22MTC01

CALCULUS
(ECE)

Instruction	3 L+1T Hours per week
Duration of SEE	3 Hours
SEE	60 Marks
CIE	40 Marks
Credits	4

COURSE OBJECTIVES: This course aim is to

1. To explain the Partial Derivatives and the extreme values of functions of two variables.
2. To discuss Physical interpretations of scalar and vector functions.
3. To discuss vector line, surface and volume integrals.
4. To explain the concepts of basis, dimension of vector space and matrix representation of a linear transformation.
5. To explain the solution of system of linear equations by Matrix Methods.

COURSE OUTCOMES: After completion of this course, students will be able to

1. Determine the extreme values of functions of two variables.
2. Apply the vector differential operator to scalar and vector functions
3. Solve line, surface & volume integrals by Greens, Gauss and Stoke's theorems.
4. Determine the basis and dimension of a vector space, compute linear transformation.
5. Apply the Matrix Methods to solve the system of linear equations

CO-PO ARTICULATION MATRIX

PO/CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO 1	3	3	3	3	-	-	-	-	-	-	-	2
CO 2	3	3	3	3	-	-	-	-	-	-	-	2
CO 3	3	3	3	3	-	-	-	-	-	-	-	2
CO 4	3	3	3	3	-	-	-	-	-	-	-	1
CO 5	3	3	3	3	-	-	-	-	-	-	-	1

UNIT I

Partial Differentiation and Its Applications: Functions of two or more variables, Partial derivatives, Higher order partial derivatives, Total derivative, Differentiation of implicit functions, Jacobians, Taylor's expansion of functions of two variables, Maxima and minima of functions of two variables.

UNIT II

Vector Differential Calculus and multiple Integrals: Scalar and Vector point functions, vector operator Del, Gradient, Directional derivative, Divergence, Curl, Del applied twice to point functions, Del applied to product of point functions (vector identities), Irrotational fields and Solenoidal fields, Double integral, Change of order of Integration and Triple integrals.

UNIT III

Vector Integral Calculus: Line integral, Surface integral and Volume integral. Verification of Green's theorem in a plane (without proof), verification of Stroke's theorem (without proof) and Gauss's divergence theorem (without proof).

UNIT IV

Vector space: Vector space, Subspace, linear combination of vectors, linear span, row and column spaces, linear dependent, independent vectors, basis, dimension, linear transformation, invertible transformation, matrix of linear transformation, kernel and range of LT, rank and nullity of LT-rank nullity theorem(without proof), change of basis.

UNIT V

Matrices: Rank of a matrix, Echelon form, consistency of linear System of equations, Eigen values, Eigenvectors, Properties of Eigen values, Cayley-Hamilton theorem, Quadratic forms, Reduction of quadratic form to canonical form by linear transformation, Nature of quadratic form.

TEXT BOOKS:

1. B.S. Grewal, "Higher Engineering Mathematics", 44th Edition, Khanna Publishers, 2017.
2. Erwin kreyszig, "Advanced Engineering Mathematics", 9th Edition, John Wiley & Sons, 2006.
3. Seymour Lipschutz, "Schaum's Outline of Linear Algebra", 5th Edition, McGraw Hill, 2013.
4. Gilbert Strang, "Introduction to linear algebra", 5th Edition, Wellesley - Cambridge press, 2016.

SUGGESTED READING:

1. Veerarajan T., "Engineering Mathematics for first year", Tata McGraw- Hill, New Delhi, 2008.
2. R.K. Jain, S.R.K. Iyengar, "Advanced Engineering Mathematics", Narosa Publications, 5th edition, 2016.
3. D. Poole, "Linear Algebra: A Modern Introduction, 2nd Edition", Brooks/ Cole, 2005.
4. Kuldeep Singh, "Linear algebra: step by step". OUP Oxford, 2013.

22CYC01

CHEMISTRY
(ECE)

Instruction	3L Hours per Week
Duration of SEE	3 Hours
SEE	60 Marks
CIE	40 Marks
Credits	3

COURSE OBJECTIVES: This course aim is to

1. This syllabus helps at providing the concepts of chemical bonding and chemical kinetics to the students aspiring to become practicing engineers
2. Thermodynamic and Electrochemistry units give conceptual knowledge about processes and how they can be producing electrical energy and efficiency of systems.
3. To teach students the value of chemistry and to improve the research opportunities knowledge of stereochemistry and organic reactions is essential.
4. Water chemistry unit impart the knowledge and understand the role of chemistry in the daily life.
5. New materials lead to discovering of technologies in strategic areas for which an insight into Polymers, nanomaterials and basic drugs of modern chemistry is essential.

COURSE OUTCOMES: After completion of this course, students will be able to

At the end of the course student will be able to:

1. Identify the microscopic chemistry in terms of molecular orbitals, intermolecular forces and rate of chemical reactions.
2. Discuss the properties and processes using thermodynamic functions, electrochemical cells and their role in batteries and fuel cells.
3. Illustrate the major chemical reactions that are used in the synthesis of organic molecules.
4. Classify the various methods used in treatment of water for domestic and industrial use.
5. Outline the synthesis of various Engineering materials & Drugs.

CO-PO ARTICULATION MATRIX

PO/CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO 1	3	2	2	-	-	2	2	-	-	-	-	2
CO 2	3	2	2	-	-	2	2	-	-	-	-	2
CO 3	3	2	3	-	-	2	2	-	-	-	-	2
CO 4	3	2	3	-	-	2	2	-	-	-	-	2
CO 5	3	2	2	-	-	2	2	-	-	-	-	2

UNIT I

Atomic and molecular structure and Chemical Kinetics:

Atomic and molecular structure: Molecular Orbital theory - atomic and molecular orbitals. Linear combination of atomic orbitals (LCAO) method. Molecular orbitals of diatomic molecules. Molecular Orbital Energy level diagrams (MOED) of diatomic molecules & molecular ions (H_2, He_2^+, N_2 , O_2 , O_2^- , CO, NO). Pi- molecular orbitals of benzene and its aromaticity.

Chemical Kinetics: Introduction, Terms involved in kinetics: rate of reaction, order & molecularity; First order reaction Characteristics: units of first order rate constant & its half-life period, second order reaction Characteristics: units of second order rate constant & its half- life period. Numericals.

UNIT II

Use of free energy in chemical equilibria

Use of free energy in chemical equilibria: Thermodynamic functions: Internal energy, entropy and free energy. Significance of entropy and free energy (criteria of spontaneity). Free energy and emf (Gibbs Helmholtz equations and its applications). Cell potentials, electrode potentials, and Reference electrodes (NHE, SCE) electrochemical series. Nernst equation and its applications. Determination of pH using combined Glass & Calomel electrode. Potentiometric Acid base & Redox Titrations. Numericals.

Battery technology: Rechargeable batteries & Fuel cells.

Lithium batteries: Introduction, construction, working and applications of Li-MnO_2 and Li-ion batteries.

Fuel Cells: Introduction, difference between conventional cell and fuel cell, limitations & advantages. Construction, working & applications of methanol-oxygen fuel cell.

UNIT III

Stereochemistry and Organic reactions

Stereochemistry: Representations of 3 dimensional structures, Types of stereoisomerism- Conformational isomerism – confirmations of n-butane (Newman and sawhorse representations), Configurational isomerism - Geometrical (cis-trans) isomerism & Optical isomerism- optical activity, Symmetry and chirality: Enantiomers (lactic acid) & Diastereomers (Tartaric acid), Absolute configurations, Sequence rules for R&S notation.

Types of Organic reactions: Substitution Reactions- Electrophilic substitution (Nitration of Benzene); Nucleophilic Substitution (S_N1& S_N2); Free Radical Substitution (Halogenation of Alkanes)

Addition Reactions: Electrophilic Addition – Markonikoff's rule, Free radical Addition - Anti Markonikoff's rule (Peroxide effect), Nucleophilic Addition – (Addition of HCN to carbonyl compounds)

Eliminations-E1 and E2 (dehydrohalogenation of alkyl halides), Cyclization (Diels - Alder reaction)

UNIT IV

Water Chemistry: Hardness of water – Types, units of hardness, Disadvantages of hard water, Alkalinity and Estimation of Alkalinity of water, Boiler troubles - scales & sludge formation, causes and effects, Softening of water by lime soda process (Cold lime soda process), ion exchange method and Reverse Osmosis. Specifications of potable water & industrial water. Disinfection of water by Chlorination; break point chlorination, BOD and COD definition, Estimation (only brief procedure) and significance, Numericals.

UNIT V

Engineering Materials and Drugs: Introduction, Terms used in polymer science; Thermoplastic polymers (PVC) &Thermosetting polymers (Bakelite); Elastomers (Natural rubber). Conducting polymers- Definition, classification and applications.

Polymers for Electronics: Polymer resists for integrated circuit fabrication, lithography and photolithography: Nano materials-Introduction to nano materials and general applications, basic chemical methods of preparation- Sol-gel method. Carbon nanotubes and their applications. Characterisation of nanomaterials by SEM and TEM (only Principle). Drugs-Introduction, Synthesis and uses of Aspirin (analgesic), Paracetamol (Antipyretic), Atenolol (antihypertensive).

TEXT BOOKS:

1. P.C. Jain and M. Jain, "Engineering Chemistry", Dhanpat Rai Publishing Company Ltd., New Delhi,16th edition (2015).
2. W.U. Malik, G.D.Tuli and R.D.Madan, "Selected topics in Inorganic Chemistry", S Chand & Company Ltd, New Delhi, reprint (2009).
3. R.T. Morrison, R.N. Boyd and S.K. Bhattacharjee, "Organic Chemistry", Pearson, Delhi, 7th edition (2019).
4. A Textbook of Polymer Science and Technology , Shashi Chawla ,Dhanpat Rai & Co. (2014)
5. T. Pradeep, Nano: The Essentials, Tata McGraw-Hill Education, Delhi, 2012
6. G.L. David Krupadanam, D. Vijaya Prasad, K. Varaprasad Rao, K.L.N. Reddy and C.Sudhakar, "Drugs", Universities Press (India) Limited, Hyderabad (2007).

SUGGESTED READING:

1. B. H. Mahan, "University Chemistry", Narosa Publishing house, New Delhi, 3rd edition (2013).
2. B.R. Puri, L.R. Sharma and M.S. Pathania, "Principles of Physical Chemistry", S. Nagin Chand & Company Ltd., 46th edition (2013).
3. T.W. Graham Solomons, C.B. Fryhle and S.A. Snyder, "Organic Chemistry", Wiley, 12th edition (2017).
4. P.W. Atkins, J.D. Paula, "Physical Chemistry", Oxford, 8th edition (2006).

22EEC01

BASIC ELECTRICAL ENGINEERING

Instruction	3 Hours per week
Duration of SEE	3 Hours
SEE	60 Marks
CIE	40 Marks
Credits	3

COURSE OBJECTIVES: This course aim is to

1. To understand the behaviour of different circuit elements R, L & C, and the basic concepts of electrical AC circuit analysis
2. To comprehend the basic principle of operation of AC and DC machines
3. To infer about different types of electrical wires and cables, domestic and industrial wiring, safety rules and methods of earthing.

COURSE OUTCOMES: After completion of this course, students will be able to

1. Understand the concepts of Kirchhoff's laws and their application various theorems to get solution of simple dc circuits.
2. Predict the steady state response of RLC circuits with AC single phase/three phase supply.
3. Infer the basics of single phase transformer
4. Describe the construction, working principle of DC machine and 3-phase Induction motor.
5. Acquire the knowledge of electrical wires, cables, earthing, Electrical safety precautions to be followed in electrical installations and electric shock and its safety and energy calculations.

CO-PO ARTICULATION MATRIX

PO/CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO-1	3	3	2	-	-	-	-	-	1	2	-	3
CO-2	3	3	2	-	-	-	-	-	1	2	-	3
CO-3	3	3	2	1	-	-	-	-	1	2	-	3
CO-4	2	1	-	-	-	-	-	-	1	2	-	3
CO-5	2	-	2	-	-	-	-	-	1	2	-	3

UNIT I

DC Circuits: Electrical circuit elements (R,L and C), voltage and current sources, Kirchhoff current and voltage laws, analysis of simple circuits with dc excitation, Superposition, Thevenin's and Norton's Theorems.

UNIT II

AC Circuits: Representation of sinusoidal waveforms, peak and RMS values, phasor representation, real power, reactive power, apparent power, power factor, Analysis of single-phase ac circuits consisting of R, L, C, series RL and RC. Three phase balanced circuits, voltage and current relations in star and delta connections.

UNIT III

Single Phase Transformer: Construction, Working principle, EMF Equation, Ideal and Practical transformer, Equivalent circuit of Transformer, OC and SC tests on a transformer, Efficiency and Regulation

UNIT IV

DC and AC Machines: DC Generators: Construction, Principle of operation, EMF equation, Classification, Characteristics of shunt generators. DC Motors: Classification, Torque Equation, Characteristics and Speed control of DC Shunt and Series Motors, Losses and efficiency Three - Phase Induction Motors: Principle of operation, Applications

UNIT V

Electrical Installations: Electrical Wiring: Types of wires and cables, Electrical Safety precautions in handling electrical appliances, electric shock, and first aid for electric shock, safety rules. Components of LT Switchgear: Switch Fuse Unit (SFU), MCB, ELCB, Earthing (Elementary Treatment only), Elementary calculations for energy consumption

TEXT BOOKS:

1. L. S. Bobrow, Fundamentals of Electrical Engineering, Oxford University Press, 2011.
2. E. Hughes, Electrical and Electronics Technology, Pearson, 2010.

SUGGESTED READING:

1. D. P. Kothari & I. J. Nagrath, “Basic Electrical Engineering”, Tata McGraw Hill, 2010.
2. V. D. Toro, “Electrical Engineering Fundamentals”, Prentice Hall India, 1989
3. D.C. Kulshreshtha, “Basic Electrical Engineering”, McGraw Hill, 2009
4. P.V. Prasad, S. Sivanagaraju, R. Prasad, "Basic Electrical and Electronics Engineering" Cengage Learning, 1st Edition, 2013

22CSC02

PROBLEM SOLVING AND PROGRAMMING LAB

Instruction	3P Hours per week
Duration of SEE	3 Hours
SEE	50 Marks
CIE	50 Marks
Credits	1.5

COURSE OBJECTIVES: This course aim is to

1. Master the fundamentals of writing Python scrips.
2. Learn Python elements such as variables, flow controls structures, and functions.
3. Discover how to work with lists and sequence data, and files.

COURSE OUTCOMES: After completion of this course, students will be able to

1. Understand various Python program development Environments.
2. Demonstrate the concepts of Python.
3. Implement algorithms/flowcharts using Python to solve real-world problems.
4. Build and manage dictionaries to manage data.
5. Write Python functions to facilitate code reuse.
6. Use Python to handle files and memory.

CO-PO ARTICULATION MATRIX

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

LABORATORY / PRACTICAL EXPERIMENTS:

1. Explore various Python Program Development Environments.
2. Demonstration of input/output operations.
3. Demonstration of operators.
4. Demonstration of selective control structures.
5. Demonstration of looping control structures.
6. Demonstration of List, Tuple and Set
7. Demonstration of Python Dictionaries.
8. Implementation of searching and sorting techniques.
9. Implementation of string manipulation operations.
10. File handling and memory management operations.

TEXT BOOKS AND REFERENCES:

1. R.S. Salaria, “Programming for Problem Solving”, First Edition, Khanna Book Publishing Co., Delhi.
2. Jeeva Jose, “Taming Python by Programming”, Revised Edition, Khanna Book Publishing Co., Delhi.
3. Mark Lutz, “Learning Python”, 5th Edition, , O'Reilly Media, Inc.,
4. Python Crash Course: A Hands-On, Project-Based Introduction to Programming by Eric Matthes, No Starch Press.
5. “Programming in Python”, R.S. Salaria, Khanna Book Publishing Co., Delhi.

NPTEL/SWAYAM COURSES:

1. Introduction to Problem Solving and Programming, Video Lectures, Prof. D Gupta, IIT Delhi.
2. Problem Solving Aspects and Python Programming, Dr. S Malinga, Dr Thangarajan, Dr. S V Kogilavani, Kongu Engineering College.
3. https://www.coursera.org/specializations/python-3-programming.

22CYC02

CHEMISTRY LAB

Instruction:	3P Hours per Week
Duration of SEE:	3 Hours
SEE:	50 Marks
Continuous Internal Evaluation:	50 Marks
Credits:	1.5

COURSE OBJECTIVES: This course aim is to

1. To impart fundamental knowledge in handling the equipment / glassware and chemicals in chemistry laboratory.
2. To provide the knowledge in both qualitative and quantitative chemical analysis
3. The student should be conversant with the principles of volumetric analysis
4. To apply various instrumental methods to analyse the chemical compounds and to improve understanding of theoretical concepts.
5. To interpret the theorical concepts in the preparation of new materials like drugs and polymers.

COURSE OUTCOMES: At the end of the course, student will be able to

1. Identify the basic chemical methods to analyse the substances quantitatively & qualitatively.
2. Estimate the amount of chemical substances by volumetric analysis.
3. Determine the rate constants of reactions from concentration of reactants/ products as a function of time.
4. Calculate the concentration and amount of various substances using instrumental techniques.
5. Develop the basic drug molecules and polymeric compounds.

CO-PO ARTICULATION MATRIX

PO/CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO 1	3	2	2	-	-	2	2	-	-	-	-	2
CO 2	3	2	1	-	-	1	2	-	-	-	-	2
CO 3	3	2	3	-	-	2	2	-	-	-	-	2
CO 4	3	2	2	-	-	2	2	-	-	-	-	2
CO 5	3	2	3	-	-	2	2	-	-	-	-	2

LIST OF EXPERIMENTS:

1. Introduction: Preparation of standard solution of oxalic acid and standardisation of NaOH.
2. Estimation of metal ions (Co^{+2} & Ni^{+2}) by EDTA method.
3. Estimation of temporary and permanent hardness of water using EDTA solution
4. Determination of Alkalinity of water
5. Determination of rate constant for the reaction of hydrolysis of methyl acetate. (first order)
6. Determination of rate constant for the reaction between potassium per sulphate and potassium Iodide. (second order)
7. Estimation of amount of HCl Conductometrically using NaOH solution.
8. Estimation of amount of HCl and CH_3COOH present in the given mixture of acids Conductometrically using NaOH solution.
9. Estimation of amount of HCl Potentiometrically using NaOH solution.
10. Estimation of amount of Fe^{+2} Potentiometrically using $KMnO_4$ solution.
11. Preparation of Nitrobenzene from Benzene.
12. Synthesis of Aspirin drug and Paracetamol drug.
13. Synthesis of phenol formaldehyde resin.

TEXT BOOKS:

1. J. Mendham and Thomas, "Vogel's text book of quantitative chemical analysis", Pearson education Pvt.Ltd. New Delhi , 6th ed. 2002.
2. Senior practical physical chemistry by B.D.Khosla, V.C.Garg & A.Gulati,; R. Chand & Co. : New Delhi (2011).

SUGGESTED READINGS:

1. Dr. Subdharani, "Laboratory Manual on Engineering Chemistry", Dhanpat Rai Publishing, 2012.
2. S.S. Dara, "A Textbook on experiment and calculation in engineering chemistry", S.Chand and Company, 9th revised edition, 2015.

22MBC02

COMMUNITY ENGAGEMENT

Instruction	3P Hours per week
SEE	Nil
CIE	50 Marks
Credits	1.5

COURSE OBJECTIVES: This course aim is to

1. Develop an appreciation of Rural culture, life-style and wisdom among the Students.
2. Learn about the various livelihood activities that contribute to Rural economy.
3. Familiarize the Rural Institutions and the Rural Development Programmes in India.

COURSE OUTCOMES: After completion of this course, students will be able to

1. Gain an understanding of Rural life, Culture and Social realities.
2. Develop a sense of empathy and bonds of mutuality with Local Communities.
3. Appreciate significant contributions of Local communities to Indian Society and Economy.
4. Exhibit the knowledge of Rural Institutions and contributing to Community's Socio Economic improvements.
5. Utilise the opportunities provided by Rural Development Programmes.

Module I

Appreciation of Rural Society: Rural life style, Rural society, Caste and Gender relations, Rural values with respect to Community, Nature and Resources, elaboration of 'soul of India lies in villages' (Gandhi), Rural Infrastructure.

Module II

Understanding Rural Economy and Livelihood: Agriculture, Farming, Landownership, Water management, Animal Husbandry, Non-farm Livelihood and Artisans, Rural Entrepreneurs, Rural markets, Rural Credit Societies, Farmer Production Organization/Company.

Module III

Rural Institutions: Traditional Rural organizations, Self-Help Groups, Panchayati Raj Institutions (Gram Sabha), Gram Panchayat, Standing Committees, Local Civil Society, Local Administration.

Module IV

Rural Development Programmes: History of Rural Development in India, Current National Programmes: Sarva Shiksha Abhiyan, Beti Bhachao, Beti Padhao, Ayushman, Bharat, Swachh Bharat, PM Awas Yojana, Skill India, Gram Panchayat Decentralised Planning, NRLM, MNREGA etc.

TEXT BOOKS:

1. Singh, Katar, Rural Development: Principles, Policies and Management, Sage Publications, New Delhi, 2015.
2. A Hand book on Village Panchayat Administration, Rajiv Gandhi Chair for Panchayati Raj Studies, 2002.
3. United Nations, Sustainable Development Goals, 2015, un.org/sdgs
4. M.P Boraia, Best Practices in Rural Development, Shanlax Publishers, 2016.

JOURNALS:

1. Journal of Rural development (published by NIRD & PR, Hyderabad).
2. Indian Journal of Social Work, (by TISS, Bombay).
3. Indian Journal of Extension Educations (by Indian Society of Extension Education).
4. Journal of Extension Education (by Extension Education Society).
5. Kurukshetra (Ministry of Rural Development, GOI).
6. Yojana (Ministry of Information & Broadcasting, GOI).

22CSC02

PROBLEM SOLVING AND PROGRAMMING LAB

Instruction	3P Hours per week
Duration of SEE	3 Hours
SEE	50 Marks
CIE	50 Marks
Credits	1.5

COURSE OBJECTIVES: This course aim is to
1. Master the fundamentals of writing Python scrips.
2. Learn Python elements such as variables, flow controls structures, and functions.
3. Discover how to work with lists and sequence data, and files.

COURSE OUTCOMES: After completion of this course, students will be able to
1. Understand various Python program development Environments.
2. Demonstrate the concepts of Python.
3. Implement algorithms/flowcharts using Python to solve real-world problems.
4. Build and manage dictionaries to manage data.
5. Write Python functions to facilitate code reuse.
6. Use Python to handle files and memory.

CO-PO ARTICULATION MATRIX

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

LABORATORY / PRACTICAL EXPERIMENTS:
11. Explore various Python Program Development Environments.
12. Demonstration of input/output operations.
13. Demonstration of operators.
14. Demonstration of selective control structures.
15. Demonstration of looping control structures.
16. Demonstration of List, Tuple and Set
17. Demonstration of Python Dictionaries.
18. Implementation of searching and sorting techniques.
19. Implementation of string manipulation operations.
20. File handling and memory management operations.

TEXT BOOKS AND REFERENCES:

1. R.S. Salaria, “Programming for Problem Solving”, First Edition, Khanna Book Publishing Co., Delhi.
2. Jeeva Jose, “Taming Python by Programming”, Revised Edition, Khanna Book Publishing Co., Delhi.
3. Mark Lutz, “Learning Python”, 5th Edition, , O'Reilly Media, Inc.,
4. Python Crash Course: A Hands-On, Project-Based Introduction to Programming by Eric Matthes, No Starch Press.
5. “Programming in Python”, R.S. Salaria, Khanna Book Publishing Co., Delhi.

NPTEL/SWAYAM Courses:
1. Introduction to Problem Solving and Programming, Video Lectures, Prof. D Gupta, IIT Delhi.
2. Problem Solving Aspects and Python Programming, Dr. S Malinga, Dr Thangarajan, Dr. S V Kogilavani, Kongu Engineering College.
3. https://www.coursera.org/specializations/python-3-programming.

22MEC37

ROBOTICS AND DRONES LAB

(Common to All Branches)

Instruction	2T + 2P Hours per week
CIE	100 Marks
Credits	3

COURSE OBJECTIVES: This course aim is to

1. To develop the students' knowledge in various robot and drone structures and their workspace.
2. To develop multidisciplinary robotics that have practical importance by participating in robotics competitions
3. To develop students' skills in performing spatial transformations associated with rigid body motions, kinematic and dynamitic analysis of robot systems.
4. Through projects done in lab, increase the true hands-on student learning experience and enhance their conceptual understanding, increase students' ability, competence and teamwork skills on dealing with real-life engineering problems

COURSE OUTCOMES: After completion of this course, students will be able to

1. Demonstrate knowledge of the relationship between mechanical structures of robotics and their operational workspace characteristics
2. Understand mechanical components, motors, sensors and electronic circuits of robots and build robots.
3. Demonstrate knowledge of robot controllers.
4. Use Linux environment for robotic programming.
5. Write Python scripts to control robots using Python and Open CV.

COURSE ARTICULATION MATRIX

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

LIST OF EXPERIMENTS:

1. Assembling of robot mechanical components, mounting of motors, sensors, electronic circuits to the chassis.
2. Connecting to electronic circuitry: motor drivers, incremental encoders proximity sensors, micro controller,
3. Different types of batteries, selection of suitable battery for application, safety precaution.
4. Introduction to Linux Command Line Interface: basic file and directory management and other useful commands
5. Controlling robot using Python: i) Move robot using Python code, ii) Make robot move in patterns using Python
6. Robot programming with Sensor inputs: i) Read sensor data using Python, ii) Visualize sensor data using Python, iii) Code robot to avoid obstacles by using sensor data
7. Open CV: i) Create an Image and display an image; ii) Read and change pixel values; iii) Create colored shapes and save image; iv) Extract the RGB values of a pixel; v) Reading and Writing Videos
8. Open CV: i) Extraction of Regions of Interest; ii) Extraction of RGB values of a pixel
9. Coding robot to work with colors, follow colored objects, identifying shape of the object-oriented
10. Projects: i)Making a line follower robot using a Camera; ii) Writing code for a complex function Assembly of a drone

SUGGESTED READINGS:

1. https://www.geeksforgeeks.org/robotics-introduction/
2. https://www.ohio.edu/mechanical-faculty/williams/html/PDF/IntroRob.pdf
3. https://www.idtechex.com/en/research-report/new-robotics-and-drones-2018-2038-technologies-forecasts-players/584
4. https://dronebotworkshop.com/

HEAD
DEPARTMENT OF ECE
Chaitanya Bharathi Institute of Technolog
Hyderabad-500 075

22EEC02

BASIC ELECTRICAL ENGINEERING LAB

Instruction	2P Hours per week
Duration of SEE	3 Hours
SEE	50 Marks
CIE	50 Marks
Credits	1

COURSE OBJECTIVES: This course aim is to

1. To acquire the knowledge on different types of electrical elements and to verify the basic electrical circuit laws and theorems.
2. To determine the parameters and power factor of a coil, calculate the time and frequency responses of RLC circuits and to familiarize with measurement of electric power & energy.
3. To determine the characteristics of Transformers, dc, ac machines and switch gear components

COURSE OUTCOMES: After completion of this course, students will be able to

1. Comprehend the circuit analysis techniques using various circuital laws and theorems.
2. Analyse the parameters of the given coil and measurement of power and energy in AC circuits
3. Determine the turns ration/performance parameters of single-phase transformer
4. Infer the characteristics of DC shunt motor different tests.
5. Illustrate different parts and their function of electrical components, equipment and machines.

