):

- 1 Hour Lecture (L) per Week = 1 Credit
- 1 Hour Tutorial (T) per Week = 1 Credit
- 1 Hour Practical (P) per Week = 0.5 Credits
- 2 Hours Practical (Lab) per Week = 1 Credit

Range of Credits (as per AICTE):

- ✓ A total of 160 credits will be necessary for a student to be eligible to get B Tech degree.
- ✓ A student will be eligible to get B Tech degree with Honours if he/she completes an additional 20 credits. These could be acquired through various Honours Courses offered by the respective departments.
- ✓ A part or all of the above additional credits may also be acquired through MOOCs. Any student completing any course through MOOC will have to submit an appropriate certificate to earn the corresponding credit.
- ✓ For any additional information, the student may contact the concerned HODs.

On line courses recommended to the students of ECE Department

Code	Name	Credit Points	Corresponding Online Course	Offered by	Platform	Comment
ECEN1011	Basic Electronics	3	Fundamentals of Semiconductor Devices	IISc Bangalore	NPTEL	
ECEN 1061	Basic Electronics Lab	1				
HMTS1011	Communication for Professionals	3	Effective Business Communication	IIM Bangalore	Swayam	**Both online courses need to be done**
HMTS1061	Professional Communication Lab	1	Developing Soft Skills and Personality	IIT Kanpur	Swayam	
ECEN2211	Control Systems	3	Control Systems	IIT Madras	NPTEL	
ECEN2261	Control Systems Lab	1				
ECEN3211	Wireless and Cellular Communication	3	Introduction to Wireless and Cellular Communication	IIT Madras	NPTEL	
ECEN3261	Wireless and Cellular Communication Lab	1				
ECEN4111	Microelectronics and Analog VLSI Design	3	Analog IC Design	IIT Madras	NPTEL	
ECEN4161	Microelectronics and Analog VLSI Design Lab	1				

Heritage Institute of Technology, Kolkata (HIT-K) – Credit Summary for B Tech Programmes with effect from 2018-2019

Sl. No.	Course Type	AICTE Suggested	AEIE	BIOT	CIVL	CHEN	CSEN	ECEN	ELEC	INFO	MECH
1.	Humanities and Social Sciences including Management Courses	12	12	12	12	12	12	12	12	12	12
2.	Basic Science Courses	25	23	26.5	21	22	23	26	23	23	27
3.	Engineering Science Courses including Workshop, Drawing, Basics of Electrical / Mechanical / Computer, etc.	24	27	27.5	26	27	30	26	28	28	23
4.	Professional Core Courses	48	54	49	57	55	51	52	53	53	51.5
5.	Professional Elective Courses relevant to chosen Specialization / Branch	18	15	16	15	15	15	15	15	15	17.5
6.	Open Subjects – Electives from other Technical and/or Emerging Subjects	18	12	12	12	12	12	12	12	12	12
7.	Project Work, Seminar and Internship in industry or elsewhere	15	17	17	17	17	17	17	17	17	17
8.	Mandatory Courses (Non-credit) [Environmental Sciences, Induction Program, Indian Constitution,	0	0	0	0	0	0	0	0	0	0

Sl. No.	Course Type	AICTE Suggested	AEIE	BIOT	CIVL	CHEN	CSEN	ECEN	ELEC	INFO	MECH
	Essence of Indian Traditional Knowledge]										
	Total	**160**	**160**	**160**	**160**	**160**	**160**	**160**	**160**	**160**	**160**
9	Honours Courses	20	20	20	20	20	20	20	20	20	20
	Grand Total	**180**	**180**	**180**	**180**	**180**	**180**	**180**	**180**	**180**	**180**

Definition of Credit (as per AICTE):

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- 1 Hour Tutorial (T) per Week = 1 Credit
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- 2 Hours Practical (Lab) per Week = 1 Credit

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- ✓ For any additional information, the student may contact the concerned HODs.

1ST YEAR 1ST SEMESTER

Course Name : Chemistry I					
Course Code : CHEM1001					
Contact hrs per week:	L	T	P	Total	Credit points
	3	1	0	4	4

Course outcomes:

The subject code CHEM1001 corresponds to chemistry theory classes for the first year B. Tech students, which is offered as Engineering Chemistry and is common for all branches of engineering subjects. The course provides basic knowledge of theory based subjects like quantum mechanics, thermodynamics, reaction dynamics, electrochemistry, structure and reactivity of molecules. The course outcomes of the subject are

1. Knowledge of understanding the operating principles and reaction involved in batteries and fuel cells and their application in automobiles as well as other sectors to reduce environmental pollution.
2. An ability to design and conduct experiments, as well as to organize, analyzes, and interprets data.
3. An ability to analyse microscopic chemistry in terms of atomic and molecular orbitals and intermolecular forces.for engineering applications.
4. Have knowledge of synthesizing nano materials and their applications in industry, carbon nano tube technology is used in every industry now-a-days.
5. Understanding of bulk properties and processes using thermodynamic considerations.
6. Elementary knowledge of IR, UV, NMR and X-ray spectroscopy is usable in structure elucidation and characterisation of various molecules.Knowledge of electronic effect and stereochemistry for understanding mechanism of the major chemical reactions involved in synthesis of various drug molecules.

MODULE 1[10 L]

Atomic structure and Wave Mechanics:

Brief outline of the atomic structure, Duel character of electron, De Broglies's equation, the Heisenberg uncertainty principle, brief introduction of quantum mechanics, the Schrodinger wave equation, Hermitian operator, solution of the Schrodinger equation for particle in a one dimensional box, interpretation of the wave function Ψ, concept of atomicorbital.3L

Thermodynamics:

Carnot cycle, 2nd law of thermodynamics, entropy, Clausius inequality, free energy and work function, Clausius Clapeyron Equation, Chemical Potential, Activity and Activity coefficient. Gibbs Duhem Relation.4L

Spectroscopic Techniques & Application

Electromagnetic spectrum: EMR interaction with matter - absorption and emission of radiation. Principle and application of UV- visible and IR spectroscopy

Principles of NMR Spectroscopy and X-ray diffraction technique. 3L

MODULE 2 [10 L]

Chemical Bonding

Covalent bond, VSEPR Theory, hybridization, molecular geometries, Dipole moment, Intermolecular forces, V.B. and M.O. theory and its application in Homo and Heteronuclear diatomic molecules, Band theory of solids, Pi- molecular orbital of ethylene and butadiene.5L

Periodicity

Effective nuclear charge, electronic configurations, atomic and ionic sizes, ionization energies, electron affinity and electro-negativity, inert pair effect.3L

Ionic Equilibria

Acid Base Equilibria, Salt Hydrolysis and Henderson Equation, Buffer solutions, pH indicator, Common ion Effect, Solubility product, Fractional Precipitation .2L

MODULE 3 [10 L]

Conductance

Conductance of electrolytic solutions, Strong and Weak electrolytes, effect of temperature and concentration. Kohlrausch's law of independent migration of ions, transport numbers and hydration of ions. Application of conductance Acid-base and precipitation titration. 3L

Electrochemical Cell

Thermodynamic derivation of Nernst equation, Electrode potential and its application to predict redox reaction; Standard Hydrogen Electrode, Reference electrode, cell configuration, half-cell reactions, evaluation of thermodynamic functions; Reversible and Irreversible cells; Electrochemical corrosion.

Electrochemical Energy Conversion: Primary & Secondary batteries, Fuel Cells. 4L

Reaction dynamics

Rate Laws, Order & Molecularity; zero, first and second order kinetics. Pseudo-unimolecular reaction, Arrhenius equation.

Mechanism and theories of reaction rates (Transition state theory, Collison theory). Catalysis: Homogeneous catalysis (Definition, example, mechanism, kinetics). 3L

MODULE 4 [10]

Stereochemistry

Representations of 3 dimensional structures, structural isomers and stereoisomers, configurations and symmetry and chirality, enantiomers, diastereomers, optical activity, absolute configurations and conformational analysis.4L

Structure and reactivity of Organic molecule

Inductive effect, resonance, hyperconjugation, electromeric effect, carbocation, carbanion, free radicals, aromaticity.3L

Organic reactions and synthesis of drug molecule

Introduction to reaction mechanisms involving substitution, addition, elimination and oxidation- reduction reactions. Synthesis of commonly used drug molecules.3L

TEXT BOOKS

1. Atkins' Physical Chemistry, P.W. Atkins (10th Edition)
2. Organic Chemistry, I. L. Finar, Vol-1 (6th Edition)
3. Engineering Chemistry, Jain & Jain,(16th Edition)
4. Fundamental Concepts of Inorganic Chemistry, A. K. Das, (2nd Edition)
5. Engineering Chemistry -I, Gourkrishna Dasmohapatra, (3rd Edition)

REFERENCE BOOKS

1. General & Inorganic Chemistry, R. P. Sarkar
2. Physical Chemistry, P. C. Rakshit, (7th Edition)
3. Organic Chemistry, Morrison & Boyd , (7th Edition)
4. Fundamentals of Molecular Spectroscopy, C.N. Banwell, (4th Edition)
5. Physical Chemistry , G. W. Castellan, (3rd Edition)
6. Basic Stereo chemistry of Organic Molecules, Subrata Sen Gupta, (1st Edition)

Course Name : Chemistry I Laboratory					
Course Code : CHEM1051					
Contact hrs per week :	L	T	P	Total	Credit points
	0	0	3	3	1.5

Course outcomes:

The subject code CHEM1051 corresponds to chemistry laboratory classes for the first year B. Tech students. This course enhances the students' experience regarding handling of various chemicals along with various laboratory equipment. Hands on experiments increase the depth of knowledge that is taught in the theory classes as well as it increases research aptitude in students because they can see the direct application of theoretical knowledge in practical field. The course outcomes of the subject are

1. Knowledge to estimate the hardness of water which is required to determine the usability of water used in industries.
2. Estimation of ions like Fe^{2+}, Cu^{2+} and Cl^- present in water sample to know the composition of industrialwater.
3. Study of reaction dynamics to control the speed and yield of various manufactured goods produced in polymer, metallurgical and pharmaceutical industries.
4. Handling physico-chemical instruments like viscometer, stalagmometer, pH-meter, potentiometer and conductometer.
5. Understanding the miscibility of solutes in various solvents required in paint, emulsion, biochemical and material industries.
6. Knowledge of sampling water can be employed for water treatment to prepare pollution free water.

List of Experiments:

1. Estimation of iron using KMnO4: self-indicator.
2. Iodometric estimation of Cu^{2+}.
3. Determination of Viscosity.
4. Determination of surface tension.
5. Adsorption of acetic acid by charcoal.
6. Potentiometric determination of redox potentials.
7. Determination of total hardness and amount of calcium and magnesium separately in a given water sample.
8. Determination of the rate constant for acid catalyzed hydrolysis of ethylacetate.
9. Heterogeneous equilibrium (determination of partition coefficient of acetic acid in n-butanol and water mixture).
10. Conductometric titration for the determination of strength of a given HCl solution against a standard NaOH solution.
11. pH-metric titration for determination of strength of a given HCl solution against a standard NaOH solution.
12. Determination of chloride ion in a given water sample by Argentometric method (using chromate indicator solution)

Course Name : Mathematics-I					
Course Code: MATH1101					
Contact hrs per week:	L	T	P	Total	Credit points
	3	1	0	4	4

Course Outcomes

1. MATH1101.1 Apply the concept of rank of matrices to find the solution of a system of linear simultaneous equations.
2. MATH1101.2 Develop the concept of eigen values and eigen vectors.
3. MATH1101.3 Combine the concepts of gradient, curl, divergence, directional derivatives, line integrals, surface integrals and volume integrals.
4. MATH1101.4 Analyze the nature of sequence and infinite series
5. MATH1101.5 Choose proper method for finding solution of a specific differential equation. MATH1101.6 Describe the concept of differentiation and integration for functions of several variables with their applications in vector calculus.

The objective of this course is to familiarize the prospective engineers with techniques in calculus, multivariate analysis and linear algebra. It aims to equip the students with standard concepts and tools at an intermediate to advanced level that will serve them well towards tackling more advanced level of mathematics and applications that they would find useful in their disciplines.

Module I [10L]

Matrix:

Inverse and rank of a matrix; Elementary row and column operations over a matrix; System of linear equations and its consistency; Symmetric, skew symmetric and orthogonal matrices; Determinants; Eigen values and eigen vectors; Diagonalization of matrices; Cayley Hamilton theorem; Orthogonal transformation.

Module II [10 L]

Vector Calculus:

Vector function of a scalar variable, Differentiation of a vector function, Scalar and vector point functions, Gradient of a scalar point function, divergence and curl of a vector point function, Directional derivative, Related problems onthese topics,

Infinite Series:

Convergence of sequence and series; Tests for convergence: Comparison test, Cauchy's Root test, D' Alembert's Ratio test(statements and related problems on these tests), Raabe's test; Alternating series; Leibnitz's Test (statement, definition); Absolute convergence and Conditional convergence.

Module III [10 L]

First order ordinary differential equations:

Exact, linear and Bernoulli's equations, Euler's equations, Equations not of first degree: equations solvable for p, equations solvable for y, equations solvable for x and Clairaut's type.

Ordinary differential equations of higher orders:

General linear ODE of order two with constant coefficients, C.F. & P.I., D-operator methods, Method of variation of parameters, Cauchy-Euler equations.

Module IV [10L]

Calculus of functions of several variables

Introduction to functions of several variables with examples, Knowledge of limit and continuity, Determination of partial derivatives of higher orders with examples, Homogeneous functions and Euler's theorem and related problems up to three variables,

Multiple Integration

Concept of line integrals, Double and triple integrals. Green's Theorem, Stokes Theorem and Gauss Divergence Theorem.

Suggested Books:

1. B.S. Grewal, Higher Engineering Mathematics, Khanna Publishers, 2000.
2. E. Kreyszig, Advanced Engineering Mathematics, John Wiley & Sons, 2006.
3. Veerarajan T., Engineering Mathematics for first year, Tata McGraw-Hill, New Delhi, 2008.
4. Ramana B.V., Higher Engineering Mathematics, Tata McGraw Hill New Delhi, 11th Reprint, 2010.
5. K. F. Riley, M. P. Hobson, S. J. Bence. Mathematical Methods for Physics and Engineering, Cambridge University Press, 23-Mar-2006.
6. S. L. Ross, Differential Equations", Wiley India, 1984.
7. G.F. Simmons and S.G. Krantz, Differential Equations, McGraw Hill, 2007.
8. Vector Analysis(Schaum's outline series): M.R. Spiegel, Seymour Lipschutz, Dennis Spellman (McGraw Hill Education)
9. Engineering Mathematics: S. S. Sastry (PHI)
10. Advanced Engineering Mathematics: M.C. Potter, J.L. Goldberg and E.F. Abonfadel (OUP),Indian Edition.
11. Linear Algebra (Schaum's outline series): Seymour Lipschutz, Marc Lipson (McGraw Hill Education)

Course Name: Basic Electrical Engineering					
Course Code : ELEC1001					
Contact Hours per week	L	T	P	Tota l	Credit Points
	3	1	0	4	4

Course Outcomes

After attending the course, the students will be able to

1. Analyse DC electrical circuits using KCL, KVL and network theorems like Superposition Theorem, Thevenin's Theorem, Norton's Theorem and Maximum Power Transfer Theorem.
2. Analyse DC Machines; Starters and speed control of DC motors.
3. Analyse magnetic circuits.
4. Analyse single and three phase AC circuits.
5. Analyse the operation of single phase transformers.
6. Analyse the operation of three phase induction motors.

Module-I: [11 L]

DC Network Theorem: Kirchhoff's laws, Nodal analysis, Mesh analysis, Superposition theorem, Thevenin's theorem, Norton's theorem, Maximum power transfer theorem, Star-Delta conversion. [6L]

Electromagnetism: Review of magnetic flux, Force on current carrying conductors, Magnetic circuit analysis, Self and Mutual inductance, B-H loop, Hysteresis and Eddy current loss, Lifting power of magnet. [5L]

Module-II[10L]

AC single phase system: Generation of alternating emf, Average value, RMS value, Form factor, Peak factor, representation of an alternating quantity by a phasor, phasor diagram, AC series, parallel and series-parallel circuits, Active power, Reactive power, Apparent power, power factor, Resonance in RLC series and parallel circuit.

Module-III [11 L]

Three phase system: Generation of three-phase AC power, Balanced three phase system, delta and star connection, relationship between line and phase quantities, phasor diagrams, power measurement by two wattmeter method. [4L]

DC Machines: Construction, EMF equation, Principle of operation of DC generator, Open circuit characteristics, External characteristics, Principle of operation of DC motor, speed-torque characteristics of shunt and series machine, starting of DC motor, speed control of DC motor.[7L]

Module-IV [10L]

Transformer: Construction, EMF equation, no load and on load operation and their phasor diagrams, Equivalent circuit, Regulation, losses of a transformer, Open and Short circuit tests, Efficiency, Introduction to three phase transformer.[6L]

Three-phase induction motor: Concept of rotating magnetic field, Principle of operation, Construction, Equivalent circuit and phasor diagram, torque-speed/slip characteristics, Starting of Induction Motor.[4L]

Text Books:

1. Basic Electrical engineering, D.P Kothari & I.J Nagrath, TMH, Second Edition
2. Basic Electrical Engineering, V.N Mittle & Arvind Mittal, TMH, Second Edition
3. Basic Electrical Engineering, Hughes
4. Electrical Technology, Vol-I,Vol-II,Surinder Pal Bali, Pearson Publication
5. A Text Book of Electrical Technology, Vol. I & II, B.L. Theraja, A.K. Theraja, S.Chand & Company

Reference Books:

1. Electrical Engineering Fundamentals, Vincent Del Toro, Prentice-Hall
2. Advance Electrical Technology, H.Cotton, Reem Publication
3. Basic Electrical Engineering, R.A. Natarajan, P.R. Babu, Sictech Publishers
4. Basic Electrical Engineering, N.K. Mondal, Dhanpat Rai
5. Basic Electrical Engineering, Nath & Chakraborti
6. Fundamental of Electrical Engineering, Rajendra Prasad, PHI, Edition 2005.

Course Name: Basic Electrical Engineering Laboratory					
Course Code : ELEC1051					
Contact Hours per week	L	T	P	Total	Credit Points
	0	0	2	2	1

Course Outcomes: The students are expected to

1. Get an exposure to common electrical apparatus and their ratings.
2. Make electrical connections by wires of appropriate ratings.
3. Understand the application of common electrical measuring instruments.
4. Understand the basic characteristics of different electrical machines.

List of Experiments:

1. Characteristics of Fluorescent lamps
2. Characteristics of Tungsten and Carbon filament lamps
3. Verification of Thevenin's & Norton's theorem.
4. Verification of Superposition theorem
5. Verification of Maximum Power Transfer theorem
6. Calibration of ammeter and voltmeter.
7. Open circuit and Short circuit test of a single phase Transformer.
8. Study of R-L-C Series / Parallel circuit
9. Starting and reversing of speed of a D.C. shunt Motor
10. Speed control of DC shunt motor.
11. No load characteristics of D.C shunt Generators
12. Measurement of power in a three phase circuit by two wattmeter method.

Course Name : Engineering Graphics and Design					
Course Code : MECH1052					
Contact hrs per week:	L	T	P	Total	Credit Points
	1	0	4	5	3

Course Outcomes:

After going through the course, the students will be able

1. To understand the meaning of engineering drawing.
2. To have acquaintance with the various standards (like lines, dimensions, scale etc.) and symbols followed in engineering drawing.
3. To represent a 3-D object into 2-D drawing with the help of orthographic and isometric projections.
4. To read and understand projection drawings.
5. To draw the section view and true shape of a surface when a regular object is cut by a section plane.
6. To use engineering drawing software (CAD).

Lecture Plan (13 L)

1. Importance and principles of engineering drawing	(1 L)
2. Concepts of Conic sections and Scale	(1 L)
3. Introduction to concept of projection (Projections of points, lines and surfaces)	(4 L)
4. Definitions of different solids and their projections	(1 L)
5. Section of solids and sectional view	(1 L)
6. Isometric projection	(2 L)
7. Introduction to CAD	(2 L)
8. Viva Voce	(1 L)

Detailed contents of Lab hours (52 hrs)

Module 1: Introduction to Engineering Drawing covering,

Principles of Engineering Graphics and their significance, usage of Drawing instruments, lines, lettering & dimensioning, Conic section like Ellipse (General method only); Involute; Scales – Plain, Diagonal.

(4 hrs + 4 hrs)

Module 2: Orthographic Projections covering,

Principles of Orthographic Projections - Conventions - Projections of Points and lines inclined to both planes; Projections on Auxiliary Planes. Projection of lamina.

(4 hrs+4 hrs + 4 hrs)

Module 3: Projections of Regular Solids covering,those inclined to both the Planes- Auxiliary Views.

(4 hrs + 4 hrs)

Module 4: Sections and Sectional Views of Right Angular Solids covering,

Prism, Cylinder, Pyramid, Cone – Auxiliary Views; Development of surfaces of Right Regular Solids - Prism, Pyramid, Cylinder and Cone; Draw the sectional orthographic views of geometrical solids.(4 hrs)

Module 5: Isometric Projections covering,

Principles of Isometric projection – Isometric Scale, Isometric Views, Conventions; Isometric Views of lines, Planes, Simple and compound Solids; Conversion of Isometric Views to Orthographic Views and Vice-versa, Conventions.

(4 hrs + 4 hrs)

Module 6: Overview of Computer Graphics covering,

listing the computer technologies that impact on graphical communication, Demonstrating knowledge of the theory of CAD software [such as: The Menu System, Toolbars (Standard, Object Properties, Draw, Modify and Dimension), Drawing Area (Background, Crosshairs, Coordinate System), Dialog boxes and windows, Shortcut menus (Button Bars), The Command Line (where applicable), The Status Bar, Different methods of zoom as used in CAD, Select and erase objects.; Isometric Views of lines, Planes, Simple and compound Solids.

(4 hrs)

Module 7: Customisation & CAD Drawing

consisting of set up of the drawing page and the printer, including scale settings, Setting up of units and drawing limits; ISO and ANSI standards for coordinate dimensioning and tolerancing; Orthographic constraints, Snap to objects manually and automatically; Producing drawings by using various coordinate input entry methods to draw straight lines, Applying various ways of drawing circles;

(2 hrs)

Annotations, layering & other functions covering

applying dimensions to objects, applying annotations to drawings; Setting up and use of Layers, layers to create drawings, Create, edit and use customized layers; Changing line lengths through modifying existing lines (extend/lengthen); Printing documents to paper using the print command; orthographic projection techniques; Drawing sectional views of composite right regular geometric solids and project the true shape of the sectioned surface; Drawing annotation.

(2 hrs)

Module 8: Demonstration of a simple team design project that illustrates

Geometry and topology of engineered components: creation of engineering models and their presentation in standard 2D blueprint form and as 3D wire-frame.

(4 hrs)

References:

1. Bhatt, N.D., Panchal V.M. & Ingle P.R., (2014) "Elementary Engineering Drawing" ; Charotan Publishing House
2. Narayana, K.L. and Kannaaiah P "Engineering Graphics"; TMH

3. Lakshminarayanan, V. and Vaish Wanar, R.S "Engineering Graphics" Jain Brothers.
4. Shah, M.B. & Rana B.C. (2008), Engineering Drawing and Computer Graphics, Pearson Education.
5. Agarwal B. & Agarwal C. M. (2012), Engineering graphics, TMH Publications.

Course Name : Communication for Professionals					
Course Code : HMTS1011					
Contact hrs per week:	**L**	**T**	**P**	**Total**	**Credit Points**
	3	0	0	3	3

Course Outcomes:

Students will be able to-

1. Write business letters and reports
2. Communicate in an official and formal environment.
3. Effectively use the various channels of communication at work place.
4. Use language as a tool to build bridges and develop interpersonal relations in multi-cultural environment.
5. Learn to articulate opinions and views with clarity.
6. Use various techniques of communication for multiple requirements of globalized workplaces.

Module- I [9hrs]

Introduction to Linguistics

Phonetics- Vowel and Consonant Sounds (Identification & Articulation)

Word- stress, stress in connected speech

Intonation (Falling and Rising Tone)

Voice Modulation

Accent Training

Vocabulary Building

The concept of Word Formation

Root words from foreign languages and their use in English

Acquaintance with prefixes and suffixes from foreign languages in Englishto formderivatives

Synonyms, Antonyms and standard abbreviations

Module- II [10hrs.]

Communication Skills

Definition, nature & attributes of Communication

Process of Communication

Models or Theories of Communication

Types of Communication

Levels or Channels of Communication

Barriers to Communication

Module- III [10hrs.]

Professional Writing Skills

Letter Writing : Importance, Types , Process, Form and Structure, Style and Tone

Proposal Writing: Purpose, Types of Proposals, Structure of Formal Proposals.

Report Writing: Importance and Purpose, Types of Reports, Report Formats, Structure of Formal Reports, Writing Strategies.

Module- IV [10hrs]

Communication skills at Work

Communication and its role in the workplace

Benefits of effective communication in the workplace

Common obstacles to effective communication

Approaches and Communication techniques for multiple needs at workplace: persuading, convincing, responding, resolving conflict, delivering bad news, making positive connections,

Identify common audiences and design techniques for communicating with each audience

References:

1. Kumar,S. &Lata, P. Communication Skills, OUP, New Delhi2011
2. Rizvi,Ashraf,M. Effective Technical Communication, Mc Graw Hill Education(India) Pvt. Ltd..Chennai,2018
3. Raman, M. and Sharma, S., Technical Communication: Principles and Practice, 2nd Ed., 2011

Course Name : Professional Communication Laboratory					
Course Code: HMTS1061					
Contact hrs per week:	**L**	**T**	**P**	**Total**	**Credit Points**
	0	0	2	2	1

Course Outcomes-

Students will be skilled in the following areas:

1. Communicate in an official and formal environment.
2. Effectively communicate in a group and engage in relevant discussion.
3. Engage in research and prepare presentations on selected topics.
4. Understand the dynamics of multicultural circumstances at workplace and act accordingly.
5. Organize content in an attempt to prepare official documents.
6. Appreciate the use of language to create beautiful expressions

Module- I [4hrs]

Techniques for Effective Speaking

Voice Modulation: Developing correct tone

Using correct stress patterns: word stress, primary stress, secondary stress Rhythm in connected speech

Module- II [6hrs]

Effective Speaking and Social awareness The Art of Speaking

Encoding Meaning Using Nonverbal Symbols

How to Improve Body Language

Eye Communication, Facial Expression, Dress and Appearance

Posture and Movement, Gesture, Paralanguage

Encoding meaning using Verbal symbols: How words work and how to use words

Volume, Pace, Pitch and Pause

Cross-Cultural Communication : Multiple aspects/dimensions of culture

Challenges of cross-cultural communication

Improving cross-cultural communication skills at workplace.

Module- III [6hrs]

Group Discussion: Nature and purpose

Characteristics of a successful Group Discussion

Group discussion Strategies: Getting the GD started, contributing systematically, moving the discussion

along, promoting optimal participation, Handling conflict, Effecting closure.

Module- IV [10hrs]

Professional Presentation Skills

Nature and Importance of Presentation skills

Planning the Presentation: Define the purpose, analyze the Audience, Analyze the occasion and choose a suitable title. Preparing the Presentation: The central idea, main ideas, collecting support material, plan visual aids, design the slides Organizing the Presentation: Introduction-Getting audience attention, introduce the subject, establish credibility, preview the main ideas, Body-develop the main idea, present information sequentially and logically, Conclusion- summaries, re-emphasize, focus on the purpose, provide closure.

Improving Delivery: Choosing Delivery methods, handling stage fright

Post-Presentation discussion: Handling Questions-opportunities and challenges.

References:

1. Carter, R. And Nunan, D. (Eds), The Cambridge guide to Teaching English to Speakers of Other Languages, CUP, 2001
2. Edward P. Bailey, Writing and Speaking At Work: A Practical Guide for Business Communication, Prentice
3. Hall, 3rd Ed., 2004
4. Munter, M., Guide to Managerial Communication: Effective Business Writing and Speaking, Prentice Hall, 5th Ed., 1999
5. R. Anand, Job Readiness For IT & ITES- A Placement and Career Companion, , McGraw Hill Education.2015
6. Malhotra, A.,Campus Placements, McGraw Hill Education.2015

1ST YEAR 2ND SEMESTER

Course Name : Physics I					
Course Code : PHYS1001					
Contact hrs per week:	L	T	P	Total	Credit Points
	3	1	0	4	4

Course Outcomes:

1. To develop basic understanding of the modern science to the technology related domain.
2. Analytical & logical skill development through solving problems.
3. To impart idea of concise notation for presenting equations arising from mathematical formulation of physical as well as geometrical problems percolating ability of forming mental pictures of them.
4. Imparting the essence and developing the knowledge of controlling distant object like satellite, data transfer through optical fiber, implication of laser technology, handling materials in terms of their electrical and magnetic properties etc.
5. To understand how the systems under force field work giving their trajectories which is the basic of classical Field theory
6. To impart basic knowledge of the electric and magnetic behavior of materials to increase the understanding of how and why electronic devices work

Module 1 : Mechanics (7+5)= 12L

Elementary concepts of grad, divergence and curl. Potential energy function; F=-grad V, Equipotential surfaces and meaning of gradient; Conservative and non-conservative forces, Curl of a force field; Central forces ; conservation of angular momentum; Energy equation and energy diagrams; elliptical, parabolic and hyperbolic orbit; Kepler Problem; Application : Satellite manoeuvres .

Non-inertial frames of reference; rotating coordinate system; five term acceleration formula- centripetal and coriolis accelerations; applications: Weather system, Foucault pendulum.

Module 2: Optics =(4 +3+ 5) = 12L

Oscillatory Motion:

Damped harmonic motion – Over damped, critically damped and lightly damped oscillators; Forced oscillation andresonance. Electrical equivalent of mechanical oscillator, Wave equation, plane wave solution.

Optics:

Elementary features of polarization of light waves. Double refraction, Production and analysis of linearly, elliptic and Circularly polarized light, Polaroid and application of polarizations.: Polarimeter.

Laser & Fiber Optics:

Characteristics of Lasers, Spontaneous and Stimulated Emission of Radiation, Meta-stable State, Population Inversion, Lasing Action, Einstein's Coefficients and Relation between them, Ruby Laser, Helium-Neon Laser, Semiconductor Diode Laser, Applications of Lasers.

Fiber optics - principle of operation, numerical aperture, acceptance angle, Single mode , graded indexed fiber.

Module 3: Electrostatics (8+4) = 12

L L Electrostatics in freespace

Calculation of electric field and electrostatic potential for a charge distribution, Divergence and curl of electrostatic
field, Laplace's and Poisson's equation for electrostatic potential. Boundary conditions of electric field and electrostatic potential. Method of images , energy of a charge distribution and its expression in terms of electric field.

Electrostatics in a linear dielectric medium

Electrostatic field and potential of a dipole, Bound charges due to electric polarization, Electric displacement, Boundary conditions on displacement, Solving simple electrostatic problem in presence of dielectric – point charge at the centre of a dielectric sphere, charge in front of dielectric slab, Dielectric slab and dielectric sphere in uniform electric field.

Module 4: **(6+3+3) = 12L**

Magnetostatics :

Biot-Savart law, divergence and curl of static magnetic field; vector potential and calculating it for a given magnetic field using Stokes' theorem; equation for vector potential and it's solutions for given current densities.

Magneto statics in a linear magnetic medium:

Magnetization and associated bound currents; Auxiliary magnetic field H ; boundary conditions on B and H . Solving for magnetic field due to simple magnet like a bar magnet; Magnetic susceptibility; ferromagnetic, paramagnetic and diamagnetic materials; Qualitative discussion of magnetic field in presence of magnetic materials.

Faraday's Law:

Differential form of Faraday's law expressing curl of electric field in terms of time derivative of magnetic field and calculating electric field due to changing magnetic fields in quasi static approximation. Energy stored in a magnetic field.

Books of reference:

1. Optics – Eugene Hecht Pearson Education India Private Limited
2. Introduction to Electrodynamics, David J. Griffiths, Pearson Education India Learning Private Limited
3. Waves and Oscillations by N.K. Bajaj
4. Principles of Physics, 10ed, David Halliday, Robert Resnick Jearl Walker , Wiley
5. Electricity, Magnetism, and Light, Wayne M. Saslow, Academic Press
6. Classical mechanics, Narayan Rana, Pramod Joag, McGraw HillEducation
7. Introduction to Classical Mechanics, R Takwale, P Puranik, McGraw Hill Education
8. Optics, Ghatak, McGraw Hill Education India Private Limited
9. Refresher Course in B.Sc. Physics – Vol1 and Vol 2 – C.L.Arora

Course Name : Physics I Laboratory					
Course Code: PHYS1051					
Contact hrs per week:	L	T	P	Total	Credit Points
	0	0	3	3	1.5

Course Outcomes:

1. To gain practical knowledge by applying the experimental methods to correlate with the Physics theory.
2. To learn the usage of electrical and optical systems for various measurements.
3. Apply the analytical techniques and graphical analysis to the experimental data.
4. Understand measurement technology, usage of new instruments and real time applications in engineering studies.
5. To develop intellectual communication skills and discuss the basic principles of scientific concepts in a group.

Minimum of six experiments taking at least one from each of the following four groups:

Group 1 : Experiments in General Properties of matter

1. Determination of Young's modulus by Flexure Method
2. Determination of bending moment and shear force of a rectangular beam of uniform cross- section.
3. Determination of modulus of rigidity of the material of a rod by static method
4. Determination of rigidity modulus of the material of a wire by dynamic method.
5. Determination of coefficient of viscosity by Poiseulle's capillary flow method.

Group 2: Experiments in Optics

1. Determination of dispersive power of the material of a prism
2. Determination of wavelength of light by Newton's ring method.
3. Determination of wavelength of light by Fresnel's biprism method.
4. Determination of the wavelength of a given laser source by diffraction method

Group 3: Electricity & Magnetism experiments

1. Determination of dielectric constant of a given dielectric material.
2. Determination of resistance of ballistic galvanometer by half deflection method and study of variation of
3. logarithmic decrement with series resistance.
4. Determination of the thermo-electric power at a certain temperature of the given thermocouple.
5. Determination of specific charge (e/m) of electron.

Group 4: Quantum Physics Experiments

7. Determination of Planck's constant.
8. Determination of Stefan's radiation constant.
9. Verification of Bohr's atomic orbital theory through Frank-Hertz experiment.
10. Determination of Rydberg constant by studying Hydrogen/ Helium spectrum.
11. Determination of Hall co-efficient of semiconductors.
12. Determination of band gap of semiconductors.
13. To study current-voltage characteristics, load response, areal characteristics and spectral response of photo voltaic solar cells.

Books of reference:

1. Optics – Eugene Hecht Pearson Education India Private Limited
2. Introduction to Electrodynamics, David J. Griffiths, Pearson Education India Learning Private Limited
3. Waves and Oscillations by N.K. Bajaj
4. Principles of Physics, 10ed, David Halliday, Robert Resnick Jearl Walker , Wiley
5. Electricity, Magnetism, and Light, Wayne M. Saslow, Academic Press
6. Classical mechanics, Narayan Rana, Pramod Joag, McGraw HillEducation
7. Introduction to Classical Mechanics, R Takwale, P Puranik, McGraw Hill Education
8. Optics, Ghatak, McGraw Hill Education India Private Limited
9. Refresher Course in B.Sc. Physics – Vol1 and Vol 2 – C.L.Arora

Course Name : Mathematics II					
Course Code: MATH1201					
Contact hrs per week:	**L**	**T**	**P**	**Total**	**Credit Points**
	3	1	0	4	4

Course Outcomes

1. MATH1201. 1. Demonstrate the knowledge of probabilistic approaches to solve wide range of engineering problem.
2. MATH1201. 2. Recognize probability distribution for discrete and continuous variables to quantify physical and engineering phenomenon.
3. MATH1201. 3. Develop numerical techniques to obtain approximate solutions to mathematical problems where analytical solutions are not possible to evaluate.
4. MATH1201. 4. Analyze certain physical problems that can be transformed in terms of graphs and trees and solving problems involving searching, sorting and such other algorithms.
5. MATH1201. 5. Apply techniques of Laplace Transform and its inverse in various advanced engineering problems.
6. MATH1201. 6. Interpret differential equations and reduce them to mere algebraic equations using Laplace Transform to solve easily.

The objective of this course is to familiarize the students with numerical techniques, integral transforms, graph theory and probability. It aims to equip the students with standard concepts and tools at an intermediate to advanced level that will serve them well towards tackling various problems in the discipline.

Module-I Fundamentals of Probability [10L)

Random experiment, Sample space and events

Classical and Axiomatic definition of probability

Addition and Multiplication law of probability

Conditional probability

Bayes' Theorem

Random variables

General discussion on discrete and continuous distributions

Expectation and Variance

Examples of special distribution: Binomial and Normal Distribution

Module-II Numerical Methods [10L]

Solution of non-linear algebraic and transcendental equations: Bisection Method, Newton-Raphson Method, Regula-Falsi Method.

Solution of linear system of equations: Gauss elimination method, Gauss-Seidel Method, LU Factorization Method, Matrix Inversion Method.

Solution of Ordinary differential equations: Euler's and Modified Euler's Method , Runge-Kutta Method of

4th order.

Module-III Basic Graph Theory [10L]

Graphs: Digraphs, Weighted graph, Connected and disconnected graphs, Complement of a graph, Regular graph, Complete graph, Subgraph

Walks, Paths, Circuits, Euler Graph, Cut sets and cut vertices

Matrix representation of a graph, Adjacency and incidence matrices of a graph

Graph isomorphism

Bipartite graph

Definition and properties of a tree

Binary tree, Spanning tree of a graph, Minimal spanning tree, properties of trees

Algorithms: Dijkstra's Algorithm for shortest path problem, Determination of minimal spanning tree using DFS, BFS, Kruskal's and Prim's algorithms

Module-IV Laplace Transformation [10L]

Basic ideas of improper integrals, working knowledge of Beta and Gamma functions (convergence to be assumed) and their interrelations.

Introduction to integral transformation

Functions of exponential order, Definition and existence of Laplace Transform(LT) (statement of initial and final value theorem only)

LT of elementary functions, Properties of Laplace Transformations , Evaluation of sine , cosine and exponential integrals using LT

LT of periodic and step functions

Definition and properties of inverse LT

Convolution Theorem (statement only) and its application to the evaluation of inverse LT

Solution of linear ODEs with constant coefficients (initial value problem) using LT

Suggested Books:

1. Advanced Engineering Mathematics , E.Kreyszig, Wiley Publications
2. Introduction to Probability and Statistics for Engineers and Scientists, S.Ross, Elsevier
3. Introductory methods of Numerical Analysis, S.S. Sastry, PHI learning
4. Introduction to Graph Theory, D. B. West, Prentice-Hall of India
5. Engineering Mathematics, B.S. Grewal, S. Chand & Co.

