NRI INSTITUTE OF TECHNOLOGY

(An Autonomous Institution Permanently Affiliated to JNTUK, Kakinada)
(Accredited by NAAC with "A" Grade and ISO 9001:2015 Certified Institution)
POTHAVARAPPADU (V), (VIA) NUNNA, AGIRIPALLI (M), PIN – 521 212

DEPARTMENT OF ELECTRONICS AND COMMUNICATION ENGINEERING

COURSE STRUCTURE FOR FIRST YEAR B.TECH PROGRAMME-NRIA 20 REG

I YEAR I SEMESTER

Sl. No	Course Code	Title of the Course	Scheme of Instruction (Periods Per Week)				Scheme of Examination (Maximum Marks)			No. of Credits
			L	T	P	Total	CIA	SEA	Total	
1	HS	Professional Communication	3	0	0	3	30	70	100	3
2	BS	Engineering Mathematics – I	3	0	0	3	30	70	100	3
3	BS	Applied Physics	3	0	0	3	30	70	100	3
4	ES	Engineering Graphics	3	0	0	3	30	70	100	3
5	ES	Programming And Problem Solving With C	3	0	0	3	30	70	100	3
6	HS	Applied Physics Lab	0	0	3	3	15	35	50	1.5
7	BS	Programming And Problem Solving With C Lab	0	0	3	3	15	35	50	1.5
Total			15	0	6	21	180	420	600	18

I YEAR II SEMESTER

Sl. No	Course Code	Title of the Course	Scheme of Instruction (Periods Per Week)				Scheme of Examination (Max Marks)			No. of Credits
			L	T	P	Total	CIA	SEA	Total	
1	HS	Engineering Mathematics – II	3	0	**0**	3	30	70	100	3
2	BS	Applied Chemistry	3	0	0	3	30	70	100	3
3	BS	Java Programming	2	0	2	4	30	70	100	3
4	ES	Network Analysis	3	1	0	4	30	70	100	4
5	PC	Basic Electrical Engineering	3	0	0	3	30	70	100	3
6	MC	Environmental Sciences	2	0	0	2	30	70	100	0
7	HS	Communicative English Lab	0	0	3	3	15	35	50	1.5
8	BS	Applied Chemistry Lab	0	0	3	3	15	35	50	1.5
9	ES	Basic Electrical Engineering Lab	0	0	3	3	15	35	50	1.5
10		Electronic Workshop Lab	0	0	3	3	15	35	50	1.5
Total			16	1	14	31	240	560	800	22

L - LECTURE T – TUTORIAL P - PRACTICAL
CIA – Continuous Internal Assessment SEA – Semester End Assessment

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DEPARTMENT OF ELECTRONICS AND COMMUNICATION ENGINEERING

COURSE STRUCTURE FOR SECOND YEAR B.TECH PROGRAMME-NRIA 20 REG

II YEAR I SEMESTER

Sl. No	Course Code	Title of the Course	Scheme of Instruction (Periods Per Week)				Scheme of Examination (Max Marks)			No. of Credits
			L	T	P	Total	CIA	SEA	Total	
1	BS	Vector Calculus, Complex Variables and Partial Differential Equations	3	-	-	3	30	70	100	3
2	PC	Signals and Systems	3	-	-	3	30	70	100	3
3	PC	Electronic Devices and circuits	3	-	-	3	30	70	100	3
4	PC	Switching Theory and Logic Design	3	-	-	3	30	70	100	3
5	PC	Random Variables and Stochastic Processes	3	-	-	3	30	70	100	3
6	PC LAB	Basic Simulation Lab	-	-	3	3	15	35	50	1.5
7	PC LAB	Electronic Devices and circuits Lab	-	-	3	3	15	35	50	1.5
8	PC LAB	Switching Theory and Logic Design Lab	-	-	3	3	15	35	50	1.5
9	SC*	Electronic Circuit Design	1	-	2	3	-	50	50	2
10	MC	Constitution of India	2	-	-		30	70	100	0
Total			**18**	**0**	**11**	**29**	**225**	**575**	**800**	**21.5**

II YEAR II SEMESTER

Sl. No	Course Code	Title of the Course	Scheme of Instruction (Periods Per Week)				Scheme of Examination (Max Marks)			No. of Credits
			L	T	P	Total	CIA	SEA	Total	
1	ES	Linear Control Systems	3	-	-	3	30	70	100	3
2	PC	Analog Communications	3	-	-	3	30	70	100	3
3	PC	Analog and Pulse Circuits	3	-	-	3	30	70	100	3
4	PC	Electromagnetic Waves and Transmission Lines	3	-	-	3	30	70	100	3
5	HS	Managerial Economics and Financial Analysis	3	-	-	3	30	70	100	3
6	PC LAB	Analog Communications Lab	-	-	3	3	15	35	50	1.5
7	PC LAB	Analog and Pulse Circuits Lab	-	-	3	3	15	35	50	1.5
8	PC LAB	VHDL Programming Lab	-	-	3	3	15	35	50	1.5
9	SC*	Python Programming	1	-	2	3	-	50	50	2
Total			**16**	**0**	**11**	**27**	**195**	**505**	**700**	**21.5**

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DEPARTMENT OF ELECTRONICS AND COMMUNICATION ENGINEERING

COURSE STRUCTURE FOR THIRD YEAR B.TECH PROGRAMME

III YEAR I SEMESTER

Sl. No	Course Code	Title of the Course	Scheme of Instruction (Periods Per Week)				Scheme of Examination (Max Marks)			No. of Credits
			L	T	P	Total	CIA	SEA	Total	
1	PC	Linear and Digital Integrated Circuits	3	-	-	3	30	70	100	3
2	PC	Antennas and Wave Propagation	3	-	-	3	30	70	100	3
3	PC	Digital Communications	3	-	-	3	30	70	100	3
4	OE	Open Elective	3	-	-	3	30	70	100	3
5	PE	i) Computer architecture and Organization ii) Biomedical Engineering iii) Electromagnetic Interference and Electromagnetic Compatibility	3	-	-	3	30	70	100	3
6	PC LAB	Linear and Digital Integrated Circuits Lab	-	-	3	3	15	35	50	1.5
7	PC LAB	Digital Communications Lab	-	-	3	3	15	35	50	1.5
8	SC*	Internet of Things	1	-	2	3	-	50	50	2
9	MC	Intellectual Property Rights and Patents	-	-	2	3	30	70	100	0
Summer Internship two months (mandatory)after second year (to be evaluated during V semester)			0	0	0	0	15	35	50	1.5
Total			16	-	10	27	255	595	850	21.5

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DEPARTMENT OF ELECTRONICS AND COMMUNICATION ENGINEERING

COURSE STRUCTURE FOR THIRD YEAR B.TECH PROGRAMME

III YEAR II SEMESTER

Sl. No	Course Code	Title of the Course	Scheme of Instruction (Periods Per Week)				Scheme of Examination (Max Marks)			No. of Credits
			L	T	P	Total	CIA	SEA	Total	
1	PC	Microprocessors and Microcontrollers	3	-	-	3	30	70	100	3
2	PC	Digital Signal Processing	3	-	-	3	30	70	100	3
3	PC	VLSI Design	3	-	-	3	30	70	100	3
4	PE	i) Optical Communications ii) Embedded Systems iii) Radar Systems	3	-	-	3	30	70	100	3
5	OE	Open Elective	3	-	-	3	30	70	100	3
6	PC LAB	VLSI Lab	-	-	3	3	15	35	50	1.5
7	PC LAB	Microprocessors and Microcontrollers Lab	-	-	3	3	15	35	50	1.5
8	PC LAB	Digital Signal Processing Lab	-	-	3	3	30	70	100	1.5
9	SC*	Sensors and Instrumentation	2	-	-	2	-	50	50	2
10	MC	Professional Ethics and Human Values	2	-	-	2	30	70	100	0
Total			19	-	9	28	240	630	900	21.5
Honors/Minor Courses(the hours distribution can be 3-0-2 or 3-1-0)			4	-	-	4	30	70	100	4
Industrial / Research Internship(Mandatory) 2 Months during summer vacation										

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DEPARTMENT OF ELECTRONICS AND COMMUNICATION ENGINEERING

COURSE STRUCTURE FOR FOURTH YEAR B.TECH PROGRAMME-NRIA-20 Reg

IV YEAR I SEMESTER

Sl. No	Course Code	Title of the Course	Scheme of Instruction (Periods Per Week)				Scheme of Examination (Max Marks)			No. of Credits
			L	T	P	Total	CIA	SEA	Total	
1	PE III	i) Low Power VLSI Design ii) Data Communications & Computer Networks iii) Electronic Measurements and Instrumentation	3	-	-	3	30	70	100	3
2	PE IV	i) Digital Image Processing ii) Digital IC Design using CMOS iii) Satellite Communications	3	-	-	3	30	70	100	3
3	PE V	i) Soft Computing skills ii) Machine learning iii) Cellular Mobile Communications	3	-	-	3	30	70	100	3
4	OE	**Open Elective - III**	3	-	-	3	30	70	100	3
5	OE	**Open Elective - IV**	3	-	-	3	30	70	100	3
6	HSE	Universal Human Values	3	-	-	3	30	70	100	3
7	SC*	Microwave & RF Communication Laboratory	1	-	2	3	15	35	50	2
8	MC	Employability Skills	2	-	-	2	30	70	100	0
Industrial / Research Internship(Mandatory) after third year to be evaluated during VII semester			-	-	-	2	-	50	50	2
Total			21	-	2	25	225	575	800	22
Honors/Minor Courses(the hours distribution can be 3-0-2 or 3-1-0)			4	-	-	4	30	70	100	4

IV YEAR II SEMESTER

Sl. No	Course Code	Title of the Course	Scheme of Instruction (Periods Per Week)				Scheme of Examination (Max Marks)			No. of Credits
			L	T	P	Total	CIA	SEA	Total	
1		Major Project work	-	-	-	-	40	60	100	8
2		Community Service Project	-	-	-	-	-	50	50	4
Total										12

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DEPARTMENT OF ELECTRONICS AND COMMUNICATION ENGINEERING

STRUCTURE FOR FIRST YEAR B.TECH PROGRAMME- NRIA 20 REG

I YEAR I SEMESTER

`Sl. No	Course Code	Title of the Course	Scheme of Instruction (Periods Per Week)				Scheme of Examination (Maximum Marks)			No. of Credits
			L	T	P	Total	CIA	SEA	Total	
1	**20A1100101**	Professional Communication	3	0	0	3	30	70	100	3
2	**20A1100201**	Engineering Mathematics-I	3	0	0	3	30	70	100	3
3	**20A1100203**	Applied Physics	3	0	0	3	30	70	100	3
4	**20A1103301**	Engineering Graphics	3	0	0	3	30	70	100	3
5	**20A1105301**	Programming and Problem Solving with C	3	0	0	3	30	70	100	3
6	**20A1100292**	Applied Physics Lab	0	0	3	3	15	35	50	1.5
7	**20A1105391**	Programming and Problem Solving with C Lab	0	0	3	3	15	35	50	1.5
Total			**15**		**6**	**21**	**180**	**420**	**600**	**18**

I YEAR II SEMESTER

Sl. No	Course Code	Title of the Course	Scheme of Instruction (Periods Per Week)				Scheme of Examination (Maximum Marks)			No. of Credits
			L	T	P	Total	CIA	SEA	Total	
1	**20A1200201**	Engineering Mathematics-II	3	0	0	3	30	70	100	3
2	**20A1200205**	Applied Chemistry	3	0	0	3	30	70	100	3
3	**20A1205302**	Java Programming	2	0	2	4	30	70	100	3
4	**20A1204301**	Network Analysis	3	1	0	4	30	70	100	4
5	**20A1202302**	Basic Electrical Engineering	3	0	0	3	30	70	100	3
6	**20A1200801**	Environmental Sciences	2	0	0	2	30	70*	100	0
7	**20A1200191**	Communicative English Lab	0	0	3	3	15	35	50	1.5
8	**20A1200294**	Applied Chemistry Lab	0	0	3	3	15	35	50	1.5
9	**20A1202392**	Basic Electrical Engineering Lab	0	0	3	3	15	35	50	1.5
10	**20A1202391**	Electronic Workshop Lab	0	0	3	3	15	35	50	1.5
Total			**16**	**1**	**14**	**31**	**240**	**560**	**800**	**22**

*** Internal Evaluation**

L - LECTURE T – TUTORIAL P - PRACTICAL

CIA – Continuous Internal Assessment SEA – Semester End Assessment

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20A1100101: PROFESSIONAL COMMUNICATION
(Common to CE,EEE,ME,ECE,CSE,IT,AIML and DS)

Lecture – Tutorial:	3-1 Hours	**Internal Marks:**	30
Credits	3	**External Marks:**	70

Prerequisites: None

Course Objectives

1. To strengthen the lexical ability of the students in different contexts.
2. To expose the students to various sub-skills and strategies of reading and writing – summarizing and paraphrasing.
3. To help the students develop effective writing skills through paragraph writing.
4. To train the students in fundamentals of grammar required to equip them with fluent English.
5. To enable the students to think critically by exposing them to different socio-cultural contexts through various literary texts.

Course Outcomes

Upon successful completion of the course, the student will be able to:

CO1	Build the grammatical structures accurately in their real-time situations in either spoken or written form.
CO2	Extend their ability to use vocabulary from various texts along with GRE and technical vocabulary in written and spoken communication
CO3	Comprehend, analyze and evaluate texts critically. Demonstrate effective writing skills in specific forms of written communication (paragraphs, summaries, email and letters.)
CO4	Apply the strategies of reading various texts and graphs, and describe in prose.
CO5	Relate human values and professional ethics in their academic, professional and social lives.
CO6	Summarize the main events of the literary texts, from different socio-cultural contexts, and interpret them critically.

Contribution of Course Outcomes towards achievement of Program Outcomes (1 – Low, 2- Medium, 3 – High)

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO1										1		2
CO2										1		2
CO3										2		2
CO4										1		2
CO5							1	1				2
CO6												2

UNIT I

1. **Text: A Drawer full of happiness** from "**Infotech English**", Maruthi Publications
2. **Reading:** Skimming text to get the main idea. Scanning to look for specific pieces of information.
3. **Reading for Writing:** Paragraph Writing (specific topics) using suitable Cohesive Devices; Linkers, Sign Posts and Transition Signals; Mechanics of Writing - Punctuation, Capital Letters.
4. **Vocabulary:** Technical vocabulary from across technical branches (20) GRE Vocabulary (20) (Antonyms and Synonyms, Word applications) Verbal Reasoning and Sequencing of Words.
5. **Grammar:** Content Words and Function Words; Word Forms: Verbs, Nouns, Adjectives and Adverbs; Nouns: Countables and Uncountables; Singular and Plural, Basic Sentence Structures; Simple Question Form - WH- Questions; Word Order in Sentences. Collocations (30 Phrases)

UNIT II

1. **Text: Nehru's letter to his daughter Indira on her birthday** from "**Infotech English**", Maruthi Publications
2. **Reading**: Identifying sequence of ideas; recognizing verbal techniques that help to link the ideas in a paragraph together

3. **Reading for Writing**: Summarizing - identifying main idea/s and rephrasing what is read; avoiding redundancies and repetitions.
4. **Vocabulary**: Technical vocabulary from across technical branches (20 words). GRE Vocabulary Analogies (20 words) (Antonyms and Synonyms, Word applications)
5. **Grammar**: Use of Articles and Zero Article; Prepositions; Connectives (25 words)

UNIT III

1. **Text: Stephen Hawking-Positivity 'Benchmark'** from "**Infotech English**", Maruthi Publications
2. **Reading**: Reading a text in detail by making basic inferences - recognizing and interpreting specific context clues; strategies to use text clues for comprehension. Critical Reading.
3. **Reading for Writing**: Summarizing - Identifying main ideas and Rephrasing what is read; avoiding Redundancies and Repetitions. Letter Writing-types, Format and Principles of Letter Writing. E-mail Etiquette, Writing CVs.
4. **Vocabulary**: Technical vocabulary from across technical branches (20 words). GRE Vocabulary (20 words) (Antonyms and Synonyms, Word applications) Association, Sequencing of Words
5. **Grammar**: Verbs, Phrasal Verbs - Tenses; Subject-Verb Agreement;

UNIT IV

1. **Text: Liking a Tree, Unbowed: Wangari Maathai-biography** from "**Infotech English**", Maruthi Publications
2. **Reading**: Studying the use of graphic elements in texts to convey information, reveal trends / patterns / relationships, communicative process or display complicated data.
3. **Reading for Writing**: Information transfer; describe, compare, contrast, identify significance/trends based on information provided in figures/charts/graphs/tables. Writing SOP, writing for media.
4. **Vocabulary**: Technical vocabulary from across technical branches (20 words) GRE Vocabulary (20 words) (Antonyms and Synonyms, Word applications) Cloze Encounters.
5. **Grammar**: Quantifying Expressions - Adjectives and Adverbs; Comparing and Contrasting; Use of Antonyms; Direct and Indirect Speech, Reporting Verbs for Academic Purposes. Idiomatic Expressions (25 Idioms)

UNIT V

1. **TEXT: Stay Hungry-Stay foolish** from "**Infotech English**", Maruthi Publications
2. **Reading**: Reading for Comprehension. RAP Strategy Intensive Reading and Extensive Reading Techniques.
3. **Reading for Writing**: Report writing (Significance, Format and Style of Writing Technical Reports)
4. **Vocabulary**: Technical vocabulary from across technical branches (20 words) GRE Vocabulary (20 words) (Antonyms and Synonyms, Word applications) Coherence, Matching Emotions.
5. **Grammar**: Change of Voice; Editing Short Texts – Identifying and Correcting Common Errors in grammar and usage (Articles, Prepositions, Tenses, Subject-Verb Agreement)

Text Book: "Infotech English", Maruthi Publications.

REFERENCE BOOKS:

1. **English Grammar in Use**, Raymond Murphy, Cambridge University Press.
2. **Oxford Practice Grammar,** John Eastwood, Oxford University Press.
3. **The Most Common Mistakes in English Usage** – Thomas Elliott Berry
4. **Essential Communication Skills** – Shalini Agarwal, Ane Books Pvt Ltd.
5. **Dictionary of Synonyms and Antonyms**, Oxford & IBH, III Ed
6. **A Practical English Grammar**, Agnes V. Martinet and Audrey Jean Thomson, Oxford University Press.
7. **English Vocabulary in Use,** Michael McCarthy and Felicity O'Dell, Cambridge University Press

E-RESOURCES

1. https://www.grammarbank.com/
2. http://guidetogrammar.org/grammar/index.htm
3. https://writeandimprove.com/
4. https://englishforeveryone.org/
5. http://www.englishvocabularyexercises.com/
6. https://englishplusmagazine.com/

20A1100201 ENGINEERING MATHEMATICS-I
(Common to CE,EEE,ME,ECE,CSE,IT,AIML and DS)

Lecture – Tutorial:	3-1	**Internal Marks:**	30
Credits:	3	**External Marks:**	70

Prerequisites: Fundamentals of matrices, Fundamentals of Trigonometry and Calculus.

Course Objectives:

- To instruct the concept of Matrices in solving linear algebraic equations
- To elucidate the different numerical methods to solve nonlinear algebraic equations
- To disseminate the use of different numerical techniques for carrying out numerical integration.
- To equip the students with standard concepts and tools at an intermediate to advanced level mathematics to develop the confidence and ability among the students to handle various real world problems and their applications.

Course Outcomes:

CO1	Student will be able to develop the **use** of matrix algebra techniques that is needed by engineers for practical applications (L6) solve system of linear algebraic equations using Gauss elimination, Gauss Seidel and **write** Eigen values and eigenvectors of a matrix (L3)
CO2	Student will be able to **write** diagonal form and different factorizations of a matrix (L3), to find inverse of a matrix and integral powers of a matrix by Cayley-Hamilton Theorem **identify** the nature of a Quadratic form such as positive definite, positive semi definite etc., and use this information to facilitate the calculation of matrix characteristics (L2)
CO3	Student will be able to **evaluate** the approximate roots of polynomial and transcendental equations by different algorithms (L5)
CO4	Student will be able to **apply** Newton's forward & backward interpolation and Lagrange's formulae for unequal intervals (L3)
CO5	Student will be able to **apply** numerical integral techniques to different Engineering problems (L3)
CO6	Student will be able to **apply** different algorithms for approximating the solutions of ordinary differential equations with initial conditions to its analytical computations (L3)

Contribution of Course Outcomes towards achievement of Program Outcomes (1 – Low, 2- Medium, 3 – High)

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO1	3	3	2	2	-	-	-	-	-	-	-	-
CO2	3	3	2	2	-	-	-	-	-	-	-	-
CO3	3	3	2	2	-	-	-	-	-	-	-	-
CO4	3	3	2	2	-	-	-	-	-	-	-	-
CO5	3	3	2	2	-	-	-	-	-	-	-	-
CO6	3	3	2	2	-	-	-	-	-	-	-	-

UNIT – I: Solving systems of linear equations, Eigen values and Eigen vectors: (10hrs)

Rank of a matrix by echelon form and normal form – Solving system of homogeneous and non- homogeneous linear equations – Gauss Elimination method – Eigen values and Eigen vectors and properties.

Unit–II:Cayley–Hamilton theorem and Quadratic forms: (10hrs)

Cayley-Hamilton theorem (without proof) – Applications – Finding the

inverse and power of a matrix by Cayley-Hamilton theorem – Reduction to Diagonal form – Quadratic forms and nature of the quadratic forms – Reduction of quadratic form to canonical forms by orthogonal transformation.

UNIT–III:Iterativemethods: (8 hrs)

Introduction– Bisection method – Method of false position– Iteration method

Newton-Raphson method (One variable).

Gauss-Jacobi and Gauss-Seidel methods for solving system of equations numerically.

UNIT – IV: Interpolation: (10 hrs)

Introduction– Errors in polynomial interpolation – Finite differences– Forward differences– Backward differences –Central differences – Relations between operators – Newton's forward and backward formulae for interpolation – Interpolation with unequal intervals – Lagrange's interpolation formula.

UNIT –V: Numerical integration and Solution of ordinary differential equations with initialconditions (10 hrs)

Trapezoidal rule– Simpson's $1/3^{rd}$ and $3/8^{th}$ rule– Solution of initial value problems by Taylor's series– Picard's method of successive approximations– Euler's method –Modified Euler's method – Runge-Kutta method (second and fourth order).

TEXT BOOKS:

1. **B. S. Grewal,** Higher Engineering Mathematics, 44^{th} Edition, Khanna Publishers.
2. **B. V. Ramana,**Higher Engineering Mathematics, 2007 Edition, Tata Mc. Graw Hill Education.
3. **David Poole,** Linear Algebra- A modern introduction, 4^{th} Edition, Cengage.

REFERENCE BOOKS:

1. **Steven C. Chapra,** Applied Numerical Methods with MATLAB for Engineering and Science,Tata Mc. Graw Hill Education.
2. **M. K. Jain, S.R.K. Iyengar and R.K. Jain,** Numerical Methods for Scientific and Engineering Computation, New Age International Publications.
3. **Lawrence Turyn,** Advanced Engineering Mathematics, CRC Press.

E-RESOURCES:1. www.nptel **videos.com/mathematics/(Math Lectures from MIT,Stanford,IIT'S**

2. nptl.ac.in/courses/1221104017

20A1100203 : **APPLIED PHYSICS**
(Common to EEE and ECE)

Lecture – Tutorial:	3-0	**Internal Marks:**	30
Credits:	3	**External Marks:**	70

Prerequisites: Knowledge on fundamental concepts of waves, optics, sound and magnetism

Course Objectives:

- The course aims at making students to understand the basic concepts of Principles of Physics in a broader sense with a view to lay foundation for the various engineering courses.
- To develop analytical capability and solve various engineering problems.

Course Outcomes:

CO1	Apply the interaction of light with matter through interference, diffraction, polarization and identify these phenomena in different natural optical processes and optical instruments.
CO2	Apply the comprehended knowledge about laser and fibre optic communication systems in various engineering applications.
CO3	Interpret the knowledge of dielectric and magnetic materials with characteristic utility in appliances.
CO4	Apply the knowledge of basic quantum mechanics, to set up one dimensional Schrodinger's wave equation and its application to a infinite potential well.
CO5	Summarize the importance of free electrons in determining the properties of metals and understand the origin & role of energy bands in classifying the solids
CO6	Understand the physics of Semiconductors and their working mechanism for their utility in sensors.

Contribution of Course Outcomes towards achievement of Program Outcomes (1 – Low, 2- Medium, 3 – High)

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO1	3				3					3		
CO2	3	3		2	2					3		
CO3	3	3			2							
CO4	3											
CO5	3		2		2							
CO6	3				2							

Unit-I: Wave Optics
(12hrs)

Interference: Principle of superposition –Interference of light - Interference in thin films (Reflection Geometry) - Colors in thin films- Newton's Rings- Determination of wavelength and refractive index.

Diffraction: Introduction - Fresnel and Fraunhofer diffraction - Fraunhofer diffraction due to single slit, double slit - N-slits (Qualitative) – Diffraction Grating - Dispersive power and resolving power of Grating (Qualitative).

Polarization: Introduction-Types of polarization - Double refraction - Nicol's Prism - Half wave and Quarter wave plates.

Unit-II: Lasers and Fiber optics
(8hrs)

Lasers: Introduction – Characteristics of laser – Spontaneous and Stimulated emissions of radiation – Einstein's coefficients – Population inversion – Lasing action - Pumping Schemes – Ruby laser – He-Ne laser - Applications of lasers.

Fiber optics: Introduction –Principle of optical fiber- Acceptance Angle - Numerical Aperture -
Classification of optical fibers based on refractive index profile and modes – Propagation of electromagnetic wave through optical fibers - Applications.

Unit-III: Magnetic and Dielectric Materials

(10hrs)

Magnetic Materials: Introduction - Origin of permanent magnetic moment - Classification of magnetic materials: Dia, para, Ferro, antiferro & Ferri magnetic materials - Domain concept for Ferromagnetism & Domain walls (Qualitative) - Hysteresis - soft and hard magnetic materials.

Dielectric Materials: Introduction - Dielectric polarization - Dielectric polarizability, Susceptibility and Dielectric constant - Types of polarizations- Electronic (Quantitative), Ionic (Quantitative) and Orientation polarizations (Qualitative) - Lorentz internal field- Clausius- Mossotti equation.

Unit IV: Quantum Mechanics, Free Electron Theory

(8hrs)

Quantum Mechanics: Dual nature of matter – Heisenberg's Uncertainty Principle – Significance and properties of wave function – Schrodinger's time independent and dependent wave equations– Particle in a one-dimensional infinite potential well.

Free Electron Theory: Classical free electron theory (Qualitative with discussion of merits and demerits) – Quantum free electron theory– Equation for electrical conductivity based on quantum free electron theory- Fermi-Dirac distribution- Fermi energy-Density of states.

Unit – V: Band theory of Solids &Semiconductors

(10hrs)

Band theory of Solids: Bloch's Theorem (Qualitative) - Kronig - Penney model (Qualitative)- E vs K diagram - v vs K diagram - effective mass of electron – Classification of crystalline solids-Concept of hole.

Semiconductors: Introduction- Intrinsic semiconductors – Density of charge carriers – Electrical conductivity – Fermi level – extrinsic semiconductors – density of charge carriers – dependence of Fermi energy on carrier concentration and temperature - Drift and diffusion currents – Einstein's equation- Hall effect – Hall coefficient –Applications of Hall effect.

TEXT BOOKS:

1. **M. N. Avadhanulu, P.G.Kshirsagar & TVS Arun Murthy**" A Text book of Engineering Physics"- S.Chand Publications, 11th Edition 2019.
2. Engineering Physics by **P.K.Palanisamy** SciTech publications

REFERENCE BOOKS:

1. Engineering Physics by **M.R.Srinivasan**, New Age international publishers (2009).
2. Engineering Physics - **Sanjay D. Jain, D. Sahasrabudhe and Girish**, University Press
3. **B.K. Pandey and S. Chaturvedi**, Engineering Physics, Cengage Learning

E-RESOURCES: www.doitpoms.ac.uk,
http://www.itp.uni-hannover.de/~zawischa/ITP/diffraction.html,
http://www.coherent.com/products/?834/Lasers,
http://plato.stanford.edu/entries/qm/

20A1103301: ENGINEERING GRAPHICS

(Common to EEE and ECE)

Lecture – Practical:	**2 - 2 Hours**	**Internal Marks:**	**30**
Credits:	**3**	**External Marks:**	**70**

Prerequisites:

1. Knowledge of basic Mathematics
2. Drawing skills

Course Objectives:

1. To introduce the students the usage of drawing instruments and to draw polygons, Engg. Curves and scales.
2. To introduce the students to use orthographic projections, projection of points & simple lines.
3. To make the students draw the projections of the lines inclined to both the planes.
4. To make the students draw the projections of the plane inclined to both the planes.
5. To make the students draw the projections of the various types of solids in different positions inclined to one of the planes.
6. To represent the object in 3D view through isometric views and to convert the isometric view to orthographic view and vice versa.

Course Outcomes:

Upon successful completion of the course, the student will be able to:

CO1	Understand the simple geometric constructions like polygons, engineering curves.
CO2	Understand the orthographic projections of points and lines
CO3	Understand the orthographic projections of straight lines- inclined to one plane and inclined to both the planes.
CO4	Understand the orthographic projections of planes and Planes inclined to both the planes.
CO5	Understand and draw the projections of the various types of solids in different positions inclined to one of the planes
CO6	Understand the transformation of orthographic views into isometric views and vice versa.

Contribution of Course Outcomes towards achievement of Program Outcomes (1 – Low, 2- Medium, 3 – High)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2	-	-	-	-	-	-	-	3	-	1
CO2	3	2	-	-	-	-	-	-	-	3	-	1
CO3	3	2	-	-	-	-	-	-	-	3	-	1
CO4	3	2	-	-	2	-	-	-	-	3	-	1
CO5	3	2	-	-	2	-	-	-	-	3	-	1
CO6	3	2	-	-	2	-	-	-	-	3	-	1

UNIT I

Polygons: Constructing regular polygons by general methods, inscribing and describing polygons on circles.

Curves: Parabola, Ellipse and Hyperbola by general and special methods, tangents & normals for the curves.

Scales: Plain scales, diagonal scales and vernier scales

UNIT II

Orthographic Projections: Reference plane, importance of reference lines, projections of points in various quadrants, projections of lines, line parallel to both the planes, line parallel to one plane and inclined to other plane.
Projections of straight lines inclined to both the planes, determination of true lengths, angle of inclination.

UNIT III

Projections of planes: regular planes perpendicular/parallel to one reference plane and inclined to the other reference plane; inclined to both the reference planes.

UNIT IV

Projections of Solids – Prisms, Pyramids, Cones and Cylinders with the axis inclined to both the planes.

UNIT V

Conversion of isometric views to orthographic views; Conversion of orthographic views to isometric views.
Computer Aided Design, Drawing practice using Auto CAD, Creating 2D&3D drawings of objects using Auto CAD

Note: In the End Examination there will be no question from CAD.

TEXT BOOKS:

1. Engineering Drawing by N.D. Butt, Chariot Publications
2. Engineering Drawing by Agarwal & Agarwal, Tata McGraw Hill Publishers

REFERENCE BOOKS:

1. Engineering Drawing by K.L.Narayana & P. Kannaiah, Scitech Publishers
2. Engineering Graphics for Degree by K.C. John, PHI Publishers
3. Engineering Graphics by PI Varghese, McGrawHill Publishers
4. Engineering Drawing + AutoCad – K Venugopal, V. Prabhu Raja, New Age

20A1105301:-Programming and Problem solving with C
(Common to EEE,ME,ECE,CSE,IT,AIML and DS)

Lecture – Tutorial-Practical::	3-0-0	**Internal Marks:**	30
Credits:	3	**External Marks:**	70

Prerequisites: Basic knowledge on computers, Mathematics

Course Objectives: The objectives of Programming for Problem Solving Using C are

- To learn about the computer systems, computing environments, developing of a computer program and Structure of a C Program
- To gain knowledge of the operators, selection, control statements and repetition in C
- To learn about the design concepts of arrays, strings, enumerated structure and union types and their usage.
- To assimilate about pointers, dynamic memory allocation and know the significance of Preprocessor.
- To assimilate about File I/O and significance of functions

Course Outcomes:

Upon successful completion of the course, the student will be able to:

CO1	Understand the programming terminology and implement various c-tokens & input-output statements to solve simple problems
CO2	Able to compare and differentiate various looping & branching constructs and apply the best looping structure for a given problem
CO3	Identify the necessity of modularity in programming and design various function types
CO4	Understand pointers and implement the programs to directly access memory locations
CO5	Interpret and implement the need of arrays and structure/union to store homogeneous and heterogeneous groups of data
CO6	Contrast the need of using files in programming and implement file operations

Contribution of Course Outcomes towards achievement of Program Outcomes (1 – Low, 2- Medium, 3 – High)

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO1	3		1									
CO2		1	3									
CO3		1	3									
CO4	3		1									
CO5			3									
CO6			3									

UNIT I : Objective: Notion of Computer Languages, algorithm, computational procedure, editing and executing programs and C Declarations

BASICS AND INTRODUCTION TO C: Basics of Computer, Introduction to C, Machine, Assembly and High level Language, Assembler, Compiler and Interpreter, Structure of a C program, Programming Rules, Executing the C Program, Advantages of C, Header Files, Flow Chart, Algorithm.

THE C DECLARATIONS: The C-Character set, Delimiters, Types of Tokens, The C keywords, Identifiers, Constants, Variables, C Data types, initialization, type modifiers, type conversions, constant and volatile variables. Properties of Operators, Operator Priority ,comma and conditional operators, arithmetic, relational, assignment operators and expressions, logical , bitwise operators. Input and output in c: Formatted and Unformatted functions

UNIT II: Objective: Understanding branching, iteration, data representation using arrays and strings

DECISION STATEMENTS: The if statement, if-else, nested if else, if-else-if ladder, break, continue, goto, Switch statement, nested switch case, Switch case and nested ifs.
LOOP CONTROL: for loop, nested for loop, while, do-while, do-while statement with while loop.
ARRAYS: Array initialization, array terminology, characteristics of an array, 1-D array and its operations, 2-D arrays and operations, Multi -dimensional arrays.
STRINGS: Declaration and initialization of string, string standard functions, string conversion functions, memory functions, application of strings.

UNIT III: Objective: Modular programming and recursive solution formulation and storage classes

FUNCTIONS: Basics, function definition, return statement, types of functions, call by value ,call by reference, function as an argument, Functions with operators, Function and Decision Statements, Functions and loop Statements, Functions with arrays and Pointers, Recursion-Types of Recursion, Rules for Recursive Function, Recursion versus Iterations, Advantages and Disadvantages of Recursion, Efficiency of Recursion, Library Functions.
STORAGE CLASS: Variable Lifetime, Automatic Variables, External Variables, Static Variables, Register Variables.

UNIT IV: Objective: Understanding pointers, dynamic memory allocation and Preprocessor Directives.

POINTERS: Features of pointers, pointers and address, pointer declaration, void pointers, arithmetic operations with pointers, pointers and arrays, array of pointers, pointers to pointers, pointers and strings. Dynamic memory allocation
PREPROCESSOR DIRECTIVES: The #define Directive, Defining and Undefining a Macros, The #include Directive

UNIT V: Objective: Understanding derived data types of C and basic of file operations.

STRUCTURE AND UNION: Features of Structures, Declaration and initialization of Structures, Structure within Structure, Arrays of Structure, Pointer to Structure, Structure and functions, typedef, Bit fields, Enumerated Data Type, Unions and Unions Vs Structures.
FILES: Streams and File Types, Steps for File Operations, FILE I/O, Structures Read and Write, Other file function, Command line Arguments.

TEXT BOOKS:

[1] Behrouz A. Forouzan & Richard F. Gilberg , —"Computer Science A Structured Programming Approach using C" , CENGAGE Learning, Third Edition.

REFERENCE BOOKS:

[1]Kernighan and Ritchie , —"The C programming language" , The (Ansi C Version), PHI, second edition.
[2]Yashwant Kanetkar , —"Let us C" , BPB Publications, 2nd Edition 2001.
[3]Paul J. Dietel and Dr. Harvey M. Deitel, —"C: How to Program", Prentice Hall, 7 th edition (March 4,2012).
[4]Herbert Schildt, —"C:The Complete reference", McGraw Hill, 4th Edition, 2002.
[5]K.R.Venugopal, Sundeep R Prasad, —"Mastering C", McGraw Hill, 2nd Edition, 2015

E-RESOURCES:

1.http://cslibrary.stanford.edu/101/EssentialC.pdf
2. http://nptel.ac.in/courses/106104128/
3.http://www.vssut.ac.in/lecture_notes

20A1100292:- Applied Physics Lab
(Common to EEE,ME,ECE,CSE,IT,AIML and DS)

Labs / Instructions Hours/Week	0-0-4	**Internal Marks:**	30
Credits:	1.5	**External Marks:**	70

Prerequisites: Knowledge on vernier callipers, Screw guage, common balance

Course Objectives:

- The Objective of this course is to make the students gain practical knowledge to co-relate with the theoretical studies.
- To achieve perfectness in experimental skills and the study of practical applications will bring more confidence and ability to develop and fabricate engineering and technical equipments.
- Training field oriented Engineering graduates to handle instruments and their design methods to improve the accuracy of measurements.

Course Outcomes:

CO1	Understand principle, concept, working of an instrument and can compare results with theoretical calculations.
CO2	Analyze the physical principle involved in the various instruments; also relate the principle to new application.
CO3	Understand design of an instrument with targeted accuracy for physical measurements.
CO4	Develop skills to impart practical knowledge in real time solution.
CO5	The various experiments in the areas of optics, mechanics and thermal physics will nurture the students in all branches of Engineering..
CO6	Think innovatively and also improve the creative skills that are essential for engineering.

Contribution of Course Outcomes towards achievement of Program Outcomes (1 – Low, 2-Medium, 3 – High)

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO1	3											
CO2	3	3		3					3			
CO3	3	3	1	3					3			
CO4	3	3		3								
CO5	3											
CO6	3	3	2	3								

List of Experiments

1. Study of variation of magnetic field along the axis of a current carrying circular coil by Stewart & Gee's method.
2. Determination of numerical aperture and acceptance angle of an optical fiber.
3. Determination of thickness of thin object by wedge method.
4. Determination of radius of curvature of given plano convex lens by Newton's rings.
5. Determination of wavelengths of different spectral lines in mercury spectrum using diffraction grating in normal incidence configuration.
6. Determination of dispersive power of the prism.
7. Sonometer: Verification of laws of string.
8. Study of I/V Characteristics of Semiconductor diode.
9. I/V characteristics of Zener diode.
10. Melde's experiment-Longitudinal and Transverse mode.
11. Study the variation of B versus H by magnetizing the magnetic material (B-H curve).
12. Estimation of Planck's constant using photoelectric effect.
13. Determination of Hall voltage and Hall coefficient of a given semiconductor using Hall Effect
14. Determination of wavelength of Laser light using diffraction grating.
15. Rigidity modulus of material of a wire-dynamic method (Torsional pendulum).

Note: Any 8 experiments out of 15 should be done in the laboratory and 2 experiments in virtual lab.
TEXT BOOKS:
S. Balasubramanian, M.N. Srinivasan "A Text book of Practical Physics"- S Chand Publishers, 2017.
REFERENCE BOOKS:
Engineering Physics / Applied Physics Lab Manual – **Spectrum Publications**
E-RESOURCES: www.vlab.co.in

20A1105391-Programming and Problem Solving with C Lab
(Common to EEE,ME,ECE,CSE,IT,AIML and DS)

Lecture – Tutorial-Practical::	0-0-4	**Internal Marks:**	30
Credits:	1.5	**External Marks:**	70

Prerequisites:

Course Objectives:

1. To make the student learn a programming language.
2. To learn problem solving techniques.
3. To teach the student to write programs in C and to solve the problems

Course Outcomes:

Upon successful completion of the course, the student will be able to:

CO1	Understand basic Structure of the C-PROGRAMMING, declaration and usage of variables
CO2	Exercise conditional and iterative statements to inscribe C programs
CO3	Exercise user defined functions to solve real time problems
CO4	Inscribe C programs using Pointers to access arrays, strings and functions
CO5	Inscribe C programs using pointers and allocate memory using dynamic memory management functions
CO6	Exercise user defined data types including structures and unions to solve problems
CO7	Exercise files concept to show input and output of files in C

Contribution of Course Outcomes towards achievement of Program Outcomes (1 – Low, 2- Medium, 3 – High)

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO1	1	-	3	-	-	-	-	-	-	-	-	-
CO2	-	-	2	-	-	-	-	-	-	-	-	-
CO3	-	-	3	-	-	-	-	-	-	-	-	-
CO4	-	-	2	-	-	-	-	-	-	-	-	-
CO5	-	-	3	-	-	-	-	-	-	-	-	-
CO6	-	2	3	-	-	-	-	-	-	-	-	-
CO7	-	1	3	-	-	-	-	-	-	-	-	-

Exercise 1:

1. Write a C program to print a block F using hash (#), where the F has a height of six characters and width of five and four characters.
2. Write a C program to compute the perimeter and area of a rectangle with a height of 7 inches and width of 5 inches.
3. Write a C program to display multiple variables.

Exercise 2:

1. Write a C program to calculate the distance between the two points.
2. Write a C program that accepts 4 integers p, q, r, s from the user where r and s are positive and p is even. If q is greater than r and s is greater than p and if the sum of r and s is greater than the sum of p and q print "Correct values", otherwise print "Wrong values".

Exercise 3:

1. Write a C program to convert a string to a long integer.
2. Write a program in C which is a Menu-Driven Program to compute the area of the various geometrical shape.
3. Write a C program to calculate the factorial of a given number

Exercise 4:

1. Write a program in C to display the n terms of even natural number and their sum.
2. Write a program in C to display the n terms of harmonic series and their sum. 1 + 1/2 + 1/3 + 1/4 + 1/5 ... 1/n terms.
3. Write a C program to check whether a given number is an Armstrong number or not.

Exercise 5:

1. Write a program in C to print all unique elements in an array.
2. Write a program in C to separate odd and even integers in separate arrays.
3. Write a program in C to sort elements of array in ascending order.

Exercise 6:
1. Write a program in C for multiplication of two square Matrices.
2. Write a program in C to find transpose of a given matrix.

Exercise 7:
1. Write a program in C to search an element in a row wise and column wise sorted matrix.
2. Write a program in C to print individual characters of string in reverse order.

Exercise 8:
1. Write a program in C to compare two strings without using string library functions.
2. Write a program in C to copy one string to another string.

Exercise 9:
1. Write a C Program to Store Information Using Structures with Dynamically Memory Allocation
2. Write a program in C to demonstrate how to handle the pointers in the program.

Exercise 10:
1. Write a program in C to demonstrate the use of & (address of) and *(value at address) operator.
2. Write a program in C to add two numbers using pointers.

Exercise 11:
1. Write a program in C to add numbers using call by reference.
2. Write a program in C to find the largest element using Dynamic Memory Allocation.

Exercise 12:
1. Write a program in C to swap elements using call by reference.
2. Write a program in C to count the number of vowels and consonants in a string using a pointer.

Exercise 13:
1. Write a program in C to show how a function returning pointer.
2. Write a C program to find sum of n elements entered by user. To perform this program, allocate memory dynamically using malloc( ) function.

Exercise 14:
1. Write a C program to find sum of n elements entered by user. To perform this program, allocate memory dynamically using calloc( ) function. Understand the difference between the above two programs
2. Write a program in C to convert decimal number to binary number using the function.

Exercise 15:
1. Write a program in C to check whether a number is a prime number or not using the function.
2. Write a program in C to get the largest element of an array using the function.

Exercise 16:
1. Write a program in C to append multiple lines at the end of a text file.
2. Write a program in C to copy a file in another name.
3. Write a program in C to remove a file from the disk.

TEXT BOOKS:

[1] Behrouz A. Forouzan & Richard F. Gilberg , —"Computer Science A Structured Programming Approach using C" , CENGAGE Learning, Third Edition.

REFERENCE BOOKS:

[1]Kernighan and Ritchie , —"The C programming language" , The (Ansi C Version), PHI, second edition.
[2]Yashwant Kanetkar , —"Let us C" , BPB Publications, 2nd Edition 2001.
[3]Paul J. Dietel and Dr. Harvey M. Deitel, —"C: How to Program", Prentice Hall, 7 th edition (March 4,2012).
[4]Herbert Schildt, —"C:The Complete reference", McGraw Hill, 4th Edition, 2002.
[5]K.R.Venugopal, Sundeep R Prasad, —"Mastering C", McGraw Hill, 2nd Edition, 2015

E-RESOURCES:

1.http://cslibrary.stanford.edu/101/EssentialC.pdf
2. http://nptel.ac.in/courses/106104128/
3.http://www.vssut.ac.in/lecture_notes

I-II SEM

(Common to All Branches)

Lecture – Tutorial:	3-1	**Internal Marks:**	30
Credits:	3	**External Marks:**	70

Prerequisites: Fundamentals of matrices, Fundamentals of Trigonometry and Calculus.

Course Objectives:

- To familiarize a variety of well-known sequences and series, with a developing intuition about the behaviour of new ones.
- To enlighten the learners in the concept of differential equations and multivariable calculus.
- To equip the students with standard concepts and tools at an intermediate to advanced level mathematics to develop the confidence and ability among the students to handle various real world problems and their applications.

Course Outcomes:

CO1	Student will be able to **find** the General/Particular solutions of first order and first degree ordinary differential equations by **apply** different methods **(L3),** know the applications of Newton's law of cooling, natural growth and decay problems and **find** orthogonal trajectories of the given family of curves. **(L3)**
CO2	Student will be able to **identify** the essential characteristics of linear differential equations with constant coefficients. **(L2)solve** the linear differential equations with constant coefficients by appropriate method **(L3)**
CO3	Student will be able to find convergence (or) divergence of a series **(L3)**
CO4	Student will be able to utilize mean value theorems to real life problems**(L3)**
CO5	Student will be able to find partial derivatives numerically and symbolically and use them to **analyze** and interpret the way a function varies. **(L4)acquire** the Knowledge maxima and minima of functions of several variable **(L1)Utilize** Jacobian of a coordinate transformation to deal with the problems in change of variables **(L3)**
CO6	Student will be able to **find** length of the arc, volume of solid of revolution and surface area of solid of revolution**(L3)**

Contribution of Course Outcomes towards achievement of Program Outcomes (1 – Low, 2- Medium, 3 – High)

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO1	3	3	2	2								
CO2	3	3	2	2								
CO3	3	3	2	2								
CO4	3	3	2	2								
CO5	3	3	2	2								
CO6	3	3	2	2								

UNIT – I: Differential equations of first order and first degree: (10hrs)

Linear differential equations– Bernoulli's equations –Exact equations and equations reducible to exact form. Applications: Newton's Law of cooling– Law of natural growth and decay– Orthogonal trajectories.

UNIT-II: Linear Differential equations of higher order: (10hrs)

Homogeneous and Non-homogeneous differential equations of higher order with constant coefficients – with non-homogeneous term of the type e^{ax}, sin ax, cos ax, polynomials in x^n, $e^{ax}V(x)$ and $x^nV(x)$ – Method of Variation of parameters, Cauchy and Legendre's linear equations.

UNIT – III: Sequences, Series and Mean value theorems: (10hrs)

Sequences and Series: Convergences and divergence – Ratio test – Comparison tests – Integral test – Cauchy's root test – Alternate series– Leibnitz's rule.

Mean Value Theorems (without proofs): Rolle's Theorem – Lagrange's mean value theorem – Cauchy's mean value theorem – Taylor's and Maclaurin's theorems with

remainders, Problems and applications on the above theorem.

UNIT – IV: Partial differentiation: (10hrs)

Introduction – Homogeneous function – Euler's theorem– Total derivative– Chain rule– Jacobian – Functional dependence –Taylor's and MacLaurin's series expansion of functions of two variables.Applications: Maxima and Minima of functions of two variables without constraints and Lagrange's multiplied method.

UNIT – V: Multiple integrals: (8hrs) (8 hrs)

Double and Triple integrals – Change of order of integration in double integrals – Change of variables to polar, cylindrical and spherical coordinates.

Applications: Finding Areas and Volumes

TEXT BOOKS:

1. **B. S. Grewal,** Higher Engineering Mathematics, 44th Edition, Khanna Publishers.
2. **B. V. Ramana,**Higher Engineering Mathematics, 2007 Edition, Tata Mc. Graw Hill Education.

REFERENCE BOOKS:

1. **Erwin Kreyszig,** Advanced Engineering Mathematics, 10th Edition, Wiley-India.
2. **Joel Hass, Christopher Heil and Maurice D. Weir,** Thomas calculus, 14thEdition, Pearson.
3. **Lawrence Turyn,** Advanced Engineering Mathematics, CRC Press, 2013.
4. **Srimantha Pal, S C Bhunia,** Engineering Mathematics, Oxford University Press.

E-RESOURCES:

1. www.nptel **videos.com/mathematics/(Math Lectures from MIT,Stanford,IIT'S**
2. nptl.ac.in/courses/1221104017

20A1200205: APPLIED CHEMISTRY
(Common to EEE and ECE)

Lecture – Tutorial:	3-1	**Internal Marks:**	30

Credits:	3	**External Marks:**	70

Prerequisites:

Course Objectives:

- Importance of usage of plastics in household appliances and composites (FRP) in aerospace and automotive industries.
- Outline the basics for the construction of electrochemical cells, batteries and fuel cells. Understand the mechanism of corrosion and how it can be prevented.
- Explain the preparation of semiconductors and nanomaterials, engineering applications of nano materials, superconductors and liquid crystals.
- Recall the increase in demand for power and hence alternative sources of power are studied due to depleting sources of fossil fuels. Advanced instrumental techniques are introduced.
- Outline the basics of computational chemistry and molecular switches

Course Outcomes:

CO1	Analyze the different types of composite plastic materials and interpret the mechanism of conduction in conducting polymers.
CO2	Predict potential complications from combining various Chemicals, metals in engineering setting and categorize materials science relevant to corrosion phenomena.
CO3	Apply new materials with excellent engineering properties to take care of society needs and environment.
CO4	Analyze the principles of different analytical instrumentation and applications
CO5	Design models for energy by different natural sources
CO6	Understand the knowledge of computational chemistry and molecular machines

Contribution of Course Outcomes towards achievement of Program Outcomes (1 – Low, 2- Medium, 3 – High)

	PO 1	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PO 12**
CO1	3	3	3	2	-	-	2	-	-	-	-	-
CO2	3	3	2	1	-	-	2	-	-	-	-	-
CO3	3	2	2	-	-	-	2	-	-	-	-	-
CO4	3	3	2	2	-	-	2	-	-	-	-	-
CO5	3	2	2	2	-	-	2	-	-	-	-	-
CO6	3	3	3	3	-	-	3	-	-	-	-	-

UNIT – I: POLYMER TECHNOLOGY

Polymerisation:- Introduction, methods of polymerization (emulsion and suspension), mechanical properties.

Plastics:Thermoplastic-Thermosetting, Compounding, fabrication (compression, injection, Transfer and extrusion), preparation, properties and applications (PVC, polycarbonates and Bakelite), mention some examples of plastic materials used in electronic gadgets.

Elastomers:- Introduction, preparation, properties and applications (Buna S, thiokol and polyurethanes).

Composite materials: Fibre reinforced plastics, conducting polymers, biodegradable polymers..

Unit – II: ELECTROCHEMICAL CELLS AND CORROSION

Single electrode potential, electrochemical series and uses of series, standard hydrogen electrode, calomel electrode, batteries (Dry cell, liquid Li ion battery), fuel cells (H2-O2).

*Corrosion:-*Definition, theories of corrosion (chemical and electrochemical), galvanic corrosion, differential aeration corrosion, factors influencing rate of corrosion, corrosion control method- Protective coatings (Galvanizing, tinning, electroplating and electroless plating [nickel])

UNIT – III: MATERIAL CHEMISTRY

Semiconductors: Preparation of semi conductors by zone refining, Czochralski crystal pulling – applications

Super conductors:-Type –I, Type II and applications

Nano materials:- Introduction, sol-gel method & Chemical reduction method of preparation , transmission electron microscopy [TEM], applications of fullerenes, carbon nanotubes (types, preparation and applications)

Liquid crystals:- Introduction-types-applications.

UNIT – IV :SPECTROSCOPIC TECHNIQUES & NON-CONVENTIONAL ENERGY SOURCES

SPECTROSCOPIC TECHNIQUES: Electromagnetic spectrum-UV laws of ab:sorption, instrumentation, theory of electronic spectroscopy, Frank-condon principle, chromophores and auxochromes, applications, FT-IR Basic principle, instrumentation and IR stretching of functional groups (alcohols, carbonyls, amines) applications,

NON-CONVENTIONAL ENERGY SOURCES Design, working, schematic diagram, advantages and disadvantages of photovoltaic cell, hydropower, geothermal power, tidal and wave power, ocean thermal energy conversion.