CO-PO ARTICULATION MATRIX

PO/CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO 1	3	2	2	-	-	2	2	-	-	-	-	2
CO 2	3	2	1	-	-	1	2	-	-	-	-	2
CO 3	3	2	3	-	-	2	2	-	-	-	-	2
CO 4	3	2	2	-	-	2	2	-	-	-	-	2
CO 5	3	2	3	-	-	2	2	-	-	-	-	2

LIST OF LABORATORY EXPERIMENTS/DEMONSTRATIONS:

1. Verification of KCL and KVL.
2. Verification of Thevenin's theorem.
3. Verification of Norton's theorem.
4. Charging and discharging of Capacitor.
5. Determination of parameters of a choke or coil by Wattmeter Method.
6. Power factor improvem
7. ent of single-phase AC System.
8. Active and Reactive Power measurement of a single-phase system using

a. 3-Ammeter method b. 3-Voltmeter method

9. Measurement of 3-Phase Power in a balanced system
10. Calibration of single-phase energy meter.
11. Verification of Turns/voltage ratio of single-phase Transformer.
12. Open Circuit and Short Circuit tests on a given single phase Transformer.
13. Brake test on DC Shunt Motor
14. Speed control of DC Shunt Motor.
15. Demonstration of Measuring Instruments and Electrical Lab components.
16. Demonstration of Low-Tension Switchgear Equipment/Components.
17. Demonstration of cut - out section of Machines like DC Machine, Induction Machine etc.

Note: TEN experiments to be conducted to cover all five Course Outcomes.

22MTC05

VECTOR CALCULUS AND DIFFERENTIAL EQUATIONS
(ECE)

Instruction	3 L+1T per week
Duration of SEE	3 Hours
SEE	60 Marks
CIE	40 Marks
Credits	4

COURSE OBJECTIVES: This course aim is to

1. To explain scalar and vector functions with its Physical interpretations.
2. To discuss vector line, surface and volume integrals.
3. To explain relevant methods to solve first order differential equations.
4. To discuss the solution of higher order Differential Equations
5. To learn Numerical solution of ODE and Engineering problems.

COURSE OUTCOMES: After completion of this course, students will be able to

1. Apply the vector differential operators to Scalars and Vector functions.
2. Solve line, surface & volume integrals by Greens, Gauss and Stoke's theorems.
3. Calculate the solutions of first order linear differential equations.
4. Solve higher order linear differential equations.
5. Find solution of algebraic, transcendental and ODE by Numerical Methods.

CO-PO ARTICULATION MATRIX

PO/PSO CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO 1	3	3	3	3	-	-	-	-	-	-	-	2
CO 2	3	3	3	3	-	-	-	-	-	-	-	2
CO 3	3	3	3	3	-	-	-	-	-	-	-	2
CO 4	3	3	3	3	-	-	-	-	-	-	-	2
CO 5	2	2	2	2	-	-	-	-	-	-	-	1

UNIT I

Vector Differential Calculus and multiple Integrals: Scalar and Vector point functions, vector operator Del, Gradient, Directional derivative, Divergence, Curl, Del applied twice to point functions, Del applied to product of point functions (vector identities), Irrotational fields and Solenoidal fields, Double integral, Change of order of Integration and Triple integrals.

UNIT II

Vector Integral Calculus: Line integral, Surface integral and Volume integral. Verification of Green's theorem in a plane (without proof), verification of Stroke's theorem (without proof) and Gauss's divergence theorem (without proof).

UNIT III

First Order Ordinary Differential Equations: Exact differential equations, Equations reducible to exact equations, Linear equation, Bernoulli's equation, Clairaut's equation, Riccati's equation, Orthogonal trajectories, Rate of decay of Radio-active materials**.**

UNIT IV

Higher Orders Linear Differential Equations: Higher order linear differential equations with constant coefficients, rules for finding Complementary function, Particular Integral and General solution. Method of variation of parameters, solution of Cauchy- Euler equation, LR and LCR circuits

UNIT V

Numerical Methods: Solution of Algebraic and transcendental equations by Bisection method, Regula-Falsi method Newton-Raphson method. Numerical Solutions of First Order Ordinary differential equations by Taylor's series method, Euler's method, Modified Euler's method and Runge-Kutta method of fourth order.

TEXT BOOKS:

1. B.S.Grewal, "Higher Engineering Mathematics", 44th Edition, Khanna Publishers, 2017.
2. Erwin Kreyszig, "Advanced Engineering Mathematics", 9th Edition, John Wiley & Sons, 2006.

SUGGESTED READING:

1. N.P.Bali and Dr. Manish Goyal, "A text book of Engineering Mathematics", 9th edition, Laxmi Publications, 2017.
2. R.K.Jain, S.R.K.Iyengar, "Advanced Engineering Mathematics", 5th edition, Narosa Publications, 2016.

22PYC01

OPTICS AND SEMICONDUCTOR PHYSICS

Instruction	3L Hours per week
Duration of SEE	3Hours
SEE	60Marks
CIE	40Marks
Credits	3

COURSE OBJECTIVES: This course aim is to
1. Understand the fundamentals of wave nature of light
2. Acquire knowledge of lasers, holography and fiber optics
3. Familiarize with quantum mechanics
4. Learn the fundamental concepts of solids

COURSE OUTCOMES: After completion of this course, students will be able to
1. Demonstrate the physical properties of light.
2. Explain characteristic properties of lasers and fiber optics
3. Find the applications of quantum mechanics
4. Classify the solids depending upon electrical conductivity
5. Identify different types of semiconductors

CO-PO ARTICULATION MATRIX

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

UNIT I

Wave Optics: Huygen's principle –Super position of waves –Interference of light by wave front splitting and amplitude splitting–Fresnel's biprism – Interference in thin films in reflected light– Newton's rings– Fraunhofer diffraction from a single slit –Double slit diffraction – Rayleigh criterion for limit of resolution– Concept of N-slits–Diffraction grating and its resolving power.

UNIT II

Lasers & Holography: Characteristics of lasers – Einstein's coefficients –Amplification of light by population inversion –Different types of lasers: solid-state lasers: Ruby & Nd:YAG; gas lasers: He-Ne & CO_2; semiconductor laser – Applications of lasers in engineering and medicine. Holography: Principle – Recording and reconstruction– Applications.

Fiber Optics: Introduction – Construction – Principle – Propagation of light through an optical fiber – Numerical aperture and acceptance angle –Step-index and graded-index fibers –Pulse dispersion –Fiberlosses--Fiber optic communication system –Applications.

UNIT III

Principles of Quantum Mechanics: Introduction – Wave nature of particles – de-Broglie hypothesis – Physical significance of ψ – Time-dependent and time-independent Schrodinger equations – Born interpretation – Probability current –Wave packets –Uncertainty principle –Particle in infinite square well potential –Scattering from potential step – Potential barrier and tunneling.

UNIT IV

Band Theory of Solids: Salient features of free electron theory of metals (Classical and Quantum) – Fermi level –Density of states – Bloch's theorem for particles in a periodic potential – Kronig-Penney model – Classification of solids: metals, semiconductors and insulators.

UNIT V

Semiconductors: Intrinsic and extrinsic semiconductors – Charge carrier concentration in intrinsic semiconductors – Dependence of Fermi level on carrier concentration and temperature in extrinsic semiconductors (qualitative) – Carrier generation and recombination – Carrier transport: diffusion and drift – P-N junction – Thermistor – Hall Effect – LED – Solar cell.

TEXT BOOKS:

1. B. K. Pandey and S. Chaturvedi, *Engineering Physics*, Cengage Publications, 2012.
2. M. N. Avadhanulu and P. G. Kshirsagar, *A Text Book of Engineering Physics*, S. Chand Publications, 2014.
3. M. Arumugam, *Materials Science*, Anuradha Publications, 2015.
4. S. L. Gupta and Sanjeev Gupta, *Modern Engineering Physics*, Dhanpat Rai Publications, 2011.

SUGGESTD READING:

1. R. Murugeshan and Kiruthiga Sivaprasath, *Modern Physics*, S. Chand Publications, 2014.
2. V. Rajendran, *Engineering Physics*, Mc Graw-Hill Education Publications, 2013.
3. P. K. Palanisamy, *Engineering Physics*, Scitech Publications, 2012.
4. V. Raghavan, *Materials Science and Engineering*, Prentice Hall India Learning Private Limited; 6th Revised edition, 2015.

22CEC01

ENGINEERING MECHANICS

Instruction	3L+1T Periods per week
Duration of SEE	3 Hours
SEE	60 Marks
CIE	40 Marks
Credits	4

COURSE OBJECTIVES: This course aim is to

1. Understand the resolution of forces and to obtain resultant of all force systems,
2. Understand equilibrium conditions of static loads for smooth and frictional surface
3. Analyse simple trusses for forces in various members of a truss
4. Obtain centroid, centre of gravity for various regular and composite areas and bodies
5. Obtain Moment of inertia for various regular and composite areas and bodies and also to obtain Mass moments of inertia of elementary bodies

COURSE OUTCOMES: After completion of this course, students will be able to

1. Calculate the components and resultant of coplanar forces system and Draw free body diagrams to analyze the forces in the given structure
2. Understand the mechanism of friction and can solve friction problems
3. Analyse simple trusses for forces in various members of a truss.
4. Determine the centroid of plane areas, composite areas and centres of gravity of bodies.
5. Determine moments of inertia, product of inertia of plane and composite areas and mass moments of inertia of elementary bodies,

CO-PO ARTICULATION MATRIX

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

UNIT I

Resolution and Resultant of Force System: Basic concepts of a force system. Components of forces in a plane. Resultant of coplanar concurrent force system. Moment of a force, couple and their applications. Resultant of coplanar non-concurrent force system

Equilibrium of force system: Free body diagrams, equations of equilibrium of planar force systems and its applications. Problems on general case of coplanar force systems.

UNIT II

Theory of friction: Introduction, types of friction, laws of friction, application of friction to a single body & connecting systems. Wedge and belt friction

UNIT III

Analysis of Simple Trusses: Introduction to trusses, Assumptions, analysis of simple trusses using method of joints and method of sections.

UNIT IV

Centroid: Significance of centroid, moment of area, centroid of line elements, plane areas, composite areas, theorems of Pappus & its applications. Center of gravity of elementary and composite bodies

UNIT V

Moment of Inertia: Definition of MI, Area MI. Polar Moment of Inertia, radius of gyration, transfer theorem, Moment of Inertia of elementary & composite areas, and Product of inertia. Mass moments of inertia of elementary bodies.

TEXT BOOKS:

1. K. Vijay Kumar Reddy and J. Suresh Kumar, Singer's Engineering Mechanics, BS Publications, Hyderabad, 2011.
2. Ferdinand L Singer, Engineering Mechanics, Harper and Collins, Singapore, 1904.

SUGGESTED READING:

1. A. Nelson, Engineering Mechanics, Tata McGraw Hill, New Delhi, 2010.
2. S. Rajashekaran & G. Sankarasubramanyam, Engineering Mechanics, Vikas publications, Hyderabad, 2002.
3. S.B. Junarkar and H.J Shah, Applied Mechanics**,** Charotar publishers, New Delhi, 2001.
4. Basudeb Bhattacharyya, Engineering Mechanics, Oxford University Press, New Delhi, 2008.
5. A K Tayal, Engineering Mechanics, Umesh Publications, New Delhi, 2010

22EGC01

ENGLISH

Instruction	2 L Hours per Week
Duration of SEE	3 Hours
SEE	60 Marks
CIE	40 Marks
Credits	2

PREREQUISITE: Basic knowledge of English grammar and vocabulary.

COURSE OBJECTIVES: This course aim is to
1. To the role and importance of communication while developing their basic communication skills in English.
2. To basics of writing coherent paragraphs and formal Emails.
3. To techniques of writing a précis and formal letters by using acceptable grammar and appropriate vocabulary.
4. To description, definition and classification of processes while enabling them to draft formal reports following a proper structure.
5. To gaining adequate reading comprehension techniques.

COURSE OUTCOMES: After completion of this course, students will be able to
1. Illustrate the nature, process and types of communication and communicate effectively without barriers.
2. Construct and compose coherent paragraphs, emails and adhering to appropriate mobile etiquette.
3. Apply techniques of precision to write a précis and formal letters by using acceptable grammar and appropriate vocabulary.
4. Distinguish formal from informal reports and demonstrate advanced writing skills by drafting formal reports.
5. Critique passages by applying effective reading techniques.

CO-PO-PSO ARTICULATION MATRIX

PO/CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO 1	1	1	1	1	1	1	1	2	3	3	2	3
CO 2	1	1	1	1	-	1	1	1	2	2	1	2
CO 3	-	2	1	1	-	2	1	1	2	2	1	2
CO 4	1	2	1	2	1	2	2	1	2	2	1	2
CO 5	1	2	1	2	1	1	1	1	1	2	1	2

UNIT I

Understanding Communication in English: Introduction, nature and importance of communication; Process of communication; Types of communication - verbal and non-verbal; Barriers to communication; Intrapersonal and interpersonal communication; Understanding Johari Window.

Vocabulary &Grammar: The concept of Word Formation; Use of appropriate prepositions and articles.

UNIT II

Developing Writing Skills I: Paragraph writing. – Structure and features of a paragraph; Cohesion and coherence. Rearranging jumbled sentences. Email and Mobile etiquette.

Vocabulary & Grammar: Use of cohesive devices and correct punctuation.

UNIT III

Developing Writing Skills II: Précis Writing; Techniques of writing precisely. Letter Writing – Structure, format of a formal letter; Letter of request and the response.

Vocabulary and Grammar: Subject-verb agreement. Use of prefixes and suffixes to form derivatives. Avoiding redundancies.

UNIT IV

Developing Writing Skills III: Report writing – Importance, structure, elements of style of formal reports; Writing a formal report.

Vocabulary and Grammar: Avoiding ambiguity - Misplaced modifiers. Use of synonyms and antonyms.

UNIT V

Developing Reading Skills: The reading process, purpose, different kinds of texts; Reading comprehension; Techniques of comprehension – skimming, scanning, drawing inferences and conclusions.

Vocabulary and Grammar: Words often Confused; Use of standard abbreviations.

TEXT BOOKS:

1. "Language and Life: A Skills Approach", Board of Editors, 2018th Edition, Orient Black Swan, 2018.
2. Swan Michael, "Practical English Usage", OUP, 1995.

SUGGESTED READING:

1. Wood F.T, "Remedial English Grammar", Macmillan, 2007.
2. Zinsser William, "On Writing Well", Harper Resource Book, 2001.
3. Sanjay Kumar and Pushp Lata, "Communication Skills", Oxford University Press, 2011.

22PYC09

ELECTROMAGNETIC THEORY AND QUANTUM MECHANICS LAB (ECE & EEE)

Instruction	3P Hours per week
Duration of SEE	3Hours
SEE	50Marks
CIE	50Marks
Credits	1.5

COURSE OBJECTIVES: This course aim is to

1. Apply the concepts of physics while doing experiments
2. Understand the nature of the light experimentally
3. Analyzethebehaviourofsemiconductormaterialsandoptoelectronicdevices

COURSE OUTCOMES: After completion of this course, students will be able to

1. Experiment with the concept of errors and find the ways to minimize the errors
2. Demonstrate properties of light experimentally
3. Find the applications of lasers and optical fibers in engineering applications
4. Make use of semiconductor devices for practical applications
5. Illustrate the working of optoelectronic devices

CO-PO ARTICULATION MATRIX

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

LIST OF EXPERIMENTS:

1. Error Analysis : Estimation of errors in the determination of time period of a torsional pendulum
2. Newton's Rings : Determination of wavelength of given monochromatic source
3. Single Slit Diffraction : Determination of wavelength of given monochromatic source
4. Diffraction Grating : Determination of wavelengths of two yellow lines of light of mercury lamp
5. Malus's Law : Verification of Malus's law
6. Double Refraction : Determination of refractive indices of O-ray and E-ray of given calcite crystal
7. Polarimeter : Determination of specific rotation of glucose
8. Laser : Determination of wavelength of given semiconductor laser
9. Optical Fiber : Determination of numerical aperture and power losses of given optical fiber
10. Energy Gap : Determination of energy gap of given semiconductor
11. P-N Junction Diode : Study of V-I characteristics and calculation of resistance of given diode in forward bias and reverse bias
12. Thermistor : Determination of temperature coefficient of resistance of given thermistor
13. Hall Effect : Determination of Hall coefficient, carrier concentration and mobility of charge carriers of given semiconductor specimen
14. LED : Study of I-V characteristics of given LED
15. Solar Cell : Study of I-V characteristics of given solar cell and calculation of fill factor, efficiency and series resistance

NOTE: A minimum of TWELVE experiments should be done.

22EGC02

ENGLISH LAB

Instruction	2 P Hours per Week
Duration of SEE	3 Hours
SEE	50 Marks
CIE	50 Marks
Credits	1

PREREQUISITE: Basic Knowledge of English Communication.

COURSE OBJECTIVES: This course aim is to
1. To nuances of Phonetics and give them sufficient practice in correct pronunciation.
2. To word stress and intonation.
3. To IELTS and TOEFL material for honing their listening skills.
4. To activities enabling them overcome their inhibitions while speaking in English with the focus being on fluency rather than accuracy.
5. To team work, role behaviour while developing their ability to discuss in groups and making oral presentations.

COURSE OUTCOMES: After completion of this course, students will be able to
1. Define the speech sounds in English and understand the nuances of pronunciation in English.
2. Apply stress correctly and speak with the proper tone, intonation and rhythm.
3. Analyze IELTS and TOEFL listening comprehension texts to enhance their listening skills.
4. Determine the context and speak appropriately in various situations.
5. Design and present effective posters while working in teams, and discuss and participate in Group discussions.

CO-PO-PSO ARTICULATION MATRIX

PO/CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO 1	-	-	-	-	-	-	-	-	1	1	-	1
CO 2	-	-	-	-	-	1	-	1	2	2	1	2
CO 3	-	-	-	-	-	1	1	1	2	1	1	2
CO 4	1	-	-	-	-	1	2	2	2	3	1	3
CO 5	1	1	1	1	1	2	2	2	3	3	2	3

LIST OF EXERCISES:
1. **Introduction to English Phonetics**: Introduction to auditory, acoustic and articulatory phonetics, organs of speech: the respiratory, articulatory and phonatory systems.
2. **Sound system of English**: Phonetic sounds and phonemic sounds, introduction to International Phonetic Alphabet, classification and description of English phonemic sounds, minimal pairs. The syllable: types of syllables, consonant clusters.
3. **Word stress**: Primary stress, secondary stress, functional stress, rules of word stress.
4. **Rhythm & Intonation**: Introduction to Rhythm and Intonation. Major patterns, intonation of English with the semantic implications.
5. **Listening skills** – Practice with IELTS and TOEFL material.
6. **Public speaking –** Speaking with confidence and clarity in different contexts on various issues.
7. **Group Discussions -** Dynamics of a group discussion, group discussion techniques, body language.
8. **Pictionary –** weaving an imaginative story around a given picture.
9. **Information Gap Activity –** Writing a brief report on a newspaper headline by building on the hints given.
10. **Poster presentation –** Theme, poster preparation, team work and e presentation.

SUGGESTED READING:
1. T Balasubramanian, "A Textbook of English Phonetics for Indian Students", Macmillan, 2008.
2. J Sethi et al., "A Practical Course in English Pronunciation (with CD)", Prentice Hall India, 2005.
3. Priyadarshi Patnaik, "Group Discussions and Interviews", Cambridge University Press Pvt. Ltd., 2011.
4. Aruna Koneru, "Professional Speaking Skills", Oxford University Press, 2016.

22MEC01

CAD AND DRAFTING

Instruction	1T+3D Hours per week
Duration of SEE	3Hours
SEE	50Marks
CIE	50Marks
Credits	2.5

COURSE OBJECTIVES: This course aim is to

1. To get exposure to a cad package and its utility.
2. Understanding orthographic projections.
3. To visualize different solids and their sections in orthographic projection
4. To prepare the student to communicate effectively by using isometric projection.
5. To prepare the student to use the techniques, skills, and modern tools necessary for practice.

COURSE OUTCOMES: After completion of this course, students will be able to

1. Become conversant with appropriate use of CAD software for drafting.
2. Recognize BIS, ISO Standards and conventions in Engineering Drafting.
3. Construct the projections of points, lines, planes, solids
4. Analyse the internal details of solids through sectional views
5. Create an isometric projections and views

CO-PO ARTICULATION MATRIX

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

LIST OF EXERCISES:

1. Introduction to CAD package: Settings, draw, modify tools, dimensioning and documentation
2. Construction of Conic Sections by General method
3. Orthographic projection: Principles, conventions, Projection of points
4. Projection of straight lines: Simple position, inclined to one plane
5. Projection of straight lines inclined to both the planes (without traces and mid-point)
6. Projection of planes: Perpendicular planes
7. Projection of planes: Oblique planes
8. Projection of solids: Simple position
9. Projection of solids: Inclined to one plane
10. Sections of solids: Prism, pyramid in simple position
11. Sections of solids: Cone and cylinder in simple position
12. Isometric projections and views
13. Conversion of isometric views to orthographic projections and vice-versa.

TEXT BOOKS:

1. N.D.Bhatt, “Elementary Engineering Drawing”, Charotar Publishers, 2012.
2. K.Venugopal, “Engineering Drawing and Graphics + AutoCAD”, New Age International Pvt.Ltd, 2011.
3. Basanth Agrawal and C M Agrawal, “Engineering Drawing”, 2/e, McGraw-Hill Education (India) Pvt. Ltd.

SUGGESTED READING:

1. Shaw M.B and Rana B.C., “Engineering Drawing”, 2/e, Pearson, 2009.
2. K.L. Narayana and P.K. Kannaiah, “Text Book of Engineering Drawing”, Scitech Publications, 2011.

22MEC38

DIGITAL FABRICATION LAB

Instruction	3P Hours per week
Duration of SEE	3 Hours
SEE	50 Marks
CIE	50 Marks
Credits	1.5

COURSE OBJECTIVES: The objectives of this course are to:

1. Give a feel of Engineering Practices & develop holistic understanding of various Engineering materials and Manufacturing processes.
2. Develop skills of manufacturing, safety, precision, quality, intelligent effort, optimization positive &team work attitude to get things right the first time.
3. Provide basic knowledge of Steel, Plastic, Composite and other materials for suitable applications.
4. Study of Principle and hands on practice on techniques of fabrication, welding, casting, manufacturing, metrology, and allied skills.
5. Advance important hard & pertinent soft skills, productivity, create skilled manpower which is cognizant of industrial workshop components and processes and can communicate their work in a technical, clear and effective way.

COURSE OUTCOMES: After completion of course, students would be able to:

1. Understand safety measures to be followed in workshop to avoid accidents.
2. Identify various tools used in carpentry, house wiring and plumbing.
3. Make a given model by using workshop trades like carpentry, plumbing, House wiring and 3d modeling using solid works software for Additive Manufacturing.
4. Perform pre-processing operations on STL files for 3D printing, also understand reverse engineering process.
5. Conceptualize and produce simple device/mechanism of their choice.

CO-PO-PSO Correlation Matrix

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

List of exercises:
Group-1

1. To make a lap joint on the given wooden piece according to the given dimensions.
2. To make a dove tail-joint on the given wooden piece according to the given dimensions.
3.
    a. Wiring of one light point controlled by one single pole switch, a three pin socket controlled by a single pole switch
    b. Wiring of two light points connected in series and controlled by single pole switch. Verify the above circuit with different bulbs. Wiring of two light points connected in parallel from two single pole switches and a three pin socket
4. Stair case wiring-wiring of one light point controlled from two different places independently using two 2- way switches.
5. To make external threads for GI pipes using die and connect the GI pipes as per the given diagram using taps, couplings & bends.
6.
    a. A. To connect the GI pipes as per the given diagram using, couplings, unions, reducer & bends.
    b. To connect the GI pipes as per the given diagram using shower, tap & valves and Demonstrate by giving water connection

Group- 2

1. To Study the method of Additive Manufacturing process using a 3D printer
2. To create a 3D CAD model of a door bracket using a modeling software
3. To Print a door bracket using an extruder type 3D Printer.
4. To create a 3D CAD model by reverse Engineering
5. To Design an innovative component using the CAD software
6. To Print the selected innovative component by the students using a 3D printer

TEXT BOOKS:

1. Hajra Choudhury S.K., Hajra Choudhury A.K. and Nirjhar Roy S.K., Elements of Workshop Technology, Vol. I, 2008 and Vol. II, Media promoters and publishers private limited, Mumbai, 2010.
2. Kalpakjian S. And Steven S. Schmid, Manufacturing Engineering and Technology, 4th edition, Pearson Education India Edition, 2002.
3. Sachidanand Jha, 3D PRINTING PROJECTS: 200 3D Practice Drawings For 3D Printing On Your 3D Printer, June 7, 2019.

SUGGESTED READING:

1. Gowri P. Hariharan and A. Suresh Babu, Manufacturing Technology – I, Pearson Education, 2008.
2. Oliver Bothmann , 3D Printers: A Beginner's Guide , January 1, 2015

20MTC07

APPLIED MATHEMATICS
(For ECE/EEE Programs)

Instruction	3 L+1T Hours per Week
Duration of SEE	3 Hours
SEE	60 Marks
CIE	40 Marks
Credits	4

Prerequisite: Students should have prior knowledge about circuit theory, coordinate systems and vector calculus.

Course Objectives:
This course aims to:
1. To learn the Laplace, Inverse Laplace Transform and Z-Transforms.
2. To learn the Z-Transform& inverse Z-Transform concepts
3. To form PDE and solve Linear and Non-Linear equations.
4. To find roots of equations, and Numerical solutions of Differential Equations.
5. To learn fitting of distribution and predicting the future values

Course Outcomes:
Upon completion of this course, students will be able to:
1. Find Laplace, Inverse Laplace and solution of engineering problems.
2. Find the solution of Difference Equation.
3. Understand the methods to find solution of linear and non-linear PDE and solution of wave equation.
4. Solve Non-Linear algebraic and transcendental equations and first order differential equations.
5. Understand the methods for analyzing the random fluctuations using probability distribution and also identify the importance of Principles of Least Squares approximations for predictions.