Course Name : Programming for Problem Solving					
Course Code: CSEN1001					
Contact Hours per week	**L**	**T**	**P**	**Total**	**Credit Points**
	3	0	0	3	3

Course outcome:

1. CO 1: Understand and remember functions of the different parts of a computer.
2. CO 2: Understand and remember how a high-level language (C programming language, in this course) works, different stages a program goes through.
3. CO 3: Understand and remember syntax and semantics of a high-level language (C programming language, in this course).
4. CO 4: Understand how code can be optimized in high-level languages.
5. CO 5: Apply high-level language to automate the solution to a problem.
6. CO 6: Apply high-level language to implement different solutions for the same problem and analyze why one solution is better than the other.

Learning Objectives: Introduction to the concept of computer and computation and solving of problems using C as a programming language. Coverage of C will include basic concepts, arithmetic and logic, flow control, and data handling using arrays, structures, pointers and files.

Total load – 40 hours

Module I: [10L] Fundamentals of Computer

History of Computers, Generations of Computers, Classification of Computers.

Basic Anatomy of Computer System, Primary & Secondary Memory, Processing Unit, Input & Output devices. Basic Concepts of Assembly language, High level language, Compiler and Assembler.

Binary & Allied number systems (decimal, octal and hexadecimal) with signed and unsigned numbers (using 1's and 2's complement) - their representation, conversion and arithmetic operations. Packed and unpacked BCD system, ASCII. IEEE-754 floating point representation (half- 16 bit, full- 32 bit, double- 64 bit).

Basic concepts of operating systems like MS WINDOWS, LINUX How to write algorithms & draw flow charts.

Module II: [10L] Basic Concepts of C

C Fundamentals:

The C character set identifiers and keywords, data type & sizes, variable names, declaration, statements. Operators & Expressions:

Arithmetic operators, relational and logical operators, type, conversion, increment and decrement operators, bit wise operators, assignment operators and expressions, precedence and order of evaluation. Standard input and output, formatted output -- printf, formatted input scanf.

Flow of Control:

Statement and blocks, if-else, switch-case, loops (while, for, do-while), break and continue, go to and labels.

Module III: [10L]

Program Structures in C

Basic of functions, function prototypes, functions returning values, functions not returning values. Storage classes -

auto, external, static and register variables – comparison between them. Scope, longevity and visibility of variables. C preprocessor (macro, header files), command line arguments.

Arrays and Pointers:

One dimensional arrays, pointers and functions – call by value and call by reference, array of arrays. Dynamic memory usage– using malloc(), calloc(), free(), realloc(). Array pointer duality.

String and character arrays; C library string functions and their use.

Module IV: [10L]

Data Handling in C

User defined data types and files:

Basic of structures; structures and functions; arrays of structures.

Files – text files only, modes of operation. File related functions – fopen(), fclose(), fscanf(), fprintf(), fgets(), fputs(), fseek(), ftell();

Text Books

1. Schaum's outline of Programming with C – Byron Gottfried
2. Teach Yourself C- Herbert Schildt
3. Programming in ANSI C – E Balagurusamy

Reference Books

1. C: The Complete Reference – Herbert Schildt
2. The C Programming Language- D.M.Ritchie, B.W. Kernighan

Course Name : Programming for Problem Solving Lab					
Course Code: CSEN1051					
Contact hrs per week:	L	T	P	Tot al	Credit Points
	0	0	4	4	2

Course Outcomes:

After completion of this course the students should be able:

1. To write simple programs relating to arithmetic and logical problems.
2. To be able to interpret, understand and debug syntax errors reported by the compiler.
3. To implement conditional branching, iteration (loops) and recursion.
4. To decompose a problem into modules (functions) and amalgamating the modules to generate a complete program.
5. To use arrays, pointers and structures effectively in writing programs.
6. To be able to create, read from and write into simple text files.

Software to be used: GNU C Compiler (GCC) with LINUX NB: Cygwin (Windows based) may be used in place of LINUX

Topic 1: LINUX commands and LINUX based editors

Topic 2: Basic Problem Solving

Topic 3: Control Statements (if, if-else, if-elseif-else, switch-case)

Topic 4: Loops - Part I (for, while, do-while)

Topic 5: Loops - Part II

Topic 6: One Dimensional Array

Topic 7: Array of Arrays

Topic 8: Character Arrays/ Strings Topic

9: Basics of C Functions

Topic 10: Recursive Functions

Topic 11: Pointers

Topic 12: Structures

Topic 13: File Handling

Text Books

1. Schaum's outline of Programming with C – Byron Gottfried
2. Teach Yourself C- Herbert Schildt
3. Programming in ANSI C – E Balagurusamy

Course Name : Business English					
Course Code: HMTS1202					
Contact hrs per week:	L	T	P	Total	Credit Points
	2	0	0	2	2

Course Outcomes:

The learner will

1. Acquire competence in using English language to communicate.
2. Be aware of the four essential skills of language usage-listening, speaking, reading and writing.
3. Be adept at using various modes of written communication at work.
4. Attain the skills to face formal interview sessions.
5. Write reports according to various specifications.
6. Acquire the skill to express with brevity and clarity.

Module- I [6hrs.]

Grammar (Identifying Common Errors in Writing)

Subject-verb agreement

Noun-pronoun agreement

Misplaced Modifiers

Articles

Prepositions

Redundancies

Module- II [6hrs.]

Basic Writing Strategies Sentence Structures

Use of phrases and clauses in sentences

Creating coherence

Organizing principles –accuracy, clarity, brevity

Techniques for writing precisely

Different styles of writing: descriptive, narrative, expository

Importance of proper punctuation

Module- III (8hrs)

Business Communication- Scope & Importance

Writing Formal Business Letters: Form and Structure-Parts ofa Business letter, Business Letter Formats, Style and Tone, Writing strategies.

Organizational Communication: Agenda & minutes of a meeting, Notice, Memo, Circular Organizing e-mail messages, E-mail etiquette

Job Application Letter: Responding to Advertisements and Forced Applications, Qualities of well-written

Application Letters: The You-Attitude, Length, Knowledge of Job Requirement, Reader-Benefit Information, Organization, Style, Mechanics – Letter Plan: Opening Section, Middle Section, Closing Section

Resume and CV: Difference, Content of the Resume – Formulating Career Plans: Self Analysis, Career Analysis, Job Analysis, Matching Personal Needs with Job Profile – Planning your Resume – Structuring the Resume: Chronological Resume, The Functional Resume, Combination of Chronological and Functional Resume, Content ofthe Resume: Heading, Career Goal or Objectives, Education, Work Experience, Summary of Job Skills/Key Qualifications, Activities, Honors and Achievements, Personal Profile, Special Interests, References

Module- IV [6hrs]

Writing skills

Comprehension: Identifying the central idea, inferring the lexical and contextual meaning, comprehension

passage - practice

Paragraph Writing: Structure of a paragraph, Construction of a paragraph, Features of a paragraph, Writing techniques/developing a paragraph.

Précis: The Art of Condensation-some working principles and strategies. Practice sessions of writing précis of given passages.

Essay Writing: Characteristic features of an Essay, Stages in Essay writing, Components comprising an Essay, Types of Essays-Argumentative Essay, Analytical Essay, Descriptive Essays, Expository Essays, Reflective Essays

References:

1. Theories of Communication: A Short Introduction, Armand Matterlart and Michele Matterlart, Sage Publications Ltd.
2. Professional Writing Skills, Chan, Janis Fisher and Diane Lutovich. San Anselmo, CA: Advanced Communication Designs.
3. Hauppauge, Geffner, Andrew P. Business English, New York: Barron's Educational Series.
4. Kalia, S. & Agarwal, S. Business Communication, Wiley India Pvt. Ltd., New Delhi, 2015
5. Mukherjee, H.S., Business Communication- Connecting at work., , Oxford University Press.2nd Edition.2015
6. Raman, M. and Sharma, S., Technical Communication: Principles and Practice, 2nd Ed., 2011.

Course Name : Language Laboratory					
Course Code: HMTS1252					
Contact hrs per week:	**L**	**T**	**P**	**Total**	**Credit Points**
	3	1	0	4	4

Course Outcomes:

The learner will

1. Acquire the techniques to become an effective listener.
2. Acquire the skill to become an effortless speaker.
3. Organize and present information for specific audience.
4. Communicate to make a positive impact in professional and personal environment.
5. Engage in research and prepare authentic, formal, official documents.
6. Acquire reading skills for specific purpose.

Module- I (4hrs)

Listening Skills

1. Principles of Listening: Characteristics, Stages.
2. Types of Listening: Passive listening, Marginal or superficial listening, Projective Listening, Sensitive or Empathetic Listening, Active or Attentive listening.
3. Guidelines for Effective Listening
4. Barriers to Effective Listening
5. Listening Comprehension

Module- II [8hrs]

Interviewing

1. Types of Interviews, Format for Job Interviews: One-to-one and Panel Interviews, Telephonic Interviews, Interview through video conferencing.
2. Interview Preparation Techniques, Frequently Asked Questions, Answering Strategies, Dress Code, Etiquette, Questions for the Interviewer, Simulated Interviews.

Module- III [6hrs]

1. Public Speaking: The Speech Process: The Message, The Audience, The Speech Style, Encoding, Feedback.
2. Characteristics of a good speech : content and delivery, structure of a speech
3. Modes of delivery in public speaking: Impromptu, Extemporaneous, Prepared or Memorized, Manuscript.
4. Conversation: Types of conversation: formal and informal, Strategies for effective conversation, Improving fluency.
5. Situational conversation practice: Greetings and making introductions, Asking for information and giving instructions, agreeing and disagreeing.
6. Conversational skills in the business scenario: One-to-one and Group communication, Gender and Culture

7. Sensitivity, Etiquette, Sample Business Conversation, Telephonic Conversation

Module- IV [8hrs]

Presentation Skills

1. Speaking from a Manuscript, Speaking from Memory, Impromptu Delivery, Extemporaneous Delivery, Analyzing the Audience, Nonverbal Dimensions of Presentation
2. Organizing the Presentation: The Message Statement, Organizing the Presentation: Organizing the Speech to Inform, The Conclusion, Supporting Your Ideas – Visual Aids: Designing and Presenting Visual Aids, Selecting the Right Medium.
3. Project Team/Group Presentations

References:

1. Carter, R. And Nunan, D. (Eds), The Cambridge guide to Teaching English to Speakers of Other Languages, CUP, 2001
2. Edward P. Bailey, Writing and Speaking At Work: A Practical Guide for Business Communication, Prentice
3. Hall, 3rd Ed., 2004
4. Munter, M., Guide to Managerial Communication: Effective Business Writing and Speaking, Prentice Hall, 5th Ed., 1999
5. Sen, S., Mahendra, A. & Patnaik, P., Communication and Language Skills, Cambridge University Press, 2015
6. Locker, Kitty O. Business and Administrative Communication McGraw-Hill/ Irwin.
7. Chaney, L. and Martin, J., Intercultural Business Communication. Prentice Hall

Course Name: Workshop/ManufacturingPractices					
Course Code : MECH1051					
Contact Hours per week	L	T	P	Total	Credit Points
	1	0	4	5	3

Course Outcomes:

Upon completion of this course

1. The students will gain knowledge of the different manufacturing processes which are commonly employed in the industry, to fabricate components using different materials.
2. The students will be able to fabricate components with their own hands.
3. They will also get practical knowledge of the dimensional accuracies and dimensional tolerances possible with different manufacturing processes.
4. By assembling different components, they will be able to produce small devices of their interest.
5. The students will be able to describe different components and processes of machine tools.
6. The students will be able to apply the knowledge of welding technology and they can perform arc and gas welding to join the material.

(i) Lectures & videos: (13 hours) detailed contents

1. Introduction on Workshop and Safety Precautions. (1 lecture)

2. Manufacturing Methods- casting, forming, machining, joining, advanced manufacturing

3. methods (3 lectures)

4. CNC machining, Additive manufacturing (1 lecture)

5. Fitting operations & power tools (1 lecture)

6. Electrical & Electronics (1 lecture)

7. Carpentry (1 lecture)

8. Plastic moulding, glass cutting (1 lecture)

9. Metal casting (1 lecture)

10. Welding (arc welding & gas welding), brazing (2 lecture)

11. Viva-voce (1 lecture)

(ii) WorkshopPractice:(52hours)[L:0;T:0;P:4(2credits)]

1. Machine shop (12 hours)
2. Fitting shop (8 hours)
3. Carpentry (4 hours)
4. Electrical & Electronics (4 hours)
5. Welding shop (Arc welding 4 hrs + gas welding 4 hrs) (8 hours)

6. Casting (4 hours)
7. Smithy (4 hours)
8. Plastic moulding& Glass Cutting (4 hours)
9. Sheet metal Shop (4 hours)

Examinations could involve the actual fabrication of simple components, utilizing one or more of the techniques covered above.

SuggestedText/ReferenceBooks:

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. Kalpakjian S. And Steven S. Schmid, "Manufacturing Engineering and Technology", 4th edition, Pearson Education India Edition, 2002.
3. Gowri P. Hariharan and A. Suresh Babu,"Manufacturing Technology – I" Pearson Education, 2008.
4. Roy A. Lindberg, "Processes and Materials of Manufacture", 4th edition, Prentice Hall India, 1998.
5. Rao P.N., "Manufacturing Technology", Vol. I and Vol. II, Tata McGrawHill House, 2017.

Course Name : Basic Electronics					
Course Code : ECEN1011					
Contact Hours per week	L	T	P	Total	Credit Points
	3	0	0	3	3

Course Outcomes:

After going through this course, the students will be able to

1. Categorize different semiconductor materials based on their energy bands and analyze the characteristics of those materials for different doping concentrations based on previous knowledge on semiconductors acquired.
2. Describe energy band of P-N Junction devices and solve problems related to P-N Junction Diode both from device and circuit perspectives.
3. Design different application specific circuits associated with diodes operating both in forward and reverse bias.
4. Analyze various biasing configurations of Bipolar Junction Transistor and categorize different biasing circuits based on stability.
5. Categorize different field-effect transistors based on their constructions, physics and working principles and solve problems associated with analog circuits based on operational amplifiers.
6. Design and implement various practical purpose electronic circuits and systems meant for both special purpose and general purpose and analyze their performance depending on the type of required output and subsequently the applied input.

Module I [10 L]

Basic Semiconductor Physics:

Crystalline materials, Energy band theory, Conductors, Semiconductors and Insulators, Concept of Fermi Energy level, intrinsic and extrinsic semiconductors, drift and diffusion currents in semiconductor

Diodes and Diode Circuits:

Formation of p-n junction, Energy Band diagram, forward & reverse biased configurations, V-I characteristics, load line, breakdown mechanisms, Zener Diode and its Application.

Rectifier circuits: half wave & full wave rectifiers: ripple factor, rectification efficiency.

Module II [8 L]

Bipolar Junction Transistors (BJT):

PNP & NPN BJT structures, current components in BJT, CE, CB, CC configurations, V-I Characteristics of CB & CE modes, regions of operation, Base width modulation & Early effect, thermal runaway, Concept of Biasing: DC load line, Q-point, basics of BJT amplifier operation, current amplification factors, different biasing circuits: fixed bias, collector to base bias, voltage divider bias.

Module III [9 L]

Field Effect Transistors (FET):

N-channel Junction Field Effect Transistor (JFET) structure & V-I characteristics.

Metal Oxide Semiconductor Field Effect Transistor (MOSFET): enhancement & depletion type MOSFETs (for both n & p channel devices), drain & transfer characteristics.

MOSFET as a digital switch, CMOS inverter, voltage transfer characteristic (VTC), NAND & NOR gate realization using CMOS logic.

Moore's Law, evolution of process node, state of integration (SSI, MSI, LSI, VLSI, ULSI), Classification of Integrated circuits (IC) and their applications.

Module IV [9 L]

Feedback in amplifiers:

Concept of feedback, advantages of negative feedback (qualitative), Barkhausen criteria.

Operational Amplifier:

Ideal OPAMP characteristics, OPAMP circuits: inverting and non-inverting amplifiers, Adder, Subtractor, Integrator, Differentiator, Basic Comparator.

Special Semiconductor Devices:

Light Emitting Diode (LED), Silicon Controlled Rectifier (SCR), Photodiode: Operations, characteristics & applications.

References:

1. Boylestad & Nashelsky:Electronic Devices & Circuit Theory
2. R.A Gayakwad:Op Amps and Linear IC's, PHI
3. D. Chattopadhyay, P. C Rakshit : Electronics Fundamentals and Applications
4. Adel S. Sedra, Kenneth Carless Smith: Microelectronics Engineering
5. Millman & Halkias: Integrated Electronics.
6. Salivahanan: Electronics Devices & Circuits.
7. Albert Paul Malvino: Electronic Principle.

Course Name : Basic Electronics Laboratory					
Course Code : ECEN1061					
Contact Hours per week	**L**	**T**	**P**	**Total**	**Credit Points**
	0	0	2	2	1

Course Outcomes:

1. The students will correlate theory with diode behavior.
2. They will design and check rectifier operation with regulation etc.
3. Students will design different modes with BJT and FET and check the operations.
4. They will design and study adder, integrator etc. with OP-AMPs.

List of Experiments

1. Familiarization with passive and active electronic components such as Resistors, Inductors, Capacitors, Diodes, Transistors (BJT) and electronic equipment like DC power supplies, multi-metersetc.
2. Familiarization with measuring and testing equipment like CRO, Signal generators etc.
3. Study of I-V characteristics of Junction diodes.
4. Study of I-V characteristics of Zener diodes.
5. Study of Half and Full wave rectifiers with Regulation and Ripple factors.
6. Study of I-V characteristics of BJTs in CB mode
7. Study of I-V characteristics of BJTs in CE mode
8. Study of I-V characteristics of Field Effect Transistors.
9. Determination of input-offset voltage, input bias current and Slew rate of OPAMPs.
10. Determination of Common-mode Rejection ratio, Bandwidth and Off-set null of OPAMPs.
11. Study of OPAMP circuits: Inverting and Non-inverting amplifiers, Adders, Integrators and Differentiators.

2nd.YEAR,1stSEMESTER

Course Name : Analog Circuits					
Course Code : ECEN2101					
Contact Hours per week	L	T	P	Total	Credit Points
	3	0	0	3	3

Course Outcomes:

After going through this course, the students will be able to

1. Apply the previous knowledge gathered from Basic Electrical and Basic Electronics papers.
2. Understand the concepts of BJT, MOSFET and biasing techniques of BJT and MOSFET based amplifier circuits.
3. Analyze frequency response of amplifier circuits.
4. Design different types sinusoidal oscillators and multivibrator circuits.
5. Construct algebraic equations based amplifier and analog computers using OP-AMP
6. Design stable high-gain amplifier circuits.

MODULE 1: Analog Signals and Devices [9L]

Basic concepts and device biasing [5L]:

Analog, discrete and digital signals. Diode: piecewise-linear model, clipping and clamping operation. BJT biasing circuits, Q-point and stability.

Small Signal analysis of Amplifiers [4L]:

Small signal (h-parameter and re model) analysis of BJT CE mode amplifier circuit (derive input impedance, output impedance, voltage gain, current gain for the amplifiers).

MODULE 2: Oscillators and Frequency Responses of Amplifiers [9L]

Frequency Responses of Amplifiers [2L]:

Frequency response of CE mode RC-coupled amplifier; effect of external and parasitic capacitors on cut-off frequencies.

Feedback & Oscillator Circuits [7L]:

Concept of feedback, Effects of negative feedback in amplifiers, Oscillators circuits: Phase-shift, Wien-Bridge, Hartley, Colpitt and crystal Oscillators.

MODULE 3: Operational Amplifiers (OPAMPs) [7L]

Fundamentals of OPAMP [4L]:

Basic building blocks of OPAMP: Differential Amplifiers, Current source and current mirror circuits. Types of differential amplifiers, AC and DC analysis of differential amplifiers; Characteristics of an ideal OPAMP.

Applications of OPAMP [3L]:

Inverting and non-inverting OPAMP amplifiers, Log-antilog amplifiers, Instrumentation amplifier, Precision rectifiers, basic comparator, Schmitt Trigger.

MODULE 4: Analog Circuit Applications [7L]

Power Amplifiers [4L]:

Concepts and operations of Class A, B and AB amplifiers; Calculation of DC power, AC power and efficiency of these amplifiers.

Applications Analog IC [3L]:

Description of 555 Timer IC, astable and mono-stable operations using 555. Study of 78XX and 79XX voltage regulator ICs.

Books:

1. Microelectronic Circuits by Adel S. Sedra, Kenneth C. Smith
2. Electronics Devices and Circuits by Robert L. Boylestad, Louis Nashelskey
3. Fundamentals of Microelectronics by Behzad Razavi
4. Integrated electronics by Jacob Millman, Christos C. Halkias

Course Name : Analog Circuits Laboratory					
Course Code : ECEN2151					
Contact Hours per week	L	T	P	Tota 1	Credit Points
	0	0	2	2	1

Course Outcomes:

The students, after finishing the course, will be able to:

1. Study and compare frequency responses of amplifiers.
2. Design different timer circuits with 555 IC.
3. Design rectifiers and measure rectifier parameters.
4. Generate various waveforms using OP AMPs.

List of experiments:

Experiments using discrete components

1. Study of frequency response of RC coupled amplifier circuit.
2. Study of astable multi-vibrator using 555 timer IC.
3. Study of monostable multi-vibrator using 555 timer IC.
4. Study of full wave and half wave precision rectifier circuits.
5. Study of Wien-Bridge oscillator circuit.
6. Study of Phase Shift oscillator circuit.
7. Study of astable multi-vibrator using OPAMP.
8. Study of Triangular wave generator circuit using OPAMP.
9. Study of Schmitt trigger circuit.
10. Study of fixed voltage regulator circuits using 78XX and 79XX ICs.

Experiments using ASLKv2010StarterKit

11. Negative feedback amplifiers and instrumentation amplifiers to measure parameters like time response, frequency response, DC transfer characteristics,
12. Study of analog filters like LPF, HPF, BPF and BSF
13. Study of VCO and PLL
14. Automatic gain / volume control (AGC/AVC)
15. PC based Oscilloscope

Course Name : Circuit and Network Theory					
Course Code : ECEN2102					
Contact Hours per week	L	T	P	Total	Credit Points
	3	0	0	3	3

Course Outcomes

1. Apply the previous knowledge gathered from Basic Electrical Engineering for understanding the basic concepts of this subject.
2. Solve problems in various electric circuits using Network Theorems.
3. Analyze complex circuits in Laplace domain.
4. Understand the application of Graph theory to solve various network behaviour.
5. Evaluate the output of various Two port network without going through the detailed configuration.
6. Design various types of filters using SPICE software.

Module-I

Network equations: Concepts of voltage source and current source, Formulation of Node & Mesh equations. Loop and node variable analysis of transformed circuits. Network Theorems: Thevenin's, Norton's, Superposition, Maximum Power Transfer Theorem, Reciprocity theorem applied to circuits containing dependent sources. [5L]

Resonant Circuits: Series and Parallel resonance, Impedance and Admittance Characteristics, Quality Factor, Half Power Points, Bandwidth, Phasor diagrams. [4L]

Coupled Circuits: Coefficient of coupling, Dot convention, Analysis of coupled circuits. [2L]

Module-II [8 L]

Laplace Transform: Concept of complex frequency. Properties of Laplace transform linearity, differentiation, integration, initial value theorem and final value theorem. Transform of standard periodic and non-periodic waveforms. Circuit elements and their transformed equivalents, Independent and dependent sources and equivalence of sources, treatment of mutual couplings in t & s domain. Transient and steady state response of RL, RC, LC and RLC with or without stored energy. Concept of natural frequency and damping. Sketching transient response, determination of time domain specifications. Concept of Convolution theorem and its application. [8L]

Module-III [9L]

Graph theory: Graph of network: Concept of path, tree, tree branch, tree link, loop, tie set and cut set. Incidence Matrix, tie-set Matrix and f-cut set matrix and their properties. Loop currents and node-pair potentials, formulation of loop and node equilibrium equations in view of graph theory.[4L]

Two port networks: Open circuit Impedance & Short circuit Admittance parameter, Transmission parameters, Hybrid parameters and inverse hybrid parameters. Inter relation between parameters. Inter connection between two port networks. Driving point & transfer impedance & admittance. [5L]

Module-IV [8L]

Filter Circuits: Concept of filters, Classification of filters. Analysis and synthesis of Active Low pass, High pass, Band pass and Band reject filters using operational amplifier. Filter approximations: Butterworth, Chebyshev filters. [5L]

SPICE: Structure of a SPICE program, active and passive device/element statements, different study like DC analysis, transient analysis and ac analysis statement in SPICE. Plotting and printing statement, input and output Impedance calculation using SPICE, voltage and current controlled components in SPICE.[3L]

Total: 36L

Text Books:

1. Networks and Systems, D. Roy Chowdhury, New Age International Publishers
2. Circuit theory, Dr. Abhijit Chakrabarty, Dhanpat Rai & Co Pvt. Ltd.
3. Network Analysis, M.E. Valkenburg, Pearson Education .
4. Fundamental of Electric circuit theory, D. Chattopadhay& P.C. Rakshit, S. Chand.

Reference Books:

1. Engineering Circuit Analysis, W.H. Hyat, J.E. Kemmerly& S.M. Durbin,The Mc Graw Hill Company.
2. Modern Network Analysis, F.M.Reza&S.Seely, McGraw Hill.

Course Name : Circuit and Network Theory Laboratory					
Course Code :ECEN2152					
Contact Hours per week	L	T	P	Total	Credit Points
	0	0	3	3	1.5

Course Outcomes:

1. The students will be able to apply MATLAB/OCTAVE for circuitanalysis.
2. They will derive transfer functions of electrical networks.
3. The students will analyze two port network
4. They will be able to design different filters.

List of Experiments:

1. Determination of Laplace transform and Inverse Laplace transform of different using MATLAB/OCTAVE.
2. Generation of Periodic, Exponential, Sinusoidal, Damped Sinusoidal, Step, Impulse, Ramp signal using MATLAB/OCTAVE in both discrete and analog form;
3. Representation of Poles and Zeros in s-plane, determination of partial fraction expansion in s-domain and cascade connection of second-order systems using MATLAB/OCTAVE
4. Find out the transfer function of an electrical Network containing RL, RC & RLC and find out pole- zero
5. Transient response of R-L and R-C network using SPICE
6. Transient response of R-L and R-C network using hardware components
7. Transient response of R-L-C series and parallel circuit using SPICE and hardware Verification
8. Verification of Network theorems (Reciprocity, Compensation theorem) using SPICE software
9. Determination of Impedance (Z), Admittance (Y) and Transmission (T) parameter of a two port network using SPICE or circuit maker.
10. Determination of Impedance (Z), Admittance (Y) and Transmission (T) parameter of a two port network using hardware.
11. Design of Butterworth Low Pass and High Pass filters: Simulation / Hardware.
12. Design of Band Pass and Band Reject filters using Butterworth Low Pass and High Pass filters: Simulation/Hardware.

Course Name : Signals And Systems					
Course Code : ECEN2103					
Contact Hours per week	L	T	P	Total	Credit Point
	3	0	0	3	3

Course Outcomes:

1. Students should be able to apply the previous knowledge of mathematics on differential calculus.
2. Students should be able to categorize and identify the different types of signals and systems.
3. Student should be able to analyze the frequency domain characteristics of signals using Fourier series, Fourier transforms, Laplace Transform, Z- Transform.
4. Students should be able to implement and extends the concepts of transformation tools to design of communication systems and filters.
5. Students should be able to analyze random signals and its properties, hence extending the concept towards in communications systems.
6. Students should be able to evaluate the response different systems with the applications of different mathematical tools.

Module No-1: Introduction to Signal and Systems: [8 L]

Classification of Signals: Discrete and continuous signal, Periodic aperiodic, even – odd, energy and power signals, deterministic and random signals, complex exponential and sinusoidal signals, periodicity, unit impulse, unit step, transformation of independent variable of signals, time scaling, time shifting.

Properties of Systems: Linearity, Causality, time invariance and stability. Dirichlet's conditions, Distortion-less systems, Invertible systems, Frequency response of LTI system-continuous and discrete system.

Module No-2: Analysis of continuous time signals: [8 L]

Convolution in continuous time, Correlation of continuous –time signals, Continuous time Fourier Series, Fourier transformation of continuous time signals and their properties.

Laplace transformation: analysis and characterization of LTI systems with examples and properties. Computation of impulse response and transfer function using Laplace transform, Analysis of basic electrical circuits using Laplace Transform, Parseval's theorem.

Module No-3: Analysis of discrete time signals: [10L]

Convolution in discrete time, Correlation of discrete time signals, Discrete time Fourier Series, Fourier transformation of discrete time signals and their properties.

Z-transform for discrete time signals, Region of convergence, System functions, Poles and zeros of system, analysis and characterization of LTI systems with examples and properties using z- transform , Computation of impulse response and transfer function using z-transform.

Module No-4: Application of Signals and Systems theory: [10 L]

4.1Sampling Theorem, Types of sampling, Aliasing, Pre-alias filter, Reconstruction of a signal from its samples, Modulation for communication, Sampling of Band-pass signals, Filtering

4.2. **Random process and noise:** Random variable, random process, ensemble, sample function, time average, ensemble average, stationary and ergodic process, correlation between two random variables. Definitions-distribution & density function, mean values &moments, function of two random variables, spectral densities, response of LTI system to random inputs, Noise sources in circuits, noise in communication circuits and systems, noise voltage.

Text Books:

1. A.V.Oppenheim, A.S.Willsky and S.H.Nawab -Signals &Systems, Pearson
2. B.P.Lathi- Signal Processing & Linear Systems- Oxford
3. P.Ramesh Babu & R.Anandanatarajan- Signals and Systems 4/e- Scitech
4. Sanjay Sharma-Signals and Systems, Kataria Publication

References:

1. J.G. Proakis & D.G. Manolakis- Digital Signal Processing Principles, Algorithms and Applications,.
2. A.Nagoor Kani- Signals and Systems- McGraw Hill
3. S.Haykin & B.V.Veen, Signals and Systems- John Wiley
4. S.Haykin,Digital Communication-John Wiley
5. Digital signal Processing by S.K. Mitra-Tata McGraw Hill

Course Name : Signals And Systems Laboratory					
Course Code :ECEN2153					
Contact Hours per week	L	T	P	Total	Credit Points
	0	0	2	2	1

Course Outcomes:

1. The students after the course will learn to study signal synthesis using SA.
2. They will understand convolution of two signals.
3. The students will learn Fourier and Laplace transforms and applications.
4. They will be able to measure filter response.

Hardware Experiments-:

1. To Study Signal Synthesis via sum of harmonics using spectrum analyzer.
2. Study of sampling theorem.

Software Experiments-:

5. To study the generation of different type of continuous and discrete signals.
6. To study the different operation ofsignals.
7. To study convolution theorem in time and frequency domain.
8. To study the autocorrelation and crosscorrelation of signal.
9. To study the Fourier transform and Laplace transform.
10. Magnitude and phase response of the filters.

Course Name : Mathematical Methods					
Course Code :MATH2001					
Contact Hours per week	L	T	P	Total	Credit Points
	3	1	0	4	4

Course Outcomes:

1. MATH2001.1 Construct appropriate mathematical models of physical systems.
2. MATH2001.2 Recognize the concepts of complex integration, Poles and Residuals in the stability analysis of engineering problems.
3. MATH2001.3 Generate the complex exponential Fourier series of a function and make out how the complex Fourier coefficients are related to the Fourier cosine and sine coefficients.
4. MATH2001.4 Interpret the nature of a physical phenomenon when the domain is shifted by Fourier Transform e.g. continuous time signals and systems.
5. MATH2001.5 Develop computational understanding of second order differential equations with analytic coefficients along with Bessel and Legendre differential equations with their corresponding recurrence relations.
6. MATH2001.6 Master how partial differentials equations can serve as models for physical processes such as vibrations, heat transfer etc.

MODULE I : [12L]

Functions of Complex Variables:

Complex numbers and its geometrical representation.

Functions of a complex variable – Limits, Continuity and Differentiability.

Analytic Functions, Cauchy- Riemann equations, Necessary and sufficient conditions for analyticity of complex functions (Statement only), Harmonic functions.

Line Integral on complex plane, Cauchy-Goursattheorem, Cauchy's Integral Formula. Taylor's and Laurent's series expansion.

Zeros, Different types of Singularities. Definitions of poles and residues, Residue Theorem, Evaluation of real integrals using residue theorem.

MODULE II : [12L]

Fourier series, Integrals and Transforms:

Definite Integral, Orthogonality Of Trigonometric Functions, Power Series And Its Convergence.

Periodic Functions , Even And Odd Functions , Dirichlet's Conditions , Euler Formulas For Fourier Coefficients , Fourier Series Representation Of A Function, E.G. Periodic Square Wave, Half Wave Rectifier, Unit Step Function.

Half Range Series, Parseval's Identity.

Fourier Integral Theorem, Fourier Transform, Fourier Sine And Cosine Transform, Linearity, Scaling, Frequency Shifting And Time Shifting Properties, Convolution Theorem.

Discussion Of Some Physical Problems: E.G Forced Oscillations.

MODULE III: [12L]

Series Solutions to Ordinary Differential Equations and Special Functions:

Series solution of ODE: Ordinary point, Singular point and Regular Singular point, series Solution when is an $x = a$ ordinary point, Freseniusmethod.

Legendre's Equation , Legendre's polynomials and its graphical representation. Bessel's equation , Bessel's function of first kind and its graphical representation. Finite Difference Method and its application to Boundary Value Problem.

MODULE IV : [12L]

Partial Differential Equations:

Introduction to partial differential equations, Formation of partial differential equations, Linear and Nonlinear pde of first order, Lagrange's and Charpit's method of solution.

Second order partial differential equations with constant coefficients , Illustration of wave equation, one dimensional heat equation, Laplace's equation, Boundary value problems and their solution by the method of separation of variables.

Solution of Boundary value problems by Laplace and Fourier transforms.

Suggested Books:

1. Complex Variables and Applications Brown ChurchillMC GrawHill
2. Complex VariableMurrey R. Spiegel Schaum's Outline Series
3. Theory of Functions of a Complex Variable Shanti Narayan, P. K. MittalS. Chand
4. Integral Transforms for Engineers and Applied Mathematicians Larry C. Andrew, B. K. ShivamoggiMacmillan
5. Fourier Analysis with Boundary Value Problem Murrey R.SpiegelSchaum's Outline Series
6. Mathematical MethodsPotter, Merle C., Goldberg, Jack. PHI Learning
7. Ordinary and Partial Differential EquationsM. D. RaisinghaniaS. Chand
8. Elements of Partial Differential Equation Ian Naismith SneddonDover Publications
9. Advanced Engineering Mathematics KreyszigWilley
10. Higher Engineering MathematicsB. V. Ramana Tata McGraw-Hill

Course Name: Data Structure and Basic Algorithms					
Course Code: CSEN2004					
Contact hrs per week	L	T	P	Total	Credit Points
	3	–	–	3	3

COURSE OUTCOMES

1. To understand the data structures, their advantages and drawbacks
2. To identify the efficiency aspects of the graph and sorting algorithms covered in this course.
3. To learn about the data structures/ methods/ algorithms mentioned in the course with a comparative perspective
4. To describe problem statements and to design the solutions using programming language
5. To analyze and apply most appropriate data structure/ method/algorithm in a program to enhance the efficiency
6. To develop an efficient program modifying an efficient one using the knowledge gathered from this course.

Module-1: Linear Data structures I [8L]
Introduction [2L]

I. Concepts of Data and data structure, Data Type and Abstract Data Type.
II. Algorithms and programs, Different types of algorithms with example
III. Algorithm efficiency and analysis, time and space analysis of algorithms–order notations.

Array [3L]

I. Different representations – row major, column major
II. Sparse matrix - its implementation and usage

Linked List [3L]

I. Singly linked list, its operations – with and without tail pointer
II. Circular linked list, its operations, Doubly linked list,

Module-2: Linear Data structures II [8L] Stack [3L]

I. Concept, Operations
II. Implementation (using array, using linked list)
III. Applications – Evaluation of expressions

Queue [3L]

I. Concept, Operations
II. Implementation (using array, using linked list)
III. Circular queue, implementation (using array)

IV. Applications

Recursion [2L]

I. Principles of recursion

II. Use of stack

III. Differences between recursion and iteration

IV. Tail recursion

Module-3: Non-linear Data structures [8L] Trees [5L]

I. Basic terminologies, tree representation (using array, using linked list)

II. Binary trees-traversal (pre, in, post - order), reconstruction

III. Binary search tree-operations (creation, insertion, deletion, searching)

IV. Height balanced binary tree –AVL tree (insertion, deletion with examplesonly)

Graphs [3L]:

I. Basic Terminologies and definitions

II. Representations/storage implementations–adjacency matrix, adjacency list,

III. Graph traversal and connectivity–Depth first search (DFS), Breadth first search (BFS)

Module-4: Searching, Sorting, Hashing [8L] Sorting Algorithms [4L]

Bubble sort, Insertion sort, Selection sort
Merge sort, Quick sort,
Comparisons

Searching [2L]

Sequential search, binary search

Hashing [2L]:

Hashing functions, collision resolution techniques

Text Books:

1. ‘‘Data Structures And Program Design In C”, 2/E by Robert L. Kruse, Bruce P. Leung.
2. “Fundamentals of Data Structures of C” by Ellis Horowitz, Sartaj Sahni, Susan Anderson
3. “Data Structures in C” by Aaron M. Tenenbaum.
4. “Data Structures” by S. Lipschutz.
5. “Introduction to Algorithms” by Thomas H. Cormen, Charles E. Leiserson, Ronald L.Rivest, Clifford Stein.

Course Name: Data Structure and Basic Algorithms Lab					
Course Code: CSEN 2054					
Contact hrsper week	**L**	**T**	**P**	**Total**	**Credit Points**
	-	-	3	3	1.5

Course Outcomes:

1. To write well-structured programs
2. To analyze run-time execution of sorting methods, including selection, merge sort and Quick sort.
3. To implement any ADT using both array based and linked-list based data structures.
4. To design advance data structure using Non-Linear data structure.
5. To select appropriate data structures as applied to specified problem definition.
6. To determine and analyze the complexity of given Algorithms.