UNIT –V: **ADVANCED CONCEPTS/TOPICS IN CHEMISTRY**

Computational chemistry: Introduction to computational chemistry, molecular modelling and docking studies.

Molecular switches: characteristics of molecular motors and machines, Rotaxanes and Catenanes as artificial molecular machines, prototypes – linear motions in rotaxanes, an acid-base controlled molecular shuttle, a molecular elevator, an autonomous light-powered molecular motor

TEXT BOOKS:

1. P.C. Jain and M. Jain "**Engineering Chemistry**", 15/e, Dhanpat Rai & Sons, Delhi, (Latest edition).
2. Shikha Agarwal, "**Engineering Chemistry**", Cambridge University Press, New Delhi, (2019).
3. S.S. Dara, "**A Textbook of Engineering Chemistry**", S.Chand & Co, (2010).
4. Shashi Chawla, "Engineering Chemistry", Dhanpat Rai Publicating Co. (Latest edition).

REFERENCE BOOKS:

1. K. Sesha Maheshwaramma and Mridula Chugh, "**Engineering Chemistry**", Pearson India Edn.
2. (a) O.G. Palana, "**Engineering Chemistry**", Tata McGraw Hill Education Private Limited, (2009).
   (b) CNR Rao and JM Honig (Eds) "**Preparation and characterization of materials**" Academic press, New York (latest edition)
3. B. S. Murthy, P. Shankar and others, "**Textbook of Nanoscience and Nanotechnology**", University press (latest edition)

E-RESOURCES:

1. https://en.wikipedia.org >wiki> Conductive polymers
2. www.sae.org/fuel cells/fuelcells-types.htm
3. https://en.wikipedia.org >wiki> Nanomaterials
4. https://en.wikipedia.org >wiki> Electrochemical cell
5. https://en.wikipedia.org >wiki> Spectroscopy

20A1205302: JAVA PROGRAMMING
(ECE&EEE)

Lecture – Tutorial-Practical::	2-0-2	**Internal Marks:**	30
Credits:	3	**External Marks:**	70

Prerequisites:

C Programming

Course Objectives:

To **introduce** the object oriented programming concepts.
To **understand** object oriented programming concepts, and apply them in solving Problems.
To **introduce** the principles of inheritance and polymorphism; and demonstrate how they relate to the design of abstract classes
To **introduce** the implementation of packages and interfaces
To **introduce** the concepts of exception handling and multithreading.
To **introduce** the design of Graphical User Interface using applets.

Course Outcomes:

Upon successful completion of the course, the student will be able to:

CO1	Able to **solve** real world problems using OOP techniques.
CO2	Able to **understand** the use of abstract classes and Packages in java.
CO3	Able to **develop** and **understand** exception handling and Interfaces in java
CO4	Able to understand multithreaded applications with synchronization and **design** GUI based applications and **develop** applets for web applications

Contribution of Course Outcomes towards achievement of Program Outcomes (1 – Low, 2- Medium, 3 – High)

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

UNIT I

The History and Evolution of Java: Java's Lineage, Java's Magic: The Byte code, The Java Buzzwords. An overview of Java: Object-Oriented Programming, A First Simple Program, A Second Short Program, Two Control Statements. Data Types, Variables, and Arrays: Java Is a Strongly Typed Language, Integers, Floating-Point Types, Characters, The Primitive Types, Booleans, Variables, Type Conversion and Casting, Automatic Type Promotion in Expressions, Arrays.

UNIT II

Introducing Classes: Class Fundamentals, Declaring Objects, Assigning Object Reference Variables, Introducing Methods, Constructors, The this Keyword, Garbage Collection, A Stack Class. A Closer Look at Methods and Classes: Overloading Methods, Using Objects as Parameters, A Closer Look at Argument Passing, Returning Objects, Introducing Access Control, Understanding static, Introducing final, Using Command-Line Arguments.

UNIT III

INHERITANCE: Inheritance basics, Using super keyword, method overriding, Dynamic method dispatch using final with inheritance, abstract classes
Packages: Defining a package, Finding packages and class path, Example, Access protection, importing packages.
Interfaces: Defining Interface, Implementing Interface, Nested Interfaces, Applying interfaces, Variables in interface, Interfaces can be extended.

UNIT IV

Exception handling: Fundamentals, Exception types, uncaught exceptions, using try and catch, multiple catch clauses, nested try statements, throw, throws, finally, Java's built-in exceptions, Creating your own exception subclasses.
Multithreaded Programming: The Java thread model, The Main thread, Creating a thread, creating multiple threads, Using isalive() and Join( ), thread priorities, Synchronization, Inter thread communication.

UNIT V

APPLETS: Concepts of Applets, differences between applets and applications, life cycle of an applet, types of applets, creating applets.

Lab Programs:

1. Create a java application that implements the concept of classes and objects.
2. Develop Java Application using inheritance.
3. Use interfaces and develop a java application.
4. Create a package and access members from a package.
5. Develop Java Application using Method overloading and method overriding.
6. Create a java application to copy content from one file to another using IO streams.
7. Develop Java Application to use String and String Buffer classes
8. Implement Exception handling in a given application.
9. Develop java application using Multithreading
10. GUI Application using applets

TEXT BOOKS:

1. The Complete Reference Java, 8th edition, Herbert Schildt, TMH.
2. Understanding Object-Oriented Programming with Java, updated edition, T. Budd, Pearson Education.

REFERENCE BOOKS:

1. An Introduction to programming and OO design using Java, J. Nino and F.A. Hosch, John Wiley & sons.
2. Introduction to Java programming, Y. Daniel Liang, Pearson Education.
3. Object Oriented Programming through Java, P. Radha Krishna, Universities Press.
4. Programming in Java, S. Malhotra, S. Chudhary, 2nd edition, Oxford Univ. Press.
5. Java Programming and Object oriented Application Development, R. A. Johnson, Cengage Learning.

E-RESOURCES:

http://www.javatpoint.com/
java.sun.com/docs/books/tutorial/java/TOC.html
http://www.learnjavaonline.org/
http://www.tutorialspoint.com/java/
www.java.com/en/download/faq/develop.xml
www.oracle.com › Java › Java SE
www.w3schools.com

20A1204301: NETWORK ANALYSIS

Lecture – Tutorial:	3-0 Hours	**Internal Marks:**	30
Credits:	4	**External Marks:**	70

Prerequisites:

Basics of Circuit elements, sources, Basic algebraic equations, Fundamentals of geometry and calculus, Fundamental knowledge of physics including basics of mechanics, Basic particles such as electron and electric charges.

Course Objectives:

1. To understand the basic concepts on RLC circuits.
2. To know the behavior of the steady states and transients states in RLCcircuits.
3. To know the basic Laplace transforms techniques inperiods'waveforms.
4. To understand the two port network parameters.
5. To understand the properties of LC networks and filters.

Course Outcomes:

Upon successful completion of the course, the student will be able to:

CO1	Identify the main circuit elements and apply Kirchhoff's Laws to calculate currents, voltages and powers in typical DC electric circuits using a variety of analytical methods.
CO2	Synthesize driving point functions of RL, RC and RLC networks
CO3	Infer and evaluate transient response, Steady state response, network functions
CO4	Analyze the series resonant and parallel resonant circuits
CO5	Gain the knowledge in characteristics of two port network parameters
CO6	Determining two port network parameters and one parameter interms of other parameters.

Contribution of Course Outcomes towards achievement of Program Outcomes (1 – Low, 2- Medium, 3 – High)

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO1	3	2	3	2	-	-	-	-	-	-	-	-
CO2	-	3	3	2	-	-	-	-	-	-	-	-
CO3	2	3	2	3	-	-	-	-	-	-	-	2
CO4	-	2	3	3	-	-	-	-	-	-	-	-
CO5	2	-	3	3	-	-	-	-	-	-	-	2
CO6	-	3	3	2	-	-	-	-	-	-	-	-

UNIT I

INTRODUCTION TO ELECTRICAL CIRCUITS:

Network elements classification, Electric charge and current, Electric energy and potential, Resistance parameter – series and parallel combination, Inductance parameter – series and parallel combination, Capacitance parameter – series and parallel combination. Energy sources: Ideal, Non-ideal, Independent and dependent sources, Source transformation, Kirchoff's laws, Mesh analysis and Nodal analysis problem solving with resistances only including dependent sources also.

FUNDAMENTALS AND NETWORK TOPOLOGY:

Definitions of terms associated with periodic functions: Time period, Angular velocity and frequency, RMS value, Average value, Form factor and peak factor- problem solving, Phase angle, Phasor representation, Addition and subtraction of phasors, mathematical representation of sinusoidal quantities, explanation with relevant theory, problem solving. Principal of Duality withexamples.

NETWORK TOPOLOGY:

Definitions of branch, node, tree, planar, non-planar graph, incidence matrix, basic tie set schedule, basic cut set schedule.

UNIT -II

TRANSIENTS:

First order differential equations, Definition of time constants, R-L circuit, R-C circuit with DC excitation, evaluating initial conditions procedure, second order differential equations, homogeneous, non-homogenous, problem solving using R-L-C elements with DC excitation and AC excitation, Response as related to s-plane rotation of roots. Solutions using Laplace transform method.

UNIT III

STEADY STATE ANALYSIS OF A.C CIRCUITS:

Impedance concept, phase angle, series R-L, R-C, R-L- C circuits problem solving. Complex impedance and phasor notation for R-L, R-C, R-LC problem solving using mesh and nodal analysis, Star-Delta conversion, problem solving.

COUPLED CIRCUITS :

Coupled Circuits: Self-inductance, Mutual inductance, Coefficient of coupling, analysis of coupled circuits, Natural current, Dot rule of coupled circuits, Conductively coupled equivalent circuits- problem solving.

UNIT IV

RESONANCE:

Introduction, Definition of Q, Series resonance, Bandwidth of series resonance, Parallel resonance, Condition for maximum impedance, current in anti-resonance, Bandwidth of parallel resonance, general case-resistance present in both branches, anti-resonance at all frequencies.

NETWORK THEOREMS:

Thevenin's, Norton's, Milliman's, Reciprocity, Compensation, Substitution, Superposition,Max Power Transfer, Tellegens- problem solving using dependent sources also.

UNIT V

TWO-PORT NETWORKS:

Relationship of two port networks, Z-parameters, Y-parameters, Transmission line parameters, h-parameters, Inverse h-parameters, Inverse Transmission line parameters, Relationship between parameter sets, Parallel connection of two port networks, cascading of two port networks, series connection of two port networks, problem solving including dependent sources also.

TEXT BOOKS:

1. Network Analysis – ME Van Valkenburg, Prentice Hall of India, 3rdEdition,2000.
2. Network Analysis by K.Satya Prasad and S Sivanagaraju,CengageLearning
3. Electric Circuit Analysis by Hayt andKimmarle,TMH

REFERENCES:

1. Network lines and Fields by John. D. Ryder 2 ndedition, Asiapublishinghouse.
2. Basic Circuit Analysis by DR Cunninghan, Jaico Publishers.
3.Network Analysis and Filter Design by Chadha,UmeshPublications.

20A1202302: BASIC ELECTRICAL ENGINEERING
(Electronics and Communication Engineering)

Lecture – Tutorial:	3-1 Hours	**Internal Marks:**	30
Credits	3	**External Marks:**	70

Prerequisites: This course covers various topics related to principle of operation and performance of various electrical machines.

Course Objectives

- To understand the principle of operation, constructional details and operational characteristics of DC generators.
- To understand the principle of operation, characteristics of DC motor. Methods of starting and speed control methods of DC motors.
- To learn the constructional details, principle of operation and performance of transformers.
- To study the principle of operation, construction and details of synchronous machines.
- To learn the principle of operation, constructional details, performance, and torque – slip characteristics and starting methods of 3- phase induction motors.

Course Outcomes

Upon successful completion of the course, the student will be able to:

CO1	Able to explain the operation of DC generator and analyze the characteristics of DC generator.
CO2	Able to explain the principle of operation of DC motor and analyze their characteristics. Acquire the skills to analyze the starting and speed control methods of DC motors.
CO3	Able to explain the operation of transformer.
CO4	Ability to analyze the performance and speed – torque characteristics of a 3- phase induction motor and understand starting methods of 3-phase induction motor.
CO5	Able to explain the operation of Synchronous Machines
CO6	Capability to understand the operation of various special machines.

Contribution of Course Outcomes towards achievement of Program Outcomes (1 – Low, 2- Medium, 3 – High)

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO1	3	**2**		**1**								**2**
CO2	3	**2**		**1**								**2**
CO3	3	**2**		**1**								**2**
CO4	3	**2**		**1**								**2**
CO5	3	**2**		**1**								**2**
CO6	3	**2**		**1**								**2**

UNIT I

DC Machines

Principle of operation of DC generator – emf equation – types of DC machines – torque equation of DC motor – applications – three point starter

- losses and efficiency - swinburne's test - speed control methods – OCC of DC generator- Brake test on DC Shunt motor- numerical problems

UNIT II

Transformers

Principle of operation of single phase transformer constructional features – EMF equation – Losses and efficiency of transformer- regulation of transformer – OC & SC tests predetermination of efficiency and regulations

– Sumpner's test- NumericalProblems.

UNIT III

Synchronous Generators

Principle of operation and construction of alternators – types of alternators Regulation of alternator by synchronous impedance method-EMF equation of three phase alternator

Synchronous Motors

Construction of three phase synchronous motor - operating principle –equivalent circuit ofsynchronous motor.

UNIT IV

Induction Machine: Principle of operation and construction of three-phase induction motors -slip ring and squirrel cage motors – slip-torque characteristics – efficiency calculation – starting methods-Brake test on 3-Phase Induction Motor.

UNIT V

Special Machines:

Principle of operation and construction - single phase induction motor -shaded pole motors – capacitor motors and AC servomotor.

Text Book: "Infotech English", Maruthi Publications.

REFERENCE BOOKS:

1. Basic Electrical Engineering by M.S.Naidu and S.Kamakshiah, TMH Publications
2. Fundamentals of Electrical Engineering by Rajendra Prasad, PHI Publications, 2nd edition
3. Basic Electrical Engineering by Nagsarkar, Sukhija, Oxford Publications, 2nd edition

E-RESOURCES

1. http://nptel.ac.in/courses.php
2. http://jntuk-coeerd.in/
3. https://ocw.mit.edu/courses/electrical-engineering-and-computer-science/

20A1200801: ENVIRONMENTAL Sciences
(Common to CE,EEE,ME and ECE

Lecture – Tutorial:	2-0	**Internal Marks:**	30+70
Credits:	0	**External Marks:**	

Prerequisites:

Course Objectives:

The objectives of the course are to impart:

- Overall understanding of the natural resources.
- Basic understanding of the ecosystem and its diversity.
- Acquaintance on various environmental challenges induced due to unplanned anthropogenic activities.
- An understanding of the environmental impact of developmental activities.
- Awareness on the social issues, environmental legislation and global treaties.

Course Outcomes:

CO1	➢ Illustrate the importance of sustainability in the progress of a nation. (L2)
CO2	➢ Infer the existence of ecosystems in maintaining ecological balance. (L2)
CO3	➢ Recall the importance of biodiversity and its conservation. (L1)
CO4	➢ Summarize the role of natural resources for the sustenance of life on earth and recognize the need to conserve them. (L2)
CO5	➢ Identify the environmental pollutants and the abatement devices to be used. (L3)
CO6	➢ Interpret environmental related acts and social issues. (L2)

Contribution of Course Outcomes towards achievement of Program Outcomes (1 – Low, 2- Medium, 3 – High)

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO1	3	2	2	-	-	2	3	2	-	-	2	2
CO2	3	2	2	-	-	2	3	2	-	-	2	2
CO3	3	2	2	-	-	2	3	2	-	-	2	2
CO4	3	2	2	-	-	2	3	2	-	-	2	2
CO5	3	2	2	-	-	2	3	2	-	-	2	2
CO6	3	2	2	-	-	2	3	2	-	-	2	2

UNIT I (6hrs)

Sustainability: Stockholm and Rio Summit–Global Environmental Challenges: Global warming and climate change, acid rains, ozone layer depletion, population growth and explosion, effects. Role of information technology in environment and human health.

Ecosystems: Concept of an ecosystem. - Structure and function of an ecosystem; Producers, consumers and decomposers. - Energy flow in the ecosystem - Food chains, food webs and ecological pyramids- Ecological succession.

UNIT II (4hrs)

Biodiversity and its conservation: Definition: genetic, species and ecosystem diversity- classification - Value of biodiversity: consumptive use, productive use, social value. India as a mega diversity nation - Hot-sports of biodiversity - Threats to biodiversity: habitat loss, man-wildlife conflicts. Endangered and endemic species of India – Conservation of biodiversity.

UNIT III **(7hrs)**

Natural Resources: Natural resources and associated problems.
Forest resources: Use and over – exploitation, deforestation – Timber extraction – Mining, dams and other effects on forest and tribal people.
Water resources: Use and over utilization of surface and ground water – Floods, drought, conflicts over water, dams – benefits and problems.
Mineral resources: Use and exploitation, environmental effects of extracting and using mineral resources.
Energy resources: Growing energy needs, renewable and non-renewable energy sources use of alternate energy
sources.
Role of an individual in conservation of natural resources; Equitable use of resources for sustainable lifestyles.

UNIT IV **(5hrs)**

Environmental Pollution: Definition, Cause, effects and control measures of Air pollution, Water pollution, Soil pollution, Noise pollution, Nuclear hazards. Role of an individual in prevention of pollution. - Pollution case studies, Sustainable Life Studies. Impact of Fire Crackers on Men and his well being.
Solid Waste Management: Sources, Classification, effects and control measures of urban and industrial solid wastes. Consumerism and waste products, Biomedical, Hazardous and e – waste management.

UNIT V **(6hrs)**

Social Issues and the Environment: Urban problems related to energy, rain water harvesting. Environmental ethics: Issues and possible solutions. Environmental Protection Act -Air (Prevention and Control of Pollution) Act. –Water (Prevention and control of Pollution) Act - Wildlife Protection Act -Forest Conservation Act. Environmental Management: Impact Assessment and its significance various stages of EIA, preparation of EMP and EIS. Ecotourism, Green Campus – Green business and Green politics.

TEXT BOOKS:

1) Perspectives in Environment Studies, Anubha Kaushik, C P Kaushik, New Age International Publishers, 2014
2)Environmental Studies, K. V. S. G. Murali Krishna, VGS Publishers, Vijayawada
3) Environmental Studies, R. Rajagopalan, 2nd Edition, 2011, Oxford University Press.
4) Environmental Studies, P. N. Palanisamy, P. Manikandan, A. Geetha, and K. Manjula Rani; Pearson Education, Chennai

REFERENCE BOOKS:

1) Text Book of Environmental Studies, Deeshita Dave & P. Udaya Bhaskar, Cengage Learning.
2) A Textbook of Environmental Studies, Shaashi Chawla, TMH, New Delhi
3) Environmental Studies, Benny Joseph, Tata McGraw Hill Co, New Delhi

E-RESOURCES: 1. http://nptel.ac.in/courses.php.
2. http://jntuk-coeerd.in/

20A1200191: Communicative English LAB
(Common to All Branches (CE, EEE, MECH, ECE, CSE, IT, AIML, DS)

Labs / Instructions Hours/Week	3 Hours	**Internal Marks:**	30
Credits	1.5	**External Marks:**	70

PREREQUISITES: None

COURSE OBJECTIVES

1. To learn the sound systems of English and understand word stress of English.
2. To train the students in the art of conversation and discussion
3. To equip the students with good communication skills.
4. To emphasize the need of English in the technical world.
5. To improve their presentation and participation skills
6. To prepare them for interviews and future job environments.

COURSE OUTCOMES

Upon successful completion of the course, the student will be able to:

CO1	Demonstrate better understanding of the nuances of spoken English to put into use in various situation and events.
CO2	Apply the rules of phonetics–pronunciation, accent and intonation– in their everyday communication
CO3	Relate their understanding of the importance of spoken skills and the need for life-long learning in day-to-day communication.
CO4	Construct strategies like critical and analytical skills to participate effectively in group discussions and debates.
CO5	Demonstrate their ideas accurately and effectively in presentations.
CO6	Build responses to the questions by listening to short audio texts and identify the context and specific pieces of information.

Contribution of Course Outcomes towards achievement of Program Outcomes (1 – Low, 2- Medium, 3 – High)

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO1										1		2
CO2										1		2
CO3												2
CO4									1	1		2
CO5										2		2
CO6										1		2

UNIT I
• Making Inquiries on the phone, Thanking and Responding to Thanks, Responding to Requests and Asking for Directions • Vowels, Consonants, Pronunciation, Phonetic Transcription, Common Errors in Pronunciation
UNIT II
• Asking for Clarifications, Inviting, Expressing Sympathy, Congratulating, Apologising, Advising, Suggesting, Agreeing and Disagreeing • Word stress – Di-Syllabic Words, Poly-Syllabic Words, Weak and Strong Forms, Contrastive Stress (Homographs)
UNIT III
• Debating • Stress in Compound Words, Rhythm, Intonation, Accent Neutralization.
UNIT IV
• Group Discussions • Listening to Short Audio Texts, and Identifying the context and specific pieces of information to answer a series of questions in speaking.
UNIT V
• Presentation Skills and Interview Skills • Newspapers reading; Understanding and identifying key terms and structures useful for writing reports.
Lab Manual: "Infotech English", Maruthi Publications.
Software: k-van solutions Multimedia language lab
REFERENCE BOOKS:
1. **Exercises in Spoken English Part 1,2,3,4,** OUP and CIEFL. 2. **English Pronunciation in use** - Mark Hancock, Cambridge University Press. 3. **English Phonetics and Phonology**-Peter Roach, Cambridge University Press. 4. **English Pronunciation in use**- Mark Hewings, Cambridge University Press. 5. **English Pronunciation Dictionary**- Daniel Jones, Cambridge University Press. 6. **English Phonetics for Indian Students**- P. Bala Subramanian, Mac Millan Publications
E-RESOURCES
1. https://learnenglish.britishcouncil.org/ 2. https://rachelsenglish.com/ 3. https://www.bbc.co.uk/learningenglish/ 4. https://www.engvid.com/ 5. https://bbclearningenglish.com

20A1200294: Applied Chemistry Lab

Labs / Instructions Hours/Week	3	**Internal Marks:**	30
Credits:	1.5	**External Marks:**	70

Prerequisites: Knowledge on Volumetric analysis.

Course Objectives:

- To provide knowledge of chemistry practicals.
- It enables the students to analyze the different parameters of water sample like hardness and alkalinity and different volumetric titrations.
- It makes the students to obtain basic knowledge of instrumentation based on different Engineering applications.

Course Outcomes:

CO1	Students of Engineering should understand and apply polymers and plastic technologies along with their utilization to solve the problems of the society.
CO2	Knowledge of cells and sensors utilized in many instruments is necessary to engineering students in solving and applying to batteries and fuel cells.
CO3	Knowledge of electrochemical cells is essential in understanding corrosion along with the methods of controlling to budding engineers.
CO4	Students should have the knowledge of water and its hardness, boiler troubles and problems associated with the environment and its sustainability.
CO5	Knowledge of fuels and energy, their advantages & disadvantages should be known by the students to solve and understand engineering problems.
CO6	Knowledge, design and analysis of materials should be understood by the Engineering students in solving the complex problems of the society.

Contribution of Course Outcomes towards achievement of Program Outcomes (1 – Low, 2- Medium, 3 – High)

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO1	3	1	1	1								
CO2	3	3	1	-								
CO3	3	2	2	-								
CO4	3	1	-	1								
CO5	3	2	2	1								
CO6	3	1	1	1								

List of Experiments

1.Introduction to Chemistry laboratory – Molarity, Normality, Primary, secondary standard solutions, Volumetric titrations, Quantitative analysis, Qualitative analysis, etc.

2. Determination of HCl using standard Na_2CO_3 solution.
3. Determination of alkalinity of a sample containing Na_2CO_3 and NaOH.
4. Determination of $KMnO_4$ using standard Oxalic acid solution.
5. Determination of total hardness of water using standard EDTA solution.
6. Determination of Iron using standard $K_2Cr_2O_7$ solution
7. Estimation of vitamin C
8. Determination of Iron by a Colorimetric method using thiocyanates as reagent.
9. Conductometric titration between strong acid and strong base.
10. Potentiometric titration between strong acid and strong base.
11. Preparation of Bakelite.
12. Determination of pH of water sample

EQUIPMENT REQUIRED:
PH meters, Potentiometers, Conductometers, colorimeters. **APPARATUS** Burettes, Pipettes, Conical flask, Beakers, Volumetric flask.
REFERENCE BOOKS:
1 . A Textbook of Quantitative Analysis, Arthur J. Vogel. 2. Dr.JyotsnaCherukuri (2012) *Laboratory Manual of engineering chemistry-II,* VGSTechno Series 3. Chemistry Practical Manual, Lorven Publications 4. K. Mukkanti (2009) *Practical Engineering Chemistry,* B.S. Publication

20A1202392: BASIC ELECTRICAL ENGINERING LAB
(Electronics and Communication Engineering)

Practical:	3 Hours	**Internal Marks:**	30
Credits	1.5	**External Marks:**	70

Prerequisites: This laboratory covers various experiments related to principle of operation and performance of various electrical machines.

Course Objectives

- ❖ To plot the magnetizing characteristics of DC shunt generator and understand the mechanism of self-excitation.
- ❖ To control the speed of DC motors.
- ❖ To determine and predetermine the performance of DC machines.
- ❖ To predetermine the efficiency and regulation of transformers and assess their performance.
- ❖ To analyse performance of three phase induction motor.
- ❖ To understand the significance of regulation of an alternators using synchronous impedance method.

Course Outcomes

Upon successful completion of the course, the student will be able to:

CO1	Determine and predetermine the performance of DC machines
CO2	Determine and predetermine the performance of transformers.
CO3	Control the DC shunt machines
CO4	Compute the performance of 1-phase transformer
CO5	Perform tests on 3-phase induction motor to determine their performance characteristics.
CO6	Perform tests on alternator to determine their performance characteristics.

Contribution of Course Outcomes towards achievement of Program Outcomes
(1 – Low, 2- Medium, 3 – High)

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

CO6	3	3	1	1					1			

List of Experiments

Any ten of the following experiments are to be conducted

1. Magnetization characteristics of D.C. Shunt generator.
2. Speed control of D.C. shunt motor.
3. Brake test on DC shunt motor.
4. Swinburne's test on DC machine
5. Load test on DC shunt generator
6. Load test on DC series generator.
7. Separation of losses in DC Shunt motor
8. OC & SC tests on single-phase transformer
9. Sumpner's test on single phase transformer
10. Brake test on 3-phase Induction motor.
11. Regulation of alternator by synchronous impedance method.

REFERENCE BOOKS:

1. Basic Electrical Engineering by M.S.Naidu and S.Kamakshiah
2. Basic Electrical Engineering by M.S.Naidu and S.Kamakshiah
3. Basic Electrical Engineering by M.S.Naidu and S.Kamakshiah
4. Principles of Electrical Machines by V.K. Mehta & RohitMehta
5. Principles of Electrical Machines by V.K. Mehta & RohitMehta

20A1204391: ELECTRONIC WORKSHOP LAB

Lecture – Tutorial:	3	**Internal Marks:**	30
Credits:	1.5	**External Marks:**	70

Prerequisites:

Basic Electronics concepts

Course Objectives:

- To create interest on Identification of Active and Passive components
- To identify the list of Laboratory Equipment
- To gain the knowledge of soldering and desoldering
- To obtain the knowledge for Preparation of layout and artwork layout planning.
- To learn testing of active and passive components.
- To Know the operation of CRO

COURSE OUTCOMES:

Upon successful completion of the course, the student will be able to:

CO1	Identify Active and Passive components: Resistor, Capacitor, Inductors, Diode and Transistor
CO2	Identify the Laboratory Equipment: Multi meters, Function generators, Power Supply, different types of transformers
CO3	Develop the practice of soldering and desoldering of different Electronic components
CO4	Design the simple printed circuit board layout
CO5	Test active and passive components: Resistor, Capacitor, Inductors, Diode and Transistor
CO6	Demonstrate the study the operation of CRO

Contribution of Course Outcomes towards achievement of Program Outcomes (1– Low, 2- Medium, 3 – High)

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO1	3	2	1	-	-	-	-	-	-	-	-	-
CO2	3	1	1	-	-	-	-	-	-	-	-	-
CO3	3	2	3	-	-	-	-	-	-	-	-	-
CO4	3	2	2	1	-	-	-	-	-	-	-	-
CO5	3	2	1	1	-	-	-	-	-	-	-	-
CO6	3	1	2	1	-	-	-	-	-	-	-	-

SYLLABUS

I. Identification of components:

- Resistors:- Types of Resistors, Value of Resistance using color code, DRBS.
- Capacitors:- Types of capacitors, value of capacitance using color code, DCBS.
- Inductors:- Types of Inductors, DLB
- Rheostats:- Types of Rheostats, Types of potentiometers, Relays.
- Switches:- Types of Switches.
- Cables: Types of Cables.
- Types of Instruments used.

Identification of active elements.

(Two Terminal, Three Terminal Devices)

- (SC diode, Zener diode, D.AC)
- Three Terminal Devices: BJT, UJT, SCR, FET, MOSFET,TRIAC.
- Digital and Analog ICs. (TO and Flat packages) IC regulators types.

- Testing of above components using Multimeter.

II. Laboratory Equipment:

A) Meters:-

- Types of Voltmeters, Types of Ammeters both Analog and Digital.
- Types of Multi meters (Analog & Digital)
- AVO Meters.
- FET input Voltmeter.

B) Laboratory Function Generators and Audio Oscillators.

C) Power Supplies.

D) RF generators.

E) Different Types of Transformers. (Power, AF, RF, etc.)

III. Soldering practice

Tools kit including soldering iron

Tools Kit:

- Insulated nose player
- Insulated cutting player
- Screw driver kit
- Electrical tester
- Soldering iron, Lead, Flex

IV. PCB layout and Design.

- Materials required, centimeter graph sheets, marker.

V. Testing of Components.

- Active and Passive Components

VI. CRO

- Acquaintance with CRO
- *Measurements on CRO*

EQUIPMENT REQUIRED:

- Analog and Digital Voltmeter, Ammeter.
- Multimeters**.**
- Power Supply

COMPONENTS REQUIRED:

- Resistors
- Inductors
- Capacitors
- Switches.

NRI INSTITUTE OF TECHNOLOGY

An Autonomous Institution, Permanently Affiliated to JNTUK, Kakinada
(Accredited by NAAC with "A" Grade and ISO 9001:2015 Certified Institute)
Pothavarappadu (V), Via Nunna, Agiripalli (M), PIN-521 212.

DEPARTMENT OF ELECTRONICS AND COMMUNICATION ENGINEERING

COURSE STRUCTURE FOR II YEAR B.TECH PROGRAMME-R20 Reg

II B.TECH I-SEMESTER

S. No	CC	Title of the Course	Scheme of Instruction (Periods Per Week)				Scheme of Examination (Maximum Marks)			No. of Credits
			L	T	P	Total	CIA	SEA	Total	
1	BS	Vector Calculus, Complex variables and Partial differential Equations	3	-	-	3	30	70	100	3
2	PC	Electronic Devices and Circuits	3	-	-	3	30	70	100	3
3	PC	Switching Theory and Logic Design	3	-	-	3	30	70	100	3
4	PC	Signals and Systems	3	-	-	3	30	70	100	3
5	PC	Random Variables and Stochastic Processes	3	-	-	3	30	70	100	3
6	PC Lab	Electronic Devices and Circuits Lab	-	-	3	3	15	35	50	1.5
7	PC Lab	Switching Theory and Logic Design Lab	-	-	3	3	15	35	50	1.5
8	PC Lab	Basic Simulation Lab	-	-	3	3	15	35	50	1.5
9	SC	Electronic Circuit Design	1	-	2	3	-	50	50	2
10	MC	Indian Constitution	2	-	-	2	30	70	100	0
Total			**18**	**0**	**11**	**29**	**225**	**575**	**800**	**21.5**

II B.TECH II-SEMESTER

S. No	CC	Title of the Course	Scheme of Instruction (Periods Per Week)				Scheme of Examination (Maximum Marks)			No. of Credits
			L	T	P	Total	CIA	SEA	Total	
1	ES	Linear Control Systems	3	-	-	3	30	70	100	3
2	BS/ PC	Analog and Pulse Circuits	3	-	-	3	30	70	100	3
3	PC	Analog Communications	3	-	-	3	30	70	100	3
4	PC	Electromagnetic waves and Transmission Lines	3	-	-	3	30	70	100	3
5	HS	Managerial Economics and Financial Analysis	3	-	-	3	30	70	100	3
6	PC Lab	Analog and Pulse Circuits Lab	-	-	3	3	15	35	50	1.5
7	PC Lab	Analog Communications Lab	-	-	3	3	15	35	50	1.5
8	PC Lab	VHDL Programming Lab	-	-	3	3	15	35	50	1.5
9	SC	Python Programming	1	-	2	3	-	50	50	2
Total			**16**	0	**11**	**27**	**195**	**505**	**700**	**21.5**

B.TECH (ECE)
II-I SEMESTER

II Year - I Semester **L T P C**

3 0 0 3

VECTOR CALCULUS, COMPLEX VARIABLES & PARTIAL DIFFERENTIAL EQUATIONS

Lecture – Tutorial:	3-0 Hours	**Internal Marks:**	30
Credits:	3	**External Marks:**	70

Prerequisites: 1.Knowledge of complex numbers, Trigonometric relations, Differentiation, Integration and co-ordinate Geometry. 2. Convergence of series

Course Objectives:

- To furnish the learners with basic concepts and techniques at plus two level to lead them into advanced level by handling various real world applications.
- To familiarize the techniques in complex variables.
- To familiarize the techniques in partial differential equations.
- To equip the students to solve application problems in their disciplines.

Course Outcomes:

Upon successful completion of the course, the student will be able to:

CO1	Interpret the physical meaning of different operators such as gradient, curl and divergence (L5).
CO2	Estimate the work done against a field, circulation and flux using vector calculus (L5)
CO3	Apply Cauchy-Riemann equations to complex functions in order to determine whether a given continuous function is analytic (L3).
CO4	Find the differentiation and integration of complex functions used in engineering problems (L5) and make use of the Cauchy residue theorem to evaluate certain integrals (L3)
CO5	Write the infinite series expansion of complex function by apply Taylor's/ Maclaurin's / Laurent's series(L3)
CO6	Identify solution methods for partial differential equations that model physical processes (L3)

Course Content(Syllabus)

UNIT I

Vector calculus

Vector Differentiation: Gradient –Directional derivative–Divergence–Curl–Scalar Potential.

Vector Integration: Line integral–Workdone–Area–Surface and volume integrals Vector integral theorems: Greens, Stokes and Gauss Divergence theorems (without proof).

UNIT II

Complex Variable – Differentiation & Integration:

Complex function , Real and Imaginary parts of Complex function, Limit, Continuity and Derivative of complex function, Cauchy-Riemann equations, Analytic function, entire function, singular point, conjugate function, Harmonic functions, Milne-Thomson method.(In all cases Cartesian form only) Line integral of a complex function, Cauchy's theorem (only statement) , Cauchy's Integral Formula.

UNIT III

Complex Variable- Series expansion, Residue Theorem & Evaluation of Real Integrals

Absolutely convergent and uniformly convergent of series of complex terms, Radius of convergence, Taylor's series, Maclaurin's series expansion, Laurent's series. Zeros of an analytic function, Singularity, Isolated singularity, Removable singularity, Essential singularity, pole of order m, simple pole, Residues, Residue theorem, Calculation of residues, Residue at a pole of order m, Evaluation of real definite integrals: Integration around the unit circle, Integration around semi circle.

UNIT IV

PDE of first order:

Formation of partial differential equations by elimination of arbitrary constants and arbitrary functions – Solutions of first order linear (Lag range) equation and nonlinear (standard types) equations.

UNIT V

Solutions of Second order PDE:

Second order PDE: Solutions of linear partial differential equations with constant coefficient – RHS term of the type e^{ax+by}, $sin(ax+by)$, $cos(ax+by)$, $x^m y^n$

Method of separation of Variables – introduction.

TEXT BOOKS:

1. B.S.Grewal, **Higher Engineering Mathematics, 43rd Edition, Khanna Publishers.**

2. B.V.Ramana**,** Higher Engineering Mathematics, 2007 Edition, Tata Mc.Graw HillEducation.

REFERENCES:

1. J. W. Brown and R. V. Churchill, Complex Variables and Applications, 7/e, Mc-GrawHill, 2004.
2. N.P. Bali and Manish Goyal, A text book of Engineering Mathematics, LaxmiPublications, 2008.
3. Erwin Kreyszig**,** Advanced Engineering Mathematics, 10thEdition, Wiley-India.
4. Dean. G. Duffy**,** Advanced Engineering Mathematics with MATLAB, 3rdEdition, CRCPress.
5. Peter O'Neil**,** Advanced Engineering Mathematics, Cengage.
   Srimantha Pal, SCBhunia**,** Engineering Mathematics, Oxford University Press.

Contribution of Course Outcomes towards achievement of Program Outcomes (POs) and Program Specific outcomes (PSOs) (1 – Low, 2- Medium, 3 – High)

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1	3	3	2	2	-	-	-	-	-	-	-	-	-	-
CO2	3	3	2	2	-	-	-	-	-	-	-	-	-	-
CO3	3	3	2	2	-	-	-	-	-	-	-	-	-	-
CO4	3	3	2	2	-	-	-	-	-	-	-	-	-	-
CO5	3	3	2	2	-	-	-	-	-	-	-	-	-	-
CO6	3	3	2	2	-	-	-	-	-	-	-	-	-	-

II Year - I Semester **L T P C**
3 0 0 3

Electronic Devices and Circuits

Lecture – Tutorial:	3-0 Hours	**Internal Marks:**	30
Credits:	3	**External Marks:**	70

Prerequisites: Semiconductor physics, Basic mathematics.

Course Objectives:

- To Study the physical phenomena such as conduction, transport mechanism and electrical characteristics of different diodes.
- Study the physical phenomena such as conduction, transport mechanism and electrical characteristics of different diodes.
- The application of diodes as rectifiers with their operation and characteristics with and without filters are discussed.
- The principal of working and operation of Bipolar Junction Transistor and Field Effect Transistor and their characteristics are explained.
- The need of transistor biasing and its significance is explained. The quiescent point or operating point is explained.
- Small signal equivalent circuit analysis of BJT and FET transistor amplifiers in different configuration is explained**.**

Course Outcomes:

Upon successful completion of the course, the student will be able to:

CO1	Understand the operation, V-I characteristics, parameters of P-N diode in different modes.
CO2	Understand the operations, V-I characteristics and applications of Zener diode and special diodes in different modes.
CO3	Evaluate the performance of various rectifiers and filters with relevant expressions
CO4	Know the construction, principle of operation of Transistors and Field Effect Transistors with their V-I characteristics in different configurations.
CO5	Analyze the biasing and stabilization techniques for BJT and JFET with necessary expressions.
CO6	Know the construction, principle of operation of MOS Field Effect Transistors with their V-I characteristics in different configurations.

Course Content(Syllabus)

UNIT I

Review of Semi Conductor Physics: Semi conductor's classification, electrons and holes in intrinsic and extrinsic semi conductors, law of junction, Fermi level in intrinsic and extrinsic Semiconductors.

Junction Diode Characteristics : Energy band diagram of PN junction Diode, Biased p-n junction, current components in PN junction Diode, diode equation, V-I Characteristics, temperature dependence on V-I characteristics, Diode resistance, Diode capacitance.

UNIT II

Special Semiconductor Devices: Zener Diode, Breakdown mechanisms, Zener diode applications, LED, Varactor Diode, Photodiode, Tunnel Diode, PIN Diode. Construction, operation and V-I characteristics.

Rectifiers and Filters: Basic Rectifier setup**,** half wave rectifier, full wave rectifier, bridge rectifier, derivations of characteristics of rectifiers, rectifier circuits-operation, input and output waveforms, Filters, Inductor filter(Series inductor), Capacitor filter (Stunt inductor), π- Filter, comparison of various filter circuits in terms of ripple factors.

UNIT III

Transistor Characteristics: Junction transistor, transistor current components, transistor equation, transistor configurations, transistor as an amplifier, characteristics of transistor in Common Base, Common Emitter and Common Collector configurations, punch through/ reach through.

FET: FET types, construction, operation, characteristics μ, g_m, r_d parameters, MOSFET-types, construction, operation, characteristics, comparison between JFET and MOSFET.

UNIT IV

Transistor Biasing: Need for biasing, operating point, DC load line analysis, BJT biasing- methods, basic stability, fixed bias, collector to base bias, self bias.

Stabilization: Stabilization against variations in V_{BE}, Ic, and β, Stability factors, (S,S',S''), Bias compensation, Thermal runaway, Thermal stability.

UNIT V

Small Signal Low Frequency Transistor Amplifier Models: Two port network, Transistor hybrid model, determination of h-parameters, conversion of h-parameters, generalized analysis of transistor amplifier model using h-parameters.

Special Transistors: Operation and characteristics of Uni Junction Transistor, Photo Transistor, Sillicon Controlled Rectifiers, UJT as Relaxation Oscillator.

TEXT BOOKS:

1. Electronic Devices and Circuits- J. Millman, C. Halkias, Tata Mc-Graw Hill, SecondEdition,2007
2.Electronic Devices and Circuits-K. Lal Kishore, BS Publications, FourthEdition,2016.
3.Electronics devices & circuit theory- Robert L.Boylestad andLouiNashelsky, Pearson/Prentice hall, tenth edition,2009

REFERENCES:

1.Integrated Electronics-J. Millman, C. Halkias,Tata Mc-Graw Hill, SecondEdition,2009
2.Electronic Devices and Integrated Circuits – B.P. Singh,Rekha , Pearson publications,
3.Electronic Devices and Circuits-Salivahanan, Kumar, Vallavaraj, Tata Mc-Graw Hill, 4thEdition,2008.

Contribution of Course Outcomes towards achievement of Program Outcomes (POs) and Program Specific outcomes (PSOs) (1 – Low, 2- Medium, 3 – High)

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO1	PSO 2
CO1	3	2	-	-	-	-	-	-	3	-	-	-	3	-
CO2	3	2	-	-	3	2	-	-	-	-	-	-	2	
CO3	2	3	-	2	-	-	-	3	-	-	3	3		2
CO4	3	-	-	-	-	-	2	-	-	-	-	-	3	
CO5	-	3	2	-	-	3	-	-	-	3	-	-		-
CO6	-	3	1	2	-	-	-	-	-	-	2	-	3	-

II Year - I Semester **L T P C**
3 0 0 3

Switching Theory and Logic Design

Lecture – Tutorial:	3-0 Hours	**Internal Marks:**	30
Credits:	3	**External Marks:**	70

Prerequisites: Set theory (Mathematics), Basic logic operations like bit wise operations, Shift operations, flow charts, ASCII codes, etc.

Course Objectives:

- To solve a typical number base conversion and analyze new error coding techniques.
- To study theorems and functions of Boolean algebra and behavior of logic gates.
- To optimize logic gates for digital circuits using various techniques.
- Boolean function simplification using Karnaugh maps and Quine-McCluskey methods.
- To understand concepts of combinational circuits.
- To develop sequential circuits.

Course Outcomes:

Upon successful completion of the course, the student will be able to:

CO1	Classify different number systems and apply to generate various codes.
CO2	Use the concept of Boolean algebra in minimization of switching functions
CO3	Design different types of combinational logic circuits.
CO4	Design combinational logic circuits using different types of Programmable Logic.
CO5	Apply knowledge of flip-flops in the design of Registers and counters.
CO6	Construct the state diagrams with the knowledge of Mealy and Moore conversions, state machines using various flip flops.

Course Content(Syllabus)

UNIT I

Part-A:

REVIEW OF NUMBER SYSTEMS & CODES: Representation of numbers of different radix, conversation from one radix to another radix, r-1's compliments and r's compliments of signed numbers.Binary arithmetic, Gray code ,4 bit codes : BCD, Excess-3, 2421, 8-4-2-1 code etc. Error detection & correction codes: parity checking, even parity, odd parity, Hamming code.

Part-B:

BOOLEAN THEOREMS AND LOGIC OPERATIONS: Boolean theorems, principle of complementation & duality, De-morgan theorems. Logic operations : Basic logic operations -NOT, OR, AND, Universal Logic operations-NAND,NOR, EX-OR, EX- NOR operations. Standard SOP and POS Forms, NAND-NAND and NOR-NOR realizations.

UNIT II

Part A: MINIMIZATION TECHNIQUES: Minimization and realization of switching functions using Boolean theorems, K-Map (up to 5 variables) and tabular method (Quine-mccluskey method) with only four variables and single function.

Part-B:

COMBINATIONAL LOGIC CIRCUITS DESIGN: Design of Half adder, full adder, half subtractor, full subtractor, applications of full adders; 4-bit adder-subtractor circuit, BCD adder circuit, Excess 3 adder circuit and carry look-a-head adder circuit, Design code converters using

Karnaugh method and draw the complete circuit diagrams.

UNIT III

Part-A:

COMBINATIONAL LOGIC CIRCUITS DESIGN USING MSI &LSI: Design of encoder ,decoder, multiplexer and de-multiplexers, Implementation of higher order circuits using lower order circuits . Realization of Boolean functions using decoders and multiplexers. Design of Priority encoder, 4-bit digital comparator and seven segment decoder.

Part-B:

INTRODUCTION OF PLD's:

PLD's : PROM, PAL, PLA -Basics structures, realization of Boolean functions.

UNIT IV

Part-A:

SEQUENTIAL CIRCUITS I: Classification of sequential circuits (synchronous and asynchronous) , operation of NAND & NOR Latches and flip-flops; truth tables and excitation tables of RS flip-flop, JK flip-flop, T flip-flop, D flip-flop with reset and clear terminals. Conversion from one flip-flop to another flip- flop.

Part-B:

SHIFT REGISTERS AND COUNTERS: Design of ripple counters, design of synchronous counters, Johnson counter, ring counter. Registers - Buffer register, control buffer register, shift register, bi-directional shift register, universal shift register.

UNIT V

Part-A:

SEQUENTIAL CIRCUITS II : Finite state machine: state diagrams, state tables, reduction of state tables. Analysis of clocked sequential circuits.

Part-B:

MEALY AND MOORE MACHINES: Introduction to Mealy and Moore machines, Mealy to Moore conversion and vice-versa, Realization of sequence generator.

TEXT BOOKS:

1. Switching and finite automata theory Zvi.KOHAVI,Niraj.K.Jha 3rd Edition,Cambridge UniversityPress,2009
2. Digital Design by M.Morris Mano,Michael D Ciletti,4th edition PHIpublication,2008
3. Switching theory and logic design by Hill and Peterson**,** Mc-Graw Hill TMH edition, 2012.

REFERENCES:

1. Fundamentals of Logic Design by Charles H. Roth Jr, JaicoPublishers,2006
2. Digital electronics by R S Sedha.S.Chand & companylimited,2010
3. Switching Theory and Logic Design by A. Anand Kumar,PHI Learning pvtltd,2016.
4. Digital logic applications and design by John M Yarbough, Cengage learning,2006.
5. TTL 74-Series data book.

Contribution of Course Outcomes towards achievement of Program Outcomes (POs) and Program Specific outcomes (PSOs) (1 – Low, 2- Medium, 3 – High)

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO1	PSO2
CO1	3	3	-	-	-		-	-	-	-	-	-	3	-
CO2	3	2	-	-	-	3	-	-	-	-	-	-	2	-
CO3	3	-	2	-		-	-	3		-	-	-	-	2
CO4	2	-	-	-	3	-	-		-	3	-	-	3	-
CO5	-	3	2	3	-	-	2	-	2	-	2	-	-	3
CO6	-	-	3	2	-	-		-	-	-	-	2	2	-

II Year - I Semester **L T P C**
3 0 0 3

Signals and Systems

Lecture – Tutorial:	3-0 Hours	**Internal Marks:**	30
Credits:	3	**External Marks:**	70

Prerequisites: Engineering Mathematics –I, Engineering Mathematics –II.

Course Objectives:

- To introduce the terminology of signals and systems.
- To study Fourier tools to convert signal from time domain to frequency domain and analyze the spectral characteristics.
- To analyze the linear systems in time and frequency domains and understand importance of convolution, correlation.
- To understand the concept of sampling and reconstruction of signals.
- To study Laplace-transform as mathematical tool to convert signals from time domain to complex frequency domain, and also study Z-transform as mathematical tool to analyze discrete-time signals and systems.

Course Outcomes:

Upon successful completion of the course, the student will be able to:

CO1	Learn the basic concepts of signals and systems and differentiate various classifications of signals and systems.
CO2	Analyze the frequency domain representation of signals using Fourier concepts.
CO3	Classify the systems based on their properties and determine the response of LTI systems through the concept of convolution and correlation.
CO4	Know sampling-reconstruction process and various types of sampling techniques.
CO5	Apply Laplace transforms to analyze continuous time signals and systems.
CO6	Apply Z-transforms to analyze discrete time signals and systems.

Course Content(Syllabus)

UNIT I

INTRODUCTION: Definition of Signals and Systems, Classification of Signals, Classification of Systems, Operations on signals: time-shifting, time-scaling, amplitude- shifting, amplitude-scaling. related problems. Complex exponential and sinusoidal signals, Singularity functions and related functions: impulse function, step function, signum function and ramp function. Orthogonal signal space, Signal approximation using orthogonal functions, related problems.

UNIT II

FOURIER SERIES: Fourier series representation of continuous time periodic signals, properties of Fourier series, Dirichlet's conditions, Trigonometric Fourier series and Exponential Fourier series, Relation between Trigonometric and Exponential Fourier series, Complex Fourier spectrum.

FOURIER TRANSFORM: Deriving Fourier transform from Fourier series, Fourier transform of arbitrary signal, Fourier transform of standard signals, Fourier transform of periodic signals, properties of Fourier transforms. related problems.

UNIT III

LINEAR SYSTEM ANALYSIS: Linear system, impulse response, Response of a linear system, Linear time invariant (LTI) system, Linear time variant (LTV) system, Transfer functions of a LTI system. Filter characteristics of linear systems. Distortion less transmission through a system, Signal bandwidth, system bandwidth, Ideal LPF, HPF and BPF characteristics.

CONVOLUTION OF SIGNALS: Concept of convolution in time domain and frequency domain, Graphical representation of convolution, Convolution property of Fourier transforms, related

problems

UNIT IV

CORRELATION: Auto-correlation and cross-correlation of functions, properties of correlation function, Energy density spectrum, Parseval's theorem, Power density spectrum, properties, Relation between auto correlation function and energy/power spectral density function, Relation between convolution and correlation.

SAMPLING THEOREM: Graphical and analytical proof for Band Limited Signals, impulse sampling, Natural and Flat top Sampling, Reconstruction of signal from its samples, effect of under sampling – Aliasing.

UNIT V

LAPLACE TRANSFORMS: Introduction**,** Concept of region of convergence (ROC) for Laplace transforms, constraints on ROC for various classes of signals, Properties of L.T's, Inverse Laplace transform, Partial fraction expansion, Relation between L.T and F.T. of a signal.

Z–TRANSFORMS: Concept of Z- Transform of a discrete sequence. Region of convergence in Z-Transform, constraints on ROC for various classes of signals, Inverse Z- transform, properties of Z-transforms. Distinction between Laplace, Fourier and Z transforms.

TEXT BOOKS:

1. Signals, Systems & Communications - B.P. Lathi, BS Publications,2003.
2. Signals and Systems - A.V. Oppenheim, A.S. Willsky and S.H. Nawab, PHI,2nd Edn,1997
3. Signals & Systems- A.Anand Kumar –2nd Edition, PHI, 2012.

REFERENCES:

1.Principles of Linear Systems and Signals – BP Lathi, Oxford University Press,2015
2. Signals and Systems – T K Rawat , Oxford University press,2011
3. Signals & Systems - Simon Haykin and Van Veen,Wiley, 2nd Edition.
4. Signals and Systems - K R RajeswariB.VisvesvaraRao, "Signals & Systems" –1st Edition, PHI, 2009.