Mapping of Course Outcomes with Program Outcomes and Program Specific Outcomes:

PO/PSO / CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO 1	3	2	2	-	-	-	-	-	2	1	-	1	1	-	-
CO 2	3	2	2	-	-	-	-	-	2	-	-	1	1	-	-
CO 3	3	2	2	-	-	-	-	-	2	-	-	1	1	-	-
CO 4	3	2	2	1	1	-	-	-	2	1	-	1	1	-	-
CO 5	3	2	2	1	1	-	-	-	2	1	-	1	1	-	-

UNIT-I

Laplace Transforms: Laplace Transform of Elementary functions, Linearity property, First Shifting property, Change of scale property. Laplace Transform of Periodic functions, Transforms of derivatives, Transforms of integrals, Multiplication by and division by Evaluation of Integrals by Laplace Transforms. Inverse Laplace transforms of elementary functions, Inverse Laplace Transform by Method of partial fractions and Convolution theorem, Solutions of Ordinary Differential Equations by Laplace Transform method. Laplace transform of Unit step and Unit Impulse function.

UNIT-II

Z-Transforms: Z-transforms of standard functions, linearity property, damping rule, shifting theorems, multiplication by 'n', Initial and Final value theorems. Inverse Z-transforms of standard functions, Inverse Z-transform by Convolution theorem and partial fractions method. Z-transform application to difference equations.

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UNIT-III

Partial Differential Equations: Formation of Partial Differential Equations, Linear Equations of First Order (Lagrange's Linear Equations), Solution of First Order Non-linear Partial Differential Equation (Standard forms) and Charpits Method. Solutions by method of separation of variables, solution of one-dimensional wave equation and its applications.

UNIT-IV

Numerical Methods: Solution of Algebraic and transcendental equations by Bisection method, Regula-Falsi method Newton-Raphson method. Numerical Solutions of First Order Ordinary differential equations by Taylor's series method, Euler's method, Modified Euler's method and Runge-Kutta method of fourth order.

UNIT-V

Probability Distributions: Basic probability, Conditional probability, Bayes theorem. Random variable, discrete probability distribution and Continuous probability distribution. Expectation, properties of expectation, properties of variance. Poisson distribution, MGF and Cumulates of the Poisson distribution, Normal distribution, characteristics of Normal distribution MGF and CGF of Normal distribution, Areas under normal curve.

Text Books:

1. B.S. Grewal, "Higher Engineering Mathematics", Khanna Publishers, 44th Edition, 2017.
2. S.C. Gupta, V.K. Kapoor, "Fundamentals of Mathematical Statistics", Sultan Chand and Sons, 2014.

Suggested Reading:

1. Erwin Kreyszig, "Advanced Engineering Mathematics", 9th Edition, John Wiley & Sons, 2006.
2. Veerarajan T, "Engineering Mathematics", Tata McGraw-Hill, New Delhi, 2008.
3. S.S. Sastry, "Introductory methods of numerical analysis", PHI, 4th Edition, 2005

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20CSC06

BASICS OF DATA STRUCTURES

(Common for all Programs except CSE & IT)

Instruction	2 L Hours per Week
Duration of SEE	3 Hours
SEE	60 Marks
CIE	40 Marks
Credits	2

Prerequisite: Basic knowledge of programming language such as C or C++ is preferred (but not mandatory) and some mathematical maturity also will be expected.

Course Objectives:
This course aims to:

1. Basic linear and non-linear data structures.
2. Analyzing the performance of operations on data structures.
3. Different sorting and searching techniques and their complexities.

Course Outcomes:
Upon completion of this course, students will be able to:

1. Identify various data structures, searching & sorting techniques and their applications.
2. Describe the linear and non-linear data structures, searching and sorting techniques.
3. Apply suitable data structures to solve problems.
4. Analyze various searching and sorting techniques.
5. Evaluate the linear and non-linear data structures.

Mapping of Course Outcomes with Program Outcomes and Program Specific Outcomes:

PO/PSO / CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO 1	2	2	2	1	3	3	1	-	-	-	-	2	3	3	2
CO 2	2	2	2	2	3	3	1	-	-	-	-	2	3	3	2
CO 3	2	2	2	1	3	2	1	-	-	-	-	2	3	3	2
CO 4	2	3	2	1	3	3	1	-	-	-	-	2	3	3	2
CO 5	2	2	2	1	3	2	1	-	-	-	-	2	3	3	2

UNIT-I
Introduction: Data Types, Data structures, Types of Data Structures, Operations, ADTs, Algorithms, Comparison of Algorithms- Complexity- Time and space tradeoff.
Recursion: Introduction, format of recursive functions, recursion Vs. Iteration, examples.

UNIT-II
Linked Lists: Introduction, Linked lists and types, Representation of linked list, operations on linked list, Comparison of Linked Lists with Arrays and Dynamic Arrays.

UNIT-III
Stacks and Queues: Introduction to stacks, applications of stacks, implementation and comparison of stack implementations. Introduction to queues, applications of queues and implementations, Priority Queues and applications

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Searching and Sorting: Linear searching, binary Searching, sorting algorithms- bubble sort, selection sort, quick sort, heap sort.

UNIT-IV

Trees: Definitions and Concepts, Operations on Binary Trees, Representation of binary tree, Conversion of General Trees to Binary Trees, Representations of Trees, Tree Traversals, Binary search Tree.

UNIT-V

Graphs: Introduction, Applications of graphs, Graph representations, graph traversals, Minimal Spanning Trees.

Text Books:

1. Narasimha Karumanchi "Data Structures and Algorithms Made Easy", Career Monk Publications, 2017
2. E.Horowitz ,S. Sahni and Susan Anderson-Freed, "Fundamentals of Data structures in C", Silicon Press; 2nd Edition August 2007
3. Reema Thareja, "Data Structures using C", Oxford, 2014

Suggested Reading:

1. https://www.tutorialspoint.com/data_structures_algorithms/index.htm
2. https://www.edx.org/course/foundations-of-data-structures
3. https://sites.google.com/site/merasemester/data-structures/data-structures-1#DS
4. https://www.cs.usfca.edu/~galles/visualization/Algorithms
5. https://www.coursera.org/specializations/data-structures-algorithms

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20ECC01

ELECTROMAGNETIC THEORYAND TRANSMISSION LINES

Instruction	3 L Hours per Week
Duration of SEE	3 Hours
SEE	60 Marks
CIE	40 Marks
Credits	3

Prerequisite: Students should have prior knowledge about circuit theory, coordinate systems and vector calculus.

Course Objectives:
This course aims to:
1. The mathematical fundamentals necessary for understanding the electromagnetic theory.
2. The electrostatics and magnetics along with Maxwell's equations for EM Waves.
3. The concepts of transmission lines

Course Outcomes:
Upon completion of this course, students will be able to:
1. Comprehend mathematically the coordinate systems and solve simple static Electromagnetic problems using various laws and theorems.
2. Understand Maxwell's equations in different forms (differential and integral) and apply them to diverse engineering problems.
3. Demonstrate the Electromagnetic wave properties with respect to different transmission mediums.
4. Predict the behavior of reflection and refraction of the waves in different mediums.
5. Estimate the transmission line properties, reflection, and matching concepts.

Mapping of Course Outcomes with Program Outcomes and Program Specific Outcomes:

PO/ PSO / CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO 1	3	3	1	1	2	2	1	1	3	3	2	2	3	2	1
CO 2	3	3	3	3	2	3	3	3	3	3	2	2	3	2	1
CO 3	3	3	3	3	2	3	3	1	2	3	2	2	3	2	1
CO 4	3	3	3	3	2	3	3	1	2	3	2	2	3	2	1
CO 5	3	3	3	3	2	3	3	2	2	2	2	2	3	2	1

UNIT-I
Electrostatics: Review of coordinate systems, Coulomb's Law, Electric field, Electric flux, Flux density and Gauss Law. Potential and Potential gradient. Laplace's and Poisson's equations. Current, Current Density and Continuity of current equation.

UNIT-II
Steady Magnetics and Time varying Fields: Biot-Savart's law, Ampere's law, Magnetic flux and Magnetic flux density. Gauss law for magnetic fields, Vector magnetic potential. Boundary conditions. Time varying fields, Maxwell equations: Integral form and Point form.

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UNIT-III

Electromagnetic Waves: Wave equations, Uniform plane waves in lossy and lossless medium. Skin Depth, Polarization, Instantaneous and average Poynting theorem and its applications. Reflection and Refraction of Plane Waves - Normal and Oblique Incidence for perfect Conductor and perfect Dielectrics, Brewster Angle, Critical Angle and Total Internal Reflection.

UNIT-IV

Transmission Lines - I: Types, Parameters, Transmission Line Equations, Primary and Secondary Constants, Characteristics Impedance, Propagation Constant, Phase and Group Velocities, Infinite Line. Impedance at any point on the transmission line.

UNIT-V

Transmission Lines - II: RF and UHF Lines, Open and Short circuit lines and their significance. Properties of λ/2, λ/4 and λ/8 Lines. Distortion and distortion less transmission line, Concept of loading of a transmission line, Campbell's formula. Reflection and VSWR. Matching: Quarter wave transformer, Single Stub matching. Smith chart and its applications.

Text Books:

1. Matthew N.O. Sadiku, "Elements of Electromagnetics", 7th Edition, New York Oxford University Press, 2018.
2. William H. Hayt Jr. and John A. Buck, "Engineering Electromagnetics", 8th Edition, TMH, 2016.
3. E.C. Jordan and K.G. Balmain, "Electromagnetic Waves and Radiating Systems", 2nd Edition, PHI, 2000.

Suggested Reading:

1. John D. Ryder, "Networks Lines and Fields", 2nd Edition, PHI, 2015.
2. R.K. Shevgaonkar, "Electromagnetics Waves", Tata McGraw Hill India, 2005.
3. Sunil Bhooshan, "Fundamentals of Engineering Electromagnetics", Oxford University Press Publication, 2012.

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20ECC02

ELECTRONIC DEVICES

Instruction	3 L Hours per Week
Duration of SEE	3 Hours
SEE	60 Marks
CIE	40 Marks
Credits	3

Prerequisite: Students should have the knowledge of semiconductor fundamentals.

Course Objectives:
This course aims to familiarize:
1. The concepts of semiconductor devices like PN junction diode, Transistor, and special diodes.
2. The applications of diodes.
3. The various configurations, characteristics of transistors – BJT, JFET & MOSFET.

Course Outcomes:
Upon completion of this course, students will be able to:
1. Demonstrate understanding of the characteristic behaviour of various electronic devices such as Diodes, Transistors etc.
2. Apply the acquired knowledge in the analysis of various diode and Transistor circuits.
3. Compare and Contrast the characteristics of BJT and FET in various configurations.
4. Evaluate the performance parameters of various diode circuits (rectifiers, clippers and clampers) and Transistor circuits.
5. Choose an appropriate electronic device for a specific application and discuss IC fabrication process.

Mapping of Course Outcomes with Program Outcomes and Program Specific Outcomes:

PO/PSO / CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO 1	1	2	-	1	1	-	-	2	-	-	-	2	3	3	1
CO 2	2	3	1	3	2	-	-	2	-	-	-	2	3	3	1
CO 3	-	2	-	1	-	-	-	2	-	-	-	2	3	3	1
CO 4	2	3	-	3	2	-	-	2	-	-	-	2	3	3	1
CO 5	-	3	-	2	2	-	-	2	-	-	-	2	3	3	1

UNIT – I
Semiconductor Diode Characteristics:
The p-n junction Diode, Energy band diagram, Current equations, I-V characteristics, Temperature dependence, Diode resistance, Transition capacitance, Diffusion capacitance, Zener diode - Regulator, Schottky diode.

UNIT – II
Diode Applications:
Diode as a circuit element, Clipping and Clamping circuits, Clamping circuit theorem. Half wave, Full wave and Bridge Rectifiers - their operation, performance characteristics- ripple factor calculations, and analysis; Filters (L, C, LC and CLC filters).

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UNIT – III

Bipolar Junction Transistor:

Construction and Operation of NPN and PNP transistor, current components and current flow in BJT, Modes of transistor operation, Early effect, BJT input and output characteristics of CB, CE, CC configuration, h-parameters, determination of h-parameters from transistor characteristics.

UNIT – IV

Field Effect Transistor: Junction Field Effect Transistor: Principle of Operation - the Pinch-off Voltage V_P, V-I Characteristics of JFET.

MOSFETs: Enhancement & Depletion mode MOSFETs, V-I characteristics, CMOS inverter.

UNIT – V

Special Purpose Semi-Conductor Devices: Elementary treatment of SCR- UJT- Diac- Triac - Tunnel diode. LED, Photodiode, Solar cell. Introduction to Integrated circuit fabrication process: Oxidation, Diffusion, Ion implantation, Photolithography, Etching, Metallization.

Text Books:

1. Millman and Halkias, "Electronic Devices and Circuits", 2nd Edition, McGraw Hill Publication, 2007.
2. Robert L. Boylestad, "Electronic Devices and Circuit Theory", 10th Edition, PHI, 2009.
3. S.K. Gandhi, "VLSI Fabrication Principles: Silicon and Gallium Arsenide", Wiley India Pvt. Ltd., New Delhi, 2nd Edition. 1994.

Suggested Reading:

1. Jacob Millman, Christos Halkias, Chetan Parikh, "Integrated Electronics", 2nd Edition, McGraw Hill Publication, 2009.
2. David Bell, "Fundamentals of Electronic Devices and Circuits", 5th Edition, Oxford University Press, 2008.
3. Christian Piguet, "Low Power CMOS Circuits Technology, Logic Design and CAD Tools" 1st Indian Reprint, CRC Press, 2010.

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20ECC03

NETWORK THEORY

Instruction	3 L Hours per Week
Duration of SEE	3 Hours
SEE	60 Marks
CIE	40 Marks
Credits	3

Prerequisite: Knowledge on Elements of Electrical Engineering.

Course Objectives:
This course aims to:
1. Make understand the concepts of Electric Circuits, Network Theorems and the transients.
2. Make understand the concept of steady state and applying phasor analysis to AC circuits and analyzing magnetic coupled circuits.
3. Familiarize resonant circuits, two port network parameters, concept of Passive Filters and Network Synthesis.

Course Outcomes:
Upon completion of this course, students will be able to:
1. Recall basics of electrical circuits with nodal and mesh analysis.
2. Illustrate electrical theorems for AC and DC Circuits.
3. Develop time domain and frequency domain analysis for circuits.
4. Analyze the electrical network and two port network parameters for different applications i.e., magnetic coupled circuits, Filters.
5. Synthesize different network functions using Foster and Cauer form.

Mapping of Course Outcomes with Program Outcomes and Program Specific Outcomes:

PO/PSO / CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO 1	3	3	3	-	-	3	1	2	1	3	3	3	1	2	3
CO 2	2	2	3	1	-	1	-	1	1	1	2	2	2	2	1
CO 3	3	2	1	-	1	-	1	1	-	-	-	1	1	1	-
CO 4	2	2	1	2	-	1	2	-	1	1	1	1	1	1	1
CO 5	2	1	2	1	1	1	1	1	1	-	1	1	3	2	1

UNIT-I
Network Theorems: Network reduction techniques, Super Nodal and Super Mesh Analysis, Superposition, Thevenin's and Norton's theorems. Reciprocity, Maximum Power Transfer, Compensation, Millman's, Duality and Tellegen's Theorems using dependent and independent sources.

UNIT-II
Transients: Introduction, Study of initial conditions, DC transients RL, RC circuits, RLC circuits, Formulation of integral, differential equations. Circuit analysis using Laplace Transform and inverse Laplace Transform, Pole-Zero Plots, Zero Input Response, Zero State Response.

UNIT-III
Steady State Analysis of AC Circuits: Phasor and vector representations, impedance and admittance, Average power, Apparent Power, Complex Power, Power triangle.

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Coupled circuits: Concept of self, mutual inductance, co-efficient of coupling, dot convention rules and analysis of simple circuits.

UNIT-IV

Frequency Domain Analysis: Concept of complex frequency, impedance and admittance functions, Series and parallel resonance, Q-factor, selectivity, bandwidth.

Two Port Networks: Z, Y, h, g, ABCD and Inverse ABCD parameters, equivalence of two port networks. Inter connection of two port networks.

UNIT-V

Filters: Introduction to Filters and classification of Filters (Low pass, High pass, Band pass and Band stop) and their design aspects.

Network Synthesis: Elements of circuit synthesis, Foster and Cauer forms of LC, RC and RL networks.

Text Books:

1. William H.Hayt, Jr.,Jck E. Kemmerly and Steven M.Durbin, "Engineering Circuit Analysis", 8th Edition, McGraw Hill, 2013.
2. Van Valkenberg M.E, "Network Analysis", PHI, New Delhi, 3rd Edition 2002.

Suggested Reading:

1. C. L. Wadhwai, "Network Analysis and Synthesis", 4th Edition, New Age Publications, 2016.
2. Sudhakar. A. and Shyam Mohan, S. P., "Circuits and Network", Tata McGraw Hill, New Delhi, 1994.

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20ECC04

SIGNALS AND SYSTEMS

Instruction	3 L Hours per Week
Duration of SEE	3 Hours
SEE	60 Marks
CIE	40 Marks
Credits	3

Prerequisite: Knowledge of Differential and Integral Calculus.

Course Objectives:
This course aims to:
1. Know Signals and systems representation/classification and also the time and frequency domain analysis of continuous time signals with Fourier series, Fourier transforms and Laplace transforms.
2. Understand Sampling, time and frequency domain analysis of discrete time signals with DTFT and Z-Transforms.
3. Understand concepts of convolution and correlation integrals.

Course Outcomes:
Upon completion of this course, students will be able to:
1. Classify signals, systems and analyse the signals using Transform techniques.
2. Evaluate signal characteristics using time and frequency domain analysis.
3. Assess the system stability and causality using ROC and Pole-Zero Plot.
4. Describe the sampling process and analyse the DT Signal/systems using DTF and Z-Transform.
5. Apply the Convolution and correlation concept for analysis of Signal and systems**.**

Mapping of Course Outcomes with Program Outcomes and Program Specific Outcomes:

PO/PSO / CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO 1	3	2	1	-	1	-	-	-	-	2	-	2	2	1	1
CO 2	3	2	1	-	1	-	-	-	-	2	-	2	2	1	1
CO 3	3	2	1	-	1	-	-	-	-	2	-	2	2	1	1
CO 4	3	2	1	-	1	-	-	-	-	2	-	2	2	1	1
CO 5	3	2	1	-	1	-	-	-	-	2	-	2	2	1	1

UNIT-I
Continuous Time Signals: Introduction to signals, their representations and classification. Introduction to systems and their classifications, Orthogonality of signals, Complete set of mutually orthogonal signals and Harmonic signals.
Signal Representation: Trigonometric Fourier series, Exponential Fourier series, Existence and Convergence. Symmetry conditions, Amplitude and Phase spectra. Power Spectral Density.

UNIT-II
Fourier Transforms: The direct and inverse Fourier transforms, Existence, Frequency spectrum and properties of Fourier Transforms, Fourier Transform of singularity functions and periodic signals. Energy Spectral Density, characteristics of linear systems, Distortion less system, Phase delay and group delay.

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UNIT-III

Signal Representation by Generalized Exponentials: The Bilateral and unilateral Laplace transforms. Region of convergence and its properties. Properties of Laplace transform, Inverse Laplace transform, Laplace transform of periodic signals.

LTI System: Impulse response, System transfer function, Stability and Causality.

UNIT-IV

Discrete Time Signals: Sampling of continuous time signals. DTS representation. Discrete Time Fourier Transform and properties.

Z–Transform: The Direct Z-Transform, Region of convergence and its properties. S–Plane and Z–Plane correspondence, Z–Transform properties. Inverse Z–Transform.

Discrete LTI system: impulse response and system transfer function. Stability and Causality.

UNIT-V

Convolution: Continuous convolution, Graphical interpretation and its properties. Discrete convolution and its properties.

Correlation: Continuous Cross correlation, Auto correlation and properties. Discrete Cross correlation, Auto correlation and properties.

Text Books:

1. B. P. Lathi, "Signals, Systems and Communications", BS Publications, 3rd Edition, 2008.
2. Simon Haykin, "Signals and Systems", Wiley India, 5th Edition, 2009.

Suggested Reading:

1. Alan V. Oppenheim, Alan S. Willsky, S. Hamid Nawad, "Signals and Systems", PHI 2nd Edition, 2015.
2. M. J. Robert, "Fundamentals of signals and systems", McGraw Hill, 2008.
3. A. Rajeswari, "Signals and Systems", Wiley India Pvt. Ltd, Publications 2021.

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20CEM01

ENVIRONMENTAL SCIENCE

(Common to all Programs)

Instruction	2 L Hours per Week
Duration of SEE	2 Hours
SEE	50 Marks
CIE	0 Marks
Credits	No Credits

Prerequisite: Basic knowledge of Science.

Course Objectives:

This course aims to:

1. Identify environmental problems arising due to over utilization of natural resources and understand the importance of use of renewable energy sources.
2. Become aware about the importance of eco system and interlinking of food chain.
3. Identify the importance of biodiversity in maintaining ecological balance.
4. Learn about various attributes of pollution management and waste management practices.
5. Contribute for capacity building of nation for arresting and/or managing environmental disasters.

Course Outcomes:

Upon completion of this course, students will be able to:

1. Identify the natural resources and realise the importance of water, food, forest, mineral, energy, land resources and effects of over utilisation.
2. Understand the concept of ecosystems and realise the importance of interlinking of food chains.
3. Contribute for the conservation of biodiversity.
4. Suggest suitable remedial measure for the problems of environmental pollution and contribute for the framing of legislation for protection of environment.
5. Follow the environmental ethics and contribute to the mitigation and management of environmental disasters.

Mapping of Course Outcomes with Program Outcomes and Program Specific Outcomes:

PO/PSO / CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO 1	1	-	-	-	-	-	3	-	-	-	-	1	1	-	-
CO 2	1	-	-	-	-	-	2	1	-	-	-	1	1	-	-
CO 3	1	-	-	-	-	-	2	1	-	-	-	1	1	-	-
CO 4	1	-	-	-	-	1	2	1	-	-	-	1	1	-	-
CO 5	1	-	-	-	-	1	2	1	-	-	-	1	1	-	-

UNIT-I

Environmental Studies: Definition, Scope and importance, need for public awareness.

Natural resources: Use and over utilization of Natural Resources - Water resources, Food resources, Forest resources, Mineral resources, Energy resources, Land resources.

UNIT-II

Ecosystems: Concept of an ecosystem, structure and function of an ecosystem, role of producers, consumers and decomposers, energy flow in an ecosystem, food chains, food webs, ecological pyramids, Nutrient cycling, Bio-geo chemical cycles, Terrestrial and Aquatic ecosystems.

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UNIT-III

Biodiversity: Genetic, species and ecosystem biodiversity, Bio-geographical classification of India, India as a Mega diversity nation. Values of biodiversity, hot-spots of biodiversity, threats to biodiversity, endangered and endemic species of India, methods of conservation of biodiversity.

UNIT-IV

Environmental Pollution: Cause, effects and control measures of air pollution, water pollution, marine pollution, soil pollution, noise pollution and Solid waste management, nuclear hazards

Environmental Legislations: Environment protection Act, Air, Water, Forest & Wild life Acts, issues involved in enforcement of environmental legislation, responsibilities of state and central pollution control boards.

UNIT-V

Social issues and the environment: Water conservation methods: Rain water harvesting and watershed management, Environmental ethics, Sustainable development and Climate change: Global warming, Ozone layer depletion, forest fires, and Contemporary issues.

Text Books:

1. Y. Anjaneyulu, "Introduction to Environmental Science", B S Publications, 2004.
2. Suresh K. Dhameja, "Environmental Studies", S. K. Kataria& Sons, 2009

Suggested Reading:

1. C. S. Rao," Environmental Pollution Control Engineering", Wiley, 1991.
2. S. S. Dara, "A Text Book of Environmental Chemistry & Pollution Control", S. Chand Limited, 2006.

20CSC07

BASICS OF DATA STRUCTURES LAB

(Common for all Programs except CSE & IT)

Instruction	2 P Hours per Week
Duration of SEE	3 Hours
SEE	50 Marks
CIE	50 Marks
Credits	1

Prerequisite: Any Programming Language.

Course Objectives:

This course aims to familiarize:

1. Design and construct simple programs by using the concepts of Data structures as abstract data type.
2. To have a broad idea about how efficiently pointers can be used in the implement of data structures.
3. To enhance programming skills while improving their practical knowledge in data structures.
4. To strengthen the practical ability to apply suitable data structure for real time applications.

Course Outcomes:

Upon completion of this course, students will be able to:

1. Implement the abstract data type.
2. Demonstrate the operations on stacks, queues using arrays and linked lists.
3. Apply the suitable data structures including stacks, queues to solve problems.
4. Analyse various searching and sorting techniques.
5. Choose proper data structures, sorting and searching techniques to solve real world problems.

Mapping of Course Outcomes with Program Outcomes and Program Specific Outcomes:

PO/PSO / CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO 1	2	1	-	1	2	2	0	-	-	-	-	1	3	3	2
CO 2	2	2	1	2	3	2	1	-	-	-	-	1	3	3	2
CO 3	2	2	2	2	3	2	1	-	-	-	-	1	3	3	2
CO 4	2	3	2	3	3	3	1	-	-	-	-	2	3	3	2
CO 5	2	2	2	3	3	3	1	-	-	-	-	2	3	3	2

List of Experiments:

1. Implementation of operations on arrays
2. Implementation of Stack.
3. Implementation of Queue.
4. Implementation of basic operations on Single Linked List.
5. Implementation of Searching techniques.
6. Implementation of Sorting Techniques
7. Case study like Banking System, Students Marks Management, Canteen Management, Library Management etc.,

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Suggested Reading:

1. Brian W Kernighan, Dennis Ritchie, C Programming Language, PH PTR, 2nd Edition.
2. Richard M Reese, Understanding and Using C Pointers, O`Reily, 2013.

Weblinks:

1. https://nptel.ac.in/courses/106102064/
2. https://www.udemy.com/algorithms-and-data-structures-in-python/

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20ECC05

ELECTRONIC DEVICES LAB

Instruction	2 P Hours per Week
Duration of SEE	3 Hours
SEE	50 Marks
CIE	50 Marks
Credits	1

Prerequisite: Students have the knowledge of semiconductor fundamentals.

Course Objectives:
This course aims to familiarize:
1. The V-I characteristics of diodes and special semiconductor devices.
2. The design and performance evaluation of various diodes as rectifiers.
3. The characteristics of transistor in various configurations.

Course Outcomes:
Upon completion of this course, students will be able to:
1. Demonstrate the characteristic behaviour of PN junction diode, Zener diode and special purpose semiconductor diodes.
2. Design various non-linear wave shaping circuits using diodes for a given specification.
3. Analyse the behaviour of non-linear wave shaping circuits using diodes.
4. Examine the characteristics of BJT and FET in various configurations.
5. Evaluate and compare the significant parameters obtained from the characteristics of BJT and FET.