List of Experiments:

1. Implementation of array operations.
2. Stacks and Queues: adding, deleting elements
3. Circular Queue: Adding & deleting elements
4. Evaluation of expressions operations using stacks.
5. Implementation of linked lists: inserting, deleting, inverting a linked list.
6. Implementation of stacks & queues using linked lists:
7. Sparse Matrices: Multiplication, addition
8. Recursive and Non-recursive traversal of Trees.
9. Binary tree traversal.
10. DFS and BFS.
11. Application of sorting and searching algorithms.

Course Name: Human Values and Professional Ethics					
Course Code : HMTS2001					
Contact Hours per week	L	T	P	Total	Credit Points
	3	0	0	3	3

COURSE OUTCOMES:
The students will:

1. be aware of the value system and the importance of following such values at workplace
2. learn to apply ethical theories in the decision making process
3. follow the ethical code of conduct as formulated by institutions and organizations
4. Implement the principles governing work ethics
5. Develop strategies to implement the principles of sustainable model of development
6. Implement ecological ethics wherever relevant and also develop eco-friendly technology

Module I (10 L)

Human society and the Value System

Values: Definition, Importance and application. Formation of Values: The process of Socialization

Self and the integrated personality Morality, courage, integrity

Types of Values:

Social Values: Justice, Rule of Law, Democracy, Indian Constitution, Secularism Aesthetic Values: Perception and appreciation of beauty

Organizational Values: Employee: Employer--- rights, relationships, obligations Psychological Values: Integrated personality and mental health

Spiritual Values &their role in our everyday life

Value Spectrum for a Good Life, meaning of Good Life

Value Crisis in Contemporary Society

Value crisis at----

Individual Level Societal Level Cultural Level

Value Crisis management Strategies and Case Studies

Module II [10L]

Ethics and Ethical Values Principles and theories of ethics

Consequential and non-consequential ethics

Egotism, Utilitarianism, Kant's theory and other non-consequential perspectives Ethics of care, justice and fairness, rights and duties

Ethics--

Standardization Codification Acceptance Application

Types of Ethics- Ethics of rights and Duties

Ethics of Responsibility Ethics and Moral judgment Ethics of care

Ethics of justice and fairness

Work ethics and quality of life at work

Professional Ethics

Ethics in Engineering Profession;

Moral issues and dilemmas, moral autonomy (types of inquiry) Kohlberg's theory, Gilligan's theory (consensus and controversy)

Code of Professional Ethics Sample Code of ethics like ASME, ASCE. IEEE Institute of Engineers, Indian Institute of materials management, Institute of Electronics and telecommunication engineers

Violation of Code of Ethics---conflict, causes and consequences

Engineering as social experimentation, engineers as responsible experimenters (computer ethics, weapons development)

Engineers as managers, consulting engineers, engineers as experts, witnesses and advisors, moral leadership Conflict between business demands and professional ideals

Social and ethical responsibilities of technologies.

Whistle Blowing: Facts, contexts, justifications and case studies

Ethics and Industrial Law

Institutionalizing Ethics: Relevance, Application, Digression and Consequences

Module III [10L]

Science, Technology and Engineering

Science, Technology and Engineering as knowledge and profession

Definition, Nature, Social Function and Practical application of science Rapid Industrial Growth and its Consequences

Renewable and Non- renewable Resources: Definition and varieties Energy Crisis

Industry and Industrialization Man and Machine interaction

Impact of assembly line and automation Technology assessment and Impact analysis Industrial hazards and safety

Safety regulations and safety engineering Safety responsibilities and rights

Safety and risk, risk benefit analysis and reducing risk Technology Transfer: Definition and Types

The Indian Context

Module IV [6L]

Environment and Eco- friendly Technology

Human Development and Environment Ecological Ethics/Environment ethics

Depletion of Natural Resources: Environmental degradation Pollution and Pollution Control

Eco-friendly Technology: Implementation, impact and assessment

Sustainable Development: Definition and Concept

Strategies for sustainable development Sustainable Development--- The Modern Trends

Appropriate technology movement by Schumacher and later development Reports of Club of Rome.

Suggested Readings:

1. Tripathi,A.N., Human Values, New Age International, New Delhi,2006
2. Ritzer, G., Classical Sociological Theory, The McGraw Hill Companies, New York,1996. 3)Doshi,S.L., Postmodern Perspectives on Indian Society, Rawat Publications, New Delhi,2008. 4)Bhatnagar, D.K., Sustainable Development, Cyber Tech Publications, New Delhi, 2008. 5)Kurzwell,R., The age of Spiritual Machines, Penguin Books, New Delhi,1999.
3. Weinberg, S.K., Social Problems in Modern Urban Society, Prentice Hall,Inc.,USA, 1970.
4. Giddens, Anthony 2009. Sociology. London: Polity Press (reprint 13th Edition).

2ND YEAR, 2ND SEMESTER

Course Name : Analog Communication					
Course Code : ECEN2201					
Contact Hours per week	L	T	P	Total	Credit Points
	3	0	0	3	3

COs:
After completing this course, the students will be able to:

1. Understand & apply the concepts of various types of signals, techniques for signal transmission and signal modulation from the knowledge gathered earlier.
2. Identify various parameters associated with Amplitude Modulation, time and frequency domain representations, side band frequencies etc and apply these knowledge to solve numerical problems.
3. Understand principles of various generation and detection techniques of Amplitude Modulation.
4. Identify and apply detailed knowledge of Angle modulation and demodulation techniques.
5. Analyze various multiplexing techniques and radio receivers.
6. Understand system noise and apply this knowledge to compare the noise performance of Analog Communication systems.

Module-1:[9L]

Introduction to Analog Communication: Introduction to basic elements of communication systems, Concept of modulation and its needs.

Continuous Wave Linear Modulation:

a) Amplitude modulation(AM-DSB/TC): Time domain representation of AM signal (expression derived using a single tone message), modulation index, frequency domain (spectral) representations, illustration of the carrier and side band components; transmission bandwidth for AM; Phasor diagram of an AM signal; Calculation of Transmitted power & sideband power & Efficiency ; concept of under, over and critical modulation of AM-DSB-TC.

b) Other Amplitude Modulations: Single side band modulation (SSB) both TC & SC ,Double side band suppressed carrier (DSBSC) modulation: time and frequency domain expressions, bandwidth and transmission power for DSB. The basic concepts of VSB, Spectra and band-width.

Module -2 :[9L]

Generation & Detection of Amplitude Modulated signals:

c) Generation: Multiplier modulator, Balanced Modulator, Switching modulator, Square law Modulator, Generation of SSB: Frequency Discrimination method, Phase Discrimination method

d) Detection: Rectifier Detector, Square Law detector, Envelope detector, Synchronous detection for AM-SC signals, Effects of Frequency & Phase error in Synchronous detection.

Module-3:[9L]

Angle Modulation:

e) Frequency Modulation (FM) and Phase Modulation (PM): Time and Frequency domain representations, Spectral representation of FM and PM for a single tone message, Phasor diagram.

f) Generation of FM & PM: Narrow and Wide-band angle modulation, Basic block diagramrepresentation of generation of FM & PM, Concept of VCO & Reactance modulator

g) Demodulation of FM: Concept of frequency discriminators and phasediscriminators, Phase LockedLoop.

h) Comparison between AM and FM.

Module - 4 :[9L]

i) Multiplexing: Frequency Division Multiplexing, Time Division Multiplexing,

j) Radio Receivers –Performance Characteristics of Radio Receivers, Basic block diagram of TRF and Superhetrodyne Receiver. Comparison between TRF and Superhetrodyne Receiver.

k) Noise in Communication System: Noise performance in Analog Communication systems: SNR calculation for DSB/TC, DSB-SC, SSB-TC, and SSBSC & FM.

Text Books:

1. B.P.Lathi -Communication Systems- BS Publications
2. Taub and Schilling , "Principles of Communication Systems", 2nd ed., Mc-Graw Hill
3. Singh & Sapre—Communication Systems: 2/e, TMH
4. Haykin, Communication Systems- PHI

References:

1. Carlson—Communication System,4/e , Mc-Graw Hill
2. Proakis & Salehi Fundamentals of Communication Systems- Pearson
3. V Chandra Sekar – Analog Communication- Oxford University Press
4. P K Ghosh- Principles of Electrical Communications- University Press
5. L.W. Couch Ii, "Digital and Analog Communication Systems", 2/e, Macmillan Publishing
6. Blake, Electronic Communication Systems- Cengage Learning

Course Name : Analog Communication Laboratory					
Course Code :ECEN2251					
Contact Hours per week	L	T	P	Tota 1	Credit Points
	0	0	2	2	1

Course Outcomes:

1. The students will learn to analyze AM and FM signals using spectrum analyzer.
2. They will be able to design AM demodulator.
3. The students will be in a position to design FM demodulator.
4. They will know the procedure to measure Radio receiver parameters.

List of Experiments:

1. Measurement of modulation index varying modulating signal amplitude of an AM signal.
2. Design an AM demodulator (Envelope detector).
3. Spectral analysis of AM Signal.
4. Design of a voltage controlled oscillator (VCO).
5. Measurement of modulation index varying modulating signal amplitude of a FM signal.
6. Design a FM demodulator using PLL.
7. Spectral analysis of FM signal.
8. Study of Pre-Emphasis and De-Emphasis.
9. Measurement of selectivity, sensitivity and fidelity of a super-heterodyne receiver.
10. Experiment Beyond curriculum.

Course Name : Digital Systems Design					
Course Code : ECEN2202 *					
Contact Hours per week	**L**	**T**	**P**	**Total**	**Credit Points**
	3	**0**	**0**	**3**	**3**

* Upto Ver 1.1, the code was ECEN 2002 modified in Ver 1.2 (Subject name remains same).
The code ECEN 2202 is applicable from 2023 pass out students.

Course outcomes:

1. Make use of the concept of Boolean algebra to minimize logic expressions by the algebraic method, K-map method, and Tabular method.
2. Construct different Combinational circuits like Adder, Subtractor, Multiplexer, De-Multiplexer, Decoder, Encoder, etc.
3. Design various types of Registers and Counters Circuits using Flip-Flops (Synchronous, Asynchronous, Irregular, Cascaded, Ring, Johnson).
4. Outline the concept of different types of A/D and D/A conversion techniques.
5. Realize basic gates using RTL, DTL, TTL, ECL, and CMOS logic families.
6. Relate the concept of Flip flops to analyze different memory systems including RAM, ROM, EPROM, EEROM, etc.

Module-1[8 L]

Data and number systems; Binary, Octal, and Hexadecimal representation and their conversions;

BCD, Gray codes and their conversions; Signed binary number representation with 1's and 2's complement methods, Binary arithmetic. Boolean algebra, De-Morgan's theorem, Various Logic gates-their truth tables and circuits; Representation in SOP and POS forms; Minimization of logic expressions by algebraic method, K- map method, Tabular method.

Module-2: [12 L]

Combinational circuits- Adder and Subtractor, BCD adder, Encoder, Decoder, Comparator, Multiplexer, De- Multiplexer and Parity Generator. [7]

Memory Systems: Concepts and basic designs of RAM, ROM, EPROM, EEROM, Programming logic devices and gate arrays. (PLAs and PLDs)[5]

Module-3: [8L]

Sequential Circuits- Basic memory element S-R, J-K, D, and T Flip Flops, Interconversions of Flip-

Flop, State table and state transition diagram, sequential circuits design methodology, various types of Registers and Counters (Synchronous, asynchronous, Irregular, ring, johnson) and their design, Lockout and its remedy.

Module-4: [8 L]

a) Different types of A/D (Flash, SAR, Counter type, Dual slope) and D/A(R-2R, weighted resistor) conversion techniques.[4 L]

b) Logic families- RTL, DTL, TTL, ECL, and CMOS, their operation and specifications.[4 L]

Total: 36 hours

Textbooks:

1. Morris Mano-Digital Logic Design, PHI
2. R.P.Jain-Modern Digital Electronics, 2/e, Mc Graw Hill
3. Virendra Kumar-Digital technology, New Age Publication
4. S.Salivahanan, S.Arivazhagan-Digital Circuit & Design, Bikas Publishing
    A. Anand kumar-Fundamental of Digital Circuits, PHI

References:

1. H.Taub & D.Shilling-Digital Integrated Electronics, Mc Graw Hill
2. Tocci, Widmer, Moss-Digital Systems, 9/e, Pearson
3. Leach & Malvino-Digital Principles &Application, 5/e, Mc Graw Hill
4. Floyed & Jain-Digital Fundamentals, Pearson

Course Name : Digital Systems Design Lab					
Course Code : ECEN2252					
Contact Hours per week	L	T	P	Total	Credit Points
	0	0	2	2	1

* Upto Ver 1.1, the code was ECEN 2052, modified in Ver 1.2 (Subject name remains same).
The code ECEN 2252 is applicable from 2023 pass out students.

Course Outcomes:

The students after finishing this course will be able to:

1. Design code converters.
2. Design adder and subtractor circuits.
3. Design decoders and multipexer circuits.
4. Realize counters.

List of Experiments:

1. Realization of basic gates using Universal logic gates.
2. Code conversion circuits- BCD to Excess-3 and vice-versa.
3. Design of Four-bit parity generator and comparator circuits.
4. Construction of simple arithmetic circuits-Adder, Subtractor.
5. Construction of simple Decoder & Multiplexer circuits using logic gates.
6. Realization of different combinational circuits using Multiplexers.
7. Realization of RS, JK, and D flip-flops using Universal logicgates.
8. Realization of Asynchronous Up/Down counters.
9. Realization of Synchronous Up/Down counters.
10. Design of Sequential Counter with irregular sequences.
11. Realization of Ring and Johnson's counters.

Course Name : EM Theory And Transmission Lines					
Course Code : ECEN2203					
Contact Hours per week	L	T	P	Tot al	Credit Point
	3	0	0	3	3

Course Outcomes:

After going through this course, the students will be able to:

1. Apply their pre-requisite knowledge of Electrostatics and Magneto statics.
2. Comprehend Electromagnetic wave propagation in different mediums.
3. Understand different electromagnetic phenomena associated with Transmission Lines.
4. Design of Impedance Matching Networks for two wire Transmission Lines.
5. Develop the ability to analyze the radiation characteristics of antenna configurations and identify respective areas of application.
6. Understand pattern synthesis and analysis in linear antenna array.

Module I: [6]

Faraday's law & Lenz's law, Transformer and Motional Electromotive Forces, Displacement Current, JC - JD Relation, Maxwell's equations, Time Varying Potentials, Time-harmonic fields, Wave Equation, Boundary Conditions between media interface; Uniform Plane wave.

Module II: [10]

Plane Wave Propagation in Lossy Dielectric, Loss-less Dielectric, Good Conductor, Free space; Poynting Theorem, Power flow, Poynting vector, Skin Depth, Surface Resistance, Wave Polarization; Reflection and Transmission for normal and oblique incidence.

Module III: [12]

Transmission Lines; Concept of Lumped parameters and Distributed parameters. Line Parameters, Transmission line equations and solutions, Physical significance of the solutions, Propagation constant, Characteristic Impedance; Wavelength; Velocity of Propagation; Condition for minimum distortion and minimum attenuation, Transmission line losses, Distortion-less Line, Reflection and Transmission coefficients; Standing Waves, VSWR, Input Impedance, Smith Chart -Applications; Load Matching Techniques / Quarter wave Matching, Bandwidth problem; Low loss RF transmission lines, line as circuit elements.

Module IV: [6]

Antenna Concepts, Antenna Characteristic; Hertzian dipole (Radiation Fields, Radiation Resistance, Radiation patterns, Directive Gain); Properties and typical applications of Half-wave dipole, Loop antenna, Yagi-Uda array, Basic Concepts of antenna array.

Text Books

1. Principles of Electromagnetics, 4th Edition, Matthew O H Sadiku, Oxford University Press.
2. Electromagnetic Field Theory & Transmission Lines, G.S.N. Raju, Pearson Education

3. Electromagnetic Waves Shevgaonkar, Tata-McGaw-Hillr –R K
4. Antenna Theory: Analysis and Design, 3rd edition, C.A. Balanis, Wiley India.

Reference Books

1. Engineering Electromagnetics, 2ed Edition - Nathan Ida, Springer India.
2. Time Harmonic Electromagnetic Fields, Roger F. Harrington, IEEE Press Series.
3. Electromagnetic Theory & Applications, A. K. Saxena, Narosa Publishing House Pvt. Ltd.
4. Engineering Electromagnetics, 7thEdition-W.H.Hayt & J.A.Buck, Tata-McGraw-Hill.
5. Electromagnetic Waves and Transmission Lines- by G.Prasad, J.Prasad and J.Reddy-Scitech.

Course Name : EM Theory and Transmission Lines Laboratory					
Course Code : ECEN2253					
Contact Hours per week	L	T	P	Tot al	Credit Point
	0	0	2	2	1

Course Outcomes:

1. The students will be able to plot SW pattern under different conditions.
2. They will learn generation and study of Smith Chart.
3. The students will be able to study radiation patterns of various types of antennae.
4. They will be able to undertake parametric study of antenna.

[At least THREE experiments from Module I and FOUR experiments from Module II]

Module I:

1. Plotting of Standing Wave Pattern along a transmission line when the line is open-circuited, short-circuited and terminated by a resistive load at the load end.
2. Measurement of Input Impedance of a terminated coaxial line using shift in minima technique.
3. Study of Smith chart on MATLAB/OCTAVE platform.
4. Simulation study of Smith chart - Single and double stub matching.

Module II:

5. Radiation Pattern study of dipole antenna.
6. Radiation Pattern study of a folded-dipole antenna.
7. Radiation pattern study of Helical Antenna.
8. Parametric study (Gain, Directivity, HPBW and FNBW) of three, five and seven element Yagi Uda configurations.
9. Radiation pattern study of a Pyramidal Horn Antenna.
10. Spectrum analysis of different analog signals (sine, triangular, square) using spectrum analyzer.

Course Name : Electronic Devices					
Course Code :ECEN2204					
Contact Hours per week	L	T	P	Total	Credit Points
	3	0	0	3	3

Course Outcomes:

The students, after going through this course, will be able to:

1. Apply the previous knowledge of basic electronics engineering to appreciate the contents of this paper.
2. Understand both the particle and wave natures of electrons in Solid State Devices.
3. Identify unknown extrinsic semiconductor type using Hall Effect.
4. Describe working principles of different devices using mathematical models and energy band diagrams.
5. Justify different operations of solid state devices using relative position of Fermi energy levels across p-n junctions in devices.
6. Evaluate performance of different hetero junctions in semiconductor devices.

Module - 1: Semiconductor Physics [11L]

Recapitulation of Quantum Mechanics, Kronig Penny Model, Energy Band diagram, E-K diagram, Direct and Indirect Band-gap semiconductors, concept of effective mass, Carrier distribution in solid, concept of density of state (only expression), Fermi-Dirac distribution function, Fermi level, Intrinsic and Extrinsic semiconductors, idea of Degeneracy and Non- Degeneracy, Fermi level shift with the changes in doping and temperature. (6L) Semiconductor under equilibrium: Carrier Concentration in terms of effective Density of States, Mass-Action Law. (2L)

Semiconductor under non-equilibrium: Excess Carrier Generation and recombination with expression, concept of quasi Fermi-level.

Drift and Diffusion of carrier with expressions, Scattering Effect, Hall Effect, Piezo-electric effect (3L)

Module - 2: Diodes: **[11L]**

Homo-junctions: p-n junction physics: derivations and plots of depletion charge, electric field, potential profiles; energy band diagram, depletion width, p-n junction capacitances, Varactor diode, Derivation of p-n junction current equations, junction resistances; concepts about linearly graded and abrupt junctions. (5L)

Basic operations of different diodes: Breakdown diodes, Tunnel diode, Photo diodes (P-N, P-I-N, APD), Photoconductor, Solar cell; Basic concept about Spontaneous and Stimulated emissions, LED. (3L)

Hetero-junctions: Physics of Metal-Semiconductor & Semiconductor-Semiconductor hetero-junctions, Rectifying & Non-rectifying natures of Hetero-junctions, basic concept of potential-well & 2D electron gas. (3L)

Module - 3: Bipolar Junction Transistors (BJT): [7L]

BJT operating principle, minority carrier distributions, Different modes of operations and respective energy band diagrams, input output characteristics of BJT in CB & CE modes, base width modulation, Early effect, punch through, thermal runaway; concepts about large and small signal modeling of the device, Eber's Moll model, Hybrid-π model. Basic operation of Photo-transistor.

Module - 4: Metal Oxide Semiconductor Field Effect Transistors (MOSFET): [7L]

Physics of 2-terminal MOS structures with proper band diagrams, formation of inversion layer; MOSFET classifications: Enhancement and Depletion type MOSFETs, basic operations and V-I characteristics of both the devices; concepts of Threshold voltage and Flat-band voltage, small signal model of MOSFET, Introduction to CMOS technology. Study of MOS capacitance.

Text Books :

1. Neamen- Semiconductor Physics and Devices- TMH
2. Bhattacharya & Sharma- Solid State Electronic Devices- Oxford
3. Streetman & Banerjee- Solid State Electronic Devices- PHI

Reference Books :

1. Milman, Halkias & Jit- Electronics Devices and Circuits- TMH
2. Bell-Electronics Devices and Circuits-Oxford
3. Bogart, Bisley & Rice- Electronics Devices and Circuits- Pearson
4. Boylestad & Nashelsky- Electronics Devices and Circuit Theory- Pearson

Course Name : Advanced Numerical Methods					
Course Code :MATH2202					
Contact Hours per week	L	T	P	Total	Credit Points
	3	0	0	3	3

Course Outcome: After completing the course the student will be able to:

1. MATH2202.1 Analyze certain algorithms, numerical techniques and iterative methods that are used for solving system of linear equations.
2. MATH2202.2 Implement appropriate numerical methods for solving advanced engineering problems dealing with interpolation, integration and differentiation.
3. MATH2202.3 Apply the knowledge of matrices for calculating eigenvalues and eigenvectors and their stability for reducing problems involving Science and Engineering
4. MATH2202.4 Develop an understanding to reduce a matrix to its constituent parts in order to make certain subsequent calculations simpler.
5. MATH2202.5 Apply various optimization methods for solving realistic engineering problems.
6. MATH2202.6 Compare the accuracy and efficiency of the above mentioned methods.

Module I[9L]

System of Linear Equations :

- Gauss Elimination: pivoting andscaling.
- Gauss-Jordan, Gauss-Jacobi,Gauss-Seidel.
- Computationalcomplexityoftheabovemethods.
- Symmetricpositivedefinitesystemsandindefinitesystems:Cholesky factorization.
- Error Analysis: error prediction andacceleration.

Module II [9L]

Eigen Value problems:

Eigenvalue location, error and stability of eigenvalues.

QR algorithm.

Power method, inversion iteration in finding dominant eigenvalues and eigenvectors of sparse matrices.

Singular value decomposition, application of SVD.

ModuleIII[9L]

Interpolation, Integration & Differentiation:

Purpose of interpolation, choice of interpolating function: Newton's forward and backward interpolation.

Polynomial interpolation: Lagrange's method.

Newton's divided difference interpolation.

Computational complexity of the above methods.

Piecewise polynomial interpolation: cubic spline interpolation.

General form of quadrature rule: Newton-Cotes quadrature.

Trapezoidal rule, Simpson's 1/3rd rule, Weddle's rule.

Gaussian quadrature rule.

ModuleIV [9L]

Optimization:

Unimodal functions.

One-dimensional unconstrained optimization algorithms: interval halving, Dichotomous search, Golden section search, Fibonacci search.

Cubic spline interpolation.

Nonlinear Least Squares.

Books:

Text Book

1. Trefethen L. N. and Bau D. Numerical Linear Algebra, SIAM
2. Watkins D. S. Fundamentals of Matrix Computation, Wiley
3. Smith G. D. Numerical Solutions to Partial Differential Equations, Oxford University Press
4. Jain M. K. and Iyengar S.R.K. Numerical methods for scientific and engineering computation
5. Conte S. D. and Boor C. D. Elementary Numerical Analysis - An Algorithmic Approach, McGraw Hill
6. Atkinson K. E. Introduction to Numerical Analysis,John Wiley
7. S. S. Rao, Engineering Optimization, New Age International Publishers

Reference Books

1. Golub G. H. and Van Loan C.F. Matrix Computation, John Hopkins U. Press, Baltimore
2. Stewart G. W. Introduction to Matrix Computations, Academic Press
3. Demmel J.W. Applied numerical linear algebra, SIAM, Philadelphia
4. Jain M.K. Numerical Solutions of Differential Equations
5. Smith, Numerical solutions of partial Differential Equations (Finite difference methods)
6. Heath M. T., Scientific Computing: An Introductory Survey, McGraw Hill
7. Joe D. Hoffman, Numerical Methods for Engineers and Scientists, McGraw Hill

Course Name : Advanced Numerical Methods Laboratory					
Course Code :MATH2253					
Contact Hours per week	L	T	P	Total	Credit Points
	0	0	2	2	1

Course outcomes: After completing the course the student will be able to:

1. MATH2253.1 Write programs in C to solve problems based on numerical methods.
2. MATH2253.2 Apply their knowledge of C programming to find non-iterative exact solutions of a system of equations.
3. MATH2253.3 Use C programming to develop algorithms to find iterative approximate solutions of a system of equations.
4. MATH2253.4 Demonstrate their ability of C programming to solve problems involving interpolation.
5. MATH2253.5 Use MATLAB/OCTAVE to implement algorithms in optimization problems.
6. MATH2253.6 Study the role of recurrence relations in optimization algorithms using

MATLAB/OCTAVE. Development of computer programs in C and/or MATLAB/OCTAVE for the following problems:

1. Gauss-elimination Method with complete and total pivoting.
2. Gauss-Seidel Method with diagonal dominance.
3. Newton's Forward Interpolation (polynomial to be printed).
4. Lagrange's interpolation (polynomial to be printed).
5. Implementation of one-dimensional unconstrained optimization algorithms (for example: Dichotomous search, Golden section search, Fibonacci search etc by MATLAB/OCTAVE).

Course Name : Environmental Sciences					
Course Code : EVSC2016					
Contact Hours per week	L	T	P	Tot al	Credit Points
	2	0	0	2	0

Course outcomes

The subject code EVS2016 corresponds to basic environmental chemistry for the 2nd year B.Tech students, which is offered as Environmental Sciences and is mandatory for all branches of engineering. The course provides basic knowledge of various environmental pollutions as well as its impact and ways to curb it. The course outcomes of the subject are

1. Understand the natural environment and its relationships with human activities.
2. Characterize and analyze human impacts on the environment.
3. Integrate facts, concepts, and methods from multiple disciplines and apply to environmental problems.
4. Educate engineers who can work in a multi-disciplinary environment to anticipate and address evolving challenges of the 21st century.
5. Understand and implement scientific research strategies, including collection, management, evaluation, and interpretation of environmental data.
6. Design and evaluate strategies, technologies, and methods for sustainable management of environmental systems and for the remediation or restoration of degraded environments.

Module 1[6L]

SocioEnvironmentalImpact

Basic ideas of environment and its component, Population growth: exponential and logistic; resources; sustainable development 3L
Concept of green chemistry, green catalyst, green solvents
Environmental disaster and social issue, environmental impact assessment, environmental audit, environmental laws and protection act of India. 3L

Module2 [6L]

Air Pollution
Structures of the atmosphere, global temperature models
Greenhouse effect, global warming; acid rain: causes, effects and control.3L
Lapse rate and atmospheric stability; pollutants and contaminants; smog; depletion of ozone layer; standards and control measures of air pollution. 3L

Module3 [6L]

Water Pollution
Hydrosphere; pollutants of water: origin and effects; oxygen demanding waste; thermal pollution; pesticides; salts.
Biochemical effects of heavy metals; eutrophication: source, effect and control. 2L
Water quality parameters: DO, BOD, COD.

Water treatment: surface water and waste water. 4L

Module4 [6L]

Land Pollution

Land pollution: sources and control; solid waste: classification, recovery, recycling, treatment and disposal. 3L

Noise Pollution

Noise: definition and classification; noise frequency, noise pressure, noise intensity, loudness of noise, noise threshold limit value; noise pollution effects and control. 3L

Text/Books

1. GourKrishna Das Mahapatra, Basic Environmental Engineering and Elementary Biology, Vikas Publishing House P. Ltd.
2. A. K. De, "Environmental Chemistry", New Age International.
3. A. K. Das, Environmental Chemistry with Green Chemistry, Books and Allied P. Ltd

References/Books

1. S. C. Santra, Environmental Science, New Central Book Agency P. Ltd
2. D. De, D. De, Fundamentals of Environment & Ecology, S. Chand & Company Ltd.

Course Name : Control Systems					
Course Code :ECEN2211					
ContactHoursperweek	L	T	P	Total	Credit Points
	3	0	0	3	3

Course Outcomes:

1. Students will be able to relate their pre-requisite knowledge from Mathematics and Signals & Systems.
2. They will develop the ability to understand mathematical model of physical systems and study their nature, configuration and relevant mapping into equivalent models.
3. The concept and classification of control systems, will be applied to identify, analyze and solve stability related issues in time response, error analysis and stability analysis in an advanced way.
4. Students will be able to evaluate, categorize and justify the margin of stability with respect to the system's nature using frequency domain analysis tools.
5. Students will be able to conceptualize different methods of evaluating system behavior with the help of models compatible to simulation.
6. Students will be able to design controllers according to desired performance specifications which can be applied for system design in higher semesters.

MODULE – I

Introduction:

Concepts of Control Systems- Open Loop and Closed Loop Control Systems, Different Control Systems - Classification of Control Systems, Feed-Back Characteristics, Effects of feedback. [4L]

Transfer Function Representation Of LTI Systems:

Block diagram representation of systems -Block diagram algebra – Representation by Signal Flow Graph - Transfer function using Mason's Gain Formula. [5L]

MODULE -II

Time Domain Analysis:

Standard test signals - Time response of first order systems – Characteristic Equation of Feedback control systems, Transient response of second order systems - Time domain specifications – Steady state response - Steady state errors and error constants. [5L]

Stability Analysis:

The concept of stability- Difference between absolute and relative stability-Routh's stability criterion, Root Locus Technique. [5L]

MODULE – III[10 L]

Frequency Domain Analysis:

Frequency domain specifications-Bode diagrams, Phase margin & Gain margin-Stability Analysis from Bode Plots. [6L]

Polar Plots- Nyquist Plots-Stability Analysis. [4L]

MODULE –IV[11 L]

Classical Control Design Techniques:

Compensation techniques – Lag, Lead, Lead-Lag Controllers design in frequency Domain, PID Controllers. [5 L]

State Space Analysis of Continuous Time Systems:
Concepts of state, state variables and state model, derivation of state models from block diagrams, Solving the Time invariant state Equations- State Transition Matrix and its properties – Concepts of Controllability and Observability. [6 L]

TEXT BOOKS:

1. Automatic Control Systems– by B. C. Kuo, John Wiley and Sons.
2. Control Systems Engineering – by I. J. Nagrath and M. Gopal, New Age International (P) Ltd.
3. Modern Control Engineering – by Katsuhiko Ogata , Prentice Hall of India Pvt. Ltd.
4. Modern Control Systems- by R.C. Dorf & R.H. Bishop- Addison- Wesley Longman.

REFERENCE BOOKS:

1. Control Systems Engg. by Norman S. Nise , John Wiley.
2. Control System Engineering by Ananda Natarajan , P. Ramesh Babu, Scitech Pub.
3. Automatic Control Systems- Basic analysis and design- by A. Wolovich- Oxford University Press.

Course Name : Control Systems Laboratory					
Course Code : ECEN2261					
Contact Hours per week	L	T	P	Total	Credit Points
	0	0	2	2	1

Course Outcomes:

1. The students will learn the study of feedback on systems.
2. They will be able to study systems of first and second order.
3. The students will be in a position to analyze steady state errors for systems.
4. They will be able to study the stability of a system using Bode plot etc.

List of Experiments:

1. Familiarization with MATLAB/OCTAVE 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. Verification and validation of time domain specifications of second order systems.
6. Study of steady state errors for different 'types' of systems.
7. Study of system stability using Root Locus Technique.
8. Study of system stability using Nyquist plot.
9. Study of system stability using Bode plot.
10. Study of system relative stability using Nyquist Plot and Bode Plot.
11. Study of system representation using State Model.
12. Determination of PI, PD and PID controller action o

3RDYEAR 1STSEMESTER

Course Name: Digital Communication					
Course Code: ECEN 3101					
Contact Hours per week	L	T	P	Total	Credit Points
	3	0	0	3	3

Course Outcomes:

After completing the course the student will be able to:

1. Apply the concepts of various techniques for analog signal transmission and modulation from the knowledge gatheredearlier.
2. Understand the functions of different components of a digital communication system and understand Pulse code ModulationSystem.
3. Apply mathematical concepts to analyse the source coder and channel coder blocks of the digital communication system.
4. Analyze error performance of a baseband receiver in digital communication system in presence of noise and other interferences and apply this knowledge to design a receiver.
5. Compare performance of various digital modulation & demodulation techniques and understand concept of OFDM and Spread Spectrum Modulationsystem.
6. Design a digital communication system and evaluate the performance of the system in presence ofnoise.

Module I: [8L]

Building Blocks of Digital Communication System, Performance comparison of Analog and Digital communication technique.

Pulse Code Modulation: Sampling, Quantization, quantization noise, linear and nonlinear quantization, Companding, Source encoding, Differential pulse code modulation, Delta modulation, Adaptive deltamodulation.

Module II: [8L]

Line Coder: Desirable properties of line code, Polar/ Unipolar /Bipolar / HDB signaling (NRZ and RZ schemes), Manchester signaling, Comparison of PSDs of these line codes,

Pulse Shaping, Inter Symbol Interference (ISI), Nyquist criterion for zero ISI, Eye pattern, Equalizer, zero forcing equalizer, Regenerative repeater, Bit synchronization, Frame synchronization.

Module III: [8L]

Digital Band pass Modulation schemes: Types of Digital Modulation, coherent and non-coherent Binary Modulation Techniques: ASK, PSK and FSK. Concept of QAM and M-ary Modulation, M-ary phase shift keying, Quadrature Phase Shift Keying (QPSK), Offset Quadrature Phase shift Queuing (OQPSK), Geometrical

representation, generation, detection, and power spectral density of the above mentioned digital carrier modulation techniques . Minimum Shift Keying (MSK), Gaussian Minimum Shift Keying, Basic Concept of OFDM and Spread Spectrum Modulation.

Module IV: [8L]

Signal Vector Representation: Basis functions, signal space diagram, message point, geometric interpretation of signals.

Baseband signal receiver : Detection of known signals in presence of noise, Integrate and Dump type filter, probability of error calculation, , Optimum threshold detection, Optimum Receiver for AWGN channel , Matched Filter receiver, Correlator Receiver and it's transfer function, Probability of error of matched filter, Concept of error function, complementary error function and Q function. Comparative study of bit error probability of various digital modulation techniques.

TEXT BOOKS:

1. Digital Communications, S. Haykin, WileyIndia.
2. Principles of Communication Systems, H. Taub and D.L.Schilling, TMH PublishingCo.
3. Digital Communications, J.G.Proakis, TMH PublishingCo.
4. B.P. Lathi, Modern Digital and Analog Communication System, Oxford UniversityPress.
5. Electronic Communications Systems, Wayne Tomasi, PearsonEducation.

REFERENCE BOOKS:

1. Digital Communications Fundamentals and Applications, B. Sklar and P.K.Ray,Pearson.
2. Digital Communication, A. Bhattacharya, TMH PublishingCo.
3. Wireless Communication and Networks: 3G and Beyond, I. SahaMisra, TMHEducation.
4. L.W. Couch II, Modern Communication System, Prentice Hall India.
5. Roden, Analog & Digital Communication Systems, 5e,SPD
6. Communication Systems (Analog and Digital), Sanjay Sharma, KatsonBooks

Course Name: Digital Communication Laboratory					
Course Code:ECEN3151					
Contact Hours per week	L	T	P	Total	Credit Points
	0	0	2	2	1

Course Outcomes:

After completing the following experiments, students will be able to:

1. Understand, design & implement PN sequences with shift registers and study performance of Pulse Amplitude Modulators and demodulators.

2. Implement and study Line codes like polar, unipolar (NRZ,RZ), Split phase and differentially encoded signals

3. Analyze and compare time domain and frequency domain representation of various digital modulation and demodulation schemes.

4. Acquire an insight into Digital Communication systems intotality

List of Experiments:

1. Design and implementation of 7-length PN sequences using shiftregister.
2. Implementation and study of Pulse Amplitude Modulation anddemodulation.
3. Implementation and study of Line Codes: polar , unipolar (NRZ,RZ), Split phase and Differentially encoded signals
4. Implementation and Study of BASKModulator.
5. Implementation and Study of BASKDemodulator
6. Implementation and Study of BFSKModulator
7. Implementation and Study of BFSK Demodulator
8. Implementation and Study of BPSK Modulator
9. Experiment beyondcurriculum.

Course Name : Digital Signal Processing					
Course Code : ECEN3102					
Contact Hours per week	L	T	P	Total	Credit Points
	3	0	0	3	3

Course outcomes:

After completion of the course, the students will be able to:

1. Recall the concepts of trigonometry, complex algebra, Fourier transform to analyze different signals and systems.
2. Apply the concept of z-transformation, convolution to determine the transfer function of a system and evaluate the output of the system.
3. Extend the knowledge of discrete-time Fourier transform to interpret DFT, FFT and apply the concept as a frequency transformation tool.
4. Design transfer functions of IIR/FIR filters applying transformation techniques/windowing methods.
5. Construct and model digital filters from their transfer function, develop concept of multirate signal processing and architecture of digital signal processor.
6. Develop a thorough understanding of the central elements of digital signal processing theory and apply this theory to real-world signal processing applications.

Module I [7L]

Introduction to Digital signal processing
Prerequisites: Concept of discrete-time signal and systems: concept of convolution, graphical, analytical methods to compute convolution supported with examples and exercises, properties of convolution, interconnections of LTI systems with physical interpretations, stability and causality conditions, recursive and non-recursive systems, Introduction to Z-transform, ROC, properties of Z-transform
Z-Transform: mapping between s-plane and z-plane, convolution, correlation and multiplication using z-transform, initial value theorem, final-value theorem, Parseval's relation, inverse Z-transform by contour integration.
Basic elements of a digital signal processing system, Advantages of digital over analog signal processing, concept of frequency in continuous-time and discrete-time signals.