Contribution of Course Outcomes towards achievement of Program Outcomes (POs) and Program Specific outcomes (PSOs) (1 – Low, 2- Medium, 3 – High)

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PS O1	PSO 2
CO1	3	2	2	-	-	-	-	-	2	-	-	2	-	3
CO2	2	3	-	3	-	-	2	-	-	-	-	-	2	-
CO3	3	-	2	-	-	2	-	-	-	-	-	2	-	-
CO4	3	2	-	2	2	-	-	3	-	-	2	-	-	-
CO5	3	2	3	2	-	-	-	-	-	2	-	-	-	3
CO6	3	2	3	2	2	-	-	-	-	2	-	-	-	3

II Year - I Semester **L T P C**
3 0 0 3

Random Variables and Stochastic Processes

Lecture – Tutorial:	3-0 Hours	**Internal Marks:**	30
Credits:	3	**External Marks:**	70

Prerequisites: Calculus skills, Solution of ordinary differential equations, Fourier transform, Linear Systems.

Course Objectives:

- To introduce the elementary probability theory, in preparation to learn the concepts of statistical analysis, random variables and stochastic processes.
- To mathematically model the random phenomena with the help of probability theory Concepts.
- To introduce the important concepts of random variables and stochastic processes.
- To analyze the LTI systems with stationary random process as input.

Course Outcomes:

Upon successful completion of the course, the student will be able to:

CO1	Mathematically model the random phenomena and solve simple probabilistic problems.
CO2	Identify different types of random variables and compute statistical averages of these random variables.
CO3	Characterize the random processes in the time and frequency domains.
CO4	Analyze the LTI systems with random inputs.
CO5	Understand the concept of random processes, spectral density of stationary random processes and cross power density spectrum, apply the above knowledge to solve basic problems.
CO6	Apply the theory of stochastic processes to analyze linear systems with random inputs and the systems in the presence of different types of noise sources.

Course Content(Syllabus)

UNIT I

THE RANDOM VARIABLE: Introduction, Review of Probability Theory, Definition of a Random Variable, Conditions for a Function to be a Random Variable, Discrete, Continuous and Mixed Random Variables, Distribution and Density functions, Properties, Binomial, Poisson, Uniform, Gaussian, Exponential, Rayleigh, Conditional Distribution, Conditional Density, Properties.

UNIT II

OPERATION ON ONE RANDOM VARIABLE - EXPECTATIONS: Introduction,
Expected Value of a Random Variable, Function of a Random Variable, Moments about the Origin, Central Moments, Variance and Skew, Characteristic Function, Moment Generating Function, Transformations of a Random Variable: Monotonic Transformations for a Continuous Random Variable, Non-monotonic Transformations of Continuous Random Variable.

UNIT III

MULTIPLE RANDOM VARIABLES: Vector Random Variables, Joint Distribution Function, Properties of Joint Distribution, Marginal Distribution Functions, Conditional Distribution and Density, Statistical Independence.
OPERATIONS ON MULTIPLE RANDOM VARIABLES: Joint Moments about the Origin, Joint Central Moments, Joint Characteristic Functions, Jointly Gaussian Random Variables: Two Random Variables case, N Random Variables case, Properties.

UNIT IV

RANDOM PROCESSES – TEMPORAL CHARACTERISTICS: The Random Process Concept, Classification of Processes, Deterministic and Nondeterministic Processes, Distribution and Density Functions, Concept of Stationarity and Statistical Independence. First-Order Stationary Processes, Second-order and Wide-Sense Stationarity, Nth-order and Strict-Sense Stationarity, Time Averages and Ergodicity, Autocorrelation Function and its Properties, Cross- Correlation Function and its Properties, Covariance Functions.

UNIT V

RANDOM PROCESSES - SPECTRAL CHARACTERISTICS: The Power Density Spectrum: Properties, Relationship between Power Density Spectrum and Autocorrelation Function, The Cross-Power Density Spectrum, Properties, Relationship between Cross-Power Density Spectrum and Cross-Correlation Function.

LINEAR SYSTEMS WITH RANDOM INPUTS: Random Signal Response of Linear Systems: System Response – Convolution, Mean and Mean-squared Value of System Response, Autocorrelation Function of Response, Cross-Correlation Functions of Input and Output, Spectral Characteristics of System Response: Power Density Spectrum of Response, Cross- Power Density Spectra of Input and Output.

TEXT BOOKS:

1. Probability, Random Variables & Random Signal Principles, Peyton Z. Peebles,TMH, 4th Edition,2001.
2. Probability, Random Variables and Stochastic Processes, Athanasios Papoulisand S.Unnikrisha, PHI, 4th Edition,2002.
3. Probability and Random Processes with Applications to Signal Processing, HenryStark and John W. Woods, Pearson Education, 3rdEdition,2001.

REFERENCES:

1. Schaum's Outline of Probability, Random Variables, and Random Processes,1997.
2. An Introduction to Random Signals and Communication Theory, B.P. Lathi, International Textbook, 1968.
3. Probability Theory and Random Processes, P. Ramesh Babu, McGrawHill,2015.

Contribution of Course Outcomes towards achievement of Program Outcomes (POs) and Program Specific outcomes (PSOs) (1 – Low, 2- Medium, 3 – High)

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PS O1	PSO 2
CO1	3	3	-	2	-	-	-	-	-	-	-	-	2	-
CO2	-	-	3	2	-	-	-	2	-	-	-	-	-	3
CO3	3	-	-	3	-	-	2	-	-	2	-	3	-	-
CO4	2	2	-	-	3	-	-	-	-	-	3	-	-	3
CO5	2	-	-	3	-	-	-	-	-	2	-	-	-	-
CO6	-	2	2	-	-	-	-	-	-	2	-	-	2	3

II Year - I Semester **L T P C**
0 0 3 1.5

Electronic Devices and Circuits Lab

Lecture – Tutorial:	0-0 Hours	**Internal Marks:**	15
Credits:	1.5	**External Marks:**	35

Prerequisites: Electron Devices and circuits.

Course Objectives:

- To measure the voltage, current and frequency using CRO.
- To observe experimentally the V-I characteristics of PN junction diode & zener diode.
- To observe experimentally the V-I characteristics of BJT in CB, CE and CC configuration.
- To observe experimentally the characteristics of FET, UJT, SCR.
- To observe experimentally the characteristics of CE,CC and CS amplifier.

Course Outcomes:

Upon successful completion of the course, the student will be able to:

CO1	Determine the voltage, current and frequency using CRO.
CO2	Plot the characteristics of PN Diode and Zener Diode.
CO3	Plot the characteristics of transistor in CB, CE and CC configurations.
CO4	Compute the V-I characteristics of FET,UJT and SCR.
CO5	Compute the characteristics of CE, CC and CS amplifier.
CO6	Verify the operation of CRO and its measurements.

LIST OF EXPERIMENTS:

(Minimum of Ten Experiments has to be performed)

1. P-N Junction DiodeCharacteristics
Part A: Germanium Diode (Forward bias& Reverse bias)
Part B: Silicon Diode (Forward Bias only)

2.Zener DiodeCharacteristics
Part A: V-ICharacteristics
Part B: Zener Diode as Voltage Regulator

3.Rectifiers (without and withc-filter)
Part A: Half-waveRectifier
Part B: Full-wave Rectifier

4. BJT Characteristics(CEConfiguration)
Part A: InputCharacteristics
Part B: Output Characteristics

5. FET Characteristics(CSConfiguration)
Part A: DrainCharacteristics
Part B: Transfer Characteristics

6. SCRCharacteristics
7. UJTCharacteristics
8. TransistorBiasing
9. CRO Operation and itsMeasurements
10. BJT-CEAmplifier
11. Emitter Follower-CCAmplifier
12. FET-CSAmplifier

EQUIPMENT REQUIRED

Equipment required:

1. Regulated Powersupplies
2. Analog/Digital StorageOscilloscopes
3. Analog/Digital FunctionGenerators
4. DigitalMulti-meters
5. Decade RésistanceBoxes/Rheostats
6. Decade CapacitanceBoxes
7. Ammeters (Analog orDigital)
8. Voltmeters (Analog orDigital)
9. Active & Passive Electronic Components.

Contribution of Course Outcomes towards achievement of Program Outcomes (POs) and Program Specific outcomes (PSOs) (1 – Low, 2- Medium, 3 – High)

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO1	PSO2
CO1	3	2	-	-	-	-	-	-	-	-	-	-	3	-
CO2	-	3	-	2	-	-	-	-	-	-	-	-	2	-
CO3	3	3	-	-	-	-	-	2	-	-	3	-	3	-
CO4	3	2	-	-	-	-	3	-	-	-	-	-	-	3
CO5	3	-	2	-	3	-	-	-	-	-	-	-	-	2
CO6	-	-	3	3	-	-	-	-	-	-	-	2	-	2

II Year - I Semester **L T P C**
0 0 3 1.5

Switching Theory and Logic Design Lab

Lecture – Tutorial:	0-0 Hours	**Internal Marks:**	15
Credits:	1.5	**External Marks:**	35

Prerequisites: Switching theory and Logic Design.

Course Objectives:

- To understand the basic building blocks of digital electronics.
- To introduce the operation of various combinational and sequential circuits.
- To analyze the combinational and sequential circuits and to perform functional verification.

Course Outcomes:

Upon successful completion of the course, the student will be able to:

CO1	Verify truth tables of basic and Universal gates.
CO2	Design combinational circuits, obtain minimal expression and to verify the truth tables using digital trainer kit.
CO3	Perform logic function verification of various standard combinational circuits.
CO4	Verify the functional tables of various flip-flops.
CO5	Design various sequential circuits using flip-flops and to verify their functionality.
CO6	Perform functional verification of various standard sequential circuits.

LIST OF EXPERIMENTS:

(Minimum of Twelve Experiments has to be performed)

1. Verification of truth tables of Logic gates
Two input (i) OR (ii) AND (iii) NOR (iv) NAND (v) Exclusive OR (vi) Exclusive NOR
2. Design a simple combinational circuit with four variables and obtain minimal SOP expression and verify the truth table using Digital Trainer Kit
3. Verification of functional table of 3 to 8 line Decoder /De-multiplexer
4. 4 variable logic function verification using 8 to 1multiplexer.
5. Design full adder circuit and verify its functional table.
6. Verification of functional tables of
(i) J K Edge triggered Flip –Flop
(ii) J K Master Slave Flip – Flop (iii)D Flip -Flop
7. Design a four bit ring counter using D Flip – Flops / JK Flip Flop and verify output
8. Design a four bit Johnson's counter using D Flip-Flops / JK Flip Flops and verify output
9. Verify the operation of 4-bit Universal Shift Register for different Modes of operation.
10. Draw the circuit diagram of MOD-8 ripple counter and construct a circuit using T-Flip- Flops and Test it with a low frequency clock and Sketch the output waveforms.
11. Design MOD – 8 synchronous counter using T Flip-Flop and verify the result and Sketch the output waveforms.
12. (a) Draw the circuit diagram of a single bit comparator and test the output.
(b) Construct 7 Segment Display Circuit Using Decoder and 7 Segment LED and test it.

ADD ON EXPERIMENTS:

1. Design BCD Adder Circuit and Test the Same using Relevant IC .
2. Design Excess-3 to 9-Complement convertor using only four Full Adders and test the Circuit.
3. Design an Experimental model to demonstrate the operation of74154 De-Multiplexer using LEDs for outputs.

EQUIPMENT REQUIRED:

1. Digital Trainer Kits
2. ICs of various Logic gates
3. Standard Combinational and sequential circuit ICs.

Contribution of Course Outcomes towards achievement of Program Outcomes (POs) and Program Specific outcomes (PSOs) (1 – Low, 2- Medium, 3 – High)

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO1	PSO 2
CO1	3	3	-	-	-		-	-	-	-	3	-	3	-
CO2	3	2	-	-	-	2	-	-	-	-	-	-	2	-
CO3	3	-	2	-	-	-	-	3	-	-	-	-	-	2
CO4	2	-	-	-	3	-	-		-	2	-	-	3	-
CO5	-	3	2	-	-	-	-	-	-	-	-	-	2	-
CO6	-	-	3	2	-	-		-	-	-	-	2	-	3

II Year - I Semester **L T P C**
0 0 3 1.5

Basic Simulation Lab

Lecture – Tutorial:	0-0 Hours	**Internal Marks:**	15
Credits:	1.5	**External Marks:**	35

Prerequisites: Signals and Systems, MATLAB

Course Objectives:

- Understand basics of MATLAB syntax, functions and programming.
- Generate and characterize various continuous and discrete time signals.
- Perform the basic operations on the signals.
- Design and analyze linear time-invariant (LTI) systems and compute its response.
- Analyze the systems using Laplace transform and Fourier transform.

Course Outcomes:

Upon successful completion of the course, the student will be able to:

CO1	Understand mathematical description and representation of continuous and discrete time signals and systems.
CO2	Develop input output relationship for linear shift invariant system and understand the convolution operator for continuous and discrete time system.
CO3	Understand and resolve the signals in frequency domain using Fourier series and Fourier transforms.
CO4	Understand the limitations of Fourier transform and need for Laplace transform and develop the ability to analyze the system in s- domain
CO5	Perform waveform synthesis using Laplace transforms.
CO6	Verify sampling theorem and identification of poles and zeroes for a given transfer function.

LIST OF EXPERIMENTS:

- **All the experiments are to be simulated using MATLAB or equivalent software.**
- **Minimum of ten experiments are to be completed.**

1. Basic Operations on Matrices.
2. Generation of Various Signals and Sequences (Periodic And Aperiodic) such as Unit Impulse, Unit Step, Square, Saw Tooth, Triangular, Sinusoidal, Ramp, Sinc.
3. Operations on Signals And Sequences such as Addition, Multiplication, Scaling, Shifting, Folding, Computation of Energy And Average Power.
4. Finding the Even and Odd Parts of Signal/ Sequence and Real and Imaginary Parts of Signal.
5. Convolution between Signals and Sequences.
6. Autocorrelation and Cross Correlation between Signals and Sequences.
7. Verification of Linearity and Time Invariance Properties of a given Continuous/Discrete System.
8. Computation of Unit Sample, Unit Step and Sinusoidal responses of the given LTI system.
9. Finding the Fourier Transform of a given signal and plotting its magnitude and phase spectrum.
10. Waveform Synthesis Using Laplace Transforms.
11. Locating the Zeros and Poles and plotting the Pole-Zero Maps in S-Plane and Z-Plane for the given Transfer Function.
12. Sampling Theorem Verification.

Contribution of Course Outcomes towards achievement of Program Outcomes (POs) and Program Specific outcomes (PSOs) (1 – Low, 2- Medium, 3 – High)

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO1	PSO2
CO1	3	2	2	-	-	-	-	-	2	-	-	-	-	3
CO2	2	3	-	3	-	-	2	-	-	-	2	-	2	-
CO3	3	-	2	-	3	-	-	-	-	-	-	2	-	-
CO4	3	-	-	2	-	-	-	3	-	-	-	-	-	3
CO5	-	2	-	-	-	-	-	-	3	-	-	-	-	-
CO6	3	2	-	3	-	-	-	-	-	-	3	-	-	3

II Year - I Semester **L T P C**
1 0 2 2

Electronic Circuit Design
(Skill Course)

Lecture – Practical:	1-2 Hours	**Internal Marks:**	0
Credits:	2	**External Marks:**	50

Prerequisites: Fundamentals of Electronics.

Course Objectives:

- To familiarize the electronic circuit rules and its parameter calculations.
- To make familiar with PCB design and various processes involved.
- To provide in-depth core knowledge in the fabrication of Printed Circuit Boards.
- To provide the knowledge in assembling and testing of the PCB based electronic circuits.

Course Outcomes:

Upon successful completion of the course, the student will be able to:

CO1	Analyze the electronic circuit rules and its parameter calculations.
CO2	Develop the simulation process in the design of Electronic Circuits.
CO3	Interpret the PCB design and various processes involved
CO4	Explore in-depth core knowledge in the and fabrication of Printed Circuit Boards
CO5	Apply assembling and testing of the PCB based electronic circuits
CO6	Design single side PCB for power supplies of various devices.

Course Content(Syllabus)

UNIT I

Fundamentals of Circuit Design:

Basic circuit laws, Current & voltage division Rules, Introduction to Linear and Non-linear elements, Equivalent Impedance Calculations in series & parallel circuits, Current, voltage and Power calculations in a circuit, Classification of sources.

UNIT II

Schematic Capture Tools :

Introduction to schematic capture tools, Simulation of simple electronic circuits, Schematic to layout transfer, Layout Printing.

UNIT III

PCB Design Process :

Conception Level Introduction: Specifying Parts, Packages and Pin Names, Libraries and Checking foot prints of the components, Partlist, Netlist, Making Netlist Files, Placing Parts, Routing Traces, Modifying Traces, Mounting Holes, Adding Text, PCB Layout.

UNIT IV

PCB Fabrication Process :

Classification of Printed Circuit Boards (SSB, DSB and multilayer board), PCB manufacturing machines, ultraviolet exposure and developing Copper clad preparation, Etching, cleaning, drying and drilling.

UNIT V

Power Supply design:

Introduction to low power design techniques and methodologies. Introduction to various types of power supplies. Estimation of power supply requirements and power loss in electronic products. Selection of appropriate power supplies for the given primary power sources (230VAC/Battery/SMPS).

TEXT BOOKS:

1. Printed Circuit Boards: Design, Fabrication, and Assembly (McGraw-Hill Electronic Engineering) by Raghbir Singh Khandpur.
2. Printed Circuits Handbook" by Clyde F Coombs and Happy Holden.

REFERENCES:

PCB Design/TINA/ORCAD.PADS software User manuals.

Contribution of Course Outcomes towards achievement of Program Outcomes (1 – Low, 2- Medium, 3 – High)

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO2
CO1	3	3	-	-	-	-	-	-	-	-	3	-	3	2
CO2	-	3	-	-	-	3	-	-	3	-	-	3	2	-
CO3	3	-	2	-	-	-	-	-	-	-	-	-	-	3
CO4	2	-	-	-	3	-	-	-	-	2	-	-	3	2
CO5	-	3	2	-	-	-	-	-	3	-	3	-	2	-
CO6	-	-	3	2	-	3	-	-	-	3	-	-	-	3

II Year - I Semester **L T P C**
3 0 0 0

INDIAN CONSTITUTION
(MANDATORY COURSE)

Lecture – Tutorial:	3-0 Hours	**Internal Marks:**	30
Credits:	0	**External Marks:**	70

Prerequisites: NIL

Course Objectives:

- To understand the importance of constitution.
- To understand the structure of executive, legislature and judiciary.
- To understand philosophy of fundamental rights and duties.
- To understand the central and state relations, financial and administrative duties.

Course Outcomes:

Upon successful completion of the course, the student will be able to:

CO1	Understand the meaning, history, features and characteristics of Indian Constitution.
CO2	Gain knowledge on fundamental rights duties and Principles and importance of State Policy.
CO3	Understand the powers of Union, the States and Indian President.
CO4	Know about amendments of the constitution and Emergency Provisions.
CO5	Understand the functioning of three wings of the government i.e., executive, legislative and judiciary.
CO6	Analyze the decentralization of power between central, state and local self-government.

Course Content(Syllabus)

UNIT I

Meaning of the constitution law and constitutionalism, Historical perspective of the constitution of India, Salient features and characteristics of the constitution of India .

UNIT II

Fundamental Rights under Indian constitution, scheme of the fundamental Rights, Scheme of the fundamental Right to Equality, Scheme of the fundamental Right to certain freedoms under Article 19 Scope of the right to life and personal Liberty under Article 21.

UNIT III

Federal structure and distribution of legislative and financial powers between the union and the states, Parliamentary form of government in India-the constitution powers and status of the President of India, Amendment of the constitutional powers and procedure, The historical perspectives of the constitutional amendments in India, Local self government-Constitutional Scheme in India.

UNIT IV

Emergency Provisions, National Emergency, President Rule, Financial Emergency **Statutory Institutions**: Elections-Election Commission of India, National Human Rights Commission, National Commission for Women.

UNIT V

Evolution: 1909 Act, 1919 Act and 1935 Act. Constituent Assembly: Composition and Functions; Fundamental features of the Indian Constitution, Directive principles, Fundamental Duties.

TEXT BOOKS:

1. Dr. S. N. Busi, Dr. B. R. Ambedkar, *—Framing of Indian Constitution‖*, 1st Edition, 2015.

REFERENCES:

1.M. P. Jain, —*Indian Constitution Law*‖, 7th Edition., Lexis Nexis, 2014.
2.D.D. Basu, —*Introduction to the Constitution of India*‖, Lexis Nexis, 2015.
3. SubhashKashyap, Our Parliament, National Book Trust, New Delhi
4. Peu Ghosh, Indian Government &Politics, Prentice Hall of India, New Delhi
5. B.Z. Fadia&KuldeepFadia, Indian Government &Politics, Lexis Nexis, New Delhi

Contribution of Course Outcomes towards achievement of Program Outcomes (1 – Low, 2- Medium, 3 – High)

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO2
CO1	-	-	-	-	-	3	-	3	-	2	-	-	-	-
CO2	-	-	-	-	-	-	-	-	2	-	-	-	-	-
CO3	-	-	-	-	-	2	2	-	-	-	1	-	-	-
CO4	-	-	-	-	-	-	-	3	2	2	-	-	-	-
CO5	-	-	-	-	-	-	-	2	-	-	-	-	-	-
CO6	-	-	-	-	-	-	2	-	3	-	-	-	-	-

B.TECH (ECE)
II-II SEMESTER

II Year - II Semester **L T P C**
3 0 0 3

LINEAR CONTROL SYSTEMS

Lecture – Tutorial:	3-0 Hours	**Internal Marks:**	30
Credits:	3	**External Marks:**	70

Prerequisites: Nil

Course Objectives:

- To introduce the concepts of open loop and closed loop systems, mathematical models of mechanical and electrical systems, and concepts of feedback
- To study the characteristics of the given system in terms of the transfer function and introducing various approaches to reduce the overall system for necessary analysis
- To develop the acquaintance in analyzing the system response in time-domain and frequency domain in terms of various performance indices
- To analyze the system in terms of absolute stability and relative stability by different approaches
- To design different control systems for different applications as per given specifications
- To introduce the concepts of state variable analysis, design and also the concepts of controllability and observability.

Course Outcomes:

Upon successful completion of the course, the student will be able to:

CO1	This course introduces the concepts of feedback and its advantages to various control systems.
CO2	The performance metrics to design the control system in time-domain and frequency domain are introduced.
CO3	Control systems for various applications can be designed using time-domain analysis.
CO4	Control systems for various applications can be designed using frequency domain analysis.
CO5	In addition to the conventional approach, for the analysis of control systems is also introduced.
CO6	In addition to the state space approach for the analysis of control systems is also introduced.

Course Content(Syllabus)

UNIT I

INTRODUCTION Concepts of System, Control Systems: Open Loop and closed loop control systems and their differences. Different examples of control systems, Feed-Back Characteristics, Effects of feedback. Mathematical models, Differential equations, Impulse Response and transfer functions. Translational and Rotational mechanical systems.

UNIT II

TRANSFER FUNCTION REPRESENTATION Transfer Function of DC Servo motor - AC Servo motor- Synchro-transmitter and Receiver, Block diagram representation of systems considering electrical systems as examples –Block diagram algebra–Representation by Signal flow graph-Reduction using mason's gain formula. TIME RESPONSE 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.

UNIT III

STABILITY ANALYSIS IN S-DOMAIN The concept of stability – Routh's stability criterion – qualitative stability and conditional stability – limitations of Routh's stability100 Root Locus Technique: The root locus concept - construction of root loci-effects of adding poles and zeros to G(s) H(s) on the root loci.

UNIT IV

Frequency response analysis: Introduction, Correlation between time and frequency response, Polar Plots, Bode Plots, Nyquist Stability Criterion.

UNIT V

CLASSICAL CONTROL DESIGN TECHNIQUES Compensation techniques – Lag, Lead, Lead-Lag Controllers design infrequency Domain, PID Controllers. State Space Analysis of Continuous Systems Concepts of state, state variables and state model, derivation of state models from block diagrams, Diagonalization Solving the Time invariant state Equations- State Transition Matrix and it's Properties – Concepts of Controllability and Observability.

TEXT BOOKS:

1. Automatic Control Systems 8th edition– by B.C.Kuo – Johnwiley and son's, 2003.
2. Control Systems Engineering –by I. J.Nagrathand M.Gopal, New Age International (P) Limited, Publishers, 2nd edition, 2007
3. Modern Control Engineering–by Katsuhiko Ogata–Pearson Publications, 5th edition, 2015.

REFERENCES:

1 Control Systems by A.Nagoorkani, RB Apublications, 3 edition, 2017.
2. Control Systems by A.Anandkumar, PHI, 2 Edition, 2014.

Contribution of Course Outcomes towards achievement of Program Outcomes (POs) and Program Specific outcomes (PSOs) (1 – Low, 2- Medium, 3 – High)

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1	2	2	1	-	-	-	-	-	-	-	1	-	-	-
CO2	3	2	1	-	-	-	-	-	-	-	1	-	-	-
CO3	3	2	1	-	-	-	-	-	-	-	1	-	-	-
CO4	3	2	1	-	-	-	-	-	-	-	1	-	-	-
CO5	3	2	1	-	-	-	-	-	-	-	1	-	-	-
CO6	3	2	1	-	-	-	-	-	-	-	1	-	-	-

II Year - II Semester **L T P C**
3 0 0 3

Analog and Pulse Circuits

Lecture – Tutorial:	3-0 Hours	**Internal Marks:**	30
Credits:	3	**External Marks:**	70

Prerequisites: Electronic devices and circuits, Basic mathematics, Circuit Analysis.

Course Objectives:

- To learn hybrid-pi parameters a high frequency and compare with low frequency parameters.
- Learn and understand the purpose of cascading of multi stage amplifiers andderive the overall voltage gain.
- Analyze the effect of negative feedback on amplifier characteristics and derive thecharacteristics.
- Learn and understand the basic principle of oscillator circuits and perform theanalysis of different oscillator circuits.
- Compare and analyze different Power amplifiers like Class A, Class B, Class C,Class AB and other types of amplifiers.
- Analyze various wave shaping circuits.
- Analyze different types of multivibrator circuits.

Course Outcomes:

Upon successful completion of the course, the student will be able to:

CO1	Design and analysis of small signal high frequency transistor amplifier using BJT.
CO2	Design and analysis of multistage amplifiers using BJT.
CO3	Derive the expressions for frequency of oscillation and condition for oscillation of RC and LC oscillators and their amplitude and frequency stability concept.
CO4	Know the classification of the power amplifiers and their analysiswith performance comparison.
CO5	Derive the expressions for RC circuits for various inputs.
CO6	Design and analysis of different types of multivibrators.

Course Content(Syllabus)

UNIT I

UNIT-I Small Signal High Frequency Transistor Amplifier models:

BJT: Transistor at high frequencies, Hybrid- π common emitter transistor model, Hybrid π conductance, Hybrid π capacitances, CE short circuit current gain, current gain with resistive load, cut-off frequencies.

Multistage Amplifiers: Classification of amplifiers, methods of coupling, analysis of two stage RC coupled amplifier.

UNIT II

Feedback Amplifiers: Feedback principle and concept, types of feedback, classification of amplifiers, feedback topologies, Characteristics of negative feedback amplifiers, Generalized analysis of feedback amplifiers, Performance comparison of feedback amplifiers.

UNIT III

Oscillators: Oscillator principle, condition for oscillations, types of oscillators, RC- phase shift and Wien bridge oscillators with BJT and their analysis, Generalized analysis of LC Oscillators, Hartley and Colpitt's oscillators using BJT.

Power Amplifiers: Classification of Power amplifiers Class A power Amplifiers, Class B Push-pull amplifiers, Complementary symmetry push pull amplifier, Class AB power amplifier, Class-C power amplifier.

UNIT IV

Linear wave shaping:
High pass, Low pass RC circuits, their response expressions for sinusoidal, step, pulse, square, ramp and exponential inputs

Non linear wave shaping:
Diode clippers, Transistor clippers, clipping at two independent levels, Emitter coupled clipper; Clamping operation, Clamping circuit theorem, practical clamping circuits.

UNIT V

Multivibrators:
Bistable Multi Vibrator: Analysis and Design of Fixed Bias Bistable Multi Vibrator, Schmitt trigger.

Monostable Multi Vibrator: Analysis and Design of Collector Coupled Monostable Multi Vibrator.

Astable Multi Vibrator: Analysis and Design of Collector Coupled Astable Multi vibrator.

TEXT BOOKS:

1. Integrated Electronics- J.Millman and C.C.Halkias, Tata McGraw-Hill, 1972.
2. Electronic Devices and CircuitsTheory –Robert L.Boylestad and Louis Nashelsky, Pearson/Prentice Hall, Tenth Edition, 2009.
3.Electronic Devices and Integrated Circuits – B.P. Singh, Rekha, Pearson publications,2006
4.Pulse and Digital Circuits – A. Anand Kumar, PHI, 2005

REFERENCES:

1. Electronic Circuit Analysis and Design – Donald A. Neaman, Mc Graw Hill.
2. Electronic Devices and Circuits Theory – Robert L. Boylestad and Louis Nashelsky, Pearson/Prentice Hall, Tenth Edition.
3. Electronic Circuit Analysis – A.P.Godse, Technical Publications
4. Pulse and Digital Circuits – B.Yoganarsimhan
5. Pulse & Digital Circuits by Venkata Rao,K,Ramasudha K, Manmadha Rao,G., Pearson,2010
6. Pulse, Digital and Switching Waveforms - J. Millman and H. Taub, McGraw-Hill, 1991

Contribution of Course Outcomes towards achievement of Program Outcomes (POs) and Program Specific outcomes (PSOs) (1 – Low, 2- Medium, 3 – High)

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO1	PSO 2
CO1	2	-	-	3	-	-	-	-	-	-	-	2	-	3
CO2	3	3	2	-	-	-	-	3	-	-	-	-	3	3
CO3	3	-	-	-	-	-	-	-	-	3	-	-	-	-
CO4	3	3	-	3	-	-	2	-	3	-	-	3	-	-
CO5	-	-	2	2	-	3	-	-	-	-	2	-	2	-
CO6	2	3		-	-	-	-	-	-	-	-	-	3	-

II Year - II Semester **L T P C**
3 0 0 3

Analog Communications

Lecture – Tutorial:	3-0 Hours	**Internal Marks:**	30
Credits:	3	**External Marks:**	70

Prerequisites: Basics of Communications, signals and systems.

Course Objectives:

- Familiarize with the fundamentals of analog communication systems.
- Familiarize with various techniques for analog modulation and demodulation of signals.
- Distinguish the figure of merits of various analog modulation methods.
- Develop the ability to classify and understand various functional blocks of radio transmitters and receivers.
- Familiarize with basic techniques for generating and demodulating various pulse modulated signals.

Course Outcomes:

Upon successful completion of the course, the student will be able to:

CO1	Demonstrate knowledge of various blocks of communication system and to analyze various modulation and demodulation schemes.
CO2	Understand the concepts of DSB-SC, SSB-SC, and VSB and to distinguish different amplitude modulation schemes with their merits, demerits and applications.
CO3	Analyze the concept of generation and detection of FM signal and to compare amplitude and angle modulation schemes.
CO4	Know the effect of noise on the performance of communication systems by computing noise figure of various analog and Frequency modulation techniques.
CO5	Explore the characteristics of AM and FM transmitters and receivers and to analyze the effect of feedback on the performance of AM and FM transmitters.
CO6	Demonstrate the generation and detection of various pulse modulation techniques.

Course Content(Syllabus)

UNIT I

AMPLITUDE MODULATION : Introduction to communication system, Need for modulation, Frequency Division Multiplexing , Amplitude Modulation, Definition, Time domain and frequency domain description, single tone modulation, power relations in AM waves, Generation of AM waves, square law Modulator, Switching modulator, Detection of AM Waves; Square law detector, Envelope detector.

UNIT II

DSB & SSB MODULATION: Double side band suppressed carrier modulators, time domain and frequency domain description, Generation of DSBSC Waves, Balanced Modulators, Ring Modulator, Coherent detection of DSB-SC Modulated waves, COSTAS Loop. Frequency domain description, Frequency discrimination method for generation of AM SSB Modulated Wave, Time domain description, Phase discrimination method for generating AM SSB Modulated waves. Demodulation of SSB Waves, Vestigial side band modulation: Frequency description.

UNIT III

ANGLE MODULATION: Basic concepts, Frequency Modulation: Single tone frequency modulation, Spectrum Analysis of Sinusoidal FM Wave, Narrow band FM, Wide band FM, Constant Average Power, Transmission bandwidth of FM Wave - Generation of FM Waves, Detection of FM Waves: Balanced Frequency discriminator, Zero crossing detector, Phase locked loop. Comparison of FM & AM.

UNIT IV

TRANSMITTERS & RECEIVERS: Radio Transmitter - Classification of Transmitter, AM Transmitter, Effect of feedback on performance of AM Transmitter, FM Transmitter – Variable reactance type and phase modulated FM Transmitter, frequency stability in FM Transmitter. **Radio Receiver** - Receiver Types - Tuned radio frequency receiver, Super hetero dyne receiver, RF section an Characteristics - Frequency changing and tracking, Intermediate frequency, AGC, FM Receiver, Comparison with AM Receiver.

UNIT V

NOISE: Review of noise and noise sources, noise figure**,** Noise in Analog communication Systems, Noise in DSB& SSB System, Noise in AM System, Noise in Angle Modulation Systems, Threshold effect in Angle Modulation System, Pre-emphasis & de-emphasis

PULSE MODULATION: Types of Pulse modulation, PAM (Single polarity, double polarity) PWM: Generation & demodulation of PWM, PPM, Generation and demodulation of PPM, Time Division Multiplexing, TDM Vs FDM

TEXT BOOKS:

1.Principles of Communication Systems – H Taub & D. Schilling, Gautam Sahe,TMH, 3rd Edition,2007.

2. Principles of Communication Systems - Simon Haykin, John Wiley, 2nd Edition,2007.

3. Modern Digital and Analog Communication Systems –B.P.Lathi,Zhi Ding,Hari Mohan Gupta,Oxford University Press,4th Edition,2017

REFERENCES:

1. Electronics & Communication System – George Kennedy and Bernard Davis,TMH 2004.

2. Communication Systems– R.P. Singh, SP Sapre, Second Edition TMH,2007.

3. Electronic Communication systems – Tomasi, Pearson, fourth Edition,2007.

Contribution of Course Outcomes towards achievement of Program Outcomes (POs) and Program Specific outcomes (PSOs) (1 – Low, 2- Medium, 3 – High)

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO1	PSO 2
CO1	-	3	-	-	2	-	-	-	-	-	-	2	2	3
CO2	2	3	2	-	-	-	-	3	-	-	-	-	-	3
CO3	3	-	2	-	-	-	-	-	-	3	-	-	-	-
CO4	-	2	-	3	-	-	2	-	-	-	-	3	-	2
CO5	-	2	2	-	-	3	-	-	-	-	2	-	2	-
CO6	2	2	-	-	-	-	-	-	-	-	-	-	-	3

II Year - II Semester **L T P C**
3 0 0 3

Electromagnetic Waves and Transmission Lines

Lecture – Tutorial:	3-0 Hours	**Internal Marks:**	30
Credits:	3	**External Marks:**	70

Prerequisites: Coordinate Systems, Vector Calculus.

Course Objectives:

1. To understand the fundamentals of steady electric and magnetic fields using various laws.
2. To Formulate Maxwell equations in Time varying fields and power flow by using pointing theorem.
3. To impart the knowledge of electric and magnetic fields in real time applications.
4. To learn Wave Propagation characteristics in different media.
5. To impart Reflections and refractions of EM Waves in different media at oblique and normal incidence.
6. To study the Transmission line parameters and Characteristics using network theory concepts.

Course Outcomes:

Upon successful completion of the course, the student will be able to:

CO1	Interpret and Apply the static electrostatic fields with respect to coordinate systems.
CO2	Analyze and Demonstrate the static magnetic fields in real time applications.
CO3	Formulate the Maxwell's Equations in different forms with time considerations.
CO4	Formulate the theory of electromagnetic waves in free space with practical applications.
CO5	Evaluate and Relate wave propagation characteristics in different conducting and non-conducting media.
CO6	Demonstrate the reflection and Refraction of EM waves at normal and oblique incidences.

Course Content(Syllabus)

UNIT-I

Part-A:

Electrostatics: Review of Co-ordinate Systems, Coulomb's Law, Electric Field Intensity, Electric Flux Density, Gauss Law and Applications, Electric Potential, Maxwell's Two Equations for Electrostatic Fields, Illustrative Problems.

Part-B:

Fields in Materials :Convection, Conduction and Displacement Current Densities, Dielectric Constant, Continuity Equation, Relaxation Time, Poisson's and Laplace's Equations..Illustrative Problems.

UNIT-II

Part-A:

Magneto Statics : Biot-Savart Law, Ampere's Circuital Law and Applications, Magnetic Flux Density, Maxwell's Two Equations for Magneto static Fields, Magnetic Scalar and Vector Potentials. Illustrative Problems**.**

Part-B:

Maxwell's Equations (Time Varying Fields): Faraday's Law and Transformer emf, Inconsistency of Ampere's Law, Maxwell's Equations in Different Final Forms and Word Statements. Conditions at a Boundary Surface: Dielectric-Dielectric and Dielectric-Conductor Interfaces. Illustrative Problems.

UNIT-III

Part-A:

EM Wave Characteristics – 1a: Characterization of conductor and dielectric media**,** Wave Equations

for Conducting and Perfect Dielectric Media, Uniform Plane Waves – Definition, All Relations Between E & H,

Part-B:

EM Wave Characteristics – 1b:

Sinusoidal Variations, Wave Propagation Characteristics in dielectric and conductor media, Wave Propagation Characteristics in good dielectric and good conductor media, skin depth..Illustrative Problems.

UNIT-IV

Part-A:

EM Wave Characteristics – 2a: Polarization & Types, Brewster Angle, Critical Angle ,Total Internal Reflection, Surface Impedance. Poynting Vector and Poynting Theorem – Applications Illustrative Problems.

Part-B:

EM Wave Characteristics – 2b: Reflections and Refractions of uniform plane waves by a perfect dielectric at normal & Oblique incidence, Reflections and Refractions of uniform plane waves by a perfect conductor at normal & Oblique incidence.

UNIT-V

Transmission Lines-I: Types, Parameters, T&π Equivalent Circuits, Transmission Line Equations, Primary & Secondary Constants, Expressions for Characteristic Impedance, Propagation Constant, Phase and Group Velocities, Infinite Line, Lossless lines, distortion less lines, Illustrative Problems.

Transmission Lines-II: Input Impedance Relations, SC and OC Lines, Reflection Coefficient, VSWR. Low loss radio frequency lines and UHF Transmission lines, UHF Lines as Circuit Elements; ImpedanceTransformations,λ/8,λ/4 and λ /2 Lines. Quarter wave transformer, Single Stub Matching, Illustrative Problems.

TEXT BOOKS:

1. Elements of Electromagnetic – Mathew N.O. Sadiku, Oxford Univ. Press, 3rd ed., 2001.
2. Electromagnetic Waves and Radiating Systems – E.C. Jordan and K.G. Balmain, PHI, 2nd Edition, 2000.
3. Transmission Lines and Networks–Umesh Sinha,Satya Prakashan (Tech. India Publications), New Delhi, 2001.

REFERENCE BOOKS:

1. Electromagnetics- *J.D. Kraus, "Electromagnetics*", 4th Edition, Mc Graw-Hill. Inc, 1992.
2. Engineering Electromagnetics:Nathan Ida, Springer(India)Pvt.Ltd., New Delhi, 2nd ed., 2005.
3. Engineering Electromagnetics – William H. Hayt Jr. and John A. Buck, TMH, 7th ed., 2006.
4. Electromagnetic Field Theory and Transmission Lines: G Sasi Bhushana Rao,Wiley India 2013.
5. Networks,Lines and Fields John D. Ryder- Second Edition, PearsonEducation,2015.

Contribution of Course Outcomes towards achievement of Program Outcomes (POs) and Program Specific outcomes (PSOs) (1 – Low, 2- Medium, 3 – High)

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO1	PSO2
CO1	3	-	2	-	-	-	-	-	3	-	-	-	-	3
CO2	-	3	-	3	-	-	-	-	-	-	2	-	2	-
CO3	-	-	3	-	-	-	-	-	-	-	-	3	-	-
CO4	3	-	-	-	2	-	-	-	-	-	-	-	-	3
CO5	-	3	-	-	-	-	3	-	-	-	-	-	-	-
CO6	-	2	-	3	-	-	-	-	-	-	-	-	3	-

II Year - II Semester **L T P C**
3 0 0 3

Managerial Economics and Financial Analysis

Lecture – Tutorial:	3-0 Hours	**Internal Marks:**	30
Credits:	3	**External Marks:**	70

Prerequisites: Basics of management, Basics of Economics.

Course Objectives:

- To familiarize with the process of management, principles, leadership styles and basic concepts on Organization.
- To provide conceptual knowledge on functional management that is on Human resource management and Marketing management.
- To provide basic insight into select contemporary management practices and Strategic Management.
- To learn theories of motivation and also deals with individual behavior, their personality and perception of individuals.
- To understand about organizations groups that affect the climate of entire organizations which helps employees in stress management.

Course Outcomes:

Upon successful completion of the course, the student will be able to:

CO1	Equip with the knowledge of estimating the Demand and demand elasticities for a product
CO2	Understand the Input-Output-Cost relationships and estimation of the least cost combination of inputs.
CO3	Understand the nature of different markets and Price Output determination under various market conditions and also to have the knowledge of different Business Units.
CO4	Prepare Financial Statements and the usage of various Accounting tools for Analysis.
CO5	Evaluate various investment project proposals with the help of capital budgeting techniques for decision making.
CO6	Understand and analyze the traditional methods and modern methods of capital budgeting.

Course Content(Syllabus)

UNIT I: Introduction to Managerial Economics and demand Analysis:

Introduction to Managerial Economics and demand Analysis: Definition of Managerial Economics –Scope of Managerial Economics and its relationship with other subjects –Concept of Demand, Types of Demand, Determinants of Demand, Demand schedule, Demand curve, Law of Demand and its limitations- Elasticity of Demand, Types of Elasticity of Demand and Measurement-Demand forecasting and Methods of forecasting, Concept of Supply and Law of Supply.

UNIT II: Theories of Production and Cost Analysis:

Theories of Production function- Law of Variable Proportions-Isoquants and Isocosts and choice of least cost factor combination-Concepts of Returns to scale and Economies of scale, Different cost concepts: opportunity costs, explicit and implicit costs-Fixed costs, Variable Costs and Total costs –Cost –Volume-Profit Analysis-Determination of Breakeven point(problems)-Managerial significance and limitations of Breakeven point.

UNIT III: Introduction to Markets, Theories of the Firm & Pricing Policies:

Market Structures: Perfect Competition, Monopoly, Monopolistic competition and Oligopoly – Features – Price and Output Determination – Managerial Theories of firm: Marris and Williamson's models – other Methods of Pricing: Average cost pricing, Limit Pricing, Market Skimming Pricing, Internet Pricing: (Flat Rate Pricing, Usage sensitive pricing) and Priority Pricing, Business Cycles: Meaning and Features – Phases of a Business Cycle. Features and Evaluation of Sole Trader, Partnership, Joint Stock Company – State/Public Enterprises and their forms.

UNIT IV: Introduction to Accounting & Financing Analysis:

Introduction to Double Entry System, Journal, Ledger, Trail Balance and Preparation of Final Accounts with adjustments – Preparation of Financial Statements-Analysis and Interpretation of Financial Statements-Ratio Analysis – Preparation of Funds flow and cash flow analysis (Problems)

UNIT V: Capital and Capital Budgeting:

Capital Budgeting: Meaning of Capital-Capitalization Meaning of Capital Budgeting-Time value of money-Methods of appraising Project profitability: Traditional Methods (payback period, accounting rate of return) and modern methods (Discounted cash flow method, Net Present Value method, Internal Rate of Return Method and Profitability Index)

TEXT BOOKS:

1. Subba Rao P., *Organizational Behaviour*, Himalaya Publishing House, Mumbai.
2. Fred Luthans *Organizational Behaviour*, TMH, NewDelhi.
3. Robins, Stephen P., *Fundamentals of Management*, Pearson, India.
4. Kotler Philip & Keller Kevin Lane: Marketing Mangement 12/e, PHI, 2007
5. Koontz & Weihrich: *Essentials of Management*, 6/e, TMH, 2007
6. Kanishka Bedi, *Production and Operations Management*, Oxford University Press, 2007.

Contribution of Course Outcomes towards achievement of Program Outcomes (POs) and Program Specific outcomes (PSOs) (1 – Low, 2- Medium, 3 – High)

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO1	PSO 2
CO1	3	3	2	-	-	-	-	-	3	-	-	-	2	-
CO2	3	-	-	-	-	-	-	-	2	3	-	-	-	2
CO3	3	-	2	2	-	-	-	-	-	-	1	-	-	-
CO4	-	2	-	3	-	3	-	-	-	-	-	-	3	-
CO5	3	2	-	-	-	-	-	-	3	-	2	-	-	3
CO6	3	3	-	-	-	-	-	-	-	-	3	-	-	-

II Year - II Semester **L T P C**
0 0 3 1.5

Analog and Pulse Circuits Lab

Lecture – Tutorial:	0-0 Hours	**Internal Marks:**	15
Credits:	1.5	**External Marks:**	35

Prerequisites: Analog and Pulse Circuits.

Course Objectives:

- To design RC phase shift oscillator using transistors for different frequencies.
- To design Wien Bridge oscillator using transistors for different frequencies.
- To obtain frequency response of two stage RC coupled amplifier.
- To design single tuned voltage amplifier.
- To design double tuned voltage amplifier.

Course Outcomes:

Upon successful completion of the course, the student will be able to:

CO1	Construct the RC phase shift oscillator using transistors for different frequencies.
CO2	Design Colpitt's oscillator using transistors for different frequencies.
CO3	Estimate frequency response of two stage RC coupled amplifier.
CO4	Understand the characteristics of power amplifiers and multivibrators.
CO5	Draw the characteristics of series and shunt feedback amplifiers.
CO6	Understand the characteristics of linear and non linear wave shaping circuits.

List of Experiments :

Note: The students are required to design the circuit and perform the simulation using Multisim/ Equivalent Industrial Standard Licensed simulation software tool**.** Further they are required to verify the result using necessary hardware equipment.

(Minimum of Ten Experiments has to be performed)

1. Voltage-Series Feedback Amplifier
2. Current-Shunt Feedback Amplifier
3. RC Phase Shift Oscillator
4. Colpitt's Oscillator
5. Two Stage RC Coupled Amplifier
6. Current-Series Feedback Amplifier
7. Class A Series-fed Power Amplifier
8. Linear Wave shaping Circuits
9. Non Linear Wave shaping Circuits – Clippers
10. Non Linear Wave shaping Circuits – Clampers
11. Astable Multivibrator
12. Monostable Multivibrator

Equipment required:

Software:

i. Multisim/ Equivalent Industrial Standard Licensed simulation software tool.

ii. Computer Systems with required specifications

Hardware Required:

1. Regulated Power supplies
2. Analog/Digital Storage Oscilloscopes
3. Analog/Digital Function Generators
4. Digital Multi meters
5. Decade Résistance Boxes/Rheostats
6. Decade Capacitance Boxes
7. Ammeters (Analog or Digital)
8. Voltmeters (Analog or Digital)
9. Active & Passive Electronic Components

Contribution of Course Outcomes towards achievement of Program Outcomes (POs) and Program Specific outcomes (PSOs) (1 – Low, 2- Medium, 3 – High)

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO1	PSO2
CO1	2	3	-	-	-	-	2	-	-	-	-	-	3	-
CO2	-	3	3	-	-	3	-	-	-	-	3	-	3	-
CO3	2	-	-	-	2	-	-	-	-	-	-	3	3	-
CO4	2	-	2	-	-	-	-	2	-	3	-	-	-	3
CO5	-	2	3	-	3	-	2	-	-	-	-	-	-	2
CO6	3	-	3	-	-	-	3	-	-	-	-	-	-	2

II Year - II Semester **L T P C**
0 0 3 1.5

Analog Communications Lab

Lecture – Tutorial:	0-0Hours	**Internal Marks:**	15
Credits:	1.5	**External Marks:**	35

Prerequisites: Analog Communications.

Course Objectives:

- Familiarize the students with basic analog communication systems.
- Integrate theory with experiments so that the students appreciate the knowledge gained from the theory course, e.g., amplitude and frequency modulation, pulse modulation.

Course Outcomes:

Upon successful completion of the course, the student will be able to:

CO1	Analyze the output waveforms of AM & FM.
CO2	Perform spectral analysis of modulated signal using spectrum analyzer.
CO3	Understand the working of diode detector, AGC and to analyze their outputs.
CO4	Perform verification of sampling theorem.
CO5	Analyze the output waveforms of various pulse modulation techniques.
CO6	Understand the operation of PLL using IC 565.

List of Experiments:

(Ten experiments to be done- **The students have to calculate the relevant parameters**)–
(a. Hardware, b. MATLAB Simulink, c. MATLAB Communication toolbox)
A. Amplitude Modulation - Modulation &Demodulation
B. AM - DSB SC - Modulation &Demodulation
C. Diode Detector Characteristics
D. Pre-emphasis& De-emphasis
E. Frequency Modulation – Modulation &Demodulation
F. AGC Circuits Characteristics
G. Verification of Sampling Theorem
H. Pulse Amplitude Modulation & Demodulation
I. PWM, PPM –Modulation & Demodulation
J. Radio receiver characteristics

Experiments to be conducted beyond the syllabus
1. Amplitude Modulation - Modulation &Demodulation
2. Frequency Modulation – Modulation &Demodulation
Note:
The above two experiments are to be executed/completed using MATLAB Communication toolbox and Simulink.

Equipment& Software required:

Software :
i)Computer Systems with latest specifications
ii) Connected in LAN(Optional)
iii) Operating system(Windows/Linux software)
iv) Simulations software (Simulink & MATLAB)
Equipment:
1. RPS - 0 – 30V
2. CRO - 0 – 20 M Hz.
3. Function Generators - 0 – 1 MHz
4. Components and Breadboards
5. Multimeters and other meters
6. Spectrum Analyzer

Contribution of Course Outcomes towards achievement of Program Outcomes (POs) and Program Specific outcomes (PSOs) (1 – Low, 2- Medium, 3 – High)

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO1	PSO 2
CO1	-	-	3	-	-	2	-	-	-	-	3	-	-	3
CO2	-	-	3	-	2	-	-	-	-	-	3	-	3	-
CO3	3	3	-	-	-	-	-	2	-	-	-	-	-	3
CO4	-	-	3	-	-	-	-	-	-	-	-	3	-	-
CO5	2	-	-	3	-	-	3	-	-	3	-	-	-	3
CO6	-	3	-	-	3	-	-	-	-	-	-	-	-	2

II Year - II Semester **L T P C**
0 0 3 1.5

VHDL Programming Lab

Practice:	3	**Internal Marks:**	15
Credits:	1.5	**External Marks:**	35

Prerequisites: Switching Theory and Logic Design, C Language, Pulse & Digital Circuits Laboratory

Course Objectives:

- To introduce the basic HDL languages and their importance in digital design.
- To analyze digital system design blocks using VHDL fundamentals.
- To model digital systems at several levels of abstractions such as dataflow, behavioral, structural & mixed signal modeling.
- To analyze and design basic digital circuits with combinatorial and sequential logic using VHDL.
- To understand the VHDL compilers, simulators and synthesis tools which are used to verify digital systems in a technology-independent fashion.

Course Outcomes:

Upon successful completion of the course, the student will be able to:

CO1	Understand the three different modeling styles of digital circuits.
CO2	Design various combinational circuits using VHDL.
CO3	Develop a VHDL source code for comparators and code converters.
CO4	Perform simulation of various sequential circuits using VHDL.
CO5	Analyze the obtained simulation results.
CO6	Verify the logic with the necessary hardware.

List of Experiments: (Minimum of ten experiments has to be performed)
Note: The students are required to develop VHDL source code, perform simulation using a relevant simulator, and analyze the obtained simulation results using a necessary synthesizer. All the experiments are required to verify and implement the logical operations on the latest FPGA Hardware in the Laboratory.

1. Realization of logic gates using three models.
2. Design of full adder and develop VHDL code using three models.
3. Design 3 to 8 decoders and develop VHDL code.
4. Design 8 to 3 encoder and develop VHDL code.
5. Design 8 x 1 multiplexer and develop VHDL code.
6. Design 4- bit magnitude comparator and develop VHDL code.
7. Design 4-bit binary to grey code converter and develop VHDL code.
8. Design D-flip-flop and develop VHDL code.
9. Design decade counter and develop VHDL code
10. Design universal shift registers and develop VHDL code.
11. Design an 8-bit serial in-parallel out and parallel in-serial out shift register and develop VHDL code.
12. Design ALU and develop VHDL code.