Mapping of Course Outcomes with Program Outcomes and Program Specific Outcomes:

PO/PSO / CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO 1	2	2	-	1	2	-	-	2	2	2	2	2	3	3	2
CO 2	2	2	-	1	2	-	-	2	2	2	2	2	3	3	2
CO 3	2	2	-	1	2	-	-	2	2	2	2	2	3	3	2
CO 4	2	2	-	1	2	-	-	2	2	2	2	2	3	3	2
CO 5	2	2	-	1	2	-	-	2	2	2	2	2	3	3	2

List of Experiments:

1. V-I Characteristics of Silicon and Germanium diodes and measurement of static and dynamic resistances.
2. Zener diode characteristics and its application as voltage regulator.
3. Clipping and Clamping Circuits.
4. Design, realization and performance evaluation of half wave rectifiers without filters and with filters (capacitor filter and π - section filter).
5. Design, realization and performance evaluation of full wave rectifiers without filters and with C & π section filters.
6. Plotting the characteristics of BJT in Common Base configuration and measurement of h-parameters.
7. Plotting the characteristics of BJT in Common Emitter configuration and measurement of h-parameters.
8. Plotting the characteristics of BJT in Common Collector configuration and measurement of h-parameters.

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9. Plotting the characteristics of JFET in CS configurations and measurement of Transconductance and Drain resistance.
10. Characteristics of special semi-conductor devices-UJT and SCR.
11. Characteristics of LED and photo diode.
12. Characteristics of Tunnel diode.
13. **Structured Enquiry:** Design a switching circuit using BJT and JFET and analyse its operation.
14. **Open ended Enquiry:** Design a LED running lights circuit for vehicles to avoid accidents in fog/rain condition.

Note:

1. Wherever possible, Analysis and design of circuits shall be carried out using simulation tools.
2. A minimum of 12 experiments should be performed.

Suggested Reading:

1. Robert Diffenderfer, "Electronic Devices Systems and Applications", Cengage Learning India Private Limited, 2010.
2. Paul B. Zbar, Albert P. Malvino, Michael A. Miller, "Basic Electronics, A Text - Lab Manual", 7th Edition, TMH 2001.
3. Mahesh Jain, "Practical semiconductors data manual No.3", BPB Publications, 1981.
4. Bharath Electronics Ltd., "Semiconductors data manual", IEC Publication 134, 1969.

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20ECC06

ELECTRONIC WORKSHOP AND NETWORKS LAB

Instruction	2 P Hours per Week
Duration of SEE	3 Hours
SEE	50 Marks
CIE	50 Marks
Credits	1

Prerequisite: Knowledge of basic Electrical components, circuits and equipment.

Course Objectives:
This course aims to:
1. Understand the basic Concepts of Electric Circuits and equipment Like CRO, Multimeter and LCR–Q meter
2. Verify network theorems.
3. Analyze Resonant circuits, Attenuators and passive filters.

Course Outcomes:
Upon completion of this course, students will be able to:
1. Identify and measure the passive and active components using electronic equipment.
2. Apply Network theorems to AC and DC Circuits.
3. Determine and analyze two port network parameters.
4. Design and verification of attenuator and filters.
5. Simulation of different networks and circuits using the simulation software.

Mapping of Course Outcomes with Program Outcomes and Program Specific Outcomes:

CO / PO/PSO	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	PSO 3
CO 1	1	-	-	-	-	1	1	-	-	-	-	1	-	1	1
CO 2	3	3	3	2	2	2	1	1	1	2	1	2	1	3	2
CO 3	1	2	-	-	1	1	1	-	-	-	-	1	-	1	1
CO 4	2	2	1	1	-	1	1	1	1	1	1	-	1	1	1
CO 5	1	-	-	-	1	-	-	-	-	-	-	1	-	-	-

List of Experiments:

1. Study of RLC components, Bread board, Regulated power supply, Function generator, CRO Measurement of R, L, C components using color code, multimeter and LCR - Q Meter.
2. Practice of Soldering and de -soldering for simple circuits on single and Multi-Layer PCBs.
3. Verification of Superposition theorem and Tellegen's theorem.
4. Verification of Maximum power transfer theorem. Verification of Reciprocity theorem.
5. Verification of Compensation theorem and Millman's theorem. Verification of Transient Response in RC, RL Circuits.
6. Design and Verification of Series Resonance.
7. Determination of two-port network parameters (Z, Y, h, T).
8. Design and Verification of Constant-K low-pass filter.
9. To sense and measure ambient temperature by Pmod TMP3 sensor with My RIO kit.
10. **Structured Enquiry:** Design and Verification of Parallel Resonance.
11. **Open ended Enquiry:** Design and Verification of Constant-K high-pass filter.

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Note: Experiments are to be simulated by using any simulation software.

Suggested Reading:

1. Thomas Petruzzellis, "Build Your Own Electronics Workshop", McGraw-Hill Companies, Inc., 2005.
2. A.M. Zungeru, J.M. Chuma, M. Mangwala, L.K. Ketshabetswe, "Handbook of Laboratory Experiments in Electronics and Communication Engineering", Vol. 2, 1st Edition, Notion press, 2017.

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20ECI01

MOOCs/Training/Internship

Instruction/Demonstration/Training	3-4 Weeks/90 Hours
Duration of Semester End Presentation	--
Semester End Evaluation	60 Marks
Mid Term Evaluation	40 Marks
Credits	2

Prerequisite: Knowledge of basic Sciences and Engineering Sciences

Course Objectives:
This course aims to:
1.
2.
3.

Course Outcomes:
Upon completion of this course, students will be able to:
1.
2.
3.
4.
5.

Mapping of Course Outcomes with Program Outcomes and Program Specific Outcomes:

PO/PSO / CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO 1															
CO 2															
CO 3															
CO 4															
CO 5															

For further information refer Internship document

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20ECC07

ANALOG CIRCUITS

Instruction	3 L Hours per Week
Duration of SEE	3 Hours
SEE	60 Marks
CIE	40 Marks
Credits	3

Prerequisite: Student should have knowledge on Electronic Devices and Network Analysis.

Course Objectives:
This course aims to:
1. The Understand the applications of BJT & FET as a switch and an amplifier.
2. Analysis of BJT & FET in various configurations using small signal equivalent models and their frequency response.
3. Know concept of multistage, feedback amplifiers, and power amplifier and their analysis.

Course Outcomes:
Upon completion of this course, students will be able to:
1. Recall and relate the knowledge of BJT and FET behavior in the design of various biasing and amplifier circuits.
2. Apply low and high frequency models of transistor in the analysis of single stage and multistage amplifiers.
3. Design and analyze amplifier and oscillator circuits.
4. Compare and Contrast different types of biasing, Multistage, Feedback and Power amplifiers.
5. Interpret a given analog circuit and evaluate its performance parameters by applying acquired knowledge.

Mapping of Course Outcomes with Program Outcomes and Program Specific Outcomes:

PO/PSO / CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO 1	3	3	2	3	-	-	-	-	-	-	-	1	3	2	1
CO 2	3	3	3	2	-	-	-	-	-	-	-	1	3	2	1
CO 3	3	3	3	3	-	-	-	-	-	-	-	1	3	2	1
CO 4	3	3	3	2	-	-	-	-	-	-	-	1	3	2	1
CO 5	3	2	1	2	-	-	-	-	-	-	-	1	3	2	1

UNIT-I
Transistor Biasing: BJT biasing techniques, stability factors, Bias compensation techniques, Thermal runaway, Thermal stability, BJT as an amplifier and as a switch. JFET biasing-zero current drift biasing, biasing of JFET, FET as an amplifier and as a switch.

UNIT-II
Single Stage Amplifiers: Analysis of BJT circuits using h-parameters in CB, CE and CC configurations - their comparison (approximate and exact analysis), Millers Theorem & its duality – application circuits. Analysis of FET circuits using small-signal model for CS and CD configurations - their comparison. Frequency response of BJT and FET Amplifiers.

UNIT-III
Multistage amplifiers: Coupling schemes - RC coupling, Transformer coupling and Direct coupling; Analysis of CE-CE, CE-CB, CE-CC, CC-CC – Darlington pair.

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Transistor at high frequencies: Hybrid π CE transistor model, Hybrid π Conductances and Capacitances, CE short circuit current gain, Current gain with resistive load.

UNIT-IV

Feed Back Amplifiers: The feedback concept, General characteristics of negative feedback amplifier, Effect of negative feedback on input and output impedances. Method of analysis of feedback amplifiers, Analysis of Voltage series, voltage shunt, current series and current shunt feedback amplifiers.

Oscillators: Positive feedback and conditions for sinusoidal oscillations, RC oscillator, LC oscillator, Crystal oscillator, Amplitude and frequency stability of oscillator.

UNIT-V

Large Signal Amplifies & Voltage Regulators: Large Signal Amplifiers: BJT as large signal audio amplifiers, Classes of operation, Harmonic distortion, Class A resistive coupled and transformer coupled amplifiers, Class-B Push-pull and complementary symmetry amplifiers, Class AB operation. power dissipation and efficiency calculations. Heat sinks.

Voltage Regulators: Transistor series and shunt voltage regulators.

Text Books:

1. Jacob Millman, Christos Halkias, Chetan Parikh, "Integrated Electronics – Analog and Digital Circuits and Systems", 2nd Edition, McGraw Hill Publication, 2010.
2. Robert L. Boylestad, "Electronic Devices and Circuit Theory", 10th Edition, PHI, 2009.

Suggested Reading:

1. David Bell, "Fundamentals of Electronic Devices and Circuits", 5th Edition, Oxford University Press, 2008.
2. Millman and Halkias, "Electronic Devices and Circuits" 2nd Edition, McGraw Hill Publication, 2007.
3. Donald Schilling, Charles Belove, Tuvia Apelewicz Raymond Saccardi, "Electronic Circuits: Discrete and Integrated", TMH, 3rd Edition, 2012.

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20ECC08

ANALOG COMMUNICATION

Instruction	3 L Hours per Week
Duration of SEE	3 Hours
SEE	60 Marks
CIE	40 Marks
Credits	3

Prerequisite: A prior knowledge of signals and systems is required.

Course Objectives:
This course aims to:
1. Introduce the fundamentals of analog communication.
2. Provide the design details of various transmitters and receivers used in analog communication system.
3. Involve the students in analyzing performance of communication system by estimating noise.

Course Outcomes:
Upon completion of this course, students will be able to:
1. Understand the various linear and nonlinear modulation schemes.
2. Design various transmitters and receivers.
3. Assess a random signal by computing various statistical properties.
4. Evaluate the performance of analog communication system through the estimation of noise.
5. Infer the concepts of various pulse modulation schemes.

Mapping of Course Outcomes with Program Outcomes and Program Specific Outcomes:

PO/PSO / CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	3	3	3	1	0	2	3	3	1	3	2	2	3	2	2
CO2	3	3	3	3	0	3	3	3	1	3	3	3	3	2	2
CO3	3	3	3	3	0	3	3	0	0	3	3	3	3	1	1
CO4	3	3	3	3	0	3	3	3	1	3	3	3	3	2	2
CO5	3	3	3	1	0	2	3	3	1	3	2	2	3	2	2

UNIT – I
Linear Modulation Schemes:
Need for Modulation, Double Side Band Suppressed Carrier Modulation, Balanced Modulator, Coherent Detector and Costas Detector. Conventional Amplitude Modulation, Phasor Diagram of AM, Switching Modulator, Envelope Detector. Hilbert Transform and its Properties. Single Side Band Modulation. Vestigial Side Band Modulation.

UNIT – II
Non-Linear Modulation Schemes:
Angle Modulation, Frequency Modulation and Phase modulation, Concept of Instantaneous Phase and Frequency. Types of FM modulation: Narrow Band FM and Wide Band FM. FM Spectrum in Terms of Bessel Functions. Phasor Diagram of NBFM. Direct and Indirect (Armstrong's) methods of FM Generation. Foster–Seeley Discriminator for FM Detection. Introduction to PLL.

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UNIT – III

Transmitters and Receivers:

High Level and Low Level AM Transmitters. Principle and Operation of Tuned Radio Frequency receiver and Super Heterodyne Receivers. Selection of RF Amplifier. Choice of Intermediate Frequency. Image Frequency and its Rejection Ratio, Receiver Characteristics: Sensitivity, Selectivity, Fidelity. Double Spotting, Pre-emphasis and De-emphasis.

UNIT – IV

Random Variables and Random Process: Concept of random variable, Uniform Random Variable, Gaussian Random Variable. Random Process: Concept of random process, Stationarity and Ergodicity, Auto Correlation and its Properties, Power Spectral Density and its Properties. Linear System with Random inputs: Random Signal Response of Linear System, Auto Correlation of Response.

UNIT – V

Noise: Thermal Noise. White Noise. Noise Temperature. Noise in Two-Port Network: Noise Figure, Equivalent Noise Temperature and Noise Bandwidth. Noise Figure and Equivalent Noise Temperature for Cascaded Stages. Figure of Merit Calculations for AM, DSB-SC and SSB systems. Pulse Analog Modulation Schemes: PAM, PWM and PPM. Generation and detection of PAM, PWM and PPM.

Text Books:

1. Simon Haykin, "Communication Systems",2nd Edition, Wiley India,2011.
2. Herbert Taub, Donald L. Shilling & Goutam Saha, "Principles of Communication Systems", 3rd Edition, TMH, 2008.
3. Peyton Z. Peebles JR., "Probability Random Variables and Random Signal Principles", Tata McGraw Hill, 4th Edition, 2002.

Suggested Reading:

1. Singh, R.P. and Sapre, S.D., "Communication Systems", TMH, 2007.

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20ECC09

ANTENNAS AND WAVE PROPAGATION

Instruction	3 L Hours per Week
Duration of SEE	3 Hours
SEE	60 Marks
CIE	40 Marks
Credits	3

Prerequisite: Students should have prior knowledge about Electromagnetics theory and Maxwell's equations.

Course Objectives:
This course aims to:
1. The basic principles of an antenna and its parameters for characterizing its performance.
2. The fundamental concepts of various types of antennas, arrays for customizing the pattern parameters.
3. The propagation behavior of the radio wave in both troposphere and ionosphere.

Course Outcomes:
Upon completion of this course, students will be able to:
1. Understand the basic parameters of an antenna.
2. Extend current distribution concept in order to estimate the field patterns.
3. Appraise the concepts of broad side and end fire arrays.
4. Understand the working principle and characteristics of various antennas.
5. Study the behavior of radio waves in various modes of wave propagation.

Mapping of Course Outcomes with Program Outcomes and Program Specific Outcomes:

PO/PSO / CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO 1	3	2	1	2	1	1	1	1	1	1	2	2	3	2	1
CO 2	2	2	3	3	2	3	3	3	2	2	2	2	3	2	1
CO 3	2	2	2	2	2	2	2	2	1	1	1	2	3	2	1
CO 4	3	3	3	2	2	3	3	3	3	3	3	2	3	2	1
CO 5	2	3	1	2	2	2	2	2	2	1	2	2	3	2	1

UNIT-I
Antenna Basics: Principles of radiation, Retarded potential, Isotropic, Directional and Omni- directional radiators. Basic antenna parameters: Radiation patterns, radiation intensity, far field, near field, gain and directivity, Antenna Polarization, effective aperture area and efficiency. Point sources, current distribution, Friis transmission formula.

UNIT-II
Antenna Analysis: Analysis of Infinitesimal dipole, Half-wave dipole, quarter wave monopole, loop antenna and their far field patterns, calculation of radiation resistance and directivity.

UNIT-III
Antenna Arrays: Concept of Antenna Array. Uniform linear array: Broadside and End-fire arrays Calculation of Directivity and Beamwidth. Two element array of Infinitesimal dipoles. Qualitative treatment of nonlinear arrays: Binomial and Chebyshev arrays.

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UNIT-IV

Practical Antennas: Qualitative treatment of Helical Antennas: Normal and Axial mode patterns, wideband characteristics. Characteristics, radiation principles and applications of Rhombic Antenna, Yagi-Uda antenna, Parabolic antenna system, Log-Periodic antenna. Microstrip antennas: Radiation mechanism, different types, advantages and disadvantages. Design of rectangular Microstrip antenna.

UNIT-V

Wave Propagation: Ground wave propagation, Space and Surface waves, Tropospheric refraction and reflection, Duct propagation. Sky wave propagation: Critical frequency, Maximum Usable Frequency (MUF) and Skip distance, Line of sight propagation.

Text Books:

1. Constantine A. Balanis, "Antenna Theory: Analysis and Design", 4th Edition, John Wiley, 2016.
2. Edward C. Jordan and Kenneth G. Balmain, "Electromagnetic Waves and Radiating Systems", 2nd Edition, PHI, 2001.

Suggested Reading:

1. John D. Krauss, Ronald J. Marhefka and Ahmad S. Khan, "Antennas and Wave Propagation", 4th Edition, TMH, 2010.
2. Dennis Roody and John Coolen, "Electronic Communications", 4th Edition, Prentice Hall, 2008.

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20ECC10

CONTROL SYSTEMS

Instruction	3 L Hours per Week
Duration of SEE	3 Hours
SEE	60 Marks
CIE	40 Marks
Credits	3

Prerequisite: The student is expected to have knowledge of Laplace transform and electrical and electronic circuits.

Course Objectives:
This course aims to:

1. Introduce various control systems (Open and closed loop) and their equivalent mathematical models using block diagrams, signal flow graphs and state space techniques.
2. Analyze the time and frequency response of control system to access the transient response and steady state response.
3. Study different types of stability concepts in control systems
4. Design various controllers and compensators to improve the system dynamic performance.

Course Outcomes:
Upon completion of this course, students will be able to:

1. Distinguish the closed-loop control systems from open-loop control systems and develop mathematical models in time domain (differential equations, state equations) and S-domain (Transfer function using Laplace transform).
2. Evaluation of transfer function from block diagram and signal flow graph by using block diagram reduction techniques and Mason gain formula, respectively.
3. Investigate the stability of control system via Routh-Hurwitz criteria, Root-locus method and Nyquist Plot.
4. Utilize standard test signals to analyze the time response of first and second-order control systems and frequency response analysis of the control system.
5. Design and develop various controllers and compensators to control the steady state error, stability and transient response.

Mapping of Course Outcomes with Program Outcomes and Program Specific Outcomes:

PO/PSO / CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO 1	3	3	1	1	-	1	1	-	-	-	-	1	3	2	2
CO 2	3	3	1	2	1	1	1	-	-	-	-	1	3	2	2
CO 3	3	3	3	3	2	1	1	-	-	-	-	1	3	2	2
CO 4	3	3	2	3	2	1	1	-	-	-	-	1	3	2	2
CO 5	3	3	3	2	1	1	1	-	-	-	-	1	3	2	2

UNIT-I
Control System Fundamentals: Classification of control systems, Open and Closed Loop control systems, Block diagram reduction and signal flow graphs, Mathematical modelling of a Mechanical system and conversion into Electrical system.

UNIT-II
Time Response Analysis: Transfer function and Impulse Response, Types of Inputs, Transient Response of first and second Order System with different inputs, Time domain Specifications. Types of Systems, static error coefficients, error series, PD, PI and PID controllers.

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UNIT-III

Routh-Hurwitz criteria for stability. Root Locus Techniques, Analysis of typical systems using root locus techniques, Effect of location of roots on system response.

UNIT-IV

Frequency Response Analysis: Frequency domain specifications, bode plot, Principle of Argument, Nyquist plot and stability criterion, Gain and Phase Margins from the Bode and Nyquist diagrams. Lead and Lag compensators.

UNIT-V

State Space Analysis: Concept of State, State Variable, State vector and State space. State space representations of linear time invariant systems, State transition matrix, Solution of state equation, Controllability, Observability and Design of control systems using state variable feedback.

Text Books:

1. I. J. Nagrath and M. Gopal, "Control Systems Engineering", New Age International Publishers, 5th Edition 2012.
2. Benjamin C. Kuo, "Automatic Control Systems", 7th Edition, PHI, 2010.

Suggested Reading:

1. K. Ogata, "Modern Control Engineering", EEE, 5th Edition, PHI, 2003.
2. Richard C. Dorf and Robert H. Bishop, "Modern Control Systems", 11th Edition Pearson, 2008.
3. Gopal Madan, "Digital control engineering" 1st Edition, New age publishers, 2008.

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20ECC11

DIGITAL SYSTEM DESIGN

Instruction	3 L Hours per Week
Duration of SEE	3 Hours
SEE	60 Marks
CIE	40 Marks
Credits	3

Prerequisite: Knowledge of Electronic device concepts.

Course Objectives:
This course aims to:
1. Learn various techniques for logic minimization.
2. Comprehend the concepts of various combinational circuits and sequential circuits.
3. Learn the Language fundamentals of Verilog HDL, also able to simulate and synthesize various digital modules.

Course Outcomes:
Upon completion of this course, students will be able to:
1. Understand the basic concepts related to digital system design.
2. Design the combinational and sequential circuits.
3. Analyze the behavior of the digital system design.
4. Develop the digital system using various Verilog HDL modeling.
5. Apply the design concepts of digital system using Verilog HDL.

Mapping of Course Outcomes with Program Outcomes and Program Specific Outcomes:

PO/PSO / CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO 1	1	1	1	3	2	1	1	-	-	-	-	-	3	2	2
CO 2	3	2	2	3	2	1	1	1	-	-	1	1	3	3	2
CO 3	3	3	3	3	2	1	1	1	1	-	1	2	3	2	2
CO 4	3	3	3	3	2	2	1	2	2	1	1	2	3	2	3
CO 5	3	3	3	3	2	2	1	2	2	1	1	2	3	2	2

UNIT-I
Logic Simplification and Combinational Logic Design: Number system representation and conversion, Review of Boolean Algebra and De Morgan's Theorem, SOP & POS forms, Canonical forms, Introduction to Logic Gates, Ex-OR, Ex-NOR operations, Minimization of Switching Functions: Karnaugh map method, Quine –McCluskey Tabular Minimization Method. Logic function realization: AND-OR, OR-AND and NAND/NOR realizations.

UNIT-II
Introduction to Combinational Design: Binary Adders, Subtractors and BCD adder, Code converters Binary to Gray, Gray to Binary, BCD to excess3, BCD to Seven Segment display, Decoders, Encoders, Priority Encoders, Multiplexers, Demultiplexers, Comparators Implementations of Logic Functions using Decoders and Multiplexers.

UNIT-III
Sequential Logic Design: Latches, Flipflops, Difference between latch and flipflop, types of flipflops like S-R, D, T JK and Master-Slave JK FF, Edge triggered FF, flipflop conversions, setup and hold times, Ripple and Synchronous counters, Shift registers, Finite state machines, Design of synchronous FSM, Algorithmic State Machines charts.

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UNIT-IV

Introduction to HDLs: VLSI Design flow, Basic Concepts of Verilog HDL, Data Types, System Tasks and Compiler Directives. Gate Level Modelling: Gate Types and Gate Delays. Dataflow Modeling: Continuous Assignment and Delays. Design of Stimulus Block.

UNIT-V

Behavioral Modeling: Structured Procedures, Procedural Assignments, Timing control, Conditional statements, Sequential and Parallel Blocks. Switch level Modelling. Introduction to tasks and functions. Design of Mealy and Moore state models using Verilog HDL. Introduction to Logic Synthesis. Concept of Programming using FPGA.

Text Books:

1. Morris Mano M. and Michael D.Ciletti, "Digital Design, With an Introduction to Verilog HDL", 5th Edition, Pearson 2013.
2. Samir Palnitkar, "Verilog HDL, A guide to Digital design and synthesis", 2nd Edition, Pearson Education, 2008.

Suggested Reading:

1. R.P. Jain, "Modern digital Electronics", Tata McGraw Hill, 4th Edition, 2009.
2. Thomas L. Floyd, "Digital Fundamentals", Pearson, 11th Edition, 2015.

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20EGM03

UNIVERSAL HUMAN VALUES II: UNDERSTANDING HARMONY

(Common for all Programs)

Instruction	2 L+1T Hours per Week
Duration of SEE	3 Hours
SEE	50 Marks
CIE	50 Marks
Credits	3

Prerequisite: Knowledge of UNIVERSAL HUMAN VALUES I

Course Objectives:

This course aims to:

1. Development of a holistic perspective based on self-exploration about themselves (human being), family, society, and nature/existence.
2. Understanding (or developing clarity) of the harmony in human being, family, society, and nature/existence.
3. Strengthening of self-reflection.
4. Development of commitment and courage to act.

Course Outcomes:

Upon completion of this course, students will be able to:

1. Students are expected to become more aware of themselves, and their surroundings (family, society, nature)
2. They would become more responsible in life, and in handling problems with sustainable solutions, while keeping human relationships and human nature in mind.
3. They would have better critical ability.
4. They would also become sensitive to their commitment towards what they have understood (human values, human relationship, and human society).
5. It is hoped that they would be able to 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.

The course has 28 lectures and 14 practice sessions:

Mapping of Course Outcomes with Program Outcomes and Program Specific Outcomes:

PO/PSO / CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO 1	-	-	1	-	-	1	-	-	1	-	-	1	-	-	-
CO 2	-	-	1	-	-	1	1	-	1	-	1	1	-	-	-
CO 3	--	-	-	-	-	1	-	-	-	1	-	-	-	-	-
CO 4	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CO 5	-	-	-	1	-	-	-	-	1	1	1	1	-	-	-

UNIT-I

Course Introduction - Need, Basic Guidelines, Content and Process for Value Education

- Purpose 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.

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- 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.

Include practice sessions to discuss natural acceptance in human being as the innate acceptance for living with responsibility (living in relationship, harmony and co-existence) rather than as arbitrariness in choice based on liking-disliking.

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.

Include practice sessions to discuss the role others have played in making material goods available to me. Identifying from one's own life. Differentiate between prosperity and accumulation. Discuss program for ensuring health vs dealing with disease.

UNIT-III

Understanding Harmony in the Family and Society- Harmony in Human- Human 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.

Include practice sessions to reflect on relationships in family, hostel and institute as extended family, real life examples, teacher-student relationship, goal of education etc. Gratitude as a universal value in relationships. Discuss with scenarios. Elicit examples from students' lives.

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.

Include practice sessions to discuss human being as cause of imbalance in nature (film "Home" can be used), pollution, depletion of resources and role of technology etc.

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: a. Ability to utilize the professional competence for augmenting universal human order b. Ability to identify the scope and characteristics of people friendly and eco-friendly production systems, c. Ability to identify and develop appropriate technologies and management patterns for above production systems.
- Case studies of typical holistic technologies, management models and production systems.
- Strategy for transition from the present state to Universal Human Order:

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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.

Include practice Exercises and Case Studies will be taken up in Practice (tutorial) Sessions eg. To discuss the conduct as an engineer or scientist etc.

Mode of Conduct (L-T-P-C 2-1-0-3)

- Lecture hours are to be used for interactive discussion, placing the proposals about the topics at hand and motivating students to reflect, explore and verify them. Tutorial hours are to be used for practice sessions.
- While analysing and discussing the topic, the faculty mentor's role is in pointing to essential elements to help in sorting them out from the surface elements. In other words, help the students explore the important or critical elements.
- In the discussions, particularly during practice sessions (tutorials), the mentor encourages the student to connect with one's own self and do self-observation, self-reflection and self- exploration.
- Scenarios may be used to initiate discussion. The student is encouraged to take up "ordinary" situations rather than" extra-ordinary" situations. Such observations and their analyses are shared and discussed with other students and faculty mentor, in a group sitting.
- Tutorials (experiments or practical) are important for the course. The difference is that the laboratory is everyday life, and practicals are how you behave and work in real life. Depending on the nature of topics, worksheets, home assignments and/or activities are included.
- The practice sessions (tutorials) would also provide support to a student in performing actions commensurate to his/her beliefs. It is intended that this would lead to development of commitment, namely behaving and working based on basic human values.