Module II [8L]

Discrete Fourier Transform
Concept and relations for DFT/IDFT, Twiddle factors and their properties,

DFT/IDFT as linear transformations, DFT/IDFT matrices, computation of DFT/IDFT by matrix method, multiplication of DFTs, circular convolution, computation of circular convolution by graphical, DFT/IDFT and matrix methods, linear filtering using DFT, aliasing error, filtering of long data sequences – Overlap-Save and Overlap-Add methods with examples and exercises. Computational burden on direct DFT

Fast Fourier Transform:

Radix-2 algorithm, decimation-in-time, decimation-in-frequency algorithms, signal flow graphs, Butterflies computations in one place, bit reversal, examples for DIT & DIF FFT Butterfly computations and exercises, IDFT using DIT & DIF-FFT.

Module III [13L]

Digital Filters

Filter Concepts: Introduction to the concept of Digital Filters, frequency response and filter characteristics, basic concepts of IIR and FIR filters.

IIR Filters:

Introduction to analog filter design: Butterworth and Chebyshev filters design,

Transformation techniques: Impulse invariant method and bilinear transformation, warping effect and prewarping. Design procedure for low pass digital Butterworth and Chebyshev filter design.

FIR Filters:

Linear phase filters: Condition for filter to have linear phase response and its frequency response (Type I, II, III, IV),

Design techniques:

Fourier series method, Gibb's phenomenon, Windowing method (Rectangular,Hamming and Hanning window. Comparison study of windows,, advantages & disadvantages of FIR & IIR Filters.

Module IV [8L]

Realization of Digital Filters: Introduction Realization of discrete time systems: FIR and IIR system. Different methods of realizations: Direct form I, Direct Form II, Cascade form structure, Parallel form structure. Their advantages and disadvantages with examples**.**

Multi-rate Signal Processing: Understanding and necessity of multi-rate system Decimation and interpolation -Time domain and frequency domain behaviour of multi-rate systems Advantages and disadvantages.(aliasing & anti-aliasing)

Introduction to Digital Signal Processor:TMS320C67XX families, architecture and applications

TEXT BOOKS:

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

5. Theory and application of digital signal processing- L.R. Rabiner& B. Gold- PHI.
6. Analog & digital Signal Processing- A. Ambardar- Books/Cole Pub.

REFERENCE BOOKS:

1. Digital Signal Processing,Tarun Kumar Rawat,Oxford Press
2. Digital Signal Processing, S.Salivahanan, A.Vallabraj& C. Gnanapriya, TMH Publishing Co .
3. Digital Signal Processing; A Hands on Approach, C. Schuler &M.Chugani, TMH Publishing Co.
4. Digital Signal Processing S. Poornachandra& B. Sasikala, MH Education .
5. Digital Signal Processing; Spectral Computation and Filter Design Chi-Tsong Chen, Oxford University Press .
6. Texas Instruments DSP Processor user manuals and application notes .

Course Name : Digital Signal Processing Laboratory					
Course Code : ECEN 3152					
Contact Hours per week	L	T	P	Total	Credit Points
	0	0	2	2	1

Course outcomes:

The students will be able to:

1. Interpret the response of discrete time systems using the concept of convolution.
2. Apply different transformation tools-z-transform, discrete fourier transform, fast fourier transform on signals and justify their properties as well.
3. Compare the frequency response of FIR and IIR filters (LPF, HPF, BPF and BSF) of digital filters and implement the systems using suitable realization techniques.
4. Develop DSP processors based real time system to analyze different real time signals like speech signal, image signal and some other biomedical signals.

Simulation Laboratory using standard Simulator:

1. Convolution of two sequences using graphical methods and using commands- verification of the properties of convolution.
2. Z-transform of various sequences – verification of the properties of Z-transform.
3. Twiddle factors – verification of the properties.
4. DFTs / IDFTs using matrix multiplication and also using commands.
5. Circular convolution of two sequences using graphical methods and using commands, differentiation between linear and circular convolutions.
6. Verifications of the different algorithms associated with filtering of long data sequences and Overlap –add and Overlap-save methods.
7. Butterworth filter design with different set of parameters.
8. Chebyshev filter design with different set of parameters.
9. FIR filter design using rectangular, Hamming and Blackman windows.

Hardware Laboratory using DSP Processor:

1. Hardware implementation to verify Convolution, DFT and IDFT using TMS320C67xx processor.

2. Hardware implementation to verify the results of different digital filters using TMS320C67xx processor.

Course Name: Microwave Engineering					
Course Code: ECEN3103					
Contact Hours per week	**L**	**T**	**P**	**Total**	**Credit Points**
	3	**0**	**0**	**3**	**3**

Course outcomes:

After completing this course, the students will be able to:

1. Apply previous E.M. theory concepts to understand microwaveengineering.
2. Identify high frequency electromagnetic wave propagation characteristics through guided media.
3. Analyze microwave passive components andcircuits.
4. Students should be able to enhance their knowledge on semiconductor and vacuum tube devices operating at highfrequency.
5. Design high frequency filters andamplifiers.
6. Implement the concepts in developing different prototype microwavesystems.

Module I [12L]

Introduction:

RF & Microwave Spectrum, Typical applications of RF and Microwave Engineering, Safety considerations [1L]

Waveguides and Resonators:

Rectangular waveguides, TE & TM modes, TE 10 mode analysis, cut-off frequency, propagation constant, intrinsic wave impedance, phase and group velocity, Power transmission, attenuation, waveguide excitation, wall current; Introduction of circular waveguide; Rectangular waveguide resonator- Design consideration, resonant frequency, Q-factor of a rectangular cavity resonator, excitation. Circular waveguides, TE11 mode analysis. Rectangular waveguide resonator [8L]

Planar Transmission Lines

Strip Line, Micro-strip lines, Coplanar waveguide, Slot line- design consideration, field patterns, propagation characteristics, Comparison for different characteristics of the above mentioned lines.[3L]

Module II [10L]

Microwave Network Representation

Impedance and Equivalent Voltage and Current, Impedance and Admittance Parameters, Scattering Matrix, Properties of Scattering Parameters for Reciprocal and Lossless Network, Generalized S parameters, S parameters of Two-port Networks with Mismatched Load [5L]

Microwave Passive Devices

T-Junctions: E/H/Hybrid T-junctions, Wilkinsion Power Divider, Directional Couplers, Isolator, Phase Shifters, Circulators, Attenuators, Waveguide Filters, Methods for coupling of Microwave signal. [5L]

Module III [9L]

Microwave Tubes
Principle of Electron beam & Field interaction for energy exchange in resonant (two cavity klystron, Reflex Klystron, Magnetron) and TWT microwave active devices: Typical characteristics &applications (only physical explanation is required, no mathematical derivation required).[3L]
Semiconductor Microwave devices
TED (Gunn diode) & Avalanche Transit Time (IMPATT) device, Tunnel diode ,Schottky diode, PIN diode characteristics & applications; Microwave field effect transistor (MESFET), High Electron Mobility Transistor(HEMT)[6L]

Module IV [11L]

Microwave Filter Design
Design procedure of filter design using insertion loss method (maximally flat and equi-ripple), low pass prototype design, conversion to other filter prototypes.[5L]
Microwave Amplifier Design
Basic consideration in the design of RF amplifier- Transistor S- parameter, Stability, matching network, noise figure; Matching network design using lumped elements and L-Section. Brief introduction to NBA, LNA [6L]

Text books:

1. Microwave Engineering, 3rd editionDavid M. Pozar, Wiley &Sons Inc.
2. Microwave Engineering, MonojitMitra, DhanpatRai&Co.
3. Microwave Engineering, A Das & S Das,TMH.
4. Microwave Devices & Circuits, SY Liao , Pearson Education/PHI
5. Microwave Engineering Fundamentals, Design and Applications, Subal Kar, University Press.

References:

1. Microwave Engineering-Passive Circuits, PA Rizzi , Pearson Education.
2. Microwaves, K C Gupta, New Age Publishers.
3. Foundation of Microwave Engineering, 2ed edition, Robert E Collin, McGraw Hill,Inc.
4. Microwave Devices & Circuit Design, GP Srivastava & VL Gupta, PHI
5. Advanced RF & Microwave Circuit Design: The Ultimate Guide to Superior Design, M. Radmanesh, Authorhouse

Course Name: Microwave Engineering Laboratory					
Course Code: ECEN3153					
Contact Hours per week	**L**	**T**	**P**	**Total**	**Credit Points**
	0	**0**	**2**	**2**	**1**

Course Outcome:

After completing the following experiments, students will be able to:

1. Understand electromagnetic wave propagation at high frequency.

2. Identify the difference between active and passive microwave devices

3. Analyze and Characterize Microwave Devices.

4. Design measurement setup to perform analysis of microwave devices.

LIST OF EXPERIMENTS:

1. Determination of phase and group velocities in a waveguide carrying TE_{10} Wave from Dispersion diagram [ω-β 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 Reflex Klystron oscillator using X-band waveguide test bench.

4. Study of Gunn Diode Characteristics using X-band waveguide test bench.

5. Characterization of waveguide tee (magic tee / E-plane tee / H-plane tee) using waveguide test bench at X-band.

6. Analysis of directional coupler using X-band waveguide test bench set up.

7. Analysis of waveguide type filter using X-band waveguide test bench set up.

Course Name: Microprocessors and Microcontrollers					
Course Code: ECEN3104					
Contact Hours per week	**L**	**T**	**P**	**Total**	**Credit Points**
	3	**0**	**0**	**3**	**3**

Course Outcomes

1. Demonstrate the knowledge of Digital Electronics with learning of the microprocessor and microcontroller.
2. Develop the concepts of CPU, timing and control signals I/O devices, and various BUS structure.
3. Learn about interrupts, stack and subroutine and write ALPs for given problems with flowcharts.
4. Conceptualize the architecture of 8086 family & ARM basics along with its parallel application.
5. Understand interfacing of processor with memory and I/O devices and analyze their problems.
6. Analyze microcontroller 8051 architecture in terms of Ports, Memory, Counters and Timers.

Module I: Introduction [8L]

MPU, I/O devices, Memory, Timing and Control Signals, Bussed Architecture, Tristate logic, Latch, Address Bus, Data Bus and Control Bus. Intel 8085 Microprocessor Architecture – Signals – Addressing modes – Instruction classification Instruction set.

Module II: Microprocessors [14L]

8085 [6L]—Timing diagram – Memory Mapped and Peripheral I/O – ALP format – Programming 8085 – 8-bit and 16-bit Operation including stack-subroutine – Interrupt structure of 8085 microprocessor, Processing of vectored and Non-vectored interrupts, Latency time and Response time; Handling multiple interrupts.

8086 [8L] 16 & 32 bit family of microprocessors (8086 & ARM) - 8086 Architecture – 8086 Signals-Segmented Memory – EU and BIU -Instruction Set-Addressing Modes – Minimum and Maximum Modes of Operation- Even and Odd Memory Bank- Basics of Assembly Language Programming. ARM Architecture – Register Organization – Processor Modes – Instruction Set.

Module III: I/O Interfacing [8L]

Memory interfacing and I/O interfacing with 8085– PPI **8255** – Programmable keyboard display – Interface 8279 – Programmable interrupt controller **8259** –Programmable DMA controller 8257 – Programmable interval timer **8253/4**. ADC & DAC Interfacing.

Module IV: Microcontroller & Systems 8051 [6L]

Architecture of 8051 Microcontroller – Signals – I/O ports – Memory – Counters and Timers – Serial Data I/O – Interrupts. Interfacing - Keyboard, LCD, Stepper Motor Control.

Text books

1. Microprocessor Architecture, Programming & Application with 8085-R. Gaonkar (Penram International).
2. Ray &Bhurchandi, Advanced Microprocessors & Peripherals, McGrawhill Education.
3. The 8051 Microcontroller and Embedded systems - Mazidi, Mazidi and McKinley (Pearson).
4. Microprocessor and Programmed Logic by Kenneth L Short.2nd Edition, Pearson.
5. Microprocessor 8086: Architecture Programming and Interfacing by S. Mathur
6. Computer Organization and Design ARM Edition: by David A. Patterson, John L. Hennessy

Reference books

1. Microprocessors and microcontrollers -N. Senthil Kumar, M. Saravanan and Jeevananthan, Oxford University Press
2. An Introduction to Microprocessor and Applications –Krishna Kant (Macmillan).
3. Fundamentals of Microprocessor and Microcontrollers by B. Ram. DhanpatRai Publications
4. Microprocessors and Microcontrollers by A. NagoorkaniMcGrawhill Education.
5. INTEL MCS 51 MICROCONTROLLER FAMILY USER'S MANUAL (free download)
6. The 8086 Family User's Manual from Intel (free download)
7. INTEL MCS® -80/85 FAMILY USER'S MANUAL (free down load)
8. INTEL Data Sheet For 8255 (free down load)
9. INTEL Data Sheet For 8279 (free down load)
10. INTEL Data Sheet For 8259 (free down load)
11. INTEL Data Sheet For 8257 (free down load)
12. INTEL Data Sheet For 8253 (free down load)

Course Name : Microprocessors and Microcontrollers Laboratory					
Course Code : ECEN 3154					
Contact Hours per week	**L**	**T**	**P**	**Total**	**Credit Points**
	0	**0**	**2**	**2**	**1**

Course Outcomes

1. Students should solve basic binary math operations using the computer.
2. Students should demonstrate programming proficiency using the various addressing modes and data transfer instructions of the target Microprocessors (8085, 8086) and Microcontroller (8051).
3. Students should program using the capabilities of the stack, the program counter, and the status register and show how these are used to execute a machine code program.
4. Students should apply knowledge of the processor's internal registers, instructions and operations to design a total system with input and output and design program for the processor I/O ports in order to interface the processor to external devices.

Experiments list with Microprocessor 8085

1. Addition of two 8 bit numbers
2. Subtraction using 8 bit numbers
3. Find largest number of array
4. Find smallest number of an array of numbers
5. Sort array in ascending order
6. Sort array in descending order
7. Multiplication with two 8 bit numbers
8. Division with 8 bit numbers
9. BCD to HEX conversion
10. HEX to BCD conversion

Experiments list with Microcontroller 8051

1. Addition of two 8 bit numbers
2. Find BCD sum
3. Nibble swap in ACC method1
4. Nibble swap in ACC method2
5. Multiplication and Division by two
6. Blinking LEDs with Timer Using 8051 in hardware

Experiments list with Microprocessor 8086

1. Data transfer using different addressing modes
2. Data move from source to destination using indirect addressing mode *(Block Move without overlap)*
3. Sixteen-Bit Data Addition and Subtraction
4. BCD Addition and Subtraction
5. Sixteen-Bit Multiplication and Division
6. Logical Operations on Sixteen Bit Data with 8086 Instructions

Course Name : Information Theory and Coding					
Course Code : ECEN 3105					
Contact Hours per week	L	T	P	Total	Credit Points
	3	0	0	3	3

Course Outcome:

After completing the course the students will be able to:

1. Distinguish between different types of source codes.
2. Figure out equations for entropy, mutual information and channel capacity for all types of channels, utilizing their knowledge on the elements.
3. Explain and estimate the merit of various methods for generating and detecting different types of error correcting codes.
4. Formulate the basic equations of linear block codes, cyclic codes.
5. Outline the basics of convolution code, linear algebra and BCH code.
6. Develop overall understanding about different types of codes applied to both source and channel end during data transmission.

Module-1: Information theory, Source coding and channels [10L]

Information theory : Uncertainty and information, measure of information, Self and conditional Information, mutual information and entropy, Fixed length code, Variable length code, Prefix code, Instantaneous code, Kraft Inequality,

Source Code: Source coding theorem, Huffman codes, Shanon- Fano coding, Arithmetic code, Lempel-Ziv algorithm.

Channels: Discrete memory less channel, Channel matrix for different channel models- Lossless channel, Deterministic channel, Noise-less channel, Deterministic channel capacity, channel coding, information capacity theorem, The Shannon limit.

Module-2: Error Control cods: Linear Block Codes [7L]

Block code: Hamming codes Minimum distance, Error detecting and Error-correcting capabilities of block code.

Linear Block Code: Definition & properties of linear block codes, Matrix description of linear block codes, Encoding of linear block code, parity check matrix, decoding of a linear block code, Syndrome and Error detection, Standard Array , equivalent codes, perfect codes.

Module-3: Cyclic and BCH code [10L]

Cyclic Code: Definition & properties of cyclic codes, Code Polynomials, Generator Polynomials, Division algorithm for polynomials, a method for generating cyclic codes, matrix description of cyclic codes, Decoding of cyclic codes. Golay codes, LFSR.

Galois Field: Introduction to Linear Algebra, Introduction to Galois Field, Primitive elements ,generator polynomials in terms of minimal polynomials, Calculation of minimal polynomial.

BCH Code: Elementary concept of BCH Codes, Encoding and Decoding, Elementary concept of Reed Solomon Code.

Module-4: Convolution Codes: [9 L]

Encoding convolution code: Polynomial description of convolution codes, Distance notions for convolution codes and the generating function.

Decoding of convolution codes: Viterbi decoder, distance and performance bounds for convolution codes.

Example of convolution code - Turbo codes, Turbo decoding.

Graphical representation of convolution code: State diagram, Tree, Trellis diagram.

Books:

1. Information theory, coding and cryptography - Ranjan Bose; TMH.

2. Introduction to Error Control Codes – S Gravano; Oxford Press

3. Information and Coding - N Abramson; McGraw Hill.

4. Introduction to Information Theory - M Mansurpur; McGraw Hill.

5. Information Theory - R B Ash; Prentice Hall. 8. Error Control Coding - Shu Lin and D J

Costello Jr; Prentice Hall.

Course Name: Telecommunication Systems					
Course Code : ECEN 3131					
Contact Hours per week	**L**	**T**	**P**	**Total**	**Credit Points**
	3	**0**	**0**	**3**	**3**

Course Outcomes:

After completing the course the student will be able to:

1. Apply the previous knowledge of analog communication to appreciate the contents of this paper.
2. Understand basics of Telecommunications and its entities along with the evolution of different types of exchanges.
3. Identify concepts of Telecommunication like signaling techniques, setting up linksetc effectively.
4. Describe working principles and practical applications of FAX, EPABX, EFT, Email, ISDN etc effectively.
5. List salient features of EWSD, NGN, ADSL etc.
6. Evaluate performance of a telecom network using the concepts of Traffic Engineering and case studies based on the observation.

Module I: (8L)

Introduction to Telecommunication &Switching Systems

Evolution of Telecommunication: Brief description of Rotary Dial and Push Button telephone, Strowger and crossbar switch.Circuit Switching and Packet Switching, Digital Switching Systems- Time Division Time Switch, Time Multiplexed Space Switch, Time Multiplexed Time Switch, Hybrid Switching.

Module II: (10L)

Telecommunication Transmission Lines and Subscriber Loop Systems

Introduction to Global Telecom Link through Satellite Networks &Satellite based data networks, LAN, Metropolitan Area network, Fiber optic networks and submarine cable landing stations.

Subscriber Loop, Hybrid Circuit for 2-wire to 4-wire conversion and vice versa. PCM Carriers, American and European standards of carrier channels.Introduction to Higher Order Multiplexing, SDH, DWDM and optical transport networks.BORSCHT Functions, Switching Hierarchy and Routing, Signaling Techniques- In channel and Common Channel Signaling, Signaling System 7 (SS7).

Module III: (10L)

Stored Program Control

Electronic Exchanges, Introduction to Cordless Telephones. Introduction to Modems, Electronics Fund Transfer, Videotex, email.

Transmission Channel: Broadband Transmission- ISDN, DSL, ADSL, ISDN, B-ISDN, Introduction to VoIP Telephony. Data terminal equipment (DTE) & Data communication equipment (DCE).

Introduction to New generation of Electronic Exchanges- EWSD (Electronic Worldwide Switch Digital),5ESS system architecture, NGN (Next-Generation Network)

Module IV: (8L)

Traffic Engineering

Network Traffic load and parameters, Grade of service and blocking probability, Incoming Traffic and Service Time Characterization, Blocking Models and Loss Estimates, Delay systems, Birth-death process, Erlang-B congestion formula &Erlang-C formula.

Text Books:

a) T. Viswanathan "Telecommunication Switching System and Networks", PHI

b) J.C Bellamy "Digital Telephony" – Wiley India

Reference Books:

a) O Hersent, D Gurle, J P Petit " IP Telephony" Pearson

b) J. E Flood "Telecommunication Switching, Traffic and Networks" Pearson

c) R L Freeman "Telecommunication System Engineering" Wiley-India

d) A Gokhale" Introduction to Telecommunication" – Cengage Learning

Course Name : Computer Networks					
Course Code : ECEN3132					
Contact Hours per week	L	T	P	Total	Credit Points
	3	0	0	3	3

Course outcomes:

After completing the course the student will be able to:

1. Understanding of the fundamental concepts of computer networking.

2. Apply the basic taxonomy and terminology of the computer networking area.

3. Identify the different types of network devices and their functions within a network.

4. Understand internetworking principles, routing principles and algorithms such as IP, IPv6, distance vector, and link state.

5. Conclude advanced networking concepts and advanced courses in computer networking.

6. Gain expertise in some specific areas of networking such as the design and maintenance of individual networks.

Module I [5L]:

Overview of Data Communication and Networking: Introduction; Data communications: components, data representation (ASCII, ISO etc.), direction of data flow (simplex, half duplex, full duplex); network criteria, 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 II [10L]:

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, Reservation, Polling, Multiple access protocols: Pure ALOHA, Slotted ALOHA, CSMA, CSMA/CD, CSMA/CA; Traditional Ethernet, fast Ethernet (in brief).

Module III [10L]:

Internetworking & devices: Repeaters, Hubs, Bridges, Switches, Router, Gateway; Addressing: IP addressing, subnetting; Routing techniques: static vs. dynamic routing; Unicast Routing Protocols: RIP, OSPF, BGP; Other Protocols: ARP, IP, ICMP, IPV6; Transport layer: Process to Process delivery; UDP; TCP; Congestion Control: Open Loop, Closed Loop choke packets; Quality of service: techniques to improve QoS, Leaky bucket algorithm, Token bucket algorithm,

Module IV [8L]:

Introduction to DNS, SMTP, SNMP, FTP, HTTP & WWW; Security: Cryptography (Public, Private Key based), Digital Signature, Firewalls; ISDN services & ATM, DSL technology, Cable Modem: Architecture & Operation in brief; Wireless LAN: IEEE 802.11, Introduction to blue-tooth.

Books:

1. B. A. Forouzan – "Data Communications and Networking (5th 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

Course Name :Speech And Audio Processing					
Course Code : ECEN3133					
Contact Hours per week	L	T	P	Total	Credit Points
	3	0	0	3	3

Course Outcomes:

After finishing this course the students will be able to

1. Apply their DSP course knowledge to a great extent.

2. Understand speech sounds, different digital models and synthesis filters.

3. Apply predictive techniques for efficient coding and decoding.

4. Estimate time warping, distance measures while recognizing speech, words.

5. Analyze filter bank design for optimum results.

6. Design complicated filters and compare & choose best models for speech processing.

Module I [7L]:

Digital speech processing and its applications, production and classification of speech sounds, lossless tube models, digital models for speech signals; Analysis and synthesis of pole-zero speech models, Levinson recursion, lattice synthesis filter.

Module II [10L]:

Time dependent processing of speech, pitch period estimation, frequency domain pitch estimation; Discrete-time short-time Fourier transform and its application, phase vocoder, channel vocoder. Homomorphic speech processing, waveform coders, hybrid coders and vector quantization of speech; Model based coding: Linear predictive, RELP, MELP, CELP; Speech synthesis.

Module III [10L]:

Principles of speech recognition, spectral distance measures, dynamic time warping, word recognition using phoneme units, hidden Markov models and word recognition, speech recognition systems,speaker recognition. Ear physiology, psychoacoustics, perception model and auditory system as filter bank; Filter bank design and modified discrete cosine transform algorithm for audio compression in MP3 and AAC coders; Standards for high-fidelity audio coding.

Module IV [9L]:

Filter bank design and modified discrete cosine transform algorithm for audio compression in MP3 and AAC coders; Standards for high-fidelity audio coding. Tree-structured filter banks, multi-complementary filter banks; Properties of wavelets and scaling functions, wavelet transform; Filter banks and wavelets, applications of wavelet signal processing in audio and speech coding.

Books:

1. Rabiner, L.R. and Schafer, R.W., "Digital Processing of Speech Signals", Pearson Education ,2006
2. Quatieri, T.F., "Discrete-Time Speech Signal Processing:Principles and Practice", Pearson Education. 2002
3. Furui, S., "Digital Speech Processing, Synthesis and Recognition", 2nd Ed., CRC Press. 2000
4. Spanias, A., Painter, T. and Venkatraman, A., "Audio Signal Processing and Coding", John Wiley & Sons. 2007
5 Gold, B. and Morgan, N., "Speech and Audio Signal Processing", John Wiley & Sons. 2002

3RD YEAR 2ND SEMESTER

Course Name: Digital VLSI Design					
Course Code : ECEN3201					
Contact Hours per week	L	T	P	Total	Credit Points
	3	0	0	3	3

Course outcomes:

1. Students will be able to relate to different MOS structures and functions in order to apply the knowledge in building CMOS circuits

2. Students will learn VLSI Design Cycle, Style and Methodology.

3. Students will be able to determine logic and performance of CMOS combinational and Sequential Circuit including Memory Array Design.

4. Students will be able to construct Physical Layout Design and Stick Diagram of Digital Gates.

5. Students will be able to make use of various synthesis flow and HDL modeling in ASIC Semi Custom Design.

6. Students will be able to interpret Si Testing and Debug related algorithms and Fault Modeling.

Module I: VLSI Design Flow and CMOS Combinational Circuits: [14L]

Unit1: Evolution of Microelectronics: Moore's Law, Process Node Definition, Evolution of Process Technology, Scale of Integration (SSI, MSI, LSI, VLSI, ULSI, GSI), VLSI Design Trend and Challenges.

Unit2: VLSI Design Cycle, Y-Chart, Design Styles: Full Custom Design, Std Cell based Semi Custom Design, Gate Array Design, PLD, FPGA: CLB, LUT, MUX.

Unit 3 : MOS as Digital Switch: Principle of operation and Characteristics of Enhancement-mode MOS transistor, MOS as Capacitor, NMOS vs PMOS, CMOS Combinational Circuit: NMOS inverter issues, CMOS Inverter Transient Analysis, DC Characteristics and Noise Margin, Dynamic Power Dissipation issues. Static CMOS Logic Gate Design, Pass Transistor Logic and Transmission Gate (TG) Design, Logical effort, pseudo-nMOS Gates, Dynamic and Domino logic.

Module II: CMOS Sequential Circuits and Physical Design [10L]

Unit 1 : Bi-stability principle, SR Latch circuit and Clocked SR Latch using CMOS. CMOS and Transmission Gate (TG) based D-latch & Edge triggered Master Slave flip-flop, Setup and Hold Definition, basic idea of 1-Transistor DRAM Operation. SRAM Array Design: 6-Transistor Bit-cell Design, Write Circuit, Sense Amplifier and Read Circuit, Pre-Charge Circuit, Decoder and I/O Design.

Unit 2 : CMOS Cross Section, Layout and Mask layers, Inverter Layout, Lambda Rule vs Micron Rule, Std Cell Layout Topology, Stick Diagram, Euler Path Algorithm .

Module III: Synthesis and HDL [8L]

Unit 1 : Synthesis – High level Synthesis, Logic level Synthesis, Physical Automation: Brief ideas on Partitioning, Floor-planning, Placement, Routing and Compaction.

Unit 2 : HDL: Front-end Design Flow using HDL (Behavioral, RTL and Gate Level), Verilog Coding, Verilog Modeling: Behavioral, Data-Flow, Structural and Mixed, Test Bench coding, FSM Example: Mealy Machine and Moore Machine.

Module IV:Test Methodology of VLSI Circuits: [7L]

Unit 1 : Si Testing: Why Testing, Challenge of Si-Testing, Manufacturing Defects, Die (Inter and Intra) Variation, Yield, DPM, Logical Fault Modelling: Stuck at Faults (D-Algorithm), Bridging Fault, Transistor Stuck open/Stuck Short, ATPG, DFT, Scan Design, BIST.

Unit 2 : Reliability of MOS Devices: Transistor Aging: NBTI (Negative Bias Temperature Instability), PBTI (Positive Bias Temperature Instability), HCI (Hot Career Injection), Reliability issue in Wire: Electromigration and Self Heating in Interconnect.

Text Books:

1. Principles of CMOS VLSI Design, A Systems Perspective, Author: Neil Weste, Kamran Eshraghian, Addison Wesley, 2nd Edition, 2000 .
2. CMOS VLSI Design, A Circuits and Systems Perspective (3rd Edition) Author: Neil Weste, David Harris, Ayan Banerjee. Pearson, 2011. Fundamental of VLSI Devices – Y. Taur& T.H. Ning- Cambridge University Press.

Reference Books:

3. CMOS Digital Integrated Circuits, Analysis and Design, Author: Sung-Mo Kang, Yusuf Leblebici, Tata McGraw Hill (3rd Edition), 2006 .
4. Digital Integrated Circuit, Design Perspective, Author: .M. Rabaey, Prentice-Hall
5. VLSI Design and EDA TOOLS, Author: Angsuman Sarkar, Swapnadip De, Chandan Kumar Sarkar, SCITECH PUBLICATIONS (India) Pvt. Ltd., 2011.

Course Name: Digital VLSI Design Laboratory					
Course Code : ECEN3251					
Contact Hours per week	L	T	P	Total	Credit Points
	0	0	2	2	1

Course Outcomes:

After completing the following experiments, students will be able to:

1. Learn Industry Standard Backend and Frontend CAD Tools
2. Design CMOS Combinational Digital Gates
3. Design TG Sequential Digital Gates
4. Learn Industry Standard Verilog HDL Design, simulation and Synthesis.

List of Experiments:

3 Category of Experiments:

1. **Backend:** Sub Micron and Deep Sub Micron Technology based Experiments:
   Backend Design flow using **Industry Standard Mentor Graphics**CAD Tool including **Eldo** Circuit Simulator (SPICE Analysis):
   a. Transient analysis of CMOS Inverter Circuit
   b. DC & Parametric analysis of CMOS Inverter
   c. Design and Analysis of Various CMOS Logic Gates (NAND, NOR, other CMOS gates)
   d. Design and Analysis of Various TG (Transmission Gate) based Logic Gates (XOR, XNOR)
   e. Implementation of TG based Various Sequential Gates (D-Latch, D-Flip-Flop) and Setup/Hold Analysis.

2. **Frontend:** Introduction to **XILINX-Vivado** Simulator: Verilog Coding and Test Bench Simulation
   a. Logic Design and Verification of Digital Gates: Mux, Encoder, Decoder
   b. Logic Design and Verification of a 4bit Ripple-Carry Adder
   c. Logic Design and Verification of Sequential Gates: D-Latch, D-Flip-Flop
   d. Logic Design and Verification of a Finite State Machine

3. **Synthesis and P & R:FPGA** Flow using XILINX Hardware Kits: Implementing and verifying many of above experiments in FPGA hardware Kits.

Course Name: Object Oriented Programming Concept By Using C++					
Course Code : CSEN3208					
Contact Hours per week	**L**	**T**	**P**	**Total**	**Credit Points**
	3	**0**	**0**	**3**	**3**

Course Outcomes:

Students who complete the course will demonstrate the ability to do the following:

1. Learn object oriented concepts and various syntax and semantics using C++ and merits of object oriented approach over procedural approach.
2. Understand various properties of OOP for appropriate use in problem solving.
3. Analyze the real life problem to identify the related objects and abstract them to classes
4. Apply various object oriented properties and reusable components in solution building.
5. Evaluate for using standard patterns and for improving performance of solution using exception handling.
6. Develop the object oriented application using++.

Module-I:

- **Overview of ObjectOrientedConcepts [2L]**
  - Difference between OOP and other conventional programming – advantages and disadvantages
  - Class, object, message passing, inheritance, encapsulation, polymorphism
- Basic Programming withC++ [8L]
  - Data Types, Operators
  - Control Statements and Loops
  - Functions and Parameters
  - Arrays, Pointers and References
  - String Manipulation
  - Fundamentals of Class and Object
  - Constructor and Destructor

Module-II:

- **ClassesandObjects [10L]**
  - Abstraction, Encapsulation, Access Specifier
  - Static Member and Friend Function
  - Function Overloading
  - Operator Overloading

Module-III:

- **Overloading and Inheritance [8L]**
  - Inheritance
  - Derived Class
- Polymorphism and Overriding [4L]
  - Abstract Class
  - Runtime Polymorphism

- Virtual Base Class
- Overriding

Module-IV:

- **Exception Handling** **[2L]**
- **Namespace** **[2L]**
- **Templates** **[4L]**
  - Class Template
  - Function Template

Textbooks / References:

1. Bjarne Stroustrup – "The C++ Programming Language" –Pearson
2. Robert Lafore – "Object-oriented Programming in C++" – SAMSPublishing
3. E Balagurusamy – "Object Oriented Programming with C++" – 6th Edition – McGraw Hill
4. Steve Oualline – "Practical C++ Programming" –O'Reilly
5. James Rambaugh & Michael Blaha – "Object Oriented Modeling and Design" – Prentice Hall,India

Course Name: Object Oriented Programming Concept by using C++ Laboratory					
Course Code : CSEN3258					
Contact Hours per week	L	T	P	Total	Credit Points
	0	0	2	2	1

Course Outcomes:

Students who complete the course will be able to

1. Perform object oriented programming to develop solutions to problems demonstrating usage of control structures, modularity, I/O. and other standard language constructs.

2. Demonstrate proficiency of object oriented programming in developing solutions to problems demonstrating usage of data abstraction, encapsulation, and inheritance.

3. Demonstrate ability to implement one or more patterns involving realization of an abstract interface and utilization of polymorphism in the solution of problems which can take advantage of dynamic dispatching.

4. Learn other features of the C++ language including use of templates, and handling exceptions.

Following topics are to be covered in the lab:

1. Basic Programming
2. Class
3. Constructor
4. Function Overloading
5. Operator Overloading
6. Inheritance
7. Polymorphism
8. Function Overriding
9. Exception Handling
10. Templates

Course Name: Economics for Engineers					
Course Code : HMTS3201					
Contact Hours per week	**L**	**T**	**P**	**Total**	**Credit Points**
	3	**0**	**0**	**3**	**3**

Course Outcome:

The student will be able to-

1. Evaluate a project and estimate the total cost of the project
2. Apply financial analytical methodologies to prepare a report regarding the financial performance of an organization
3. Participate actively in an organization's capital budgeting process
4. Provide vital inputs regarding the pricing of a product
5. Apply the knowledge of the interplay of various economic variables and indicators in workplace
6. Provide insight about different accounting concepts and apply broader concepts like costs, revenues, assets, liabilities, capital, profit, investment and interest

Module 1: (6L)

Market: Meaning of Market, Types of Market, Perfect Competition, Monopoly, Monopolistic and Oligopoly market. The basic concept of economics – needs, wants, utility.

National Income-GDP, GNP. Demand & Supply, Law of demand, Role of demand and supply in price determination, Price Elasticity. Inflation: meaning, reasons, etc.

Module 2: (4L)

Business: Types of business, Proprietorship, Partnership, Joint-stock company, and cooperative society – their characteristics.

Banking: role of commercial banks; credit and its importance in industrial functioning. Role of central bank: Reserve Bank of India. International Business or Trade Environment.

Module 3: (14 L)

Financial Accounting-Journals. Ledgers, Trial Balance, Profit & Loss Account, Balance Sheet.

Financial Statement Analysis (Ratio and Cash Flow analysis).

Cost Accounting- Terminology, Fixed, Variable and Semi-variable costs.

Break Even Analysis. Cost Sheet. Budgeting and Variance Analysis.

Marginal Cost based decisions.

Module 4: (12 L)

Time Value of Money: Present and Future Value, Annuity, Perpetuity. Equity and Debt, Cost of Capital.

Capital Budgeting: Methods of project appraisal - average rate of return - paybackperiod - discounted cash flow method: net present value, benefit cost ratio, internal rate of return. Depreciation and its types, Replacement Analysis, Sensitivity Analysis.

Suggested Readings:

1. R. Narayanswami, Financial Accounting- A Managerial Perspective. Prentice-Hall of India Private Limited. New Delhi

2. Horne, James C Van, Fundamentals of Financial Management. Prentice-Hall of India Private Limited, New Delhi

3. H. L. Ahuja., Modern Economic Theory. S. Chand. New Delhi.

4. Newman, Donald G., Eschenbach, Ted G., and Lavelle, Jerome P. Engineering Economic Analysis. New York: Oxford University Press. 2012.

Course Name : Digital Image Processing & Pattern Recognition					
Course Code : ECEN 3231					
Contact Hours per week	L	T	P	Total	Credit Points
	3	0	0	3	3

Course outcomes:

After completing the course the student will be able to:

1. Gain a working knowledge about the mathematical tools needed for Image Processing and Pattern Recognition.
2. Understand the need for different types of digital image transforms their properties and application.
3. Evaluates the technique for morphological operations and image compression.
4. Gain knowledge about the fundamentals of Pattern Recognition like recognition, decision making and statistical learning problems.
5. Identify parametric and non-parametric techniques, supervised and unsupervised learning of pattern recognition.
6. Design systems and algorithms for Image Processing and Pattern Recognition.

Digital Image Processing

Module 1 [12L]

Digital Image Acquisition: Sampling and quantization; spatial, grey level and temporal resolution.
Spatial domain Processing: Pixel point processing: linear and piecewise linear transformations, log and power law transformations, Image Histogram and histogram equalization,
Pixel Group Processing: Convolution in spatial domain, low frequency and high frequency filtering, mean and median filters.
Frequency Domain Processing: Relation with spatial domain convolution, standard low pass and high pass spatial domain filters.

Module 2 [8L]

Morphological operations: Dilation, Erosion, Opening and Closing, Boundary extraction, Region filling.
Colour Image Processing: RGB and HIS colour models and interrelation,
Image Compression Standards: Lossy and lossless compressions, BMP, TIFF & JPG image formats.

Module 3 [10L]

Introduction to the Pattern Recognition System: Components of Pattern Recognition System, Learning and adaptation, Supervised Learning (Classification) and Unsupervised Learning (Clustering), Bayesian Decision Theory: classifiers, discriminant functions, decision surfaces, Discriminant functions

for Normal density, Error bounds for Normal density, Maximum Likelihood and Bayesian Parameter Estimation, Principal Component Analysis, Fisher Linear Discriminant, Hidden Markov Models.