Equipment Required:

1. Xilinx Vivado software / Equivalent Industry Standard Software.
2. Xilinx Hardware / Equivalent hardware.
3. Personal computer system with necessary software to run the programs and implement.

Contribution of Course Outcomes towards achievement of Program Outcomes (POs) and Program Specific outcomes (PSOs) (1 – Low, 2- Medium, 3 – High)

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PS O1	PSO 2
CO1	3	2	-	-	2	-	-	-	1	-	-	-	-	-
CO2	3	2	2	-	-	-	-	2	-	-	-	-	2	3
CO3	3	2	-	3	3	-	-	-	-	3	-	-	-	3
CO4	3	2	2	-	-	-	3	-	2	-	-	-	-	-
CO5	3	2	-	-	-	3	-	-	-	-	2	-	2	3
CO6	3	3	2	-	3	-	-	-	-	-	-	3	-	-

II Year - II Semester **L T P C**
1 0 2 2

PYTHON PROGRAMMING
(Skill Course)

Lecture – Practice:	1-2 Hours	**Internal Marks:**	0
Credits:	2	**External Marks:**	50

Prerequisites: Adequate exposure to Programming ,A basic understanding on various computer concepts , C programming basic syntax

Course Objectives:

- To understand the PYTHON environment and make numerical computations and analysis.

Course Outcomes:

Upon successful completion of the course, the student will be able to:

CO1	Know comprehensions, generators in python.
CO2	Understand the exception handling in python
CO3	Know the usage of file I/O
CO4	Understand various data types like lists, tuples, strings etc
CO5	Know the usage of various pre-defined functions on the above data types

Course Content(Syllabus)

Exercises

1. a. Write a program to get the list of even numbers upto a given number.

b. Write a program to get the ASCII distance between two characters.

c. Write a program to get the binary form of a given number.

d. Write a program to convert base 36 to octal.

2. a. Write a program to get the number of vowels in the input string (No control flow allowed)

b. Write a program to check whether a given number has even number of 1's in its binary representation (No control flow, the number can be in any base)

c. Write a program to sort given list of strings in the order of their vowel counts.

3. a. Write a program to return the top 'n' most frequently occurring chars and their respective counts. E.g. aaaaaabbbbcccc, 2 should return [(a5) (b 4)]

b. Write a program to convert a given number into a given base.

Note: Convert the given number into a string in the given base. Valid base is 2<=base <=36 Raise exceptions similar to how int ("XX", YY) does (play in the console to find what errors it raises). Handle negative numbers just like bin and oct do.

4. a. Write a program to convert a given iterable into a list. (Using iterator)

b. Write a program to implement user defined map() function.

Note: This function implements a map. It goes through the iterable and applies funcon each of the elements and returns a list of results. Don't use a for loop or the built-in map function. Use exceptions, while loop and iter.

c. Write a program to generate an infinite number of even numbers (Use generator) d. Write a

program to get a list of even numbers from a given list of numbers. (use only comprehensions)

5. Write a program to implement round robin.

Note: This routine to take a variable number of sequences and return elements from them in round robin till each sequence is exhausted. I fone of the input sequences is infinite, this is also infinite. e.g if input is [1,2,3], (4,5) -> yield 1,4,2,5,3 one after the other. Use exception control and comprehensions to write elegant code. Hint: This requires you to use understand variable arguments, lists, list copy, comprehensions, iterators, generators, exception handling, control flow etc.

6. a. Write a program to sort words in a file and put them in another file. The output file should have only lower case words, so any upper case words from source must be lowered. (Handle exceptions)

b. Write a program return a list in which the duplicates are removed and the items are sorted from a given input list of strings.

7. a. Write a program to test whether given strings are anagrams are not.

b. Write a program to implement left binary search.

Note: Left binary search returns the left most element when a search key repeats. Fore.gif input is [1,2,3,3,4,4,5] and I search 3, it should return 2 as index 2 is the left most occurrence of 3.

8. a. write a class Person with attributes name, age, weight (kgs), height (ft) and takes them through the constructor and exposes a method get_bmi_result() which returns one of "underweight", "healthy", "obese"

b. Write a program to convert the passed in positive integer number into its prime factorization form.

Note: If number = a1 ^ p1 * a2 ^ p2 ... where a1, a2 are primes and p1, p2 are powers >=1 then were present that using lists and tuples in pythonas [(a1,p1),(a2,p2), ...] e.g.[(2,1),(5,1)] is the correct prime factorization of 10

TEXT BOOKS:

1.Python Programming: A Modern Approach , Vamsi Kurama,Pearson

2. Learning Python , Mark Lutz ,Orielly

3.Mark Lutz & David Ascher, "Learning Python", Oreilly Publications, 5th edition

REFERENCE BOOKS:

1. Think Python , Allen Downey , Green Tea Press

E-RESOURCES:

1. https://www.tutorialspoint.com/python/
2. https://docs.python.org/3/tutorial/
3. https://www.w3schools.com/python/
4. https://www.javatpoint.com/python-tutorial

Contribution of Course Outcomes towards achievement of Program Outcomes (POs) and Program Specific outcomes (PSOs) (1 – Low, 2- Medium, 3 – High)

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

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DEPARTMENT OF ELECTRONICS AND COMMUNICATION ENGINEERING

DEPARTMENT OF ELECTRONICS AND COMMUNICATION ENGINEERING

COURSE STRUCTURE FOR III YEAR B.TECH PROGRAMME-NRIA20 REG

III B.TECH I-SEMESTER

Sl. No	Course Code	Title of the Course	Scheme of Instruction (Periods Per Week)				Scheme of Examination (Max Marks)			No. of Credits
			L	T	P	Total	CIA	SEA	Total	
1	PC	Linear and Digital Integrated Circuits	3	-	-	3	30	70	100	3
2	PC	Antennas and Wave Propagation	3	-	-	3	30	70	100	3
3	PC	Digital Communications	3	-	-	3	30	70	100	3
4	OE	Open Elective	3	-	-	3	30	70	100	3
5	PE	i) Computer architecture and Organization ii) Biomedical Engineering iii) Electromagnetic Interference and Electromagnetic Compatibility	3	-	-	3	30	70	100	3
6	PC LAB	Linear and Digital Integrated Circuits Lab	-	-	3	3	15	35	50	1.5
7	PC LAB	Digital Communications Lab	-	-	3	3	15	35	50	1.5
8	SC*	Internet of Things	1	-	2	3	-	50	50	2
9	MC	Intellectual Property Rights and Patents	-	-	2	3	30	70	100	0
Summer Internship two months (mandatory)after second year (to be evaluated during V semester)			0	0	0	0	15	35	50	1.5
Total			16	-	10	27	255	595	850	21.5

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DEPARTMENT OF ELECTRONICS AND COMMUNICATION ENGINEERING

DEPARTMENT OF ELECTRONICS AND COMMUNICATION ENGINEERING

COURSE STRUCTURE FOR III YEAR B.TECH PROGRAMME-NRIA20 REG

III B.TECH II-SEMESTER

Sl. No	Course Code	Title of the Course	Scheme of Instruction (Periods Per Week)				Scheme of Examination (Max Marks)			No. of Credits
			L	T	P	Total	CIA	SEA	Total	
1	PC	Microprocessors and Microcontrollers	3	-	-	3	30	70	100	3
2	PC	Digital Signal Processing	3	-	-	3	30	70	100	3
3	PC	VLSI Design	3	-	-	3	30	70	100	3
4	PE	i) Optical Communications ii) Embedded Systems iii) Radar Systems	3	-	-	3	30	70	100	3
5	OE	Open Elective	3	-	-	3	30	70	100	3
6	PC LAB	VLSI Lab	-	-	3	3	15	35	50	1.5
7	PC LAB	Microprocessors and Microcontrollers Lab	-	-	3	3	15	35	50	1.5
8	PC LAB	Digital Signal Processing Lab	-	-	3	3	30	70	100	1.5
9	SC*	Sensors and Instrumentation	2	-	-	2	-	50	50	2
10	MC	Professional Ethics and Human Values	2	-	-	2	30	70	100	0
Total			19	-	9	28	240	630	900	21.5
Honors/Minor Courses(the hours distribution can be 3-0-2 or 3-1-0)			4	-	-	4	30	70	100	4
Industrial / Research Internship(Mandatory) 2 Months during summer vacation										

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DEPARTMENT OF ELECTRONICS AND COMMUNICATION ENGINEERING

III Year - I Semester **L T P C**
Professional Course (PC) **3 0 0 3**

LINEAR & DIGITAL IC APPLICATIONS

Lecture – Tutorial:	3-0 -0 Hours	**Internal Marks:**	30
Credits:	3	**External Marks:**	70

Prerequisites: Basic Electronics, Digital Electronics, Electronic Circuit Analysis.

Course Objectives:

- To understand the basic operation &performance parameters of differential amplifiers illustrate the measuring techniques, performance parameters of OP-AMP.
- To infer the linear and non-linear applications of operational amplifiers and different waveform generators.
- To understand the analysis & design of different types of active filters using OP-AMP
- To understand the internal structure, operation and applications of different analog ICs and converters.
- To Acquire skills required for designing and testing integrated circuits

Course Outcomes:

Upon successful completion of the course, the student will be able to:

CO1	Analyze different types of differential amplifiers and its application.
CO2	Utilize different circuits for various applications of Operational amplifiers.
CO3	Experiment with various active filters and timer circuits.
CO4	Conclude the applications of PLL and A/D and D/A converters.
CO5	Identify the importance and applications of digital ICs.74x151,155,138

Course Content(Syllabus)

UNIT I

DIFFERENTIAL AMPLIFIERS

Introduction, DC and AC analysis of Dual input Balanced output Configuration, Properties of other differential amplifier configurations, Integrated circuits-Types, Classification, Package Types and Temperature ranges, Power supplies.

OP-AMPS

Introduction to OP-amp, Characteristics of OP-Amps, Op-amp Block Diagram, ideal and practical Op-amp Specifications, DC and AC characteristics, 741 op-amp & its features, Op-Amp parameters & Measurement, Input & Output Off set voltages & currents, Slew rate, CMRR, PSRR, drift.

UNIT II

OP-AMP APPLICATIONS

Inverting and Non-Inverting amplifiers, Difference Amplifier, Instrumentation Amplifier, AC Amplifier, Differentiator and Integrator, Comparator.

WAVE FORM GENERATORS

Triangular, Saw-tooth and Square Wave generators, Schmitt Trigger, Log and Anti log Amplifiers.

UNIT III

OP-AMP FILTERS& TIMERS

Introduction to Active Filters, Characteristics of Low pass, high pass, band pass, band reject and all pass filters, Design and analysis of Butterworth active filters--1st - 2nd order LPF, HPF,BPF,BRF and All pass filters.

TIMERS

Introduction to 555 timer, functional diagram, Monostable and Astable operations and applications, Schmitt Trigger.

UNIT IV

PHASE LOCKED LOOPS

PLL - introduction, block schematic, principles and description of individual blocks,
565 PLL, Applications of PLL: frequency multiplication, frequency translation and Amplitude Modulation.

D/A and A/D CONVERTERS

Introduction, Basic DAC techniques, Different types of DACs-Weighted resistor DAC, R-2R ladder DAC, Inverted R-2R DAC, Different Types of ADCs - Parallel Comparator Type ADC, Counter Type ADC, Successive Approximation ADC and Dual Slope.

UNIT V

COMBINATIONAL & SEQUENTIAL LOGIC DESIGN ICs

Decoders-74x138, 74x139, Encoders-74x148, Priority Encoder, Multiplexers-74x151 MUX, De-multiplexers -74X155, Barrel shifter

SEQUENTIAL LOGIC DESIGN ICs

8-Bit Latch 74x373, Flip Flops-D Flip Flop74X74, JK Flip Flop74X109, Counters- 74x163 4-Bit Binary Counter, 74X163 as Modulus-N Counter, Universal Shift Register 74x194.

TEXT BOOKS:

1. Linear Integrated Circuits, D. Roy Chowdhury, New Age International (p) Ltd.
2. Op-Amps & Linear ICs, Ramakanth A. Gayakwad, PHI

REFERENCES:

1. Operational Amplifiers & Linear Integrated Circuits, R.F. Coughlin & Fredrick F. Driscoll, PHI.
2. Operational Amplifiers & Linear Integrated Circuits: Theory & Applications, Denton J. Daibey, TMH.
3. Design with Operational Amplifiers & Analog Integrated Circuits, Sergio Franco, McGraw Hill.
4. Digital Fundamentals - Floyd and Jain, Pearson Education.

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DEPARTMENT OF ELECTRONICS AND COMMUNICATION ENGINEERING

III Year - I Semester **L T P C**
Professional Course (PC) **3 0 0 3**

ANTENNAS AND WAVE PROPAGATION

Lecture – Tutorial:	3-0-0 Hours	**Internal Marks:**	30
Credits:	3	**External Marks:**	70

Prerequisites: Vector Calculus, Electromagnetic Field Theory.

Course Objectives: Students will be able to:

- To introduce the fundamental principles of antenna theory and to apply them for the analysis and design
- To introduce to the design principles of different antenna arrays
- To understand the radiation mechanism of various types of antennas and also to learn about the basic parameters of antennas and their measurement
- To understand the wave propagation over ground and through different layers of atmosphere

Course Outcomes:

Upon successful completion of the course, the student will be able to:

CO1	Understand the basic antenna radiation parameters and radiation mechanism ofsingle wire & two wire antennas with current distribution analysis
CO2	Quantify the radiation fields and power radiated bydipole antennas and also analyze their radiation characteristics using a mathematical approach
CO3	Illustrate the different types of arrays and their radiation patterns with both mathematical and geometrical analysis
CO4	Analyze the geometry and working principle of operation of non-resonant radiators and Microstrip antennas with qualitative analysis
CO5	Design Microwave antennas and analyze antenna measurements to assess antenna performance
CO6	Identify and distinguish the characteristics of different modes of radio wave propagation in the atmosphere with both qualitative and quantitative treatment

Course Content (Syllabus)

UNIT I

ANTENNA FUNDAMENTALS: Introduction, Radiation Mechanism – Single wire, Two wire, Antenna Parameters - Radiation Patterns, Patterns in Principal Planes, Main Lobe and Side Lobes, Beamwidths, Beam Area, Radiation Intensity, Beam Efficiency, Directivity, Gain, Antenna Apertures, Aperture Efficiency, Effective Height, illustrated Problems

THIN LINEAR WIRE ANTENNAS: Retarded Potentials, Dipoles, Current Distribution on a thin wire antenna,Radiation from Small Electric Dipole, Quarter wave Monopole and Half-wave Dipole – Directivity, Effective Area. Natural current distributions and patterns of Thin Linear Center-fed Antennas of different lengths.

UNIT II

ANTENNA ARRAYS - I: 2 element arrays – different cases, Principle of Pattern Multiplication, N element Uniform Linear Arrays – Broadside, End-fire Arrays, EFA with Increased Directivity, Derivation of their characteristics and comparison, Directivity Relations (no derivations). Related Problems

ANTENNA ARRAYS-II: Concept of Scanning Arrays. Binomial Arrays, Effects of Uniform and Non-
Uniform Amplitude Distributions, Design Relations. Arrays with Parasitic Elements, Yagi - Uda Arrays.

UNIT III

NON-RESONANT RADIATORS: Introduction, Traveling wave radiators – basic concepts, Long wire antennas –field strength calculations and patterns, Helical Antennas – Significance, Geometry, basic properties; Design considerations for monofilar helical antennas in Axial Mode and Normal Modes (Qualitative Treatment)

MICROSTRIP ANTENNAS: Introduction, Definition, Basic geometry, Features; Advantages and Limitations, Different Shapes of patch elements, Rectangular Patch Antennas –Geometry and Parameters, Radiation Mechanism of Microstrip antenna. Characteristics of Microstrip antennas, Impact of different parameters on characteristics.

UNIT IV

MICROWAVE ANTENNAS: Paraboloidal Reflectors – Geometry, characteristics, types of feeds, Spill Over, Back Lobes, Aperture Blocking, Cassegrain Feeds. Horn Antennas - Types, Optimum Horns, Design Characteristics of Pyramidal Horns; Antenna Measurements - Directivity and Gain Measurements

MICROWAVE MEASUREMENTS: Antenna Measurements – Patterns Required, Set Up, Distance Criterion, Directivity and Gain Measurements (Comparison, Absolute and 3-Antenna Methods

UNIT V

WAVE PROPAGATION-I: Concepts of Propagation – frequency ranges and types of propagations. Ground Wave Propagation–Characteristics, Parameters, Wave Tilt. Sky Wave Propagation – Formation of Ionospheric Layers and their Characteristics, Mechanism of Reflection and Refraction, Critical Frequency, MUF and Skip Distance, Virtual Height

WAVE PROPAGATION-II: Concepts of Propagation – frequency ranges and types of propagation. Fundamental Equation for Free-Space Propagation, Space Wave Propagation– Mechanism, LOS and Radio Horizon. Effective Earth's Radius, Field Strength Calculations, Duct Propagation, Tropospheric Scattering.

TEXT BOOKS:

1. Antennas and Wave Propagation– John D. Kraus and Ronald J. Marhefka, 4th Edition, TMH, 2010.
2. Electromagnetic Waves and Radiating Systems – E.C. Jordan and K.G. Balmain, PHI, 2nd Edition,

REFERENCES:

1. Antenna Theory - C.A. Balanis, John Wiley and Sons, 2nd Edition, 2001.
2. Antennas and Wave Propagation – K.D. Prasad, Satya Prakashan, Tech India Publications, New Delhi, 2001.
3. Micro strip Antenna Design Hand Book – Ramesh Garg, Prakash Bhartia,InderBahl, ApisakIttipiboon, Artech House, second edition 2001
4. Transmission and Propagation – E.V.D. Glazier and H.R.L. Lamont, The Services Text Book of Radio, vol. 5,Standard Publishers Distributors, Delhi.
5. Electronic and Radio Engineering – F.E. Terman, McGraw-Hill, 4th Edition, 1955.
6. Antennas – John D. Kraus, McGraw-Hill, 2nd Edition, 1988

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DEPARTMENT OF ELECTRONICS AND COMMUNICATION ENGINEERING

III Year - I Semester **L T P C**
Professional Course (PC) **3 0 0 3**

DIGITAL COMMUNICATIONS

Lecture – Tutorial:	3-0-0 Hours	**Internal Marks:**	30
Credits:	3	**External Marks:**	70

Prerequisites: Basics of Communications, Signals and Systems and Probability and Random processes.

Course Objectives:

- To acquire basic knowledge of digital communication systems and its advantages.
- To analyze various pulse digital and digital modulation techniques and their error performance.
- To understand and analyze various source coding and channel coding techniques.

Course Outcomes:

Upon successful completion of the course, the student will be able to:

CO1	Apply the knowledge of statistical theory of communication and understand the basics of digital communication systems.
CO2	Analyze the performance of digital modulation techniques for generation, detection and digital representation of the signal.
CO3	Explore the probability of error for various digital modulation techniques with the help of random variables and filters.
CO4	Integrate and apply the basics of information theory to the communication and compute entropy, information rate of the source.
CO5	Understand and analyze the source coding techniques and channel capacity.
CO6	Compute and analyze different error control coding schemes for reliable transmission of digital information over the channel.

Course Content (Syllabus)

UNIT I

PULSE DIGITAL MODULATION: Elements of digital communication systems, Advantages of digital communication systems, Elements of PCM: Sampling, Quantization & Coding, Quantization error, Companding in PCM systems. Differential PCM systems (DPCM), Delta modulation, its Draw backs, Adaptive delta modulation, Comparison of PCM and DM systems, Noise in PCM and DM systems.

UNIT II

DIGITAL MODULATION TECHNIQUES: Introduction, Line Codes, ASK, FSK, PSK, DPSK, DEPSK, QPSK, Coherent detection, Non-coherent detection, M-ary PSK, ASK, FSK.

UNIT III

DATA TRANSMISSION: Base band signal receiver, Probability of error, The optimum filter, Matched filter, Probability of error using matched filter, Coherent reception, Non-coherent detection of FSK, Calculation of error probability of ASK,BPSK,BFSK,QPSK.

UNIT IV

INFORMATION THEORY: Discrete messages, Concept of amount of information and its properties. Average information, Entropy and its properties, Information rate, Mutual information and its properties
SOURCECODING: Introductions, Advantages, Shannon's theorem, Shanon-Fano coding, Huffman coding, efficiency calculations, channel capacity of discrete and analog Channels, capacity of a Gaussian channel, bandwidth–S/N trade off.

UNIT V

LINEAR BLOCKCODES: Introduction, Matrix description of Linear Block codes, Error detection and error correction capabilities of Linear block codes, Hamming codes, Binary cyclic codes, Algebraic structure, encoding, syndrome calculation, BCH Codes.

CONVOLUTIONCODES: Introduction, encoding of convolution codes, time domain approach, transform domain approach. Graphical approach: state, tree and trellis diagram decoding using Viterbi algorithm.

TEXT BOOKS:

1. Digital communications - Simon Haykin, John Wiley, 2005
2. Principles of Communication Systems – H. Taub and D. Schilling, TMH, 2003

REFERENCES:

1 Digital and Analog Communication Systems - Sam Shanmugam, John Wiley, 2005.

2. Digital Communications – John Proakis, TMH, 1983. Communication Systems- Analog & Digital – Singh & Sapre, TMH, 2004.

3. Modern Analog and Digital Communication – B.P.Lathi, Oxford reprint, 3rd edition, 2004.

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DEPARTMENT OF ELECTRONICS AND COMMUNICATION ENGINEERING

III Year - I Semester **L T P C**
Professional Course (PC) **3 0 0 3**

COMPUTER ARCHITECTURE AND ORGANIZATION

Lecture – Tutorial:	3-0-0 Hours	**Internal Marks:**	30
Credits:	3	**External Marks:**	70

Prerequisites: Digital logic design.

Course Objectives:

- Understand the principles and the implementation of computer arithmetic and ALU.
- Understand the fundamentals of different instruction set architectures and their relationship to the CPU design.
- Understand the operation of modern CPUs including interfacing, pipelining, memory systems and buses.
- Understand the memory system, I/O organization.
- Understand the principles of operation of multiprocessor systems..

Course Outcomes:

Upon successful completion of the course, the student will be able to:

CO1	Understand the basics, evolution and architecture of the computer.
CO2	Analyze the machine instructions and to write programs and to calculate the effective address of an operand by addressing modes.
CO3	Demonstrate the relationship between the software and the hardware and to understand concepts of control unit and all arithmetic operations.
CO4	Analyze the concept of I/O organization and design how to interface i/o devices.
CO5	Demonstrate the memory organization and understand the concept of cache mapping techniques.
CO6	Understand the principles of operation of multiprocessor systems.

Course Content (Syllabus)

UNIT I

BASIC STRUCTURE OF COMPUTERS: Computer Types, Functional unit, Basic Operational concepts, Bus structures, Software, Performance, The history of computer development**.**

REGISTER TRANSFER AND MICRO OPERATIONS – Register transfer language, Register Transfer, Bus and Memory transfers, Three-state Bus Buffers, Arithmetic Micro operations, Logic Operations, Shift Micro operations, Arithmetic Logic shift unit.

UNIT II

BASIC COMPUTER ORGANIZATION AND DESIGN: Instruction codes, Computer Registers, Computer Instructions, Timing and Control, Instruction Cycle, Memory reference instructions, Input Output and Interrupts.

CENTRAL PROCESSING UNIT: Introduction, General register organization, Stack organization, Instruction formats, Addressing modes, Data transfer and Manipulation, Program control, reduced Instruction set computer (RISC).

UNIT III

MICRO PROGRAMMED CONTROL: Control memory, Address sequencing, Micro program

example, Design of control unit.

COMPUTER ARITHMETIC: Introduction, Addition and Subtraction, Multiplication algorithms, Division algorithms, Gloating point Arithmetic operations, Decimal Arithmetic Unit, Decimal Arithmetic operations.

UNIT IV

INPUT OUTPUT ORGANIZATION: Peripheral devices, Input-Output Interface, Asynchronous data transfer, Modes of Transfer, priority interrupt, Direct Memory Access (DMA), Input output Processor (IOP), Serial Communication.

UNIT V

MEMORY ORGANIZATION: Memory Hierarchy, Main Memory, Auxiliary Memory, Associative Memory, Associative Memory, Cache Memory, Virtual Memory, Memory Management Hardware.

MULTIPROCESSORS: Characteristics of multiprocessors, Interconnection structures, Interprocessor Arbitration, Interprocessor communication and synchronization.

TEXT BOOKS:

1. Morris M. Mano, Computer Systems Architecture.3 Ed, Pearson/PHI, 2013
2. Carl Hamacher, Zvonko Vranesic, Safwat Zaky: Computer Organization, 5th Edition, Tata McGraw Hill, 2002.

REFERENCES:

1.John P.Hayes, 'Computer architecture and Organisation', Tata McGraw-Hill, Third edition, 1998.

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DEPARTMENT OF ELECTRONICS AND COMMUNICATION ENGINEERING

III Year - I Semester **L T P C**
Professional Elective (PE) **3 0 0 3**

BIOMEDICAL ENGINEERING

Lecture – Tutorial:	3-0-0 Hours	**Internal Marks:**	30
Credits:	3	**External Marks:**	70

Prerequisites: Basics of instrumentation.

Course Objectives:

- To explain the importance of various sources of bio-electric potentials in human body.
- To enhance the knowledge of various electrodes and transducers used for measuring bioelectrical potentials.
- To familiarize mechanisms of cardiovascular and respiratory systems and their measuring equipments.
- To introduce elements of patient care & monitoring system and various therapeutic & prosthetic devices.
- To provide fundamentals of various diagnostic techniques and introduce the concepts of bio-telemetry.

Course Outcomes:

Upon successful completion of the course, the student will be able to:

CO1	Identify various sources of bio-electric potentials in man-instrumentation system.
CO2	Interpret how electrodes and transducers are involved in biomedical engineering concepts.
CO3	Outline the anatomy of Cardiovascular and respiratory system and their measuring instruments.
CO4	Summarize the functionality of patient care & monitoring equipments used to identify the malfunction of human body.
CO5	Analyze various therapeutic and prosthetic devices, clinical laboratory instruments and biomaterials used for patient care.
CO6	Identify the different diagnostic imaging techniques and monitors, recorders and electrical accident prevention methods.

Course Content (Syllabus)

UNIT I

INTRODUCTION TO BIOMEDICAL INSTRUMENTATION: Age of Biomedical Engineering, Development of Biomedical Instrumentation, Man Instrumentation System, Components of the Man-Instrument System, Physiological System of the Body, Problems Encountered in Measuring a Living System, Sources of Bioelectric Potentials, Muscle, Bioelectric Potentials, Resting and Action Potentials, Propagation of Action Potential, Bioelectric Potentials-ECG, EEG and EMG, Envoked Responses.

UNIT II

ELECTRODES AND TRANSDUCERS: Introduction, Electrode Theory, Biopotential Electrodes, Examples of Electrodes, Basic Transducer Principles, Biochemical Transducers, The Transducer and Transduction Principles, Active Transducers, Passive Transducers, Transducers for Biomedical Applications, Pulse Sensors, Respiration Sensor, Transducers with Digital Output.

UNIT III

CARDIOVASCULAR SYSTEM AND MEASUREMENTS: The Heart and Cardiovascular System, Electro Cardiography, Blood Pressure Measurement, Measurement of Blood Flow and Cardiac Output, Measurement of Heart Sound, Plethysmography.

MEASUREMENTS IN THE RESPIRATORY SYSTEM: The Physiology of The Respiratory System, Tests and Instrumentation for The Mechanics of Breathing, Respiratory Therapy Equipment.

UNIT IV

PATIENT CARE AND MONITORING: Elements of Intensive-Care Monitoring, Patient Monitoring Displays, Diagnosis, Calibration and Repair ability of Patient-Monitoring Equipment, Other Instrumentation for Monitoring Patients, Organization of the Hospital for Patient-Care Monitoring, Pacemakers, Defibrillators, Radio Frequency Applications of Therapeutic use.

THERAPEUTIC AND PROSTHETIC DEVICES: Audiometers and Hearing Aids, Myoelectric Arm, Laparoscope, Ophthalmology Instruments, Anatomy of Vision, Electrophysiological Tests, Ophthalmoscope, Tonometer for Eye Pressure Measurement, Diathermy, Clinical Laboratory Instruments, Biomaterials, Stimulators.

UNIT V

DIAGNOSTIC TECHNIQUES AND BIO-TELEMETRY: Principles of Ultrasonic Measurement, Ultrasonic Imaging, Ultrasonic Applications of Therapeutic Uses, Ultrasonic Diagnosis, X-Ray and Radio-Isotope Instrumentations, CAT Scan, Emission Computerized Tomography, MRI, Introduction to Biotelemetry, Physiological Parameters Adaptable to Biotelemetry, The Components of Biotelemetry System, Implantable Units, Telemetry for ECG Measurements during Exercise, Telemetry for Emergency Patient Monitoring.

MONITORS, RECORDERS AND SHOCK HAZARDS: Bio potential Amplifiers, Monitors, Recorders, Shock Hazards and Prevention, Physiological Effects and Electrical Current, Shock Hazards from Electrical Equipment, Methods of Accident Prevention, Isolated Power Distribution System.

TEXT BOOKS:

1. "Bio-Medical Electronics and Instrumentation", Onkar N. Pandey, Rakesh Kumar, Katson Books.
2. "Bio-Medical Instrumentation", Cromewell , Wiebell, Pfeiffer.

REFERENCES:

1."Introduction to Bio-Medical Equipment Technology", 4th Edition, Joseph J. Carr, John M. Brown, 2.Pearson Publications. 2. "Hand Book of Bio-Medical Instrumentation", Khandapur. McGrawHill.

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DEPARTMENT OF ELECTRONICS AND COMMUNICATION ENGINEERING

III Year - I Semester	**L**	**T**	**P**	**C**
Professional Elective (PE)	**3**	**0**	**0**	**3**

Electromagnetic Interference and Electromagnetic Compatibility

Lecture – Tutorial:	3-0 -0 Hours	**Internal Marks:**	30
Credits:	3	**External Marks:**	70

Prerequisites: EM Waves & Transmission Lines, Wave Propagation, Antennas.

Course Objectives: Students will be able to:

- Familiarize with the fundamentals that are essential for the electronics industry in the field of EMI and EMC.
- Understand the lightning discharge and electrostatic discharge.
- Learn electromagnetic emissions from systems, appliances, and circuits.
- Understand the various techniques for electromagnetic compatibility.
- Understand EMI measurement in Anechoic Chamber.
- Discuss electromagnetic interference measurements.

Course Outcomes:

Upon successful completion of the course, the student will be able to:

CO1	Describe the concept of electromagnetic interference and sources of EMI.
CO2	Interpret the concept of EMC related to product design & development.
CO3	Demonstrate various Open area test site measurement techniques.
CO4	Analyze electromagnetic emission systems and noise from relays and switches.
CO5	Utilize the techniques like grounding, shielding, bonding, and EMI filters in the usage of cables, connectors, and components.
CO6	Quantify the various radiated and conducted interference and measurements.

Course Content (Syllabus)

UNIT I

INTRODUCTION, NATURAL AND NUCLEAR SOURCES OF EMI AND EMC: Concepts of EMI and EMC and Definitions, Practical experiences and concerns, Natural and Nuclear sources of EMI, Lightning Discharge: Cloud-to-Ground Discharge, Cloud-to-Cloud Discharge, EM field produced by Lightning, Effects of Lightning Discharge on Transmission Lines, Electro Static Discharge: Charge accumulation and discharge, Model MSD waveform, ESD equivalent circuit, Radiated field from ESD.

UNIT II

EMI FROM APPARATUS AND CIRCUITS, OPEN AREA TEST SITES: Electromagnetic emissions: Systems, Appliances, Noise from Relays and Switches, Nonlinearities in circuits, Cross talk in transmission lines, Transients in power supply lines, Electromagnetic interference (EMI), Open area test sites measurements: Measurement of RE and RS, Open area test site: Stationary EUT, Stationary Antenna, EUT-Antenna separation.

UNIT III

RADIATED AND CONDUCTED INTERFERENCE MEASUREMENTS, ESD: Anechoic chamber, TEM cell, GH TEM Cell, Characterization of conduction currents/voltages (CM & DM interference), Conducted EM noise on power lines, Conducted EMI from equipment, Immunity to conducted EMI detectors and measurements, ESD, Electrical fast transients/bursts, Electrical surges.

UNIT IV

GROUNDING, SHIELDING, BONDING: Principles and types of grounding, Shielding, and bonding, Characteristics of filters, **Power line filter design:** common-mode, differential mode, and combined CM & DM filters, EMI suppression cables, EMC connectors, EMC gaskets, Isolation Transforms, Opto-Isolators.

UNIT V

CABLES, CONNECTORS, COMPONENTS, AND EMC STANDARDS: EMI suppression cables, EMC **Connectors:** Pigtail effect, Connector shielding, Connector testing, Intermodulation Interference, **EMC gaskets:** Knitted Wire-mesh gaskets, Wire screen gaskets, Oriented wire mesh, Isolation transformers, Opto-isolators, Standers for EMI/EMC, MIL-STD- 461/462, IEEE /ANSI standards.

TEXT BOOKS:

1. Engineering Electromagnetic Compatibility - Dr. V.P. Kodali, IEEE Publication, Printed in India by S. Chand & Co. Ltd., New Delhi, 2000.
2. Electromagnetic Interference and Compatibility IMPACT series, IIT Delhi, Modules 1-9.

REFERENCES:

1. Introduction to Electromagnetic Compatibility - Ny, John Wiley, 1992, by C.R. Pal.
2. Henry W. Ott, "Electromagnetic Compatibility Engineering", John Wiley & Sons Inc, Newyork, 2009.
3. Daryl Gerke and William Kimmel, "EDN"s Designer"s Guide to Electromagnetic Compatibility", Elsevier Science & Technology Books, 2002.
4. W Scott Bennett, "Control and Measurement of Unintentional Electromagnetic Radiation", John Wiley & Sons Inc., (Wiley Interscience Series) 1997.
5. Dr Kenneth L Kaiser, "The Electromagnetic Compatibility Handbook", CRC Press 2005.

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DEPARTMENT OF ELECTRONICS AND COMMUNICATION ENGINEERING

III Year - I Semester **L T P C**
Professional Course (PC Lab) **0 0 3 1.5**

Linear & Digital IC Applications Lab

Practical:	0-0-3 Hours	**Internal Marks:**	15
Credits:	1.5	**External Marks:**	35

Prerequisites: Circuit Analysis, Basic Electronics.

Course Objectives:

- To Gain the practical hands-on experience on 741 Op-Amp applications.
- To Gain the practical hands-on experience on 555 Timer applications.
- To Gain the practical hands-on experience on IC 565 – PLL Applications.
- To Gain the practical hands-on experience on different digital ICs.

Course Outcomes:

Upon successful completion of the course, the student will be able to:

CO1	Understand the basics of Op-Amp(IC 741), timer (IC 555) and PLL(IC 565).
CO2	Design; analyze various applications of Opamp 741 IC.
CO3	Designs the Multivibrator circuits using IC555 and determine the frequency of oscillation and time delay.
CO4	Understand the characteristics of PLL.
CO5	Design various combinational circuits using various Digital Integrated IC's.
CO6	Design various sequential circuits using various Digital Integrated IC's.

List of Experiments

Minimum Ten Experiments to be conducted:

1. Introduction - Study Of IC-741, IC-555 & IC-565
2. Op-Amp Applications – Adder, Sub tractor, Comparator
3. Integrator And Differentiator Using IC-741 Op-Amp
4. Active Filter Applications – LPF And HPF(1st Order)
5. IC-741 Waveform Generators – Sine, Square And Triangular Waves
6. IC-555 Timer – Monostable And Astable Multivibrators
7. Schmitt Trigger Circuit Using IC-741
8. IC 565 – PLL Applications
9. Realization Of All Logic Gates

10. Design Of 2-To-4 Decoder
11. Design Of 8-To-1 Multiplexer
12. Design Of Flip Flops (SR,JK,D,T)

Equipment required:

1. RPS
2. CRO
3. Function Generator
4. Multi Meters
5. IC Trainer Kits (Optional)
6. Bread Boards
7. Components:- IC741, IC555, IC565, IC1496, IC723, 7805, 7809, 7912 and other essential components.
8. Analog IC Tester

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DEPARTMENT OF ELECTRONICS AND COMMUNICATION ENGINEERING

III Year - I Semester **L T P C**
Professional Course (PC lab) **0 0 3 1.5**

DIGITAL COMMUNICATIONS LAB

Practical:	0-0-3 Hours	**Internal Marks:**	**15**
Credits:	1.5 credits	**External Marks:**	**35**

Prerequisites: Basics of Communications, Signals & Systems and Probability & Random Processes.

Course Objectives:

- To acquire practical knowledge of digital communication systems.
- To implement different modulation and demodulation techniques.
- To analyze the outputs of various digital modulation techniques.
- To perform and interpret various source coding and error control coding techniques.

Course Outcomes:

Upon successful completion of the course, the student will be able to:

CO1	Understand the Time-Division Multiplexing systems, and verify the output of pulse code modulation and demodulation.
CO2	Analyze the output of differential pulse code modulation and demodulation and verify the delta modulation.
CO3	Analyze the outputs of different digital modulation techniques-FSK, PSK.
CO4	Interpret the outputs of DPSK modulation and demodulation.
CO5	Analyze the outputs of source encoder and decoder, linear block codes, convolution codes and binary cyclic codes.
CO6	Perform and analyze the output of companding circuit.

List of Experiments: Minimum Twelve Experiments to be conducted

1. Time division multiplexing.
2. Pulse code modulation.
3. Differential pulse code modulation.
4. Delta modulation.
5. Frequency shift keying.
6. Phase shift keying.
7. Differential phase shift keying.
8. Companding
9. Source Encoder and Decoder
10. Linear Block Code-Encoder and Decoder
11. Binary Cyclic Code – Encoder and Decoder

12. Convolution Code – Encoder and Decoder
13. BCH Codes

Equipment Required:

1. RPS – 0 – 30 V.
2. CRO – 0 – 20 M Hz.
3. Function Generators – 0 – 1 M Hz.
4. RF Generators – 0 – 1000 M Hz. /0 – 100 M Hz.
5. Multimeters.
6. Lab Experimental kits for Digital Communication Components.

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DEPARTMENT OF ELECTRONICS AND COMMUNICATION ENGINEERING

III Year - I Semester **L T P C**
Skill Course (SC) **1 0 2 2**

INTERNET OF THINGS

Lecture – Practical:	1-2 Hours	**Internal Marks:**	15
Credits:	2	**External Marks:**	35

Prerequisites: Embedded Systems, Microcontrollers, Operating Systems, Programming.

Course Objectives:

- To Understand Smart Objects and IoT architecture.
- To introduce the concept of M2M (machine to machine) with necessary protocols.
- To acquaint with the various security concepts in IoT architecture.
- To build simple IOT system using Arduino and Raspberry PI platform.
- To understand data analytics and cloud in the context of IOT.

Course Outcomes:

Upon successful completion of the course, the student will be able to:

CO1	Summarize on the term 'internet of things' in different contexts and to learn about Internet of Things with the help of Arduino and Raspberry Pi.
CO2	Comprehend and analyze Software defined networks.
CO3	Understand the communication between microcontroller and pc using serial communication.
CO4	Analyze various protocols for IoT.
CO5	Acquire knowledge to interface sensors and actuator with microcontroller based Arduino platform.
CO6	Apply data analytics and use cloud offerings related to design and develop a solution for a given application using APIs and test for errors in the application.

Course Content(Syllabus)

UNIT I

Introduction to IoT: Introduction to IoT, Architectural Overview, Design principles and needed capabilities, Basics of Networking, M2M and IoT Technology Fundamentals- Devices and gateways, Role of Cloud in IoT, Security aspects in IoT, Elements of IoT Hardware Components- Computing- Arduino, Raspberry Pi.

UNIT II

IOT and M2M: Software defined networks, Network Function Virtualization, Difference between SDN and NFV for IOT, Basics of IOT system management with NETCONF, YANG-NETCONF, YANG, NETOPEER.

UNIT III

IoT Application Development: Communication, IoT Applications, Sensing, Actuation, I/O interfaces. Software Components- Programming API's (using Python/Node.js/Arduino) for Communication Protocols-MQTT, ZigBee, CoAP, UDP, TCP, Bluetooth overview, Bluetooth Key Versions, Bluetooth Low Energy (BLE) Protocol, Bluetooth, Low Energy Architecture, PSoC4 BLE architecture and Component Overview.

UNIT IV

BUILDING IOT APPLICATIONS: Introduction to Arduino IDE – writing code in sketch, compiling-debugging, uploading the file to Arduino board, role of serial monitor. Embedded 'C' Language basics. Interfacing sensors – The working of digital versus analog pins in Arduino platform, interfacing LED, Button, Sensors-DHT, LDR, MQ135 interfacing HC-05(Bluetooth module) Control/handle 220v AC supply – interfacing relay module.

UNIT V

Cloud Analytics for IoT Application: Introduction to cloud computing, Difference between Cloud Computing and Fog Computing: The Next Evolution of Cloud Computing, Role of Cloud Computing in IoT, Connecting IoT to cloud, Cloud Storage for IoT Challenge in integration of IoT with Cloud.

IoT Case Studies: IoT case studies and mini projects based on Industrial automation, Transportation, Agriculture, Healthcare, Home Automation.

TEXT BOOKS:

1. Raj Kamal, "Internet of Things: Architecture and Design Principles", 1st Edition, McGraw HillEducation, 2017.
2. The Definitive Guide to the ARM Cortex-M0 byJosephYiu,2011
3. Vijay Madisetti, Arshdeep Bahga, Internet of Things, "A Hands on Approach", University Press, 2015.

REFERENCES:

Cypress Semiconductor/PSoC4BLE (Bluetooth Low Energy)Product Training Modules.

1. Pethuru Raj and AnupamaC.Raman,"The Internet of Things:EnablingTechnologies,Platforms, and Use Cases", CRC Press,2017.
2. Macro Schwartz, "Internet of Things with Arduino", Open Home Automation

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DEPARTMENT OF ELECTRONICS AND COMMUNICATION ENGINEERING

III Year - II Semester **L T P C**
Professional Course (PC) **3 0 0 3**

MICROPROCESSORS AND MICROCONTROLLERS

Lecture – Tutorial:	3-0 Hours	**Internal Marks:**	30
Credits:	3	**External Marks:**	70

Prerequisites: Digital Electronics, Computer Organization.

Course Objectives:

- Learn concepts of microprocessor, different addressing modes and programming of 8086.
- Learn assembly language Programming of 8086.
- Understand interfacing of 8086, with memory and other peripherals.
- Study the features of 8051 Microcontroller, its instruction set and also other controllers.
- Learn Architecture details and Real time applications of ARM processor.

Course Outcomes:

Upon successful completion of the course, the student will be able to:

CO1	Understand the architecture of 8086 microprocessor and their operation.
CO2	Demonstrate programming skills in assembly language for 8086 microprocessors.
CO3	Analyze various interfacing techniques and apply them for the design of processor based systems.
CO4	Interface external peripherals and I/O devices and program the 8086 microprocessor.
CO5	Understand the architecture of 8051 microcontroller and their operation and programming skills for 8051.
CO6	Understand the concepts of ARM processor.

Course Content(Syllabus)

UNIT I

8086 MICROPROCESSOR: Evolution of Microprocessor, Features of 8086, Register Organization of 8086, Architecture, 8086 Pin Diagram/Description, Physical Memory Organization, General Bus Operation,8086 System Timing, Minimum Mode And Maximum Mode Configuration.

UNIT II

INSTRUCTIONS AND PROGRAMMING OF 8086: Program Development Steps, Assembly Language Program Development Tools, Addressing Modes, Instruction Set, Assembler Directives, Interrupts and Interrupt Service Routine, Interrupt Cycle of 8086, Writing Simple Programs with An Assembler.

UNIT III

I/O INTERFACING: Intel 8255 Programmable Peripheral Interface, Modes of Operation of 8255, Intel 8251 USART Architecture, Intel 8257 DMA Controller,Interfacing Switches And LEDS, Seven Segment Displays, Interfacing A/D And D/A Converters, Stepper Motor Interfacing.

UNIT-IV

8051MICROCONTROLLER: Introduction to Microcontrollers, Architecture of 8051, Signal Description of 8051, Register Set of 8051, PSW, Memory Organization, Interrupts and Stack of 8051, Addressing Modes of 8051, Instruction Set of 8051,Simple Programs Using Assembly Language, Keyboard and Traffic Light Control Interfacing.

UNIT V

ARM PROCESSOR: Introduction to 16/32 Bit Processors, ARM Families, ARM Architecture,ARM Organization, ARM / Thumb Instruction Set, Exception Handling in ARM, Development Tools.

TEXT BOOKS:

1. Advanced Microprocessor and Peripherals", A.K Ray, K.M.Bhurchandhi, Tata McGraw Hill Publications, 2000.
2. The 8051 Microcontrollers and Embedded systems Using Assembly and C, Muhammad Ali Mazidi and Janice Gillespie Mazidi and Rollin D. McKinlay; Pearson 2-Edition, 2011.
3. Microcontrollers - Architecture, Programming, Interfacing and System Design, Rajkamal, Pearson, 2nd Edition.

REFERENCES:

1. Microprocessors and Interfacing – Programming and Hardware by Douglas V Hall, SSSP Rao, Tata McGraw Hill Education Private Limited, 3 rdEdition, 1994.
2. The Intel Microprocessors, Barry B.Brey, PHI, 7th Edition, 2006.

Contribution of Course Outcomes towards achievement of Program Outcomes (PO) and Program Specific outcomes (PSO)
(1 – Low, 2- Medium, 3 – High)

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PS O1	PSO 2
CO1	-	3	-	2	-	3	-	-	-	2	-	-	-	-
CO2	2	2	-	2	-	-	-	3	-	-	-	-	3	-
CO3	-	3	3	-	2	-	-	-	-	-	3	-	3	-
CO4	3	2	-	2	-	-	-	-	3	-	-	-	-	2
CO5	2	-	-	3	-	-	3	-	-	-	3	2	3	-
CO6	-	2	-	2	-	-	-	-	-	2	-	-	-	-

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DEPARTMENT OF ELECTRONICS AND COMMUNICATION ENGINEERING

III Year - II Semester **L T P C**
Professional Course (PC) **3 0 0 3**

DIGITAL SIGNAL PROCESSING

Lecture – Tutorial:	3-0-0 Hours	**Internal Marks:**	30
Credits:	3	**External Marks:**	70

Prerequisites: Mathematics-I, Mathematics-II and Signals & Systems.

Course Objectives:

- To analyze the Discrete Time Signals and Systems.
- To know the importance of FFT algorithm for computation of Discrete Fourier Transform.
- To understand the various implementations of digital filter structures.
- To learn the FIR and IIR Filter design procedures.
- To learn the concepts of DSP Processors.

Course Outcomes:

Upon successful completion of the course, the student will be able to:

CO1	Understand the representation of different Discrete time signals and apply the difference equations concept in the analysis of Discrete Time Systems.
CO2	Interpret and explore the concepts of Discrete Fourier Series and Transforms on various discrete time signals
CO3	Use FFT algorithm for solving DFT of sequences
CO4	Design the Digital IIR Filters from the analog filters using frequency transformations and FIR filters using windowing techniques
CO5	Construct the basic structures of Digital FIR and IIR systems.
CO6	Apply the signal processing concepts on programmable Digital Signal Processors.

UNIT I

INTRODUCTION TO DIGITAL SIGNAL PROCESSING: Discrete time signals & sequences, Classification of Discrete time systems, stability of LTI systems, Response of LTI systems to arbitrary inputs. Solution of Linear constant coefficient difference equations. Frequency domain representation of discrete time signals and systems. Review of Z-transforms, solution of difference equations using Z-transforms, System function.

UNIT II

DISCRETE FOURIER SERIES AND FOURIER TRANSFORMS: Properties of Discrete Fourier series, DFS representation of periodic sequences. Discrete Fourier Transforms**,** Properties of DFT, linear filtering methods based on DFT. Fast Fourier Transforms (FFT) - Radix-2 decimation in time and decimation in frequency FFT Algorithms, Inverse FF

UNIT III

DESIGN OF IIR DIGITAL FILTERS & REALIZATIONS: Analog filter approximations – Butter worth and Chebyshev, Design of IIR Digital filters from analog filters, Design Examples, Analog and Digital frequency transformations. Basic realization structures of IIR systems Direct form-1, Direct form-2, Transposed forms.

UNIT IV

DESIGN OF FIR DIGITAL FILTERS & REALIZATIONS: Characteristics of FIR Digital Filters, linear phase FIR filters, Design of FIR Digital Filters using rectangular, triangular, hamming and hanning window techniques and Frequency Sampling technique, Comparison of IIR & FIR filters, Basic realization structures of FIR systems-Direct form, cascade and parallel forms.

UNIT V

INTRODUCTION TO DSP PROCESSORS: Introduction to programmable DSPs: Multiplier and Multiplier Accumulator, Modified bus structures and memory access schemes in P-DSPs, Multiple Access Memory, Multiported memory, VLIW architecture, Pipelining, Special addressing modes, On-Chip Peripherals. Architecture of TMS320C5X: Introduction, Bus Structure, Central Arithmetic Logic Unit, Auxiliary Register ALU, Index Register, Block Move Address Register, Parallel Logic Unit, Memory mapped registers, program controller, some flags in the status registers, On- chip memory, On-chip peripherals.

TEXT BOOKS :

1. Digital Signal Processing, Principles, Algorithms, and Applications: John G. Proakis, Dimitris G.Manolakis, Pearson Education /PHI, 2007.
2. Discrete Time Signal Processing – A.V.Oppenheim and R.W. Schaffer, PHI.
3. Digital Signal Processors – Architecture, Programming and Applications,, B.Venkataramani,M.Bhaskar, TATA McGraw Hill, 2002.
4. Digital Signal Processing – K Raja Rajeswari, I.K. International Publishing House.

REFERENCE BOOKS:

1. Digital Signal Processing: Andreas Antoniou, TATA McGraw Hill , 2006.
2. Digital Signal Processing: MH Hayes, Schaum's Outlines, TATA Mc-Graw Hill, 2007.
3. DSP Primer - C. Britton Rorabaugh, Tata McGraw Hill, 2005.
4. Fundamentals of Digital Signal Processing using MATLAB – Robert J. Schilling, Sandra L. Harris,Thomson, 2007.
5. Digital Signal Processing – Alan V. Oppenheim, Ronald W. Schafer, PHI Ed., 2006.
6. Digital Signal Processing – P.Ramesh babu, Sci Tech publications.

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III Year - II Semester **DEPARTMENT OF ELECTRONICS AND COMMUNICATION ENGINEERING** **L T P C**

Professional Course (PC) **3 0 0 3**

VLSI DESIGN

Lecture – Tutorial:	3-0 Hours	**Internal Marks:**	30
Credits:	3	**External Marks:**	70

Prerequisites: Basic electrical properties of MOSFET, Digital electronic circuits.

Course Objectives:

- Use mathematical methods and circuit analysis models in analysis of CMOS digital electronics circuits, including logic components and their interconnects.
- Learn the various fabrication steps of IC and come across basic electrical properties of MOSFET.
- Apply CMOS technology-specific layout rules in the placement and routing of transistors and interconnect and to verify the functionality, timing, power and parasitic effects.
- Understand the design for testability.
- Know the FPGA architecture and design flow, CPLD and system on chip.
- Highlight the circuit design issues in the context of VLSI technology, power calculations and clock mechanism.

Course Outcomes:

Upon successful completion of the course, the student will be able to:

CO1	Demonstrate a clear understanding of CMOS fabrication flow and technology scaling.
CO2	Apply the design Rules and draw layout of a given logic circuit.
CO3	Understand the scaling factors determining the characteristics and performance of MOS circuits in silicon.
CO4	Understand the switch logic and gate logic.
CO5	Apply the concepts in testing which can help them design a better yield in IC design.
CO6	Analyze the FPGA architecture , design flow and CPLD architecture.

Course Content (Syllabus)

UNIT I

INTRODUCTION AND BASIC ELECTRICAL PROPERTIES OF MOS CIRCUITS: VLSI Design Flow, Introduction to IC technology, Fabrication process: nMOS, pMOS and CMOS. Ids versus Vds Relationships, Aspects of MOS transistor Threshold Voltage, MOS transistor Trans, Output Conductance and Figure of Merit.

nMOS Inverter, Pull-up to Pull-down Ratio for nMOS inverter driven by another nMOS inverter, and through one or more pass transistors. Alternative forms of pull-up, The CMOS Inverter, Latch-up in CMOS circuits, Bi-CMOS Inverter, Comparison between CMOS and BiCMOS technology.