Assessment:

This is a compulsory credit course. The assessment is to provide a fair state of development of the student, so participation in classroom discussions, self- assessment, peer assessment etc. will be used in evaluation.
Example:
Assessment by faculty mentor: 10 marks
Self-assessment/Assessment by peers: 10 M
Socially relevant project/Group Activities/Assignments: 20 marks
Semester End Examination: 60 marks
The overall pass percentage is 40%. In case the student fails, he/she must repeat the course.

Text Books:

1. R R Gaur, R Asthana, G P Bagaria, "A Foundation Course in Human Values and Professional Ethics", 2nd Revised Edition, Excel Books, New Delhi, 2019. ISBN 978-93-87034-47-1 The teacher's manual
2. R R Gaur, R Asthana, G P Bagaria, "Teachers' Manual for A Foundation Course in Human Values and Professional Ethics", 2nd Revised Edition, Excel Books, New Delhi, 2019. ISBN 978-93-87034-53-2

Reference Books:

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

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20EGM01

INDIAN CONSTITUTION AND FUNDAMENTAL PRINCIPLES

(Common to all Programs)

Instruction	2 L Hours per Week
Duration of SEE	2 Hours
SEE	50 Marks
CIE	0 Marks
Credits	No Credits

Prerequisite: Knowledge of social studies.

Course Objectives:
This course aims to:

1. History of Indian Constitution and how it reflects the social, political, and economic perspectives of the Indian society.
2. Growth of Indian opinion regarding modern Indian intellectuals constitutional role and entitlement to civil and economic rights as well as the emergence of nationhood in the early years of Indian nationalism.
3. Various Organs of Governance and Local Administration.

Course Outcomes:
Upon completion of this course, students will be able to:

1. Understand the making of the Indian Constitution and its features.
2. Identify the difference among Right To equality, Right To freedom and Right to Liberty.
3. Analyze the structuring of the Indian Union and differentiate the powers between Union and States.
4. Distinguish between the functioning of Lok Sabha and Rajya Sabha while appreciating the importance of Judiciary.
5. Differentiate between the functions underlying Municipalities, Panchayats and Co-operative Societies.

Mapping of Course Outcomes with Program Outcomes and Program Specific Outcomes:

PO/PSO / CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO 1	-	-	-	-	-	-	-	-	-	-	-		-	-	-
CO 2	--	-	-	-	-	1	-	-	-	-	-	-	-	-	-
CO 3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CO 4	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CO 5	-	-	-	-	-	-	1	-	1	-	-	-	-	-	-

UNIT-I

Constitution of India: Constitutional history-Govt of India Act 1909, 1919 and 1935, Constitution making and salient features. Directive Principles of State Policy - Its importance and implementation.

UNIT-II

Scheme of the Fundamental Rights & Duties: The Fundamental Rights - To Equality, to certain Freedom under Article 19, to Life and Personal Liberty Under Article 21. Fundamental Duties - the legal status.

UNIT-III

Union Government and its Administration - Structure of the Indian Union: Federalism, distribution of legislative and financial powers between the Union and the States. Parliamentary form of government in India: Executive-President's role, power and position.

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UNIT-IV

Legislature and Judiciary: Central Legislature-Powers and Functions of Lok Sabha and Rajya Sabha. Judiciary: Supreme Court-Functions, Judicial Review and Judicial Activism.

UNIT-V

Local Self Government - District's Administration Head (Collector): Role and Importance. Municipalities: Introduction, Mayor and Role of Elected Representative, CEO of Municipal Corporation. Panchayati Raj: Introduction, Zilla Panchayat, Elected Officials and their roles, CEO Zilla Panchayat: Position and Role. Block level: Organizational Hierarchy (Different departments). Village level: Role of Elected and Officials.

Text Books:

1. Indian Government & Politics, Ed Prof V Ravindra Sastry, Telugu Akademy, 2nd Edition, 2018.
2. Indian Constitution at Work, NCERT, First Edition 2006, Reprinted- January 2020.

Suggested Reading:

1. The Constitution of India, 1950 (Bare Act), Government Publication.
2. Dr. S. N. Busi, Dr. B. R. Ambedkar, Framing of Indian Constitution, 1st Edition, 2015.
3. M. P. Jain, Indian Constitution Law, 7th Edition., Lexis Nexis, 2014.
4. D.D. Basu, Introduction to the Constitution of India, Lexis Nexis, 2015.

Online Resources:

1. http://www.nptel.ac.in/courses/103107084/Script.pdf

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20EGM02

INDIAN TRADITIONAL KNOWLEDGE

(Common to all Programs)

Instruction	2 L Hours per Week
Duration of SEE	2 Hours
SEE	50 Marks
CIE	0 Marks
Credits	No Credits

Prerequisite: Knowledge on Indian Culture.

Course Objectives:

This course aims to:

1. To get a knowledge in Indian Culture
2. To know Indian Languages and Literature and the fine arts in India
3. To explore the Science and Scientists of Medieval and Modern India.

Course Outcomes:

Upon completion of this course, students will be able to:

1. Understand philosophy of Indian culture.
2. Distinguish the Indian languages and literature.
3. Learn the philosophy of ancient, medieval, and modern India.
4. Acquire the information about the fine arts in India.
5. Know the contribution of scientists of different eras.

Mapping of Course Outcomes with Program Outcomes and Program Specific Outcomes:

PO/PSO / CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO 1	--	-	1	-	-	1	-	-	-	-	-	-	-	-	-
CO 2	--	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CO 3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CO 4	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CO 5	-	-	-	1	-	-	-	-	-	-	-	1	-	-	-

UNIT-I

Culture and Civilization: Culture, civilization and heritage, general characteristics of culture, importance of culture in human literature, Cultural diversity, Aesthetics, Women seers, Indus culture, Indian cuisine, Martial arts.

UNIT-II

Education system: Education in ancient, medieval and modern India, aims of education, subjects, languages, Science and Scientists of Ancient India, Science and Scientists of Medieval India, Scientists of Modern India.

UNIT-III

Linguistic Wealth: Indian Languages and Literature: the role of Sanskrit, Paleography, Significance of scriptures to current society, Indian semantics and lexicography, Bhakti literature, Darsanas.

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UNIT-IV

Science and Logic: Helio-centic system, Sulbasutras, Katapayadi, Hindu calendar, 6 pramanas in Indian logic, Scientific method applied to therapeutics, Fallacies, Tarka – Induction &Deduction, Ayurvedic biology, Definition of health.

UNIT-V

Behavioral Modeling: Structured Procedures, Procedural Assignments, Timing control, Conditional statements, Sequential and Parallel Blocks. Switch level Modelling. Introduction to tasks and functions. Design of Mealy and Moore state models using Verilog HDL. Introduction to Logic Synthesis. Concept of Programming using FPGA.

Text Books:

1. Kapil Kapoor, Text and Interpretation: The Indian Tradition, ISBN: 81246033375, 2005.
2. Samskrita Bharati, Science in Samskrit, ISBN-13: 978-8187276333, 2007.
3. Satya Prakash, Founders of sciences in Ancient India, Govindram Hasanand, ISBN-10: 8170770009, 1989.
4. Brajendranath Seal, The Positive Sciences of the Ancient Hindus, Motilal Banarasidass, ISBN-10: 8120809254, 1915.

Suggested Reading:

1. Swami Vivekananda, *Caste, Culture and Socialism*, Advaita Ashrama, Kolkata ISBN-9788175050280.
2. Swami Lokeswarananda, *Religion and Culture*, Advaita Ashrama, Kolkata ISBN-9788185843384.
3. Kapil Kapoor, *Language, Linguistics and Literature: The Indian Perspective*, ISBN-10: 8171880649, 1994.
4. Karan Singh, *A Treasury of Indian Wisdom: An Anthology of Spiritual Learn*, ISBN: 978-0143426158, 2016.
5. Swami Vivekananda, *The East and the West*, Advaita Ashrama, Kolkata 9788185301860.
6. Srivastava R.N., *Studies in Languages and Linguistics*, Kalinga Publications ISBN-13: 978-8185163475.
7. Subhash Kak and T.R.N. Rao, Computation in Ancient India, Mount Meru Publishing ISBN-1988207126.
8. R.N Misra, *Outlines of Indian Arts Architecture, Painting, Sculpture, Dance and Drama*, IIAS, Shimla & Aryan Books International, ISBN 8173055149.
9. S. Narain, *Examinations in ancient India*, Arya Book Depot, 1993.
10. M. Hiriyanna, Essentials of Indian Philosophy, Motilal Banarsidass Publishers, ISBN-13: 978-8120810990, 2014.
11. Ravi Prakash Arya, Engineering and Technology in Ancient India, Indian Foundation for Vedic Science, ISBN-10: 1947593072020.

SWAYAM / NPTEL:

1. History of Indian Science and Technology - https://onlinecourses.swayam2.ac.in/arp20_ap35/preview
2. Introduction to Ancient Indian Technology – https://onlinecourses.nptel.ac.in/noc19_ae07/preview
3. Indian Culture & Heritage - https://onlinecourses.swayam2.ac.in/nos21_sc11/preview
4. Language and Society - https://nptel.ac.in/courses/109/106/109106091/
5. Science, Technology & Society - https://nptel.ac.in/courses/109/103/109103024/
6. Introduction to Indian Philosophy - https://nptel.ac.in/courses/109/106/109106059/
7. Introduction to Indian Art - An appreciation - https://onlinecourses.nptel.ac.in/noc20_hs09/preview

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20ECC12

ANALOG CIRCUTS LAB

Instruction	2 P Hours per Week
Duration of SEE	3 Hours
SEE	50 Marks
CIE	50 Marks
Credits	1

Prerequisite: Knowledge on Electronic Devices Lab and Electronic Workshop and Networks Lab.

Course objectives:
This course aims to:
1. Design and analysis of Biasing circuits and Power Amplifiers.
2. Know frequency response and behaviour of various Single Stage, Multistage and Feedback amplifiers.
3. Generation of sinusoidal signals using Oscillators.

Course Outcomes:
Upon completion of this course, students will be able to:
1. Design various BJT/FET biasing circuits to identify the appropriate circuit for faithful amplification.
2. Experiment with single stage and multistage BJT/FET amplifiers including large signal amplifiers.
3. Compare and contrast different types of feedback topologies.
4. Develop and test various oscillator circuits.
5. Evaluate and compare the significant parameters obtained from the Frequency response plots of BJT and FET amplifier circuits.

Mapping of Course Outcomes with Program Outcomes and Program Specific Outcomes:

PO/PSO / CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO 1	2	1	3	2	2	-	-	-	2	1	-	1	3	2	-
CO 2	2	1	3	2	2	-	-	-	2	1	-	1	3	2	-
CO 3	2	1	3	2	2	-	-	-	2	1	-	1	3	2	-
CO 4	2	1	3	2	2	-	-	-	2	1	-	1	3	2	-
CO 5	2	1	3	2	2	-	-	-	2	1	-	1	3	2	-

List of Experiments:

1. Design of BJT and FET Biasing Circuits for given specifications.
2. Design of a Common Emitter BJT amplifier and study of its frequency response.
3. Frequency response of Two RC - Coupled CS FET amplifier
4. Voltage series feedback amplifier.
5. Voltage shunt feedback amplifier.
6. Current series feedback amplifier.
7. Current shunt feedback amplifier.
8. RC Phase Shift Oscillator.
9. Hartley Oscillator
10. Colpitts Oscillator.
11. Design of transformer coupled Class-A amplifier.

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12. Design of Class-B power amplifier.
13. **Structured enquiry:** Design a circuit that converts a given D.C Voltage to Frequency using BJTs and verify its operation.
14. **Open ended Enquiry:** Design and implement a classroom sound monitoring system using BJTs and a 0.5W speaker.

Note: Wherever possible, Analysis and design of circuits should be carried out using SPICE tools.

Suggested Reading:

1. Robert Diffenderfer, "Electronic Devices: Systems and Applications", Cengage Learning India Private Limited, 2010.
2. Paul B. Zbar, Albert P. Malvino, Michael A. Miller, "Basic Electronics, A Text - Lab Manual", 7th Edition, TMH 2001.

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20ECC13

ANALOG COMMUNICATION LAB

Instruction	2 P Hours per Week
Duration of SEE	3 Hours
SEE	50 Marks
CIE	50 Marks
Credits	1

Prerequisite: A thorough knowledge on signal analysis and its representation along with communication systems is required.

Course Objectives:
This course aims to:
1. Generate and detect various analog and pulse modulation schemes.
2. Develop and analyze the characteristics of PLL, Mixer and Pre-Emphasis & De-Emphasis circuits.
3. Estimate the power spectral density by analyzing the spectrum of a given signal.

Course Outcomes:
Upon completion of this course, students will be able to:
1. Demonstrate the generation and detection of various analog modulated signals.
2. Illustrate the sampling concept and interpret the generation and detection of various pulse modulated signals.
3. Obtain and Analyze frequency response of Pre-Emphasis and De Emphasis circuits
4. Experiment with Mixer, Radio receiver and PLL characteristics, FDM and TDM.
5. Estimate the Power spectral density of noise and SNR and analyze the spectra of AM and FM signals.

Mapping of Course Outcomes with Program Outcomes and Program Specific Outcomes:

PO/PSO / CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO 1	3	3	3	1	1	2	2	3	3	3	3	3	3	3	3
CO 2	3	3	3	1	1	2	2	3	3	3	3	3	3	3	3
CO 3	3	3	3	1	1	2	2	3	3	3	3	3	3	3	3
CO 4	3	3	3	2	1	2	2	3	3	3	3	3	3	3	3
CO 5	3	3	3	3	1	2	2	3	3	3	3	3	3	3	3

List of Experiments:

1. AM signals generation and detection.
2. Generation of DSB-SC using Balanced modulator.
3. SSB Modulation and Demodulation.
4. FM generation and detection.
5. Frequency response of Pre-Emphasis and De-Emphasis circuits.
6. Evaluation of Radio Receiver characteristics.
7. Sampling of continuous time signal and its Reconstruction (PAM).
8. Frequency division multiplexing and De-Multiplexing.
9. Time division multiplexing and De-Multiplexing.
10. PWM Modulation and Demodulation.
11. PPM Modulation and Demodulation.
12. Determination of PLL Characteristics.
13. Spectral Analysis of AM and FM signals using Spectral Analyzer.

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14. **Structured Enquiry:** Design a frequency mixer based on the given specifications and analyze its characteristics.
15. **Open ended Enquiry:** Design a Phase Locked Loop for the given free running frequency and determine its capture range and Lock range.

Note: Students have to design and develop any concept as a part of Mini project**.**

Suggested Reading:

1. A.M. Zungeru, J.M. Chuma, M. Mangwala, L.K. Ketshabetswe, "Handbook of Laboratory Experiments in Electronics and Communication Engineering", Vol. 2, 1st Edition, Notion press, 2017.

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20ECC14

DIGITAL SYSTEM DESIGN LAB

Instruction	2 P Hours per Week
Duration of SEE	3 Hours
SEE	50 Marks
CIE	50 Marks
Credits	1

Prerequisite: Digital concepts and C language concepts.

Course Objectives:
This course aims to:
1. Simulate and synthesize combinational logic circuits.
2. Simulate and synthesize sequential logic circuits.
3. Learn and implement procedure for any digital design.

Course Outcomes:
Upon completion of this course, students will be able to:
1. Design a Digital circuit using Verilog HDL.
2. Understand various abstraction levels of a digital design.
3. Verify the functionality of a design using Test bench.
4. Simulate and synthesize combinational logic circuits.
5. Simulate and synthesize sequential logic circuits.

Mapping of Course Outcomes with Program Outcomes and Program Specific Outcomes:

CO \ PO/PSO	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	PSO 3
CO 1	3	2	2	2	3	1	1	1	3	2	1	1	2	3	3
CO 2	3	2	2	2	3	1	1	1	3	2	1	1	2	3	3
CO 3	3	3	2	2	3	2	2	1	3	2	2	2	2	3	3
CO 4	3	3	2	3	3	2	2	2	3	2	2	2	3	3	3
CO 5	3	3	2	3	3	2	2	2	3	2	2	2	3	3	3

List of Experiments:

Write a Verilog HDL code to Simulate and synthesize the following in Gate level, Data flow and Behavioral Modeling styles.

1. Logic Gates.
2. Arithmetic Units: Adders and Subtractors.
3. Multiplexers and De-multiplexers.
4. Encoders, Decoders, Priority Encoder and Comparator.
5. Implementation of logic function using Multiplexers and Decoders.
6. Arithmetic and Logic Unit.
7. Flip-Flops.
8. Sequence Detector using Mealy and Moore type state machines.
9. Implementation of SSI Circuits using FPGA.
10. **Structured Enquiry:** Design of a counter for the given specifications.
11. **Open ended Enquiry:** Design of a simple Digital System for real time applications.

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Suggested Reading:

1. Samir Palnitkar, "Verilog HDL, A guide to Digital design and synthesis", 2nd Edition, Pearson Education, 2008.

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20EC C15

COMPUTER ARCHITECTURE AND MICROPROCESSORS

Instruction	3 L Hours per Week
Duration of SEE	3 Hours
SEE	60 Marks
CIE	40 Marks
Credits	3

Prerequisite: Basic knowledge on digital system design

Course Objectives: This course aims to:

1. Study and understand the principles of computer system
2. Understand the design of computer system
3. Explore the architecture and instruction set of the microprocessors

Course Outcomes: Upon completion of this course, students will be able to:

1. Apply fixed and floating-point arithmetic algorithms.
2. Understand how the computer works.
3. Classify different organizations of CPU and I/O.
4. Compare various memories and memory access techniques.
5. Understand the architecture and instruction set of a microprocessor.

Course Articulation Matrix

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	2	3	2	-	-	-	-	-	-	-	-	2	2	1
CO2	2	1	3	1	-	-	-	-	-	-	-	2	3	2	-
CO3	2	1	2	1	-	-	-	-	-	-	-	-	3	2	-
CO4	2	2	2	2	2	-	-	-	-	-	-	1	3	2	-
CO5	3	1	2	2	2	-	-	-	-	-	-	1	3	3	-

UNIT-I

Data representation and Computer Arithmetic: Basic structure of computers, Functional units, Fixed point representation of numbers, Digital arithmetic algorithms for Addition, Subtraction, Multiplication using Booth's algorithm and Division using restoring and non-restoring algorithms, Floating-point representation with IEEE standards.

UNIT-II

Basic Computer Organization and Design: Instruction codes, Stored program organization, Computer registers and computer instructions, Timing and control, hardwired and microprogrammed control unit, Instruction cycle, Program interrupt, Interrupt cycle, Micro programmed Control organization, Address sequencing, Micro instruction format.

UNIT-III

Central Processing Unit: General register organization, Stack organization, Instruction formats, Addressing modes, Data transfer and manipulation, Program control, CISC and RISC: features and comparison, Instruction Pipeline.

Input-Output Organization: Peripheral devices, I/O interface: I/O Bus and interface modules, isolated versus memory-mapped I/O. Modes of Transfer: Programmed I/O, DMA and Interrupt initiated I/O. Priority interrupt: Daisy chaining, Parallel Priority interrupt

UNIT-IV

Memory Organization: Memory hierarchy, Primary memory, Auxiliary memory, Associative memory, Cache memory, mapping functions: direct, associate and set associate, Virtual memory: address mapping using pages, Memory management.

UNIT-V

8086 Microprocessor: Evolution of microprocessors, 8086 Microprocessor**:** Internal architecture, flag register, Signal description under minimum and maximum mode of operation, register organization, Addressing modes. Overview of Instruction set. Introduction to the advanced microprocessors (x86): Salient features, real and protected modes. Evolution of Pentium Processors.

Text Books:

1. Moris Mano M., "Computer System Architecture", 3/e, Pearson Education, 2005.
2. Hayes J.P, "Computer Architecture and Organization", 3/e, Mcgraw Hill, 2012.
3. Barry B. Brey, "The Intel Microprocessors 8086/8088, 80186/80188, 80286, 80386, 80486, Pentium, Pentium Pro, Pentium II, III, IV", 8/e Pearson Education, 2006.

Suggested Reading:

1. Carl Hamacher, ZvonkoVranesic, SafwatZaky, "Computer Organization" 5/e McGraw Hill, 2011.
2. Ray A.K. and Bhurchandi, K.M., "Advanced Microprocessor and peripherals", 2/e TMH 2007.
3. Douglas V Hall, SSSP Rao, "Microprocessors and Its Interfacing" (SIE), 3/e, Tata McGraw-Hill Education Pvt. Ltd, 2012.

20EC C16

DIGITAL COMMUNICATION

Instruction	3 L Hours per Week
Duration of SEE	3 Hours
SEE	60 Marks
CIE	40 Marks
Credits	3

Prerequisite: Fundamentals of probability theory and analog communication systems are required.

Course Objectives: This course aims to:

1. Make the student learn the different techniques involved in the digital transmission of analog signals.
2. Give the student an understanding of the various concepts of information theory, source coding, and channel coding schemes.
3. Enable the student to interpret the performance of digital modulation schemes and various Spread spectrum modulation schemes.

Course Outcomes: Upon completion of this course, students will be able to:

1. Understand the concept of pulse digital modulation schemes and compare their performance.
2. Interpret the concept of information theory and apply source coding schemes.
3. Demonstrate various error control schemes and develop the encoding and decoding techniques to detect and correct the errors.
4. Analyze different digital modulation schemes and can compute the bit error performance.
5. Identify and apply spread spectrum modulation techniques.

Course Articulation Matrix

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	1	1	-	-	1	-	-	2	-	3	3	2	-
CO2	3	3	1	1	-	-	1	-	-	2	-	3	3	2	-
CO3	3	3	3	2	-	2	1	-	-	2	-	3	3	2	2
CO4	3	3	1	1	-	1	1	-	-	2	-	3	3	2	1
CO5	3	3	1	2	-	2	2	-	-	2	-	3	3	2	1

UNIT-I

Digital Transmission of Analog Signals: Elements of a digital communication system, Uniform quantization, PCM system, Bandwidth requirement of PCM system, Noise in PCM Systems, Non- uniform quantization, TDM-PCM system. Differential quantization, Differential PCM system, Delta Modulation, Noise in DM system, ADM. Comparison of PCM, DPCM, DM and DM schemes.

UNIT-II

Information Theory: Uncertainty, Information and Entropy, Source coding: Source coding theorem, Shannon – Fano algorithm and Huffman coding. Discrete memory-less channels, Types of channels, cascaded channels, mutual information, Channel capacity, Information rate and Information capacity.

UNIT-III

Error Control Coding: Need for error control coding, Types of transmission errors. Linear Block Codes (LBC): description of LBC, generation, Syndrome and error detection, minimum distance of a block code, error detecting capabilities and error correcting, Hamming codes, Standard array and syndrome decoding. Binary cyclic codes (BCC): description of cyclic codes, encoding, decoding and error correction of cyclic codes using shift registers, Convolution codes: description, encoding, decoding: Exhaustive search method and sequential decoding.

UNIT-IV

Digital Carrier Modulation Schemes: Optimum receiver for Binary Digital Modulation Schemes, Binary ASK, PSK, DPSK, FSK signaling schemes and their error probabilities. Introduction to MSK, Comparison of Digital Modulation Schemes. Introduction to M-ary Signaling Schemes: QPSK, Synchronization methods.

UNIT–V

Spread-Spectrum Modulation: Need for spreading a code, generation and properties of PN sequence. Direct Sequence Spread Spectrum, Frequency Hopping spread spectrum systems and their applications. Acquisition and Tracking in DSSS and FHSS Systems.

Text Books:

1. Sam Shanmugham K., "Digital and Analog Communication Systems", Wiley, 2012.
2. Simon Haykin, "Communication Systems", 4/e, Wiley India, 2011.
3. Herbert Taub, Donald L. Shilling & Goutam Saha, "Principles of Communication Systems", 4/e, Tata McGraw-Hill Education 2013.

Suggested Reading:

1. John Proakis, Massoud Salehi, "Digital Communications", 5/e, McGraw Hill Higher Education, 2007.
2. R.P. Singh, S.D. Sapre, "Communication Systems", 2/e, Tata McGraw Hill Education, 2008.

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20EC C17

DIGITAL SIGNAL PROCESSING

Instruction	3 L Hours per Week
Duration of SEE	3 Hours
SEE	60 Marks
CIE	40 Marks
Credits	3

Prerequisite: Concepts of Signals, Systems and analog filter design.

Course Objectives: This course aims to:

1. Know Discrete-time signals in the frequency domain using DFT and FFT.
2. Design digital IIR and FIR filters for the given specifications.
3. Introduce the basics of Multi-rate digital signal processing, Digital signal processor and its applications

Course Outcomes: Upon completion of this course, students will be able to:

1. Apply the concept of DFT and FFT for signal processing applications.
2. Implementation of IIR filters for the given specifications.
3. Design FIR filters for the given specifications.
4. Interpret the concepts of Multi-rate digital signal processing and its applications.
5. Understand the architecture features of TMS320C67XX processor.

Course Articulation Matrix

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PS01	PSO2	PSO3
CO1	3	3	3	2	3	2	-	-	3	2	-	3	3	3	3
CO2	3	3	3	2	3	2	-	-	3	2	-	3	3	3	3
CO3	3	3	3	2	3	2	-	-	3	2	-	3	3	3	3
CO4	3	3	3	2	3	2	-	-	3	2	-	3	3	3	3
CO5	3	3	3	2	3	2	-	-	3	2	-	3	3	3	3

UNIT-I

Discrete Fourier Transform: Introduction, Discrete Fourier Transform (DFT), Properties of DFT, Efficient computation of DFT-Fast Fourier Transform (FFT) algorithms: Radix-2 FFT algorithms – Decimation in Time, Decimation in Frequency algorithms, Inplace computation, Bit reversal algorithm, Linear filtering using FFT algorithm.

UNIT-II

IIR Filter Design: Butterworth and Chebyshev approximation, IIR digital filter design techniques- Impulse Invariant transformation, Bilinear transform techniques, Digital Butterworth and Chebyshev filters, Spectral transformation techniques. Comparison between FIR and IIR filters.

UNIT-III

FIR Filter Design: Linear phase FIR filters –Introduction, types, magnitude and phase responses of linear phase FIR filters, Windowing technique for design of FIR filters – Rectangular, Bartlet, Hamming, Blackman, and Kaiser Windows. Realization of IIR filters-Direct form-I and II, Realization of FIR filters-Direct form, linear phase, Finite word length effects.

UNIT- IV

Multirate Digital Signal Processing: Introduction -Decimation by a Factor -D, Interpolation by a Factor -I, Sampling Rate Conversion by a Rational Factor -I/D, Nobel identities, design of multistage decimator, Applications of Multirate Signal Processing: Narrowband filters, subband coding of speech signal.