Module 4 [10L]

Non-parametric Techniques &Feature Extraction: Parzen window estimation, k-nearest neighbour classification, Perceptron classifier, Support Vector Machines, Decision Tree based classifiers. Feature extraction – discrete cosine and sine transform, Principal Component analysis, Kernel Principal Component Analysis.

Text Books:

1. R.C. Gonzalez and R.E. Woods, Digital Image Processing, Pearson.
2. R.O.Duda, P.E.Hart and D.G.Stork, Pattern Classification, John Wiley.
3. S.Theodoridis and K.Koutroumbas, Pattern Recognition, 4th Ed., Academic Press.
4. C. M. Bishop, "Pattern Recognition and Machine Learning", Springer.

References:

1. C. Solomon, T. Breckon ,Fundamentals of Digital Image Processing: A Practical Approach with Examples ,Wiley
2. K. Fukunaga, "Statistical pattern Recognition", Academic Press.

Course Name : IoT for Communication					
Course Code : ECEN 3232					
Contact Hours per week	L	T	P	Total	Credit Points
	3	0	0	3	3

Course Outcomes:

1. The students will know about IoT and the concept behind.

2. Students will be able to explain about the importance of radio transmission for IoT applications and different standards to match varying requirements, M2M area network , Physical Layers, IEEE 802.15.4 family of protocols.

3. They will be able to explain M2M protocols for Sensor networks and be able to apply knowledge for building and home automation.

4. The students will know about ZigBee and ZigBee smart energy protocols.

5. The students will know about next generation IP-based protocols like 6LoWPAN and RPL.

6. They should be able to analyze communication systems with ideas from Smart Grid and Electric Vehicle Charging projects.

Module – I [6 L]

IoT- the concept and technology, M2M – the idea and the tools required. Reliable, interference free radio communication- the challenges and present scenario.

Module – II [12 L]

M2M- area network physical layers, IEEE802.15.4 – physical layer, Medium Access Control (MAC) layer, uses.Poweline communication for M2M applications. Legacy protocols for Sensor Networks, Building and Home automation.

Module – III [9 L]

ZigBee- standard ,ZigBee and 802.15.4, Network Layer, Security, Applications, Z-wave concept, Protocols for M2M metering using wireless M-BUS

Module – IV [9 L]

Next generation IP based protocols – 6LoWPAN and RPL, typical applications of wireless M2M applications- Smart Grid, Electric Vehicle Charging.

Text Books:

1. Internet of Things from Hype to Reality – The road to digitization:
   Ammar Rayes and Samer Salam, Springer
2. Internet Of Things: Converging Technologies For Smart Environment And Integrated Ecosystems - Vermesan, Ovidiu, Fries, Peter - River Publishers, 2013

3. Python Programming For Teens - Lambart, Kenneth A. CENGAGE Learning, 2014

Reference Books:

1. Understanding Smart Sensors - Frank, Randy, Artech House,2013
2. Learning Internet Of Things - Peter Wahar- Publisher PACKT - Amazon.In
3. Internet Of Things Applications: From Research And Innovation To Market Deployment - Vermesan, Ovidiu, Fries, Peter- River Publishers, 2014

Course Name : Power Electronics					
Course Code : ECEN 3233					
Contact Hours per week	L	T	P	Total	Credit Points
	3	0	0	3	3

Course Outcomes:

1. The students will understand the importance of this course.
2. They will learn the details of power semiconductor devices (Construction, Characteristics and operation).
3. The students will understand the working of various types of rectifiers.
4. They will be able to analyze the choppers and converters and their operations.
5. They will be familiar with inverters and will recognize the role of power electronics in emerging areas.
6. The students will be able to design an efficient power supply for a given application.

Module I: [**10L]**

Power semiconductor devices: Power diodes- general purpose diode, fast recovery diodes, Schottky diode, PNPN devices, Thyristor, DIAC, TRIAC, G.T.O. devices. Power
Transistors, Power MOSFET, Rating of power devices, Losses and Cooling. Triggering circuits for SCR, SCR commutation circuits, UJT, Schmitt trigger circuits – Power MOS gate drive circuits.

Module II: [**9L]**

Uncontrolled and controlled Rectifiers: Single phase and poly phase half wave and full wave rectifiers with resistive load and RL load, freewheeling diode, Transformer ratings. Single phase & three phase Converter operation: Power factor and its improvement, regulation, Pulse converters, power factor control via PWM converters.

Module III: [**8L]**

D.C. Choppers: Principles, classification, use. Buck, Boost, Buck-Boost and Cuk Converters, Concept of resonant switching, Cycloconverter single and three phase circuits, blocked group operation, circulating current mode.

Module IV: [9L]

Single phase and three phase inverters, constant voltage source and constant current source inverters, HF inverters for heating. Application: D.C. and A.C. drives, S.M.P.S., Resonant converters, A.C. Line Filters, interference suppression. Speed control of AC/DC motors.

Books:

1. M.H.Rashid, 'Power Electronics: Circuits, Devices and Applications', Pearson Education, PHI Third Edition, New Delhi, 2004.
2. P.S.Bimbra "Power Electronics" Khanna Publishers, third Edition, 2003.
3. L. Umanand, " Power Electronics Essentials and Applications", Wiley, 2010.
4. P.C Sen, Power Electronics, TMH

Course Name : Network Security					
Course Code : ECEN 3234					
Contact Hours per week	L	T	P	Total	Credit Points
	3	0	0	3	3

Course outcomes:

After completing the course the student will be able to:

1. Understand various tools and protocols for different levels of security.
2. Compare various Cryptographic Techniques.
3. Describe the principles of public-key cryptosystems, hash functions, and digital signature.
4. Add secure coding in the developed applications.
5. Have enough knowledge about various Intrusion algorithm.
6. Design secure systems and applications.

Module 1 [10L]

Services, Mechanisms and attacks-the OSI security architecture-Network security model-Classical Encryption techniques-Symmetric Cipher Model, Substitution Techniques, Transposition Techniques, Simplified Data encryption standard (DES), DES, The strength of DES, Differential and Linear Cryptanalysis, Block Cipher Design Principles and Modes of Operation, Evaluation Criteria for Advanced Encryption Standard, The AES Cipher.

Module 2 [10L]

Principles of Public-Key Cryptosystems, The RSA algorithm, Key Management, Diffie-Hellman Key Exchange, Elliptic Curve Arithmetic, Authentication functions, Hash Functions. Digital signatures, Authentication Protocols, Digital Signature Standard.

Module 3 [6L]

Web Security Consideration, Security socket layer (SSL) and Transport layer security, Secure Electronic Transaction. Intruders, Intrusion Detection, Password Management.

Module 4 [6L]

Viruses and Related Threats, Virus Countermeasures. Firewalls Design Principles, Trusted Systems.

Text Books:

1. William Stallings, "Cryptography and Network Security", 6th Edition, Pearson Education,
2. Charlie Kaufman, Radia Perlman and Mike Speciner, "Network Security, Private communication in a public world", 2nd Edition, Prentice Hall of India.
3. Douglas R. Simson, "Cryptography - Theory and Practice", CRC Press.

References:

4. Behrouz A. Ferouzan, "Cryptography & Network Security", Tata McGraw Hill.
5. Bruce Schneier, Niels Ferguson, "Practical Cryptography", Wiley Dreamtech India Pvt Ltd.
6. Charles Pfleeger, "Security in Computing", 4th Edition, Prentice Hall of India.

Course Name : Advanced Digital Communication					
Course Code : ECEN 3235					
Contact Hours per week	**L**	**T**	**P**	**Total**	**Credit Points**
	3	**0**	**0**	**3**	**3**

Course Outcomes:

1. Students will learn about the transmission techniques, synchronization in digital communication.
2. They will compare the multiple access schemes, OFDMA etc.
3. The students will acquire knowledge about the CDMA in details. Technologies like SIMO and MIMO.
4. The students will have clear idea about estimation and detection schemes. They will be able to design reliable channel coding system.
5. They will understand the differences between coding schemes – both source and channel types.
6. The students will be able to analyse the quality obtained in a digital link.

Module I [9L]

Review of random variables and random processes

Review of baseband digital signal transmission –PCM DM ADM ADPCM. Inter Symbol Interference (ISI)

Review of digital modulation schemes – BPSK DPSK QPSK M-ary PSK etc., idea of signalspace, bandwidth efficiency.Nyquist criteria for no ISI in band limited channel

Module II [6L]

GMSK Orthogonal frequency division multiplexing (OFDM) – principles of generation and detection, OFDMA

Equalizer: Linear equalization, Decision feedback equalizer, iterative equalizer and decoding

Multiplexing and multiple access: TDM/TDMA FDM/FDMA Space DMA ALOHA – slotted ALOHA and reservation ALOHA

Module III [12L]

Spread spectrum modulation: Principle of DSS, processing gain, jamming margin, single tone interference, probability of error, Principle of frequency hopping spread spectrum (FHSS) – slow frequency and fast frequency hopping

Principle of CDMA Multiple access interference (MAI) and limit of simultaneous users Digital cellular CDMA system – forward and reverse link error rate performance.

Module IV [9L]

Optimum Detection and Estimation:Noise vector in signal space Bayes detection of received signal, optimum M-ary receiver design Decision region and minimum error probability

Optimum detection of 16 QAM signal, MPSK signal orthogonal and bi orthogonal signalDecision criterion: maximum Likelihood, Neyman ,Pearson and Minimax decision criterionEstimation: Linear estimation – simple mean, Linear mean, squared error Wiener filterNon linear estimation: Bayes estimation Source coding and Channel coding, Channel coding using different techniques.

BOOKS:

1. Digital Communications 4th edition J G Proakis MGH international Edition
2. Principle of Communication Systems Taub and Schilling 7th edition TMH
3. Digital Communications :Fundamentals and Applications 2nd edn 2008 Bernard Sklar and Pabitra Kumar Ray Pearson Education
4. Principle of Digital Communications Simon Haykin Wiley Student Edition
5. Digital Communications Zeimer and Tranter CRC Press
6. Analog and digital Communication, B.P. Lathi, Oxford University Press.

Course Name : **Wireless and Cellular Communication**					
Course Code : **ECEN 3211**					
Contact hours per week :	**L**	**T**	**P**	**Total**	**Credit Points**
	3	0	0	3	3

Course Outcome:

After completing this course, the students will be able to:

1. The students will learn about the evolution of radio communication.

2. They will be able to appreciate the challenges of RF communication.

3. Different wireless networks and their operations will be clear to them.

4. The students will learn about the current multiplexing and modulation schemes.

5. They will be able to understand the functioning of internet protocols.

6. Our students will be able to take up research work in communication domain.

Module I: [11L]

- **Introduction**

Brief introduction to wireless communication system and system, Evolution history of different wireless cellular networks generations- 1G, 2G, 3G and 4G networks, Brief introduction of 5G network, Potential challenges **[2L].**

- **Cellular Networks: Design Fundamentals**

Principle of cellular communication, Description of cellular system- Cellular Structure, Cell clustering, and Capacity enhancement techniques for cellular networks, Frequency Reuse- Co-channel and Adjacent channel interferences, Channel Assignment Strategy, Handoff Schemes, Mobility Management- Location, Radio Resource and Power management **[4L]**

Radio Propagation Path Loss Models: Large Scale and Small Scale

Introduction to Radio Wave Propagation, Multipath Propagation Mechanism and Effects on Wireless Communication, Propagation Models for Wireless Networks- Free space propagation model, Ground reflection (Two-Ray) model, Log distance path loss model, Log normal shadowing model, Brief Description on Outdoor and Indoor Propagation Models, Small-Scale Multipath Propagation- Influencing factors and Doppler shift, Parameters of Mobile Multipath Channel, Types of Small Scale Fading. **[5L]**

Module II: [9L]

- **Multiple Access Techniques for Wireless Communications**

Introduction to Multiple Access Techniques, Narrow Band Channelized Systems- Frequency Division Duplex and Time Division Duplex Systems, Frequency Division Multiple Access, Time Division Multiple Access, Wideband Systems- Principles of WDM, Spread Spectrum Multiple Access, Space Division Multiple Access, Orthogonal Frequency Division Multiple Access, Random Access Method-

Pure and Slotted ALOHA, Carrier Sense Multiple Access with collision detection and collision avoidance . **[4L]**

- **Equalization and Diversity Techniques**

Fundamentals of Equalization, Types of Equalizer-Linear and Nonlinear Equalizer, Diversity Techniques-Frequency, Time and Space, RAKE Receiver. **[2L]**

- **GSM & GPRS: Architecture and Protocols- 2G & 2.5G**

Introduction, GSM Subsystems, GSM Subsystems entities, GSM Air Interface, GSM Frequency Bands and Allocation Strategies, GSM Channel Structure, GSM Call Set-up Procedure, GPRS (2.5G) Network Architecture, GPRS Attachment and Detachment Procedure. **[3L]**

Module III [10L]

- **Digital Modulation Techniques for Wireless Communications**

Digital Modulation-An overview, Types of Digital Modulation Techniques, Linear Modulation Techniques- Binary Phase Shift Keying, Quadrature Phase Shift Keying, Concept of M-ary Communication, Constant Envelope Modulation- Gaussian Minimum Shift Keying, Quadrature Amplitude Modulation, Spread Spectrum Modulation Techniques. **[5L]**

- **Overview of CDMA Systems- 2G**

CDMA Evolution-An overview, CDMA IS-95 Systems, CDMA Channel Concept-Forward and Reverse, Transmission Power Control- Near Far Problem and Multipath Phenomenon, Handoff Process. **[3L**]

- **The Universal Mobile Telecommunication System-3G**

UMTS Network Architecture, Frequency Allocation Strategy, UMTS Channels. Practical application of optical communication in IFL (Interfacility link)[2L]

Module IV [6L]

- **Fundamentals of Wireless Local Area Networks**

Introduction to wireless LAN 802.11X technologies, WLAN System Architecture, Bluetooth Introduction to Broadband wireless MAN, 802.16X technologies. **[3L]**

- **Mobile Internet Protocol**

Basic Mobile IP, Mobile IP Type-MIPv4 and MIPv6, Basic Entities of MIPv4, MIPv4 Operations, Registration, Tunneling and Reverse Tunneling, Triangular Routing. **[3L]**

Text Books:

1.Wireless Communications: Principles and Practice, T.S. Rappaport, Pearson Education

2. Wireless Communication and Networks: 3G and Beyond, I.SahaMisra, TMH Education.

3. Wireless Communication and Networking, Vijay K. Garg, Morgan Kaufmann Publishers Inc.

Reference Books:

1. Wireless Digital Communications: Modulations and Spread Spectrum Applications, K. Feher, Prentice Hall.
2. Wireless Communications and Networking, J.W.Mark and W. Zhuang, PHI.

Course Name : **Wireless and Cellular Communication Laboratory**					
Course Code : **ECEN 3261**					
Contact hours per week :	**L**	**T**	**P**	**Total**	**Credit Points**
	0	0	2	2	1

Course Outcome:

1. The students will be able to correlate different theories of wireless communication with practical experiments.

2. They will learn the procedures for testing radio parameters.

3. They will learn working of fiber optic links.

4. Students will be learn various real time applications of wireless communication system.

Experiments:

Exp1: RSSI measurement using the satellite trainer kit at 2.4 GHz in line of sight (LOS) and non-line of sight (NLOS) conditions for variable distance.

Exp2: Determine the importance of repeater station in wireless communication by the measurement of signal strength using satellite trainer kit at 2.4 GHz.

Exp3: Study the working of AT commands in the global system for mobile (GSM) and observe the waveforms of different timing signals.

Exp4: Study of Global Positioning System (GPS) and plotting of active satellite with SNR etc.

Exp5: Study of spread spectrum: DSSS modulation and demodulation.

Exp6: Study of LASER characteristics.

Exp7: Measurement of propagation loss, bending loss and connector loss in an optical fiber using B-link kit.

Exp8: Measurement of numerical aperture of a optical fiber using B-link kit.

Exp9: Study of time division multiplexing (TDM) using fiber optic data link.

Exp10: Experiment beyond Curriculum.

OPEN ELECTIVE -1

Course Name : Artificial Intelligence In Radio Communication					
Course Code : ECEN3221					
Contact Hours per week	L	T	P	Total	Credit Points
	3	0	0	3	3

Course Outcomes:

The students after studying this course will be able to:

1. Understand difference between passive radios and cognitive radios.
2. Explain difference between SDR and cognitive Radios
3. Apply in AI in radios.
4. Analyze weakness on cognitive radios
5. Develop radios based on Genetic Algorithm (GA).
6. Evaluate radio performance.

Module – I [10L]

SDR- history, concept (reconfigurable radios) ,SDR- benefits, problems, GNU radio design.

Cognitive Radios- brief history, basic concept; Cognitive Radio Design, Cognitive Engine Design.

AI in wireless communication; AI techniques in radios.

Module – II [10L]

Optimization of Radio Resources,

Multi-objective optimization- BER, Transmit Power, Bandwidth, Spectral Efficiency, Interference, SINR, dependence.

Module – III [8L]

Genetic Algorithms for Radio optimization,

Review, simple example, multi-objective GA, Wireless system- GA, simple CBDT example

Module – IV [8L]

Cognitive Radio Network, Distributed AI,

Example- Cognitive Engine, System Design, Interference, Over-the-air results.

Suggested Books:

1.Artificial Intelligence in Wireless Communications-By Rondeau, Thomas W; Bostian, Charles W, Artech House, 2009

2. Cognitive Radio Techniques : Spectrum Sensing, Interference Mitigation and Localization-

By Sithamparanathan, Kandeepan; Giorgetti, Andrea, Artech House, 2012

3. Cognitive Radio Technology-By Bates, Martin; Fettee, Bruce A, Elsevier Science & Technology

4. All the titles are available with British Council Library- on line.

Subject Name: Fundamentals Of Sensors And Transducers					
Paper Code: AEIE3221					
Contact hrs per week:	L	T	P	Total	Credit points
	3	0	0	3	3

Course Outcomes:

After the completion of the course, the students will be able to:

1. Use different methods for converting a physical parameter into an electrical quantity.
2. Select the best fit transducers, including those for measurement of temperature, strain, motion, position and light intensity.
3. Choose proper sensor comparing different standards and guidelines to make sensitive measurements of physical parameters like displacement, stress, force, acceleration, flow, etc.
4. Acquire knowledge on high temperature sensing systems used in steel, aluminium, and copper plants.
5. Learn basic principle ofsmart sensors.
6. Identify different type of sensors used in real life applications and know their importance.

Module I [10 L]

Definition, principle of sensing & transduction, classification of transducers.

Resistive Transducers:

Potentiometric transducer- Construction, symbol, materials, loading effect, error calculations, sensitivity.

Strain gauge- Theory, type, materials, gauge factor, temperature compensation and dummy gauge, adhesive used to mount strain gauge.

Inductive sensor**-** Principle, common types, Reluctance change type, Mutual inductance change type, transformer action type. LVDT- Construction, working principle.

Module II [6 L]

Capacitive sensors: Variable distance-parallel plate type, variable area- parallel plate, variable dielectric constant type, calculation of sensitivity, Microphone, response characteristics.

Piezoelectric transducers: piezoelectric effect, charge and voltage co-efficient and relationships, crystal model, materials, natural & synthetic type, charge amplifier.

Ultrasonic sensors- Liquid velocity and level measurements.

Module III [12 L]

Thermal sensors:

Resistance Temperature Detector (RTD) - materials, temperature range, R-T characteristics, configurations, applications.

Thermistors- materials, shape, R-T characteristics, ranges and accuracy specification.

Thermocouple- Thermo electric laws, types, temperature ranges, series and parallel configurations, cold junction compensation, compensating cables.

Thermal Radiation sensors- types, constructions and comparison.

Introduction to semiconductor type temperature sensors.

Module IV [8 L]

Radiation sensors:

LED, LDR, photodiodes, Photovoltaic cells, photo emissive cell types, materials, construction, response, applications.

Geiger counters, Scintillation detectors.

Introduction to smart sensors.

References:

1. Sensor & transducers, D. Patranabis, 2nd edition, PHI

2. Instrument transducers, H.K.P. Neubert, Oxford University press.

3. Measurement systems: application & design, E.A.Doebelin, McGraw Hill

Subject Name: Fundamentals of RDBMS					
Paper Code: CSEN3221					
Contact hrs per week:	**L**	**T**	**P**	**Total**	**Credit points**
	3	**0**	**0**	**3**	**3**

Course Outcome: At the end of the course, the students will be able to:

CSEN3221.1. Identify the basic concepts and various data model used in database design. Be able to model an application's data requirements using conceptual modeling tools like ER diagrams and design database schemas based on the conceptual model.

CSEN3221.2. Formulate relational algebra expression for queries and evaluate it using the concept of query processing and optimization.

CSEN3221.3. Create RDBMS schema mapping various business validations and formulate queries based on that schema using SQL to satisfy business requirements.

CSEN3221.4. Apply normalization and various types of dependencies for evaluating a relational database design.

CSEN3221.5. Apply and relate the concept of transaction, concurrency control and recovery in database.

CSEN3221.6. Understand with basic database storage structures and access techniques: file and page organizations, indexing methods including B tree, and hashing.

Module 1 [8L]

Introduction: Concept & Overview of DBMS, Data Models, Database Languages, Role of database administrator and database Users, Three Tier architecture of DBMS.

Entity-Relationship Model: Basic concepts, Design Issues, Mapping Constraints, Keys, Entity-Relationship Diagram, Weak Entity Sets, Extended E-R features.

Module 2 [10L]

Relational Model:

Structure of relational Databases, Relational Algebra, Extended Relational Algebra Operations, Views, Modifications of the Database.

Relational Database Design: Functional Dependency, Different anomalies in designing a Database., Normalization using functional dependencies, Decomposition, Boyce-Codd Normal Form, 3NF, Normalization using multi-valued dependencies.

Module 3 [8L]

SQL and Integrity Constraints: Concept of DDL, DML, DCL. Basic Structure, Set operations, Aggregate Functions, Null Values, Domain Constraints, Referential Integrity Constraints, views, Nested Subqueries, Stored procedures and triggers.

Module 4 [10L]

Internals of RDBMS: Transaction processing, Concurrency control and Recovery Management: transaction model properties, state serializability, lock base protocols, two phase locking.

File Organization & Index Structures: File & Record Concept, Placing file records on Disk, Fixed and Variable sized Records, Types of Single-Level Index (primary, secondary, clustering), Multilevel Indexes, Dynamic Multilevel Indexes using B tree and B+ tree.

Text Books:

1. Henry F. Korth and Silberschatz Abraham, —Database System Concepts‖, Mc.Graw Hill.
2. Elmasri Ramez and Novathe Shamkant, —Fundamentals of Database Systems‖, Benjamin Cummings Publishing Company.
3. Ramakrishnan: Database Management System, McGraw-Hill.
4. Gray Jim and Reuter Address, —Transaction Processing: Concepts and Techniques‖, Moragan Kauffman Publishers.
5. Jain: Advanced Database Management System Cyber Tech.
6. Date C. J., —Introduction to Database Management‖, Vol. I, II, III, Addison Wesley.
7. Ullman JD., —Principles of Database Systems‖, Galgottia Publication.

References:

1. James Martin, —Principles of Database Management Systems‖, 1985, Prentice Hall of India, New Delhi
2. Fundamentals of Database Systems‖, Ramez Elmasri, Shamkant B.Navathe, Addison WesleyPublishing Edition.
3. Database Management Systems‖, Arun K.Majumdar, Pritimay Bhattacharya, Tata McGraw Hill

Course Name: Computational Mathematics					
Course Code:MATH3221					
Contact Hours per week	L	T	P	Total	Credit Points
	3	0	0	3	3

1. **MATH3221.1.** Identify patterns in data in the form of recurrences and using the latter to evaluate finite and infinite sums.

2. **MATH3221.2.**Explain combinatorial phenomena by using binomial coefficients, generating functions and special numbers.

3. **MATH3221.3.** Solve computational problems by applying number theoretic concepts such as primality, congruences, residues etc.

4. **MATH3221.4.**Analyze the properties of networks by invoking graph theoretic concepts such as connectivity, matchings, colouring etc.

5. **MATH3221.5.** Combine the concepts of recurrences, sums, combinatorics, arithmetic and graph theory in order to comprehend computational methods.

6. **MATH3221.6.** Interpret mathematically the algorithmic features of computational situations.

Module I:

Sums: Sums and recurrences, manipulation of sums, multiple sums, general methods, finite and infinite calculus, infinite sums 9L

Module II:

Binomial coefficients and special numbers: Basic identities involving binomial coefficients. Bernoulli numbers, Euler numbers, harmonic numbers, Fibonacci numbers, recurrence relations for these numbers.9L

Module III:

Integer functions and arithmetic: Floors and ceilings, the binary operation 'mod', divisibility, primes, relative primality, the congruence relation 'mod', residues, Euler phi function, Fermat's Little Theorem, Wilson Theorem, primitive roots, the law of quadratic reciprocity, (Statement only). 9L

Module IV:

Generating functions:Basic manoeuvres, well-known sequences and their generating functions, using generating functions to solve recurrences, generating functions for special numbers. 9L

References:

1. Ronald Graham, Donald Knuth, Oren Patashnik, 'Concrete Mathematics', Addison-Wesley
2. Douglas B. West, 'Introduction to Graph Theory', Pearson

Course Name: Advanced Probability And Information Theory					
Course Code:MATH3222					
Contact Hours per week	L	T	P	Total	Credit Points
	3	0	0	3	3

After successfully completing this course the students will be able to:

1. **MATH3222.1**: Articulate the axioms (laws) of probability.
2. **MATH3222.2**: Compare and contrast different interpretations of probability theory selecting the preferred one in a specific context.
3. **MATH3222.3**: Formulate predictive models to tackle situations where deterministic algorithms are intractable.
4. **MATH3222.4:** Quantifies the amount of uncertainty involved in the value of a random variable or the outcome of a random process.
5. **MATH3222.5:** Apply the data processing inequality to data science, machine learning and social science.
6. **MATH3222.6:** Develop the concept of data compression in the process of encoding information in signal processing.

MODULE-I: SINGLE AND BIVARIATE PROBABILITY DISTRIBUTIONS

- Review of basic probability : Axiomatic definition,Addition and Multiplication law, Conditional probability and Bayes' Theorem
- Expectation and Variance of single variable discrete and continuous distributions
- Covariance and variance of sums of random variables
- Moment generating functions
- Markov's inequality, Chebyshev's inequality and law of large numbers
- Joint distribution using joint probability mass/density function
- Finding marginal pmf/pdf from joint distribution
- Multiplicative property of joint pmf/pdf in case of independent random variables

MODULE-II: MARKOV CHAINS AND STATISTICAL METHODS

- Markov Chains: Introduction
- Chapman-Kolmogorov equations
- Classification of states
- Some applications: Gambler's Ruin Problem
- Measures of Central tendency: Moments, skewness and Kurtosis

- Probability distributions: Binomial, Poisson and Normal - evaluation of statistical parameters for these three distributions
- Spearman's Rank Correlation coefficient
- Curve fitting: Straight line and parabolas

MODULE-III: CLASSICAL INFORMATION THEORY-I

- Motivation with some relevant examples
- Entropy : Definition with examples
- Joint Entropy and Conditional Entropy
- Relative Entropy and Mutual Information
- Relationship Between Entropy and Mutual Information
- Chain Rules for Entropy, Relative Entropy and Mutual Information
- Jensen's Inequality and Its Consequences
- Log Sum Inequality and Its Applications

MODULE-IV: CLASSICAL INFORMATION THEORY-II

- Data-Processing Inequality
- Sufficient Statistics
- Fano's Inequality
- Asymptotic Equipartition Property Theorem
- Consequences of the Asymptotic Equipartition Property Theorem: Data compression
- High probability sets and the Typical set

Suggested Books:

1. Introduction to Probability Models, S.M.Ross, Elsevier
2. Fundamentals of Mathematical Statistics, S.C.Gupta and V.K.Kapoor, Sultan Chand and Sons
3. An Introduction to Probability theory and its applications Vol-I, W. Feller, John Wiley and Sons
4. Elements of Information Theory, Thomas M. Cover and Joy A. Thomas, Wiley
5. Information Theory and Reliable Communication, Robert G. Gallager, John Wiley and Sons

Course Name: Scientific Computing					
Course Code:MATH3223					
Contact Hours per week	L	T	P	Total	Credit Points
	3	0	0	3	3

After successfully completing this course the students will be able to:

1. **MATH3223.1**: Analyze certain algorithms, numerical techniques and iterative methods that are used for solving system of linear equations.
2. **MATH3223.2**: Implement appropriate numerical methods for solving advanced engineering problems dealing with interpolation, integration and differentiation.
3. **MATH3223.3**:Apply the knowledge of matrices for calculating eigenvalues and eigenvectors and their stability for reducing problems involving Science and Engineering
4. **MATH3223.4**: Develop an understanding to reduce a matrix to its constituent parts in order to make certain subsequent calculations simpler.
5. **MATH3223.5**: Develop the concept of predictor-corrector methods in solving Initial Value Problems numerically.
6. **MATH3223.6**: Apply numerical techniques in solving Boundary Value Problems where the analytical methods fail.

Module I

System of Linear Equations:

- Linear systems, solving linear systems
- Gauss elimination, pivoting and scaling, Gauss-Jordan method
- Symmetric positive define systems and indefinite systems, Cholesky factorization
- Iterative method: Gauss Jacobi and Gauss Seidel, Error prediction and acceleration

Module II

***Eigen Value problems*:**

- QR algorithm
- Power Method
- Linear least square data fitting
- Singular Value Decomposition

Module III

***Interpolation, Integration & Differentiation*:**

- Purpose of interpolation
- Choice of interpolating function, Polynomial interpolation

- Piecewise polynomial interpolation: cubic spline interpolation
- General form of quadrature rule; Newton-Cotes rule, Gaussian quadrature rule
- Numerical Differentiation: Methods Based on Finite Difference approximations

Module IV

***Initial Value & Boundary Value Problem*:**

- Multistep method to solve Initial Value Problem and its stability
- Predictor-corrector method: Adam Moulton method, Milne's Method
- Solving Boundary Value Problems: Finite Difference Method, Shooting Method

Books:

Text Book

1. Trefethen L. N. and Bau D. *Numerical Linear Algebra*, SIAM
2. Watkins D. S. *Fundamentals of Matrix Computation*, Wiley
3. Smith G. D. *Numerical Solutions to Partial Differential Equations*, Oxford University Press
4. Jain M. K. and Iyengar S.R.K. *Numerical methods for scientific and engineering computation*
5. Conte S. D. and BoorC. D. *Elementary Numerical Analysis - An Algorithmic Approach*, McGraw Hill
6. Atkinson K. E. *Introduction to Numerical Analysis,*John Wiley

Reference Books

1. Golub G. H. and Van Loan C.F. Matrix Computation, John Hopkins U. Press, Baltimore
2. Stewart G. W. Introduction to Matrix Computations, Academic Press
3. Demmel J.W. Applied numerical linear algebra, SIAM, Philadelphia
4. Jain M.K. Numerical Solutions of Differential Equations
5. Smith, Numerical solutions of partial Differential Equations (Finite difference methods)
6. Heath M. T., Scientific Computing: An Introductory Survey, McGraw Hill
7. Joe D. Hoffman, Numerical Methods for Engineers and Scientists, McGraw Hill
8. W. Layton and M. Sussman, Numerical Linear Algebra.

Course Name: Indian Constitution and Civil Society					
Course Code: INCO3016					
Contact Hours per week	L	T	P	Total	Credit Points
	2	0	0	2	0

Course Outcomes

The learner will be able to-

1. Analyse the historical, political and philosophical context behind the Indian Constitution-making process
2. Appreciate the important principles characterizing the Indian Constitution and institute comparisons with other constitutions
3. Understand the contemporaneity and application of the Indian Constitution in present times
4. Critique the contexts for constitutional amendments in consonance with changing times and society
5. Establish the relationship between the Indian Constitution and civil society at the collective as well as the individual levels
6. Consciously exercise the rights and the duties emanating from the Indian Constitution to one's own life and work

Module 1- 6L

Introduction to the Constitution of India-Historical Background

Making of Indian Constitution -the process of framing the constitution, the constituent assembly

Module II-6L

Salient Features of the Indian constitution

Comparison with the constitutions of other countries

Module III-6L

Relevance of the Constitution of India

Constitution and Governance

Constitution and Judiciary

Constitution and Parliament-Constitutional amendments

Module IV-6L

Constitution and Society- democracy, secularism, justice

Constitution and the individual citizen- Fundamental Rights, Directive Principles of state policy and Fundamental Duties

Reference Books

C.M.Elliot, (ed.), Civil Society and Democracy, OUP, Oxford, 20012..

David Held et.al (ed),The Idea of the Modern State, Open Univ. Press, Bristol, 1993

Neera Chandoke, State and Civil Society, Sage, Delhi, 19953

Open Elective -1 (to be offered by ECE Department)

Course Name: Designing With Processors And Controllers					
Course Code : ECEN3222					
Contact Hours per week	**L**	**T**	**P**	**Total**	**Credit Points**
	3	**0**	**0**	**3**	**3**

Course Outcomes:

After completing the course the student will be able to:

1. Understand microprocessors and microcontrollers – their operation and programming.
2. Identify RISC processors from CISC processors and apply them in circuits.
3. Analyse operations of different serial and parallel buses and interrupts.
4. Evaluate different hardware designs and memory configurations.
5. Write RTOS for complex processor-based designs.
6. Design processor and controller based intelligent systems for real life problems.

Module I [8L]:

Designing with microprocessors and microcontrollers- the issues and solutions, Embedded systems VS General computing systems, Purpose of Embedded systems, optimizing design metrics, prominent processor and controller technology, RISC vs CISC.

Module II [10L]:

Devices and Communication Buses: I/O types, serial and parallel communication devices, wireless communication devices, timer and counting devices, watchdog timer, real time clock, serial bus communication protocols UART RS232/RS85, parallel communication network using ISA, PCI, PCT-X, Internet embedded system network protocols, USB, Bluetooth. Different types of I/O devices and interfacing: Keypad, LCD, VGA. Introduction to I/O interfaces: Interrupts, Interrupt hardware, Enabling and disabling interrupts, Concepts of handshaking, Polled I/O, Memory mapped I/O, Priorities, Stack and Queues. Vectored interrupts, Direct memory access, few types of Sensors and actuators.

Module III [10L]:

Memory: SRAM, DRAM, EEPROM, FLASH, CACHE memory organizations, (direct, associative, set associative mapping), Virtual memory, organization, mapping and management techniques, Fundamental issues in Hardware software co-design, Unified Modeling Language (UML), Hardware Software trade-offs DFG model, state machine programming model, model for multiprocessor system. Introduction to ARM architecture, Processor design, ARM organization and implementation.

Module IV [8L]:

Real Time Operating Systems: Operating system basics, Tasks, Process and Threads, Multiprocessing and multitasking, task communication, task synchronization, qualities of good RTOS. Resource Management/scheduling paradigms: static priorities, static schedules, dynamic scheduling, best effort current best practice in scheduling (e.g. Rate Monotonic vs. static schedules), Real-world issues: blocking, unpredictability, interrupts, caching, Examples of OSs for embedded systems - RT Linux, VRTX, Mobile phones, RFID.

Books:

Text Books:

1. David Simon, "An Embedded Software Primer", (Addison Wesley), 2000.
2. Jack Ganssle, "The Art of Designing Embedded Systems", (Newnes), 1999.
3. G. Osborn, "Embedded microcontroller and processor design", (Pearson)
4. S. Heath, "Embedded System design ", (Elsevier)
5. Steve Furber, ARM System-on-Chip Architecture, (Pearson)

Reference Books:

1. Shibu, "Introduction to Embedded Systems" K. V. (TMH)
2. Frank Vahid, Tony Givargis, "Embedded System Design – A unified hardware and software introduction:" (John Wiley)
3. Rajkamal "Embedded Systems": (TMH)
4. L. B. Das "Embedded Systems" (Pearson)
5. RTS: Real-Time Systems, by C.M. Krishna and Kang G. Shin, McGraw-Hill, 1997, ISBN 0-07-057043.
6. J. A. Stankovic and K. Ramamritham, Advances in Hard Real-Time Systems, IEEE Computer Society Press, Washington DC, September 1993, 777 pages. Selected papers and references

Course Name: Analog And Digital Communication					
Course Code :ECEN 3223					
Contact Hours per week	L	T	P	Total	Credit Points
	3	0	0	3	3

Course Outcomes:

After completing the course the student will be able to:

1. Explain the necessity of communication, its history, evolution , the role of efficient communication in the present day.
2. Understand & apply the concepts of various types of signals, techniques for signal transmission and signal modulation from the knowledge gathered earlier.
3. Identify various parameters associated with Amplitude and frequency Modulation, time and frequency domain representations, side band frequencies etc and apply these knowledge to solve numerical problems.
4. Apply sampling theorem to sample analog signal properly and differentiate among pulse modulation & demodulation techniques and understand PCM, DPCM.
5. Analyze performance of various digital modulation & demodulation techniques and understand concept of OFDM and Spread Spectrum Modulationsystem.
6. Analyze various multiplexing and Multiple access techniques and compare modern multiple access schemes, explain the concept of frequency reuse, channel assignment strategies and make use of wireless communication tools

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Module I –[10L]

Introduction-Signal Analysis and Transmission: Overview of communication- base-band transmission, various types of signals, analog signal, digital signal, fundamental limitations in communication system- noise, power and bandwidth. Fourier series and Fourier Transformation representations, ; Modulation and its need and types; Time domain and frequency domain analysis. AMPLITUDE MODULATION: Modulation principle and definitions, spectrum and power considerations, DSB,SSB, VSB and AM principles. Different type of modulator circuits.

DEMODULATOR Basic principle of coherent detections, envelope detectors.

FREQUENCY AND PHASE MODULATION Principles and definitions, Relationship between frequency and phase modulations. Phase and frequency deviations, Spectrum of FM signal, bandwidth considerations. Effect of modulation index on bandwidth, Narrow band and sideband FM and PM principles, RADIO RECEIVER Basic block diagram of TRF, Superhetrodyne principle,

Module II –[10L]

Digital Transmission: Sampling theorem, sampling rate, aliasing and aperture effect; analog pulse modulation -PAM (ideal, natural & flat topped sampling),PWM, PPM; basic concept of pulse code modulation, block diagram of PCM; quantizer; non-uniform quantizer, conceptual idea of A-law &μ-law companding; encoding, coding efficiency, source, line coding channel coding & properties, NRZ & RZ, AMI, manchester coding PCM, DPCM, Delta modulation, adaptive delta modulation (basic concept and applications); baseband pulse transmission, matched filter (its importance and basic concept), error rate due to noise;, nyquist criterion for distortion-less transmission.