UNIT II

DESIGN RULES, STICK AND LAYOUT DIAGRAMS: MOS Layers, Stick Diagrams, Design Rules and Layout, Layout Diagrams for MOS circuits.

BASIC CIRCUIT CONCEPTS: Sheet Resistance, Sheet Resistance concept applied to MOS transistors and Inverters, Area Capacitance of Layers, Standard unit of capacitance, some area Capacitance Calculations, The Delay Unit, Inverter Delays, driving large capacitive loads, Propagation Delays, Wiring Capacitances, Choice of layers.

UNIT III

SCALING OF MOS CIRCUITS: Scaling models and scaling factors, Scaling factors for device parameters, Limitations of scaling, Limits due to sub threshold currents, Limits on logic levels and supply voltage due to noise and current density. Switch logic, Gate logic.

UNIT IV

INTRODUCTION TO TESTING: Testing Philosophy, Role of Testing, VLSI Testing, VLSI Technology Trends affecting Testing, Types of Testing, Fault Modeling: Defects, Errors and Faults, Functional Versus Structural Testing, Levels of Fault Models, Single Stuck-at Fault.

UNIT V

FPGA DESIGN: FPGA design flow, Basic FPGA architecture, FPGA Technologies, Introduction to FPGA Families, CPLD.

INTRODUCTION TO ADVANCED TECHNOLOGIES: Short channel effects, High–k, Metal Gate Technology, Fin-FET, TFET.

TEXT BOOKS:

1. Essentials of VLSI Circuits and Systems – Kamran Eshraghian, Douglas and A.Pucknell and Sholeh Eshraghian, Prentice-Hall of India Private Limited, 2005 Edition.
2. Design of Analog CMOS Integrated Circuits by Behzad Razavi, McGraw Hill, 2003
3. Digital Integrated Circuits, Jan M.Rabaey, Anantha Chandrakasan and Borivoje Nikolic, 2nd edition, 2016.

REFERENCES:

1. "Introduction to VLSI Circuits and Systems", John P.Uyemura, John Wiley&Sons, reprint 2009.
2. Integrated Nano electronics: Nano scale CMOS, Post-CMOS and Allied Nano technologies Vinod Kumar Khanna, Springer India, 1stedition, 2016.
3. Fin-FETs and other multi-gate transistors, Colinge JP, Editor NewYork, Springer, 2008.

Contribution of Course Outcomes towards achievement of Program Outcomes (PO) and ProgramSpecific outcomes (PSO)
(1 – Low, 2- Medium, 3 – High)

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO1	PSO2
CO1	3	-	-	-	3	3	-	-	-	-	-	-	3	2
CO2	-	-	3	2	-	-	3	-	-	-	-	3	-	-
CO3	3	3	2	-	-	-	-	2	-	-	3	-	3	-
CO4	-	2	-	-	3	-	-	3	-	3	-	-	-	2
CO5	3	2	3	-	-	-	-	-	3	-	-	-	3	-
CO6	2	3	3	-	-	-	-	-	-	-	-	3	-	-

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DEPARTMENT OF ELECTRONICS AND COMMUNICATION ENGINEERING

III Year - II Semester **L T P C**
Professional Elective (PE) **3 0 0 3**

OPTICAL COMMUNICATIONS

Lecture – Tutorial:	3-0 -0 Hours	**Internal Marks:**	30
Credits:	3	**External Marks:**	70

Prerequisites: Engineering Physics, Analog Communication, Digital Communication.

Course Objectives: Students will be able to:

- Analyze and design optical communication and fiber optic sensor systems.
- Understand the properties of optical fiber that affect the performance of a communication link and types of fiber materials with their properties and the losses that occur in fibers.
- Analyze the principles of single and multi-mode optical fibers and their characteristics.
- Working with semiconductor lasers, and differentiating direct modulation and external electro-optic modulation.
- Analyze the operation of LEDs, laser diodes, and PIN photodetectors (spectral properties, bandwidth, and circuits) and apply them in optical systems.
- Design the functionality of each of the components that comprise a fiber optic communication system, the models of analog and digital receivers.

Course Outcomes:

Upon successful completion of the course, the student will be able to:

CO1	Understand the basic structure and operation of optical fiber communication system.
CO2	Design the optical fibers using various materials and illustrate various attenuation losses.
CO3	Illustrate various dispersion models and splicing techniques.
CO4	Analyze different types of optical sources and photodetectors.
CO5	Evaluate the power coupled intoStep-Index and Graded-Index optical fibers.
CO6	Estimate the optical link power and Rise time budgets.

Course Content(Syllabus)

UNIT I

OVERVIEW OF OPTICAL FIBER COMMUNICATION: Historical development, The general system, advantages, disadvantages, and applications of optical fiber communications, **Optical Fiber Waveguides -** Introduction, Ray theory transmission, **Basic Optical Laws** - Refractive Index, Reflection and Refraction, Total Internal Reflection, Acceptance angle, Numerical Aperture, Skew rays.

CYLINDRICAL FIBERS: Modes, V-number, Mode coupling, Step Index fibers, Graded Index fibers, **Single Mode Fibers -** Cut off wavelength, Mode Field Diameter, Effective Refractive Index, Related problems **Fiber Materials -** Glass, Halide, Active glass, Chalgenide (or *Chalcogenide)* glass, Plastic optical fibers.

UNIT II

FIBER LOSSES: Attenuation, Absorption, Scattering, and Bending losses, Core and Cladding losses, Information capacity determination, Group delay.

TYPES OF DISPERSION: Material dispersion, Wave-guide dispersion, Polarization-Mode dispersion, Intermodal dispersion, Pulse broadening in Graded index fiber, Related problems.

UNIT III

OPTICAL FIBER CONNECTORS: Connector types, Single-mode fiber connectors, Connector return loss, Fiber Splicing- Splicing techniques, Splicing single-mode fibers,

FIBER ALIGNMENT AND JOINT LOSS: Multimode fiber joints, single-mode fiber joints.

UNIT IV

OPTICAL SOURCES : LEDs, Structures, Materials, Quantum efficiency, Power, Modulation, Power bandwidth product, **Laser Diodes**- Types, Fabry Perot resonator cavity Laser diode, Distributed feedback (DFB) Laser diode, External quantum efficiency, Reliability of LED & ILD,

OPTICAL DETECTORS: Physical principles of PIN and APD, Detector response time, Temperature effect on Avalanche gain, Comparison of Photodetectors, Related problems.

UNIT V

OPTICAL RECEIVER OPERATION: Fundamental receiver operation, Digital signal transmission, Error sources in optical pulse detection mechanism, Receiver configuration, Digital receiver performance, Probability of Error, Quantum limit, Analog receivers, **Source to Fiber Power Launching** - Output patterns, Power coupling, Power launching, Equilibrium Numerical Aperture, Laser diode to fiber coupling.

OPTICAL SYSTEM DESIGN: Point-to-point links- Component choice and considerations, Link power budget with examples, Rise time budget with examples, Line coding in Optical links, WDM, Necessity, Principles, Measurement of Attenuation and Dispersion, Eye pattern.

TEXT BOOKS:

1. Optical Fiber Communications - Gerd Keiser, Mc Graw-Hill International edition, 3rd Edition, 2000.
2. Optical Fiber Communications - John M. Senior, PHI, 2nd Edition, 2002.

REFERENCES:

1. Fiber Optic Communications - D.K. Mynbaev, S.C. Gupta and Lowell L. Scheiner, Pearson Education, 2005.
2. Text Book on Optical Fiber Communication and its Applications - S.C.Gupta, PHI, 2005.
3. Fiber Optic Communication Systems - Govind P. Agarwal , John Wiley, 3rd Edition, 2004.
4. Fiber Optic Communications - Joseph C. Palais, 4th Edition, Pearson Education, 2004.

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DEPARTMENT OF ELECTRONICS AND COMMUNICATION ENGINEERING

	L	T	P	C
III Year - II Semester				
Professional Elective (PE)	**3**	**0**	**0**	**3**

EMBEDDED SYSTEMS

Lecture – Tutorial:	3-0-0 Hours	**Internal Marks:**	30
Credits:	3	**External Marks:**	70

Prerequisites: Computer Architecture And Organization, Microprocessors And Microcontrollers

Course Objectives:

- Introduce the basic concepts of embedded system.
- Understand the various elements of embedded hardware and their design principles.
- Design and develop firmware for embedded systems.
- Familiarize with different IDEs for firmware development.
- Implement the embedded systems and discuss the testing tools.

Course Outcomes:

Upon successful completion of the course, the student will be able to:

CO1	Understand the basic concepts of embedded system.
CO2	Design an approach of an embedded hardware.
CO3	Design various approaches for embedded firmware.
CO4	Design RTOS and discuss fundamental issues in hardware software co design.
CO5	Understand how to integrate hardware and firmware of embedded system.
CO6	Understand the various tools used in implementing the embedded systems

Course Content(Syllabus)

UNIT I

INTRODUCTION: Embedded system-Definition, history of embedded systems, classification of embedded systems, major application areas of embedded systems, purpose of embedded systems, the typical embedded system-core of the embedded system, Memory, Sensors and Actuators, Communication Interface, Embedded firmware, Characteristics of an embedded system, Quality attributes of embedded systems, Application-specific and Domain-Specific examples of an embedded system.

UNIT II

EMBEDDED HARDWARE DESIGN: Analog and digital electronic components, I/O types and examples, Serial communication devices, Parallel device ports, Wireless devices, Timer and counting devices, Watchdog timer, Real time clock.

UNIT III

EMBEDDED FIRMWARE DESIGN: Embedded Firmware design approaches, Embedded Firmware development languages, ISR concept, Interrupt sources, Interrupt servicing mechanism, Multiple interrupts, DMA, Device driver programming, Concepts of C versus Embedded C and Compiler versus Cross-compiler.

UNIT IV

REAL TIME OPERATING SYSTEM: Operating system basics, Types of operating systems, Tasks, Process and Threads, Multiprocessing and Multitasking, Task Scheduling, Threads, Processes and Scheduling, Task communication, Task synchronization. **HARDWARE SOFTWARE CO-DESIGN:** Fundamental Issues in Hardware Software Co- Design, Computational models in embedded design, Hardware software Trade-offs, Integration of Hardware and Firmware.

UNIT V

EMBEDDED SYSTEM DEVELOPMENT, IMPLEMENTATION AND TESTING: The integrated development environment, Types of files generated on cross-compilation, De- assembler/ De-compiler, Simulators, Emulators and Debugging, Target hardware debugging, Embedded Software development process and tools, Interpreters, Compilers and Linkers, debugging tools, Quality assurance and testing o the design, Testing on host machine, Simulators, Laboratory Tools.

Case Study: digital camera hardware and software architecture, embedded systems in automobile, embedded system for a smart card, mobile phone software for key inputs.

TEXT BOOKS:

1. Embedded Systems Architecture- By Tammy Noergaard, Elsevier Publications, 2013.
2. Embedded Systems-By Shibu.K.V-Tata McGraw Hill Education Private Limited, 2013.

REFERENCES:

1. Embedded System Design, Frank Vahid, Tony Givargis, John Wiley Publications, 2013.
2. Embedded Systems-Lyla B.Das-Pearson Publications, 2013.

III Year - II Semester **L T P C**

Professional Elective (PE) **3 0 0 3**

RADAR SYSTEMS

Lecture – Tutorial:	3-0 Hours	**Internal Marks:**	30
Credits:	3	**External Marks:**	70

Prerequisites: Analog Communication, Digital Communication, electromagnetic theory and Antennas and wave propagation.

Course Objectives:

- To understand the basic concepts, applications, frequencies used and types of RADARs.
- To study CW radar and FM-CW radar and their applications.
- To gain knowledge about the basics of RADAR and its parameters.
- To understand the concepts of Doppler effect and its application to pulse Doppler radar.
- To learn about different types of Radars and their applications.

Course Outcomes:

Upon successful completion of the course, the student will be able to:

CO1	Acquire the knowledge of Radar system to apply and to design required parameters for a RADAR system and to derive the RADAR Equation.
CO2	Analyze the working principle of CW and Frequency Modulated Radar and their applications.
CO3	Understand the principle of MTI and pulse Doppler Radar and analyze MTI Radar parameters and their limitations.
CO4	Acquire the knowledge of phase array antennas used for transmission and reception in RADAR.
CO5	Analyze different types of tracking RADARs and to study different types of Radar receivers and displays.
CO6	Explore the detection of Radar signals in the presence of noise and analyze the performance of matched filter receiver and its characteristics.

Course Content (Syllabus)

UNIT I

BASICS OF RADAR: Introduction, Maximum Unambiguous Range, simple Radar range Equation, Radar Block Diagram and Operation, Radar Frequencies and Applications. Prediction of Range Performance, Minimum Detectable Signal, Receiver Noise, Illustrative Problems.

RADAR EQUATION : Modified Radar Range Equation, SNR, probability of detection, probability of False Alarm, Integration of Radar Pulses, Radar Cross Section of Targets (simple targets - sphere, cone-sphere), Creeping Wave, Transmitter Power, PRF and Range Ambiguities, System Losses (qualitative treatment), Illustrative Problems.

UNIT II

CW AND FREQUENCY MODULATED RADAR : Doppler Effect, CW Radar – Block Diagram, Isolation between Transmitter and Receiver, Non-zero IF Receiver, Receiver Bandwidth Requirements, Applications of CW radar. Illustrative Problems**.**

FM-CW RADAR: Range and Doppler Measurement, Block Diagram and Characteristics, FM-CW altimeter, Multiple Frequency CW Radar.

UNIT III

MTI AND PULSE DOPPLER RADAR: Introduction, Principle, MTI Radar with - Power Amplifier Transmitter and Power Oscillator Transmitter, Delay Line Cancellers – Filter Characteristics, Blind Speeds, Double Cancellation, Nth Cancellation Staggered PRFs. Range Gated Doppler Filters. MTI Radar Parameters, Limitations to MTI Performance, MTI versus Pulse Doppler Radar.

UNIT IV

TRACKING RADAR: Tracking with Radar, Sequential Lobing, Conical Scan, Mono pulse Tracking Radar – Amplitude Comparison Mono pulse (one- and two- coordinates), Phase Comparison Mono pulse, Tracking in Range, Acquisition and Scanning Patterns, Comparison of Trackers.

UNIT V

DETECTION OF RADAR SIGNALS IN NOISE : Introduction, Matched Filter Receiver – Response Characteristics and Derivation, Correlation detection and Cross-correlation Receiver, Efficiency of Non-matched Filters, Matched Filter with Non-white Noise, Noise Figure and Noise Temperature.

RADAR TRANSMITTERS & RECEIVERS –Displays – types. Duplexers – Branch type and Balanced type, Circulators as Duplexers, Series versus parallel feeds, Applications, Advantages and Limitations. Radomes.

TEXT BOOKS:

1. Introduction to Radar Systems – Merrill I. Skolnik, TMH Special Indian Edition, 2nd Ed., 2007.

REFERENCES:

1. Radar: Principles, Technology, Applications – Byron Edde, Pearson Education, 2004.
2. Radar Principles – Peebles, Jr., P.Z., Wiley, New York, 1998.
3. Principles of Modern Radar: Basic Principles – Mark A. Richards, James A. Scheer, William A. Holm, Yesdee, 2013
4. Radar Engineering – GSN Raju, IK International.

Contribution of Course Outcomes towards achievement of Program Outcomes (PO) and Program Specific outcomes (PSO)
(1 – Low, 2- Medium, 3 – High)

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO1	PSO 2
CO1	3	2	2	-	-	-	-	-	-	2	-	-	-	2
CO2	3	2	-	-	-	-	-	-	-	-	-	-	3	-
CO3	2	2	2	-	-	-	-	-	-	2	-	-	-	3
CO4	3	2	2	-	-	-	-	-	-	3	2	3	3	3
CO5	3	2	2	-	-	-	-	-	-	2	-	-	3	2
CO6	3	2	2	-	-	-	-	-	-	2	-	-	-	-

III Year - I Semester **L T P C**
Professional Course (PC Lab) **0 0 3 1.5**

VLSI Design Lab

Lecture-Practical:	0-3 Hours	**Internal Marks:**	15
Credits:	1.5	**External Marks:**	35

Prerequisites: CMOS technology, Digital Electronic Circuits.

Course Objectives:

- To analyze digital system design blocks using VHDL fundamentals.
- To understand the physics and modeling of MOSFET.
- To understand fabrication steps and layout of CMOS integrated circuits.
- To analyze the performance of CMOS inverter and various circuits.
- To design CMOS circuits using various design rules.

Course Outcomes:

Upon successful completion of the course, the student will be able to:

CO1	Design CMOS logic circuits.
CO2	Simulate the circuit with tanner EDA tools.
CO3	Apply the design rules to get the layout of the circuits.
CO4	Apply lambda based design rules and solve the problem in the design of CMOS logic circuits.
CO5	Design various gates, adders, encoders and flip-flops.
CO6	Understand various design rules to obtain the CMOS logic circuits.

LAB EXPERIMENTS

Back-end Level Design and Implementation (Any Ten Experiments)

Note: The students need to design the following experiments at schematic level using CMOS logic and verify the functionality. Further students need to draw the corresponding layout and verify the functionality including parasites. Available state of the art technology libraries can be used while simulating the designs using Industry standard EDA Tools.

1. Implementation of an inverter using CMOS logic.
2. Implementation of the universal gates using CMOS logic.
3. Implementation XOR gate using CMOS logic.
4. Full Adder using CMOS logic.
5. Full subtractor using CMOS logic.
6. Implementation of SR latch using CMOS logic.
7. Implementation of D latch using CMOS logic.
8. Design of Decoder using CMOS logic.
9. Design of Static RAM cell using CMOS logic.
10. Design of Differential Amplifier using CMOS logic.
11. Design of flip flop using CMOS logic.

EDA Tools/Hardware Required:

- Mentor Graphics Software / Cadence/Synopsys/Tanner or Equivalent Industry Standard/CAD Tool.
- Desktop computer with appropriate Operating System that supports the EDA tools.

Contribution of Course Outcomes towards achievement of Program Outcomes (PO) and Program Specific outcomes (PSO)

(1 – Low, 2- Medium, 3 – High)

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO1	PSO 2
CO1	3	-	-	3	-	-	3	-	-	-	-	-	3	-
CO2	-	2	-	2	-	-	-	3	-	2	-	-	-	2
CO3	-	-	3	-	-	2	-	-	2	-	3	3	-	-
CO4	2	-	-	-	-	-	-	-	-	3	-	-	2	-
CO5	-	2	-	2	3	-	2	-	-	-	2	3	-	-
CO6	-	3	-	-	-	-	-	-	-	-		-	3	-

III Year - II Semester **L T P C**
Professional Course (PC Lab) **0 0 3 1.5**

MICROPROCESSOR AND MICROCONTROLLERS LAB

Lecture-Practical:	0-3 Hours	**Internal Marks:**	15
Credits:	1.5	**External Marks:**	35

Prerequisites: CMOS technology, Digital Electronic Circuits.

Course Objectives:

- To develop assembly language program skills and providing the basic knowledge of interfacing various peripherals to 8086 microprocessor and 8051 Microcontroller.

Course Outcomes:

Upon successful completion of the course, the student will be able to:

CO1	Develop the assembly language Programmes for 8086 Microprocessor
CO2	Use the cross compiler such as MASM to verify and simulate the 8086 codes
CO3	Develop the assembly language Programmes for 8051 Microcontroller.
CO4	Use Keil to verify and simulate the 8051 Programming
CO5	Use various interfacing circuits for Real world and practical Applications.
CO6	Analyze the performance of various interface techniques for the computing circuits.

LAB EXPERIMENTS

PART A: (Minimum of 5 Experiments has to be performed) 8086 Assembly Language Programming

1. Multi Byte Arithmetic Operations.
2. Programs for 16-bit Addition of n-BCD numbers.
3. String Instructions (Inserting, Deleting)
4. Program for Sorting an Array.
5. Program for Factorial of given N-Numbers.
6. Sum of Squares/Cubes of a given N-Numbers

PART-B: (Minimum of 5 Experiments has to be performed) 8051 Assembly Language Programming

1. Finding Number of 1's and Number of 0's in a given 8-bit Number.
2. Addition Of Even Numbers From A Given Array.
3. Average of N-Numbers.
4. Ascending / Descending order.
5. Serial Communication.
6. Square Wave Generator using Timers.

PART-C: (Minimum of 2 Experiments has to be performed) Conduct the following experiments using interface devices with 8086 and 8051

1. Interfacing ADC to 8086 / 8051.
2. Interfacing DAC to 8086 / 8051.
3. Interfacing Stepper Motor to 8086 / 8051.
4. Interfacing Traffic Light Controller to 8051.

Equipment Required:

1. Regulated Power supplies
2. Analog/Digital Storage Oscilloscopes
3. 8086 Microprocessor kits
4. 8051 microcontroller kits

5. ADC module, DAC module
6. Stepper motor module
7. Traffic Light Controller.
9. Digital Multi-meters

Contribution of Course Outcomes towards achievement of Program Outcomes (PO) and Program Specific outcomes (PSO)
(1 – Low, 2- Medium, 3 – High)

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO1	PSO 2
CO1	2	3	-	2	-	-	-	-	-	3	-	-	-	3
CO2	-	3	-	2	-	-	-	-	-	2	-	-	-	2
CO3	3	-	3	-	3	-	-	-	-	-	2	-	-	-
CO4	-	3	3	-	-	2	-	-	2	-	-	-	2	3
CO5	2	-	-	-	-	-	3	-	-	-	-	-	-	-
CO6	-	2	-	2	-	-	-	3	-	2	-	-	3	-

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DEPARTMENT OF ELECTRONICS AND COMMUNICATION ENGINEERING

III Year - I Semester **L T P C**
Professional Course (PC Lab) **0 0 3 1.5**

DIGITAL SIGNAL PROCESSING LABORATORY

Lecture-Practical:	0-0-3 Hours	**Internal Marks:**	15
Credits:	1.5	**External Marks:**	35

Prerequisites: Signals and Systems and Basic Simulation Lab

Course Objectives:

- To acquire the knowledge of generation of various signals and perform different operations on them using MATLAB tool
- To understand the concept and importance of Discrete Fourier Transforms and Fast Fourier Transforms.
- To analyze the frequency response of IIR and FIR digital filters.
- To perform decimation and interpolation processes on a sequence.

Course Outcomes:

Upon successful completion of the course, the student will be able to:

CO1	Make use of a software tool to generate various discrete time signals and perform different operations on them.
CO2	Examine Linear and Circular Convolution of discrete time signals.
CO3	Evaluate the Discrete Fourier Transform of a signal and its inverse.
CO4	Analyze the Frequency response of IIR Filters using Butterworth and Chebyshev Approximations.
CO5	Analyze the Frequency Response of FIR filters using windowing techniques.
CO6	Illustrate the Decimation and Interpolation processes on a given Sequence.

LIST OF EXPERIMENTS

Note: All the following experiments are to be simulated using MATLAB or equivalent software.

1. Generation of discrete time signals.
2. Addition of sinusoidal signals.
3. Computation of Linear Convolution.
4. Computation of Circular Convolution.
5. Computation of DFT and IDFT.
6. Computation of N-Point FFT.
7. Frequency response of IIR low pass and high pass Butterworth filter.
8. Frequency response of IIR low pass and high pass Chebyshev filter.
9. Frequency response of FIR low pass and high pass filter using Rectangular window.
10. Frequency response of FIR low pass and high pass filter using Triangular window.

Experiments to be conducted beyond the syllabus

1. Implementation of Decimation and Interpolation on a sequence/signal.
2. Verification of Linear Convolution and Circular Convolution of sequences using Code Composer Studio (CCS).

III Year - II Semester **L T P C**
Skill Course (SC) **1 0 2 2**

SENSORS AND INSTRUMENTATION

(Skill Course)

Lecture-Practical:	1-2	**Internal Marks:**	15
Credits:	2	**External Marks:**	35

Prerequisites: Basic electrical and electronics engineering, basics of measuring systems and method of measurement.

Course Objectives:

- To make students familiar with the constructions and working principle of different types of sensors and transducers.
- To make students aware about the measuring instruments and the methods of measurement and the use of different transducers.
- To make students aware of the latest trends in sensor technology.
- To make the students identify the necessary sensor for various applications.

Course Outcomes:

Upon successful completion of the course, the student will be able to:

CO1	Understanding the concept of measurement system
CO2	Identifying concepts in common methods for converting a physical parameter into an electrical quantity.
CO3	Applying concepts in advances in transducers for various engineering applications.
CO4	Choose proper sensor comparing different standards and guidelines to make sensitive measurements of physical parameters like pressure, flow, acceleration, etc.
CO5	Applying knowledge on advanced sensor which related to detect the enhanced parameters using sensors.
CO6	Set up testing strategies to evaluate performance characteristics of different types of sensors and transducers and develop professional skills in acquiring and applying the knowledge outside the classroom through design of a real-life instrumentation system.

Course Content (Syllabus)

UNIT I

INTRODUCTION TO INSTRUMENTATION: Functional elements of the Measurement system, Static and dynamic characteristics, Errors in measurements - systematic, gross, random; Loading effect, Calibration.

UNIT II

Transducers-1: Introduction to transducers, Classification, Characteristics, working principles of strain gauge, Displacement measurement using Potentiometer and LVDT, Temperature measurement using thermocouple, RTD and thermistor.

UNIT III

Transducers-2: Piezoelectric transducer for force and pressure measurement, Speed measurement, Capacitive transducer and Inductive transducers.

UNIT IV

SENSORS-1:
Introduction to sensors, Light sensors using LDR and photo diode, Level and distance measurement using Ultrasonic sensor, Accelerometer.

UNIT V

SENSORS-2: Proximity sensor, Humidity sensor, Analog, soil moisture sensor, Digital data acquisition, Single channel, multi-channel data acquisition, PC based data acquisition.

Experiments:

1. **Strain gauge.**
2. **Linear Displacement using LVDT**
3. **Temperature calibration using thermocouple.**
4. **Pressure measurement.**
5. **Speed measurement.**
6. **Capacitance trainer module.**
7. **Light sensor.**
8. **Distance measurement using ultrasonic sensor.**
9. **Accelerometer.**
10. **Proximity sensor.**
11. **Humidity measurement.**
12. **Soil moisture sensor.**

TEXT BOOKS:

1. Doebelin, E.O., "Measurement systems – Application and Design", McGraw Hill.
2. D. Patranabis, "Sensors and Transducers", PHI, 2nd Edition.

REFERENCES:

1. Instrumentation Measurement & Analysis, by B.C. Nakra, K.K. Choudry, (TMH) .
2. Transducers and Instrumentation, by D.V.S. Murthy (PHI).

Contribution of Course Outcomes towards achievement of Program Outcomes (PO) and Program Specific outcomes (PSO)
(1 – Low, 2- Medium, 3 – High)

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PS O1	PSO 2
CO1	3	2	-	-	3	-	-	-	-	-	-	-	3	-
CO2	-	3	-	-	3	-	-	3	-	3	-	-	-	-
CO3	2	-	-	-	-	-	-	-	3	-	-	3	-	-
CO4	-	-	-	2	-	3	-	-	-	-	-	-	3	-
CO5	3	3	-	2	-	-	3	-	-	-	2	-	-	2
CO6	3	-	3	-	-	-	-	-	-	-	-	-	2	-

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DEPARTMENT OF ELECTRONICS AND COMMUNICATION ENGINEERING

DEPARTMENT OF ELECTRONICS AND COMMUNICATION ENGINEERING
COURSE STRUCTURE FOR FOURTH YEAR B.TECH PROGRAMME-NRIA-20 Reg
IV YEAR I SEMESTER

Sl. No	Course Code	Title of the Course	Scheme of Instruction (Periods Per Week)				Scheme of Examination (Max Marks)			No. of Credits
			L	T	P	Total	CIA	SEA	Total	
1	**PE III**	i) Low Power VLSI Design ii) Data Communications & Computer Networks iii) Electronic Measurements and Instrumentation	3	-	-	3	30	70	100	3
2	**PE IV**	i) Digital Image Processing ii) Digital IC Design using CMOS iii) Satellite Communications	3	-	-	3	30	70	100	3
3	**PE V**	i) Soft Computing skills ii) Machine learning iii) Cellular Mobile Communications	3	-	-	3	30	70	100	3
4	**OE**	**Open Elective - III**	3	-	-	3	30	70	100	3
5	**OE**	**Open Elective - IV**	3	-	-	3	30	70	100	3
6	**HSE**	Universal Human Values	3	-	-	3	30	70	100	3
7	**SC***	Microwave & RF Communication Laboratory	1	-	2	3	15	35	50	2
8	**MC**	Employability Skills	2	-	-	2	30	70	100	0
Industrial / Research Internship(Mandatory) after third year to be evaluated during VII semester			-	-	-	2	-	50	50	2
Total			21	-	2	25	225	575	800	22
Honors/Minor Courses(the hours distribution can be 3-0-2 or 3-1-0)			4	-	-	4	30	70	100	4

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DEPARTMENT OF ELECTRONICS AND COMMUNICATION ENGINEERING

DEPARTMENT OF ELECTRONICS AND COMMUNICATION ENGINEERING
COURSE STRUCTURE FOR FOURTH YEAR B.TECH PROGRAMME- NRIA-20 Reg
IV YEAR II SEMESTER

Sl. No	Course Code	Title of the Course	Scheme of Instruction (Periods Per Week)				Scheme of Examination (Max Marks)			No. of Credits
			L	T	P	Total	CIA	SEA	Total	
1		Major Project work	-	-	-	-	40	60	100	8
2		Community Service Project	-	-	-	-	-	50	50	4
Total										12

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DEPARTMENT OF ELECTRONICS AND COMMUNICATION ENGINEERING

IV Year - I Semester **L T P C**
3 0 0 3

PROFESSIONAL ELECTIVE - III
LOW POWER VLSI DESIGN

Lecture – Tutorial:	3-0 Hours	**Internal Marks:**	30
Credits:	3	**External Marks:**	70

Prerequisites: VLSI Design, Scaling Techniques, Digital Logic Design, Knowledge of Digital ICs

Course Objectives: The students will be able to

- Understand the need for low power in VLSI
- Categorize various dissipation types in CMOS
- Infer the impact of power on system performance
- Estimate about different Design Approaches
- Exemplify the concept of low voltage and low power logic circuits.

Course Outcomes:

Upon successful completion of the course, the student will be able to:

CO1	Capability to recognize advanced issues in VLSI systems, specific to the deep submicron silicon Technologies.
CO2	Understand deep submicron CMOS technology and digital CMOS design styles.
CO3	Design chips used for battery powered systems and high performance circuits.
CO4	Categorize the design of various CMOS dynamic logic circuits.
CO5	Infer the design techniques of low voltage and low power CMOS circuits for various applications.
CO6	Exemplify the different types of memory circuits and their design.

Course Content(Syllabus)

UNIT I

Sources of Power Dissipation - Introduction, Short-Circuit Power Dissipation, Switching Power Dissipation, Dynamic Power for a Complex Gate, Reduced Voltage Swing, Switching Activity, Leakage Power Dissipation, p–n Junction Reverse-Biased Current, Band-to-Band Tunneling Current, Subthreshold Leakage Current, Short-Channel Effects

UNIT II

Supply Voltage Scaling for Low Power -Device Feature Size Scaling, Constant-Field Scaling, Constant-Voltage Scaling, Architectural-Level Approaches: Parallelism for Low Power, Pipelining for Low Power, Combining Parallelism with Pipelining, Voltage Scaling Using High-Level Transformations: Multilevel Voltage Scaling Challenges in MVS Voltage Scaling Interfaces, Static Timing Analysis Dynamic Voltage and Frequency Scaling

UNIT III

Switched Capacitance Minimization -Probabilistic Power Analysis: Random logic signals, probability and frequency, probabilistic power analysis techniques, signal entropy, Bus Encoding: Gray Coding, One-Hot Coding, Bus-Inversion, T0 Coding, Clock Gating, Gated-Clock FSMs Glitching Power Minimization

UNIT IV

Leakage Power Minimization - Fabrication of Multiple Threshold Voltages, Multiple Channel Doping, Multiple Oxide CMOS, Multiple Channel Length, Multiple Body Bias, VTCMOS Approach, MTCMOS Approach, Power Gating, Clock Gating Versus Power Gating, Power-Gating Issues, Isolation Strategy, State Retention Strategy, Power-Gating Controller, Power Management, Combining DVFS and Power Management

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DEPARTMENT OF ELECTRONICS AND COMMUNICATION ENGINEERING

UNIT V

Low power clock distribution & Simulation Power Analysis - Low power clock distribution: Power dissipation in clock distribution, single driver versus distributed buffers, Zero skew versus tolerable skew, chip and package co design for clock network. Simulation Power Analysis: SPICE circuit simulators, gate level logic simulation and capacitive power estimation.

TEXT BOOKS:

1. Low-Power VLSI Circuits and Systems, Ajit Pal, SPRINGER PUBLISHERS @ 2015.
2. Practical Low Power Digital VLSI Design , Gary Yeap Motorola, Springer Science Business Media, LLC, 1st edition @1998

REFERENCES:

1. Low Power CMOS Design – Anantha Chandrakasan, IEEE Press/Wiley International, 1998.
2. Massoud Pedram, Jan M. Rabaey, "Low power design methodologies ", Kluwer Academic Publishers.
3. Low Power CMOS VLSI Circuit Design – A. Bellamour, M. I. Elamasri, Kluwer Academic Press, 1995.

Contribution of Course Outcomes towards achievement of Program Outcomes (POs) and Program Specific outcomes (PSOs) (1 – Low, 2- Medium, 3 – High)

	PO1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO1	PS O2
CO1	3	2	2	-	-	-		-	-	-	-	-	2	-
CO2	2	3	-	-	-	-	-	-	-	-	-	-	3	-
CO3	2	-		-		-	-	-	-	-	-	2	2	-
CO4	3	2		2	-	-		2	-	-	-	-	-	3
CO5	2	3		-	-	-	-	-	-		-	-	-	2
CO6	2		2	-	-	-	-		-	-	-	2	-	2

SK. Ashraf Ali
Signature of faculty

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DEPARTMENT OF ELECTRONICS AND COMMUNICATION ENGINEERING

IV Year - I Semester **L T P C**
3 0 0 3

PROFESSIONAL ELECTIVE - III
DATA COMMUNICATIONS & COMPUTER NETWORKS

Lecture – Tutorial:	3-0 Hours	**Internal Marks:**	30
Credits:	3	**External Marks:**	70

Prerequisites: Computer Architecture and organization, Data Structures.

Course Objectives:

- To provide insight about networks, topologies, and the key concepts.
- To gain comprehensive knowledge about the layered communication architectures (OSI and TCP/IP) and its functionalities.
- To design and analyze various error detection techniques.
- To know the basic concepts of network services and mechanism of routing.
- To know the functioning of various application layer protocols

Course Outcomes:

Upon successful completion of the course, the student will be able to:

CO1	Demonstrate different network models for networking links OSI, TCP/IP and get knowledge about various communication techniques, methods and protocol standards.
CO2	Analyze data link layer services, compare and classify medium access control protocols
CO3	Demonstrate network service models, virtual circuits and routing mechanism
CO4	Analyze the internet protocol addressing in internet using IPV4 & IPV6 format
CO5	Determine the relationship between transport and network layer, understand connection and connection less services in transport layer.
CO6	Determine application layer services and client server protocols

Course Content(Syllabus)

UNIT I

Introduction to Data Communications: Components, Data Representation, Data Flow, Networks-Distributed Processing, Network Criteria, Physical Structures, Network Models, Categories of Networks Interconnection of Networks, The Internet - A Brief History, The Internet Today, Protocol and Standards - Protocols, Standards, Standards Organizations, Internet Standards. Network Models, Layered Tasks, OSI model, Layers in OSI model, TCP/IP Protocol Suite, Addressing Introduction,

UNIT II

Data Link Layer - Introduction to the Link Layer, The Services Provided by the Link Layer, Types of errors, Error-Detection and Correction Techniques, Parity Checks, Check summing Methods, Cyclic Redundancy Check (CRC) , Multiple Access control- Random Access, ALOHA, CSMA, CSMA with collision detection, CSMA with collision avoidance, Wireless Links and Network Characteristics, WiFi: 802.11 Wireless LANs -The 802.11 Architecture,802.11 MAC Protocol, IEEE 802.11 Frame

UNIT III

The Network Layer - Introduction, Forwarding and Routing, Network Service Models, Virtual Circuit and Datagram Networks-Virtual-Circuit Networks, Datagram Networks, Origins of VC and Datagram Networks, Inside a Router-Input Processing, Switching, Output Processing, Queuing, The Routing Control Plane, The Internet Protocol(IP):Forwarding and Addressing in the Internet-Datagram format, Ipv4 Addressing, Internet Control Message Protocol(ICMP), IPv6

UNIT IV

Transport Layer - Introduction and Transport Layer Services : Relationship Between Transport and Network Layers, Overview of the Transport Layer in the Internet, Multiplexing and Demultiplexing, Connectionless Transport: UDP -UDP Segment Structure, UDP Checksum, Principles of Reliable Data Transfer- Connection Oriented Transport: TCP - The TCP Connection, TCP Segment Structure, Flow Control, TCP Connection Management, Principles of Congestion Control - The Cause and the Costs of Congestion, Approaches to Congestion Control

UNIT V

Application Layer - Principles of Networking Applications – Network Application Architectures, Processes Communicating, Transport Services Available to Applications, FTP,- FTP Commands and Replies, Electronic Mail in the Internet- STMP, Comparison with HTTP, DNS-The Internet's Directory Service – Service Provided by DNS, Overview of How DNS Works, DNS Records and messages.

TEXT BOOKS:

1. Computer Networking A Top-Down Approach – Kurose James F, Keith W, 6th Edition, Pearson.
2. Data Communications and Networks – Behrouz A. Forouzan, Fifth Edition TMH.

REFERENCES:

1. Data Communications and Networks- Achut S Godbole, Atul Kahate.
2. Computer Networks, Mayank Dave, CENGAGE.
3. Computer Networks — Andrew S Tanenbaum, Fifth Edition. Pearson Education/PHI

Contribution of Course Outcomes towards achievement of Program Outcomes (POs) and Program Specific outcomes (PSOs) (1 – Low, 2- Medium, 3 – High)

	PO1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO1	PSO2
CO1	3	2	-	2	-	-	-	-	-	-	-	-	-	-
CO2	2	2	3	-	-	-	-	-	-	-	-	-	-	-
CO3	2	-	-	2	-	-	-	-	-	-	-	-	-	-
CO4	-	2	-	-	2	-	-	-	-	2	-	-	-	-
CO5	3	-	-	3	2	-	-	-	-	-	-	-	-	-
CO6	2	2	2	-	2	-	-	1	-	2	-	2	2	2

Ch.Swathi
Signature of faculty

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DEPARTMENT OF ELECTRONICS AND COMMUNICATION ENGINEERING

IV Year - I Semester **L T P C**
3 0 0 3

PROFESSIONAL ELECTIVE - III

ELECTRONIC MEASUREMENTS AND INSTRUMENTATION

Lecture – Tutorial:	3-0 Hours	**Internal Marks:**	30
Credits:	3	**External Marks:**	70

Prerequisites: Electrical circuits, Electronic Devices and circuits.

Course Objectives:

- I ntroduce the basic concepts related to the operation of electronic measuring instruments.
- Acquire a sound understanding theory and performance characteristics of instruments and errors in measurement and apply to DC voltmeters, ammeters, ohmmeters.
- To analyze fundamental characteristics of Micro strip lines through electromagnetic field concepts.
- Compare and contrast different types of oscilloscopes.
- Select different types of D.C and A.C bridges for measurement of passive components.
- Study the principles behind various transducers and their applications in the measurement of various parameters.

Course Outcomes:

Upon successful completion of the course, the student will be able to:

CO1	Understand the fundamental concepts of instrumentation and characteristics of measuring systems. Describe different types of meters and understanding the operation of meters.
CO2	Analyze Different types of signal generators and signal analyzers and their working principles.
CO3	Interpret the basic principle of Oscilloscope, measurement of parameters using CRO and understand different types of CRO probes.
CO4	Understand the working of different types of special purpose oscilloscopes.
CO5	Explore the different types of A.C. and DC Bridges, Q meters, Counters and their operations
CO6	Demonstrate the different types of transducers and their principles and operations.

Course Content(Syllabus)

UNIT I

Performance characteristics of instruments, Static characteristics:
Accuracy, Resolution, Precision, Expected value, Error, Sensitivity. Dynamic Characteristics; speed of response, Fidelity, Lag and Dynamic error, Types of errors in measurements and their analysis, Design of multi-range AC, DC meters (voltmeter &ammeter) and ohmmeter(series &shunt type) using D'arsonval movement. True rms meter.

UNIT II

Specifications and designing aspects of Signal Generators
AF sine and square wave signal generators, Function Generators, Random noise generators, Arbitrary waveform generators. WaveAnalyzers, Harmonic Distortion Analyzers, Spectrum Analyzers, Digital Fourier Analyzers.

UNIT III

Oscilloscopes
General purpose CROs, block diagram, functions and implementation of various blocks, specifications, various controls and their functions , types of probes used in CROs, Measurement of frequency and phase difference using Lissajous patterns Special purpose CROs; sampling oscilloscope, analog storage oscilloscope, digital storage oscilloscope

UNIT IV

Bridge circuits - Wheat stone bridge, measurement of very low resistance, Measurement of inductance- Maxwell's bridge, Anderson bridge. Measurement of capacitance-Schearing Bridge, Wien Bridge, Errors and precautions in using bridges Q-meter, principle of operation, measurement methods and sources of errors Counters : principle of operation -modes of operation- totalizing mode, frequency mode and time period mode-sources of errors.

UNIT V

Transducers

Active & passive transducers: Resistance, Capacitance, inductance, Strain gauges, LVDT, Piezo Electric transducers. Measurement of physical parameters temperature, force, pressure, velocity, acceleration and displacement

TEXT BOOKS:

1. Electronic Instrumentation, second edition-H.S.Kalsi, Tata McGraw Hill, 3rd edition.
2. Modern Electronic Instrumentation and Measurement Techniques- A.D.Helfrick and W.D.Cooper, PHI, 5th Edition, 2002.

REFERENCES:

1. Electronic Instrumentation & Measuements- David A. Bell, PHI,2nd Edition,2003.
2. Electronic Measurements and Instrumentation by K.Lal Kishore, Pearson Education-2005.

Contribution of Course Outcomes towards achievement of Program Outcomes (POs) and Program Specific outcomes (PSOs) (1 – Low, 2- Medium, 3 – High)

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO1	PSO2
CO1	3	3	-	-	3	-	-	3	-	3	-	-	3	-
CO2	2	-	-	-	-	-	-	-	3	-	-	3	-	-
CO3	-	-	-	2	-	3	-	-	-	-	-	-	3	-
CO4	-	-	-	2	-	3	-	-	-	-	-	-	3	-
CO5	3	3	-	2	-	-	3	-	-	-	2	-	-	2
CO6	3	-	3	-	-	-	-	-	-	-	-	-	2	-

B.V. R. V Prasad
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DEPARTMENT OF ELECTRONICS AND COMMUNICATION ENGINEERING

IV Year - I Semester **L T P C**
3 0 0 3

PROFESSIONAL ELECTIVE - IV
DIGITAL IMAGE PROCESSING

Lecture – Tutorial:	3-0 Hours	**Internal Marks:**	30
Credits:	3	**External Marks:**	70

Prerequisites: Mathematics, Engineering physics, Linear integrated circuits, Signals and systems, Digital Signal Processing.

Course Objectives:

- To understand the fundamentals of Image Processing.
- To introduce different intensity filtering techniques in spatial and frequency domain to enhance quality of image.
- To introduce different filtering techniques to estimate degradation and restoration of images.
- To explain the concept of color image processing.
- To discuss various compression techniques.
- To apply morphological and segmentation techniques for processing images.

Course Outcomes:

Upon successful completion of the course, the student will be able to:

CO1	Understands the fundamentals of image processing.
CO2	Differentiate different intensity filtering techniques in spatial and frequency domain to enhance quality of image.
CO3	Implement different filtering techniques to estimate degradation and restoration of images.
CO4	Demonstrate techniques to convert color images to black and white or vice versa.
CO5	Implement various compression techniques.
CO6	Morphological and Segmentation techniques for processing images.

Course Content(Syllabus)

UNIT I

Introduction: Introduction to digital image processing, Principal fields using Digital Image Processing, Fundamental steps in digital image processing, Components of Image Processing, Image sensing and acquisition, Image sampling and quantization, Representing digital images, Some basic relationships between pixels, An introduction to Mathematical tools in Digital image processing.

UNIT II

Image transforms: Need for image transforms, Discrete Fourier transform (DFT) of one variable, Extension to functions of two variables, some properties of the 2-D Discrete Fourier transform, Discrete cosine transform

Intensity transformations, Spatial domain filtering: Back ground, Some basic intensity transformation functions – Image Negatives, Log Transformations, Power – Law Transformation, piece-wise linear transformation functions, Histogram – Processing, equalization and matching, Smoothing spatial filters, Sharpening spatial filters

UNIT III

Frequency domain filtering: Image smoothing using frequency domain filters – Ideal, Butterworth and Gaussian Low Pass filters, Image Sharpening using Frequency Domain Filters – Ideal, Butterworth and Gaussian High Pass filters, Selective filtering

Image Restoration: A model of image degradation / Restoration process, Noise models, Restoration in the presence of Noise only- Spatial filtering, Periodic Noise Reduction by frequency domain filtering, Linear Position invariant degradation, Estimation of degradation function

UNIT IV

Color image processing: Color fundamentals, Color models, Pseudo color image processing, Basics of full color image processing, Color transformations, Color image smoothing, Color image sharpening
Image Compression: Types of redundancies, Image compression models, Huffman coding, Arithmetic coding, LZW coding, Run length coding, Block transform coding, Predictive coding, Wavelet coding.

UNIT V

Morphological image processing: Preliminaries, Erosion and Dilation, opening and closing, Hit or miss transformations, Some basic morphological algorithms, Gray scale morphology, Some basic gray scale morphological algorithms
Image segmentation: Fundamentals, Point detection, Line detection, Basic edge detection, Edge models, Thresholding, Region based segmentation.

TEXT BOOKS:

1. R.C. Gonzalez and R.E. WOODS, Digital Image Processing – 3rd edition, Prentice Hall, 2008
2. Jayaraman, S. Esakkirajan and T. Veerakumar, "Digital Image Processing"., Tata McGraw Hill Education, 2011.

REFERENCES:

1. Anil K Jain, " Fundamentals of Digital Image Processing", Prentice Hall of India, 9th Edition, Indian Reprint, 2002
2. B. Chanda, D. Dutta Majumder, "Digital Image Processing and Analysis", PHI, 2009.

Contribution of Course Outcomes towards achievement of Program Outcomes (POs) and Program Specific outcomes (PSOs) (1 – Low, 2- Medium, 3 – High)

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1	3	3	-	-	-	-	-		-	-	-	-	-	3
CO2	3	3	2	3	-	-	-		-	-	3	-	-	3
CO3	3	3	2	2	-	-	-		-	-	3		-	3
CO4	2	3	3	3	-	-			-	-	3	-	-	3
CO5	3	3	3	2	-	-	-	3	-	-	3	-	-	3
CO6	3	3	3	3	-	-	-	3	-	-	3	-	-	3

Dr. R. Sunitha

Signature of faculty

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DEPARTMENT OF ELECTRONICS AND COMMUNICATION ENGINEERING

IV Year - I Semester **L T P C**
3 0 0 3

PROFESSIONAL ELECTIVE - IV

DIGITAL IC DESIGN USING CMOS

Lecture – Tutorial:	3-0 Hours	**Internal Marks:**	30
Credits:	3	**External Marks:**	70

Prerequisites: STLD, Digital Communications, VLSI

Course Objectives:

1. Introduce the fundamentals of MOS logic circuits with time response
2. Understand the design of combinational circuits
3. Understand the basic design of sequential circuits
4. Extending the design of various sequential circuits
5. Relating the dynamic CMOS logic operations
6. Define the concepts of memory related MOS circuits

Course Outcomes:

Upon successful completion of the course, the student will be able to:

CO1	Understand the concepts of MOS Design.
CO2	Design and analysis of Combinational MOS Circuits.
CO3	Design and analysis of sequential MOS Circuits.
CO4	Extend the Digital IC Design to Different Applications.
CO5	Analyze the principle and behavior of high performance dynamic CMOS circuits.
CO6	Understand the Concepts of Semiconductor Memories, various memory architectures and building blocks.

Course Content (Syllabus)

UNIT I

MOS Design: Pseudo NMOS Logic – Inverter, Inverter threshold voltage, Output high voltage, Output Low voltage, Gain at gate threshold voltage, Transient response, Rise time, Fall time, Pseudo NMOS logic gates, Transistor equivalency, CMOS Inverter logic.

UNIT II

Combinational MOS Logic Circuits: MOS logic circuits with NMOS loads, Primitive CMOS logic gates – NOR & NAND gate, Complex Logic circuits design – Realizing Boolean expressions using NMOS gates and CMOS gates , AOI and OIA gates, CMOS full adder, CMOS transmission gates, Designing with Transmission gates.

UNIT III

Sequential MOS Logic Circuits: Behaviour of bistable elements, SR Latch, Clocked latch and flip flop circuits, CMOS D latch and edge triggered flip-flop.

UNIT IV

Dynamic Logic Circuits: Basic principle, Voltage Bootstrapping, Synchronous dynamic pass transistor circuits, Dynamic CMOS transmission gate logic, High performance Dynamic CMOS circuits.

UNIT V

Interconnect: Capacitive Parasitics, Resistive Parasitics, Inductive Parasitics, Advanced Interconncet Techniques.

Semiconductor Memories: Memory Types, RAM array organization, DRAM – Types, Operation, Leakage currents in DRAM cell and refresh operation, SRAM operation Leakage currents in SRAM cells, Flash Memory- NOR flash and NAND flash. Designing Memory and Array Structures: Introduction, Memory Classification, Memory Architectures and Building Blocks, The Memory Core, Read Only Memories, Non-volatile Read-Write Memories, Read-Write Memories (RAM), Contents Addressable or

Associative Memory (CAM), Memory Peripheral Circuitry, The Address Decoders, Sense Amplifiers, Voltage References, Drivers/Buffers, Timing and Control.

TEXT BOOKS:

1. Digital Integrated Circuits – A Design Perspective, Jan M. Rabaey, Anantha Chandrakasan, Borivoje Nikolic, 2nd Ed., PHI.
2. Digital Integrated Circuit Design – Ken Martin, Oxford University Press, 2011.

REFERENCES:

1. CMOS Digital Integrated Circuits Analysis and Design – Sung-Mo Kang, Yusuf Leblebici, TMH, 3rd Ed., 2011.
2. CMOS VLSI Design – Neil H.E Weste, David harris, Ayan Banerjee 3rd Edition, Pearson.

Contribution of Course Outcomes towards achievement of Program Outcomes (POs) and Program Specific outcomes (PSOs) (1 – Low, 2- Medium, 3 – High)

	PO1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO2
CO1	3	2	-	-	-	-	-	-	-	-	-	-	-	3
CO2	3	3	-	3	-	-	-	3	-	-	-	-	-	-
CO3	2	3	3	2	-	-	-	-	-	3	-	-	-	3
CO4	-	-	-	-	-	-	-	-	-	-	-	-	-	2
CO5	3	-	-	-	-	-	-	-	-	-	-	-	-	-
CO6	-	2	-	-	-	-	-	-	-	-	-	-	-	2

D. Murali
Signature of faculty

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DEPARTMENT OF ELECTRONICS AND COMMUNICATION ENGINEERING

IV Year - I Semester **L T P C**
3 0 0 3

PROFESSIONAL ELECTIVE - IV

SATELLITE COMMUNICATIONS

Lecture – Tutorial:	3-0 Hours	**Internal Marks:**	30
Credits:	3	**External Marks:**	70

Prerequisites: Analog Communications, Digital Communications, Optical Communications.

Course Objectives:

- This course will introduce the basic concepts and techniques of Satellite communication and frequency allocations.
- By the end of the course, student will be familiar with the most important methods in satellite launching.
- To explain the tools necessary for the calculation of basic parameters in a satellite communication system.
- To produce graduates who understand how to analyze and manipulate digital signals and to determine the orbital issues to have the fundamental knowledge to do so, for navigation and GPS.