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UNIT-V

DSP Processors: Introduction, Difference between DSP and General Purpose Processor architectures, need for DSP processors. TMS320C67XX DSP processor: architecture, functional units, pipelining, registers, linear and circular addressing modes, instruction set.

Text Books:

1. John G. Proakis & Dimtris G. Manolakis, "Digital Signal Processing Principles, Algorithms and Application", PHI, 4/e, 2012.
2. Sanjit K Mitra, "Digital Signal Processing, A computer based approach", TMH, 3/e, 2011.
3. Rulph Chassaing, "Digital Signal Processing and Applications with the C6713 and C6416 DSK", John wiley & sons, 2005.

Suggested Reading:

1. K. Deergha Rao & MNS swamy, "Digital Signal Processing: Theory and Practice", Springer, 2018
2. Avtar Singh & S. Srinivasan, "Digital Signal Processing Implementation using DSP microprocessors", Thomson Brooks, 2/e, 2004.

20EC C18

LINEAR AND DIGITAL INTEGRATED CIRCUITS

Instruction	3 L Hours per Week
Duration of SEE	3 Hours
SEE	60 Marks
CIE	40 Marks
Credits	3

Prerequisite: Knowledge about Analog electronic circuits.

Course Objectives: This course aims to:

1. Impart the concepts of Op-Amp, 555 Timers, IC regulator, data converter and its characteristics.
2. Illustrate the linear and nonlinear applications of operational amplifier.
3. Design combinational and sequential circuits with IC, memories and PLD.

Course Outcomes: Upon completion of this course, students will be able to:

1. Understand the basic construction, characteristics and parameters of Op-Amp.
2. Analyze the linear and nonlinear applications of Op-Amp.
3. Explain the concepts of IC555 timer, IC723 regulator, memories and PLD.
4. Classify and describe the characteristics of different logic families
5. Design logic functions of Combinational and Sequential circuits with ICs.

Course Articulation Matrix

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	3	2	1	-	-	-	-	-	-	2	2	1	-
CO2	2	3	3	3	2	2	-	1	-	-	-	3	3	3	2
CO3	2	2	2	2	2	-	-	1	-	-	-	2	2	1	1
CO4	1	1	2	2	2	-	-	-	-	-	-	2	2	1	1
CO5	2	2	3	3	2	2	-	1	-	-	-	3	3	3	1

UNIT – I

Operational Amplifier: Op-Amp block diagram, ideal Op-Amp Characteristics, Inverting and Non-inverting amplifiers with ideal and non-ideal Op-amps, Voltage Follower, Op-Amp parameters: Input offset voltage, Output offset voltage, input offset and bias currents, Slew rate, CMRR and PSRR.

UNIT – II

Op-Amp Applications: Summing Amplifier, Difference Amplifier, ideal and practical Integrator and differentiator. Sample and hold circuit, Comparator, Schmitt Trigger with and without reference voltage, Triangular waveform generator.

UNIT – III

555 Timer: Functional diagram. Modes of operation: Monostable, Astable multivibrators.

Voltage Regulator: IC7805, Analysis and design of regulators using IC 723.

Data Converters: Specifications, DAC- Weighted Resistor, R-2R Ladder, ADC-Parallel Comparator, Successive Approximation and Dual Slope.

UNIT – IV

Logic Families: Digital IC characteristics. TTL logic family, TTL series and TTL output configurations: open collector, Totem pole, Tri state logic. MOS logic family, CMOS logic family and its series characteristics, CMOS transmission gate, CMOS open drain and high impedance outputs. Comparison of TTL and CMOS logic families.

UNIT – V

Combinational and Sequential Circuits: Design of logic functions/circuits with: Decoder, Multiplexer, Adder: Serial adder, parallel adder and BCD adder, counters: asynchronous counter (7493/74293) and synchronous counter (74163/74193)

Semiconductor Memories: Memory Terminology, ROM, RAM types, Architectures, operation, Expanding word size and capacity, Introduction to PLD's: PAL and PLA, Programming with PLDs, Introduction to CPLD&FPGA and it's architectures.

Text Books:

1. Ramakant A. Gayakwad, "Op-Amps and Linear Integrated Circuits", 4/e, PHI, 2015.
2. Ronald J. Tocci, Neal S. Widmer & Gregory L. Moss, "Digital Systems: Principles and Applications", PHI, 12/e, 2016..

Suggested Reading:

1. K.R. Botkar, "Integrated Circuits", 10/e, Khanna Publishers, 2010.
2. Roy Chowdhury D, Jain S.B, "Linear Integrated Circuits",4/e, New Age International Publishers, 2018.
3. Jain R.P., "Modern Digital Electronics", 4/e, TMH, 2011.
4. Charles H Roth and Larry L Kinney, "Fundamentals of Logic Design" 7th edition, Cengage Publication, 2014.
5. David A. Bell, 'Operational Amplifier and Linear ICs', third edition, Oxford university press, 2013.

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20MB C01

ENGINEERING ECONOMICS AND ACCOUNTANCY

Instruction	3 L Hours per Week
Duration of SEE	3 Hours
SEE	60 Marks
CIE	40 Marks
Credits	3

Prerequisite: Concepts related to business, economics and accountancy are required.

Course Objectives: This course aims to:

1. To demonstrate the importance of Managerial Economics in Decision Making.
2. To explain the concept of Accountancy and provide basic knowledge on preparation of Final accounts.
3. To understand the importance of Project Evaluation in achieving a firm's Objective.

Course Outcomes: Upon completion of this course, students will be able to:

1. Apply fundamental knowledge of Managerial Economics concepts and tools.
2. Analyze various aspects of Demand Analysis, Supply and Demand Forecasting.
3. Understand Production and Cost relationships to make best use of resources available.
4. Apply Accountancy Concepts and Conventions and preparation of Final Accounts.
5. Evaluate Capital and Capital Budgeting decision based on any technique

Course Articulation Matrix

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	1	1	3	1	1	1	1	1	1	1	-	-	-	-	-
CO2	2	2	2	2	-	1	1	1	-	1	-	1	-	-	-
CO3	1	2	1	2	2	-	2	1	-	1	-	-	-	-	-
CO4	2	2	1	2	2	1	1	3	-	1	-	-	-	-	-
CO5	1	3	1	2	1	1	2	-	-	1	2	1	-	-	-

Unit-I

Introduction to Managerial Economics: Introduction to Economics and its evolution - Managerial Economics - its Nature and Scope, Importance; Relationship with other Subjects. Its usefulness to Engineers; Basic concepts of Managerial economics - Incremental, Time perspective, Discounting Principle, Opportunity Cost, Equimarginal Principle, Contribution, Negotiation Principle.

Unit-II

Demand and Supply Analysis: Demand Analysis - Concept of Demand, Determinants, Law of demand - Assumptions and Exceptions; Elasticity of demand - Price, Income and Cross elasticity - simple numerical problems; Concept of Supply - Determinants of Supply, Law of Supply; Demand Forecasting - Methods.

Unit-III

Production and Cost Analysis: Theory of Production - Production function - Isoquants and Isocosts, MRTS, Input-Output Relations; Laws of returns; Internal and External Economies of Scale. Cost Analysis: Cost concepts – Types of Costs, Cost-Output Relationship – Short Run and Long Run; Market structures – Types of Competition, Features, Price Output Determination under Perfect Competition, Monopoly and Monopolistic Competition; Break-even Analysis – Concepts, Assumptions, Limitations, Numerical problems.

Unit-IV

Accountancy: Book-keeping, Principles and Significance of Double Entry Book Keeping, Accounting Concepts and Conventions, Accounting Cycle, Journalization, Subsidiary books, Ledger accounts, Trial Balance concept and preparation of Final Accounts with simple adjustments. Ratio Analysis.

Unit-V

Capital and Capital Budgeting: Capital and its Significance, Types of Capital, Estimation of Fixed and Working capital requirements, Methods and sources of raising finance. Capital Budgeting, Methods: Traditional and Discounted Cash Flow Methods - Numerical problems.

Text Books:

1. Mehta P.L., "Managerial Economics: Analysis, Problems and Cases", Sultan Chand & Son's Educational publishers, 2016.
2. Maheswari S.N. "Introduction to Accountancy", Vikas Publishing House, 11th Edition, 2013.

Suggested Reading:

1. Panday I.M. "Financial Management", 11th edition, Vikas Publishing House, 2015.
2. Varshney and K L Maheswari, Managerial Economics, Sultan Chand, 2014.
3. M. Kasi Reddy and S. Saraswathi, Managerial Economics and Financial Accounting, Prentice Hall of India Pvt Ltd, 2007.
4. A. R. Aryasri, Managerial Economics and Financial Analysis, McGraw-Hill, 2013.

20EC E04

EMBEDDED C PROGRAMMING

(Professional Elective-I)

Instruction	3 L Hours per Week
Duration of SEE	3 Hours
SEE	60 Marks
CIE	40 Marks
Credits	3

Prerequisite: Programming in 'C' Language

Course Objectives: This course aims to:

1. Describe the developments of embedded C programming
2. Interfacing of various sensors along with displays using Embedded 'C'
3. Develop the various applications using embedded development board

Course Outcomes: Upon completion of this course, students will be able to:

1. Analyze the various functions used in embedded C programming
2. Understand the evaluation of Arduino family and its development board details
3. Interface the sensors and various i/o devices to embedded development board
4. Apply the concepts of IoT to embedded development board
5. Demonstrate and design embedded C based applications.

Course Articulation Matrix

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	1	1	1	-	-	-	-	-	-	-	-	-	2	2	-
CO2	2	2	2	1	2	-	-	-	-	-	-	1	-	3	2
CO3	2	2	3	2	2	-	-	-	-	-	-	-	3	2	2
CO4	2	1	2	2	3	-	-	-	-	-	-	2	3	2	3
CO5	2	2	3	3	2	-	-	-	-	-	-	2	3	2	2

UNIT-I

Introduction to Embedded C: Overview, Data types: variables and constants, Operators, Control Statements, Arrays and Functions. i/o Functions: Pins Configured as input, Pins Configured as output, pinMode function, digitalWrite function, analog Read function, time delay functions. Simple programming in 'C'

UNIT-II

Introduction to Arduino: Origin of Arduino, familiarizing with Arduino family Introduction to Arduino UNO: Pin configuration and architecture, power connections, concept of digital and analog ports, Arduino clones and variants , installation of Arduino IDE, uploading of the program.

UNIT-III

Interfacing with Displays and Sensors: Working with Serial Monitor, Line graph via serial monitor, LED interfacing, 8 bit LCD interfacing to Arduino, Fixed one line static message display, Running message display,. Interfacing-humidity sensor, temperature sensor, gas detection sensor, PIR Sensor, Ultrasonic Sensor.

UNIT-IV

Internet of Things Programming: Communicating with web servers: HTTP, HTML, Arduino uno as a web server, Web controllers using Arduino, calling web services, Arduino uno and IFTTT, Introduction to NodeMCU and its web services

UNIT-V

Applications/Case Study: Testing the Arduino board, problems with IDE, debugging techniques, Case studies related on agriculture, medical domains using Ardunio, Applications on consumer electronics, automotive and security using Arduino development board

Text Books:

1. Simon Monk, "Programming Arduino: Getting Started with Sketches", McGraw-Hill Education, Second Edition, 2016
2. Massimo Banzi, "Getting Started with Arduino: The Open Source", Shroff Publishers & Distributors Pvt Ltd, 2014
3. Michael J. Pont, "Embedded C", 2nd Edition, Pearson Education, 2008

Suggested Reading:

1. Margolis, "Arduino Cookbook", Shroff/O'Reilly Publication, 2nd Edition 2012

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20EC E06

PRINCIPLES AND APPLICATIONS OF AI

(Professional Elective-I)

Instruction	3 L Hours per week
Duration of SEE	3 Hours
SEE	60 Marks
CIE	40 Marks
Credits	3

Prerequisite: Knowledge of probability, Linear Algebra, Data Structure and programming.

Course Objectives: This course aims to:

1. Exposure to the foundation of Artificial Intelligence.
2. Familiarize the applications of Artificial Intelligence in Industry
3. Inculcate the concepts of Neural Networks and Pattern Recognition

Course Outcomes: Upon completion of this course, students will be able to:

1. Understand the basics of AI and intelligent agents.
2. Apply Expert Systems to solve real time problems
3. Understand knowledge representation methods.
4. Build algorithms using neural network techniques for various applications
5. Solve the various classification problems like object recognition

Course Articulation Matrix

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	-	-	-	1	1	-	-	-	-	1	3	-	-
CO2	3	3	3	2	2	3	2	1	2	-	1	2	3	1	-
CO3	3	3	-	3	1	1	1	-	-	-	-	1	3	-	-
CO4	3	3	3	2	2	1	1	-	1	-	-	1	3	1	-
CO5	3	3	3	3	1	3	2	1	2	-	-	1	3	2	-

UNIT-I

Introduction to AI and Intelligent Agents: Concept of AI, current status of AI, Agents, Good Behavior: Environment, problem formulation. The structure of agents. Basic concepts of Search Algorithms: Uninformed depth first search, breadth first search, uniform cost search, depth limited search, iterative deepening search and informed search techniques like greedy best first search and A* algorithm, concepts of admissibility.

UNIT-II

Knowledge representation: Bayesian network representation, Construction and inference. Hidden Markov Model.Approaches to knowledge representation, knowledge representation using the semantic network, extended semantic networks for Knowledge representation, knowledge representation using frames.

UNIT-III

Expert system and applications: Introduction phases in building expert systems, expert system versus traditional systems, Rule-based expert systems, blackboard systems truth maintenance systems and application of expert systems.

UNIT-IV

Neural Networks: What is a neural network, the human brain, models of a neuron, neural networks as a directed graph, feedback and network architectures. Learning processes and learning tasks.

UNIT-V

Applications and tools of Artificial Intelligence: Pre-processing, feature extraction and time series prediction. Principle Component Analysis.

Statistical Pattern Recognition: Object recognition, Classification and regression. Application of AI in speech, Image processing and IoT, AI applications in biometric and face recognition. Introduction AI & Deep Learning with TensorFlow, Case Studies – AI in Finance and Agriculture.

Text Books:

1. Stuart Russell and Peter Norvig, "Artificial Intelligence—A Modern Approach", 3rd Edition, Prentice-Hall Series, 2010.
2. Christopher M. Bishop, Clareddon, "Neural networks for pattern Recognition", Oxford, 1995.
3. Simon Haykin, "Neural networks and learning Machines", 3rd Edition, Pearson- Prentice Hall, 2009.
4. M. Narsimhamurty and V. Susheela Devi, "Pattern Recognition- An Algorithmic Approach", Springer Universities Press, 2011
5. B. Yegnanarayana, "Artificial Neural Networks", PHI, 2005.

Suggested Books:

1. Elaine Rich, Kevin Knight and Shivashankar B Nair, "Artificial Intelligence", Tata McGraw Hill Education Pvt. Ltd., 2010.
2. Flasiński, Marius, "Introduction to Artificial Intelligence", Springer International Publisher, 2016.

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20EC E08

Mobile Cellular Communication

(Professional Elective-II)

Instruction	2 L Hours per Week
Duration of SEE	3 Hours
SEE	60 Marks
CIE	40 Marks
Credits	2

Prerequisite: A course on digital communications is required.

Course Objectives: This course aims to:

1. To familiarize the concepts related to cellular communication and its capacity.
2. To teach students the fundamentals of propagation models and multipath fading.
3. To describe diversity schemes as applied in mobile communication and understand latest Mobile technologies

Course Outcomes: Upon completion of this course, students will be able to:

1. Relate the cellular concepts like frequency reuse, hand off, coverage and capacity.
2. Analyse the mobile radio propagation with large scale and small scale fading.
3. Select the suitable diversity technique to combat the multipath fading effects.
4. Compare the mobile radio standards.
5. Examine the advance wireless standards.

Course Articulation Matrix

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	2	2	2	-	2	-	-	-	-	1	3	2	2
CO2	3	2	3	3	2	-	1	-	-	-	-	1	3	2	2
CO3	2	2	2	2	3	-	2	-	-	-	-	1	3	2	2
CO4	2	2	2	3	2	2	1	-	-	2	-	2	3	2	2
CO5	1	1	2	3	2	2	1	-	-	1	-	1	3	2	2

UNIT – I

Cellular concepts: Frequency reuse, Channel Assignment strategies, Hand off strategies. Interference and System capacity, improving coverage and capacity in cellular systems.

UNIT – II

MOBILE RADIO PROPAGATION : Large Scale Fading - Free space propagation model, Three basic propagation mechanisms, Reflection, Ground Reflection(Two-Ray)Model, Diffraction, Scattering, Practical link budget using path loss models. Small Scale Fading : Multipath Propagation, Types of small scale fading, Parameters of Mobile Multipath channels, Fading effects due to multipath time delay Spread and Doppler spread.

UNIT – III

Diversity Techniques: Diversity – Types of diversity – Diversity combining techniques: Selection, Feedback, Maximal Ratio Combining and Equal Gain Combining – Rake receiver

FDMA, TDMA, CDMA, OFDM, SDMA, Comparison of Multiple Access Techniques.

UNIT - IV

Mobile Radio standards: AMPS,2G Architecture such as GSM and CDMA, GSM system overview: GSM system architecture, GSM radio subsystem, GSM channel types, Frame structure for GSM, Signal processing in GSM, 2.5G – GPRS and EDGE- features. Concept of UWB

UNIT - V

Advance Wireless standards: Need for 3G and 4G technologies, 3G standard: UMTS - Introduction to LTE, IS-95/CDMA one, CDMA-2000.4G-features and architecture, 4G-LTE, 4.5 G and 5G.

Text books:

1. Theodore S. Rappaport - Wireless Communications Principles and Practice, 2nd Edition, Pearson Education, 2003.
2. Andrea Goldsmith, "Wireless Communications", Cambridge University Press, First Edition, 2005.
3. Andreas F.MOlisch - Wireless Communications John Wiley, 2nd Edition, 2006.

Suggested Reading:

1. W.C.Y. Lee - Mobile Cellular Communications, 2nd Edition, MC Graw Hill, 1995.
2. Modern Wireless Communications-Simon Haykin, Michael Moher, Pearson Education, 2005.
3. Wireless Communications and Networking, Vijay Garg, Elsevier Publications, 2007.

20EC E10

SENSORS AND ACTUATORS

(Professional Elective-II)

Instruction	2 L Hours per Week
Duration of SEE	3 Hours
SEE	60 Marks
CIE	40 Marks
Credits	2

Prerequisite: Basic electronics, Measurements and Instruments

Course Objectives: This course aims to:

1. To expose the students to many varieties of transducers, measuring instruments, their Operating principles and construction.
2. Understand the concept sensor and actuator systems for practical applications
3. To provide an idea of strengths and weaknesses of the various types of sensors and actuators.

Course Outcomes: Upon completion of this course, students will be able to:

1. Understand the fundamental and applications of several different types of sensors and actuators.
2. Evaluate and perform accurate measurements for any engineering system with clear idea of the potential errors.
3. Understand the working principles of various transducers.
4. Select an appropriate transducer for given application.
5. How to develop a sensor and actuator systems for practical applications.

Course Articulation Matrix

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	1	1	-	2	2	-	1	1	-	2	3	1	1
CO2	3	3	2	1	-	-	1	1	1	1	-	2	3	2	1
CO3	3	3	2	1	-	2	2	-	1	1	-	2	3	1	1
CO4	3	3	2	1	-	-	2	-	1	1	-	2	3	1	1
CO5	3	3	2	1	-	2	1	-	1	1	-	2	3	2	2

UNIT-I

SENSORS: Difference between sensor, transmitter and transducer - Primary measuring elements - selection and characteristics: Range; resolution, Sensitivity, error, repeatability, linearity and accuracy, impedance, backlash, Response time, Dead band. Strain Gauges, Resistance thermometer, Thermistor, Resistance Hygrometer, Photo-resistive sensor.

Electronic measurement: Moving coil and moving iron meters.

UNIT-II

INDUCTIVE & CAPACITIVE TRANSDUCER: Transducer principles, active and passive transducers

Inductive transducers: - Principle of operation, construction details, characteristics and applications of LVDT, Induction potentiometer.

Capacitive transducers: - Principle of operation, construction details, characteristics of Capacitive transducers – different types & signal conditioning- Applications: - capacitor microphone, capacitive pressure sensor, proximity sensor.

UNIT-III

ACTUATORS: Definition, types and selection of Actuators; linear; rotary; Logical and Continuous Actuators, Pneumatic actuator- Electro-Pneumatic actuator; cylinder, rotary actuators, Mechanical actuating system: Hydraulic actuator - Control valves; Construction, Characteristics and Types, Selection criteria.

UNIT-IV

MICRO SENSORS AND MICRO ACTUATORS:

Micro Sensors: Principles and examples, Force and pressure micro sensors, position and speed micro sensors, acceleration micro sensors, chemical sensors, biosensors, temperature micro sensors and flow micro sensors.

Micro Actuators: Actuation principle, shape memory effects-one way, two way and pseudo elasticity. Types of micro actuators-Electrostatic, Magnetic, Fluidic, Inverse piezo effect, other principles.

UNIT-V

SENSOR MATERIALS AND PROCESSING TECHNIQUES: Materials for sensors: Silicon, Plastics, Metals, Ceramics, Glasses, Nano Materials. Processing Techniques: Vacuum deposition, sputtering, chemical vapour deposition, electro plating, photolithography, silicon micro machining, Bulk silicon micro machining, Surface silicon micro machining and LIGA process.

Text Books:

1. D. Patranabis, “Sensors and Transducers”, Prentice Hall India Pvt., 2nd Ed, 2021.
2. Clarence W. De Silva, “Sensors and Actuators Engineering System Instrumentation”, Taylor & Francis Ltd, 2nd Ed, 2015.

Suggested Readings:

1. Jacob Fraden, “Hand Book of Modern Sensors: Physics, Designs and Application” 4Ed, Springer, 2010.
2. Jonathan Wolpaw and Elizabeth Winter Wolpaw, “Brain-Computer Interfaces: Principles and Practice”, Oxford University Press, 2012.
3. D. V. S. Murty, “Transducers and Instrumentation”, Prentice Hall India Pvt., Limited, 2008.

20EC E11

DRONES AND APPLICATIONS

(Professional Elective-II)

Instruction	2 L Hours per Week
Duration of SEE	3 Hours
SEE	60 Marks
CIE	40 Marks
Credits	2

Prerequisite: Knowledge of basic concepts of signals, control systems and microprocessors is required.

Course Objectives: This course aims to:

1. To understand Flight dynamics and construction of Drones
2. To assemble and Control the operations of Drones
3. To design Quadcopter and Implement them for real world applications

Course Outcomes: Upon completion of this course, students will be able to:

1. Apply the concept of Flight dynamics for building Drone
2. Assemble and Program the Drone
3. Perform Testing and Control operations on the Drone
4. Apply control mechanism to track and control Parallax ELEV-8 Quadcopter Build.
5. Use of Drone for real-world applications

Course Articulation Matrix

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	-	3	2	2	2	-	-	-	-	-	-	3	3	1
CO2	3	-	1	1	2	2	-	-	-	-	-	-	3	2	3
CO3	2	-	3	2	3	3	-	-	-	-	-	-	3	3	2
CO4	2	-	2	3	2	3	-	-	-	-	-	-	2	3	2
CO5	1	-	1		2	2	-	-	-	-	-	-	3	3	1

UNIT I

FLIGHT DYNAMICS OF AERIAL VEHICLES:

Types of current generation of drones based on their method of propulsion, Drone design and fabrication: Classifications of the UAV, Overview of the main drone parts, assembling a drone the energy sources, Level of autonomy. UAV, RPA, Quad copters, Basic Components and Categories, Principles of Flight, Flight Maneuvers Airframes, creating a Frame: Materials, Different Frame Shapes, Building Airframes, Flight dynamics

UNIT II

HARDWARE ANATOMY OF DRONES

Power Train, Propellers, Motors, Total Lift, Electronic Speed Controllers, Flight Battery, Radio transmitter and receiver, Flight Controller, GPS, Compass, Camera Assembling for Quad copter, Connectors, Mounting of Propellers and Powering up. Flight modes Wi-Fi connection, Concept of operation for drone Flight modes Operate a small drone in a controlled environment Drone controls Flight operations management tool.

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UNIT III

TESTING AND MAINTENANCE OF DRONES

Key Flight Safety Rules, Preflight Checklist and Flight Log Information, Flight Instructions, Repair and Maintenance: Crash analysis, Common issues, Voltage testing. The safety risks Guidelines to fly safely Specific aviation regulation in the European Union European system of standardization.

UNIT IV

PARALLAX ELEV-8 QUADCOPTER:

Parallax Open Source Project,- Building the Elev-8 Quadcopter, Programming the Parallax Propeller Chip, Propulsors, Radio Controlled Systems and Telemetry, Servo Control Systems, Tracking and Performance Checks.

UNIT V

REAL WORLD APPLICATIONS AND CASE STUDIES:

Beneficial Drones, Aerial Photography, Mapping and Surveying, Precision Agriculture, Search and Rescue, Infrastructure Inspection, Conservation. Case Studies: Agriculture Weed Classification, Microdrone surveillances.

Text Books:

1. Terry Kilby and Belinda Kilby, "Make: Getting Started with Drones ",Maker Media, Inc, 2016
2. Vasilis Tzivaras, "Building a Quadcopter with Arduino", Packt Publishing, 2016.
3. Donald Norris, "Build Your Own Quadcopter -Power Up Your Designs with the Parallax Elev-8" , McGraw-Hill Education, 2014

Suggested Reading:

1. Baichtal, "Building Your Own Drones: A Beginners' Guide to Drones, UAVs, and ROVs", Que Publishing, 2016.
2. Austin, Unmanned Aircraft Systems: UAVS Design, Development and Deployment. Wiley, 2010.
3. Sebbane, Smart Autonomous Aircraft: Flight Control and Planning for UAV. CRC Press, 2015.
4. Zavrsnik, Drones and Unmanned Aerial Systems: Legal and Social Implications for Security and Surveillance. Springer, 2015

20EC E12

FUNDAMENTALS OF CLOUD COMPUTING

(Professional Elective-II)

Instruction	2 L Hours per Week
Duration of SEE	3 Hours
SEE	60 Marks
CIE	40 Marks
Credits	2

Prerequisite: Fundamental concepts of computer networking.

Course Objectives: This course aims to:

1. To impart the fundamentals and essentials of Cloud Computing.
2. Describes the cloud architecture, layers and models.
3. Introduce the concepts of resource management and security in cloud.

Course Outcomes: Upon completion of this course, students will be able to:

1. Understand the basic concepts of cloud computing.
2. Describe the characteristics, advantages, risks and challenges associated with cloud computing.
3. Explain and characterize various cloud service models, cloud deployment models.
4. Investigate/Interpret the security and privacy issues related to cloud computing environments.
5. Apply the concepts of cloud computing in real world scenario.