Module III –[8L]

Digital Modulation Techniques: Types of Digital Modulation, coherent and non-coherent Binary Modulation Techniques, Bit rate, baud rate; information capacity generation and detection, digital carrier modulation techniques: ASK, PSK and FSK, DPSK . Concept of QAM and M-ary Communication, M-ary phase shift keying, (QPSK), Generation, detection, , Offset Quadrature Phase shift Queuing (OQPSK), Minimum Shift Keying (MSK), Basic Concept of OFDM and Spread Spectrum Modulation.

Module IV –[8L]

Multiplexing -TDM, FDM. Multiple Access Techniques and Radio Communication: Multiple access techniques, TDMA, FDMA and CDMA in wireless communication systems, advanced mobile phone system (AMPS), global system for mobile communications (GSM), cellular concept and frequency reuse, channel assignment and handoff, Bluetooth, introduction to satellite communication.

Text Books:

7. Taub and Schilling , "Principles of Communication Systems", 2nd ed., Mc-Graw Hill

8. B.P.Lathi -Communication Systems- BS Publications

2. V Chandra Sekar – Analog Communication- Oxford University Press

References:

9. Carlson—Communication System,4/e , Mc-Graw Hill

10. Proakis&Salehi Fundamentals of Communication Systems- Pearson

11. Singh &Sapre—Communication Systems: 2/e, TMH

12. P K Ghosh- Principles of Electrical Communications- University Press

13. L.W.Couch Ii, "Digital and Analog Communication Systems", 2/e, Macmillan Publishing

14. Blake, Electronic Communication Systems- Cengage Learning

15. S Sharma, Analog Communication Systems- Katson Books

4th YEAR 1st SEMESTER

Course Name: Adaptive Signal Processing.					
Course Code: ECEN4141					
Contact Hours per week	L	T	P	Total	Credit Points
	3			3	3

Course Outcomes:

After completing the course the student will be able to:

1. Know the basic principles of Adaptive signal processing and its various application areas.

2. Realize the physical and parametric issues involved with Statistical modeling using Stochastic processes.

3. Understand basics of designing adaptive filters using linear algorithms for predictions.

4. Learn to design adaptive filters based on Least Mean Squares and gradient method of steepest descent with Convergence analysis.

5. Understand the design of Recursive Least square (RLS) matrix based algorithm for adaptive filters with Convergence Analysis, and the design of Kalman filter.

6. Gain knowledge about tracking time varying adaptive system using the Markov Model.

Module1: Introduction: [6L]

Background and Purpose, Adaptive Systems and areas of application, Properties of Adaptive systems, Adaptive filters with introduction to Mean Square Error Estimation (MSE), Statistical Signal Processing recap{ Stochastic Processes and Models}; Random variables, Random processes, Correlation matrix, Autoregressive process, Ergodicity, Means, Variance, Stationarity, Wide sense stationarity, Power spectrum, Spectral correlation [6L].

Module 2: Adaptive filter theory and linear algorithms for prediction [10L]

Adaptive filters - Prediction, Smoothing, and Efficiency - Linear Optimum Filtering, Problem statement, Principle of Orthogonally – Minimum Mean Square Error, Wiener- Hopf equations, Error Performance analysis, linearly constrained minimum-variance filter [5L].

Forward linear prediction - Backward linear prediction, Levinson Durbin Algorithm, Properties of prediction - error filters, Autoregressive model of a Stationary stochastic process, Cholesky Factorization, Lattice predictors, Joint process estimation [5L].

Module 3: Method of steepest descent and Least Mean Square based adaptive filters [10L]

Background and purpose of Steepest Descent Algorithm, application to the Wiener filter, Stability and Convergence analysis with examples [3L].

Overview of Least mean square (LMS) algorithm, LMS adaptation algorithm, Stability Performance and Convergence analysis with examples. Normalized LMS filter as the solution to a constrained Optimization problem, Stability of the normalized LMS filter, Step size control, Convergence Analysis [4L].

Fast Block LMS algorithm, Computational complexity, Convergence rate, Two stage adaptive filter with (Discrete Cosine Transform)DCT-LMS algorithm [3L].

Module 4: Kalman filter and Markov Model [10L]

Recursive Least square (RLS) matrix based algorithm for adaptive filters, Convergence analysis, Recursive Minimum Mean - Square Estimation for scalar random variables, Kalman filtering problem, derivation of Kalman filter, Filter Gain, Kalman Filtering example with observations from noisy signals [5L].

Markov model for System identification, Degree of Nonstationarity, Criteria for tracking assessment, Tracking performance of the LMS algoritm, Tracking performance of the RLS algorithm, Comparison of the tracking performance between LMS and the RMS algorithm [5L].

Total Lectures 36

Text Books:

1. Adaptive Signal Processing, - Bernard Widrow, Samuel D. Stearns (Pearson)
2. Adaptive Filter Theory – Simon Haykin (Pearson)

Reference Books:

1. Adaptive Signal Processing next generation solution, - TulayAdali and Simon Haykin (Wiley)
2. Adaptive Signal Processing : Theory and Applications - S Thomas Alexander (Springer Verlag)

Course Name:		Fiber Optic Communication			
Course Code :		ECEN4142			
Contact Hours per week	L	T	P	Total	Credit Points
	3	0	0	3	3

Course Outcomes:

After completing the course the student will be able to:

1. Apply the basic idea of electronics, physics and solid state devices and explain the operation of different components in an optical communication system.

2. Understand the properties of optical fiber and categorize the transmission characteristics of a wave through the optical fiber.

3. Analyze the structure of various optical sources and can classify them according to the performance, efficiency and application.

4. Explain the operation of optical detectors and can analyze the performance parameters of a detector.

5. Recognize the current optical technologies used for long distance communication and their application in optical networks.

6. Solve the problems related to optical fiber communication and can justify the physical significance of the solutions.

Module I [8L]: Optical Fiber

- Introduction to communication systems:
  Principles, Components; Different Forms of Communications, Advantages Of Optical Fiber Communication, Spectral Characteristics.
- Optical Fiber
  Cylindrical Wave Guide Structure, Fabrication and Related Parameters, Single and Multimode Operation; Attenuation & losses, Material and Wave Guide Dispersion. Dispersion Compensation and Management. Nonlinear effects in propagation of optical signal through fiber: Self phase modulation, Cross Phase Modulation, Four wave mixing, Fiber Splices, Fiber Optic Connectors, OTDR.

Module II [10L]: Optical Sources

- Light Emitting Diode:
  Principle, Structures, Power And Efficiency, Surface Emitting LED And Edge Emitting LED, Super Luminescent Diode (SLD), Coupling of LEDs to Fibers. Modulation Response of an LED.
- Laser diodes:
  Principle, Coherence, Significance Of Modes, Double Heterostructure, Gain and Index Guiding, Distributed Lasers. Quantum Well Lasers and Narrow Line Width Lasers. Modulation;

Bandwidth for Modulation, Optical Transmitters: Components.

Module III [12L]: Detectors & Other Network Components

- Photo Detectors:
  Photo Diodes, Photo Conducting Detectors, Photo Transistors, Optical Detection Principles, PIN Photo Detector, Avalanche Photo Detector: Efficiency, Responsivity, Bandwidth.
- WDM System:
  Preamplifiers; Noise Sources, Signal to Noise Ratio. WDM Link Analysis and Bit-Error-Rate Calculation. Point-To-Point Link, Wavelength Division Multiplexing and De-multiplexing: Building Blocks; Multiplexing; Intensity Modulation/Direct Detection System; Principle Of Regeneration.
- Optical amplifiers & Filters
  EDFA, SOA, Raman Amplifier, Fabry-Perot Filters.

Module IV [6L]: Optical Network

- Network Topologies:
  LAN, MAN, WAN; Topologies: Bus, Star, Ring; Ethernet; FDDI, PON (Passive Optical Network), FSO: The concept & Challenges
- Telecom Networking:
  SDH/SONET, SONET/SDH Layers, SONET Frame Structure, SONET/SDH Physical Layer

Text Books:

1. Fiber Optics and Optoelectronics, R. P. Khare, Oxford University Press
2. Optical Fiber Communication : John M. Senior (Pearson)
3. Optical Networks – A Practical Perspective: Rajiv Ramaswami, K. N. Sivarajan, Galen H. Sasaki (Morgan-Kaufman)
4. Optical Communication Systems : John Gawar (PHI)

Reference Book:

1. Optical Fiber Communication: Gerd Kaiser (TMH)

Course Name : Electromagnetic Interference and Compatibility					
Course Code: ECEN4143					
Contact hrs per week	L	T	P	Total	Total Credits
	3	0	0	3	3

Course Outcome:

After completing the course the student will be able to:

1. Identify sources of EMI
2. Understand coupling of electromagnetic signals leading to interference
3. Develop an ability to design EMI mitigation techniques
4. Demonstrate EMI test method and its capabilities
5. Indentify EMC requirements for electronic systems
6. Understand EMC standards and its application

Module I: [10]

Introduction To EMI and EMC: Definitions, Different Sources of EMI(Electro-magnetic Interference), Victims of EMI, Inter Source and Intra Source s EMI, Electro-static discharge(ESD),Electro-magnetic pulse(EMP).

Coupling Mechanism : Coupling paths, Coupling via the supply network, Common mode coupling, Differential mode coupling, Impedance coupling, Radiative coupling, Ground loop coupling, Cable related emissions and coupling, Transient sources, Automotive transients. Categorization of the electromagnetic interference: emission, susceptibility, transients, crosstalk, shielding and compatibility, signal integrity.

Module II: [8]

EMC requirements for electronic systems:-World regulatory bodies- FCC, CISPR etc. Class- A devices, class-B devices, Regulations of the bodies on EMC issues.

Standards And Regulation: Need for Standards, EMI Standardizing for different application. IEC, ANSI, FCC, AS/NZS, CISPR, BSI, CENELEC, ACEC. MIL461E. Indian perspective on EMI standards.

Module III: [10]

EMI Mitigation Techniques: Working principle of Shielding, LF Magnetic shielding, Apertures and shielding effectiveness, Choice of Materials for H, E, and free space fields, Gasketting and sealing, PCB Level shielding, Principle of Grounding.

Module IV: [10]

EMI Test Methods And Instrumentation: Fundamental considerations, EMI Shielding effectiveness tests, Open field test, TEM cell for immunity test, Shielded chamber , Shielded anechoic chamber, EMI test receivers, Spectrum analyzer, EMI test wave simulators, EMI coupling networks, Line impedance

stabilization networks, Feed through capacitors, Antennas, Current probes, Effect of ambient noise on home appliances.

Text Books:

1) W. Ott Henry, "Electromagnetic Compatibility Engineering", John Wiley & Sons Inc, New York, 2009.
2) W Scott Bennett, "Control and Measurement of Unintentional Electromagnetic Radiation", John Wiley & Sons Inc., (Wiley Interscience Series) 1997.

Reference Books:

1) Dr Kenneth L Kaiser, "The Electromagnetic Compatibility Handbook", CRC Press 2005.
2) C.R. Paul, "Introduction to Electromagnetic Compatibility", 2nd ed., Wiley (2010).

Course Name : Ad Hoc Networks and Security					
Course Code : ECEN4144					
Contact hours per week :	L	T	P	Total	Credit Points
	3	0	0	3	3

Course Outcome:

After completing this course, the student will be able to:

1. Understand the under lying technologies of wireless networks.

2. Analyze the various design issues and challenges of Ad hoc (wireless) Networks.

3. Learn different routing protocols and their working.

4. Learn and analyze end to end transmission schemes.

5. Understand network design strategies and QoS.

6. Our students will be able to take up research work in communication domain.

Module I: [8L]

- **Introduction [2L]**

Ad hoc wireless networks, Applications of Ad hoc wireless networks. Issues in Ad hoc wireless networks, Types of Ad hoc network, Static and mobile Ad hoc network, Ad hoc wireless internet.

- **MAC Protocols [3L]**

Issues in designing a MAC protocol for Ad hoc wireless Networks, Design goals of a MAC protocol for Ad hoc wireless Networks, Classification of MAC protocols, IEEE802.11 in Ad hoc mode.

- **Contention-based MAC Protocols [3L]**

Contention based protocols with reservation mechanisms and scheduling mechanisms, MAC protocols using directional antennas, Other MAC protocols.

Module II: [12L]

- **Routing Protocols [6L]**

Issues in designing a routing protocol for Ad hoc wireless Networks, Classification of routing protocols, Proactive & Reactive routing protocol, Unicast & Multicast routing algorithm. Location aided routing, Link reversal routing.

- **Hybrid Routing Protocols [6L]**

Hybrid routing algorithm, Energy aware routing algorithm, Hierarchical routing, QoS aware routing, Tree based & Mesh based multicast routing protocols.

Module III [6L]

- **Transport Layer Protocols [6L]**

Issues in designing a transport layer protocol for Ad hoc wireless Networks, Design goals of a transport layer protocol for Ad hoc wireless Networks, Classification of transport layer solutions, TCP over Ad hoc wireless Networks.

Module IV [10L]

- **Security [8L]**

Security in wireless Ad hoc wireless Networks, Network security requirements, Issues & challenges in security provisioning, practical solutions against the network security attacks, Transport layer security.

- **Energy Management Schemes [2L]**

Battery management, transmission power management, Processor power management schemes.

Text Books:

1) "Ad Hoc Wireless Networks – Architectures and Protocols" - C.Siva Ram Murthy and B.S. Manoj –Pearson Education.

2) "Security and Quality of Service in Ad Hoc Wireless Networks" – Amitabh Misra – Cambridge University Press.

Reference Books:

1) "Ad Hoc Mobile Wireless Networks – Protocols and Systems" - Chai K. Toh – Prentice Hall.

2) "Ad hoc wireless Networking", Xiuzhen Cheng, Xiao Hung, DingZhu Du, Kluwer Academic publishers.

3) "Mobile Ad Hoc Networking" – Stefano Basagni, Marco Conti, Silvia Giardano, Ivan Stojmenovic –Wiley India

Open Elective - 2 (For ECE Students)

Course Name: Fundamentals Of Cloud Computing					
Course Code: INFO4121					
Contact Hours per week	L	T	P	Total	Credit Points
	3	0	0	3	3

Course Outcomes:

After completing the course the student will be able to:

1. Articulate the main concepts, key technologies, strengths, and limitations of cloud computing
2. Identify the architecture and infrastructure of cloud computing, including SaaS, PaaS, IaaS, public cloud, private cloud, hybrid cloud, etc.
3. Explain the core issues of cloud computing such as security, privacy, and interoperability.
4. Discuss system, network and storage virtualization and outline their role in enabling the cloud computing system model.
5. Explain AWS, Google App Engine, Microsoft Azure
6. Understand different web services techniques to provide SaaS.

Detailed Syllabus:

Module-I: [7L]

Overview of Computing Paradigm: Recent trends in Computing, Grid Computing, Cluster Computing, Distributed Computing, Utility Computing, Cloud Computing
Introduction to Cloud Computing: Introduction to Cloud Computing, History of Cloud Computing, Cloud service providers, Properties, Characteristics, Pros and Cons of Cloud Computing, Benefits of Cloud Computing, Cloud computing vs. Cluster computing vs. Grid computing

Module-II: [11L]

Cloud Computing Architecture: Cloud computing stack, Comparison with traditional computing architecture (client/server), Services provided at various levels, How Cloud Computing Works, Role of Networks in Cloud computing, protocols used, Role of Web services
Service Models (XaaS): Infrastructure as a Service (IaaS), Platform as a Service(PaaS), Software as a Service(SaaS)
Deployment Models: Public cloud, Private cloud, Hybrid cloud, Community cloud
Infrastructure as a Service (IaaS): Introduction to IaaS, Introduction to virtualization, Different approaches to virtualization, Hypervisors, Machine Image, Virtual Machine (VM)
Resource Virtualization: Server, Storage, Network, Virtual Machine (resource) provisioning and manageability, storage as a service, Data storage in cloud computing (storage as a service)
Examples: Amazon EC2, Renting, EC2 Compute Unit, Platform and Storage, pricing, customers

Module-III:[11L]

Platform as a Service(PaaS): Introduction to PaaS, Service Oriented Architecture (SOA)
Cloud Platform and Management: Computation, Storage
Examples: Google App Engine, Microsoft Azure
Software as a Service(SaaS): Introduction to SaaS, Web services, Web 2.0, Web OS

Module-IV: [12L]

Service Management in Cloud Computing: Service Level Agreements(SLAs), Billing & Accounting, Comparing Scaling Hardware: Traditional vs. Cloud, Economics of scaling: Benefitting enormously,
Managing Data: Looking at Data, Scalability & Cloud Services, Database & Data Stores in Cloud, Large Scale Data Processing
Cloud Security: Infrastructure Security, Network level security, Host level security, Application level security, Data security and Storage, Data privacy and security Issues, Identity & Access Management, Access Control, Trust, Reputation, Risk, Authentication in cloud computing, Client access in cloud, Cloud contracting Model, Commercial and business considerations

Text Books:

1) Cloud Computing Bible, Barrie Sosinsky, Wiley-India, 2010

2) Cloud Computing: Principles and Paradigms, Editors: Rajkumar Buyya, James Broberg, Andrzej M. Goscinski, Wile, 2011

Reference Books:

1) Cloud Computing: Principles, Systems and Applications, Editors: Nikos Antonopoulos, Lee Gillam, Springer, 2012

2) Cloud Security: A Comprehensive Guide to Secure Cloud Computing, Ronald L. Krutz, Russell Dean Vines, Wiley-India, 2010

Course Name : Software Defined Radio					
Course Code : ECEN4121					
Contact Hours per week	L	T	P	Total	Credit Points
	3	0	0	3	3

Course Outcomes:

After completing the course the student will be able to:

1. Understand the technological differences between families of radios.
2. Explain the function of reconfigurable hardware.
3. Analyze the processing techniques required for software defined radio.
4. Evaluate the effects of probability in communication reliability.
5. Analyze the synchronization requirements in SDR and SDR based networks.
6. Analyze functioning of different families of radios.

Module – I [10 L]

Introduction to SDR, Brief history of development of SDR, RF architectures applied in SDR, Processing architectures suitable for SDR, Software environment for SDR. SDR- benefits, problems, GNU radio design.

Module – II [12 L]

Signals and Systems in relation to SDR, Probability in Communications- the effects on reliability, Understanding SDR hardware, Timing and Carrier synchronization, Frame synchronization, Channel coding.

Receive techniques for SDR, Transmit Power, Bandwidth, Spectral Efficiency, Interference.

Module – III [8 L]

OFDM, introduction and implementation of the general model, Channel estimation, Equalization, Power allocation techniques for bits.

Module – IV [6 L]

SDR – some applications, future directions.

SDR-3000 series Software Defined Radio Transceiver Systems
Smart Antenna API for SDR
Networking and SDR- some case histories, Vehicular networking.

Suggested Books:

1. Software Defined Radio for Engineers By T.Collins, Robin Getz, Di Pu, and Alexander M. Wyglinski, Artech House, 2015

2. Cognitive Radio Techniques : Spectrum Sensing, Interference Mitigation and Localization-By Sithamparanathan, Kandeepan; Giorgetti, Andrea, Artech House, 2012

3. Cognitive Radio Technology-By Bates, Martin; Fettee, Bruce A, Elsevier Science & Technology

4. Software Defined Radios : From Smart(er) to Cognitive By Liesbet Van Der Perre, Michael Timmers and SofiePollin, Springer

The titles (2) and (3) are available with British Council Library- on line.

Subject Name: Linear Control Systems and Applications					
Paper Code: AEIE 4122					
Contact hrs per week:	L	T	P	Total	Credit points
	3	0	0	3	3

Course Outcomes:

After completing the course the student will be able to:

1. Derive mathematical model of physical and simulated systems.
2. Execute block diagram reduction and signal flow graph to calculate overall system gain.
3. Investigate the time response of systems and calculate performance indices.
4. Analyze the stability of linear systems using Routh stability criterion and root locus method.
5. Explain frequency response of a process and determine stability using Bode plot.
6. Understand the concept and utility of control actions and its usages.

Module-I [9L]

Concepts of control systems: open loop and closed loop control systems, effect of feedback in control system; mathematical model of physical system: differential equation representation of physical systems, transfer function, block diagram representation and reduction, signal flow graphs.

Module-II [8L]

Standard test signals, time response analysis: transient and steady state response of first order and second order processes, steady state error coefficients, performance indices, effect of pole–zero addition in system response.

Module- III [10L]

Stability analysis: characteristic equation and concept of stability; Routh stability criterion; root locus technique and stability analysis from root locus plot.

Introduction to frequency domain analysis; Bode plot for stability analysis: minimum and non minimum phase system, concept of phase margin and gain margin.

Module –IV [9L]

Control elements: dc servomotors, ac servomotors, dc motor speed and position control.

Basic control actions: P, PI, PD and PID controller and applications. Case study: Level and flow control.

Text Books:

1) Nagrath I. J. and Gopal M., Control System Engineering, 5th Ed., New Age International Private Ltd. Publishers.
2) Kuo B. C., Automatic Control Systems, 8th Ed., Wiley India

Reference Books:

1) Ogata K., Modern Control Engineering, 4th Ed., Pearson Education.
2) Dorf R. C. and Bishop R. H., Modern Control Systems; Pearson Education.
3) Norman S. N., Control Systems Engineering, 4th Ed., Wiley India.
4) B.W. Bequette, Process Control Modeling, Design and Simulation, Prentice Hall of India, New Delhi.

Course Name : Fundamentals of Operating Systems					
Course Code : CSEN 4121					
Contact hours per week :	L	T	P	Total	Credit Points
	3	0	0	3	3

Course Outcome:

After completing the course the student will be able to:

1. Apply knowledge of mathematics, science and engineering in the areas of process management, memory management and storage management.
2. Understand the underlying technologies and features of memory management and storage management.
3. Understand the various design issues in process management.
4. Learn operating system operation, structures.
5. Be familiar with various types of operating systems.
6. Identify the concepts learned here which are used in their own field of work.

Module I: [8L]

- **Introduction of General Operating System [5L]**

  Introduction: What do OS do? Computer System Organization, Interrupt Driven System, Storage Structure, I/O Structure**,** Operating System Functions, OS Services, Dual Mode Operations ,Kernel, System Calls, Types of System Calls

- **Types of Operating Systems [3L]**

  Computer System Architecture (Monolithic, Microkernel, Layered, Hybrid), Different types of O.S.(Batch, Multi-programmed, Time-sharing, Real-time, Distributed, Parallel, for Mobile Unit, Single Processor System, Multiprocessor Systems)
  Virtual Machines, System Boot

Module II: [10L]

- **Process Concept [3L]**

  What is process, Operations on Process (Process States), Process Control Block, Process Scheduling, Scheduling Queues,

- **Cooperating Process [2L]**

  Co-operating Processes, Inter-process Communication. IPC,
  Examples in IPC, Communication in Client-Server Systems

- **Threads [2L]**

  Threads, Benefits of Threads, User and Kernel Threads.
- **CPU Scheduling [3L]**
  Scheduling Criteria, Pre-emptive & Non-pre-emptive Scheduling, Scheduling Algorithms (FCFS, SJF, RR, priority).

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Module III [11L]

- **Process Synchronization [7L]**

Critical Section Problem, Critical Region, Synchronization Hardware.
Petersons Solution, Classical Problems of Synchronization,
Semaphores, Monitors, Synchronization examples, Atomic Transactions.

- **Deadlock[4L]**

Deadlocks: System model, Deadlock characterization, Method of handling Deadlock,
Deadlock Prevention, Avoidance, Detection, Recovery from deadlock

Module IV [11L]

- **Memory Management Strategies[7L]**

Contiguous Memory Allocation, Paging, Structure of Page Table, Segmentation, Demand Paging, Copy-on-Write, Swapping, Page Replacement, Allocation of Frames, Thrashing, Memory Mapped Files, Allocating Kernel Memory, Operating System examples

- **File Management [4L]**

File System: File Concept, Access Methods, Directory Structure, File System Mounting,
File Sharing, Protection

:

Text Books:

1. A. Silberschatz, P B Galvin, G Gagne, Operating systems, 9th edition/10th edition, John Wiley and sons,.

Reference Books:

1. William Stalling, "Operating Systems: Internals and Design Principles", Pearson Education, 1st Edition, 2018.
2. Andrew S Tanenbaum, Herbert BOS, "Modern Operating Systems", Pearson Education, 4th Edition, 2016

Paper Name: **Methods in Optimization**					
Paper Code: **MATH 4121**					
Contact hours per week:	L	T	P	Total	Credit Points
	3	0	0	3	3

COURSE OUTCOME:

After completing the course the student will be able to:

1. Describe the way of writing mathematical model for real-world optimization problems.
2. Identify Linear Programming Problems and their solution techniques.
3. Categorize Transportation and Assignment problems.
4. Apply the way in which Game theoretic models can be useful to a variety of real-world scenarios in economics and in other areas.
5. Apply various optimization methods for solving realistic engineering problems and compare their accuracy and efficiency.
6. Convert practical situations into non-linear programming problems and solve unconstrained and constrained programming problems using analytical techniques.

Module- I (10L)

Linear Programming Problem (LPP)-I

Formulation of an LPP; Graphical Method of solution of an LPP; Convex Combination and Convex Set; Convex Hull and Convex Polyhedron; Canonical and Standard form of an LPP; Basic Solution of a system of linear equations; Simplex Method; Big-M Method; Concept of Duality; Mathematical formulation of duals.

Module- II (10L)

Linear Programming Problem (LPP)-II and Game Theory

Transportation Problems (TP) ; Representation of Transportation Problems as LPP; Methods of finding initial basic feasible solution of TP: North-West Corner Rule, Matrix Minima Method, Vogel's Approximation Method; Optimality test of the basic feasible solution; Assignment Problems; Hungarian Method.

Strategies; The Minimax and Maximin Criterion; Existence of Saddle Point; Games without a Saddle Point; Mixed Strategies; Symmetric Games; Dominance Principle; Two-Person Zero-Sum Game; Graphical Method of Solution; Algebraic Method of Solution.

Module- III (10L)

Non-Linear Programming Problem (NLPP)-I

Single-variable Optimization; Multivariate Optimization with no constraints: Semidefinite Case, Saddle Point; Multivariate Optimization with Equality Constraints: Method of Lagrange Multipliers; Multivariable Optimization with inequality constraints: Kuhn-Tucker Conditions.

Module- IV (10L)

Non-Linear Programming Problem (NLPP)-II

Unimodal Function; Elimination Methods: Interval Halving Method, Fibonacci Method, Golden Section Method; Interpolation Methods: Quadratic Interpolation Methods; Cubic Interpolation Method, Newton Method, Quasi- Newton Method, Secant Method.

Text Books:

1. Linear Programming and Game Theory by J. G. Chakraborty and P. R. Ghosh, Moulik Library.
2. Operations Research by KantiSwarup, P. K. Gupta and Man Mohan, S. Chand and Sons.
3. Engineering Optimization by S. S. Rao, New Age Techno Press.

Reference Books:

1. Algorithms for Minimization without Derivative by R. P. Brent, Prentice Hall.
2. Operations Research: Theory and Applications by J. K. Sharma, Laxmi Publications.
3. Operations Research by T. Veerarajan, The Orient Blackswan.

Paper Name: **Advanced Linear Algebra**					
Paper Code:**MATH4122**					
Contact hours per week:	L	T	P	Total	Credit Points
	3	0	0	3	3

COURSE OUTCOME:

After completing the course the student will be able to:

1. Explain concepts of diagonalization, orthogonal diagonalization and Singular Value Decomposition (SVD).
2. Discuss basis, dimension and spanning sets.
3. Design Gram-Schmidt Orthogonalization Process and QR decomposition using concepts of inner product spaces.
4. Analyze Least squares solutions to find the closest line by understanding projections.
5. Define linear transformations and change of basis.
6. Illustrate applications of SVD such as, Image processing and EOF analysis, applications of Linear algebra in engineering with graphs and networks, Markov matrices, Fourier matrix, Fast Fourier Transform and linear programming.

Detailed Syllabus:

Module I:[9L]

Characteristic equations, Eigen Values and Eigen vectors, Diagonalization, Applications to differential equations, Symmetric matrices, Positive definite matrices, similar matrices, Singular Value Decomposition, Generalized Inverses.

Module II:[9L]

Definition of Field, Vector Spaces, Elementary Properties in Vector Spaces, Subspaces, Linear Sum of Subspaces, Spanning Sets, Linear Dependence and Independence, Basis and Dimension. Application to matrices and system of linear equations.

Module III:[9L]

Inner Product Spaces, Concept of Norms, Orthogonality, Projections and subspaces, Orthogonal Complementary Subspaces, Orthogonal Projections, Gram-Schmidt Orthogonalization Process, Least square approximations, QR decomposition.

Module IV:[9L]

Linear Transformations, kernels and images, The Rank-Nullity-Dimension Theorem.Matrix representation of a Linear Transformation, Change of Basis, Linear space of linear mappings.

Text Book

1) Linear Algebra and its Applications: Gilbert Strang (Thomson Brooks/Cole CengageLearning)

Reference Books

1) Matrix Computations : Gene H. Golub, Charles F. Van Loan (JHU Press)
2) Linear Algebra : Kenneth M. Hoffman, Ray Kunze (Prentice-Hall)
3) Linear Algebra A Geometric Approach: S. Kumaresan(PHI)

Open Elective -3 (For ECE Students)

Subject Name: Optical Instrumentation					
Paper Code: AEIE4126					
Contact hrs per week:	L	T	P	Total	Credit points
	3	0	0	3	3

Course Outcome:

After completing the course the student will be able to:

1. Learn the techniques of communications using optical fiber.
2. Learn the difference between direct and indirect band gap semiconductors.
3. Characterize structures and performance of LEDs and lasers.
4. Learn the structures and performance of photo detectors (like photo diode, PIN diode, APD etc).
5. Explain the techniques of measurement of distance, length, velocity, acceleration, current, voltage using laser. Formulate the structure of generalized measurement system.
6. Acquire the knowledge of different types of Optical Fiber sensors and their applications.

Module I – [9L]

Optical detectors:

PIN photodiode, avalanche photo diode, phototransistor, LDR, photo voltaic cell.

LED:

Power and efficiency calculation, structure of LED and its characteristics, hetero-junction LED.

Module II - [9L]

Optical Fibers and their Performances:

Propagation of light through fiber, different types of fibers and their properties and characteristics, different types of losses in optical fiber communications, dispersions, optical fiber connectors and splices.

Module III - [9L]

LASER fundamentals:

Fundamental characteristics of lasers-Three level and four level lasers-Properties of lasers-laser modes-Resonator configuration-Q switching and mode locking- cavity damping-Types of lasers-gas lasers, liquid laser, solid lasers, semi-conductor lasers.

Industrial applications of LASER:

Laser for measurement of distance, length, velocity, acceleration, current,voltage and atmospheric effect- Material processing -Laser Heating, Welding, Melting and trimming of material-Removal and vaporization.

Module IV - [9L]

Optical Fiber sensors:

Fiber optic sensors-fiber optic Instrumentation system-Different types of modulators-Inferometric method of measurement of length-Moire fringes-Measurement of pressure, temperature, current, voltage, liquid level and strain.

Text Books:

1. J.M. Senior, Optical Fiber Communication – Principles and Practice, Prentice Hall of India, 1985.
2. J. Wilson and J. F. B. Hawkes, Introduction to Opto Electronics, Prentice Hall of India, 2001.
3. Donald J. SterlingJr, Technicians Guide to Fiber Optics, 3rd Edition, Vikas Publishing House, 2000.

Reference Books:

1. M. Arumugam, Optical Fiber Communication and Sensors, Anuradha Agencies, 2002.
2. John F. Read, Industrial Applications of Lasers, Academic Press, 1978.
3. Monte Ross, 'Laser Applications', McGraw Hill, 1968
4. G. Keiser, Optical Fiber Communication, McGraw Hill, 1995.
5. Mr. Gupta, Fiber Optics Communication, Prentice Hall of India, 2004.

Subject Name : Introduction To Embedded Systems					
Paper Code : AEIE 4127					
Contact hrs per week :	L	T	P	Total	Credit Points
	3	0	0	3	3

Course Outcomes:

After completing the course the student will be able to:

1. Explain the definitions, components and requirements of the Embedded System.
2. Acquire knowledge in the area of embedded system using AVR microcontroller.
3. Develop the interfacing and communication techniques of the Embedded System.
4. Learn the basic concept of RTOS.
5. Understand the message passing technique, task synchronization techniques.
6. Develop algorithms for real time applications of Embedded System.

Module I- [10L]

Introduction to an embedded system : Definition Of Embedded Systems, Embedded System V/S General Computing System, Challenges In Embedded System Design, Design Process, Requirements, Examples Of Embedded Systems. Embedded System Architecture: Harvard Vs Princeton, CISC Vs RISC. Introduction to AVR, PIC, ARM and Arduino based systems.

Module II- [10L]

Overview of AVR microcontroller: Introduction to AVR (ATmega328p-pu) microcontroller, pin layout, architecture, program memory, Data Direction register (DDRx), Port Registers (PORTx), PWM registers (8-bit), ADC registers, interrupts, basics of communication, overview and interfacing I/O devices with I^2C Bus, UART and Serial Peripheral Interchange (SPI) bus.

Module III- [8L]

Embedded operating systems: Operating system basics, types of operating systems, tasks, process and threads, multiprocessing and multitasking, task scheduling; task communication: shared memory, message passing, remote procedure call and sockets, task synchronization: task communication/synchronization issues, task synchronization techniques, device drivers, how to choose an RTOS.

Module IV- [8L]

Hardware Interfacing and Programming with ATmega 328p: Interfacing of LCD, interfacing with analog sensors (i.e LM35, ADXL 335 accelerometer), interfacing of stepper motor, interfacing with a keyboard and MPU6050 (MEMS Accelerometer and Gyroscope) using I^2C bus.

Text Books:

1. Raj Kamal, "Embedded System-Architecture, Programming, Design", McGraw Hill, 2013.
2. Shibu K.V, "Introduction to Embedded Systems", Tata McGraw Hill, 2009.

Reference Books:

1. Elliot Williams, AVR Programming: Learning to Write Software for Hardware, Maker Media, Incorporated, 2014.
2. Muhammad Ali Mazidi, SarmadNaimi, SepehrNaimi, "The AVR Microcontroller and Embedded Systems: Using Assembly and C"; Pearson, 2014.
3. DhananjayGadre, "Programming and Customizing the AVR Microcontroller";McGraw Hill Education, 2014.
4. Silberschatz Galvin Gagne, "Operating System Concepts", WILEY, 2014.

Course Name : Intelligent Web and Big Data					
Course Code: CSEN4126					
Contact hrs per week:	**L**	**T**	**P**	**Total**	**Credit points**
	3	0	0	3	3

Course Outcome:

After completing the course the student will be able to:

1. Learn the basics of web Intelligence and Big data.
2. Acquire fundamental enabling techniques and scalable algorithms like Hadoop, Map Reduce etc in big data analytics.
3. Understand the key issues in big data management and its associated applications in intelligent business and scientific computing.
4. Interpret business models and scientific computing paradigms.
5. Understand and practice **big data** analytics.
6. Apply the knowledge of Big Data and web intelligence on industry applications.

Module-1:

Intelligent Information Retrieval Learning from User Interactions – Rating and Voting, E-Mailing and Link Forwarding, Bookmarking, Purchasing Items, Customer Reviews Extracting Intelligence from Tags – Tag-related Meta-data, Tag Generation; Leveraging Tags: Dynamic Navigation, using Tag Clouds, Targeted Search, and Recommendations based on Tags Extracting Intelligence from Contents – Blogs, Wikis, Message Boards.

Module-2:

Recommendations, Clustering and Classification Creating Suggestions and Recommendations – Concepts of Distance and Similarity, Recommendations based on Similar Users, Recommendations based on Similar Items; Recommendations based on Contents Clustering – Overview of Clustering Algorithms Classification – Need for Classification; Overview, Automatic Categorization of E-Mails and Spam Filtering; Classification and Fraud Detection, Combining Classifiers.

Module-3:

Introduction to Hadoop Starting Hadoop; Components of Hadoop: HDFS, Working with files in HDFS; Introduction to MapReduce; Streaming in Hadoop; Advanced MapReduce: Chaining MapReduce Jobs, Joining Data from Different Sources; Developing MapReduce Programs in Local Mode and Pseudo-distributed Mode; Moving Data into and out of Hadoop; Data Input and Output in MapReduce; Applying MapReduce Patterns to Big Data; Streamlining HDFS for Big Data

Module-4:

Algorithms Using MapReduce Matrix-Vector Multiplication by MapReduce, Relational-Algebra Operations, Computing Selections by MapReduce, Computing Projections by MapReduce, Union, Intersection, and Difference by MapReduce, Computing Natural Join by MapReduce, Grouping and Aggregation by MapReduce, Matrix Multiplication.

Text Books:

1) Algorithms of the Intelligent Web by H Marmanis and D Babenko from Manning Publishers, 2009

2) Collective Intelligence in Action by S Alag from Manning Publishers, 2009

3) Hadoop in Action by Chuck Lam from Manning Publishers, 2011

4) Hadoop in Practice by Alex Holmes from Manning Publishers, 2012

5) Mining of Massive Datasets by Jure Leskovec, Anand Rajaraman, Jeff Ullman from Cambridge University Press, 2011.

Reference Books:

1) Mining the Web: Discovering Knowledge from Hypertext Data by Chakrabarti from MorganKaufmann Publishers, 2002

2) Recommender Systems Handbook by Francesco Ricci, Lior Rokach, Bracha Shapira, Paul B. Kantor from Springer, 2011.

Subject Name : Industrial Total Quality Management					
Paper Code: CHEN 4126					
Contact Hours Per Week	**L**	**T**	**P**	**Total**	**Credit Points**
	3	**0**	**0**	**3**	**3**

Prerequisites: Mathematics I , Mathematics II

Course Outcomes:

After completing the course the student will be able to:

1. Identify and control the quality of processes and hence that of products or goods & services by applying basic statistical tools.
2. Draw various types of Control Charts and analyze to ascertain the state of the process.
3. Develop different sampling plans to evaluate the quality of various types of defects.
4. Apply the techniques of Quality Circles and Kaizen in order to enhance work culture and Total Quality status in an organization.

Module I [10L]

Basic concepts– Three paradigms of management and evolution of concept of quality management, Organization: its basic objectives and goal, Mission and Vision, customer and secondary customer, Deming's wheel, bottom line: profit vs quality, historical developments with contribution of different scientists Basic statistical concepts associated with quality management, measurement of central tendency and dispersion, range versus variance, Random variables and expected value calculations, quality and process capability, probability distributions, concept of statistical quality control.