Course Outcomes:

Upon successful completion of the course, the student will be able to:

CO1	Understand the historical background of satellite communication and analyze different frequency allocation of satellites communication.
CO2	Ability to calculate the orbital mechanics, determination of satellite orbits, orbital effects and launching methods.
CO3	Ability to develop AOCS, commands, monitoring power systems and developments of antennas.
CO4	Able to design antennas to provide Uplink and Down link Frequency and analyze multiple access techniques like TDMA, CDMA, FDMA.
CO5	Ability to design different kinds of transmitter and receiver antennas, design and develop Satellite for real time applications.
CO6	Ability to learn the concepts of Radio and Satellite Navigation system and GPS location principles, DGPS.

Course Content(Syllabus)

UNIT I

INTRODUCTION : Origin of Satellite Communications, Basic Concepts of Satellite Communications, Frequency allocations for Satellite Services, Applications, Future Trends of Satellite Communications.
ORBITAL MECHANICS AND LAUNCHERS: Orbital Mechanics, Look Angle determination, Orbital perturbations, launches and launch vehicles, Orbital effects in communication systems performance.

UNIT II

SATELLITE SUBSYSTEMS: Altitude and orbit control system, telemetry, tracking, Command and monitoring, power systems, communication subsystems, Satellite antenna Equipment reliability and Space qualification.

UNIT III

SATELLITE LINK DESIGN: Basic transmission theory, system noise temperature and G/T ratio, Design of down links, up link design, Design of satellite links for specified C/N, System design example.
MULTIPLE ACCESS: Frequency division multiple access (FDMA), Calculation of C/N. Time division Multiple Access (TDMA) Frame structure, Code Division Multiple access (CDMA), Spread spectrum transmission and reception.

UNIT IV

EARTH STATION TECHNOLOGY: Introduction, Transmitters, Receivers, Antennas, Tracking systems, Terrestrial interface, Primary power testing methods.

LOW EARTH ORBIT AND GEO-STATIONARY SATELLITE SYSTEMS: Orbit consideration, coverage and frequency considerations, Delay & Throughput considerations, System considerations, Operational NGSO constellation Designs.

UNIT V

SATELLITE NAVIGATION & THE GLOBAL POSITIONING SYSTEM: Introduction, GPS Position Location principles, Satellite signal acquisition, GPS Navigation Message, GPS receiver operation, GPS C/A code accuracy, Differential GPS.

TEXT BOOKS:

1. Satellite Communications – Timothy Pratt, Charles Bostian and Jeremy Allnutt, WSE, Wiley Publications, 2nd Edition, 2003.
2. Satellite Communications Engineering – Wilbur L. Pritchard, Robert A Nelson and Henri G.Suyderhoud, 2nd Edition, Pearson Publications, 2003.

REFERENCES:

1. Satellite Communications: Design Principles – M. Richharia, BS Publications, 2nd Edition, 2003.
2. Satellite Communication - D.C Agarwal, Khanna Publications, 5th Ed.
3. Fundamentals of Satellite Communications – K.N. Raja Rao, PHI, 2004.
4. Satellite Communications – Dennis Roddy, McGraw Hill, 2nd Edition, 1996.

Contribution of Course Outcomes towards achievement of Program Outcomes (POs) and Program Specific outcomes (PSOs) (1 – Low, 2- Medium, 3 – High)

	PO1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1	2	-	2	-	-	2	-	-	-	-	-	-	-	-
CO2	3	2	2	-	-	-	-	-	-	-	-	-	-	3
CO3	-	-	3	-	-	-	-	-	-	-	-	-	-	-
CO4	-	3	3	-	-	-	-	-	-	-	2	-	-	-
CO5	2	-	3	-	-	-	-	-	-	-	-	2	-	2
CO6	-	3	3	-	-	-	2	-	-	-	-	2	-	-

A. Satti Babu

Signature of faculty

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DEPARTMENT OF ELECTRONICS AND COMMUNICATION ENGINEERING

IV Year - I Semester **L T P C**
3 0 0 3

PROFESSIONAL ELECTIVE - V
SOFT COMPUTING TECHNIQUES

Lecture – Tutorial	3-0 Hours	**Internal Marks:**	30
Credits:	3	**External Marks:**	70

Prerequisites: Basics of Neural Networks.

Course Objectives:

1. To provide an introduction to the basic principles, techniques, and applications of soft computing.
2. To understand the basic areas of Soft Computing including Artificial Neural Networks, Fuzzy Logic and Genetic Algorithms.
3. To provide the mathematical background for carrying out the optimization associated with neural network learning.
4. To develop some familiarity with current research problems and research methods in Soft Computing by working on a research or design project.

Course Outcomes:

Upon successful completion of the course, the student will be able to:

CO1	Develop intelligent systems leveraging the paradigm of soft computing techniques.
CO2	Implement, evaluate and compare solutions by various soft computing approaches for finding the optimal solutions.
CO3	Recognize the feasibility of applying a soft computing methodology for a particular problem.
CO4	Design the methodology to solve optimization problems using fuzzy logic, genetic algorithms and neural networks.
CO5	Relate with neural networks that can learn from available examples and generalize to form appropriate rules for inference systems.
CO6	Design hybrid system to revise the principles of soft computing in various application.

Course Content(Syllabus)

UNIT I

Introduction to soft computing: Introduction, Artificial Intelligence, Artificial Neural Networks, Fuzzy Systems, Generic Algorithms And Evolutionary Programming, Swarm, Intelligent Systems, Expert Systems, Comparison Among Intelligent Systems

UNIT II

Artificial Neural Networks: Introduction to Artificial Neural Networks, Classification of ANNs, First generation neural networks, perceptron network, Adaline, Madaline, Second generation Neural networks, Back propagation neural networks, Hop field neural networks, Kohonen neural networks, Hamming neural network, radial basis function neural networks, spike neuron models

UNIT III

Fuzzy Logic System: Introduction to crisp sets and fuzzy sets, basic fuzzy set operation and approximate reasoning, Introduction to fuzzy logic modeling and control, fuzzification, inferencing and defuzzification, Fuzzy knowledge and rule bases, Fuzzy modeling and control schemes for nonlinear systems, Self-organizing fuzzy logic control, Fuzzy logic control for nonlinear time delay system.

UNIT IV

Genetic Algorithm: Basic concept of Genetic algorithm and detail algorithmic steps, Adjustment of free parameters, Solution of typical control problems using genetic algorithm, Concept on some other search techniques like Tabu search and ant D-colony search techniques for solving optimization problems.

UNIT V

Applications: GA application to power system optimization problem, Case studies: Identification and control of linear and nonlinear dynamic systems using MATLAB-Neural Network toolbox, Stability analysis of Neural Network interconnection systems, Implementation of fuzzy logic controller using MATLAB fuzzy-logic toolbox, Stability analysis of fuzzy control systems.

TEXT BOOKS:

1. Introduction to Artificial Neural Systems - Jacek.M.Zurada, Jaico Publishing House, 1999.
2. Neural Networks and Fuzzy Systems - Kosko, B., Prentice-Hall of India Pvt. Ltd., 1994.

REFERENCES:

1. Fuzzy Sets, Uncertainty and Information - Klir G.J. &Folger T.A., Prentice-Hall of India Pvt. Ltd., 1993.
2. Fuzzy Set Theory and Its Applications - Zimmerman H.J. Kluwer Academic Publishers, 1994. Introduction to Fuzzy Control - Driankov, Hellendroon, Narosa Publishers.
3. Artificial Neural Networks - Dr. B. Yagananarayana, 1999, PHI, New Delhi.
4. Elements of Artificial Neural Networks - KishanMehrotra, Chelkuri K. Mohan, Sanjay Ranka, Penram International.
5. Artificial Neural Network –Simon Haykin, 2nd Ed., Pearson Education.
6. Introduction Neural Networks Using MATLAB 6.0 - S.N. Shivanandam, S. Sumati, S. N. Deepa,1/e, TMH, New Delhi.

Contribution of Course Outcomes towards achievement of Program Outcomes (POs) and Program Specific outcomes (PSOs) (1 – Low, 2- Medium, 3 – High)

	PO1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO1	PSO2
CO1	3	3	-	-	-	-	-		-	-	-	-	-	3
CO2	3	-	2	-	-	-	-		-	-	-	-	-	3
CO3	3	3	2	2	-	-	-		-	-	-		3	-
CO4	2	3	3	3	-	-			-	-	3	-	3	-
CO5	3	-	3	-	-	-	-	3	-	-	-	-	-	3
CO6	3	3	3	3	-	-	-	3	-	-	-	-	-	3

SK. Ashraf Ali

Signature of faculty

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DEPARTMENT OF ELECTRONICS AND COMMUNICATION ENGINEERING

IV Year – I Semester **L T P C**
3 0 0 3

PROFESSIONAL ELECTIVE - V

MACHINE LEARNING

Lecture – Tutorial:	3-0 Hours	**Internal Marks:**	30
Credits:	3	**External Marks:**	70

Prerequisites: Linear algebra, Probability and statistics.

Course Objectives:

1. Able to know about data preprocessing and its uses in prediction.
2. Understands the natural language processing.
3. Able to know how linear models are learning from the data.
4. Able to understand how to Improve efficiency of the models using nonlinearity and ensembles.
5. Explain how neural networks help in increasing efficiency.

Course Outcomes:

Upon successful completion of the course, the student will be able to:

CO1	Understanding the machine learning basics and how data is preprocessed.
CO2	Understands the natural language processing.
CO3	Able to form clusters based on Distance models.
CO4	Understands the Probabilistic models.
CO5	Understands Nonlinear models and ensembles to improve efficiency.
CO6	Learn how neural network provide nonlinearity.

Course Content(Syllabus)

UNIT I

The Ingredients of Machine Learning: Introduction to Machine Learning, deep learning, applications of machine learning

Statistical learning: Introduction, supervised Learning, unsupervised Learning and Reinforcement Learning, training and Test loss, tradeoffs in statistical learning, estimating risk statistics, Empirical risk Minimization.

Models: Geometric models, Probabilistic models, Logical models, Grouping and Grading

UNIT II

Supervised Learning(regression/classification): Basic methods: Distance based methods- Distance Measures (Euclidean, Manhattan and Minkowski) Nearest Neighbours (KNN), Decision Trees

Linear Models: Binary class and multiclass classification**,** Finding minimum and maximum of a function, Gradient Descent, Linear Regression, Least Square method, Multiple Regression, **Logistic Regression** - Sigmoid function in logistic regression, Loss functions in logistic regression, Effect of Outliers and Noisy data.

Probabilistic model: Naive Bayes algorithm for classification, Laplace smoothing .

.

UNIT III

Ensemble Learning and Random Forest: Introduction, Random Forest, bagging, Boosting, Stacking, Overfitting and Underfitting models, K-fold cross validation, confusion matrix

Support Vector Machine (SVM): Linear SVM Classification, Non Linear SVM Classification

UNIT IV

Unsupervised Learning Techniques: Clustering, K-Means, Limits of K-Means, DBSCAN, Hierarchical Clustering, Agglomerative Clustering

Dimensionality Reduction: The Curse of Dimensionality, Main Approaches for Dimensionality Reduction ,Principal Component Analysis (PCA), Implementation and demonstration.

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DEPARTMENT OF ELECTRONICS AND COMMUNICATION ENGINEERING

UNIT V

Artificial Neural Networks: Introduction, Neural network representation, training a single and Multilayer networks, MLPs and Back propagation chain rule, Epochs, Batch Normalization **Activation functions –** sigmoid, Tanh, ReLu, **Optimizers –** GD,SGD.

TEXT BOOKS:

1. Machine Learning: The art and science of algorithms that make sense of data, Peter Flach, Cambridge.
2. Machine Learning, Tom M. Mitchell, MGH.
3. Introduction to Machine Learning - Nils J. Nilsson, Standford University

REFERENCES:

1. Understanding Machine Learning: From Theory to Algorithms, Shai Shalev-Shwartz, Shai Ben- David, Cambridge.
2. Machine Learning in Action, Peter Harington, 2012, Cengage.

Contribution of Course Outcomes towards achievement of Program Outcomes (POs) and Program Specific outcomes (PSOs) (1 – Low, 2- Medium, 3 – High)

	PO1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PS O2
CO1	1	-	2	3	3	-	-	-	-	-	-	-	1	2
CO2	-	-	2	2	2	-	-	-	-	-	-	-	-	2
CO3	-	-	2	3	1	-	-	-	-	-	-	-	-	1
CO4	2	-	3	1	1	-	-	-	-	-	-	-	-	3
CO5	2	-	1	2	2	-	-	-	-	-	-	-	2	-
CO6	1	--	2		2	-	-	-	-	-	-	-	-	2

SK. Ashraf Ali
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DEPARTMENT OF ELECTRONICS AND COMMUNICATION ENGINEERING

IV Year - I Semester **L T P C**
3 0 0 3

PROFESSIONAL ELECTIVE - V

MOBILE AND CELLULAR COMMUNICATIONS

Lecture – Tutorial:	3-0 Hours	**Internal Marks:**	30
Credits:	3	**External Marks:**	70

Prerequisites: Analog Communications, Digital Communications.

Course Objectives: Students will be able to:

- To understand cellular communication system block diagram, functioning, various cellular mobile standards.
- To acquire Knowledge on Cellular concept, Frequency reuse, Hand-off strategies, cell splitting, cell sectoring, Cellular structures.
- To know the different co-channel and non co-channel interference methods.
- To understand the concept of frequency management, Channel assignment with fixed and non-fixed channels.
- 5. To distinguish the multiple access techniques FDMA, TDMA, CDMA and OFDMA.

Course Outcomes:

Upon successful completion of the course, the student will be able to:

CO1	Demonstrate an understanding on cellular communication system, architecture, functioning, various standards and different evolution of cellular communication systems up to 5G.
CO2	Measure Co-Channel and Non-Co-Channel interferences for various mobile radio propagation models and interpret the C/I measurements for different antenna systems.
CO3	Design frequency management chart and need for self-location scheme at the mobile unit.
CO4	Compare different channel assignments, Channel sharing and Channel borrowing techniques.
CO5	Design the Omni-directional and directional antennas used at cell sites and their synthesis methods.
CO6	Demonstrate the fundamental techniques to assign a handoff without termination of call, different multiple accessing methods.

Course Content (Syllabus)

UNIT I

Introduction to Cellular Mobile Systems: Introduction to Cellular Mobile System, uniqueness of mobile radio environment, operation of cellular systems, consideration of the components of Cellular system, Hexagonal shaped cells, Analog and Digital Cellular systems.

Elements of Cellular Mobile Radio System Design: Concept of frequency reuse channels: Frequency reuse schemes, Frequency reuse distance, Number of customers in the system, Permanent and Dynamic cell splitting, cell sectoring, Cellular structures: macro, micro, pico and femto cells.

UNIT II

Interference: Co-channel Interference at the mobile unit and cell site, Design of Omni- directional and Directional antenna systems. Non-co channel Interference: Adjacent channel interference: Next channel interference, Neighboring channel interference, Near-End-Far-End Interference.

Cell Coverage for Signal and Traffic: Signal reflections in flat and hilly terrain, obtaining the mobile point-to-point model (Lee Model), Phase difference between direct and ground reflected paths, General formula for mobile radio propagation between two fixed stations over water or flat open area, Land to mobile transmission over water, Foliage loss.

UNIT III

Frequency Management: Numbering the channels and grouping into subsets, Frequency spectrum utilization, Setup, access and paging channels, Self-location scheme at the mobile unit.

Channel Assignment: Channel assignments to cell sites and travelling mobile units, Fixed channel assignment: Adjacent-channel assignment, Channel sharing, Channel borrowing and Underlay-overlay cells, non-fixed channel assignment algorithms.

UNIT IV

Cell Site and Mobile Antennas: Sum and difference patterns and their synthesis, Antennas at cell site: Omni directional and Directional antennas: Start-up and Abnormal antenna configurations, Space diversity antennas, Umbrella pattern antennas, unique situations of cell site antennas, Mobile antennas: Roof-mounted and Glass-mounted antennas, Mobile high gain antennas, horizontally oriented and vertically oriented space-diversity antennas.

UNIT V

Handoff and Dropped calls: Concept of Handoff, Types of handoffs: Based on signal strength and based on carrier to interference Ratio, Handoff initiation, Delaying handoff, Forced handoff, Power-difference handoff, mobile assigned handoff, soft and hard handoff, cell site handoff only, Intersystem handoff, Dropped call rates- introduction and formula for Dropped call rate.

Digital Cellular Systems: Global System for Mobile (GSM): GSM architecture, OSI model of GSM, GSM channels, Multiple Access schemes: FDMA, TDMA CDMA, OFDMA, concepts of LTE and LTE-advanced standards, 5G & 6G features and challenges.

TEXT BOOKS:

1. Mobile Cellular Telecommunications – W.C.Y. Lee, Tata McGraw Hill, 2rd Edn, 2006.
2. Mobile cellular communication- G. Sasibhushan Rao, Pearson Education.

REFERENCES:

1. Principles of Mobile Communications–Gordon L. Stuber, Springer International 2nd Edt. 2007.
2. Wireless Communications – Theodore. S. Rapport, Pearson education, 2nd Edn., 2002.
3. Wireless Communication and Networking – Jon W. Mark and Weihua Zhqung, PHI, 2005.
4. Wireless Communication Technology – R. Blake, Thompson Asia Pvt. Ltd., 2004.
5. Wireless and Mobile Communications – Lee McGraw Hills, 3rd Edition, 2006.

Contribution of Course Outcomes towards achievement of Program Outcomes (POs) and Program Specific outcomes (PSOs) (1 – Low, 2- Medium, 3 – High)

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1	3	-	-	-	-	-	1	-	-	2	-	-	3	-
CO2	3	2	3	1	-	-	-	-	-	2	-	2	3	2
CO3	3	1	2	1	-	-	-	-	-	1	-	1	3	1
CO4	3	-	1	1	-	-	-	-	-	-	-	-	3	-
CO5	-	-	-	-	2	-	2	-	1	3	2	2	-	-
CO6	-	1	2	-	1	-	1	-	-	2	1	1	-	1

Dr. S.V. Ramarao
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DEPARTMENT OF ELECTRONICS AND COMMUNICATION ENGINEERING

IV Year - I Semester **L T P C**
0 0 1 1

MICROWAVE AND RF COMMUNICATIONS

(Skill Course)

Lecture – Tutorial:	3-0 Hours	**Internal Marks:**	30
Credits:	3	**External Marks:**	70

Prerequisites: Transmission Lines, Electromagnetic Field Theory.

Course Objectives:

- Measure the parameters using microwave components.
- Analyze the generation and propagation of microwaves in waveguides.
- Evaluate scattering parameters of different microwave junctions.
- Determine characteristic parameters of Microwave Sources

Course Outcomes:

Upon successful completion of the course, the student will be able to:

CO1	Describe the microwave bench set-up with different blocks and their features.
CO2	Determine the measurements of microwave power, attenuation, frequency, VSWR and impedance.
CO3	Understand Wave guide parameter measurements.
CO4	Understand the types of cavity resonators and determine the dominant mode.
CO5	Analyze the waveguide multiport junctions.
CO6	Understand the velocity modulation process and power output in Reflex Klystron.

Course Content(Syllabus)

UNIT I

Microwave Sources, and Components-Microwave Bench Setup or Experimental arrangement for Microwave Communication.

List of Experiments:

1. Introduction and identification of microwave components.
2. Demonstration of Microwave Bench setup.

UNIT II

Microwave Devices-VSWR meter, Precision Frequency Meter, Microwave Power Supply (KLYSTRON and GUNN Power supplies), and Power Meter.

List of Experiments:

1. Calibration of VSWR meter, Precision Frequency Meter and Power Meter.
2. Demonstration & Calibration of Microwave Power supplies.

UNIT III

Characteristics of Microwave and Optical Sources, frequency bands for Microwave and Optical communications.

List of Experiments:

1. Study of the characteristics of Klystron tube and to determine its electronic tuning range.
2. Study of following characteristics of Gunn Diode.

a) Output power and frequency as a function of voltage.
b) Square wave modulation through PIN diode.

3. LED Characteristics.
4. LASER diode Characteristics.

UNIT IV

Microwave Passive components: Directional Coupler, Wave-guide T-Junctions, Magic Tee, Attenuator, Circulator, Isolator.

List of Experiments:

1. Determine the frequency & wavelength in a rectangular waveguide working in TE10 mode.
2. Study of function of multi hole directional coupler by measuring the following parameters:
a) Insertion Loss
b) Coupling factor and directivity.
3. Determine the standing wave ratio and reflection coefficient of a given Microwave Component.
4. Measurement of Attenuation of a given Attenuator.
5. Measure S-Parameters of Magic Tee Junction.
6. Measure Input VSWR, Insertion loss of circulator.

UNIT V

Introduction to Radio Receivers, Frequency Bands, Applications, Introduction to spectrum Analyzer, Frequency Range, Applications.

List of Experiments:

1. Introduction to spectrum analyser and measurement of spectrum of given signal using the same.
2. Demonstration of antenna radiation parameters

TEXT BOOKS:

1. Microwave Devices and Circuits – Samuel Y. Liao, PHI, 3rd Edition,1994.
2. Dennis Roddy - Microwave Technology, PHI.
3. Annapurna Das, Sisir K.Das- Microwave engineering, (TMG).

REFERENCES:

1. Foundations for Microwave Engineering – R.E. Collin, IEEE Press, John Wiley, 2nd Edition, 2002.
2. Microwave Engineering -David M. Pozar,Wiley publications,4th Edition.
3. Microwave Principles – Herbert J. Reich, J.G. Skalnik, P.F. Ordung and H.L. Krauss, CBS Publishers and Distributors, New Delhi.

Contribution of Course Outcomes towards achievement of Program Outcomes (POs) and Program Specific outcomes (PSOs) (1 – Low, 2- Medium, 3 – High)

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1	2	2	-	2	-	-	-	-	-	-	-	-	2	2
CO2	2	2	-	2	-	-	-	-	2	2	-	-	2	2
CO3	3	3	-	-	-	-	-	-	2	2	2	-	3	3
CO4	3	3	-	2	-	-	-	-	2	-	2	-	3	3
CO5	2	2	-	2	-	-	-	-	-	-	2	-	2	2
CO6	-	2	-	2	-	-	-	-	-	2	-	-	-	2

Dr. S. A. Rahiman
Signature of faculty

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DEPARTMENT OF ELECTRONICS AND COMMUNICATION ENGINEERING

IV Year - I Semester **L T P C**
2 0 0 0

EMPLOYABILITY SKILLS
(Mandatory Course)

Lecture – Tutorial:	2-0 Hours	**Internal Marks:**	30
Credits:	0	**External Marks:**	70

Prerequisites: None

Course Objectives: The students will be able

- To learn skills for discussing and resolving problems on the work site.
- To assess and improve personal grooming EMPLOYABILITY.
- To promote safety awareness including rules and procedures on the work site.
- To develop and practice self management skills for the work site.
- Students will be introduced to various Arithmetic and Reasoning Problems.

Course Outcomes:

Upon successful completion of the course, the student will be able to:

CO1	Recite the corporate etiquette.
CO2	Make presentations effectively with appropriate body language.
CO3	Be composed with positive attitude.
CO4	Apply their core competencies to succeed in professional and personal life.
CO5	Solve the Arithmetic and Reasoning Problems as fast as possible and as simple as possible. Exhibits good analytical skills and aptitude skills.
CO6	Perform well in all competitive exams like RRB, SSC, GROUPS, and BANKING and clear the aptitude section of exams for higher education like CAT, GMAT, and GRE etc…

Course Content(Syllabus)

UNIT I

COMMUNICATION SKILLS:
Types of Communication – Verbal Communication – Hierarchy of Communication, Upward, Downward, Horizontal, Vertical; Non-Verbal Communication – Kinesics – Proximics – Haptics – Vocalics (Paralanguage) Physiological changes, facial expression, Handshake.

UNIT II

SOFT SKILLS :
Interpersonal Communication – Adaptability – Stress Management, Time Management, Leadership Skills, Goal Setting, Conflict Resolution, Team Building and Team Work.
Intrapersonal Communication – Self Confidence, Resilience, Self Discipline, Empathy, Attitude, Motivation, Emotional Intelligence and Social Skills.
Etiquettes - Social Etiquette, Telephone Etiquette, Dining Etiquette and Business Etiquette.

UNIT III

PERCENTAGES: Basics of Percentages, Percentage Change, Simple Interest and Compound Interest Data Arrangements – Linear, Circular and Multi Dimensional Arrangements.

UNIT IV

NUMBER SYSTEM: Classification of Numbers, Divisibility Rules, Factors and Multiples, Power Cycle and Remainder Cycle method, LCM & HCF, Coding & Decoding, Alphabet & Number Series.

UNIT V

TECHNICAL WRITING: Resume and Cover Letter, Types of Letters, Email Writing, Agenda and Minutes of Meeting, Memo and Report Writing.

TEXT BOOKS:

1. Barun K. Mitra, Personality Development and Soft Skills, Oxford University Press, 2011.
2. APTIPEDIA, WILEY.
3. Quantitative Aptitude, RS AGARWAL, S.Chand Publishers.

REFERENCES:

1)Rizvi Ashraf M, Effective Technical Communication, Tata Mc Graw - Hill, 2007.
2)Raman Meenakshi & Sangeeta Sharma, Technical Communication – Principles and Practice, Oxford University Press, 2011.
3)Bhatnagar Nitin & Bhatnagar Mamata, Effective Communication & Soft Skills – Strategies for Success, Pearson Publishers, 2011.
4) Mitra Barun, Personality Development & Soft Skills, Oxford University Press, 2016.
5)Rao M.S, Soft Skills-Enhancing Employability; Connecting Campus with Corporate, IK International Publishing House Pvt. Ltd, 2010.
6) HOW TO PREPARE FOR Quantative Aptitude, ARUN SHARMA, Mc GRAW HILL.
E-RESOURCES For Aptitude.
Indiabix.
Faceprep.

Contribution of Course Outcomes towards achievement of Program Outcomes (POs) and Program Specific outcomes (PSOs) (1 – Low, 2- Medium, 3 – High)

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1	2	-	-	3	-	-	2	-	-	2	-	2	2	-
CO2	-	-	-	3	-	-	-	-	2	-	-	-	-	-
CO3	-	3	-	-	-	2	-	-	-	3	-	-	-	3
CO4	-	-	-	3	-	-	-	-	2	3	-	2	2	-
CO5	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CO6	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Dr. T. Sreelatha
Signature of faculty

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DEPARTMENT OF ELECTRONICS AND COMMUNICATION ENGINEERING

IV Year - I Semester **L T P C**
3 0 0 3

ENVIRONMENTAL PROJECT MANAGEMENT
(Open Elective)

Lecture – Tutorial:	3-0 Hours	**Internal Marks:**	30
Credits:	3	**External Marks:**	70

Prerequisites:

Course Objectives:

- Acquire knowledge about steps involved in project management.
- Advantages of Network analysis by understanding the elements.
- Methods of project management – PERT & CPM.
- Cost Management and optimization.

Course Outcomes:

Upon successful completion of the course, the student will be able to:

CO1	Attain knowledge on planning and scheduling of various projects.
CO2	Learn and apply the knowledge of Networks in project planning.
CO3	Analysis by PERT.
CO4	Analysis by CPM.
CO5	Optimization of the cost.
CO6	Evaluation of the project by using various methodologies.

Course Content(Syllabus)

UNIT I

PROJECT MANAGEMENT: Introduction, objectives of Project Planning, Scheduling, controlling, role of decision in project management, methods of planning and programming – bar charts and milestone charts.

UNIT II

PROJECT MANAGEMENT THROUGH NETWORKS: Objectives of network techniques, Fundamentals of network analysis, Events, Activities, Dummies, Networks Rules, Numbering the events, Cycles, Steps in development of Network.

UNIT III

PROGRAM EVALUATION AND REVIEW TECHNIQUE (PERT): Introduction, Time estimates, Earliest expected time, Latest allowable occurrence time, Slack, Critical path, Probability of completion time for a project.

UNIT IV

CRITICAL PATH METHOD (CPM): Introduction, Difference between CPM and PERT, Earliest event time, Latest event time, Activity time, Float, Critical activities and critical path.

UNIT V

COST CONTROL: Direct cost, Indirect cost, Total project cost, Optimization of cost through networks, Steps involved in optimization of cost.

TEXT BOOKS:

1. Project Planning and control with PERT and CPM by Dr B.C.Punmia and K.K.Khandelwal.
2. Bhattacharjee, S.K. Fundamentals of PERT/CPM and Project Management,Khanna, NDLS, 1996.

REFERENCES:

1. PERT & CPM Principles and applications by L. S. Srinath; Affiliated East West Press.
2. Construction Management & Planning by B. Sengupta& H. Guha; Tata Mc Graw – Hill Publishing Co. Ltd., New Delhi.

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	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1	2	2	2	2	-	-	-	-	-	-	-	2	-	-
CO2	2	2	2	2	-	-	-	-	-	-	-	2	-	-
CO3	2	2	2	2	-	-	-	-	-	-	-	2	-	-
CO4	2	2	2	2	-	-	-	-	-	-	-	2	-	-
CO5	2	2	2	2	-	-	-	-	-	-	-	2	-	-
CO6	2	2	2	2	-	-	-	-	-	-	-	-	-	-

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DEPARTMENT OF ELECTRONICS AND COMMUNICATION ENGINEERING

IV Year - I Semester **L T P C**
3 0 0 3

DATABASE MANAGEMENT SYSTEMS

(Open Elective)

Lecture – Tutorial:	3-0 Hours	**Internal Marks:**	30
Credits:	3	**External Marks:**	70

Prerequisites: C- Programming.

Course Objectives:

- To understand the basic concepts and the applications of database systems.
- To learn and practice data modelling using the entity-relationship and developing database designs.
- To master the basics of SQL and construct queries using SQL.
- To apply normalization techniques to normalize the database.
- To understand the needs of database processing and learn techniques for controlling the consequences of concurrent data access.
- To learn the concepts of transaction management and how they provide security and consistency.
- To topics include data models, database design, relational model, relational algebra, transaction control, concurrency control, storage structures and access techniques.

Course Outcomes:

Upon successful completion of the course, the student will be able to:

CO1	Ability to define, understand the database management system structure.
CO2	Ability to apply as relational algebra to find solutions to a broad range of queries.
CO3	Ability to create applications using various normal forms, functional dependencies, validating and identifying anomalies.
CO4	Will be able to explain the principle of transaction management design.
CO5	Understands and applies indexing mechanisms in databases.
CO6	

Course Content(Syllabus)

UNIT I

DATABASE SYSTEM APPLICATIONS:

Database System Applications, Purpose of Database Systems, File Systems versus a DBMS**,** View of Data – Data Abstraction, Instances and Schemas, Data Models, Data Independence, Database Users and Administrators, Structure of a DBMS.

INTRODUCTION TO DATABASE DESIGN:

Database Design and ER Diagrams, Entities, Attributes, and Entity Sets, Relationships and Relationship Sets, Additional Features of the ER Model, Conceptual Design With the ER Model.

UNIT II

INTRODUCTION TO THE RELATIONAL MODEL:

Integrity constraint over relations, enforcing integrity constraints, querying relational data, logical data base design, introduction to views, Destroying/altering tables and views.

RELATIONAL ALGEBRA AND CALCULUS:

Relational Algebra – Selection and Projection, Set operations,Renaming, Joins,Division,Examples of Algebra Queries, Relational calculus – Tuple relationalCalculus – Domain relational calculus.

UNIT III

SQL: QUERIES, CONSTRAINTS, TRIGGERS:

Form of basic SQL query, UNION, INTERSECT, and EXCEPT, Nested Queries, aggregation operators, NULL values, complex integrity constraints in SQL, Triggers and active data bases.

SCHEMA REFINEMENT:

Problems caused by redundancy, decompositions, problems related to decomposition, reasoning about functional dependencies, FIRST, SECOND, THIRD normal forms, BCNF, lossless join decomposition, multi-valued dependencies, FOURTH normal form, FIFTH normal Form.

UNIT IV

OVERVIEW OF TRANSACTION MANAGEMENT:

The ACID Properties, Transactions and Schedules, Concurrent Execution of Transactions – Lock Based Concurrency Control, Deadlocks –Performance of Locking – Transaction Support in SQL.

CONCURRENCY CONTROL:

Serializability, and recoverability – Introduction to Lock Management – Lock Conversions, Dealing with Dead Locks, Specialized Locking Techniques – Concurrency Control without Locking.

CRASH RECOVERY:

Introduction to Crash recovery, Introduction to ARIES, the Log, and Other Recovery related Structures, the Write-Ahead Log Protocol, Check pointing, recovering from a System Crash, Media recovery.

UNIT V

OVERVIEW OF STORAGE AND INDEXING:

Data on External Storage, File Organization and Indexing, Cluster Indexes, Primary and Secondary Indexes, Index data Structures, Hash Based Indexing, Tree base Indexing, Comparison of File Organizations, Indexes and Performance Tuning, Intuitions for tree Indexes, Indexed Sequential Access Methods (ISAM), B+ Trees: A Dynamic Index Structure.

TEXT BOOKS:

- Data base Management Systems, Raghu Ramakrishnan, Johannes Gehrke, TMH, 3rd Edition,2003.
- Data base System Concepts, A.Silberschatz, H.F. Korth, S.Sudarshan,McGraw hill, VI edition,2006.
- 3. Fundamentals of Database Systems 5th edition., Ramez Elmasri, Shamkant .Navathe,Pearson Education,2008.

REFERENCES:

1. Database Systems design, Implementation, and Management, Peter Rob & Carlos Coronel 7th Edition.
2. Fundamentals of Database Systems, Elmasri Navrate, *Pearson Education.*
3. Introduction to Database Systems, C. J. Date, *Pearson Education.*
4. Oracle for Professionals, The X Team, S.Shah and V. Shah, *SPD.*
5. Database Systems Using Oracle: A Simplified guide to SQL and PL/SQL,Shah, *PHI.*
6. Fundamentals of Database Management Systems, M. L. Gillenson, *Wiley Student* Edition.

e-Resources:

1.https://www.javatpoint.com/dbms-tutorial

2.https://www.tutorialspoint.com/dbms/index.htm

3.https://www.geeksforgeeks.org/dbms/

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CO4	2	2	3	-	2	2	-	-	-	-	2	3	2	2
CO5	3	3	3	-	2	3	-	-	-	-	2	2	2	2
CO6	2	2	2	-	2	-	-	-	-	-	-	2	2	2

Signature of faculty

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DEPARTMENT OF ELECTRONICS AND COMMUNICATION ENGINEERING

IV Year - I Semester **L T P C**
3 0 0 3

Universal Human Values

(HSE)

Lecture – Tutorial:	3-0 Hours	**Internal Marks:**	30
Credits:	3	**External Marks:**	70

Prerequisites: None

Course Objectives: The students will be able

- To help the student to see the need for developing a holistic perspective of life.
- To sensitize the student about the scope of life – individual, family (inter-personal relationship), society and nature/existence strengthening self-reflection.
- To develop more confidence and commitment to understand, learn and act accordingly.

Course Outcomes:

Upon successful completion of the course, the student will be able to:

CO1	Describe more aware of themselves, and their surroundings (family, society, nature.)
CO2	Illustrate more responsibility in life, and in handling problems with sustainable solutions, while keeping human relationships and human nature in mind.
CO3	Show better critical ability.
CO4	Exhibit sensitivity to their commitment towards what they have understood (human values, human relationship and human society).
CO5	Apply what they have learnt to their own self in different day-to-day settings in real life, at least a beginning would be made in this direction.

Course Content(Syllabus)

UNIT I

Introduction - Need, Basic Guidelines, Content and Process for Value Education: pose and motivation for the course, recapitulation from Universal Human Values-I, Self-Exploration–what is it? - Its content and process; 'Natural Acceptance' and Experiential Validation- as the process for self- exploration, Continuous Happiness and Prosperity- A look at basic Human Aspirations, Right understanding, Relationship and Physical Facility- the basic requirements for fulfilment of aspirations of every human being with their correct priority, Understanding Happiness and Prosperity correctly- A critical appraisal of the current scenario, Method to fulfil the above human aspirations: understanding and living in harmony at various levels

UNIT II

Understanding Harmony in the Human Being - Harmony in Myself! Understanding human being as a co-existence of the sentient 'I' and the material 'Body', Understanding the needs of Self ('I') and 'Body' - happiness and physical facility, Understanding the Body as an instrument of 'I' (I being the doer, seer and enjoyer),Understanding the characteristics and activities of 'I' and harmony in 'I', Understanding the harmony of I with the Body: Sanyam and Health; correct appraisal of Physical needs, meaning of Prosperity in detail, Programs to ensure Sanyam and Health

UNIT III

Understanding Harmony in the Family and Society- Harmony in HumanHuman Relationship: Understanding values in human-human relationship; meaning of Justice (nine universal values in relationships) and program for its fulfilment to ensure mutual happiness; Trust and Respect as the foundational values of relationship. Understanding the meaning of Trust; Difference between intention and competence, Understanding the meaning of Respect,Difference between respect and differentiation; the other salient values in relationship, Understanding the harmony in the society (society being an

extension of family): Resolution, Prosperity, fearlessness (trust) and co- existence as comprehensive Human Goals, Visualizing a universal harmonious order in society- Undivided Society, Universal Order- from family to world family

UNIT IV

Understanding Harmony in the Nature and Existence - Whole existence as Coexistence: Understanding the harmony in the Nature, Interconnectedness and mutual fulfilment among the four orders of nature- recyclability and self regulation in nature, Understanding Existence as Co-existence of mutually interacting units in all- pervasive space, Holistic perception of harmony at all levels of existence

UNIT V

Implications of the above Holistic Understanding of Harmony on Professional Ethics: Natural acceptance of human values, Definitiveness of Ethical Human Conduct, Basis for Humanistic Education, Humanistic Constitution and Humanistic Universal Order, Competence in professional ethics: Ability to utilize the professional competence for augmenting universal human order b. Ability to identify the scope and characteristics of people friendly and eco-friendly production systems, c. Ability to identify and develop appropriate technologies and management patterns for above production systems. Case studies of typical holistic technologies, management models and production systems, Strategy for transition fromthe present state to Universal Human Order: a. At the level of individual: as socially and ecologically responsible engineers, technologists and managers b. At the level of society: as mutually enriching institutions and organizations

TEXT BOOKS:

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

REFERENCES:

1. JeevanVidya: Ek Parichaya by A Nagaraj, Jeevan Vidya Prakashan, Amarkantak, 1999.
2. HumanValues by A.N.Tripathi,New Age Intl.Publishers,NewDelhi,2004.
3. The Story of Stuff (Book).
4. The Story of My Experiments with Truth – by Mohandas Karam chand Gandhi

Contribution of Course Outcomes towards achievement of Program Outcomes (POs) and Program Specific outcomes (PSOs) (1 – Low, 2- Medium, 3 – High)

	PO1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO2
CO1	--	--	--	--	--	2	--	2	--	--	--	--	--	--
CO2	--	--	--	--	--	2	--	2	--	--	--	--	--	--
CO3	--	--	--	--	--	2	--	2	--	--	--	--	--	--
CO4	--	--	--	--	--	2	--	2	--	--	--	--	--	--
CO5	--	--	--	--	--	2	--	2	--	--	--	--	--	--

Signature of Faculty

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DEPARTMENT OF ELECTRONICS AND COMMUNICATION ENGINEERING

OPEN ELECTIVES NRIA20 REGULATION

S.No	Name of the Course	L – T - P	Credits
1	IoT & Applications	3 – 0 - 0	3
2	Image Processing	3 – 0	3
3	Bio Medical Mechanisms	3 – 0	3
4	Transducers and Sensors	3 – 0	3
5	Industrial Electronics	3 – 0	3
6	Micro Processors and Applications	3 – 0	3
7	Principles of Communications	3 – 0	3
8	IC Applications	3 – 0	3

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DEPARTMENT OF ELECTRONICS AND COMMUNICATION ENGINEERING

Open Elective **L T P C**
3 0 0 3

IoT & APPLICATIONS

Lecture – Tutorial:	3-0 Hours	**Internal Marks:**	30
Credits:	3	**External Marks:**	70

Prerequisites: Embedded Systems, Microcontrollers, Operating Systems, Programming.

Course Objectives:

- To understand Smart Objects and IoT architecture.
- To introduce the concept of M2M (machine to machine) with necessary protocols.
- To acquaint with the various security concepts in IoT architecture.
- To build simple IOT system using Arduino and Raspberry PI platform.
- To understand data analytics and cloud in the context of IOT.

Course Outcomes:

Upon successful completion of the course, the student will be able to:

CO1	Summarize on the term 'internet of things' in different contexts and to learn about Internet of Things with the help of Arduino and Raspberry Pi.
CO2	Comprehend and analyze Software defined networks.
CO3	Acquire knowledge to interface sensors and actuator with microcontroller based Arduino platform.
CO4	Understand the communication between microcontroller and pc using serial communication and to analyze various protocols for IoT.
CO5	Apply data analytics and use cloud offerings related to design and develop a solution for a given application using APIs and test for errors in the application.
CO6	Implement real field problem by gained knowledge of Industrial applications with IoT capability.

Course Content(Syllabus)

UNIT I

INTRODUCTION TO IOT: Introduction to IoT, Architectural Overview, Design principles and needed capabilities, Basics of Networking, M2M and IoT Technology Fundamentals- Devices and gateways, Role of Cloud in IoT, Security aspects in IoT, Elements of IoT Hardware Components- Computing- Arduino, Raspberry Pi.

UNIT II

IOT and M2M: Software defined networks, Network Function Virtualization, Difference between SDN and NFV for IOT, Basics of IOT system management with NETCONF, YANG-NETCONF, YANG, NETOPEER.

UNIT III

IOT APPLICATION DEVELOPMENT: Communication, IoT Applications, Sensing, Actuation, I/O interfaces. Software Components- Programming API's (using Python/Node.js/Arduino) for Communication Protocols-MQTT, ZigBee, CoAP, UDP, TCP, Bluetooth overview, Bluetooth Key Versions, Bluetooth Low Energy (BLE) Protocol, Bluetooth, Low Energy Architecture, PSoC4 BLE architecture and Component Overview.

UNIT IV

CLOUD ANALYTICS FOR IOT APPLICATION: Introduction to cloud computing, Difference between Cloud Computing and Fog Computing: The Next Evolution of Cloud Computing, Role of Cloud Computing in IoT, Connecting IoT to cloud, Cloud Storage for IoT Challenge in integration of IoT with Cloud.

IOT CASE STUDIES: IoT case studies and mini projects based on Industrial automation, Transportation, Agriculture, Healthcare, Home Automation.

UNIT V

INTRODUCTION TO INDUSTRY 4.0 AND II0T: Defining Industry 4.0, Characteristics of Industry 4.0, and Benefits to Business, Industry 4.0 Design Principles, and Building blocks of Industry 4.0, Industry 4.0 Reference Architecture, and Smart Factories.

CONCEPT OF 5G TECHNOLOGY: A New Step to IOT Platform.

TEXT BOOKS:

1. Raj Kamal, "Internet of Things: Architecture and Design Principles", 1st Edition, McGraw HillEducation, 2017.
2. The Definitive Guide to the ARM Cortex-M0 byJosephYiu,2011
3. Vijay Madisetti, Arshdeep Bahga, Internet of Things, "A Hands on Approach", University Press, 2015.

REFERENCES:

1. Cypress Semiconductor/PSoC4BLE (Bluetooth Low Energy) Product Training Modules.
2. Pethuru Raj and AnupamaC.Raman,"The Internet of Things:EnablingTechnologies,Platforms, and Use Cases", CRC Press,2017.

Contribution of Course Outcomes towards achievement of Program Outcomes (PO) and Program Specific outcomes (PSO)
(1 – Low, 2- Medium, 3 – High)

	PO1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO1	PSO2
CO1		2	3		2		2	3	2	3	2	2	2	
CO2				3									3	
CO3			3											3
CO4	3									2				
CO5											3		2	
CO6												3	2	

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DEPARTMENT OF ELECTRONICS AND COMMUNICATION ENGINEERING

Open Elective **L T P C**
3 0 0 3

IMAGE PROCESSING

Lecture – Tutorial:	3-0 Hours	**Internal Marks:**	30
Credits:	3	**External Marks:**	70

Prerequisites: Mathematics I & II, Engineering Physics, Linear integrated circuits, Signals and Systems, Analog Communications, Digital Signal Processing.

Course Objectives:

- To introduce the concepts of image processing and basic analytical methods to be used in image processing.
- To familiarize students with image enhancement.
- To introduce different image restoration techniques.
- To introduce the concepts of colour image processing.
- To familiarize the students with image compression techniques.
- To introduce morphological processing and segmentation techniques.

Course Outcomes:

Upon successful completion of the course, the student will be able to:

CO1	Understand the fundamentals of image processing, necessity for transforms, DFT and its properties, DCT.
CO2	Evaluate techniques for image enhancement.
CO3	Estimate the degradation of an image and apply appropriate restoration techniques.
CO4	Understand the need for colour image processing and learn the fundamentals of colour image processing.
CO5	Understand the need for image compression and learn different techniques to compress image.
CO6	Interpret morphological processing and implement different techniques to segment an image.

Course Content(Syllabus)

UNIT I

INTRODUCTION: Introduction to Image Processing, Fundamental steps in digital image processing, components of an image processing system, image sensing and acquisition, image sampling and quantization, some basic relationships between pixels, an introduction to the mathematical tools used in digital image processing.

IMAGE TRANSFORMS: Need for image transforms, Discrete Fourier transform (DFT) of one variable, Extension to functions of two variables, some properties of the 2-D Discrete Fourier transform.

UNIT II

INTENSITY TRANSFORMATIONS AND SPATIAL FILTERING: Background, Some basic intensity transformation functions, histogram processing, fundamentals of spatial filtering, smoothing spatial filters , sharpening spatial filters, Combining spatial enhancement methods

FILTERING IN THE FREQUENCY DOMAIN: Preliminary concepts, The Basics of filtering in the

frequency domain, image smoothing using frequency domain filters, Image Sharpening using frequency domain filters, Selective filtering

UNIT III

IMAGE RESTORATION AND RECONSTRUCTION: A model of the image degradation / Restoration process, Noise models, restoration in the presence of noise only-Spatial Filtering, Periodic Noise Reduction by frequency domain filtering, Linear, Position –Invariant Degradations, Estimating the degradation function, Inverse filtering, Minimum mean square error (Wiener) filtering.

IMAGE COMPRESSION: Fundamentals, Basic compression methods: Huffman coding, Golomb coding, Arithmetic coding, LZW coding, Run-Length coding, Symbol-Based coding, Bit-Plane coding, Block Transform coding, Predictive coding

UNIT IV

MORPHOLOGICAL IMAGE PROCESSING: Preliminaries, Erosion and dilation, opening and closing, basic morphological algorithms for boundary extraction, thinning, gray-scale morphology

IMAGE SEGMENTATION: Fundamentals, point, line, edge detection, thresholding, region –based segmentation.

UNIT V

COLOR IMAGE PROCESSING: color fundamentals, color models, pseudo color image processing, basics of full color image processing, color transformations, smoothing and sharpening. Image segmentation based on color, noise in color images, color image compression.

TEXT BOOKS:

1. R. C. Gonzalez and R. E. Woods, Digital Image Processing, 3rd edition, Prentice Hall, 2008.
2. 2. Jayaraman, S. Esakkirajan, and T. Veerakumar," Digital Image Processing", Tata McGraw-Hill Education, 2011.

REFERENCES:

1. Anil K.Jain, "Fundamentals of Digital Image Processing", Prentice Hall of India, 9th Edition, Indian Reprint, 2002.
2. B.Chanda, D.Dutta Majumder, "Digital Image Processing and Analysis", PHI, 2009.

Contribution of Course Outcomes towards achievement of Program Outcomes (PO) and Program Specific outcomes (PSO)
(1 – Low, 2- Medium, 3 – High)

	PO1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO1	PSO2
CO1	2	3	2	2								2		3
CO2	2	3												3
CO3	2	3		3										2
CO4	3		2										2	
CO5	3		2											
CO6	2	2										2	3	

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DEPARTMENT OF ELECTRONICS AND COMMUNICATION ENGINEERING

Open Elective **L T P C**
3 0 0 3

BIOMEDICAL MECHANISMS

Lecture – Tutorial:	3-0 Hours	**Internal Marks:**	30
Credits:	3	**External Marks:**	70

Prerequisites: Basics of instrumentation.

Course Objectives:

- To explain the importance of various sources of bio-electric potentials in human body.
- To enhance the knowledge of various electrodes and transducers used for measuring bioelectrical potentials.
- To familiarize mechanisms of cardiovascular and respiratory systems and their measuring equipments.
- To introduce elements of patient care & monitoring system and various therapeutic & prosthetic devices.
- To provide fundamentals of various diagnostic techniques and introduce the concepts of bio-telemetry.

Course Outcomes:

Upon successful completion of the course, the student will be able to:

CO1	Identify various sources of bio-electric potentials in man-instrumentation system.
CO2	Interpret how electrodes and transducers are involved in biomedical engineering concepts.
CO3	Outline the anatomy of Cardiovascular and respiratory system and their measuring instruments.
CO4	Summarize the functionality of patient care & monitoring equipments used to identify the malfunction of human body.
CO5	Analyze various therapeutic and prosthetic devices, clinical laboratory instruments and biomaterials used for patient care.
CO6	Identify the different diagnostic imaging techniques and monitors, recorders and electrical accident prevention methods.

Course Content(Syllabus)

UNIT I

SOURCES OF BIOELECTRIC POTENTIALS AND ELECTRODES: Resisting and Action Potentials, Propagation of Action Potentials, The Bioelectric Potentials. Electrodes: Electrode theory, Bio Potential Electrodes, Biochemical Transducers, introduction of biomedical signals.

UNIT II

THE CARDIOVASCULAR SYSTEM: The Heart and Cardiovascular System, The Heart, Blood Pressure, Characteristics of Blood Flow, Heart Sounds, Cardio Vascular Measurements, Electrocardiography, Measurement of Blood Pressure, Measurement of Blood Flow and Cardiac output, Plethysmography, Measurement of Heart Sounds, Event detection, PQRS &T-waves in ECG, the first & second Heartbeats, ECG rhythm analysis.

UNIT III

PATIENT CARE & MONITORY AND MEASUREMENTS IN RESPIRATORY SYSTEM: The elements of Intensive Care Monitory, Diagnosis, Calibration and reparability of Patient Monitoring equipment, other instrumentation for monitoring patients, pacemakers, defibrillators, the physiology of respiratory system, tests and instrumentation for mechanics of breathing, respiratory theory equipment, analysis of respiration.

UNIT IV

BIO TELEMETRY AND INSTRUMENTATION FOR THE CLINICAL LABORATORY: Introduction to biotelemetry, Physiological parameters adaptable to biotelemetry, the components of biotelemetry system, implantable units, applications of telemetry inpatient care – The blood, tests on blood cells, chemical test, automation of chemical tests.

UNIT V

X-RAY AND RADIOISOTOPE INSTRUMENTATION AND ELECTRICAL SAFETY OF MEDICAL EQUIPMENT:

Generation of Ionizing radiation, instrumentation for diagnostic X rays, special techniques, instrumentation for the medical use of radioisotopes, radiation therapy – Physiological effects of electrical current, shock Hazards from electrical equipment.

TEXT BOOKS:

1. Biomedical Instrumentation and Measurements–C.Cromwell, F.J.Weibell, E.A.Pfeiffer–Pearsoneducation.

2. Biomedicalsignalanalysis–Rangaraj,M.Rangayya–WileyInterscience–Johnwilley&Sons Inc.

REFERENCES:

1.HandBookookofBio-MedicalInstrumentation – R.S. Khandpur, (TMH).

2.IntroductiontoBio-MedicalEngineering–Domach, (Pearson).

3.Introductionto Bio-Medical Equipment Technology–Cart,(Pearson).

Contribution of Course Outcomes towards achievement of Program Outcomes (PO) and Program Specific outcomes (PSO)
(1 – Low, 2- Medium, 3 – High)

	PO1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO1	PSO2
CO1	2	3	2	3										3
CO2	3	3				2							2	
CO3	2	2		3	2								3	
CO4	2												2	
CO5	2		3										2	
CO6	3				2							2		3

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DEPARTMENT OF ELECTRONICS AND COMMUNICATION ENGINEERING

Open Elective **L T P C**
3 0 0 3

TRANSDUCERS AND SENSORS

Lecture – Tutorial:	3-1 Hours	**Internal Marks:**	30
Credits:	4	**External Marks:**	70

Prerequisites: Basic electrical and electronics engineering, basics of measuring systems and method of measurement.

Course Objectives:

- To make students familiar with the constructions and working principle of different types of sensors and transducers.
- To make students aware about the measuring instruments and the methods of measurement and the use of different transducers.
- To make students aware of the latest trends in sensor technology.