Course Articulation Matrix

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	3	-	1	-	-	-	-	-	-	-	2	-	-	-
CO2	3	2	1	2	-	-	-	-	-	-	-	1	-	-	-
CO3	3	2	1	1	-	-	-	-	-	-	-	1	1	-	-
CO4	3	3	1	2	-	-	-	-	-	-	-	1	-	-	-
CO5	2	3	-	1	-	-	-	-	-	-	-	2	-	-	-

UNIT-I

Cloud Computing Overview: Origins of Cloud computing – Cloud components - Essential characteristics – On-demand self-service, Broad network access, Location independent resource pooling, Rapid elasticity, Measured service, Comparing cloud providers with traditional IT service providers, Roots of cloud computing.

UNIT-II

Cloud Insights: Architectural influences – High-performance computing, Utility and Enterprise grid computing, Cloud scenarios – Benefits: scalability, simplicity, vendors, security, Limitations – Sensitive information - Application development-security level of third party - security benefits, Regularity issues: Government policies.

UNIT-III

Cloud Architecture- Layers and Models

Layers in cloud architecture, Software as a Service (SaaS), features of SaaS and benefits, Platform as a Service (PaaS), features of PaaS and benefits, Infrastructure as a Service (IaaS), features of IaaS and benefits, Service providers, challenges and risks in cloud adoption. Cloud deployment model: Public clouds – Private clouds – Community clouds - Hybrid clouds - Advantages of Cloud computing.

UNIT-IV

Resource Management and Security in Cloud: Inter Cloud Resource Management – Resource Provisioning Methods – Security Overview – Cloud Security Challenges – Data Security –Application Security – Virtual Machine Security.

UNIT-V

Case Studies: Google App Engine(GAE) – GAE Architecture – Functional Modules of GAE – Amazon Web Services(AWS), Google Cloud Platform (GCP) and Azure. GAE Applications – Cloud Software Environments – Eucalyptus – Open Nebula – Open Stack.

Text Books:

1. Buyya R., Broberg J., Goscinski A., "Cloud Computing: Principles and Paradigm", 1st Edition, John Wiley and Sons, 2011.
2. Kai Hwang, Geoffrey C. Fox, Jack G. Dongarra, "Distributed and Cloud Computing, From Parallel Processing to the Internet of Things", Morgan Kaufmann Publishers, 2012.
3. Rittinghouse, John W, and James F. Ransome, Cloud Computing: Implementation, Management, And Security, CRC Press, 2017.
4. Cloud computing a practical approach - Anthony T.Velte , Toby J. Velte Robert Elsenpeter, Tata McGraw- Hill , New Delhi – 2010
5. Michael Miller – Que, "Cloud Computing: Web-Based Applications That Change the Way You Work and Collaborate Online", 2008

Suggested Reading:

1. Rajkumar Buyya, Christian Vecchiola, S. Thamarai Selvi, "Mastering Cloud Computing", Tata Mcgraw Hill, 2013.
2. Toby Velte, Anthony Velte, Robert Elsenpeter, "Cloud Computing – A Practical Approach", Tata Mcgraw Hill, 2009.
3. George Reese, "Cloud Application Architectures: Building Applications and Infrastructure in the Cloud: Transactional Systems for EC2 and Beyond (Theory in Practice)", OReilly, 2009.
4. Judith Hurwitz, Robin Bloor, Marcia Kaufman, Fern Halper, "Cloud computing for dummies", Wiley Publishing, Inc, 2010.

20EC C19

DIGITAL COMMUNICATION LAB

Instruction	2 P Hours per Week
Duration of SEE	3Hours
SEE	50 Marks
CIE	50 Marks
Credits	1

Prerequisite: Knowledge about analog communication is required.

Course Objectives: This course aims to:

1. Carry out experiments on various pulse digital modulation techniques.
2. Conduct the experiment to identify errors in cyclic codes
3. Work on convolutional encoder and decoder for controlling the errors.

Course outcomes: Upon completion of this course, students will be able to:

1. Demonstrate various pulse digital modulation techniques.
2. Assess different line coding techniques.
3. Detect and correct errors in cyclic codes.
4. Examine the errors in convolutional encoder and decoder.
5. Evaluate various digital carrier modulation techniques experimentally.

Course Articulation Matrix

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	3	3	2	3	3	1	1	2	1	2	3	3	1
CO2	3	3	3	3	2	3	2	1	1	2	1	2	3	3	2
CO3	3	3	3	3	2	3	3	2	1	2	1	3	3	3	2
CO4	3	3	3	3	1	3	3	2	1	2	1	3	3	3	2
CO5	3	3	3	3	1	3	3	2	1	2	1	3	3	3	2

List of Experiments:

1. PCM generation and detection.
2. Data formats / Line coding techniques.
3. Linear Delta Modulation and demodulation.
4. Adaptive Delta Modulation and demodulation.
5. Error detection and correction in cyclic codes.
6. Convolutional encoder and decoder.
7. ASK generation and detection.
8. FSK generation and detection.
9. BPSK generation and detection.
10. QPSK generation and detection.
11. MSK generation and detection.
12. Structured Enquiry:
    - Design N-bit PCM encoder based on the given specifications.

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13. Open ended Enquiry:

- Develop a code for different digital modulation schemes and verify through simulation.
- Design different Line coding schemes using logic Gates.

Suggested Reading:

1. A.M. Zungeru, J.M. Chuma, M. Mangwala , L.K. Ketshabetswe, “Handbook of Laboratory Experiments in Electronics and Communication Engineering”, Vol. 2, 1st Edition, Notion press, 2017.

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20EC C20

DIGITAL SIGNAL PROCESSING LAB

Instruction	2 P Hours per Week
Duration of SEE	3 Hours
SEE	50 Marks
CIE	50 Marks
Credits	1

Prerequisite: The knowledge of basics of signals, systems, linear algebra and calculus is required.

Course Objectives: This course aims to:

1. Simulation of DFT, FFT, Digital filters and multirate concepts using MATLAB.
2. Understand spectral analysis of noisy signals using MATLAB.
3. Implementation of digital filters on DSP Processor.

Course Outcomes: Upon completion of this course, students will be able to:

1. Illustrate linear convolution and correlation using MATLAB.
2. Design the digital filters using MATLAB.
3. Examine the performance of multirate techniques using MATLAB.
4. Experiment with decimator and interpolator on DSP processor.
5. Implement the digital filters on DSP processor.

Course Articulation Matrix

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PS01	PSO2	PSO3
CO1	2	2	1	2	2	-	-	-	-	2	-	1	3	1	1
CO2	2	3	2	2	2	-	-	-	-	2	-	1	3	2	2
CO3	2	2	1	2	2	-	-	-	-	2	-	1	3	2	1
CO4	2	2	1	2	2	-	-	-	-	2	-	1	3	2	1
CO5	2	3	2	2	2	-	-	-	-	2	-	1	3	3	2

List of Experiments

(A) Experiments on signal processing using MATLAB.

1. To Perform basic matrix operations and Generation of test signals.
2. Compute the Linear Convolution, circular convolution and Correlation of two sequences.
3. Determine the Discrete Fourier Transform(DFT) and Fast Fourier Transform(FFT) of the given sequence.
4. Design of FIR filter using different windows
5. Design of IIR filter: Butter worth, Chebyshev type 1 and 2: LPF, HPF, BPF & BSF filter.
6. Spectral Analysis of noisy signal using Welch's method
7. Implementation of Interpolation and Decimation
8. Design of Multistage filter

(B) Experiments on DSK and CCS

1. Study of procedure to work in real- time
2. Solutions of difference equations
3. Linear Convolution
4. Implementation of FIR filter
5. Implementation of second order IIR filters
6. Decimation and Interpolation
7. Dual Tone Multi Frequency(DTMF)

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Structured enquiry: Design the best IIR band pass filter to meet the given specifications:

Pass band cut off frequencies: [500 600] Hz
Stop band cut off frequencies: [525 675] Hz
Pass band ripple: ≤ 2dB
Stop band attenuation: ≥ 60dB

Open-ended enquiry: Design a three stage multirate filter to meet the given specifications:

Pass band cut off frequency: 450 Hz
Stop band cut off frequency: 500 Hz
Pass band ripple: ≤ 3dB
Stop band attenuation: ≥ 40dB
Sampling frequency: 40 KHz
Compare with single stage filter.

Note:

1. Minimum of 6 from Part A and 4 from Part B is mandatory.
2. For Part "A", MATLAB with different toolboxes like Signal Processing, Signal Processing block set, and SIMULINK/ MATHEMATICA/ any popular software can be used.

Suggested Reading:

1. Vinay K. Ingle and John G. Proakis, "Digital Signal Processing using MATLAB", 4/e, Cengage learning, 2011.
2. B. Venkataramani and M. Bhaskar, "Digital Signal Processor architecture, programming and application", 6/e, TMH, 2006.

20EC C21

LINEAR AND DIGITAL INTEGRATED CIRCUITS LAB

Instruction	2 P Hours per Week
Duration of SEE	3Hours
SEE	50 Marks
CIE	50 Marks
Credits	1

Prerequisite: Knowledge of Analog electronic circuits.

Course Objectives: This course aims to:

1. Know and verify the concepts of 741 Op-Amp, IC555 timer, IC723 and data converters.
2. Know the various characteristics of TTL and CMOS gates and implement the circuits with Digital ICs.
3. Contrast the differences between linear and digital ICs.

Course Outcomes: Upon completion of this course, students will be able to:

1. Analyze the configurations, parameters of Op-Amp (IC741).
2. Demonstrate the circuits of Op-Amp for various applications.
3. Design the circuits using IC555 timer, IC723 and data converters.
4. Determine the characteristics of TTL and CMOS gates
5. Develop various combinational circuits and sequential circuits using digital ICs.

Course Articulation Matrix

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	2	3	1	1	-	-	1	2	2	-	2	2	2	1
CO2	2	3	3	3	1	-	-	1	2	2	-	2	3	3	1
CO3	2	3	3	3	1	-	-	1	2	2	-	2	3	3	1
CO4	2	2	2	1	1	-	-	1	2	2	-	2	2	2	1
CO5	2	3	3	3	1	-	-	1	2	2	-	2	3	3	1

Lab Experiments

Part-A: Linear IC Experiments

1. Implement Voltage Follower, Inverting and Non-Inverting Amplifiers using Op-Amp.
2. Measurement of Op-Amp parameters
3. Implement Arithmetic Circuits using Op-Amp
4. Implement Waveform generation using Op-Amp.
5. Implement Astable and Monostable multi vibrators using IC555Timer.
6. Implement Low and High Voltage Regulators using IC723.
7. Implement D to A Converter using R-2R ladder.
8. Implement A to D Converter

Part-B: Digital IC Experiments

1. Measurement of various characteristic parameters of TTL and CMOS gates.
2. Implement Logic function Implementations using Decoders.
3. Implement Logic function Implementations using Multiplexers
4. Implement Binary adder and subtractor, BCD adders using ICs.
5. Design of Synchronous, Asynchronous up/down counters.
6. Implement Shift registers and ring counter using ICs.
7. Implement the Interfacing counters with 7-segment LED display units.

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Structured enquiry: Implement a Security Monitoring System (Use only nonprogrammable ICs.)

Open ended enquiry: Design a Digital Clock structure to display minutes and seconds. (Use only non-programmable ICs.)

Suggested Reading:

1. National Semiconductor Corporation, “Linear applications”, Data book, 1986.
2. National Semiconductor Corporation, “Logic data book-Vol-II”, 1984.

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20EC I02

INDUSTRIAL INTERNSHIP/ RURAL INTERNSHIP

Instruction/Demonstration/Training	3-4 Weeks/90 Hours
Duration of SEE	--
SEE	--
CIE	50 Marks
Credits	2

Prerequisite: Knowledge of Basic Sciences and Engineering Sciences/Knowledge about rural environment

Course Objectives: This course aims to:

1. Exposing the students to the industrial environment/ rural environment
2. Create awareness with the current industrial technological developments relevant to program domain
3. Provide opportunity to understand the social, economic and administrative considerations in organizations/rural areas

Course Outcomes: Upon completion of this course, students will be able to:

1. Understand Engineer's responsibilities and ethics
2. Use various materials, processes, products and quality control
3. Provide innovative solutions to solve real world problems
4. Acquire knowledge in technical reports writing and presentation
5. Apply technical knowledge to real world industrial/rural situations

.

Course Articulation Matrix

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	-	-	-	-	-	3	3	-	3	-	3	3	-	-	3
CO2	1	1	1	3	3	-	2	1	-	-	-	-	3	3	-
CO3	2	3	3	3	3	2	3	1	1	-	-	-	3	3	-
CO4	-	-	-	-	-	3	-	1	3	3	-	1	-	-	3
CO5	1	3	3	3	3	2	3	-	1	-	-	1	3	3	3

For implementation procedures and letter formats, annexures I and III of Internship document may be referred.
Evaluation of Internship: The industrial training/internship of the students will be evaluated in three stages:

a) Evaluation by the Industry (in the scale of 1 to 10 where 1-Unsatisfactory; 10-Excellent)

b) Evaluation by faculty Mentor on the basis of site visit(s) or periodic communication (15 marks)

c) Evaluation through seminar presentation/Viva-Voce at the Institute by the constituted committee (25 marks)

Evaluation through Seminar presentation/Viva-Voce at the institute: Students shall give a seminar before an E*xpert Committee* constituted by college (Director, HoD/Senior faculty, mentor and faculty expert from the same department) based on his/her training/internship carried out

The evaluation will be based on the following criteria:

- Quality of content presented
- Proper planning for presentation
- Effectiveness of presentation
- Depth of knowledge and skills

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- Attendance record, daily diary, departmental reports shall be analyzed along with the internship Report

Monitoring/ Surprise Visits: During the internship program, the faculty mentor makes a surprise visit to the internship site, to check the student's presence physically. If the student is found to be absent without prior intimation to the concerned industry, entire training/internship may be canceled. Students should inform through email to the faculty mentor as well as the industry supervisor at least one day prior to avail leave.

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20EC C22

MICROCONTROLLERS

Instruction	3 L Hours per Week
Duration of SEE	3 Hours
SEE	60 Marks
CIE	40 Marks
Credits	3

Prerequisite: Knowledge of Computer Architecture and Microprocessors.

Course Objectives: This course aims to:

1. Understand architecture features of the microcontrollers
2. Learn the programming of the microcontrollers
3. Understand interfacing of various modules with microcontrollers.

Course Outcomes: Upon completion of this course, students will be able to:

1. Understand the architectures of different microcontrollers to enable to design of applications using them.
2. Develop code both in assembly and in high level language for various applications of microcontrollers.
3. Analyze and develop applications by using on-chip peripherals of different microcontrollers.
4. Interface various I/O Modules with 8051 microcontrollers.
5. Apply theoretical learning to practical real time problems for automation.

Course Articulation Matrix

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	2	3	1	3	3	-	-	-	-	-	-	3	3	2
CO2	3	3	3	2	3	3	-	-	-	-	-	-	3	3	2
CO3	3	3	3	2	3	3	-	-	-	-	-	-	3	3	2
CO4	2	2	3	2	3	2	-	-	-	-	-	-	3	3	2
CO5	3	3	3	2	3	3	-	-	-	-	-	3	3	2	2

UNIT-I

8051Microcontroller: Introduction to Microcontroller, Overview of 8051 family, Internal Architecture of 8051, PSW, Pin description, I/O Ports, Memory organization and expansion. Addressing modes and Bit addressable features, 8051 Instruction set: Data transfer, Arithmetic, Logical, Program branching and bit manipulation instructions.

UNIT-II

8051 Programming: Introduction to 8051 programming development tools, basic programming using instruction set, Introduction to 8051 C Programming, SFRs, 8051 Timer Programming in Assembly and C, 8051 Serial port Programming in Assembly and C, 8051 Interrupt Programming in Assembly and C.

UNIT-III

8051 Interfacing: 8051 interfacing to external memory (RAM, ROM), 8255 PPI interfacing, LCD and Keyboard interfacing, Digital to Analog converter, Analog to Digital converter and Sensor interfacing, Relay and PWM, DC Motor interfacing, Stepper Motor interfacing

UNIT-IV

ARM: Introduction to RISC Processors, ARM Design Philosophy, ARM Processor families, Architecture- Revisions, Registers, Program status register, Pipeline, Introduction to Exceptions,

ARM Instruction set: Data processing instructions, Branch instructions, Load-Store instructions, Software interrupt instruction, Program Status Register instructions, Loading constants, and Conditional executions. Introduction to THUMB instructions: Differences between Thumb and ARM modes, Register usage.

UNIT-V

ARM 7 Microcontroller (LPC2148)**:** Salient features of LPC 2148, Pin description of 2148, Architectural Overview.

ARM 7(LPC2148) **Peripherals:** Description of General-purpose input/output (GPIO) ports, Pin control Block. Features, Pin description, Register description and operation of PLL, Timers, PWM, ADC, DAC. Brief overview on I2C, SPI and Embedded application using communication protocols.

Text Books:

1. Mazidi M.A, Mazidi JG & Rolin D. Mckinlay, "The 8051 Microcontroller & Embedded Systems using Assembly and C", 2/e, Pearson Education, 2007.
2. Andrew N. Sloss, Domonic Symes, Chris Wright, "ARM System Developers Guide Designing and Optimizing system software", 1/e, Elsever, 2004.

Suggested Reading:

1. Ayala K.J, "The 8051 Microcontroller Architecture, Programming and Applications", Penram International, 2007.
2. Steve Furber, "ARM System on Chip Architecture", 2/e, Pearson education, 2000.
3. Philips semiconductors, "ARM 7 (LPC 214x)user manual", 2005.
4. Lyla B. Das, "Architecture, Programming and Interfacing of Low-power Processors-ARM 7, Cortex-M", CENGAGE, 2017.

20EC C23

VLSI DESIGN

Instruction	3 L Hours per Week
Duration of SEE	3 Hours
SEE	60 Marks
CIE	40 Marks
Credits	3

Prerequisite: Aprior knowledge of Verilog HDL and MOS Transistor Theory.

Course Objectives: This course aims to:

1. Study the concepts of Verilog HDL, simulation and synthesis process/concepts.
2. Learn the various characteristics of MOS transistor, process steps in IC fabrication.
3. Learn the various concepts required to obtain the digital logic layout diagrams. To know various subsystem design concepts.

Course Outcomes: Upon completion of this course, students will be able to:

1. Model a digital design using Advanced Verilog HDL constructs.
2. Analyse the characteristic behavior of MOSFET and discuss CMOS circuit Design Process
3. Explain various process steps involved in IC fabrication.
4. Design various NMOS and CMOS based logic circuits.
5. Discuss the concepts of subsystem designs and Testing.

Course Articulation Matrix

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PS01	PSO2	PSO3
CO1	1	2	-	-	-	-	-	2	-	-	-	2	3	1	1
CO2	2	3	-	3	-	-	-	2	-	-	-	2	3	2	1
CO3	-	-	-		-	-	-	2	-	-	-	2	3	1	1
CO4	1	3	-	2	-	-	-	2	-	-	-	2	3	3	1
CO5	-	1	-	1	-	-	-	2	-	-	-	2	3	1	1

UNIT-I

Advanced Verilog HDL: Review of behavioural modelling**.** Functions and tasks Switch level Modelling, UDP, Design of Mealy and Moore state models using Verilog, Logic Synthesis, Synthesis Design flow, Gate level Netlist.

UNIT–II

Introduction to MOS Technology, Basic MOS Transistor action: Enhancement and Depletion Modes. Basic electrical properties of MOS, Threshold voltage and Body Effect.

Scaling of Technology, MOS Layers, Stick diagrams, Lambda based Design rules and Layout diagrams.

UNIT–III

Process steps in IC fabrication Crystal growth and wafer preparation-Czochralski process-apparatus-silicon shaping, slicing and polishing- Diffusion, Ion implantation- Annealing process- Oxidation process- Lithography-Photolithography, electron beam and x-ray lithography-Chemical vapour deposition (CVD)-epitaxial growth-reactors-metallisation and packaging.

UNIT–IV

Design of MOS inverters with different loads. Basic Logic Gates with CMOS: INVERTER, NAND, NOR, AOI and OAI gates. Transmission gate logic circuits, BiCMOS inverter, D flip flop using Transmission gates.

UNIT–V

Memories:1T, 3T Dynamic RAM Cell, 6T Static RAM Cell. NOR and NAND based ROM Memory Design.

Testing: Introduction to Testing, Fault models (stuck-at 1 and stuck – at-0)-Path sensitization and D-Algorithm, Controllability, Observability. Introduction to SoC and ASIC design.

Text Books:

1. Samir Palnitkar,"Verilog HDL:A guide to Digital design and synthesis", 2/e, Pearson Education, 2008.
2. Kamran Eshraghian, Douglas A. Pucknell, Sholeh Eshraghian, "Essentials of VLSI circuits and systems", PHI, 2011.
3. Neil HEWeste, David Harris, Ayan Banerjee, "CMOS VLSI Design–A circuit and System Perspective", 3/e, Pearson Education,2006.
4. Parag K Lal, " Fault Tolerant and Fault Testable Hardware Design " , BS Publications, 2020
5. S.M. Sze, VLSI Technology,McGraw-Hill, 2nd Edition, 1988.

Suggested Reading:

1. Michael D. Ciletti, "Advanced Digital Design with Verilog HDL", PHI, 2005.
2. John P. Uyemura, "Introduction to VLSI Circuits and systems", John Wiley & Sons, 2011.
3. Sung-Mo Kang & Yusuf Leblebici, CMOS Digital Integrated Circuits Analysis and Design, McGraw-Hill, 1998.

20EC E13

CPLD AND FPGA ARCHITECTURES

(Professional Elective-III)

Instruction	3 L Hours per Week
Duration of SEE	3 Hours
SEE	60 Marks
CIE	40 Marks
Credits	3

Prerequisite: Digital logic design and digital integrated circuits.

Course Objectives: This course aims to:

1. Study various PLD, CPLDs and FPGA Architectures and its features.
2. Understand the different programming technologies, placement and routing,.
3. Study the design tools for FPGA and ASICs.

Course Outcomes: Upon completion of this course, students will be able to:

1. Explain the concepts of PLDs, CPLDs and FPGAs.
2. Analyze and compare the various architectures of CPLD and FPGA and its programming technologies.
3. Implement various logic functions on PLDs, CPLDs and FPGAs.
4. Understand the concepts of placement and routing and classifying ASICs.
5. Demonstrate VLSI tool flow for CPLDs and FPGAs.

Course Articulation Matrix

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	1	2	-	1	1	-	-	2	-	-	-	2	3	3	1
CO2	2	3	1	3	2	-	-	2	-	-	-	2	3	3	1
CO3	-	2	-	1	-	-	-	2	-	-	-	2	3	3	1
CO4	2	3	-	3	2	-	-	2	-	-	-	2	3	3	1
CO5	-	3	-	2	2	-	-	2	-	-	-	2	3	3	1

UNIT I

Review of Logic Design: Implementation of logic functions with multiplexers.
Programmable Logic Devices: Architectures of PROM, PLA and PAL. Implementation of MSI circuits using Programmable Logic Devices.

UNIT II

Complex Programmable Logic Devices: Introduction to CPLD Architecture of CPLD. Logic Block, I/O Block, Interconnect matrix, and features of Altera max 7000 series, AMD Mach 4 and Xilinx XC-9500 CPLD.

UNIT III

Xilinx FPGAs: Introduction to FPGA, FPGA Programming Technologies. Architecture, Logic Blocks, I/O Block, Routing Architecture and features of Xilinx XC-4000, SPARTAN-II, Virtex-II and salient features of Virtex III to VII devices.

UNIT IV

Actel and Altera FPGAs: Anti-Fuse Programmed FPGAs: Introduction, Architecture of Actel's Act1, Act2, and Act3 FPGAs. Designing of logic circuits with the ACT devices. Logic Block, I/O Block, Routing Architecture and features of Altera's Flex 10000 series FPGA.

UNIT V

Digital Design Flow: Digital design tools for FPGAs. Digital design flow for CPLDs and FPGAs. Importance of Placement and Routing, Introduction to ASICs: Semi-Custom and Full-Custom ASICs.

Text books:

1. S. Trimberger, Edr, "Field Programmable Gate Array Technology", Springer Pub., 2011.
2. Ronald J . Tocci, Neal S. Widmer, Gregory L. Moss "Digital Systems", 10/e, Pearson academic press 2011.
3. P.K.Chan& S. Mourad, "Digital Design Using Field Programmable Gate Array", PHI, 1994.

Suggested Reading:

1. S. Brown, R.J.Francis, J.Rose, Z.G.Vranesic, "Field programmable gate array", BSP, 2007.
2. Altera, AMD, Actel, "Manuals Xilinx", 2015

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20EC E18

CRYPTOGRAPHY AND BLOCKCHAIN TECHNOLOGY

(Professional Elective-III)

Instruction	3 L Hours per Week
Duration of SEE	3 Hours
SEE	60 Marks
CIE	40 Marks
Credits	3

Prerequisite: Data Structures and Algorithms, Introduction to Programming.

Course Objectives: This course aims to:

1. Provide conceptual understanding of basic concepts of cryptography.
2. Describes the Blockchain technology and its applications.
3. Introduce cryptocurrency transactions using Blockchain technology.

Course Outcomes: Upon completion of this course, students will be able to:

1. Comprehend the key concepts of fundamental cryptography techniques which are required for Blockchain Technology.
2. Describe the key concepts and compare various models of Blockchain Technology.
3. Understand consensus mechanism in Blockchain.
4. Acquire knowledge regarding cryptocurrency transactions and their validation.
5. Apply the concepts of Blockchain technology in real world scenario.

Course Articulation Matrix

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	1	1	-	2	1	-	-	-	-	-	1	2	2
CO2	3	3	2	1	-	-	-	-	-	-	-	-	2	-	1
CO3	2	2	2	1	-	-	-	-	-	-	-	-	-	-	2
CO4	3	2	2	2	1	-	-	-	-	-	-	-	-	-	2
CO5	3	2	1	1	-	2	1	-	-	-	-	-	1	2	2

UNIT-I

Overview of Cryptography: Introduction to Cryptography, History and development of cryptography; Cryptanalysis; Classical cryptosystems: shift, substitution and Vigenere ciphers; Attacks on shift, substitution and Vigenere ciphers; Designing a provably secure system, One -Time pads.

Basic Crypto Primitives: Cryptographic Hash Function, Properties of a hash function, Hash pointer and Merkle tree, Digital Signature, Public Key Cryptography: RSA Algorithm, Elliptical Curve Cryptography, A basic Cryptocurrency and example.

UNIT-II

Introduction to Blockchain Technology: Introduction to client-server architecture, distributed computing and their limitations. Evolution of Blockchain and how it is changing the landscape of digitalization, Block in a Blockchain, Working principles of blockchain technology. Types of Blockchain: Public, Private and Consortium, Permissioned Model of Block chain, Public Ledgers, Smart Contracts, Transactions, Mining Mechanism, Consensus.