Module II [10L]

Tools and techniques for improvement in TQM: type A and type B techniques with a special reference to SWOT Analysis, brainstorming, stratification, Pareto Analysis, Ischikawa diagram, check sheet.

Use of control charts and process engineering techniques for implementing the quality plan: X—R chart, moving average chart, p-chart and c-chart.

Module III [10L]

Principles of Acceptance sampling: single–double and multiple sampling, AOQ, AQL, LTPD, Chain sampling plan, Dodge-Romig plan.

Philosophy and concept of quality circle: formation, steering committee, power and functions of leader, dy. Leader, coordinator, facilitator, case studies.

Module IV [10L]

Principles of Kaizen and Gemba principles. Concept of Six Sigma standards, case studies.

Different standards: ISO, BS and Bureau of Indian Standards, details of ISO 9000 series, ISO 14000 series and SA 8000, OSHAS 18000 and the certification authorities.

Text Books:

1) Grant, Eugene and Leavenworth, Richard, Statistical Quality Control, TMH, 7th Edition2012.
2) Udpa, S R , Quality Circles: Progress through Participation, TMH, 1992.
3) Bedi, Kanishka, Quality Management, Oxford University Press.

Books of reference:

1) H. Lal Total Quality Management- A Practical Approach (1st Edition): New Age International, 1990.
2) Sundararaju, S. M., Total Quality Management – A Primer: TMH, 1995.
3) Mitra, Amitava, Fundamentals of Quality Control and Improvement, 2nd Edition.; Prentice- Hall of India, 1998.
4) SubburajRamasamy, Total Quality management, Mc-Graw Hill Education (India) Pvt. Ltd, 2012.

Course Name : Principles of Radar					
Course Code: ECEN4126					
Contact hrs per week	**L**	**T**	**P**	**Total**	**Total Credits**
	3	**0**	**0**	**3**	**3**

Course Outcomes:

After completing the course the student will be able to:

1. Understand the concept and characteristics of Radar operation.
2. Know the role of probability in the Radar communication.
3. Understand the importance of shape and material for Radar targets.
4. Develop the idea of Radar Transmission and Reception and in what aspects it is different from data communication.
5. Classify between different types of Radars and their distinct areas of application.
6. Have the concept of the specific design considerations of the antennas under the use for Radar communication.

Module I: [8L]

Introduction to radar: Basic radar equation and block diagram, Types of radar, Information available from a radar, Effects of operating frequency on radar, Applications of radar, Detection of signals in noise, Receiver noise and Signal-to-Noise Ratio, Probability Density Functions, Probabilities of Detection and False Alarm.

Module II: [8L]

Atmospheric attenuation and refraction of radar waves, Attenuation, back scatter and Doppler effects in rain, clouds and snow, Radar Cross Section(RCS) of targets, Control of RCS, Body shaping, Radar absorbing materials, Enhancement of RCS by multiple scattering, RCS prediction techniques, RCS measurement techniques, Radar echo suppression.

Module III: [8L]

Types of radar transmitters, Gyrotrons, Modulators, Choice of RF power source, Radar receiver configurations, Bandwidth considerations, Receiver front end, Digital receivers, Automatic detection, Practical detectors, Optimal detectors, Automatic tracking, Range and velocity tracking.

Module IV: [8L]

MTI radar, Adaptive MTI radar, Air-borne MTI radar, Pulse Doppler radar, Detection algorithm, Radar reflector antennas, Reflector feed design considerations, Phased Array antennas, Beam formers, Beam steering, Mutual coupling, Phase shifters.

Text Books:

1) M Skolnik, " Introduction to Radar Systems", McGraw Hill.

References:

1) George W Stimson, "Introduction to Airborne Radar",SciTech Publishing Inc.3rd Edition

Course Name : Principles of Management					
Course Code: HMTS4101					
Contact hrs per week:	L	T	P	Total	Credit points
	3	0	0	3	3

Course Outcome:

After completing the course the student will be able to:

1. To study the evolution of Management.

2. To understand various management functions and have some basic knowledge on different aspects of management.

3. To understand the planning process in an organization.

4. To understand the concept of organizational structure.

5. To demonstrate the ability to direct, lead and communicate effectively.

6. To analyse and isolate issues and formulate best control methods.

Module I:

Introduction (8L)

Management: Definition, nature, purpose and scope of management

Skills and roles of a Manager, functions, principles;

Evolution of Management Thought: Taylor Scientific Management, Behavioural Management, Administrative Management, Fayol's Principles of Management, Hawthorne Studies.

Types of Business organization -Sole proprietorship, partnership, company-public and private sector enterprises -Organization culture and Environment –Current trends and issues in Management.

Module II (8L)

Planning: Types of plans, planning process, Characteristics of planning, Traditional objective setting, Strategic Management, premising and forecasting.

Organizing: Nature and Purpose-Formal and informal, organizational chart, organization structure-types-line and staff authority, departmentalization, delegation of authority, centralization and decentralization.

Controlling: Concept, planning-control relationship, process of control, Types of Control, Control Techniques

Human Resource Management-HR Planning, Recruitment, Selection, Training and Development, Performance Management, Career planning and management

Module III (8L)

Directing: Foundations of individual and group behaviour –motivation –motivation theories – motivational-Techniques –job satisfaction –job enrichment –leadership –types and theories of leadership –Communication –process of communication –barrier in communication –effective communication –communication and IT

Decision-Making: Process, Simon's model of decision making, creative problem solving, group decision-making.

Coordinating: Concepts, issues and techniques.

Module IV (8L)

Leading: Managing Communication: Nature & function of communication, methods of interpersonal communication, barriers of effective communication, direction of communication flow, role of technology in managerial communication

Motivating Employees: Define motivation, compare and contrast early theories of motivation, compare and contrast contemporary theories of motivation & current issues.

Being an Effective Leader Define leader/ leadership, compare and contrast early theories of leadership, understand three contingency theories, understand modern views on leadership. Motivation, Leadership, Communication, Teams and Teamwork.

Management by Objectives (MBO): Management by exception; Styles of management: (American, Japanese and Indian), McKinsey's 7-S Approach, Self-Management

Text Books:

1) Stephen P. Robbins and Mary Coulter, "Management", Pearson Education, 2017, 13th edition
2) Koontz H. and Weihrich H., "Essentials of Management", Mcgraw Hill Int. Ed., 2015, 10thedition

Reference Books:

1) Bhat A and Kumar A. "Management: Principles, Processes & Practices", Oxford University Press, 2016, 2ndedition
2) Robbins, Coulter, and DeCenzo, "Fundamentals of Management", Pearson Education, 2016, 9th edition
3) .Richard L.Daft, "Management", Cengage Learning, 10th edition

Honours Paper:

Course Name : MICROELECTRONICS AND ANALOG VLSI DESIGN					
Course Code : ECEN 4111					
Contact Hours per week	L	T	P	Total	Credit Points
	3	0	0	3	3

Course Outcomes (COs):

After completing the course the student will be able to:

1. Understand the fundamentals of MOSFET Device Physics.
2. Correlate the fundamental understanding with the evolving VLSI Design Trends and Challenges.
3. Understand the IC Fabrication Process Flow leading to the practical realization of the scaled MOSFETs.
4. Analyze MOS-based analog VLSI sub-circuits and design them namely, current mirrors, voltage, and current references.
5. Design MOS circuits of practical importance e.g., common-source amplifiers and differential amplifiers.
6. Understand and apply the knowledge of analog sampled data circuits to synthesize practical circuits such as switched- capacitor filters.

Module I: Introduction and the MOS Transistor: [10L]

Unit1: Evolution of Microelectronics, Moore's Law, Process Node Definition, Evolution of Process Technology, Scale of Integration (SSI, MSI, LSI, VLSI, ULSI, GSI), ITRS, VLSI Design Trend and Challenges.
Unit2: Knowledge about MOS, Structure and Principle of operation of enhancement-mode MOS transistor, MOS-Characteristics, MOS Capacitors, Short Channel MOS, NMOS vs PMOS, brief introduction to SOI and FINFET structures.

Module II: Fabrication Flow: [10L]

Unit1: IC Process Flow: clean environment, Wafer Growth and Preparation, CVD Techniques, Epitaxy, Oxidation (Dry and Wet), LOCOS and Shallow Trench Isolation (STI), Photo Lithography: Contact, Proximity, Projection, Photo Resist, Etching (Wet and Dry), Diffusion, Ion Implantation, Metallization and interconnects.

Unit2: CMOS Fabrication flow step by step using self aligned techniques (N-well Process), CMOS Fabrication Process Overview and Structure for N-Well, P-Well, Twin Tub, Lambda and Micron rules, Analog layout techniques of passive components, concept of fingering, interdigitated structure and common centroid technique.

Module III: Analog VLSI Sub-circuits: [10L]

Analog VLSI Design Steps, Basic Building Blocks of Analog VLSI Chips, large signal and small signal analysis and equivalent circuit model, small signal parameters for low frequency and high frequency model, MOS Switch, MOS Diode, Active Load/Resistors, Voltage Dividers, Current Mirror, CMOS Current Mirror & Sink (Cascode), CMOS Voltage Reference, CMOS Bandgap Reference (Basic Circuit Only).

Module IV: Analog VLSI Circuits: [9L]

Unit1: Common-Source, Common-Drain and Common-Gate single stage amplifiers, Differential Amplifier: Common Mode, Differential Mode, Transfer Characteristic Curves, CMRR, Differential Amplifier with Active Load.

Unit2: Switched Capacitor Circuit topologies, Filter, Integrator.

Unit3: I/O Design: GPIO (General Purpose I/O) Transmitter and Receiver block diagram, Level Shifter Design.

Text Book:

1. VLSI Technology 2ND Edition, Author: Sze, S.M.; MCGRAW HILL COMPANIES.
2. CMOS Analog Circuit Design (second edition) Phillip E. Allen and Douglas R. Holberg (Oxford)
3. Microelectronic Circuits- A.S. Sedra & K.C.Smith- Oxford International student edition.

References:

1. Design of Analog CMOS Integrated Circuit, B. Razavi, Mc, Graw Hill.
2. Analog Design for CMOS VLSI Systems - Franco Maloberti, Kluwer Academic Publishers

Course Name : MICROELECTRONICS AND ANALOG VLSI DESIGN LAB					
Course Code : ECEN 4161					
Contact Hours per week	L	T	P	Total	Credit Points
	0	0	2	2	1

Course Outcomes:

After completing the course the student will be able to:

1. Understand the basics of VLSI design flow

2. Understand the basic principle of operation of NMOS and PMOS

3. Analysis of VLSI sub-circuits

4. Design and analysis of amplifier circuits

List of Experiments:

1. Familiarization with Industry Standard Mentor Graphics Software Tool using Submicron Technology
2. Study of Transfer and Output Characteristics of NMOS
3. Study of Transfer and Output Characteristics of PMOS
4. Study of MOS as a Capacitor
5. Study of MOS as a Diode
6. Study of Voltage Divider using MOS as Active Resistor
7. Study of Current Mirror Circuit using MOS
8. Study of Cascode Current Mirror Circuit using MOS
9. Circuit analysis of a Single Stage Amplifier
10. Circuit Analysis of a Differential Amplifier

Open Elective 2 (to be offered by ECE department)

Course Name : Software Defined Radio					
Course Code : ECEN4121					
Contact Hours per week	L	T	P	Total	Credit Points
	3	0	0	3	3

Course Outcomes:

After completing the course the student will be able to:

1. Understand the technological differences between families of radios.
2. Explain the function of reconfigurable hardware.
3. Analyze the processing techniques required for software defined radio.
4. Evaluate the effects of probability in communication reliability.
5. Analyze the synchronization requirements in SDR and SDR based networks.
6. Analyze functioning of different families of radios.

Module – I [10 L]

Introduction to SDR, Brief history of development of SDR, RF architectures applied in SDR, Processing architectures suitable for SDR, Software environment for SDR. SDR- benefits, problems, GNU radio design.

Module – II [12 L]

Signals and Systems in relation to SDR, Probability in Communications- the effects on reliability, Understanding SDR hardware, Timing and Carrier synchronization, Frame synchronization, Channel coding.

Receive techniques for SDR, Transmit Power, Bandwidth, Spectral Efficiency, Interference.

Module – III [8 L]

OFDM, introduction and implementation of the general model, Channel estimation, Equalization, Power allocation techniques for bits.

Module – IV [6 L]

SDR – some applications, future directions.

SDR-3000 series Software Defined Radio Transceiver Systems
Smart Antenna API for SDR
Networking and SDR- some case histories, Vehicular networking.

Text Books:

1) Software Defined Radio for Engineers , T.Collins, Robin Getz, Di Pu, and Alexander M. Wyglinski, Artech House, 2015

2) Cognitive Radio Techniques : Spectrum Sensing, Interference Mitigation and Localization- Sithamparanathan, Kandeepan; Giorgetti, Andrea, Artech House, 2012

Reference Books:

1) Cognitive Radio Technology, Bates, Martin; Fettee, Bruce A, Elsevier Science & Technology
2) Software Defined Radios : From Smart(er) to Cognitive, Liesbet Van Der Perre, Michael Timmers and SofiePollin, Springer

Course Name : Introduction to Machine Learning					
Course Code : ECEN 4122					
Contact Hours per week		T	P	Total	Credit Points
	3	0	0	0	3

Course outcomes:

After completing the course the student will be able to:

1. Select an appropriate Machine Learning tool for analyzing data in a given feature space.
2. Apply machine learning techniques such as regression, classification, clustering, and feature selection to detect patterns in the data.
3. Distinguish between supervised, and unsupervised learning.
4. Outline solution for classification and regression approaches in real-world applications.
5. Formulate a machine learning problem.
6. Determine cutting edge technologies related to machine learning applications.

Introduction to Machine Learning

Module 1 **[10L]**

Introduction: Foundations for ML: What is Machine Learning, Examples of Various Learning Paradigms, Perspectives and Issues, Version Spaces and Candidate Elimination Algorithm, Data Normalization, Feature Reduction/Dimensionality reduction,Validation Techniques (Cross-Validations), Bias-Variance Trade-off.

Supervised Learning:

Classification: Learning a Class from Examples, Linear, Non-linear, Multi-class and Multi-label classification, Generalization error bounds: VC Dimension, Regression and Classification Trees, Neural Networks: Introduction, Perceptron, Multilayer Perceptron, Support vector machines: Linear and Non-Linear, Kernel Functions.

Module 2 **[10L]**

Supervised Learning:

Regression: Ordinary Least Squares, Linear Regression, Multiple Linear Regression: Ridge Regression, Lasso Regression, Non-Linear Regression: Logistic Regression.

Ensemble Learning: Ensemble Learning Model Combination Schemes, Voting, Error-Correcting Output Codes, Bagging: Random Forest Trees, Boosting: Adaboost.

Reinforcement Learning:

Introduction to reinforcement learning, Defining reinforcement learning Framework and Markov Decision Process, Tabular methods: Planning through the use of Dynamic Programming and Monte Carlo.

Module 3 **[8L]**

Unsupervised Learning:

Introduction to clustering, A Categorization of Major Clustering Methods, Partitioning Methods, Density-Based Methods, Grid-Based Methods, Model-Based Clustering Methods, Hierarchical: AGNES, DIANA, Partitional: K-means clustering, K-Mode Clustering, Self-Organizing Map, Expectation Maximization, Gaussian Mixture Models.

Module 4 **[7L]**

Feature Selection and Dimensionality Reduction: Principal Components Analysis (PCA), Independent Component Analysis (ICA), and Linear Discriminate Analysis (LDA).

Deep Learning: Autoencoder, Convolutional Neural Networks, Recurrent Neural Networks.

Text Books:

1) EthemAlpaydin, 'Introduction to Machine Learning" , MIT Press, Prentice Hall of India.
2) R.O. Duda, P.E. Hart, and D.G. Stork, "Pattern Classification", John Wiley.
3) M. Bishop, "Pattern Recognition and Machine Learning", Springer.
4) "The Elements of Statistical Learning" by Jerome H. Friedman, Robert Tibshirani, and Trevor Hastie.

References:

1) T. M. Mitchell, "Machine Learning", McGraw Hill Education.
2) Murphy, Kevin, "Machine learning: a probabilistic perspective", MIT press.
3) Stuart Russell, and Peter Norvig, "Artificial intelligence: a modern approach", Prentice Hall.
4) "Deep Learning" by Ian Goodfellow, YoshuaBengio, Aaron Courville.
5) Richard S. Sutton and Andrew G. Barto, "Reinforcement learning: An introduction", Second Edition, MIT Press.

Course Name : Error Control Coding for Secure Data Transmission					
Course Code : ECEN 4123					
Contact Hours per week	L	T	P	Total	Credit Points
	3	0	0	0	3

Course outcomes:

After completing the course the student will be able to:

1. Find the equations for entropy, mutual information and channel capacity for all types of channels, utilizing their knowledge on the elements.
2. Analyze a discrete memory less channel, given the source and transition probabilities.
3. Demonstrate encoder and decoders for Linear Block Codes, Cyclic codes, etc.
4. Apply the concept of modern linear algebra for the error control coding technique.
5. Select decoding algorithms for efficient decoding of Block codes and Convolution codes.
6. Develop overall understanding about different types of codes applied to both source and channel end during data transmission.

Error Control Coding for Secure Data Transmission

Module 1 **[10L]**

Information theory : Uncertainty and information, measure of information, Self and conditional Information, mutual information and entropy, Fixed length code, Variable length code, Prefix code, Instantaneous code, Kraft Inequality.

Source Code: Source coding theorem, Huffman codes, Shanon- Fano coding, Arithmetic code, Lempel-Ziv algorithm.

Channels: Discrete memory less channel, Channel matrix for different channel models- Lossless channel, Deterministic channel, Noise-less channel, Deterministic channel capacity, channel coding, information capacity theorem, The Shannon limit.

Module 2 **[7L]**

Block code: Hamming codes Minimum distance, Error detecting and Error-correcting capabilities of block code.

Linear Block Code: Definition & properties of linear block codes, Generator and parity check matrices, Encoding of a linear block code, Decoding of a linear block code, Syndrome and error detection, Minimum distance considerations, Error detecting and error correcting capabilities.

Module 3 **[10L]**

Cyclic Code: Definition & properties of cyclic codes, Code Polynomials, Generator Polynomials, Division algorithm for polynomials, a method for generating cyclic codes, matrix description of cyclic codes, Syndrome computing and error detection, Decoding of cyclic codes.

Galois Field: Introduction to Linear Algebra: Groups, Fields, binary field arithmetic, Introduction to Galois Field, Primitive elements, generator polynomials in terms of minimal polynomials, Calculation of minimal polynomial.

BCH Code: Concept of BCH Codes, Encoding and Decoding, Reed Solomon Codes.

Module 4 **[8L]**

Convolution code: Polynomial description of convolution codes, Distance notions for convolution codes and the generating function. Encoding of convolution codes: Systematic and Non-systematic convolution Codes. Decoding of convolution codes: Viterbi decoder, distance and performance bounds for convolution codes. Structural properties of convolution codes: state diagram, state table, state transition table, tree diagram, and trellis diagram.

Text Books:

1) Introduction to Error Control Codes - S Gravano; Oxford Press.
2) Information theory, coding and cryptography - Ranjan Bose; TMH.
3) Information and Coding - N Abramson; McGraw Hill.

References:

1) Introduction to Information Theory - M Mansurpur; McGraw Hill.
2) Information Theory - R B Ash; Prentice Hall.
3) Error Control Coding - Shu Lin and D J Costello Jr; Prentice Hall.

Open Elective 3 (to be offered by ECE department)

Course Name : Principles of Radar					
Course Code: ECEN4126					
Contact hrs per week	L	T	P	Total	Total Credits
	3	0	0	3	3

Course Outcomes:

After completing the course the student will be able to:

1. Understand the concept and characteristics of Radar operation.
2. Know the role of probability in the Radar communication.
3. Understand the importance of shape and material for Radar targets.
4. Develop the idea of Radar Transmission and Reception and in what aspects it is different from data communication.
5. Classify between different types of Radars and their distinct areas of application.
6. Have the concept of the specific design considerations of the antennas under the use for Radar communication.

Module I: [8L]

Introduction to radar: Basic radar equation and block diagram, Types of radar, Information available from a radar, Effects of operating frequency on radar, Applications of radar, Detection of signals in noise, Receiver noise and Signal-to-Noise Ratio, Probability Density Functions, Probabilities of Detection and False Alarm.

Module II: [8L]

Atmospheric attenuation and refraction of radar waves, Attenuation, back scatter and Doppler effects in rain, clouds and snow, Radar Cross Section(RCS) of targets, Control of RCS, Body shaping, Radar absorbing materials, Enhancement of RCS by multiple scattering, RCS prediction techniques, RCS measurement techniques, Radar echo suppression.

Module III: [8L]

Types of radar transmitters, Gyrotrons, Modulators, Choice of RF power source, Radar receiver configurations, Bandwidth considerations, Receiver front end, Digital receivers, Automatic detection, Practical detectors, Optimal detectors, Automatic tracking, Range and velocity tracking.

Module IV: [8L]

MTI radar, Adaptive MTI radar, Air-borne MTI radar, Pulse Doppler radar, Detection algorithm, Radar reflector antennas, Reflector feed design considerations, Phased Array antennas, Beam formers, Beam steering, Mutual coupling, Phase shifters.

Text Books:

1) M Skolnik, " Introduction to Radar Systems", McGraw Hill.

References:

1) George W Stimson, "Introduction to Airborne Radar",SciTech Publishing Inc.3rd Edition

Course Name : Ad Hoc Wireless Networks					
Course Code : ECEN4127					
Contact hours per week :	L	T	P	Total	Credit Points
	3	0	0	3	3

Course Outcome:

After completing the course the student will be able to:

1. Understand the under lying technologies of wireless communication networks.
2. Analyze the various design issues and challenges of Ad hoc Networks.
3. Different routing protocols and their operations will be clear to them.
4. Learn about the contention in MAC layer and ways to solve them.
5. Students will be familiar with the network design strategies to assure adequate QoS.
6. Apply their knowledge to develop new and improved applications.

Module I: [10L]

- **Introduction [2L]**

Ad hoc wireless networks, Applications of Ad hoc wireless networks. Issues in Ad hoc wireless networks, Static and mobile Ad hoc network, Indoor Outdoor network model.

- **MAC Protocols [8L]**

Issues in designing a MAC protocol for Ad hoc wireless Networks, Hidden and Exposed terminal problem, Contention based protocols with reservation mechanisms and scheduling mechanisms, MAC protocols using directional antennas, IEEE802.11 in Ad hoc mode.

Module II: [8L]

- **Routing Protocols [8L]**

Issues in designing a routing protocol for Ad hoc wireless Networks, Classification of routing protocols, Proactive & Reactive routing protocol, Unicast & Multicast routing algorithm. Location aided routing, Link reversal routing, Hybrid routing algorithm, Energy aware routing algorithm, Hierarchical routing, QoS aware routing.

Module III [6L]

- **Transport Layer Protocols [6L]**
- Issues in designing a transport layer protocol for Ad hoc wireless Networks, Design goals of a transport layer protocol for Ad hoc wireless Networks, Classification of transport layer solutions, TCP over Ad hoc wireless Networks.

Module IV [12L]

- **QoS in Ad hoc wireless network [8L]**

Issues and challenges in providing QoS in Ad hoc wireless networks, Classification of QoS solutions, QoS in wireless ad hoc network – analysis of degradation of receiver sensitivity, practical solutions.

- **Energy Management Schemes [4L]**

Battery management, transmission power management, System power management schemes.

Text Books:

1) "Ad Hoc Wireless Networks – Architectures and Protocols" - C.Siva Ram Murthy and B.S. Manoj –Pearson Education.

Reference Books:

1) "Ad Hoc Mobile Wireless Networks – Protocols and Systems" - Chai K. Toh – Prentice Hall.
2) "Ad hoc wireless Networking", Xiuzhen Cheng, Xiao Hung, DingZhu Du, Kluwer Academic publishers.
3) "Mobile Ad Hoc Networking" – Stefano Basagni, Marco Conti, Silvia Giardano, Ivan Stojmenovic –Wiley India

Course Name : Introduction To VLSI Design					
Course Code : ECEN 4128					
Contact Hours per week	L	T	P	Total	Credit Points
	3	0	0	3	3

Course Outcomes:

After completing the course the student will be able to:

1. Learn about VLSI Technology Growth as driven by Moore's law
2. Understand Various VLSI Design Methodologies
3. Design Digital Combinational logic, Circuits and Layout using CMOS Technology
4. Design Digital Sequential logic and Circuits using CMOS Technology.
5. Learn RTL Design using Verilog Hardware Description Language
6. Learn Basic Building Blocks of Analog Circuit using CMOS Technology

Module I- [4L]

VLSI Design Methodology:

Moore's Law, Scale of Integration (SSI, MSI, LSI, VLSI, ULSI, GSI), Technology growth and process Node, VLSI Design Trend and Challenges. VLSI Design Cycle, Y-Chart, Full Custom Design, Std Cell based Semi Custom Design, Gate Array Design, PLD: PLA, PAL, FPGA

Module II- [14L]

Digital VLSI Circuits:

Unit1: MOS Transistor Characteristics, MOS as Digital Switch, NMOS Logic Family, CMOS Logic Family, CMOS Inverter Characteristics (VTC), Inverter Delay & Noise, NAND and NOR gates, Complex Logic Circuits, Pass Transistor Logic & Transmission Gate, CMOS Sequential Circuits, CMOS D-Latch and D-Flip-Flop

Unit2: CMOS Cross Section, Layout and Mask layers, Layout Design Rule, Inverter Layout, Lambda Rule vs Micron Rule, Std Cell Layout Topology, Stick Diagram, Euler Path Algorithm

Module III-[6L]

Hardware Description Language:

Introduction to Verilog Modeling: Behavioral, Data-Flow, Structural and Mixed Mode. Front-end Design Flow using Verilog (Behavioral, RTL and Gate Level), Combinational and sequential circuits with various examples, FSM Example: Mealy Machine and Moore Machine.

Module IV- [12L]

Analog VLSI Circuits:

Unit1: MOS large signal model, Transconductance gain, MOS small signal model, MOS switch, MOS Diode, MOS Resistor, CMOS Current Source/Sink, Active Load, Voltage Dividers, CMOS Current Mirror

Unit2: CMOS Differential Amplifiers with passive and active load, Differential Gain, Common Mode Gain, CMRR, Switched Capacitor Filter and Integrator.

Text Book:

1. CMOS VLSI Design, A Circuits and Systems Perspective (4th Edition) Author: Neil Weste, David Harris. Addison-Wesley, Pearson
2. Design of Analog CMOS Integrated Circuit, B. Razavi, Mc, GrawHill .
3. Fundamentals of Digital Logic with Verilog Design, 3rd Edition, Brown and Vranesic, Mc, GrawHill .

Reference Book:

1. Phillip E. Allen and Douglas R. Holberg, CMOS Analog Circuit Design, 2nd Ed., Oxford.
2. Digital Integrated Circuit, Design Perspective, Author: .M. Rabaey, Prentice-Hall
3. CMOS Digital Integrated Circuits, Analysis and Design, Author: Sung-Mo Kang, Yusuf Leblebici, Tata McGraw Hill (3rd Edition), 2006 .

4th YEAR 2nd SEMESTER

Course Name : Introduction To MEMS					
Course Code : ECEN 4241					
Contact Hours per week	L	T	P	Total	Credit Points
	3	0	0	3	3

Course Outcomes:

After completing the course the student will be able to:

1. Understand material properties and their importance in the field of MEMS.
2. Develop the knowledge of fluid motion in microchannel.
3. Understand crystal structure and associated imperfections in order to identify their role in determining material properties.
4. Understand the aspects of MEMS fabrication.
5. Identifiy specific materials for MEMS application and the scope of their use.
6. Understand the concept of sensing and actuation and development of wide range of MEMS structure.

Module 1: Overview of physical phenomena for MEMS [8L]

Stress and strain analysis, Hooke's Law, Young's modulus, Bulk modulus, Modulus of rigidity, Poisson's Ratio, Flexural beam bending, Torsional deflection.

Kinematics of moving fluids, Equation of continuity, Idea of Streamline and turbulent flow, Reynold's number, Poiseuille's equation for the flow of viscous liquid.

Electrostatics, Electromagnetic Induction, Thermal properties of materials, Heat Transport

Module 2: Crystal Structure [8L]

Crystal structure of materials, crystal systems, unit cells and space lattices, determination of structures of simple crystals, miller indices of planes and directions, concept of amorphous, single and polycrystalline structures and their effect on properties of materials, imperfections in crystalline solids and their role in influencing various properties.

Module 3: **MEMS Fabrication** [8L]

Introduction to Micro fabrication , Optical Lithography. Wet and Dry etching, PVD and CVD of semiconductors, metals and insulators, nanofabrication techniques.

Bulk & Surface Micromachinig, Silicon based MEMS processes, Silicon and other materials(Quartz, GaAs,SiN, Polymer) for MEMS, Etching methods, Non-lithographic micro- fabrication techniques, SOI MEMS.

Module 4:**MEMS Structures and Systems for sensors and actuators** [8L]

Electrostatic sensors, Parallel plate capacitors – Applications, Interdigitated Finger capacitor, Comb drive devices, Micro Motors, Magnetic Actuators.

Piezoresistive sensors, Piezoresistive sensor materials, Stress analysis of mechanical elements – Applications to Inertia, Pressure, Flow sensors. Piezoelectric effects, Piezoelectric materials, Piezoelectric sensors and actuators – Applications to Inertia, 3D Accelerometer, Energy harvesters and scavengers.

Microfluidics, Pumping in Microfluidic systems- Electroosmotic& Electrophoretic flow , Mixing in microfluidics.

Text Books:

1) NadimMaluf, Kirt William, "An Introduction to Microelectromechanical System Engineering", Artech House.

Reference Books:

1) C Chatterjee, S Sengupta, "A Treatise on General Properties of Matter", New Central Book Agency.

2) S.O Pillai, "Solid State Physics", New Age International Publishers.

Course Name: Satellite Communication And Remote Sensing.					
Course Code: ECEN4242					
Contact Hours per week	L	T	P	Total	Credit Points
	3			3	3

Course Outcomes:

After completing the course the student will be able to:

1. Know the basic principles of satellite communication and its various application areas in remote sensing.

2. Realize the physical, architectural and networking issues of the satellite system.

3. Understand modulation, coding and multiple access schemes, and review areas as speech and video coding, satellite networking, internet over satellite and satellite personal communications.

4. Know parameters associated with remote sensing using satellites through the use of mathematical and logical tools to gain insight into the concept.

5. Using basics of remote sensing principles and technology acquire knowledge about the important applications for satellite remote sensing in research and the public and private sectors.

6. Gain knowledge about the remote sensing techniques about various applications to improve social, economic and environmental conditions under agricultural, forestry and water body management.

Module 1: Basics of Satellite Communication (10L)

Historical background, Basic concepts, Frequency allocation for satellite services, orbital & spacecraft problems, comparison of networks and services, modulation techniques used for satellite communication (2L). Orbit - Two body problem, orbital mechanics, geostationary orbit, change in longitude, orbital maneuvers, orbital transfer, orbital perturbations (2L). Launch Vehicles- principles of Rocket propulsion, powered flight, Launch vehicles for communication satellite (1L) RF link- noise, the basic RF link, satellite links (up and down) , optimization RF link, inter-satellite link, noise temperature, Antenna temperature, overall system temperature, propagation factors, rain attenuation model. Tropospheric and Ionospheric effects (5L).

Module 2: Satellite Communication Architecture and Networking (9L)

Features of Satellite communication systems in relation to terrestrial systems; Satellite orbits, earth segment and space segment components. Modulation techniques used in satellite Communication;{Multiple access- FDMA, TDMA, CDMA techniques, comparison of multiple access techniques, error connecting codes} (4L). Satellite orbital parameters, orbital perturbations, station keeping, geo stationary and non Geo-stationary orbits – Look Angle Determination (3L); Satellite subsystems and satellite link design- AOCS, TT&C , power system, spacecraft antenna, transponder, Friis transmission equation, G/T ratio of earth station (2L).

Module 3: Basics of Remote Sensing (9L)

Definition of Remote sensing, Electromagnetic(EM) radiation, and spectrum, EM radiation sources, Active & Passive sources, Radiometric terms and definitions, Radiation Principles (Plank's Law, Stephen Boltzman law), Interaction of EM Radiation with atmosphere, and target, Atmospheric Windows, Imaging spectrometry, Spectral signature of various land cover features Ground and space based remote sensing techniques; Concept of thematic mapping with remote sensed data. (4L)

Satellite mounted remote sensors, spatial, radiometric and temporal resolution, field of View (FOV). Data acquisition platforms: Various types of platforms, different types of aircraft, manned and Unmanned spacecrafts used for data acquisition - characteristics of different types of platforms LANDSAT, SPOT, IRS, ERS, INSAT. Image analysis and interpretation-thermal imaging-image processing, classification and interpretation. Satellite sensors, detectors and scanning techniques. Radio Occultation (5L).

Module 4: Remote sensing systems (8L)

Weather forecasting radars, IR Radiometer Airborne and space borne radar, Satellite TTR (Telemetry, Telecommand and Ranging Stations) , LIDAR (light detection and ranging), Acoustic sounding systems, SODAR(Sonic detection and ranging), TRMM (Tropical rainfall measuring mission), AURA MLS, MeghaTropiques, Altimeter, Scatterometer, Radiometer, sea surface temperature, wind speed, water vapour and trace gas measuring systems. Generic software used for Remote sensing [8L]

Total 36 Lectures

Text Books:

1) Satellite communication – D. Roddy (TMH)
2) Global Navigation satellite systems - B. S. Rao (TMH)
3) Remote Sensing & GIS – BasudebBhatta (Oxford University press)
4) Remote sensing of the environment : an earth resource perspective –John R Jenson(Pearson)
5) Satellite Communication System Engineering W.Pritchrd (Pearson)
6) Satellite Communication- ManojitMitra PHI learning Pvt Ltd

Reference Books:

1) An Introduction to Remote Sensing And Its Applications: S.Somvansh&M.Kumari (S.K Kataria)
2) Remote Sensing - R.A. Schowengerdt)Academic press
3) NASA'S Remote Sensing Tutorial http://rst.gsfc.nasa.gov/start.html
4) Satellite Communication: Maini& Agrawal (Wiley)

Course Name : Digital Beam forming Techniques					
Course Code: ECEN4243					
Contact hrs per week	L	T	P	Total	Total Credits
	3	0	0	3	3

Course Outcome:

After completing the course the student will be able to:

1. Differentiate between analog and digital Beam forming
2. Understand the necessity of adaptive Beam forming
3. Apply signal processing concepts in developing beam formers
4. Understand different digital Beam forming configurations
5. Identify error and its corresponding effects in digital Beam forming
6. Apply digital Beam forming concepts in wireless communication

Module I: [8L]

Fundamentals of Beam forming : Introduction to Antenna arrays, Basic Antenna Parameters, Different antenna array configurations, concept of pattern multiplication, Analog Beam forming , Phased Arrays.

Digital Beam forming : Element space Beam forming , Beam Space Beam forming Two Dimensional Beam forming .

Module II: [8L]

Adaptive Beam forming: Basic Concepts, Criteria for Optimal weights, Adaptive Algorithms, Partial Adaptivity, Reference Signal Acquistion.

Errors Effects on Digital Beam forming: Error Sources in DBF Antenna Arrays, Quantization Errors in DBF Arrays, Random Errors in DBF Arrays, Nonlinearities in DBF Arrays.

Module III: [10L]

Spatial Processing in Communications: Diversity and combining Techniques, Space Division Multiple Access, Cell Based SDMA, Beam forming based SDMA, Concept of Blind Adaptive Beam forming , Constant modulus Beam forming , Decision directed Beam forming , Cyclostationery beam forming.

Digital Beam forming Configurations: Element space Beam forming networks, Beam Space Beam forming, DBF with FDMA, DBF with TDMA, DBF with CDMA.

Module IV: [10L]

Adaptive Beam forming in Mobile Communication: Benefits of Adaptive Beam forming , BER performance with Fading, Cochannel Interference Reduction, Improvement in CDMA systems, Adaptive Beam forming for uplink and downlink.

Adaptive Beam forming in Indoor and Data Communication: Characteristics of Indoor Communications, Capacity with Adaptive beam forming, Voice and low Data rate Indoor communication, High Data rate Indoor communication, Wireless Data Networks, Benefits and performances.

Text Books:

1) John Litva, "Digital beam forming in wireless communications." Artech house (1996).
2) Wei Liu and Stephan Weiss, "Wideband beam forming: concepts and techniques." Vol. 17. John Wiley & Sons, 2010.

Reference Books:

1) Athanassios Manikas, ed. Beam forming: Sensor Signal Processing for Defence Applications. Vol. 5. World Scientific.
2) Randy L. Haupt, "Antenna arrays." A Computational Approach (2010).

Course Name : Nanoelectronics & Nanophotonics					
Course Code : ECEN4244					
Contact Hours per week	L	T	P	Total	Credit Points
	3	0	0	3	3

Course Outcomes:

After completing the course the student will be able to:

1. Understand the quantum mechanical properties and phenomena for low-dimensional systems
2. Apply the concept of band gap engineering, novel electronic transport & optical interaction properties of nanostructures for diverse practical applications
3. Understand the fundamentals of nanophotonics, and photonic crystals
4. Identify the application areas of nanophotonics and photonic crystals
5. Understand the basic concepts of plasmonics as a developing field from nanophotonics
6. Identify and analyze the latest research trends & challenges in the real life applications of nanoelectronics and nanophotonics

Module 1[12L]

Fundamentals of Low-Dimensional Systems

Introduction to Quantum Mechanics; Schrodinger equation and expectation values, Solutions of the Schrodinger equation for free particle, particle in a box, Angular momentum and its operators, Eigen values and Eigen functions of the angular momentum operators; Heterostructures : Band gap engineering, Layered structures : quantum wells & barriers, superlattice and minibands ; Strained layers : structural aspects, effect of strain on band structure, *Si-Ge*heterostructures; Tunneling Transport Phenomenon, resonant tunneling diode, transistor.

Module 2[8L]

Semiconducting Nanostructures and Applications

Nanostructures: Quantum well, wire, dot; Optical Properties :Interband, inter-subband transition, optical gain & laser, excitons, Quantum Confined Stark Effect (QCSE), optical absorption : Fermi Golden rule; Applications : Infra-Red Photodetectors, solar cells; Quantum Dot Cellular Automata (QCA): logic gates design using QCA.