Course Outcomes:

Upon successful completion of the course, the student will be able to:

CO1	Apply concepts in common methods for converting a physical parameter into an electrical quantity.
CO2	Classify and explain with examples of transducers, including those for measurement of temperature, strain, motion, position and light.
CO3	Choose proper sensor comparing different standards and guidelines to make sensitive measurements of physical parameters like pressure, flow, acceleration, etc.
CO4	Predict correctly the expected performance of various sensors.
CO5	Locate different type of sensors used in real life applications and paraphrase their importance.
CO6	Set up testing strategies to evaluate performance characteristics of different types of sensors and transducers and develop professional skills in acquiring and applying the knowledge outside the classroom through design of a real-life instrumentation system.

Course Content (Syllabus)

UNIT I

INTRODUCTION: Functional elements of an instrument, generalized performance characteristics of instruments – static characteristics, dynamic characteristics.
Zero order, first order, second order instruments – step response, ramp response and impulse response. Response of general form of instruments to periodic input and to transient input Experimental determination of measurement system parameters, loading effects under dynamic conditions.

UNIT II

TRANSDUCERS FOR MOTION AND DIMENSIONAL MEASUREMENTS: Relative displacement, translation and rotational resistive potentiometers, resistance strain guages, LVDT, synchros, capacitance pickups, Piezo-electric transducers, electro-optical devices, nozzle – flapper transducers, digital displacement transducers, ultrasonic transducers.
Magnetic and photoelectric pulse counting methods, relative acceleration measurements, seismic acceleration pickups, calibration of vibration pickups. Gyroscopic sensors.

UNIT III

TRANSDUCERS FOR FORCE MEASUREMENT: Bonded strain guage transducers, Photo-electric transducers, variable reluctance pickup, torque measurement dynamometers.
TRANSDUCERS FOR FLOW MEASUREMENT: Hot wire and hot-film anemometers, Electro-magnetic flow meters, laser Doppler velocimeter.
TRANSDUCERS FOR PRESSURE MEASUREMENT: Manometers, elastic transducers, liquid systems, gas systems, very high pressure transducers. Thermal conductivity guages, ionization guages, microphone.

UNIT IV

TRANSDUCERS FOR TEMPERATURE MEASUREMENT: Thermal expansion methods, Thermometers (liquid in glass), pressure thermometers, Thermocouples, Materials configuration and techniques. Resistance thermometers, thermistors, junction semiconductors, Sensors, Radiation methods, Optical pyrometers, Dynamic response of temperature sensors heat flux Sensors, Transducers for liquid level measurement, humidity, silicon and quartz sensors, fiber optic sensors.

UNIT V

SMART SENSORS: Introduction, primary sensors, converters, compensation. Recent trends in sensor technology – film sensors, semi conductor IC technology, MEMS, Nano-sensors.

TEXT BOOKS:

1. Doebelin, E.O., "Measurement systems – Application and Design", McGraw Hill.
2. D. Patranabis, "Sensors and Transducers", PHI, 2nd Edition.

REFERENCES:

1. Instrumentation Measurement & Analysis, by B.C. Nakra, K.K. Choudry, (TMH) .
2. Transducers and Instrumentation, by D.V.S. Murthy (PHI).

Contribution of Course Outcomes towards achievement of Program Outcomes (PO) and Program Specific outcomes (PSO)
(1 – Low, 2- Medium, 3 – High)

	PO1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO1	PSO2
CO1	2		2	3						2		3		3
CO2	2	2		2										3
CO3	3	2		2	2									3
CO4			2										2	
CO5	2		2										2	
CO6	2		3		2							2		3

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DEPARTMENT OF ELECTRONICS AND COMMUNICATION ENGINEERING

Open Elective **L T P C**
3 0 0 3

INDUSTRIAL ELECTRONICS

Lecture – Tutorial:	3-0 Hours	**Internal Marks:**	30
Credits:	3	**External Marks:**	70

Prerequisites: Power Electronics, Electrical Machines – I, and Electrical Machines– II.

Course Objectives: Students will be able to:

- Simulate and analyse the semiconductor-controlled ac and DC drive system.
- Design and develop an illumination system for domestic, industrial, and commercial sites.
- Design an electric heating system for industrial purposes.
- Equip the skill to design and develop a regulated power supply.
- Simulate and analyse the series and shunt compensators for power factor improvement in the drive system.

Course Outcomes:

Upon successful completion of the course, the student will be able to:

CO1	Understand the characteristics of DC amplifiers.
CO2	Analyse the Operation and Characteristics of Switched-mode DC power supplies.
CO3	Learn about the principles and operations of thyristor components.
CO4	Characterize the applications of SCR.
CO5	Describe the various applications of industrial electronics.
CO6	Understand the characteristics of Operational Amplifiers.

Course Content (Syllabus)

UNIT I

DC AMPLIFIERS - Need for DC amplifiers, DC amplifiers - Drift, Causes, Darlington Emitter Follower, Cascode amplifier, Stabilization. **DIFFERENTIAL AMPLIFIERS -** Chopper stabilization, Operational Amplifiers, Ideal specifications of Operational Amplifiers, Instrumentation Amplifiers.

UNIT II

REGULATED POWER SUPPLIES - Block diagram, Principle of voltage regulation, Series and Shunt type Linear Voltage Regulators. **PROTECTION TECHNIQUES -** Short Circuit, Overvoltage, and Thermal Protection. **SWITCHED MODE & IC REGULATORS -** Switched Mode voltage regulator, Comparison of Linear and Switched Mode Voltage Regulators, Servo Voltage Stabilizer, monolithic voltage regulators Fixed and Adjustable IC Voltage regulators, 3-terminal Voltage regulators - Current boosting.

UNIT III

SCR: Principles of operation and characteristics of SCR, Applications of SCR. **Thyristor -** Triggering of Thyristors. **COMMUTATION TECHNIQUES OF THYRISTORS -** Classes A, B, C, D, E, and F, Ratings of SCR, Static circuit breaker, Protection of SCR.

UNIT IV

APPLICATIONS OF SCR IN POWER CONTROL - Static circuit breaker, Protection of SCR. **INVERTERS -** Classification, Single Phase inverters. **CONVERTERS –** single-phase Half wave and Full wave. DIAC, TRIAC, and Thyristor Applications. **CHOPPER CIRCUITS –** Principle, methods and Configurations, DIAC AND TRIAC, **TRIACS -** Triggering modes, Firing Circuits, Commutation.

UNIT V

INDUSTRIAL APPLICATIONS -I: **Industrial Timers -** Classification, types. **Electronic Timers -** Classification, RC and Digital timers, Time base Generators. Electric Welding Classification, types, and methods of Resistance and ARC wielding Electronics DC Motor Control, **INDUSTRIAL APPLICATIONS -II**:**High-Frequency Heating** – principle, merits, applications, High-frequency Source for Induction heating. **Dielectric Heating –** principle, material properties, Electrodes, and their Coupling to RF generator, Thermal losses, and Applications. **Ultrasonics –** Generation and Applications.

TEXT BOOKS:

1. Industrial and Power Electronics – G. K. Mithal and Maneesha Gupta, Khanna Publishers, 19th Ed., 2003.
2. Integrated Electronics – J. Millman and C.C Halkias, McGraw Hill, 1972.

REFERENCES:

1. Electronic Devices and circuits – Theodore. H. Bogart, Pearson Education, 6th Edn., 2003.

2. Thyristors and applications – M. Rammurthy, East-West Press, 1977.

3. Integrated Circuits and Semiconductor Devices – Deboo and Burroughs, ISE.

Contribution of Course Outcomes towards achievement of Program Outcomes (PO) and Program Specific outcomes (PSO)
(1 – Low, 2- Medium, 3 – High)

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO1	PSO2
CO 1	3	3	2	2						2		3		3
CO 2	2	3												2
CO 3	2	2		2	2									2
CO 4	3												3	
CO 5	3		2										3	
CO 6	2				2							2		2

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DEPARTMENT OF ELECTRONICS AND COMMUNICATION ENGINEERING

Open Elective **L T P C**
3 0 0 3

MICROPROCESSOR AND APPLICATIONS

Lecture – Tutorial:	3-0 Hours	**Internal Marks:**	30
Credits:	3	**External Marks:**	70

Prerequisites: Digital Design, Digital logic.

Course Objectives:

- Learn concepts of microprocessor, different addressing modes and programming of 8086.
- Learn assembly language Programming of 8086.
- Understand interfacing of 8086, with memory and other peripherals.
- Study the features of 8051 Microcontroller, its instruction set and also other controllers.

Course Outcomes:

Upon successful completion of the course, the student will be able to:

CO1	Demonstrate the architecture of 8086 microprocessor and its operation.
CO2	Apply assembly language program concepts for microprocessors.
CO3	Analyze various interfacing techniques and apply them for the design of processor/Controller based systems.
CO4	Distinguish between microprocessor and microcontroller.
CO5	Outline the architecture and operation of 8051 microcontroller.
CO6	Determining the various applications of 8051 microcontroller.

Course Content(Syllabus)

UNIT I

8086 PROCESSOR: 8086 microprocessor family, 8086 Main features, Register organization, internal architecture, bus interfacing unit, execution unit, program status register pin diagram/description, 8086 system timing, minimum mode and maximum mode configuration with timing diagrams.

UNIT II

8086 PROGRAMMING: Program development steps, instructions, addressing modes, assembler directives, writing simple programs with an assembler, assembly language program development tools.

UNIT III

8086 INTERFACING: Semiconductor memories interfacing (RAM, ROM), Intel 8255 programmable peripheral interface, Interfacing switches and LEDS, Interfacing seven segment displays, Intel 8237a DMA controller, stepper motor, A/D and D/A converters.

UNIT IV

8051 MICRO CONTROLLER: Hardware Architecture, pinouts — Functional Building Blocks of controller — Memory organization — I/O ports and data transfer concepts– Timing Diagram - Data Transfer, Manipulation, Control Algorithms& I/O instructions, sample programs.

UNIT V

MICRO CONTROLLER PROGRAMMING & APPLICATIONS: Simple programming exercises-Traffic signal interface, 7-segment interface, keyboard –Control of servo motor stepper motor control-Application to automation systems.

TEXT BOOKS:

1. A.K Ray, K.M.Bhurchandhi," Advanced Microprocessor and Peripherals", Tata McGraw Hill Publications, 2000.

2. The 8051 Microcontrollers and Embedded systems Using Assembly and C, Muhammad Ali Mazidi and Janice Gillespie Mazidi and Rollin D.McKinlay; Pearson 2-Edition, 2011.

REFERENCES:

1. Microprocessors and Interfacing – Programming and Hardware by Douglas V Hall, SSSP Rao, Tata Mc Graw Hill Education Private Limited,3rdEdition, 1994.

Contribution of Course Outcomes towards achievement of Program Outcomes (PO) and Program Specific outcomes (PSO)
(1 – Low, 2- Medium, 3 – High)

	PO1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO1	PSO2
CO1	3	3	2	2						2		3		3
CO2	2	3												2
CO3	2	2		2	2									2
CO4	3												3	
CO5	3		2										3	
CO6	2				2							2		2

NRI INSTITUTE OF TECHNOLOGY

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DEPARTMENT OF ELECTRONICS AND COMMUNICATION ENGINEERING

Open Elective

L	T	P	C
3	0	0	3

PRINCIPLES OF COMMUNICATIONS

Lecture – Tutorial:	3-1 Hours	**Internal Marks:**	30
Credits:	4	**External Marks:**	70

Prerequisites: Probability theory and Stochastic Processes, Basics of Communications.

Course Objectives:

- To develop ability to analyze system requirements of analog and digital communication systems.
- To understand the generation, detection of various analog and digital modulation techniques.
- To acquire knowledge of impact of noise on performance of communication system.
- To understand the concepts of binary codes and error detection and correction.

Course Outcomes:

Upon successful completion of the course, the student will be able to:

CO1	Analyze and design of various continuous wave and angle modulation and demodulation techniques.
CO2	Understand the effect of noise present in continuous wave and angle modulation techniques.
CO3	Analyze the impact of noise on the performance of communication system.
CO4	Analyze the various Pulse Modulation Techniques.
CO5	Understand the concepts of Digital Modulation Techniques and Baseband transmission.
CO6	Understand the importance of digital codes in communication and error detection and correction.

Course Content (Syllabus)

UNIT I

AMPLITUDE MODULATION: Introduction, Amplitude Modulation: Time & Frequency – Domain description, switching modulator, Envelop detector.

DOUBLE SIDE BAND-SUPPRESSED CARRIER MODULATION: Time and Frequency – Domain description, Ring modulator, Coherent detection, Costas Receiver, Quadrature Carrier Multiplexing.

SINGLE SIDE–BAND AND VESTIGIAL SIDEBAND METHODS OF MODULATION: SSB Modulation, VSB Modulation, Frequency Translation, Frequency- Division Multiplexing, Theme Example: VSB Transmission of Analog and Digital Television.

UNIT II

ANGLE MODULATION: Basic definitions, Frequency Modulation: Narrow Band FM, Wide Band FM, Transmission bandwidth of FM Signals, Generation of FM Signals, Demodulation of FM Signals, FM Stereo Multiplexing.

UNIT III

SIGNAL SAMPLING AND ANALOG PULSE COMMUNICATION: Ideal Sampling, Pulse Amplitude Modulation, Pulse Width Modulation, Pulse Position Modulation. Digital Communication Techniques: Quantization, Digital Transmission of Data, Parallel and Serial Transmission, Data Conversion, Pulse Code Modulation, Delta Modulation.

UNIT IV

NOISE IN ANALOG MODULATION: Introduction, Receiver Model, Noise in DSB-SC receivers, Noise in AM receivers, Threshold effect, Noise in FM receivers, Capture effect, FM threshold effect, FM threshold reduction, Pre-emphasis and De-emphasize in FM.

UNIT V

TRANSMISSION OF BINARY DATA IN COMMUNICATION SYSTEMS: Digital Codes, Principles of Digital Transmission, Transmission Efficiency, Modem Concepts and Methods – FSK, BPSK, Error Detection and Correction.

TEXT BOOKS:

1. Principles of Communication Systems – H Taub& D. Schilling, GautamSahe, TMH, 2007, 3rdEdition.
2. Communication Systems – B.P. Lathi, BS Publication,2006.

REFERENCES:

1. Principles of Communication Systems - Simon Haykin, John Wiley,2ndEdition.
2. Electronics & Communication System – George Kennedy and Bernard Davis, TMH 2004.
3. Communication Systems– R.P. Singh, SP Sapre, Second Edition TMH,2007.

Contribution of Course Outcomes towards achievement of Program Outcomes (PO) and Program Specific outcomes (PSO)
(1 – Low, 2- Medium, 3 – High)

	PO1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO1	PSO2
CO1	3	3	2	2									3	
CO2	2	2					2							2
CO3	3	2		2						2		2	2	
CO4	2													3
CO5	2	3	3										3	
CO6	2													3

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DEPARTMENT OF ELECTRONICS AND COMMUNICATION ENGINEERING

Open Elective **L T P C**
3 0 0 3

IC APPLICATIONS

Lecture – Tutorial:	3-0 Hours	**Internal Marks:**	30
Credits:	3	**External Marks:**	70

Prerequisites: Basic Electronics, Circuit Analysis.

Course Objectives:

- To introduce the basic building blocks of linear integrated circuits.
- To understand the linear and non-linear applications of operational amplifiers.
- To introduce the theory and applications of filters and TIMERS.
- To analyze the concepts of ADC and DAC.
- To know classification of digital integrated circuits and their ICs.

Course Outcomes:

Upon successful completion of the course, the student will be able to:

CO1	Analyze the operational characteristics of IC 741.
CO2	Apply the concepts of OP-AMP 741 to design linear & non-linear applications.
CO3	Construct various filters and timers circuits.
CO4	Analyze the importance of A/D to D/A converters in digital systems.
CO5	Summarize various types of digital integrated circuits and logic families.

Course Content(Syllabus)

UNIT I

INTEGRATED CIRCUITS: Classification of ICs , differential amplifiers and types, Block diagram of op-amp, Ideal and Practical Op-Amp, Op-amp characteristics,741 Op-Amp and its Features, Modes of operation-inverting, non-inverting.

UNIT II

APPLICATIONS OF OPERATIONAL AMPLIFIERS:
Linear and Nonlinear Circuits using operational amplifiers and their analysis, Inverting and Non inverting Amplifiers, Differentiator, Integrator, Voltage to current converter, Instrumentation amplifier, adder, sub tractor, Comparator, Multi-vibrators and Schmitt trigger, Triangular wave generator, Precision rectifier, Log and Antilog amplifiers.

UNIT III

ACTIVE FILTERS and TIMERS: Introduction. First. Order and Second Order Low Pass. High Pass and Band Pass Filters Active Band Reject and All Pass Filters.
TIMERS & PHASE LOCKED LOOPS: Introduction to 555 Timer, Functional Diagram, Mono-stable and Astable Operations and Applications, Schmitt Trigger, PLL- Introduction, Block Schematic, Principles and Description of individual Blocks of 565, VCO.

UNIT IV

D-A AND A- D CONVERTERS: Introduction, Basic DAC Techniques - Weighted Resistor Type. R-2R Ladder Type inverted R-2R Type. Different types of ADCs - Parallel Comparator Type. Counter Type. Successive Approximation Register Type and Dual Slope Type DAC

UNIT V

DIGITAL INTEGRATED CIRCUITS INTRODUCTION: Classification of Integrated Circuits. Standard TTL NAND Gate-Analysis & Characteristics.

COMBINATIONAL CIRCUIT ICs: Use of TTL-74XX Series & CMOS 40XX Series ICs- Encoders, Decoders, multiplexers , De-multiplexers, Priority Encoders, & their applications.

TEXT BOOKS:

1. Linear Integrated Circuits, D. Roy Chowdhury, New Age International (p) Ltd.
2. Op-Amps & Linear ICs, Ramakanth A. Gayakwad, PHI

REFERENCES:

1. Operational Amplifiers & Linear Integrated Circuits, R.F. Coughlin & Fredrick F. Driscoll, PHI.
2. Operational Amplifiers & Linear Integrated Circuits: Theory & Applications, Denton J. Daibey, TMH.
3. Design with Operational Amplifiers & Analog Integrated Circuits, Sergio Franco, McGraw Hill.
4. Digital Fundamentals - Floyd and Jain, Pearson Education.

Contribution of Course Outcomes towards achievement of Program Outcomes (PO) and Program Specific outcomes (PSO)
(1 – Low, 2- Medium, 3 – High)

	PO1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO1	PSO2
CO1	2	3		2									2	
CO2	3	3												
CO3	2	2		2								3		
CO4	3												3	
CO5	2	3	2										3	
CO6	3													2

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DEPARTMENT OF ELECTRONICS AND COMMUNICATION ENGINEERING

HONORS COURSES – NRIA20 Reg

POOL - 1 (Instrumentation and Control systems)

S.No	Year/Semester	Name of Course	L – T - P	Credits
1	II/IV	Data Acquisition Systems	3 -1 - 0	4
2	III/V	Bio-Medical Instrumentation	3 -1 - 0	4
3	III/VI	Digital Control systems	3 -1 - 0	4
4	IV/VII	Intelligent & Smart Instrumentation	3 -1 - 0	4
In Addition to any of the four subjects, MOOCs/ NPTEL courses for 04 credits (02 courses @ 2 credits each) are compulsory in the domain of Electronics and Communication)				

POOL - 2 (Integrated Circuits and Systems)

S.No	Year/Semester	Name of Course	L – T - P	Credits
1	II/IV	PLD & ASIC	3 -1 - 0	4
2	III/V	Design for Testability	3 -1 - 0	4
3	III/VI	System on Chip	3 -1 - 0	4
4	IV/VII	Low power VLSI Design	3 -1 - 0	4
In Addition to any of the four subjects, MOOCs/NPTEL courses for 04 credits (02 courses @ 2 credits each) are compulsory in the domain of Electronics and Communication)				

POOL - 3 (Communication Engineering)

S.No	Year/Semester	Name of Course	L – T - P	Credits
1	II/IV	Software Defined Radio	3 -1 - 0	4
2	III/V	Cognitive Radio	3 -1 - 0	4
3	III/VI	5G Communications	3 -1 - 0	4
4	IV/VII	Global Navigational Satellite	3 -1 - 0	4

		systems		
In Addition to any of the four subjects, MOOCs/NPTEL courses for 04 credits (02 courses @ 2 credits each) are compulsory in the domain of Electronics and Communication)				

POOL - 4 (Digital Signal processing)

S.No	Year/Semester	Name of Course	L – T - P	Credits
1	II/IV	Speech Signal Processing	3 -1 - 0	4
2	III/V	Video Signal Processing	3 -1 - 0	4
3	III/VI	Biomedical Signal Processing	3 -1 - 0	4
4	IV/VII	DSP Processors and Architectures	3 -1 - 0	4
In Addition to any of the four subjects, MOOCs/NPTEL courses for 04 credits (02 courses @ 2 credits each) are compulsory in the domain of Electronics and Communication)				

Total Credits

Total Credits	**20**

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DEPARTMENT OF ELECTRONICS AND COMMUNICATION ENGINEERING

HONORS COURSE: POOL-I (Instrumentation and Control Systems) **L T P C**
NRIA20 Reg, Semester - IV **3 1 0 4**

DATA ACQUISITION SYSTEMS

Lecture – Tutorial:	3-1-0 Hours	**Internal Marks:**	30
Credits:	4	**External Marks:**	70

Prerequisites: Digital Logic Design, Digital IC Design.

Course Objectives:

- Understand and learn Single and Multichannel Data Acquisition System.
- Acquire basic skills on capturing experimental data.
- Understand and learn Digital to Analog and Analog to Digital conversion techniques.
- Understand and learn on-linear data convertor techniques and applications.
- Understand and learn monolithic data convertors and error budget of Data Acquisition System.

Course Outcomes:

Upon successful completion of the course, the student will be able to:

CO1	Identify and explore various data acquisition systems.
CO2	Analyze and Interpret Analog to Digital conversion Techniques for the digital systems.
CO3	Apply various Analog to Digital conversion Techniques for signal process in communication Systems.
CO4	Design and Develop various Digital to Analog conversion Techniques for Digital Systems.
CO5	Investigate the suitable Digital to Analog conversion Techniques for Computing Systems.
CO6	Understand the error budget analysis of Data Acquisition System.

Course Content(Syllabus)

UNIT I

INTRODUCTION: Objective of a DAS, single channel DAS, Multi-channel DAS, Components used in DAS– DC Input Characteristics: offset voltages, offset currents, and bias current - Parameters of a DAS System: Resolution- Non linearity, Monotonicity, Accuracy and Precision, Noise, settling time, Acquisition Time.

UNIT II

ANALOG TO DIGITAL CONVERTERS (ADCS): Classification of A/D Converters, : Flash ADC, Flash ADC with interpolation, Multi-step ADC, Sub-ranging ADC, Folding ADC, Pipelined ADC, Parallel feedback – Successive approximation (SAR) ADC – Ramp comparison – Dual slope integration – Voltage to frequency – Voltage to Time - Logarithmic types of ADCS.
ADC APPLICATIONS: Data Acquisition systems – Digital signal processing systems – PCM voice communication systems – Test and measurement instruments – Electronic weighing machines.

UNIT III

DIGITAL TO ANALOG CONVERTERS (DACS): Principles and design of – Parallel R– 2R, Binary Weighted resistor DAC, inverted R-2R ladder DAC, DAC Performance Specifications: Resolution, Output Voltage Range, Accuracy, Linearity D/A decoding – Codes other than ordinary binary.

UNIT IV

DATA CONVERTER APPLICATIONS: DAC applications – Digitally programmable V/I sources – Arbitrary waveform generators – Digitally programmable gain amplifiers – Analog multipliers/ dividers – Analog delay lines.

MONOLITHIC DATA CONVERTERS: Typical study of monolithic DACS and ADCS. Interfacing of
DACS and ADCS to a Micro Processors- Hybrid integrated Circuits DACS- monolithic DAC – Parameter specifications.

UNIT V

ERROR BUDGET OF DACs AND ADCs: Error sources, error reduction and noise reduction Techniques in DAS: Controlling Noise, Grounding Conflict, Symptoms of Ground loops- Cross talk in DAS- Isolation & Floating DAS- Error budget analysis of DAS, case study of a DAC and an ADC.

TEXT BOOKS:

1. Electronic data converters fundamentals and applications – Dinesh K. Anvekar, B.S. Sonde – Tata McGraw Hill.
2. Data Acquisition Systems- From Fundamentals to applied design by PAOLO Emilio, Maurizio,@2013,Springer.

REFERENCES:

1. Electronic Analog/ Digital conversions – Hermann Schmid – Tata McGraw Hill.
2. E.R. Hanateck, User's Handbook of D/A and A/D converters – Wiley
3. Electronic instrumentation by HS Kalsi- TMH 2 ndEdition, 2004.
4. Data converters by G.B. Clayton

Contribution of Course Outcomes towards achievement of Program Outcomes (PO) and Program Specific outcomes (PSO)
(1 – Low, 2- Medium, 3 – High)

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PS O1	PS O2
CO1	2	3		2									3	
CO2	2	2	2									2	3	
CO3	3												3	
CO4		2	3											2
CO5	3				2									3
CO6	3	2	2											2

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DEPARTMENT OF ELECTRONICS AND COMMUNICATION ENGINEERING

HONORS COURSE: POOL-I (Instrumentation and Control Systems) **L T P C**
NRIA20 Reg, Semester - V **3 1 0 4**

BIOMEDICAL INSTRUMENTATION

Lecture – Tutorial:	3-1-0 Hours	**Internal Marks:**	30
Credits:	4	**External Marks:**	70

Prerequisites: Linear and Digital Integrated Circuits, Electronic Measuring and Instrumentation.

Course Objectives:

- To explain the importance of various sources of bio-electric potentials in human body.
- To enhance the knowledge of various electrodes and transducers used for measuring bioelectrical potentials.
- To familiarize mechanisms of cardiovascular and respiratory systems and their measuring equipments.
- To introduce elements of patient care & monitoring system and various therapeutic & prosthetic devices.
- To provide fundamentals of various diagnostic techniques and introduce the concepts of bio-telemetry.

Course Outcomes:

Upon successful completion of the course, the student will be able to:

CO1	Identify various sources of bio-electric potentials in man-instrumentation system.
CO2	Interpret how electrodes and transducers are involved in biomedical engineering concepts.
CO3	Outline the anatomy of Cardiovascular and respiratory system and their measuring instruments.
CO4	Summarize the functionality of patient care & monitoring equipments used to identify the malfunction of human body.
CO5	Analyze various therapeutic and prosthetic devices, clinical laboratory instruments and biomaterials used for patient care.
CO6	Identify the different diagnostic imaging techniques and monitors, recorders and electrical accident prevention methods.

Course Content(Syllabus)

UNIT I

SOURCES OF BIOELECTRIC POTENTIALS AND ELECTRODES: Resisting and Action Potentials, Propagation of Action Potentials, The Bioelectric Potentials. Electrodes: Electrode theory, Bio Potential Electrodes, Biochemical Transducers, introduction of biomedical signals.

UNIT II

THE CARDIOVASCULAR SYSTEM: The Heart and Cardiovascular System, The Heart, Blood Pressure, Characteristics of Blood Flow, Heart Sounds, Cardio Vascular Measurements, Electrocardiography, Measurement of Blood Pressure, Measurement of Blood Flow and Cardiac output, Plethysmography, Measurement of Heart Sounds, Event detection, PQRS &T-waves in ECG, the first & second Heartbeats, ECG rhythm analysis.

UNIT III

PATIENT CARE & MONITORY AND MEASUREMENTS IN RESPIRATORY SYSTEM: The elements of Intensive Care Monitory, Diagnosis, Calibration and reparability of Patient Monitoring equipment, other instrumentation for monitoring patients, pacemakers, defibrillators, the physiology of respiratory system, tests and instrumentation for mechanics of breathing, respiratory theory equipment, analysis of respiration.

UNIT IV

BIO TELEMETRY AND INSTRUMENTATION FOR THE CLINICAL LABORATORY: Introduction to biotelemetry, Physiological parameters adaptable to biotelemetry, the components of biotelemetry system, implantable units, applications of telemetry inpatient care – The blood, tests on blood cells, chemical test, automation of chemical tests.

UNIT V

X-RAY AND RADIOISOTOPE INSTRUMENTATION AND ELECTRICAL SAFETY OF MEDICAL EQUIPMENT: Generation of Ionizing radiation, instrumentation for diagnostic X rays, special techniques, instrumentation for the medical use of radioisotopes, radiation therapy – Physiological effects of electrical current, shock Hazards from electrical equipment.

TEXT BOOKS:

1.Biomedical Instrumentation andMeasurements – C.Cromwell, F.J.Weibell, A.P Feiffer – Pearson Education.
2. Biomedicalsignalanalysis–Rangaraj,M.Rangayya–WileyInterscience–Johnwilley&Sons Inc.

REFERENCES:

1. Hand Book ook of Bio-Medical Instrumentation – R.S. Khandpur, (TMH)
2. Introduction to Bio-Medical Engineering–Domach, (Pearson)
3.Introductionto Bio-Medical Equipment Technology–Cart,(Pearson)

Contribution of Course Outcomes towards achievement of Program Outcomes (PO) and Program Specific outcomes (PSO)
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	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PS O1	PS O2
CO1	-	3	2	-	-	-	-	-	-	-	2	-	3	-
CO2	2	-	-	-	2	-	-	-	-	-	-	-	-	2
CO3	-	2	-	-	-	-	-	-	-	-	-	-	-	2
CO4	2	2	-	2	-	-	-	-	-	-	-	-	2	-
CO5	3	2	-	-	-	-	-	-	-	-	-	-	-	2
CO6	2	-	-	2	-	-	-	-	-	-	-	-	3	-

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DEPARTMENT OF ELECTRONICS AND COMMUNICATION ENGINEERING

HONORS COURSE: POOL-I (Instrumentation and Control Systems) **L T P C**
NRIA20 Reg, Semester - VI **3 1 0 4**

DIGITAL CONTROL SYSTEMS

Lecture – Tutorial:	3-1-0 Hours	**Internal Marks:**	30
Credits:	4	**External Marks:**	70

Prerequisites: Mathematics, Networks and control systems.

Course Objectives: Students will be able to:

- Understand the basics of Z- Transform.
- Study the stability analysis of the digital control system.
- Equip the basic Knowledge about the design of digital control systems for different engineering model
- Analyze digital control systems using state-space methods.
- Analyze digital control systems using transform techniques (frequency response) and state-space methods (pole-assignment).

Course Outcomes:

Upon successful completion of the course, the student will be able to:

CO1	Understand a pure, two-pole system that satisfies specified performance specifications like percent overshoot, peak time, settling time, and DC gain.
CO2	Quantify the z-plane location of a pair of dominant poles given time-domain performance information like percent overshoot, settling time, and peak time.
CO3	Describe discrete equivalents from given continuous-time systems.
CO4	Analyze discrete-time difference equation containing input variables and output variables at particular time instances from a system's discrete-time transfer function.
CO5	Estimate the value of any system variable (e.g., state variable or output variable) at any discrete, time instant given initial conditions and input waveforms.
CO6	Design of state feedback controller through pole placement.

Course Content (Syllabus)

UNIT I

SAMPLING AND RECONSTRUCTION: Introduction, sample and hold operations, Sampling theorem, Reconstruction of original sampled signal to continuous-time signal, **Z-TRANSFORMS:** Introduction, Z – transforms, Theorems of Z-Transforms, the inverse Z – transforms, Modified Z- Transforms, **Z-PLANE ANALYSIS OF DISCRETE-TIME CONTROL SYSTEM:** Z-Transform method for solving difference equations; Pulse transforms function, block diagram analysis of sampled - data systems, mapping between s-plane and z-plane: Primary strips and Complementary Strips.

UNIT II

STATE-SPACE ANALYSIS: State Space Representation of discrete-time systems, Pulse Transfer Function Matrix solving discrete-time state-space equations, State transition matrix, and its Properties, Methods for Computation of State Transition Matrix, Discretization of continuous-time state-space equations.

UNIT III

POLE PLACEMENT AND OBSERVER DESIGN: CONTROLL ABILITY AND OBSERVABILITY: Concepts of Controllability and Observability, Tests for controllability and Observability, Duality between Controllability and Observability, Controllability and Observability conditions for Pulse Transfer Function. **Stability Analysis:** Stability Analysis of closed-loop systems in the Z-Plane, Jury stability test – Stability Analysis by use of the Bilinear Transformation and Routh Stability criterion, Stability analysis using Liapunov theorems.

UNIT IV

DESIGN OF DISCRETE-TIME CONTROL SYSTEM BY CONVENTIONAL METHODS: Design of digital control based on the frequency response method - Bilinear Transformation and Design procedure in the W-plane, Lead, Lag, and Lead-Lag compensators and digital PID controllers. Design digital control through the deadbeat response method.

UNIT V

STATE FEEDBACK CONTROLLERS AND OBSERVERS: Design of state feedback controller through pole placement – Necessary and sufficient conditions, Ackerman's formula, **State Observers:** Full order and Reduced-order observers.

TEXT BOOKS:

1. K. Ogata - "Discrete-Time Control Systems" - Pearson Education/PHI, 2nd Edition.
2. M. Gopal - "Digital Control and State Variable Methods"- TMH.

REFERENCES:

1. B. C. Kuo, "Digital Control Systems", 2nd Edition, Oxford University Press, 2003.
2. M. Gopal - "Digital Control Engineering". New Age International, 2014.

Contribution of Course Outcomes towards achievement of Program Outcomes (PO) and Program Specific outcomes (PSO)
(1 – Low, 2- Medium, 3 – High)

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PS O1	PS O2
CO1	2	3		2									2	
CO2	3	3											3	
CO3	2	2		2								3		2
CO4	3												2	
CO5	2	3	2										3	
CO6	3													2

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DEPARTMENT OF ELECTRONICS AND COMMUNICATION ENGINEERING

HONORS COURSE: POOL-I (Instrumentation and Control Systems) **L T P C**
NRIA20 Reg, Semester - IV **3 1 0 4**

INTELLIGENT AND SMART INSTRUMENTATION

Lecture – Tutorial:	3 – 1 - 0 Hours	**Internal Marks:**	30
Credits:	4	**External Marks:**	70

Prerequisites:

Course Objectives: Electronics measurements and Instrumentation, Basics of Sensors.

- To explain the concept of intelligent instrumentation and impart knowledge on automation.
- To develop an ability to model and analyze a real time system.
- To develop an ability to evaluate the performance of a real time system.
- To develop an ability to design an intelligent system for industrial automation.
- To discuss the latest technology in automation.

Course Outcomes:

Upon successful completion of the course, the student will be able to:

CO1	Develop the design methodologies for measurement and instrumentation of real world problems.
CO2	Study the concepts of intelligent sensor devices, their performance characteristics and signal and system dynamics.
CO3	Address the issues in dealing signal conditioning operations such as calibration, linearization and compensation.
CO4	Use artificial intelligence in sensor signal processing to solve real world problems.
CO5	Perceive with interfacing protocols in wireless networking platform.
CO6	Analyze various sensors with AI and understand the intelligent sensor standards and protocols.

Course Content(Syllabus)

UNIT I

INTRODUCTION: Definition of intelligent instrumentation, Types of instruments, Static Characteristics: Accuracy and Precision, Error, Correction, and Uncertainty, Repeatability, Reproducibility, and Hysteresis, Sensitivity, Offset, and Dead Band, Resolution and Linearity, Statistical Characteristics, Error Modeling, Dynamic Characteristics, Dynamic Error and Dynamic Sensitivity, Input-Output Impedances, Historical Perspective, Current status, software based instruments.

UNIT II

INTELLIGENT SENSORS: Classification, Smart sensors , Cogent Sensors, Soft or Virtual sensors, Self-Adaptive Sensors, Self-Validating Sensors, VLSI Sensors, Temperature Compensating Intelligent Sensors, Pressure Sensor, Indirect Sensing.

UNIT III

LINEARIZATION, CALIBRATION, AND COMPENSATION: Analog Linearization of Positive and Negative Coefficient Resistive Sensors, Higher-Order Linearization, Nonlinear ADC- and

Amplifier-Based Linearization, Interpolation, Piecewise Linearization, Microcontroller-Based Linearization, Artificial Neural Network–Based Linearization, Nonlinear Adaptive Filter–Based Linearization, Sensor Calibration, Conventional Calibration Circuits, Offset Compensation, Error and Drift Compensation, Lead Wire Compensation.

UNIT IV

SENSORS WITH ARTIFICIAL INTELLIGENCE: Artificial Intelligence, Sensors with Artificial Intelligence, Multidimensional Intelligent Sensors, AI for Prognostic Instrumentation, ANN-Based Intelligent Sensors, Fuzzy Logic–Based Intelligent Sensors.

UNIT V

INTELLIGENT SENSOR STANDARDS AND PROTOCOLS: IEEE 1451 Standard, STIM, TEDS, NCAP, Network Technologies, LonTalk, CEBUS, J1850 Bus, 1 Signal Logic and Format, MI Bus, Plug-n-Play Smart Sensor Protocol.

TEXT BOOKS:

1. Manabendra Bhuyan, ―Intelligent Instrumentation: Principles and Applications‖ CRC Press,2011.
2. G. C. Barney, ―Intelligent Instrumentation‖, Prentice Hall, 1995.

REFERENCES:

1. J.B DIXIT, A. yadav Laxmi Publications, Ltd., 01-Sep-2011

Contribution of Course Outcomes towards achievement of Program Outcomes (PO) and Program Specific outcomes (PSO)
(1 – Low, 2- Medium, 3 – High)

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PS O1	PS O2
CO1	3	3	-	-	-		-	-	-	-	-	-	3	-
CO2	3	2	-	-	-	3	-	-	-	-	-	-	2	-
CO3	3	-	2	-		-	-	3		-	-	-	-	2
CO4	2	-	-	-	3	-	-		-	3	-	-	3	-
CO5	-	3	2	3	-	-	2	-	2	-	2	-	-	3
CO6	-	-	3	2	-	-		-	-	-	-	2	2	-

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DEPARTMENT OF ELECTRONICS AND COMMUNICATION ENGINEERING

HONORS COURSE: POOL-II (Integrated Circuits and Systems) **L T P C**
NRIA20 Reg, Semester - IV **3 1 0 4**

PROGRAMMABLE LOGIC DEVICES AND ASIC

Lecture – Tutorial:	3-1-0 Hours	**Internal Marks:**	30
Credits:	4	**External Marks:**	70

Prerequisites: Digital Logic Design, Basics of VLSI Deign.

Course Objectives:

- To introduce the concepts of various programmable logic devices and their architectures.
- To know the types of ASICs, their design using CMOS, their design flow and ASIC library design.
- To understand various programming methodologies and design systems using programmable ASIC interconnect.

Course Outcomes:

Upon successful completion of the course, the student will be able to:

CO1	Recognize the need for programmable logic devices.
CO2	Describe the architecture of various programmable logic devices.
CO3	Analyze various programming methodologies available and their comparison.
CO4	Recall types of ASICs, ASIC library design and design flow using CMOS technology.
CO5	Relate design and implementation flow for PLDs with low power design techniques and methodologies.
CO6	Understand various SOC design challenges and design for integration.

Course Content(Syllabus)

UNIT I

INTRODUCTION TO PROGRAMMABLE LOGIC DEVICES: Introduction, Simple PLDs- Read only memories, Programmable Logic arrays, Programmable Array Logic, PLDs/Generic array logic, Complex Programmable Logic devices- architecture of Xilinx Cool runner XCR3064XL CPLD.

UNIT II

INTRODUCTION TO ASICs, CMOS LOGIC, ASIC LIBRARY DESIGN*:* **Types of ASICs -** Design flow – CMOS transistors- CMOS Design rules –Combinational logic Cell Sequential logic cell - Transistor as Resistors - Transistor parasitic capacitance – Logical effort - Library cell design – Library architecture.

UNIT III

PROGRAMMABLE ASICs, PROGRAMMABLE ASIC LOGIC CELLS AND PROGRAMMABLE ASIC I/O CELLS: Anti fuse - Static RAM - EPROM and EEPROM technology - PREP benchmarks - Actel ACT - Xilinx LCA – Altera FLEX - Altera MAX DC & AC inputs and outputs - Xilinx I/O blocks.

UNIT IV

PROGRAMMABLE ASIC INTERCONNECT: Actel ACT -Xilinx LCA - Xilinx EPLD - Altera MAX 5000 and 7000 - Altera MAX 9000 - Altera FLEX – Design systems - Logic Synthesis - Half

gate ASIC.

UNIT V

SILICON ON CHIP DESIGN: Voice over IP SOC - Intellectual Property – SOC Design challenges- Methodology and design-FPGA to ASIC conversion – Design for integration-SOC verification-Set top box SOC.

TEXT BOOKS:

1. M.J.S. Smith, ―Application Specific Integrated Circuits‖, Pearson Education, 2008
2. Wayne Wolf, ―FPGA-Based System Design‖, Prentice Hall PTR, 2009.
3. Farzad Nekoogar and Faranak Nekoogar, ―From ASICs to SOCs: A Practical Approach‖, Prentice Hall PTR, 2003.

REFERENCES:

1. Low Power CMOS Design – Anantha Chandrakasan, IEEE Press/Wiley International, 1998. 2
2. Massoud Pedram, Jan M. Rabaey , "Low power design methodologies ", Kluwer Academic Publishers.
3. Low Power CMOS VLSI Circuit Design – A. Bellamour, M. I. Elamasri, Kluwer Academic Press, 1995.
4. Digital Systems Design with FPGAs and CPLDs - Ian Grout, Elsevier, Newnes.

Contribution of Course Outcomes towards achievement of Program Outcomes (PO) and Program Specific outcomes (PSO)

(1 – Low, 2- Medium, 3 – High)

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PS O1	PS O2
CO1	3	2	2	-	-	-	-	-	2	-	-	2	-	3
CO2	2	3	-	3	-	-	2	-	-	-	-	-	2	-
CO3	3	-	2	-	-	2	-	-	-	-	-	2	-	-
CO4	3	2	-	2	2	-	-	3	-	-	2	-	-	-
CO5	3	2	3	2	-	-	-	-	-	2	-	-	-	3
CO6	3	2	3	2	2	-	-	-	-	2	-	-	-	3

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DEPARTMENT OF ELECTRONICS AND COMMUNICATION ENGINEERING

HONORS COURSE: POOL-II (Integrated Circuits and Systems) **L T P C**
NRIA20 Reg, Semester - V **3 1 0 4**

DESIGN FOR TESTABILITY

Lecture – Tutorial:	3-1-0 Hours	**Internal Marks:**	30
Credits:	4	**External Marks:**	70

Prerequisites: Mathematical expressions for threshold voltage, substrate biasing, digital electronics, basics of VLSI Design.

Course Objectives:

- To provide an in-depth understanding of the testing and verification of faults affecting VLSI circuits.
- To provide a basic idea on importance of testing in fault tolerance.
- To expose the students, the basics of testing techniques for VLSI circuits and Test Economics.
- To understand the testability measures and scanning techniques.
- To test the various self testing methods .

Course Outcomes:

Upon successful completion of the course, the student will be able to:

CO1	Apply the concepts in testing which can help them design a better yield in IC design.
CO2	Acquire the knowledge of fundamental concepts in fault and fault diagnosis.
CO3	Tackle the problems associated with testing of semiconductor circuits at earlier design levels so as to significantly reduce the testing costs.
CO4	Analyze the various test generation methods for static & dynamic CMOS circuits.
CO5	Identify the design for testability methods for combinational & sequential CMOS circuits.
CO6	Recognize the BIST techniques for improving testability.

Course Content(Syllabus)

UNIT I

INTRODUCTION TO TESTING: Testing Philosophy, Role of Testing, Digital and Analog VLSI Testing, VLSI Technology Trends affecting Testing, Types of Testing, Fault Modeling: Defects, Errors and Faults, Functional Versus Structural Testing, Levels of Fault Models, Single Stuck-at Fault.

UNIT II

LOGIC AND FAULT SIMULATION: Simulation for Design Verification and Test Evaluation, Modeling Circuits for Simulation, Algorithms for True-value Simulation, Algorithms for Fault Simulation, Automatic Test Pattern Generation.

UNIT III

TESTABILITY MEASURES: SCOAP Controllability and Observability, High Level Testability Measures, Digital DFT and Scan Design: Ad-Hoc DFT Methods, Scan Design, Partial-Scan Design, Variations of Scan.

UNIT IV

BUILT-IN SELF-TEST: The Economic Case for BIST, Random Logic BIST: Definitions, BIST Process, Pattern Generation, Response Compaction, Built-In Logic Block Observers, Test-Per-Clock, Test-Per Scan BIST Systems, Circular Self Test Path System, Memory BIST, Delay Fault BIST.

UNIT V

BOUNDARY SCAN STANDARD: Motivation, System Configuration with Boundary Scan: TAP Controller and Port, Boundary Scan Test Instructions, Pin Constraints of the Standard, Boundary Scan Description Language: BDSL Description Components, Pin Descriptions.

TEXT BOOKS:

1. M.L. Bushnell, V. D. Agrawal, "Essentials of Electronic Testing for Digital, Memory and Mixed Signal VLSI Circuits" Kluwer Academic Publishers.

REFERENCES:

1. M. Abramovici, M. A. Breuer and A.D Friedman, "Digital Systems and Testable Design", Jaico Publishing House.
2. P.K. Lala, "Digital Circuits Testing and Testability", Academic Press.

Contribution of Course Outcomes towards achievement of Program Outcomes (PO) and Program Specific outcomes (PSO)
(1 – Low, 2- Medium, 3 – High)

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO1	PSO2
CO1	2	3		2									2	
CO2	3	3											3	
CO3	2	2		2								3		2
CO4	3												3	
CO5	2	3	2										3	
CO6	3													2

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DEPARTMENT OF ELECTRONICS AND COMMUNICATION ENGINEERING

HONORS COURSE: POOL-II (Integrated Circuits and Systems) **L T P C**
NRIA20 Reg, Semester - VI **3 1 0 4**

SYSTEM ON CHIP

Lecture – Tutorial:	3-1 Hours	**Internal Marks:**	30
Credits:	4	**External Marks:**	70

Prerequisites: Basic C & Assembly Programming**,** Microprocessors and Microcontrollers**.**

Course Objectives:

- To design, optimize, and program a modern System-on-a-Chip.
- To understand and estimate Processor Selection for System-on-a-Chip.
- To understand the system on a chip from Vector Processors, Vector Instructions extensions, VLIW Processors, Superscalar Processors.
- To implement Interconnect architectures.

Course Outcomes:

Upon successful completion of the course, the student will be able to:

CO1	Understand the concepts of system architecture, hardware and software in the SoC.
CO2	Demonstrate the concepts of Processor selection, classify and compare different processors.
CO3	Identify internal Memory, Size, Scratchpads and Cache memory.
CO4	Classify and compare different types of cache, SoC Memory Systems, Board-based Memory System.
CO5	Determine SoC standard buses, NOC architecture, Layered Architecture, Network Interface and explain the importance of Mapping design onto Reconfigurable devices
CO6	Discuss SOC Design approach, AES algorithms and develop different applications like Image compression, Video Compression, MP3 Audio Decoding.

Course Content(Syllabus)

UNIT I

INTRODUCTION TO THE SYSTEM APPROACH: System Architecture, Components of the system, Hardware and Software in the SoC: programmability versus performance, Processor Architectures, Memory and Addressing. System level interconnection, Approaches to designing a SoC, System Architecture and Complexity.

UNIT II

PROCESSORS: Introduction, Processor Selection for SOC, Basic concepts in Processor Architecture, Basic concepts in Processor Micro Architecture, Basic elements in Instruction handling. Buffers: minimizing Pipeline Delays, Branches. **MORE ROBUST PROCESSORS**: Vector Processors and Vector Instructions extensions, VLIW Processors, Superscalar Processors, Soft Processors, Custom Designed Accelerators.

UNIT III

MEMORY DESIGN FOR SOC: Overview of SOC external memory, Internal Memory, Size, Scratchpads and Cache memory, Cache Organization, Cache data, Write Policies, Strategies for line replacement at miss time. **TYPES OF CACHE**: Split – I, and D – Caches, Multilevel Caches, Virtual to real translation, SoC (On-Die) Memory Systems, Board-based (Off-Die) Memory System, Models of Simple Processor – memory interaction.

UNIT IV

INTERCONNECT ARCHITECTURES: Bus: - Basic Architecture, SoC Standard Buses (AMBA, Core Connect) Network on Chip (NoC) Architecture, NoC with Switch Interconnects with example, Layered Architecture and Network Interface. **CUSTOMIZATION AND CONFIGURABILITY:** SOC Customization: An overview, Customizing Instruction Processor, Mapping design onto Reconfigurable devices, Instance Specific design.

UNIT V

APPLICATION STUDIES / CASE STUDIES: SOC Design approach, AES algorithms, Design and evaluation, Image compression – JPEG compression, Video Compression, MP3 Audio Decoding.

TEXT BOOKS:

1. Michael J. Flynn and Wayne Luk, "Computer System Design System-on-Chip", Wiley India Pvt. Ltd.
2. Steve Furber, "ARM System on Chip Architecture ", 2nd Edition, 2000, Addison WesleyProfessional.

REFERENCES:

1. Ricardo Reis, "Design of System on a Chip: Devices and Components", 1st Edition, 2004, Springer
2. Jason Andrews, "Co-Verification of Hardware and Software for ARM System on Chip Design (Embedded Technology)", Newnes, BK and CDROM.
3. Prakash Rashinkar, Peter Paterson and Leena Singh L, "System on Chip Verification – Methodologies and Techniques", 2001, Kluwer Academic Publishers.

Contribution of Course Outcomes towards achievement of Program Outcomes (PO) and Program Specific outcomes (PSO)
(1 – Low, 2- Medium, 3 – High)

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PS O1	PS O2
CO1	3	-	-	-	-	-	-	-	-	-	-	-	3	-
CO2	3	-	-	-	-	-	-	-	-	-	-	-	-	-
CO3	3	-	-	-	-	-	-	-	-	-	-	-	-	-

CO4	**3**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**
CO5	**3**	**2**	**2**	**3**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**3**	**-**
CO6	**2**	**3**	**3**	**3**	**3**	**2**	**2**	**-**	**-**	**-**	**-**	**-**	**3**	**3**

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DEPARTMENT OF ELECTRONICS AND COMMUNICATION ENGINEERING

HONORS COURSE: POOL-II (Integrated Circuits and Systems) **L T P C**
NRIA20 Reg, Semester - VII **3 1 0 4**

LOW POWER VLSI DESIGN

Lecture – Tutorial:	3-1 Hours	**Internal Marks:**	30
Credits:	4	**External Marks:**	70

Prerequisites: VLSI Design, Scaling techniques, Design for testability.

Course Objectives:

- Understand the need for low power in VLSI.
- Understand various dissipation types in CMOS.
- Understand the impact of power on system performances.
- To Known about different Design approaches.
- To study the concepts of low voltage and low power logic circuits.

Course Outcomes:

Upon successful completion of the course, the student will be able to:

CO1	Capability to recognize advanced issues in VLSI systems, specific to the deep-submicron silicon Technologies.
CO2	Understand deep submicron CMOS technology and digital CMOS design styles.
CO3	Design chips used for battery-powered systems and high performance circuits.
CO4	Learn the design of various CMOS dynamic logic circuits.
CO5	Learn the design techniques low voltage and low power CMOS circuits for various applications.
CO6	Learn the different types of memory circuits and their design.

Course Content(Syllabus)

UNIT I

SOURCES OF POWER DISSIPATION: Resisting and Action Potentials, Propagation of Action Potentials, Introduction, Short-Circuit Power Dissipation, Switching Power Dissipation, Dynamic Power for a Complex Gate, Reduced Voltage Swing, Switching Activity, Leakage Power Dissipation, p–n Junction Reverse-Biased Current, Sub threshold Leakage Current, Short-Channel Effects.

UNIT II

SUPPLY VOLTAGE SCALING FOR LOW POWER*:* Device Feature Size Scaling, Constant-Field Scaling, Constant-Voltage Scaling, Architectural-Level Approaches: Parallelism for Low Power, Pipelining for Low Power, Combining Parallelism with Pipelining, Voltage Scaling Using High-Level Transformations: Multilevel Voltage Scaling Challenges in MVS Voltage Scaling Interfaces, Static Timing Analysis Dynamic Voltage and Frequency Scaling.

UNIT III

SWITCHED CAPACITANCE MINIMIZATION: Probabilistic Power Analysis: Random logic signals, probability and frequency, probabilistic power analysis techniques, signal entropy, Bus Encoding: Gray Coding, One-Hot Coding, Bus-Inversion, Clock Gating, Gated-Clock FSMs, Glitching Power Minimization.