Module 3[6L]

Carbon Nano Tubes and Applications

Carbon Nanotubes &Graphene : Graphene vs. Carbon Nano Tube (CNT), basic structure, chirality, SWNT, DWNT, and MWNT, strain-induced band gap changes, piezoresistance property; Metallic CNT : Ballistic transport, resonant tunneling, current carrying capacity, current saturation;

Semiconducting CNT: switching behavior of CNTFET, schottky barrier, ambipolar transistor ; Applications : Logic gates with CNTFET, infra-red emitters, photo detectors, solar cell, Nano-antenna, NEMS.

Module 4 [10L]

Nano Photonics and plasmonics

Foundations for Nanophotonics: Photons and electrons, similarities and differences, free space propagation. Confinement of photons and electrons. Propagation through a classically forbidden zone: tunneling. Nanoscale optical interactions; Photonic Crystals: Basics Concepts, Features of Photonic Crystals, wave propagation, photonic band gaps, Photonic crystal fiber, photonic crystal sensors; Applications of Nanophotonics: Bioimaging, nanoparticles for optical diagnostics & targeted therapy; Applications of Nanophotonics in Plasmonics: Basic of plasmonics, Metallic nanoparticles, nanorods and nanoshells, local field enhancement, plasmonic waveguiding. Applications of Metallic Nanostructures, radiative decay engineering.

Text Books:

1) "Quantum Mechanics: Theory & Applications", *by*Ajoy K. Ghatak, S. Loknathan, McMillan publishing
2) "The Physics of Low-Dimensional Semiconductors", *by* John H. Davies, Cambridge University Press
3) "Nanophotonics", *by* Paras N. Prasad, Wiley Interscience
4) "Carbon Nanotubes Properties and Applications", *Edited by* Michael J. O'Connell, Taylor & Francis

Reference Books:

1) "Theory of Optical Processes in Semiconductors: Bulk and Microstructures", *by*Prasanta K. Basu, Clarendon Press
2) "Design & Test of Digital Circuits by Quantum-Dot Cellular Automata", *by* Jing Huang, Fabrizio Lombardi, Artech publisher

Course Name : Cognitive Radio - Deployment Strategies and Applications					
Course Code : ECEN 4245					
Contact hours per week :	L	T	P	Total	Credit Points
	3	0	0	3	3

Course Outcome:

After completing the course the student will be able to:

1. Apply knowledge of mathematics, science and engineering in the emerging areas of Wireless Communication System.
2. Understand the under lying technologies and features of cognitive radio network.
3. Analyze the various deployment issues and design challenges of cognitive radio network.
4. Learn different spectrum sensing and detection schemes of cognitive radio.
5. Learn correct technique in locating radios in the network.
6. Pursue research work.

Module I: [8L]

- **Introduction on Cognitive Radio [3L]**

Radio flexibility and capability, Aware & Adaptive Radio, Policy Based & Learning Radio, Marking radio self-aware- Position & Environment awareness, Definition of Cognitive Radio, Cognition cycle – orient, plan, decide and action phases, Cognitive Radio Framework, Paradigms of Cognitive Radio, Artificial Intelligence.

- **Cognitive Radio Network [5L]**

Classification of Cognitive Radio Network, Deployment Strategy of Cognitive Radio Network, Transmit Power Optimization Strategy, Challenges Associated with the Network, Architecture maps, Building the Cognitive Radio Architecture on Software defined Radio Architecture.

Module II: [8L]

- **Spectrum Sensing [3L]**

Spectrum Sensing, Spectrum Management, Spectrum Mobility, Unlicensed and Licensed Spectrum Sharing, Dynamic Spectrum Access, Spectrum Handoff, Spectrum Utilization Strategies of Overlay/Underlay/Interweave Users.

- **Signal Detection [5L]**

Cooperative & Non Cooperative Detection, Primary User Signal Detection Techniques – Energy Detection, Feature Detection, Matched Filtering,Waveform Based Sensing, Cyclostationary Based Sensing, Fundamental Limits of Cognitive Radio.

Module III [11L]

- **Localization [6L]**

Importance of Localization, Cooperative and Non Cooperative Localization, Miss-Detection & False Detection Probability, Localization Algorithms, AOA, TDOA, DOA Localization, RSSI based Localization, Weighted Centroid Localization, Maximum Likelihood Detection, Hybrid Localization Scheme

- **Network Security [5L]**

Security Requirements, Types of Network Security Issues, Primary User Emulation Attack, Hidden and Exposed Terminal Problem, Cross Layer Issues, Upper Layer Issues.

Module IV [9L]

Application Domain [9L]

Application of Cognitive Radio Technology, Autonomous Cognitive Cellular network, Cognitive Radio Networks in Heal care, Cognitive Vehicular Networks, Real Time Multimedia Transmission, Economic Approaches in Cognitive Radio Networks

Text Books:

1) Kwang-Cheng Chen, Ramjee Prasad **Cognitive Radio Networks**. Germany: Wiley, 2009, ISBN: 9780470742013.

2) Ashish Bagwari, GeetamTomar, JyotshanaKanti. **Introduction to Cognitive Radio Networks and Applications.** United States: CRC Press, 2016. ISBN: 9781498762991.

3) Robert CaimingQiu, Zhen Hu, Husheng Li, Michael C. Wicks. **Cognitive Radio Communication and Networking: Principles and Practice**. Germany, Wiley, 2012. ISBN: 9781118376294

Reference Books:

1) Ekram Hossain, DusitNiyato, Zhu Han, "Dynamic Spectrum Access and Management in Cognitive Radio Networks", Cambridge University Press, 2009.

2) Mubashir Husain Rehmani, RiadhDhaou, **Cognitive Radio, Mobile Communications and Wireless Networks**. Germany, Springer International Publishing, 2018, ISBN: 9783319910024

Course Name : Wireless Sensor Networks					
Course Code : ECEN4246					
Contact Hours per week	L	T	P	Total	Credit Points
	3	0	0	3	3

Course Outcomes:

After completing the course the student will be able to:

1. Understand the differences between Ad Hoc wireless networks and Sensor networks.
2. Analyze the properties of WSN.
3. Compare performances of sensors and protocols.
4. Find causes of problem in WSN and to solve them.
5. Develop new applications of WSN.
6. Form ideas about new sensors and efficient protocols for new applications.

Module – I [8 L]

WSN – the vision, Comparison with Ad Hoc wireless networks, Key design challenges, Network architecture, Deployment and connectivity logic.

Module – II [12 L]

Wireless standards for WSN nodes, Data dissemination – flooding, gossiping, rumour routing, layered architecture, LEACH. MAC protocols, sleep scheduling, Topology control, Wireless characteristics- link quality, SINR model for interference checking.

Module – III [8 L]

Localization- the methods and importance in WSN, Key issues in localization, approaches.

Time synchronization, Energy efficient robust routing.

Module – IV [8 L]

Transport reliability, Congestion control, Data-centric networking, Operating Systems for WSN, Energy management in WSN.
Security issues and solutions.

Text Books:

1. Networking Wireless Sensors Bhaskar Krishnamachari, Cambridge University Press

2. Ad Hoc Wireless Networks By C>Siva Ram Murthy and B.S. Manoj, Pearson

Reference Books:

1. Wireless Sensor Networks ByKazemSohraby, Wiley
2. Building Wireless Sensor Networks: Theoretical and Practical Perspectives", Nandini Mukherjee, Sarmistha Neogy, Sarbani Roy, CRC Press, November 2015

Course Name:		Mobile Communication – 3G and above			
Course Code :		ECEN4247			
Contact Hours per week	L	T	P	Total	Credit Points
	3	0	0	3	3

Course Outcomes:

After completing the course the student will be able to:

1. Recapitulate cellular communication systems, architecture, functioning, and various standards.
2. Learn evolution of mobile communication generations 2G, 2.5G
3. Learn 3G with their characteristics and limitations.
4. Understand emerging technologies required for fourth generation mobile systems such as SDR, MIMO etc.
5. Understand the concept of LTE-advanced, 4G features and challenges, 5G vision.
6. Analyze and compare architecture, functioning, protocols, capabilities and application of various mobile communication networks.

Module I [5 L]:

Introduction:

The cellular fundamentals: cellular communication and frequency reuse, general architecture of a cellular system, channel assignment strategies, hand-off in a cellular system. Evolution of mobile cellular communication: different generations of mobile cellular communication (1G, 2G, 2.5G). Need for 3G cellular network.

Module II [10 L]:

Third-Generation (3G) Wireless System:

GSM Evolution for Data, UMTS Core Network Architecture, Channel Structure in UMTS Terrestrial Radio Access Network, UMTS Bearer Service, High-Speed Downlink Packet Access (HSDPA).

Evolution of CDMA-One (IS-95) to CDMA-2000, CDMA-2000 Layering Structure, Physical Channels of CDMA-2000 , CDMA-2000 1X EV-DO , CDMA-2000 1X EV-DV, WCDMA : Differences between CDMA-2000 and WCDMA

Module III [10 L]:

Fourth Generation Systems:

4G Vision, 4G Features and Challenges, Applications of 4G, 4G Technologies: Multicarrier Modulation, OFDM-MIMO Systems, Bell Labs Layered Space Time (BLAST) System

Long Term Evolution (LTE):

System Architecture – Radio interface and channels – Resource mapping – Session, mobility and security procedures , VoLTE

Module IV [5 L]:

Over view of LTE Advanced – Heterogeneous Networks – Internetworking – IP based coupling Architecture - Multimode terminals and intersystem handover. Relays, HetNets& Other Features of LTE-Advanced, Introduction to 5G.

Text Books:

1. Wireless Communications: Principles and Practice, T.S. Rappaport, Pearson Education
2. Wireless Communication, Andrews F. Molisch, Wiley
3. Wireless Communications and Networking, V.K. Garg, Morgan Kaufmann Publishers
4. Wireless Communication and Networks: 3G and Beyond, I.SahaMisra, TMH Education.

Reference Book:

1. From GSM to LTE-Advanced Pro and 5G: An Introduction to Mobile Networks and Mobile Broadband, Martin Sauter, Wiley

Course Name : Machine Intelligence And Introduction To Python					
Course Code : ECEN4248					
Contact hours per week :	**L**	**T**	**P**	**Total**	**Credit Points**
	3	0	0	3	3

Course Outcome:

After completing the course the student will be able to:

1. Evaluate of Machine Intelligence (MI) methods and its foundations.
2. Apply basic principles of machine intelligence in solutions that require problem solving, perception, knowledge representation, and learning.
3. Show the importance of MI and planning in solving real world problems.
4. Demonstrate working knowledge of reasoning in the presence of incomplete and/or uncertain information also to show how the searching algorithms playing vital role in problem solving.
5. Learn and understand the basics of the Python Programming Language.
6. Design simple software to experiment using Python with various MI concepts.

Module I: [9L]

Introduction: Introduction to Machine Intelligence. Applications- natural language processing, vision and speech processing, robotics, expert systems. MI techniques- intelligent agents, search knowledge. [2L]

Problem Solving: State space search; Uninformed and informed search. Hill Climbing, Simulated Annealing, Genetic Algorithms, Tabu Search. [7L]

Module II: [9L]

Knowledge Representation: Knowledge representation issues First order predicate calculus, Logic based representations, Rule based representations, Forward and backward chaining. [5L]

Probabilistic reasoning and uncertainty: Bayes nets and reasoning with them. Uncertainty and methods to handle it. Brief discussion on Fuzzy sets and Fuzzy logic.[4L]

Module III [11L]

Machine Learning: Forms of learning, Test statistics, Linear regression, Classification-naive-Bayes, nearest neighbour, neural network models, Decision trees, support vector machine, Clustering-K-means, Hierarchical Clustering, and Density-based Clustering. A brief overview of deep learning. [9L]

Planning: Planning with State Space Search, Planning graph. [2L]

Module IV [7L]

Introduction to Python: Intro to Python Language, Setting up the development environment Variables, Functions, Conditionals, Recursion, Iteration, Nested loops.[3L]

Machine learning with python: Data Visualization, Filtering Data, Python Exercise on Classification and Regression, Python Exercise on Clustering approaches. [4L]

Text Books:

1) Stuart Russell, and Peter Norvig, "Artificial intelligence: a modern approach", Prentice Hall.
2) N. J. Nilsson. "Principles of Artificial Intelligence", Narosa Publishing House.
3) Kevin Night,, and Elaine Rich. "Artificial Intelligence (SIE)", McGraw Hill.
4) Y. Daniel Liang. "Introduction to Programming Using Python", Pearson,

Reference Books:

1) Charles Severance. "Python for Everybody".
   B. M. Bishop, "Pattern Recognition and Machine Learning", Springer.
2) R. Brachman, and H. Levesque. "Knowledge Representation and Reasoning", Morgan Kaufmann.
3) N.P. Padhy. Artificial Intelligence and Intelligent Systems, Oxford University Press.
4) Andreas C Müller, and Sarah Guido. "Introduction to machine learning with Python: a guide for data scientists." O'Reilly Media, Inc.

Open Elective 4 (For ECE Students)

Course Name: Fundamentals Of Cryptography					
Course Code:INFO4221					
Contact Hours per week	L	T	P	Total	Credit Points
	3	0	0	3	3

Course Outcome:

After completing the course the student will be able to:

1. Define the concepts of Network security. Classify different types of attack on Network security. Recall the principles of security.

2. Classify different kinds of Substitution techniques and Transposition techniques and Describe the concepts of Symmetric key cryptography and Asymmetric key cryptography. Discuss in detail DES, RSA and IDEA algorithm.

3. Solve numerical based on DES and RSA. Analyze the concept of SSL, PEM and PGP. Compare MAC, Message Digest and Hash function.

4.Analyse HMAC algorithm. Describe Digital Signature.

5. Explain Authentication token and Classify between different types of Authentication tokens. Compare Certificate based authentication and Biometric Authentication

6. Explain the concepts of Firewall and DMZ Network. Compare between Packet filtering router, Application-level gateway and Circuit-level gateway. Classify between different Firewall Configurations.

MODULE – I [8L]

Network Security and Cryptography- Concepts and Techniques

Need for Security, Security approaches, Principles of Security, Types of Active attack and Passive attack. Introduction to cryptography, Plaintext & Cipher text, Substitution Techniques, Transposition Techniques, Types of Cipher, Cryptanalysis and Brute-force attack, Type of attacks on encrypted text, Symmetric & Asymmetric key Cryptography.

MODULE – II [10L]

Symmetric Key Algorithms

Algorithm types & Modes, Overview of Symmetric Key Cryptography, Diffie-Hellman key exchange algorithm, Digital Envelope, DES(Data Encryption Standard) algorithm & its variant and IDEA(International Data Encryption Algorithm) algorithm.

MODULE – III [11L]

Asymmetric Key Algorithms, Digital Signature and User Authentication

Overview of Asymmetric key Cryptography, RSA algorithm, Digital Signature, Basic concepts of Message Authentication code, Message Digest and Hash Function. HMAC algorithm. Authentication Basics, Password, Authentication Token, Certificate based Authentication and Biometric Authentication.

MODULE – IV [11L]

Electronic mail security, SSL and Firewall

Basics of e-mail security, PEM, PGP, Secure Socket Layer (SSL) protocol. Introduction to

Firewall, Characteristics of Firewall, Packet filtering router, Application-level gateway, Circuit-level gateway, Bastion Host, Firewall Configurations and DMZ Network.

Text Books

1. "Cryptography and Network Security", William Stallings, 3rd Edition, Pearson Education Asia

2. Cryptography & Network Security: AtulKahate, TMH.

Reference Books

1. "Cryptography and Network Security", Behrouz A. Forouzan, Special Indian Edition, 2007, TMH

2. "Network Security Essentials: Applications and Standards" by William Stallings, Pearson.

3. "Cryptography and Security", C K Shyamala, N Harini and Dr T R Padmanabhan, Wiley India

4. "Network Security private communication in a public world", C. Kaufman, R. Perlman and M.

Speciner, Pearson.

Subject Name: Process Instrumentation					
Paper Code: AEIE4221					
Contact hrs per week:	L	T	P	Total	Credit points
	3	0	0	3	3

Course Outcome:

After completing the course the student will be able to:

1. Acquire knowledge about the characteristics of different process instruments.
2. Explain the working principle and functions of displacement, strain, pressure, temperature, flow and level measuring instruments.
3. Formulate the mathematical equation of the linear processes and derive their response.
4. Apply their knowledge of controllers and final control element in various control schemes for effective process control.
5. Gain knowledge of industrial signal transmission and transmitters.
6. Choose proper automation system for specific application.

Module I – [9L]

Introduction to process and instrumentation, static and dynamic characteristics of instruments, active and passive transducers; measurement methods and applications: displacement, strain, pressure, temperature, flow and level measurement.

Module II - [9L]

Introduction to process control, open and closed loop process, mathematical model and transfer function, dynamic behavior of first and second order processes; feedback controllers: on-off controllers, basic control modes, PID controllers.

Module III - [9L]

Control system instrumentation: transducers and transmitters, two wire and four wire transmitters, smart transmitters, final control elements; feedforward, ratio and cascade control; basic concept of stability.

Module IV- [9L]

Introduction to process automation, brief idea and application of PLC, DCS and SCADA; case study: boiler drum level control/ distillation column control.

Text Books:

1. B. G. Liptak, Instrumentation Engineers Handbook (Measurement), Chilton Book Co.; 1994
2. John P. Bentley, Principles of Measurement Systems, Third edition, Addison Wesley Longman Ltd., UK, 2000.

3. E.O. Doebelin, Measurement Systems - Application and Design, Fourth edition, McGraw-Hill International Edition, New York, 1992.

Reference Books:

1. U. A. Bakshi, A.V.Bakshi; Instrumentation Engineering; Technical Publications; 2009.
2. Harold E. Soisson; Instrumentation in Industry; John Wiley & Sons Canada, Limited, 1975.
3. B.E. Noltingk, Instrumentation Reference Book, 2nd Edition, Butterworth Heinemann, 1995.
4. L.D. Goettsche, Maintenance of Instruments and Systems – Practical guides for measurements and control, ISA, 1995.

Paper Name: **Applied Illumination Engineering**					
Paper Code: **ELEC4221**					
Contact hours per week:	L	T	P	Total	Credit Points
	3	0	0	3	3

Course Outcomes

After completing the course the student will be able to:

1. Apply laws of photometry for calculation of illuminance levels for different lighting applications
2. Understand the principles of operation of different photometers
3. Compare different types of lamps according to their specifications and uses
4. Develop energy efficient indoor lighting installations complying with lighting code
5. Correlate parameters of energy efficient outdoor lighting installations

Module I

Illumination Engineering Basics and Photometers **9L**

Visible spectrum of electromagnetic radiation.
Radiometric and photometric quantities, visual response curve of standard observer, relation between Lumen and Watt.
Laws of Illumination, perfect diffuser, Lambert's law.
Bench photometer, luxmeter, integrating sphere.

Module II

Principle of operation of lamps: **9L**

Incandescent lamps, tungsten halogen lamps, fluorescent lamps, low and high pressure sodium vapour lamps, high pressure mercury vapour lamps, metal halide lamps, Light Emitting Diode (LED) lamps.

Module III

Interior Lighting Design **9L**

General requirements and recommendations for working interiors. Recommendations for lighting of industries, offices, hospitals, educational institutes. Design calculations bylumen method in accordance with lighting code.

Module IV

Outdoor Lighting **9L**

Basic concepts of outdoor lighting design- objectives, design parameters, qualitative & quantitative evaluation of outdoor lighting systems. Energy efficient street lighting guidelines. High mast lighting.

Text Books:

1) Lighting Engineering Applied Calculations – R. H. Simons & A.R. Bean, Architectural Press
2) Applied Illumination Engineering, Second Edition, Jack L Lindsey, Prentice Hall.
3) Lamps and Lighting – Edited by J.R.Coaton and A.M.Marsden, 4th Edition Arnold

Reference Books:

1) IES Lighting Handbook – IES North America.
2) National Lighting Code- Published by Govt of India,2011

Course Name : Non-conventional Energy					
Course Code: BIOT4222					
Contact hrs per week:	L	T	P	Total	Credit points
	3	0	0	3	3

Course outcomes:
After completing the course the student will be able to:

1. Understand the concept and necessity of non-conventional energy as an alternative source of energy.
2. Comprehend and apply the concepts of solar energy to design Photovoltaic cells and wind energy to design wind turbine.
3. Classify and design different biogas production processes.
4. Design a production process for biodiesel.
5. Understand the concept of hydrogen energy as a clean fuel and characterize the hydrogen production process.
6. Comprehend the importance and classification of hydrogen fuel cells.

Module I: Non-conventional energy: Different forms [10L]
Solar energy: Solar energy balance, production of electricity, photovoltaic systems.
Wind Energy: Wind energy conversion systems, power generation. Calculations on wind turbine.
Hydro thermal energy: Basics of hydro thermal energy.
Energy from waves and tides.

Module II: Biogas [10L]
Biomass as a renewable energy source; types of biomass – forest, agricultural and animal residues, industrial and domestic organic wastes.
Classification of biogas production processes: combustion, pyrolysis, gasification and other thermo-chemical processes.
Production of alcohol and biogas from biomass. Biogas from anaerobic digestion.

Module III: Bio-diesel [10L]
Bio-diesel: Fundamentals; Trans-esterification of vegetable oils for biodiesel production; Characterization of biodiesel; Biodiesel from different sources; Economics, current trends and future prospects in usage of biodiesel.

Module III: Hydrogen as energy source [10L]
Hydrogen energy: Hydrogen energy system and analysis; Hydrogen infrastructure; Safety, codes and standards.
Hydrogen production: Electrolysis; Thermochemical; Hydrogen from fossil fuel, biomass and renewable sources of energy. Problems on combustion of fuels.
Hydrogen storage: Carbon storage materials; Metal hydrides and chemical hydrides; Cryogenic hydrogen storage.
Hydrogen fuel cells: Principle, importance and classification.

Texts Books:

1) J.E. Smith, Biotechnology, 3rd ed. Cambridge University Press.
2) S. Sarkar, Fuels and combustion, 2nd ed., University Press.

Reference Books

1) Donald L. Klass, Biomass for renewable energy, fuels and chemicals, Academic Press.

Course Name : Biology for Engineers					
Course Code: BIOT4223					
Contact hrs per week:	L	T	P	Total	Credit points
	3	0	0	3	3

Course Outcomes:

After completion of the course, the students will be able to:

i) Understand the basic structure and function of cells and cellular organelles.

ii) Understand the fundamental concepts of cellular reproduction and cell metabolism.

iii) Characterize the different types of proteins, lipids and carbohydrates.

iv) Analyze the mechanism of inheritance of characters through generations.

v) Understand and implement the working principles of enzymes and their applications in biological systems and industry.

vi) Design and evaluate different environmental engineering projects with respect to background knowledge about bioresources, biosafety and bioremediation.

MODULE-I: BASIC CELL BIOLOGY

Prokaryotic and Eukaryotic cells, Cell theory; Cell structure and function, Cell organelles, Structure and function of DNA and RNA, Central Dogma; Genetic code and protein synthesis, differences between eukaryotic and prokaryotic protein synthesis

MODULE-II: BIOCHEMISTRY AND CELLULAR ASPECTS OF LIFE

Biochemistry of carbohydrates, proteins and lipids; Cell metabolism – Glycolysis, TCA cycle, Fermentation; Cell cycle and cell death; Stem cells and their applications, Basics of Mendelian Genetics

MODULE-III: ENZYMES AND INDUSTRIAL APPLICATIONS

Enzymes – significance, co-factors and co-enzymes, classification of enzymes; Enzyme kinetics, enzyme inhibition, models for enzyme action; Restriction enzymes; industrial applications of enzymes; enzymes in human gene therapy and disease diagnostics

MODULE-IV: BIODIVERSITY AND BIOENGINEERING INNOVATIONS

Molecular motors, Basics of neural networks; Tissue Engineering; Basic concepts of environmental biosafety, bioresources, biodiversity, bioprospecting, bioremediation, biosensors; recent advances in engineering designs inspired by examples in biology

TEXT BOOKS:

1. Wiley Editorial, "Biology for Engineers: As per Latest AICTE Curriculum," Wiley-India, 2018.
2. S. ThyagaRajan, N. Selvamurugan, M. P. Rajesh, R. A. Nazeer, Richard W. Thilagaraj, S. Barathi, and M. K. Jaganathan, "Biology for Engineers," Tata McGraw-Hill, New Delhi, 2012.

REFERENCES:

1. Jeremy M. Berg, John L. Tymoczko and Lubert Stryer, "Biochemistry," W.H. Freeman and Co. Ltd., 6th Ed., 2006.
2. Robert Weaver, "Molecular Biology," MCGraw-Hill, 5th Edition, 2012.
3. Jon Cooper, "Biosensors A Practical Approach" Bellwether Books**,** 2004.
4. Martin Alexander, "Biodegradation and Bioremediation," Academic Press, 1994.
5. Kenneth Murphy, "Janeway's Immunobiology," Garland Science; 8th edition, 2011.

Course Name : Low Power High Performance Digital VLSI Circuit Design					
Course Code : ECEN 4221					
Contact Hours per week	**L**	**T**	**P**	**Total**	**Credit Points**
	3	**0**	**0**	**3**	**3**

Pre-requisite: Basic Digital VLSI Design: MOS Transistor Characteristics, CMOS Logic Family, CMOS Inverter Characteristics (VTC), Inverter Delay & Noise, NAND, NOR and other CMOS Logic Circuits, Pass Transistor Logic & Transmission Gate, CMOS Sequential Circuits, Full Custom Design, Std Cell based Semi Custom Design, VLSI Design flow and Y-Chart.

Course Outcomes:

After completing the course the student will be able to:

1. Learn timing Verification flows
2. Learn Static Timing Analysis Method
3. Learn Interconnect Design
4. Learn Process Variation impact on design
5. Learn Dynamic Power Reduction Techniques
6. Learn Standby Power Reduction Techniques

Module I: VLSI Verification Flows and Timing Analysis: [10L]

Unit1: VLSI Design and Verification Cycles: Logic, circuit and Layout design and Verification, pre-layout simulation, parasitic Extraction and Back-annotation, post layout verification.

Unit2: Timing Analysis: Dynamic vs Static Timing Analysis. Types of Path for Timing Analysis: Data-path, Clock-path, Clock Gating Path, Asynchronous Path. Flop based Design: Launch path, Capture Path, Longest Path, Shortest Path, Critical Path. Timing checks: Setup (max) check, Hold (min) check, Gated Clock check, Process Variation study with PVT analysis, Clock Skew, Library Cell characterization

Module II: VLSI Interconnect Design: [6L]

Component of Interconnect, Interconnect Cross Section, Wire material, Interconnect Modelling, Interconnect Design Issues and WirePlan: Capacitance, Delay, Lumped Model vs Distributed Model, RC Scaling, Repeater, Interconnect Power, Interconnect Noise: Coupling, Cross Talk

Module III: Dynamic Power Reduction: [12L]

Unit1: Definition of dynamic power, Transition probability, Signal probability, Transition probability of basic gates, Glitch power, sources of switching capacitance

Unit2: Dynamic Power reduction with Vdd, Delay vs Power Trade-off, Dual Vdd, Dynamic Voltage Scaling (DVS), Capacitance Scaling, Transistor sizing, Transition probability reduction by clock gating, Logic restructuring, Input Reordering, Glitch reduction

Module IV: Standby Power Reduction: [8L]

Unit1: Definition of Leakage power: Gate Leakage, Channel Leakage, Junction Leakage. Channel leakage issue with Threshold Voltage Scaling

Unit2: Technology Solution of Gate Leakage reduction: High-K, FinFET, Channel leakage reduction techniques: Multiple Threshold Voltage, Long Channel Transistor, Device Downsizing, Stacking, Power Gating, Dual Vdd, Dynamic Body-Biasing, Technology Solution: FinFET

Text Book:

1) CMOS VLSI Design, A Circuits and Systems Perspective (4th Edition) Author: Neil Weste, David Harris. Addison-Wesley, Pearson
2) Practical Low Power Digital VLSI Design, Author: Gary Yeap, KLUWER ACADEMIC PUBLISHERS, 2010

Reference Book:

1) Low Power CMOS VLSI Circuit Design, Author: Kuashik Roy and Sharat Prasad, John Wiley & Sons, Inc. 2009
2) Digital Integrated Circuit, Design Perspective, Author: .M. Rabaey, Prentice-Hall

Open Elective 4 (to be offered by ECE Department)

Course Name : Low Power High Performance Digital VLSI Circuit Design					
Course Code : ECEN 4221					
Contact Hours per week	L	T	P	Total	Credit Points
	3	0	0	3	3

Pre-requisite: Basic Digital VLSI Design: MOS Transistor Characteristics, CMOS Logic Family, CMOS Inverter Characteristics (VTC), Inverter Delay & Noise, NAND, NOR and other CMOS Logic Circuits, Pass Transistor Logic & Transmission Gate, CMOS Sequential Circuits, Full Custom Design, Std Cell based Semi Custom Design, VLSI Design flow and Y-Chart.

Course Outcomes:

After completing the course the student will be able to:

7. Learn timing Verification flows
8. Learn Static Timing Analysis Method
9. Learn Interconnect Design
10. Learn Process Variation impact on design
11. Learn Dynamic Power Reduction Techniques
12. Learn Standby Power Reduction Techniques

Module I: VLSI Verification Flows and Timing Analysis: [10L]

Unit1: VLSI Design and Verification Cycles: Logic, circuit and Layout design and Verification, pre-layout simulation, parasitic Extraction and Back-annotation, post layout verification,

Unit2: Timing Analysis: Dynamic vs Static Timing Analysis. Types of Path for Timing Analysis: Data-path, Clock-path, Clock Gating Path, Asynchronous Path. Flop based Design: Launch path, Capture Path, Longest Path, Shortest Path, Critical Path. Timing checks: Setup (max) check, Hold (min) check, Gated Clock check, Process Variation study with PVT analysis, Clock Skew, Library Cell characterization

Module II: VLSI Interconnect Design: [6L]

Component of Interconnect, Interconnect Cross Section, Wire material, Interconnect Modelling, Interconnect Design Issues and WirePlan: Capacitance, Delay, Lumped Model vs Distributed Model, RC Scaling, Repeater, Interconnect Power, Interconnect Noise: Coupling, Cross Talk

Module III: Dynamic Power Reduction: [12L]

Unit1: Definition of dynamic power, Transition probability, Signal probability, Transition probability of basic gates, Glitch power, sources of switching capacitance

Unit2: Dynamic Power reduction with Vdd, Delay vs Power Trade-off, Dual Vdd, Dynamic Voltage Scaling (DVS), Capacitance Scaling, Transistor sizing, Transition probability reduction by clock gating, Logic restructuring, Input Reordering, Glitch reduction

Module IV: Standby Power Reduction: [8L]

Unit1: Definition of Leakage power: Gate Leakage, Channel Leakage, Junction Leakage. Channel leakage issue with Threshold Voltage Scaling

Unit2: Technology Solution of Gate Leakage reduction: High-K, FinFET, Channel leakage reduction techniques: Multiple Threshold Voltage, Long Channel Transistor, Device Downsizing, Stacking, Power Gating, Dual Vdd, Dynamic Body-Biasing, Technology Solution: FinFET

Text Book:

3) CMOS VLSI Design, A Circuits and Systems Perspective (4th Edition) Author: Neil Weste, David Harris. Addison-Wesley, Pearson
4) Practical Low Power Digital VLSI Design, Author: Gary Yeap, KLUWER ACADEMIC PUBLISHERS, 2010

Reference Book:

3) Low Power CMOS VLSI Circuit Design, Author: Kuashik Roy and Sharat Prasad, John Wiley & Sons, Inc. 2009
4) Digital Integrated Circuit, Design Perspective, Author: .M. Rabaey, Prentice-Hall

Course Name : Cellular and Mobile Communication					
Course Code : ECEN 4222					
Contact hours per week :	L	T	P	Total	Credit Points
	3	0	0	3	3

Course Outcome:

After completing the course the student will be able to:

1. Learn about the evolution of radio communication and fundamental design strategies of cellular network.

2. Appreciate the challenges of RF communication.

3. Understand the concepts of propagation over wireless channels.

4. Learn about the both physical and networking of LTE-4G systems.

5. Understand the functioning of IP technology.

6. Apply their knowledge for research work in communication domain.

Module I: [11L]

- **Introduction [2L]**

Brief introduction to wireless communication and systems, Evolution of wireless/mobile standards - 1G, 2G, 3G and 4G and related networks, Brief introduction to 5G network, Potential challenges.

- **Cellular Networks: Design Fundamentals [4L]**

Principle of cellular communication, Description of cellular system- Cellular Structure, Cell clustering, and Capacity enhancement techniques for cellular networks, Frequency Reuse- Co-channel and Adjacent channel interferences, Channel Assignment Strategy, Handoff Schemes, Mobility Management- Location, Radio Resource and Power management.

- **Radio Propagation Path Loss Models :Large Scale and Small Scale [5L]**

Introduction to Radio Wave Propagation, Multipath Propagation mechanism and effects on Wireless Communication, Propagation models for Wireless networks- Free space propagation model, Ground reflection (Two-Ray) model, Log distance path loss model, Log normal shadowing model, Small-Scale Multipath Propagation- Influencing factors and Doppler shift, Types of Small Scale Fading, Introduction to antenna systems in mobile radio.

Module II: [8L]

- **Multiple Access Techniques for Wireless Communications [3L]**

Introduction to multiple access techniques, Narrow band channelized systems- Frequency Division Duplex and Time Division Duplex Systems, Frequency Division Multiple Access, Time Division

Multiple Access, Wideband Systems- Principles of WDM, Spread Spectrum Multiple Access, Space Division Multiple Access, Orthogonal Frequency Division Multiple Access.

- **GSM& GPRS: Architecture and Protocols- 2G & 2.5G [5L]**

Introduction, GSM subsystems, GSM subsystems entities, GSM Air Interface, GSM frequency bands and allocation strategies, GSM channel structure, GSM call set-up procedure, GPRS (2.5G) network architecture, GPRS Attachment and Detachment procedure.

Module III [9L]

- **Overview of CDMA Systems- 2G [3L]**

CDMA Evolution-An overview, CDMA IS-95 systems, CDMA channel concept-Forward and Reverse, Transmission power control- Near Far problem and Multipath Phenomenon, Handoff process.

- **The Universal Mobile Telecommunication System-3G [2L]**

UMTS Network architecture, Frequency allocation strategy, UMTS channels.

- **LTE 4G [4L]**

Introduction to LTE network architecture, Uplink and Downlink frequency bands and allocation strategies, Channel Structure of LTE, Channel dependent multiuser resource scheduling.

Module IV [8L]

- **Key Enablers for LTE 4G[5L]**

Multicarrier concepts, Basics of OFDM, SC-FDE and SC-FDMA, OFDM in LTE, Timing and Frequency synchronization, Multiple Access for OFDM systems, OFDMA and SC-FDMA in LTE, OFDMA system design considerations.

- **Mobile Internet Protocol [3L]**

Basic Mobile IP, Mobile IP Type-MIPv4 and MIPv6, Basic Entities of MIPv4, MIPv4 Operations, Registration, Tunneling and Reverse Tunneling, Triangular Routing.

Text Books:

1.Wireless Communications: Principles and Practice, T.S. Rappaport, Pearson Education

2. Wireless Communication and Networks: 3G and Beyond, I.SahaMisra, TMH Education.

3. Fundamentals of LTE, Arunabha Ghosh, Jan Zhang, Jefferey Andrews, Riaz Mohammed, Pearson Education, ISBN-13: 978-0-13-703311-9.

Reference Books:

1. Wireless Digital Communications: Modulations and Spread Spectrum Applications, K. Feher, Prentice Hall.
2. Wireless Communications and Networking, J.W.Mark and W. Zhuang, PHI.

Course Name:		Optical Fiber Communication			
Course Code :		ECEN4223			
Contact Hours per week	L	T	P	Total	Credit Points
	3	0	0	3	3

Course Outcomes:

After completing the course the student will be able to:

1. Apply the basic idea of electronics, physics and solid state devices and explain the operation of different components in an optical communication system.

2. Understand the properties of optical fiber and categorize the transmission characteristics of a wave through the optical fiber.

3. Analyze the structure of various optical sources and can classify them according to the performance, efficiency and application.

4. Explain the operation of optical detectors and can analyze the performance parameters of a detector.

5. Recognize the current optical technologies used for long distance communication and their application in optical networks.

6. Solve the problems related to optical fiber communication and can justify the physical significance of the solutions.

Module I [8L]:

Introduction to communication systems: Principles, Components; Different Forms Of Communications, Advantages Of Optical Fiber Communication, Spectral Characteristics.

Optical Fiber: Cylindrical Wave Guide Structure (qualitative discussions only), Fabrication and Related Parameters, Single and Multimode Operation; Attenuation and losses, Material and Wave Guide Dispersion. Fiber Splices, Fiber Optic Connectors, OTDR.

Module II [10L]:

Optical Sources:

Light Emitting Diode: Principle, Structures, Power And Efficiency, Surface Emitting LED And Edge Emitting LED, Super Luminescent Diode (SLD), Coupling of LEDs to Fibers. Laser diodes: Principle, Modes, Double Hetero structure, Gain and Index Guiding, Distributed Lasers, Narrow Line Width Lasers.

Module III [12L]:

Detectors & Other Network Components

Photo Detectors: Photo Diodes, Optical Detection Principles, Efficiency, Responsively, Bandwidth. WDM System: Preamplifiers; Noise Sources, Wavelength Division Multiplexing: Building Blocks; Multiplexing; Intensity Modulation/Direct Detection System; Principle of Regeneration.

Optical amplifiers & Filters: EDFA, SOA, Raman Amplifier, Fabry-Perot Filters.

Module IV [6L]:

Optical Network

Network Topologies: LAN, MAN, WAN; Topologies: Bus, Star, Ring; Ethernet; FDDI;

Telecom Networking: SDH/SONET, SONET/SDH Layers, SONET Frame Structure, SONET/SDH Physical Layer

Text Books:

1) Fiber Optics and Optoelectronics, R. P. Khare, Oxford University Press
2) Optical Fiber Communication : John M. Senior (Pearson)
3) Optical Networks – A Practical Perspective: Rajiv Ramaswami, K. N. Sivarajan, Galen H. Sasaki (Morgan-Kaufman)
4) Optical Communication Systems : John Gawar (PHI)

Reference Book:

1) Optical Fiber Communication: Gerd Kaiser (TMH)