UNIT IV

LEAKAGE POWER MINIMIZATION: Fabrication of Multiple Threshold Voltages, Multiple Channel Doping, Multiple Oxide CMOS, Multiple Channel Length, Multiple Body Bias, VTCMOS Approach, MTCMOS Approach, Power Gating, Clock Gating Versus Power Gating, Power-Gating Issues, Isolation Strategy, State Retention Strategy, Power-Gating Controller, Power Management, Combining DVFS and Power Management.

UNIT V

LOW POWER CLOCK DISTRIBUTION& SIMULATION POWER ANALYSIS: Low power clock distribution: Power dissipation in clock distribution, single driver versus distributed buffers, Zero skew versus tolerable skew, chip and package co design for clock network. **SIMULATION POWER ANALYSIS**: SPICE circuit simulators, gate level logic simulation, capacitive power estimation, architecture level analysis, Monte Carlo Simulation.

TEXT BOOKS:

1. Low-Power VLSI Circuits and Systems, Ajit Pal, SPRINGER PUBLISHERS.
2. PRACTICAL LOW POWER DIGITAL VLSI DESIGN , Gary Yeap Motorola, SPRINGER SCIENCE+BUSINESS MEDIA, LLC.

REFERENCES:

1. Low Power CMOS Design – Anantha Chandrakasan, IEEE Press/Wiley International, 1998. 2
2. Massoud Pedram, Jan M. Rabaey , "Low power design methodologies ", Kluwer Academic Publishers.
3. Low Power CMOS VLSI Circuit Design – A. Bellamour, M. I. Elamasri, Kluwer Academic Press, 1995.

Contribution of Course Outcomes towards achievement of Program Outcomes (PO) and Program Specific outcomes (PSO)
(1 – Low, 2- Medium, 3 – High)

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PS O1	PS O2
CO1	3	2	2										2	
CO2	2	3	-										3	
CO3	2											2	2	
CO4	3	2		2				2						3
CO5	2	3												2
CO6	2		2											2

HONORS COURSE: POOL-III (Communication Engineering) **L T P C**

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DEPARTMENT OF ELECTRONICS AND COMMUNICATION ENGINEERING

NRIA20 Reg, Semester - IV **3 1 0 4**

SOFTWARE DEFINED RADIO

Lecture – Tutorial:	3-1 Hours	**Internal Marks:**	30
Credits:	4	**External Marks:**	70

Prerequisites: Introduction to Programming with Scientific Applications, Introduction to Object-oriented Programming.

Course Objectives:

- The course gives students knowledge of fundamental and state-of-the-art concepts in software-defined radio.
- Simulation of the SDR system such as the front-end RF system, analog-to-digital and digital-to-analog conversion,
- Learning different blocks of SDR systems involving modulation.

Course Outcomes:

Upon successful completion of the course, the student will be able to:

CO1	Demonstrate advanced knowledge in the evolving paradigm of Software defined radio and technologies for its implementation.
CO2	Analyze complex problems critically in the domains of Radio frequency implementation issues.
CO3	Understand the multirate signal processing in SDR.
CO4	Analyze Smart antenna techniques for better spectrum exploitation for conducting research.
CO5	Apply appropriate techniques for the development of technological knowledge in designing software defined radios and their usage for cognitive radio.
CO6	Apply scientific techniques for the development of designing software defined radios and their usage for cognitive radio.

Course Content(Syllabus)

UNIT I

INTRODUCTION: The Need for Software Radios, What is Software Radio, Characteristics and benefits of software radio- Design Principles of Software Radio, RF Implementation issues- The Purpose of RF Front – End, Dynamic Range- The Principal Challenge of Receiver Design – RF Receiver Front- End Topologies- Flexibility of the RF Chain with Software Radios- Importance of the Components to Overall Performance- Transmitter Architectures and Their Issues.

UNIT II

MULTI RATE SIGNAL PROCESSING: Introduction- Sample Rate Conversion Principles- Polyphase Filters Digital Filter Banks- Timing Recovery in Digital Receivers Using Multirate Digital Filters. Digital generation signals: Introduction- Comparison of Direct Digital Synthesis with Analog Signal Synthesis- Approaches to Direct Digital Synthesis- Analysis of Spurious Signals- Spurious Components due to Periodic jitter- Band Pass Signal Generation.

UNIT III

ANALOG TO DIGITAL AND DIGITAL TO ANALOG CONVERSION: Parameters of ideal data converters- parameters of Practical data converters- Analog to Digital and Digital to Analog Conversion-Techniques to improve data converter performance- Common ADC and DAC architectures. Applications of SDR: Cognitive radio, Intelligent wireless application-wireless device parameters, vehicular communication networks, satellite communication.

UNIT IV

DIGITAL HARDWARE CHOICES: Introduction- Key Hardware Elements- DSP Processors- Field Programmable Gate Arrays- Trade-Offs in Using DSPs, FPGAs, and ASICs- Power Management Issues Using a Combination of DSPs, FPGAs, and ASICS, GNU radio.

UNIT V

OBJECT – ORIENTED REPRESENTATION OF RADIOS AND NETWORK RESOURCES: Networks- Object Oriented Programming- Object Brokers- Mobile Application Environments- Joint Tactical Radio System. Case Studies in Software Radio Design: Introduction and Historical Perspective, SPEAK easy- JTRS, Wireless Information Transfer System, SDR-3000 Digital Transceiver Subsystem, Spectrum Ware, CHARIOT.

TEXT BOOKS:

1. Software Radio: A Modern Approach to Radio Engineering - Jeffrey H. Reed, 2002, PEA Publication.
2. Software Defined Radio: Enabling Technologies- Walter Tuttle Bee, 2002, Wiley Publications.

REFERENCES:

1. Software Defined Radio for 3G - Paul Burns, 2002, Artech House.
2. Software Defined Radio: Architectures, Systems and Functions - Markus Dillinger, KambizMadani, Nancy Alonistioti, 2003, Wiley.
3. Software Radio Architecture: Object Oriented Approaches to wireless System Engineering – Joseph Mitola, III, 2000, John Wiley & Sons.
4. R.F Microelectronics – B. Razavi, 1998, PHI. 5. DSP – A Computer Based Approach – S. K. Mithra, 1998, McGraw-Hill

Contribution of Course Outcomes towards achievement of Program Outcomes (PO) and Program Specific outcomes (PSO)
(1 – Low, 2- Medium, 3 – High)

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PS O1	PS O2
CO1	3	2												
CO2		3		2									2	
CO3	2	2		3										
CO4				3						2				2
CO5			2			2								
CO6			2			3							2	

HONORS COURSE: POOL-III (Communication Engineering) **L T P C**
NRIA20 Reg, Semester - V **3 1 0 4**

COGNITIVE RADIO

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DEPARTMENT OF ELECTRONICS AND COMMUNICATION ENGINEERING

Lecture – Tutorial:	3-1-0 Hours	**Internal Marks:**	30
Credits:	4	**External Marks:**	70

Prerequisites: Radio Spectrum concept, Programming knowledge.

Course Objectives:

- To understand the evolving software defined radio and cognitive radio techniques and their essential functionalities.
- To study the basic architecture and standard for cognitive radio.
- To expose the student to evolving applications and advanced features of cognitive radio.

Course Outcomes:

Upon successful completion of the course, the student will be able to:

CO1	Understand the fundamental concepts of cognitive radio networks.
CO2	Develop the cognitive radio, as well as techniques for spectrum holes detection that cognitive radio takes advantages in order to exploit it.
CO3	Understand technologies to allow an efficient use of TVWS for radio communications based on two spectrum sharing business models/policies.
CO4	Understand fundamental issues regarding dynamic spectrum access.
CO5	Understand the radio-resource management and trading.
CO6	Find out the number of optimization techniques for better Spectrum exploitation.

Course Content(Syllabus)

UNIT I

INTRODUCTION TO COGNITIVE RADIOS: Evolution of Software Defined Radio and Cognitive radio: goals, benefits, definitions, relations with other radios, Digital dividend, cognitive radio (CR) architecture, functions of cognitive radio, dynamic spectrum access (DSA), components of cognitive radio, spectrum sensing, spectrum analysis and decision, potential applications of cognitive radio.

UNIT II

SENSING: Primary signal detection. energy detector, Spectrum sensing, detection of spectrum holes (TVWS), collaborative sensing, geo-location database and spectrum sharing business models (spectrum of commons, real time secondary spectrum market).

UNIT III

OPTIMIZATION TECHNIQUES OF DYNAMIC SPECTRUM ALLOCATION: Linear programming, convex programming, non-linear programming, integer programming, dynamic programming, stochastic programming. Fundamental Limits of Cognitive Radio.

UNIT IV

DYNAMIC SPECTRUM ACCESS AND MANAGEMENT: Spectrum broker, cognitive radio architectures, centralized dynamic spectrum access, distributed dynamic spectrum access, learning algorithms and protocols.

UNIT V

SPECTRUM TRADING: Introduction to spectrum trading, classification to spectrum trading, radio resource pricing, brief discussion on economics theories in DSA (utility, auction theory), classification of auctions (single auctions, double auctions, concurrent, sequential).Research Challenges in Cognitive Radio: Network layer and transport layer issues, cross- layer design for cognitive radio networks.

TEXT BOOKS:

1. Ekram Hossain, DusitNiyato, Zhu Han, "Dynamic Spectrum Access and Management in Cognitive Radio Networks", Cambridge University Press,2009.
2. Kwang-Cheng Chen, Ramjee Prasad, "Cognitive radio networks", John Wiley & Sons Ltd.,2009.

REFERENCES:

1. Bruce Fette, "Cognitive radio technology", Elsevier, 2nd edition,2009.
2. Huseyin Arslan, "Cognitive Radio, Software Defined Radio, and Adaptive Wireless Systems", Springer,2007.
3. Francisco Rodrigo Porto Cavalcanti, Soren Andersson, "Optimizing Wireless Communication Systems" Springer,2009.
4. Linda Doyle, "Essentials of Cognitive Radio", Cambridge University Press,2009

Contribution of Course Outcomes towards achievement of Program Outcomes (PO) and Program Specific outcomes (PSO)
(1 – Low, 2- Medium, 3 – High)

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO1	PSO2
CO1	1	-	-	-	-	-	-	-	-	-	-	-	3	-
CO2	1	-	1	-	-	-	-	-	-	-	-	-	2	-
CO3	-	-	-	1	1	-	-	-	-	-	-	-	2	2
CO4	1	-	-	1	-	-	-	-	-	-	-	-	3	-
CO5	1	-	-	1	-	-	-	-	-	-	-	1	2	-
CO6	-	-	-	1	-	-	-	-	-	-	-	1	3	-

HONORS COURSE: POOL-III (Communication Engineering) **L T P C**
NRIA20 Reg, Semester - VI **3 1 0 4**

5G COMMUNICATIONS

Lecture – Tutorial:	3-1-0 Hours	**Internal Marks:**	30
Credits:	4	**External Marks:**	70

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DEPARTMENT OF ELECTRONICS AND COMMUNICATION ENGINEERING

Prerequisites: Analog Communication, Digital Communication, Cellular Mobile Communication, Wireless communication.

Course Objectives: Students will be able to:

- Learn the Basics of 5G and Beyond Wireless communication.
- Provide a basic understanding of the key technologies and enablers of 5G and beyond communication systems.
- Study various 5G wireless channel models.
- Learn 5G techniques such as massive MIMO and mm Wave.

Course Outcomes:

Upon successful completion of the course, the student will be able to:

CO1	Distinguish and understand the major cellular communication standards (1G/2G/3G/4G/5G/6G systems) and wireless communications networks.
CO2	Learn 5G Technology propagation channels modelling.
CO3	Understand the Vehicle-to-Vehicle channel modeling in 5G Mobile Systems.
CO4	Describe Radio resource management for mobile broadband D2D, multi-hop, and multi-operator D2D communications.
CO5	Understand the different Multiple accesses techniques in 5G communication.
CO6	Illustrate the 5G communication technique using Massive MIMO models.

Course Content (Syllabus)

UNIT I

HISTORICAL BACKGROUND - Industrial and technological revolution: from steam engines to the Internet, Evaluation of Mobile communications generations: from 1G to 4G (LTE, LTEA, LTEA Pro), **An Overview of 5G** – Introduction, Use cases, and challenges, Use Cases of Mobile Internet, Use Cases of Internet of Things, 5G requirements, Regulations for 5G, Spectrum Analysis and Sharing for 5G.

UNIT II

THE 5G WIRELESS PROPAGATION CHANNELS - Channel modeling requirements, propagation scenarios, and challenges in the 5G modeling, **OVERVIEW OF VEHICLE-TO-VEHICLE CHANNEL MODELING IN 5G MOBILE SYSTEMS-** Introduction, V2V Channel Models, MIMO V2V Channel Modeling, **Channel Models -** Channel Models for mm-Wave MIMO Systems.

UNIT III

TRANSMISSION AND DESIGN TECHNIQUES FOR 5G: Basic requirements of transmission over 5G, Modulation Techniques – Orthogonal frequency division multiplexing (OFDM), generalized frequency division multiplexing (GFDM), filter bank multi-carrier (FBMC), and universal filtered multi-carrier (UFMC), **MULTIPLE ACCESSES TECHNIQUES -** Orthogonal Frequency Division Multiple Accesses (OFDMA), Generalized Frequency Division Multiple Accesses (GFDMA), and Non-Orthogonal Multiple Accesses (NOMA).

UNIT IV

DEVICE-TO-DEVICE (D2D) AND MACHINE-TO-MACHINE (M2M) TYPE COMMUNICATIONs - Extension of 4G D2D standardization to 5G,**RADIO RESOURCE MANAGEMENT** -Radio resource management for mobile broadband D2D, multi-hop, and multi-operator D2D communications.

UNIT V

MILLIMETER-WAVE COMMUNICATIONS - spectrum regulations, deployment scenarios, beam forming, physical layer techniques, interference, and mobility management, **Massive MIMO**: Massive MIMO propagation channel models, Channel Estimation in Massive MIMO, Massive MIMO with Imperfect CSI, Multi-Cell Massive MIMO, Pilot Contamination, Spatial Modulation (SM).

TEXT BOOKS:

1. Wei Xiang · Kan Zheng, Xuemin (Sherman) Shen Editors "5G Mobile Communications", Springer International Publishing Switzerland 2017.
2. Afif Osseiran, Jose F. Monserrat, Patrick Marsch, "5G Mobile and Wireless Communications Technology", Cambridge University Press 2016.
3. Martin Sauter "From GSM From GSM to LTE–Advanced Pro and 5G: An Introduction to Mobile Networks and Mobile Broadband", Wiley-Blackwell.
4. Afif Osseiran, Jose.F.Monserrat, Patrick Marsch, "Fundamentals of 5G Mobile Networks" , Cambridge University Press.
5. Athanasios G.Kanatos, Konstantina S.Nikita, Panagiotis Mathiopoulos, "New Directions in Wireless Communication Systems from Mobile to 5G", CRC Press.

REFERENCES:

1. Jonathan Rodriguez, "Fundamentals of 5G Mobile Networks", John Wiley & Sons.
2. Amitabha Ghosh and Rapeepat Ratasuk "Essentials of LTE and LTE-A", Cambridge University Press.
3. Theodore S.Rappaport, Robert W.Heath, Robert C.Danials, James N.Murdock "Millimeter Wave Wireless Communications", Prentice Hall Communications.
4. Hao Jiang, Guan Gui, "Channel Modeling in 5G Wireless Communication Systems", Wireless Networks, Springer, 2019.

Contribution of Course Outcomes towards achievement of Program Outcomes (PO) and Program Specific outcomes (PSO)
(1 – Low, 2- Medium, 3 – High)

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PS O1	PS O2
CO1	3	3		2									3	
CO2	3	3	2										3	
CO3	2	3		2				2				3		2
CO4			2										3	
CO5	2	2	2			2							3	
CO6	3													2

HONORS COURSE: POOL-III (Communication Engineering) **L T P C**
NRIA20 Reg, Semester - VII **3 1 0 4**

GLOBAL NAVIGATIONAL SATELLITE SYSTEMS

NRI INSTITUTE OF TECHNOLOGY

(An Autonomous Institution Permanently Affiliated to JNTUK, Kakinada)
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POTHAVARAPPADU (V), (VIA) NUNNA, AGIRIPALLI (M), PIN – 521 212

DEPARTMENT OF ELECTRONICS AND COMMUNICATION ENGINEERING

Lecture – Tutorial:	3-1-0 Hours	**Internal Marks:**	30
Credits:	4	**External Marks:**	70

Prerequisites:

Course Objectives:

- To learn concepts of Global navigational satellite System.
- To learn Concepts of Global Positioning System characteristics.
- To understand Concepts of navigation with Indian Constellation.
- To understand concepts and operation of GNSS receiver.
- To learn about types of GNSS errors.

Course Outcomes:

Upon successful completion of the course, the student will be able to:

CO1	Summarize the concepts of Global Navigational Satellite System.
CO2	Apply the concepts of GPS system navigation in real time applications.
CO3	Conclude operation, advantages and applications of NavIC.
CO4	Outline the various characteristics of GNSS receiver.
CO5	Analyze various effects and errors generated in GNSS.
CO6	Emphasize the noise and shadowing effects on GNSS.

Course Content(Syllabus)

UNIT I

INTRODUCTION:- GNSS overview, Global Positioning System, Russian GLONASS system, Galileo satellite system, Chinese BeiDou system, Regional system: Quasi-Zenith Satellite System (QZSS), Navigation with Indian Constellation (NavIC), Augmentations, Markets and Applications.

FUNDAMENTALS OF SATELLITE NAVIGATION:- Concept of Ranging using Time of arrival Measurements: Two-Dimensional Position Determination, Principle of Position Determination via Satellite-Generated Ranging Codes, Fundamentals of satellite orbits: Orbital Mechanics, Constellation Design.

UNIT II

GLOBAL POSITIONING SYSTEM: overview: Space Segment Overview, Control Segment Overview, User Segment Overview, Space segment description: GPS Satellite Constellation Description, Space Segment Phased Development, Control segment description: OCS Current Configuration, User segment: GNSS Receiver Characteristics.

UNIT III

NAVIGATION WITH INDIAN CONSTELLATION (NAVIC): overview, space segment, NavIC control segment, Geodesy and time system, Navigation services, signals, applications and NavIC user equipment.

UNIT IV

GNSS RECEIVER*:* Acquisition: Single Trial Detector, Tong Search Detector, M of N Search Detector, Combined Tong and M of N Search Detectors, FFT-Based Techniques, Direct Acquisition of GPS Military Signals, Vernier Doppler and Peak Code Search, carrier tracking.

UNIT V

GNSS ERRORS: Introduction, Measurement errors: satellite clock error, ephemeris error, relative effects, atmospheric effects, receiver noise and resolution, multipath and shadowing effects, hardware bias errors, Psedo range error budgets.

TEXT BOOKS:

1. Elliott D. Kaplan, Christopher J. Hegarty**, Understanding GPS/GNSS** principles and applications, third edition, artech house publishers, Boston, 2017.

REFERENCES:

1. G S Rao, Global Navigational satellite system, Tata McGraw-Hill education private Ltd, New Delhi, 2010.
2. ISRO-IRNSS-ICD-SPS-1.1, Bangalore, 2017
3. Bhatta, B., 2010. Global Navigation Satellite Systems: Insights Into GPS, Glonass, Galileo, Compass, and Others, BS Publications, New Delhi.
4. Grewal, M. S., Weill, L. R., Andrews, A. P., 2006. Global Positioning Systems, Inertial Navigation, and Integration, John Wiley & Sons, New York.
5. Hofmann-Wellenhof, B., Lichtenegger, H., Wasle, E., 2008. GNSS – Global Navigation Satellite Systems, Springer, Verlag Wien.

Contribution of Course Outcomes towards achievement of Program Outcomes (PO) and Program Specific outcomes (PSO)
(1 – Low, 2- Medium, 3 – High)

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PS O1	PS O2
CO1	3	2											2	
CO2		2			2							3		3
CO3	3	2												
CO4	2			2									2	
CO5	2			3	2									
CO6	2			2									2	

HONORS COURSE: POOL-IV (Digital Signal Processing) **L T P C**
NRIA20 Reg, Semester - IV **3 1 0 4**

SPEECH SIGNAL PROCESSING

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DEPARTMENT OF ELECTRONICS AND COMMUNICATION ENGINEERING

Lecture – Tutorial:	3-1-0 Hours	**Internal Marks:**	30
Credits:	4	**External Marks:**	70

Prerequisites: Signals and Systems, Digital Signal Processing.

Course Objectives:

- Understand the concepts and practical aspects of Speech signal processing.
- Able to model the speech production mechanism, Source-system model of speech.
- To analyze and model the speech signals in different domains
- To extract different feature extraction and utilize these features in various speech processing algorithm development.
- Design of automatic speech recognition (ASR) system.

Course Outcomes:

Upon successful completion of the course, the student will be able to:

CO1	Summarize the mechanism of human speech production and articulation.
CO2	Identify the time domain speech signal parameters.
CO3	Differentiate time and frequency domain methods of speech processing.
CO4	Attribute linear predictive analysis for speech signals.
CO5	Explore the solutions for LPC equations.
CO6	Implement the different algorithms and models involved for speaker and speech recognition Systems.

Course Content(Syllabus)

UNIT I

MECHANICS OF SPEECH: Speech production: Mechanism of speech production, Acoustic phonetics, The Acoustic Theory of Speech Production: Uniform lossless tube, Effects of losses in the vocal tract, Digital models for speech signals: Vocal tract, Radiation, Excitation, Auditory perception: psycho acoustics. Representations of speech waveform: Sampling of speech signals, Quantization.

UNIT II

TIME DOMAIN METHODS FOR SPEECH PROCESSING: Time domain parameters of Speech signal: Short-Time Energy, Average Magnitude, Average Zero crossing Rate, Silence Discrimination using ZCR and energy, Short Time Auto Correlation Function, Pitch period estimation using Auto Correlation Function.

UNIT III

LINEAR PREDICTIVE ANALYSIS OF SPEECH: Basic Principles of linear predictive analysis: Auto correlation method, Covariance method, Solution of LPC equations: Cholesky method, Durbin's Recursive algorithm, Application of LPC parameters: Pitch detection using LPC parameters, Formant analysis using LPC parameters, VELP. Relations Between the Various Speech Parameters, CELP.

UNIT IV

APPLICATION OF SPEECH PROCESSING: Voice response systems: General considerations in the design of voice response systems, A multiple output digital voice response system, Speaker recognition systems: Speaker verification system, Speaker identification system.

UNIT V

HIDDEN MARKOV MODEL (HMM) FOR SPEECH: Hidden Markov Model (HMM) for speech recognition, Viterbi algorithm, Training and testing using HMMS.

TEXT BOOKS:

1. L.R.Rabinerand, R.W.Schaffer, Digital Processing of Speech signals, Prentice Hall, 2004
2. Ben Gold and Nelson Morgan, Speech and Audio Signal Processing, John Wiley and Sons Inc., Singapore, 2004
3. Speech Communications: Human and Machine, Douglas O'Shaughnessy, Wiley, 2nd Ed.2000

REFERENCES:

1. Quatieri, Discrete-time Speech Signal Processing, PrenticeHall,2001.
2. L.R. Rabiner and B. H. Juang, Fundamentals of speech recognition, Prentice Hall,1999.

Contribution of Course Outcomes towards achievement of Program Outcomes (PO) and Program Specific outcomes (PSO)
(1 – Low, 2- Medium, 3 – High)

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PS O1	PS O2
CO1	2	3	2	3				2				2		2
CO2	3	3												3
CO3	3	2		2										2
CO4	3	3			2								3	
CO5	2	3	3										3	
CO6	3												3	

HONORS COURSE: POOL-IV (Digital Signal Processing) **L T P C**
NRIA20 Reg, Semester - V **3 1 0 4**

VIDEO SIGNAL PROCESSING

Lecture – Tutorial:	3-1-0 Hours	**Internal Marks:**	30

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DEPARTMENT OF ELECTRONICS AND COMMUNICATION ENGINEERING

Credits:	4	**External Marks:**	70

Prerequisites: Digital Signal Processing, Digital Image Processing.

Course Objectives:

- To Know an overview of video technology, and analytical framework for video analysis in the frequency domain
- To learn how a continuous-space video signal can be sampled to retain the maximum perceivable information within the affordable data rate.
- To Know about Motion Estimation and basic Video coding techniques
- To Learn about waveform-based methods and block-based hybrid coding framework
- To know about H.261, H.263, MPEG-1, MPEG-2, and MPEG-4 standards for video Coding.

Course Outcomes:

Upon successful completion of the course, the student will be able to:

CO1	Understand the formation of video, its perception and representation, and characterization of video in the frequency domain.
CO2	Understand the concept of Lattice theory, sampling of video signals and sample rate conversion.
CO3	Apply the appropriate motion estimation technique for a given video processing application.
CO4	Comprehend the basics of video processing and video coding.
CO5	Explain the advanced motion estimation techniques and appropriate coding system for a given video.
CO6	Know various video compression standards and applications of modern video coding standards.

Course Content(Syllabus)

UNIT I

VIDEO FORMATION, PERCEPTION, AND REPRESENTATION – color perception and specification – light and color, human perception of color, trichromatic theory of color mixure color specifications by tri stimulation values video capture and display – Analog video raster – Analog color television systems, Digital video and Frequency Domain characterization of Video Signals.

UNIT II

VIDEO SAMPLING – Basics of the Lattice theory, Sampling of Video Signals required sampling rates sampling video in two dimensional sampling a rastar scan sampling video in three dimensionlas spatial and temporal aliasing, Conversion of Signals Sampled on Different Lattices, Sampling Rate Conversion of Video Signals.

UNIT III

TWO-DIMENSIONAL MOTION ESTIMATION-Optical Flow Optical Flow Equation and Ambiguity in Motion Estimation, Motion Estimation Criteria. Block-Matching Algorithm, Exhaustive and fast algorithms, Multi resolution Motion Estimation, Application of Motion Estimation in Video Coding.

UNIT IV

WAVEFORM BASED VIDEO CODING-Predictive coding, Video coding using Temporal prediction and transform coding, Content Dependent Video Coding – Two dimensional shape coding, Texture coding for Arbitrarily shaped Regions.

UNIT V

VIDEO COMPRESSION STANDARDS-Standardization Standards Organizations, Requirements for a Successful Standard, Standard Development Process, Applications for Modern Video Coding Standards-Video Telephony with H.261andH.263-Multimedia content description with MPEG7.

TEXT BOOKS:

1.VideoProcessingandCommunication–1stedition YaoWang,J.Ostermann,YaZhang,PrenticeHall,2001

REFERENCES:

1. Image processing, analysis, and machinevision,2nd Edition ,-Sonka M,Hlavac V,Boyle R.Brooks Cole publishing,1999.
2. Multidimensional, signal, image and video processing and coding,-Woods, Elsevier,Academic press,2006.

Contribution of Course Outcomes towards achievement of Program Outcomes (PO) and Program Specific outcomes (PSO)
(1 – Low, 2- Medium, 3 – High)

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PS O1	PS O2
CO1	2	2		3					2					3
CO2	3	2												3
CO3	3	2		2										3
CO4	2	2	2										2	
CO5	3	3			2							2	2	
CO6		2												3

HONORS COURSE: POOL-IV (Digital Signal Processing) **L T P C**
NRIA20 Reg, Semester - VI **3 1 0 4**

BIOMEDICAL SIGNAL PROCESSING

Lecture – Tutorial:	3-1-0 Hours	**Internal Marks:**	30
Credits:	4	**External Marks:**	70

Prerequisites: Signals and Systems, Digital signal processing, Biomedical engineering.

Course Objectives:

- To introduce the basic signal processing techniques in analyzing biological signals.
- To understand Sources and characteristics of noise and artifacts in bio signals.
- To explore application of established engineering methods to complex biomedical signals problems.

Course Outcomes:

Upon successful completion of the course, the student will be able to:

CO1	Study origins and characteristics of some of the most commonly used biomedical signals, including ECG, EEG, evoked potentials, and EMG.
CO2	Develop a thorough understanding on basics of digital signals and biological signals.
CO3	Find applications related to biomedical signal processing.
CO4	Develop a thorough understanding on basics of signal pre-processing and digital filtering.
CO5	Develop a thorough understanding on basics of ECG and EEG feature extraction.
CO6	Develop a thorough understanding on basics of ECG pattern recognition and classification algorithms.

Course Content (Syllabus)

UNIT I

Acquisition, Generation of Bio-signals, Origin of bio-signals, Types of bio-signals, Study of diagnostically significant bio-signal parameters.

UNIT II

Electrodes for bio-physiological sensing and conditioning, Electrode-electrolyte interface, polarization, electrode skin interface and motion artifact, biomaterial used for electrode, Types of electrodes (body surface, internal, array of electrodes, microelectrodes), Practical aspects of using electrodes, Acquisition of bio-signals (signal conditioning).

UNIT III

Signal conversion (ADC's and DAC's) Processing, Digital filtering, biomedical signal processing by Fourier analysis, Biomedical signal processing by wavelet (time-frequency) analysis, Analysis (Computation of signal parameters that are diagnostically significant).

UNIT IV

Classification of signals and noise, Spectral analysis of deterministic, stationary random signals and non-stationary signals, Coherent treatment of various biomedical signal processing methods and applications.

UNIT V

Principal component analysis, Correlation and regression, Analysis of chaotic signals Application areas of Bio–Signals analysis Multi resolution analysis (MRA) and wavelets, Pattern classification– supervised and unsupervised classification, Neural networks, Support vector Machines, Examples of biomedical signal classification examples.

TEXT BOOKS:

1.W. J. Tompkins, "Biomedical Digital Signal Processing", Prentice Hall,1993.
2. Eugene N Bruce, "Biomedical Signal Processing and Signal Modeling", John Wiley & Son's publication,2001.

REFERENCES:

1. Myer Kutz, "Biomedical Engineering and Design Handbook, Volume I", McGraw Hill, 2009.
2. D C Reddy, "Biomedical Signal Processing", McGraw Hill, 2005.
3. Katarzyn J. Blinowska, Jaroslaw Zygierewicz, "Practical Biomedical Signal Analysis Using MATLAB", 1st Edition, CRC Press,2011.

Contribution of Course Outcomes towards achievement of Program Outcomes (PO) and Program Specific outcomes (PSO)

(1 – Low, 2- Medium, 3 – High)

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PS O1	PS O2
CO1	3	2	-	-	-	-	2	-	-	-	3	-	-	3
CO2	-	3	2	-	-	2	-	-	-	-	-	-	2	-
CO3	2	-	-	3	-	-	-	-	2	-	-	2	-	-
CO4	-	2	-	2	-	-	-	-	-	3	-	-	-	3
CO5	2	-	3	-	-	-	-	3	-	-	-	2	-	-
CO6	-	3	2	-	3	-	-	-	-	-	-	-	-	2

HONORS COURSE: POOL-IV (Digital Signal Processing) **L T P C**

NRIA20 Reg, Semester - VII **3 1 0 4**

DSP PROCESSORS AND ARCHITECTURES

NRI INSTITUTE OF TECHNOLOGY

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DEPARTMENT OF ELECTRONICS AND COMMUNICATION ENGINEERING

Lecture – Tutorial:	3-1-0 Hours	**Internal Marks:**	30
Credits:	4	**External Marks:**	70

Prerequisites: Signals and Systems. Digital Signal Processing and Microprocessors.

Course Objectives:

- To recollect the fundamental concepts of digital signal processing.
- To study the architectures of basic DSP processors.
- To know the architectures and features of commercial DSP processors.
- To write the assembly language programs and implementing them on processors.
- To interface memory and I/O peripherals to DSP processors.

Course Outcomes:

Upon successful completion of the course, the student will be able to:

CO1	Summarize the basics of Digital Signal Processing and transforms.
CO2	Distinguish between the architectural features of general purpose processors and DSP processors.
CO3	Understand the architectures of TMS320C54xx devices and ADSP 2100 DSP devices.
CO4	Analyze the architectures of high performance processors of analog devices family.
CO5	Take part in writing simple assembly language programs using instruction set of TMS320C54xx.
CO6	Interface various devices to DSP Processors.

Course Content (Syllabus)

UNIT-I

INTRODUCTION TO DIGITAL SIGNAL PROCESSING: Introduction, A Digital signal-processing system, The sampling process, Discrete time sequences, Discrete Fourier Transform (DFT) and Fast Fourier Transform (FFT), Linear time-invariant systems, Digital filters, Decimation and interpolation. Computational Accuracy in DSP Implementations: Number formats for signals and coefficients in DSP systems, Dynamic Range and Precision.

UNIT-II

ARCHITECTURES FOR PROGRAMMABLE DSP DEVICES: Basic Architectural features, DSP Computational Building Blocks, Bus Architecture and Memory, Data Addressing Capabilities, Address Generation Unit, Programmability and Program Execution, Speed Issues, Features for External interfacing.

UNIT-III

PROGRAMMABLE DIGITAL SIGNAL PROCESSORS: Commercial digital signal processing devices, Data Addressing modes of TMS320C54XX DSPs, data Addressing modes of TMS320C54XX Processors, Memory space of TMS320C54XX processors, program control, TMS320C54XX instructions and programming, On-Chip Peripherals, Interrupts of TMS320C54XX processors, pipeline Operation of TMS320C54XX Processors.

UNIT-IV

ANALOG DEVICES FAMILY OF DSP DEVICES: Analog Devices Family of DSP Devices ALU and MAC block diagram, Shifter Instruction, Base Architecture of ADSP 2100, ADSP2181 high performance processor. Introduction to Blackfin Processor- The Blackfin Processor, Introduction to Micro signal Architecture, Overview of Hardware Processing Units and Register files, Address Arithmetic Unit, Control Unit, Bus Architecture and Memory, Basic Peripherals.

UNIT-V

INTERFACING MEMORY AND I/O PERIPHERALS TO PROGRAMMABLE DSP DEVICES: Memory space organization, External bus interfacing signals, Memory interface, Parallel I/O interface, Programmed I/O, Interrupts and I/O, Direct memory access (DMA).

TEXT BOOKS:

1. Digital Signal Processing – Avtar Singh and S. Srinivasan, Thomson Publications, 2004.
2. A Practical Approach To Digital Signal Processing - K Padmanabhan, R. Vijayarajeswaran, Ananthi. S, New Age International, 2006/2009.
3. Embedded Signal Processing with the Micro Signal Architecture Publisher: Woon-Seng Gan, Sen M. Kuo, Wiley-IEEE Press, 2007.

REFERENCE BOOKS:

1. Digital Signal Processors, Architecture, Programming and Applications–B. Venkata ramani and M. Bhaskar, 2002, TMH.
2. DSP Processor Fundamentals, Architectures & Features – Lapsley et al., S. Chand & Co.
3. Digital Signal Processing Applications Using the ADSP-2100 Family, Amy Mar, PHI.
4. The Scientist and Engineer's Guide to Digital Signal Processing by Steven W. Smith, California Technical Publishing.
5. Embedded Media Processing, David J. Katz and Rick Gentile of Analog Devices, Newnes.

Contribution of Course Outcomes towards achievement of Program Outcomes (PO) and Program Specific outcomes (PSO)
(1 – Low, 2- Medium, 3 – High)

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PS O1	PS O2
CO1	3	2	2											2
CO2			2		2			2					3	
CO3	2	2												2
CO4	3											3	3	
CO5	2	2	2										2	
CO6	3	3	3											3

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DEPARTMENT OF ELECTRONICS AND COMMUNICATION ENGINEERING

MINORS COURSES – NRIA20 Reg

S.No	Year/Semester	Name of Course	L – T - P	Credits
1	II/IV	Analog Electronics	3 -1 - 0	4
2	III/V	Electronic Communication Systems	3 -1 - 0	4
3	III/VI	Fundamentals of Digital systems	3 -1 - 0	4
4	IV/VII	Signal Analysis	3 -1 - 0	4
In Addition to any of the four subjects, MOOCs/ NPTEL courses for 04 credits (02 courses @ 2 credits each) are compulsory in the domain of Electronics and Communication Engineering.				

Total Credits

Total Credits	20

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DEPARTMENT OF ELECTRONICS AND COMMUNICATION ENGINEERING

Minor Course:IVth Semester **L T P C**
NRIA20 Reg **3 1 0 4**

ANALOG ELECTRONICS

Lecture – Tutorial:	3 –1-0 Hours	**Internal Marks:**	30
Credits:	4	**External Marks:**	70

Prerequisites:

- Fundamentals in semiconductor physics
- Basic knowledge in Mathematics

Course Objectives:

1. Demonstrate the principle and operation of various semiconductor diodes
2. Understand and apply the concepts of transistors and their amplifiers – BJT, FET & MOSFET and their frequency responses
3. Illustrate the concepts of feed back in amplifiers and emphasize on feedback topologies Illustrate various oscillator circuits and its applications using BJT
4. Familiarize with different power amplifier circuits using BJT and design the power amplifier

Course Outcomes:

Upon successful completion of the course, the student will be able to:

CO1	Acquire basic knowledge essential for understanding the operation of electronic circuits
CO2	Explain the working of various semi conductor diodes and their VI characteristics
CO3	Understand the behavior of various transistors and their working as amplifiers and observe their frequency responses
CO4	Interpret the performance of feedback topologies using BJT
CO5	Develop the capability to design oscillator circuits by transistors using the knowledge of positive feedback
CO6	Analyze various power amplifier circuits and calculate their efficiency

Course Content (Syllabus)

UNIT I

TYPES OF DIODES AND DIODE APPLICATIONS:

Basic principle of operation and V I characteristics of diodes: – PN junction diode, Zener diode, LED, Varactor diode, Photo diode and Tunnel diode

Diode applications: clamping circuits and clipping circuits - operation and transfer characteristics

UNIT II

TRANSISTOR AMPLIFIERS:

Bipolar Junction transistors – Working of BJT, Transistor as an amplifier, Types of Configurations CB, CE, CC, Classification of amplifiers, Amplifier configurations of BJT – CB, CE and CC, their operation,

frequency response and applications.

Unipolar Junction Transistors – Working of FET, FET as an amplifier, Types of configurations- CG,CD,CS, FET as Common Source Amplifier its operation and frequency response, Basic concepts of MOSFETs Depletion and Enhancement, amplifiers – Common source MOSFET amplifier only

UNIT III

FEEDBACK AMPLIFIERS:

Feedback concept, types of feedback, general characteristics of negative feedback, Block diagram representation of feedback topologies, Method of analysis of negative feedback amplifier, Comparison of feedback amplifiers

UNIT IV

OSCILLATORS:

Oscillatory circuit, conditions for oscillations, classification of oscillators, RC oscillators- basic principle and working of RC phase shift and Wien bridge oscillators, LC oscillators – basic principle and working of Hartley and Colpitts oscillators, Working of crystal oscillator

UNIT V

POWER AMPLIFIERS:

Classification of power amplifiers, class A power amplifier – series fed and transformer coupled, efficiency of class A amplifier, class B power amplifier – class B push pull amplifier and Complementary symmetry class B push pull amplifiers, efficiency of class A amplifier, class AB push pull amplifier, thermal runaway, thermal stability, heat sinks.

TEXT BOOKS:

1. Integrated Electronics Analog Digital Circuits, Jacob Millman and D. Halkias, McGraw Hill
2. Electronic Circuit Analysis for JNTU, S Salivahanan, N Suresh Kumar
3. Robert L. Boylestad, Louis Nashelsky, ―Electronic Devices and Circuits Theory, Pearson education

REFERENCE BOOKS:

1. Electronic Circuit Analysis- K.LalKishore, K. Lal Kishore B.S Publications
2. G. K. Mithall, Electronic Devices and Circuits, Khanna Publishers, New Delhi.
3. Electronic Circuit Analysis, A.P Godse, U.A Bakshi , Technical Publications
4. Electronic Circuit Analysis - K.S. Srinivasan, Anurdha Agencies

Contribution of Course Outcomes towards achievement of Program Outcomes (PO) and Program Specific outcomes (PSO)

(1 – Low, 2- Medium, 3 – High)

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PS O1	PS O2
CO1	3	3	2											3

CO2	2	2										2		3
CO3		3		3			2							2
CO4	3	2	2	2										3
CO5	3	3		2										3
CO6	2	2											2	

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POTHAVARAPPADU (V), (VIA) NUNNA, AGIRIPALLI (M), PIN – 521 212

DEPARTMENT OF ELECTRONICS AND COMMUNICATION ENGINEERING

Minor Course: Vth Semester **L T P C**
NRIA20 Reg **3 1 0 4**

ELECTRONIC COMMUNICATION SYSTEMS

Lecture – Tutorial:	3-1-0 Hours	**Internal Marks:**	30
Credits:	4	**External Marks:**	70

Prerequisites: Basics of Communications, Signals and Systems.

Course Objectives:

- Familiarize with the fundamentals of analog and digital communication systems.
- Familiarize with various techniques for analog as well as digital modulation and demodulation of signals.
- To understand the influence of noise on the performance of the communication systems.
- Familiarize with basic techniques for generating and demodulating various analog and digital pulse modulated signals.

Course Outcomes:

Upon successful completion of the course, the student will be able to:

CO1	Understand basic elements of analog and digital communication system.
CO2	Demonstrate various analog and digital modulation and demodulation techniques.
CO3	Compute the power and bandwidth requirements of various modulation schemes.
CO4	Analyze the performance of modulation and demodulation techniques in various transmission environments.
CO5	Analyze various analog and digital pulse modulation and demodulation techniques.
CO6	Evaluate the performance of the communication system in the presence of noise.

Course Content (Syllabus)

UNIT I

AMPLITUDE MODULATION : Introduction to communication systems, Need for modulation, Frequency Division Multiplexing , Amplitude Modulation, Definition, Time domain and frequency domain description, single tone modulation, power relations in AM waves, Generation of AM waves, square law Modulator, Switching modulator, Detection of AM Waves; Square law detector, Envelope detector.

UNIT II

DSB & SSB MODULATION: Double side band suppressed carrier modulators, time domain and frequency domain description, Generation of DSBSC Waves, Balanced Modulators, Ring Modulator, Coherent detection of DSB-SC Modulated waves, COSTAS Loop. Frequency domain description, Frequency discrimination method for generation of AM SSB Modulated Wave, Time domain description, Phase discrimination method for generating AMSSB Modulated waves. Demodulation of SSB Waves, Comparison of AM Techniques, Applications of different AM Systems, FDM.

UNIT III

ANGLE MODULATION: Basic concepts, Frequency Modulation: Single tone frequency modulation, Spectrum Analysis of Sinusoidal FM Wave, Narrowband FM, Wideband FM, Constant Average Power, Transmission bandwidth of FM Wave- Generation of FM Waves, Detection of FM Waves: Balanced Frequency discriminator, Zero crossing detector, Phase locked loop. Comparison of FM & AM.

UNIT IV

PULSE DIGITAL MODULATION: Elements of digital communication systems, advantages of digital communication systems, Elements of PCM: Sampling, Quantization & Coding, Quantization error, Companding in PCM systems. Differential PCM systems (DPCM), Delta modulation, its draw backs, adaptive delta modulation, comparison of PCM and DM systems, noise in PCM and DM systems.

UNIT V

DIGITALMODULATIONTECHNIQUES:Introduction,ASK,FSK,PSK,DPSK,DEPSK,QPSK,M-aryPSK,ASK,FSK, similarity of BFSK and BPSK.

TEXT BOOKS:

1. Principles of Communication Systems–HTaub&D.Schilling, GautamSahe, TMH, 3rd Edition, 2007.
2. Principles of Communication Systems-Simon Haykin, John Wiley, 2nd Edition, 2007.
3. Modern Digital and Analog Communication Systems –B.P.Lathi, Zhi Ding, Hari Mohan Gupta, Oxford University Press, 4th Edition, 2017
4. Digital communications- Simon Haykin, JohnWiley,2005
5. Digital and Analog Communication Systems -SamShanmugam, JohnWiley, 2005.

REFERENCES:

1. Electronics & Communication System– George Kennedy and Bernard Davis, TMH 2004.
2. Communication Systems–R.P.Singh, SP Sapre, Second Edition TMH, 2007.
3. Electronic Communication systems–Tomasi, Pearson, fourth Edition, 2007.
4. Principles of Communication Systems–H.Tauband D. Schilling, TMH,2003
5. Digital Communications–John Proakis, TMH, 1983.
6. Communication Systems Analog & Digital– Singh & Sapre, TMH, 2004.
7. Modern Digital and Analog Communication Systems–B.P.Lathi, ZhiDing, Hari Mohan Gupta, Oxford University Press, 4th Edition, 2017.

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(1 – Low, 2- Medium, 3 – High)

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PS O1	PS O2

CO1	3	2	-	-	-	-	2	-	-	-	3	-	-	3
CO2	-	3	2	-	-	2	-	-	-	-	-	-	2	-
CO3	2	-	-	3	-	-	-	-	2	-	-	2	-	-
CO4	-	2	-	2	-	-	-	-	-	3	-	-	-	3
CO5	2	-	3	-	-	-	-	3	-	-	-	2	-	-
CO6	-	3	2	-	3	-	-	-	-	-	-	-	-	2

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DEPARTMENT OF ELECTRONICS AND COMMUNICATION ENGINEERING

Minor Course: VI th Semester **L T P C**
NRIA2O Reg **3 0 0 3**

FUNDAMENTALS OF DIGITAL SYSTEMS

Lecture – Tutorial:	3-1 Hours	**Internal Marks:**	30
Credits:	4	**External Marks:**	70

Prerequisites: Basic Mathematics, Basic Electronics.

Course Objectives:

- To learn the characteristics of various types of logic families.
- To understand concepts of combinational circuits
- To develop advanced sequential circuits.
- To understand the importance of memories in digital systems.

Course Outcomes:

Upon successful completion of the course, the student will be able to:

CO1	Summarize about different types of logic families
CO2	Apply the concepts of combinational circuits to design advance digitals systems.
CO3	Build various sequential circuits to design advanced digital systems.
CO4	Analyze the importance of memories in digital systems.
CO5	Understand the architecture of CPLD and FPGA to program various digital circuits.
CO6	Apply the concepts to specific applications using ASIC and SoC.

Course Content(Syllabus)

UNIT I

Introduction of Logic Families: Diode Logic (DL), Resistor Transistor Logic (RTL), Diode Transistor Logic (DTL), Transistor- Transistor Logic (TTL), Emitter Coupled Logic (ECL) or Current Mode Logic (CML), Integrated Injection Logic (IIL), Characteristics of Logic Families, Uni-Polar and Bi-Polar Logic Families.

UNIT II

Combinational circuits Design: 4- bit adder-sub tractor circuit, BCD adder circuit, Excess 3 adder circuit and carry look-a-head adder circuit, Design of encoder , decoder, multiplexer and de-multiplexers,. Design of Priority encoder, 4-bit digital comparator and seven segment decoder.

UNIT III

Sequential circuits Design: Classification of sequential circuits (synchronous and asynchronous) , operation of NAND & NOR Latches and flip-flops; truth tables and excitation tables of RS flip-flop, JK flip-flop, T flip-flop, D flip-flop with reset and clear terminals. Conversion from one flip-flop to another flip-flop. Design of registers - Buffer register, control buffer register, shift register, bidirectional shift register, universal shift, register

UNIT IV

Memories: Programmable Logic Devices PLDs: Programmable Read Only Memory(PROM),Programmable Array Logic(PAL),Programmable Logic Array(PLA) Types of ROM: PROM(Programmable Read only Memory),EPROM(Erasable Programmable Read only Memory),EEPROM(Electrically Erasable Programmable Read only Memory),MROM(Mask ROM).

UNIT V

Types of RAM: Static Random Access Memory (SRAM), Dynamic Random Access Memory (DRAM), Types of DRAM: DDR, SDRAM, CDRAM. Introduction of CPLD, FPGA, difference between CPLD, Field Programmable Gate Array (FPGA), Application Specific Integrated Circuit (ASIC), System on Chip (SoC)

TEXT BOOKS:

1. Switching and finite automata theory Zvi. KOHAVI, Niraj.K.Jha 3rd Edition, Cambridge University Press,2009
2. Digital Design by M.Morris Mano, Michael D Ciletti,4th edition PHI publication,2008
3. Switching theory and logic design by Hill and Peterson, Mc-Graw Hill TMH edition, 2012.

REFERENCES:

1. Fundamentals of Logic Design by Charles H. Roth Jr, Jaico Publishers,2006
2. Digital electronics by R S Sedha.S.Chand& company limited,2010
3. Switching Theory and Logic Design by A. Anand Kumar, PHI Learning pvt ltd,2016.
4. Digital logic applications and design by John M Yarbough, Cengage learning, 2006.TTL 74-Series data book.

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(1 – Low, 2- Medium, 3 – High)

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PS O1	PS O2
CO1	3	2												3
CO2	2	3										2		3
CO3		2		2										2
CO4	3			2										2
CO5	3	2											2	
CO6	2													

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DEPARTMENT OF ELECTRONICS AND COMMUNICATION ENGINEERING

Minor Course: VII th Semester **L T P C**
NRIA20 Reg **3 1 0 4**

SIGNAL ANALYSIS

Lecture – Tutorial:	3-1 Hours	**Internal Marks:**	30
Credits:	4	**External Marks:**	70

Prerequisites: Engineering Mathematics –I, Engineering Mathematics –II.

Course Objectives:

- To introduce the terminology of signals and systems.
- To study Fourier tools to convert signal from time domain to frequency domain and analyze the spectral characteristics.
- To know the importance of convolution and correlation.
- To understand the concept of sampling and reconstruction of signals.
- To study Laplace-transform as mathematical tool to convert signals from time domain to complex frequency domain, and also study Z-transform as mathematical tool to analyze discrete-time signals.

Course Outcomes:

Upon successful completion of the course, the student will be able to:

CO1	Learn the basic concepts of signals and differentiate various classifications of signals.
CO2	Analyze the frequency domain representation of signals using Fourier concepts.
CO3	Understand the concept of convolution, correlation and relate them.
CO4	Illustrate the sampling-reconstruction process and various types of sampling techniques.
CO5	Apply Laplace transforms to analyze continuous time signals.
CO6	Apply Z-transforms to analyze discrete time signals.

Course Content (Syllabus)

UNIT-I

INTRODUCTION: Definition of Signals and Systems, Classification of Signals, Classification of Systems, Operations on signals: time-shifting, time-scaling, amplitude- shifting, amplitude-scaling. related problems. Complex exponential and sinusoidal signals, Singularity functions and related functions: impulse function, step function, signum function and ramp function.

UNIT-II

FOURIER ANALYSIS OF PERIODIC SIGNALS: Fourier series representation of continuous time periodic signals, properties of Fourier series, Dirichlet's conditions, Trigonometric Fourier series and Exponential Fourier series, Relation between Trigonometric and Exponential Fourier series, Complex Fourier spectrum.

UNIT-III

FOURIER ANALYSIS OF APERIODIC SIGNALS: Deriving Fourier transform from Fourier series, Fourier transform of arbitrary signal, Fourier transform of standard signals, Fourier transform of periodic signals, properties of Fourier transforms. related problems.

UNIT-IV

CORRELATION: Auto-correlation and cross-correlation of functions, properties of correlation function, Energy density spectrum, Parseval's theorem, Power density spectrum, Relation between convolution and correlation. **SAMPLING THEOREM:** Graphical and analytical proof for Band Limited Signals, impulse sampling, Natural and Flat top Sampling, Reconstruction of signal from its samples, effect of under sampling – Aliasing, related problems.

UNIT-V

LAPLACE TRANSFORMS: Introduction**,** Concept of region of convergence (ROC) for Laplace transforms, constraints on ROC for various classes of signals, Properties of L.T's, Inverse Laplace transform, Partial fraction expansion, Relation between L.T and F.T. of a signal. **Z–TRANSFORMS:** Concept of Z- Transform of a discrete sequence. Region of convergence in Z-Transform, constraints on ROC for various classes of signals, Inverse Z- transform, properties of Z-transforms. Distinction between Laplace, Fourier and Z transforms.

TEXT BOOKS:

1. Signals, Systems & Communications - B.P. Lathi, BS Publications,2003.
2. Signals and Systems - A.V. Oppenheim, A.S. Willsky and S.H. Nawab, PHI,2nd Edn,1997
3. Signals & Systems- A.Anand Kumar –2nd Edition, PHI, 2012.

REFERENCE BOOKS:

1.Principles of Linear Systems and Signals – BP Lathi, Oxford University Press,2015
2. Signals and Systems – T K Rawat , Oxford University press,2011
3. Signals & Systems - Simon Haykin and Van Veen,Wiley, 2nd Edition.
4. Signals and Systems - K R RajeswariB.VisvesvaraRao, "Signals & Systems" –1st Edition, PHI, 2009.

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(1 – Low, 2- Medium, 3 – High)

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PS O1	PS O2
CO1	3	3								2		3		3
CO2	2	3	2									2		3
CO3	2	2												3
CO4	3	2		2									2	
CO5	3	2											2	
CO6	3											2	2	