UNIT-III

Introduction to digital wallet and types of wallets: Desktop, mobile and Meta mask/Browser based wallets. Introduction to Bitcoin Blockchain, Working with Consensus in Bitcoin: Distributed consensus in open environments, Consensus in a Bitcoin network, Proof of Work (PoW), HashcashPoW, Bitcoin PoW, Attacks on PoW and the monopoly problem, Proof of Stake, Proof of Burn and Proof of Elapsed Time, The life of a Bitcoin Miner, Mining Difficulty, Mining Pool.

UNIT-IV

Bitcoin versus Ethereum, Ethereum and Smart Contracts, The Turing Completeness of Smart Contract Languages and verifications, using smart contracts to enforce legal contracts, Introduction to Hyperledger and Truffle..

UNIT-V

Applications: Blockchain Technologies for IoT, Supply Chain Management in Agriculture using Blockchain and IoT.

Text Books:

1. Paar Christof, Pelzl Jan, "Understanding Cryptography A Textbook for Students and Practitioners", Springer, 2010.
2. Joseph J. Bambara, Paul R. Allen, “Blockchain A Practical Guide to Developing Business, Law, and Technology Solutions”, 1st Edition, Mc. Graw Hill, 2018.
3. Daniel Drescher, “Block Chain Basics”, Apress; 1st Edition, 2017.
4. Shiho Kim, Ganesh Chandra Deka, "Advanced Applications of Blockchain Technology", Springer, 2020.

Suggested Reading:

1. Imran Bashir, “Mastering Block Chain: Distributed Ledger Technology, Decentralization and Smart Contracts Explained”, Packt Publishing, 2018.
2. Ritesh Modi, “Solidity Programming Essentials: A Beginner’s Guide to Build Smart Contracts for Ethereum and Block Chain”, Packt Publishing, 2018.

20EC E19

DESIGN FOR TESTABILITY

(Professional Elective-IV)

Instruction	3 L Hours per Week
Duration of SEE	3 Hours
SEE	60 Marks
CIE	40 Marks
Credits	3

Prerequisite: A prior knowledge of Digital System Design.

Course Objectives: This course aims to:

1. Provide an in-depth understanding of the testing and faults affecting VLSI circuits.
2. Provide knowledge on various testing methods.
3. Evaluate various test cases

Course Outcomes: Upon completion of this course, students will be able to:

1. Understand the concepts of testing for VLSI circuits.
2. Apply techniques to improve testability of VLSI circuits.
3. Utilize logic simulation methods such as ATPG in testing of VLSI circuits.
4. Analyze the concepts of BIST in testing of VLSI circuits.
5. Evaluate various Testing methods

Course Articulation Matrix

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	1	-	-	-	-	-	-	2	-	-	-	2	3	1	1
CO2	2	2	2	-	-	-	-	2	-	-	-	2	3	`	1
CO3	1	-	-	-	-	-	-	2	-	-	-	2	3	1	1
CO4	1	2	1	-	-	-	-	2	-	-	-	2	3	1	1
CO5	1	1	1	-	-	-	-	2	-	-	-	2	3	1	1

UNIT-I

Introduction to VLSI testing: Importance of testing, Challenges in VLSI testing, Levels of abstractions in VLSI testing, Functional vs. Structural approach to testing, Complexity of the testing problem, Controllability and Observability, Generating test for a single stuck at fault in combinational logic, D-algorithm, PODEM algorithms, Test optimization and fault coverage.

UNIT–II

Design for testability (DFT): Testability analysis, Scan cell design, Scan architectures, Scan design rules, Scan design flow, Special purpose scan designs Logic and fault simulation, Fault detection, Adhoc and structured approaches to DFT, Various kinds of scan design.

UNIT–III

Test generation: Random test generation, Boolean difference, ATPG algorithms for combinational circuits, Sequential ATPG, Untestable faults, IDDQ testing The LFSRs and their use in random test generation and response compression.

UNIT–IV

Built-in self-test (BIST): Design rules, Exhaustive testing, Pseudo-random testing, Pseudo-exhaustive testing, Output response analysis, Logic BIST architectures Test compression: Test stimulus compression,

UNIT–V

Boundary scan and core -based testing: IEEE standards for digital boundary scan, Embedded core test standards Analog and mixed signal testing, Delay testing, Physical failures, Soft errors Reliability, FPGA testing.

Text Books:

1. Parag K. Lala, An Introduction to Logic Circuit Testing, Morgan & Claypool Publishers
2. Michael L. Bushnell and Vishwani D. Agrawal, Essentials of Electronic Testing, Springer India

Suggested Reading:

1. Parag K Lal, " Fault Tolerant and Fault Testable Hardware Design " , BS Publications, 2020
2. M. Abramovici, M. Breuer, and A. Friedman, Digital System Testing and Testable Design, Jaico Publishing House

20EC E20

SATELLITE COMMUNICATION

(Professional Elective-IV)

Instruction	3 L Hours per Week
Duration of SEE	3 Hours
SEE	60 Marks
CIE	40 Marks
Credits	3

Prerequisite: A course on digital communications is required.

Course Objectives: This course aims to:

1. To understand the orbital aspects of satellite communication.
2. To study the satellite links and earth stations.
3. To know the working principles of DBSTV and VSAT.

Course Outcomes: Upon completion of this course, students will be able to:

1. Demonstrate the fundamental concepts of Orbital Aspects and Orbital Mechanics
2. Identify the mechanisms for placing satellites and examine the orbital effects on satellites, launch mechanisms.
3. Compare the Multiple access techniques for satellite communications and demonstrate the satellite subsystems.
4. Design an appropriate satellite communication link for the given specifications
5. Inspect the working principle and related aspects of DBSTV and VSAT.

Course Articulation Matrix

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	3	1	3	-	1	-	-	-	-	1	3	2	-
CO2	3	2	2	2	2	-	2	-	-	-	-	1	3	2	-
CO3	2	2	2	1	3	2	-	-	-	-	-	1	3	-	-
CO4	2	2	1	3	2	2	-	-	-	-	-	1	3	3	1
CO5	2	2	2	2	2	-	-	-	-	-	-	2	3	-	-

UNIT - I

INTRODUCTION AND ORBITAL ASPECTS OF SATELLITE COMMUNICATIONS : Introduction to Satellite Communication: Brief history of satellite communications, satellite services, frequency allocations, basic communication satellite system – earth segment and satellite segment, advantages and applications of satellite communications, salient features of Indian communication satellites. Introduction to satellite orbits – LEO, MEO, HEO, Polar orbits, sun-synchronous orbits, geo-synchronous and geo-stationary orbits. **Orbital Mechanics:** Kepler's laws, describing the orbit of a satellite, locating the satellite in the orbit and with respect to earth, Keplerian elements.

UNIT – II

Look Angle Determination: sub-satellite point, elevation and azimuth angle calculations, visibility test.

Orbital Perturbations: Longitudinal changes and inclination changes

Orbital Effects on Communication System Performance

Launches and Launch Vehicles: Launch vehicles, placing satellites into geo-stationary orbit, salient features of Indian launch vehicles – PSLV and GSLV.

UNIT – III

SATELLITE SUB SYSTEMS: Introduction, attitude and orbit control system, Telemetry, tracking, command and monitoring, Power Systems, Communication Subsystems, Satellite antennas. **MULTIPLE ACCESS TECHNIQUES:** Introduction, FDMA Systems, TDMA Systems, Beam switching and satellite switched TDMA, Spread spectrum techniques (CDMA), Comparison of multiple access techniques.

UNIT - IV

SATELLITE LINK DESIGN: **Satellite Link Design:** Basic transmission theory, system noise temperature and G/T ratio – noise temperature, calculation of system noise temperature, noise figure and noise temperature, design of down link, uplink design, design for specified C/N – combining C/N and C/I values, overall $(C/N)_0$ with uplink and downlink attenuation, attenuation in rain, uplink attenuation and $(C/N)_{up}$, downlink attenuation and $(C/N)_{dl}$, satellite communication link design procedure.

UNIT - V

DBS TV: Introduction, power rating and number of transponders, frequencies and polarization, transponder capacity, home receiver outdoor unit and indoor unit.

VSAT: Overview, network architecture, modulation, coding and interference issues, brief introduction to VSAT antennas, indoor and outdoor units.

Text Books:

1. T Pratt and W Bostiain - Satellite Communications, 2nd Edition, John Wiley, 2003.
2. Dennis Roddy, Satellite communications, McGraw Hill, 4 th Edition, 2009.
3. DC Agarwal, Satellite Communications, Khanna Publishers, 2003 Robert M Gagliard, Satellite
4. Communications.

Suggested Reading:

1. M. Richharia, "Satellite Communication Systems: Design Principles", McGraw Hill, 2/e, 2003.
2. Gagliardi Robert M, "Satellite Communications", 2/e, Van Nostrand Reinhold, 1991.

20EC E22

EMBEDDED SYSTEMS

(Professional Elective - IV)

Instruction	3 L Hours per Week
Duration of SEE	3 Hours
SEE	60 Marks
CIE	40 Marks
Credits	3

Prerequisite: Computer Architecture, Microprocessors and Microcontrollers.

Course Objectives: This course aims to:

1. Learn about fundamentals of the embedded systems.
2. Understand the hardware and software details of the embedded systems.
3. Acquire knowledge on the serial, parallel and network communication protocols.

Course Outcomes: Upon completion of this course, students will be able to:

1. Understand the fundamentals of the embedded systems.
2. Analyze the hardware and software details of the embedded systems.
3. Design interfacing of the systems with other data handling / processing systems.
4. Evaluate the performance of an embedded system using various debugging tools.
5. Apply the embedded design approach for various applications.

Course Articulation Matrix

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PS01	PSO2	PSO3
CO1	-	-	-	1	-	-	2	-	-	-	-	1	-	-	-
CO2	-	2	1	1	3	3	2	-	-	-	-	2	-	2	1
CO3	2	2	-	3	3	3	3	-	-	-	-	2	2	2	-
CO4	2	3	2	1	3	3	-	-	-	-	-	3	2	3	2
CO5	3	3	2	1	3	3	3	-	-	-	-	3	3	3	2

UNIT-I

Introduction to Embedded Systems: Embedded systems versus General Computing Systems, History of embedded systems, classifications, applications areas, characteristics and quality attributes of embedded systems, Design metrics and challenges in embedded system design.

UNIT-II

Embedded Hardware and Software: Processor embedded into a system, Processor selection for embedded system, embedded hardware units and devices in a system, embedded software in a system and an overview of programming languages, challenges and issues related to embedded software development.

UNIT-III

Communication Protocols: I2C, CAN, Firewire-IEEE 1394 Bus standard, advanced serial high-speed buses. Parallel Bus device protocols: ISA, PCI, PCI-X, Internet Enabled Systems-Network protocols: Ethernet.

UNIT-IV

Embedded Software Development Process: Embedded System design and co-design issues in system development process, Design cycle in the development phase for an Embedded Systems. Embedded software development tools: Host and Target Machines, Linker/Locators for embedded software, Embedded Software into the Target system. Issues in hardware and software design and co-design.

UNIT-V

Testing, Debugging Techniques and Applications: Integration and testing of embedded hardware, testing methods, debugging techniques, Laboratory tools and target hardware debugging: Logic Analyzer, simulator, emulator and In-circuit emulator, IDE **Case Study**: Embedded Systems design for automatic vending machines and digital camera.

Text Books:

1. Raj Kamal, "Embedded Systems-Architecture, Programming and Design",3/e, McGraw Hill Education,2017.
2. J.W. Valvano, "Embedded Microcomputer System: Real Time Interfacing", Brooks/Cole, 2011.

Suggested Reading:

1. Shibu K V, "Introduction to Embedded systems", 1/e McGraw Hill Education,2009.
2. David Simon, "An Embedded software primer", Pearson Education,2002

20EC E25

CMOS Data Converters

(Professional Elective-V)

Instruction	3 L Hours per Week
Duration of SEE	3 Hours
SEE	60 Marks
CIE	40 Marks
Credits	3

Prerequisite: A prior knowledge of Analog IC Design

Course Objectives: This course aims to:

1. Familiarization of OP-AMP based circuits
2. To understand performance measures of Data converters.
3. To study different types of data converter circuits.

Course Outcomes: Upon completion of this course, students will be able to:

1. Understand Op-Amp based designs
2. Explain various performance measures of Data converters
3. Design and analyze mixed mode circuits such as Comparator, switched capacitor and sample & hold circuits
4. Design and analyze an A/D or D/A converter circuits.
5. Explain principles of oversampling

Course Articulation Matrix

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PS01	PSO2	PSO3
CO1	1	2	-	-	-	-	-	2	-	-	-	2	3	1	1
CO2	2	3	-	3	-	-	-	2	-	-	-	2	3	2	1
CO3	-	-	-	-	-	-	-	2	-	-	-	2	3	1	1
CO4	1	3	-	2	-	-	-	2	-	-	-	2	3	3	1
CO5	-	1	-	1	-	-	-	2	-	-	-	2	3	1	1

UNIT I

OP-Amp as comparator, Charge injection error, switched capacitor basic operation and analysis, first order filter, switched capacitor gain circuits, Sample and hold circuit-its performance

UNIT II

Introduction, Ideal data converter, Quantization, Static performance, Dynamic performance, frequency domain measures.

UNIT III

Nyquist rated DAC, Decoder based converter, binary scaled converter, thermometer coded converter, hybrid converter

UNIT IV

Successive approximation converter, algorithmic ADC, Flash converter, two-step ADC, Interpolation ADC, folding ADC, piplied ADC,Time interleaved adc

UNIT V

Oversampled converter -Oversampling with and without noise shaping, system architecture, digital decimation filter, high order modulation, band pass over sampling converter, multi bit oversampling converter, third order ADC

Text Books:

1. D.A John & Ken Martin, "Analog Integrated Circuit Design". John Wiley Publications, Reprint 2011.
2. BehzadRazavi, "Design of Analog CMOS Integrated Circuits", Tata-McGraw Hill Publications,2002.

Suggested Book:

1. Philip E. Allen & Douglas R. Holberg, "CMOS Analog Circuit Design", Oxford University Press, 2002

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20EC E26

5G COMMUNICATIONS

(Professional Elective-V)

Instruction	3 L Hours per Week
Duration of SEE	3 Hours
SEE	60 Marks
CIE	40 Marks
Credits	3

Prerequisite: The student must prior knowledge in Communication systems, Mobile Cellular Communications

Course Objectives: This course aims to:

1. Understand the requirements & concepts of 4G/5G.
2. Expose the architecture and radio access technologies of 5G.
3. Learn Massive MIMO concepts.

Course Outcomes: Upon completion of this course, students will be able to:

1. Recall the requirements and key functionalities of 4G LTEA/5G NR technology.
2. Compare various channel access technologies, modulation techniques used in 5G wireless systems.
3. Illustrate the architecture of 5G and its NextGen core network.
4. Apply the 5G concepts to D2D communications.
5. Demonstrate the concept of massive MIMO.

Course Articulation Matrix

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PS01	PSO2	PSO3
CO1	3	-	3	2	2	3	-	-	-	-	-	-	3	3	1
CO2	3	-	2	1	2	3	-	-	-	-	-	-	3	3	3
CO3	3	-	3	3	3	3	-	-	-	-	-	-	3	3	2
CO4	3	-	3	3	3	3	-	-	-	-	-	-	3	3	2
CO5	1	-	1		2	2	-	-	-	-	-	-	3	3	2

UNIT I

Overview of 4G/5G Wireless Communications: Evolution of mobile technologies (1G-5G), 3GPP Releases & its key aspects,4G overview, Overview of 5G, three high level 5G usage scenarios (eMBB, URLLC, mMTC), Key capabilities & requirements, performance & efficiency indicators, 5G vs. LTE-A Comparison, 5G frequency bands, 5G Use cases.

UNIT II

5G Channel Access Techniques: Basic requirements of transmission over 5G, Modulation Techniques- generalized frequency division multiplexing (GFDM), filter bank multi-carriers (FBMC) and universal filtered multi-carrier (UFMC), Multiple Accesses Techniques –non-orthogonal multiple accesses (NOMA), Sparse Code Multiple Access (SCMA) –Comparison of multiple access methods.

UNIT III

5G Architecture: Introduction: NGMN 5G Architecture framework, Layered functionality, 3GPP 5G architecture, Non-Roaming 5G system architecture, overall RAN architecture, Functional Split Between NG-RAN and 5G Core Network.

5G NextGen core network: Modern network requirements, SDN architecture, NFV benefits and requirements, – NFV Reference Architecture.

UNIT IV

Device-to-device (D2D) communications: use cases of D2D communication in Cellular networks, D2D in 5G: research challenges, Radio resource management for mobile broadband D2D.Multi-hop D2D communications for proximity and emergency services.

UNIT V

Massive Multiple-Input Multiple-Output (MIMO) Systems: Introduction to Multi-Antenna system, Theoretical background: MIMO requirement, MIMO vs. massive MIMO, Massive MIMO benefits, single user and multi-user MIMO, capacity of MIMO for unknown CSIT, massive MIMO capacity, Massive MIMO OFDM transmitter employing digital precoding, analog beamforming and hybrid of digital precoding and analog beamforming.

Text Books:

1. Saad Z. Asif, "5G Mobile Communications Concepts and Technologies" CRC Press, 2019. (Unit1, Unit2)
2. Suvra Sekhar Das and Ramjee Prasad, "Evolution of Air Interface Towards 5G: Radio Access Technology and Performance Analysis", Gistrup, Denmark: River Publishers series in Communication, 2018.(Unit 2)
3. Wei Xiang, Kan Zheng, Xuemin (Sherman) Shen, **"**5G Mobile Communications", Springer publications-2016.(Unit 1)
4. William Stallings "5G Wireless: A Comprehensive Introduction", Pearson Education, 2021.(Unit 3)
5. Afif Osseiran, Jose F. Monserrat, Patrick Marsch, "5G Mobile and Wireless Communications Technology" Cambridge University Press-2016.(Unit 4 & 5)

Suggested Reading:

1. R. S. Kshetrimayum, "Fundamentals of MIMO Wireless Communications", Cambridge University Press, UK, 2017.(Unit 5)
2. Jonathan Rodriguez, "Fundamentals of 5G Mobile Networks" first edition, John Wiley & Sons, 2015.

20EC E28

ADVANCED MICROPROCESSORS AND APPLICATIONS

(Professional Elective-V)

Instruction	3 L Hours per Week
Duration of SEE	3 Hours
SEE	60 Marks
CIE	40 Marks
Credits	3

Prerequisite: Computer Architecture and Microprocessors

Course Objectives: This course aims to:

1. Describe the hardware and software enhancements of the 80x86 microprocessors as compared to the 8086.
2. Contrast the changes in memory management unit and paging unit when compared to 80386 and 80486 microprocessors.
3. Detail the improvements in the Pentium Pro when compared to the Pentium.

Course Outcomes: Upon completion of this course, students will be able to:

1. Understand the historic evaluation of 80286,386,486
2. Explain the basic and advance Pentium features & architecture.
3. Analyze the Memory Management mechanisms employed in advanced Microprocessors.
4. Understand the concepts related to SoC Design
5. Demonstrate and design a microprocessor based applications.

Course Articulation Matrix

UNIT-I

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	2	3	2	-	-	-	-	-	-	-	-	2	2	-
CO2	2	1	3	1	-	-	-	-	-	-	-	2	2	2	-
CO3	2	1	2	1	-	-	-	-	-	-	-	-	2	2	-
CO4	2	2	2	2	2	-	-	-	-	-	-	1	2	2	-
CO5	3	1	2	2	2	-	-	-	-	-	-	1	2	2	2

The 80186 and 80286 Microprocessors:

80186 Architecture, Features, Pin-Out, Peripheral Control Block, Interrupt Controller, Timers, DMA Controller, Chip Selection Unit.

Introduction to 80286 Microprocessor, Hardware Features, Additional Instructions, The Virtual Memory Machine - Real and Protected Virtual Address Modes.

UNIT-II

The 80386 and 80486 Microprocessors:

Introduction to 80386 Microprocessor, Special registers, Memory Management – Descriptors and Selectors, Descriptor tables, Protected and Virtual 8086 modes, The Memory Paging Mechanism.

Introduction to 80486 Microprocessor – Basic Architecture, Memory System.

UNIT-III

The PENTIUM Microprocessors:

Introduction to the Pentium Microprocessor, Branch Prediction Logic, Cache structure, Superscalar Architecture, Special Pentium registers, Pentium Memory Management- Paging Unit, memory Management mode, New Pentium Instructions.

Introduction to the Pentium Pro Microprocessor – Internal structure, Pin connections, The Memory System, Input/Output system, Special features.

Introduction to the Pentium II, Pentium III, Pentium 4 and Core2.

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UNIT-IV

System on Chip: System-on-Chip Concept, SoC Architecture, SoC Design Flow, IP based SoC Designs, Basic Concepts of Bus-Based Communication: Bus based approach and NoC based approach, Processor selection for SoC, Embedded Processors, ASIP, Product economics and implications of SoC.

UNIT-V

Applications of Microprocessors:

Microprocessor based Aluminium Smelter Control – General Process Description of an Aluminium Smelter, Sailent Issues in Design, Smelter Controller Hardware, and Control Algorithm.

Design of Microprocessor based Pattern Scanner System – Organization of the Scanner system, Description of Scanning system, Programmed mode of operation, Memory read/write system and Start-Up Procedures.

Text Books:

1. Barry B. Brey, "The Intel Microprocessors 8086/8088, 80186/80188, 80386, 80486, Pentium, Pentium Pro, Pentium II, Pentium III, Pentium 4, and Core2 with 64 – bit extensions Architecture, Programming, and Interfacing", 8/e Pearson Education, 2009.
2. K M Bhurchandi and A K Ray, "Advanced Microprocessor and peripherals", 3/e McGraw Hill, 2013.
3. Michael J Flinn, Wayne Luk, "Computer System Design: System-on-Chip", Wiley, 2012.

Suggested Reading:

1. Douglas V Hall, SSSP Rao, "Microprocessors and Interfacing", 3/e McGraw Hill, 2012.
2. James L Antonakos, "The Intel ® Microprocessor Family: Harware and Software Principles and Applications", First edition, CENGAGE Delmar Cengage Learning, 2006.
3. Gilmore, "Microprocessors Principles and Applications", 2/e TATA McGraw Hill, 1995.
4. Shuying Ma, Jianwei Chang et.al " Progress and Applications of Embedded System in Chip Technology" IEEE 70th Electronic Components and Technology Conference (ECTC) 03-30 June 2020, Orlando, Florida, USA DOI: 10.1109/ECTC32862.2020.00262

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20EC E29

PRINCIPLES OF GNSS

(Professional Elective-V)

Instruction	3 L Hours per Week
Duration of SEE	3 Hours
SEE	60 Marks
CIE	40 Marks
Credits	3

Prerequisite: Fundamental concepts of communication are required.

Course Objectives: This course aims to:

1. Explain the basic principle of operation of GPS, GPS ephemerides and signal structure.
2. Make the students to understand various coordinate systems and highlight the effect of various errors affecting GPS signals.
3. Make the students to appreciate the significance of other GNSS systems, principle of DGPS and augmentation systems.

Course Outcomes: Upon completion of this course, students will be able to:

1. Demonstrate the fundamental concepts of communications in understanding of GPS architecture, operation and signal structure.
2. Apply the principles of orbital mechanics, time references, coordinate systems and range measurements in estimating user position.
3. Examine the effect of various error sources and satellite geometry on position estimates and analyze the suitability of a given data format.
4. Compare the architecture and working of other GNSS systems and make use of GNSS systems in a variety of civilian and defense applications.
5. Relate the knowledge of DGPS techniques in understanding augmentation systems.

Course Articulation Matrix

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	1	1	2	1	1	1	2	-	1	-	2	3	1	1
CO2	3	3	2	2	1	1	1	2	-	1	-	2	3	1	-
CO3	3	3	3	3	1	1	1	2	-	1	-	2	3	1	-
CO4	2	2	2	1	-	1	1	2	-	1	-	2	3	-	-
CO5	3	2	2	1	1	1	1	2	-	1	-	2	3	1	-

UNIT-I

GPS Fundamentals: Introduction to Radio Navigation system: VOR, ILS. GPS System Segments: space, control and user segments, Principle of operation, Current status of GPS satellite constellation. Orbital Mechanics: GPS ephemeris data, algorithm for computation of satellite's position from ephemeris data. Time References: solar and sidereal days, UTC time, GPS time.

UNIT-II

GPS Signals: Legacy GPS signals: Signal structure, Operating frequencies, C/A and P-Code, Navigation message, Modernized GPS signals: list of signals and their significance. Range measurements: code and carrier measurements, User position estimation with PRN codes.

Coordinate Systems: Earth Centered Earth Fixed (ECEF) coordinate system, Earth Centered Inertial (ECI) coordinate system, Geodetic coordinate system, Ellipsoid and Geoid, Regional and Global Datum, World Geodetic System (WGS-84).

UNIT-III

GPS Error Sources: Satellite clock error, ephemeris error, Receiver clock errors, satellite and receiver instrumental bias, Multipath error, receiver measurement noise, ionospheric error and tropospheric error, Klobuchar model, ionospheric delay estimation using dual frequency measurements and UERE. Dilution of precision: HDOP, VDOP, TDOP, PDOP & GDOP.

UNIT-IV

Data Formats: RINEX Observation and Navigation Data formats, NMEA format.
GNSS: Architecture, operation and signals of other navigational satellite systems Galileo, Beidou and GLONASS, QZSS.
IRNSS: Architecture and signals.

UNIT-V

Differential GPS (DGPS): Principle of DGPS, Types of DGPS: Local Area DGPS (LADPS), Wide Area DGPS (WADGPS).
GPS Augmentation Systems: Principle of operation of Satellite Based Augmentation system (SBAS) and Ground Based Augmentation System (GBAS).
GNSS Applications: Surveying, Mapping, Marine, air and land Navigation, Military and Space Application.

Text Books:

1. Elliot D Kaplan and Christopher J Hegarty, "Understanding GPS principles and applications", Artech House Publishers, 2/e Boston & London 2005.
2. Pratap Misra and Per Enge, "Global Positioning System Signals, Measurement, and Performance", Ganga- Jamuna Press, 2/e, Massachusetts, 2010.

Suggested Reading:

1. B. Hofmann-Wellenhof, H. Lichtenegger, and J. Collins, "GPS Theory and Practice", Springer Verlog, 5/e, 2008.
2. Ahmed El-Rabbany, "Introduction to GPS", Artech House Publishers, 2/e, Boston 2006.
3. Bradford W. Parkinson and James J. Spilker, "Global Positioning system: Theory and Application", Vol.II, American Institution of Aeronautices and Astronautics Inc., Washington, 1996.

20EC E30

PATTERN RECOGNITION USING MACHINE LEARNING

(Professional Elective-V)

Instruction	3 L Hours per Week
Duration of SEE	3 Hours
SEE	60 Marks
CIE	40 Marks
Credits	3

Prerequisite: The student should have knowledge of probability and random variables.

Course Objectives: This course aims to:

1. Model of pattern recognition using decision theory.
2. Develop of linear models for classification problems.
3. Analyze the unsupervised learning models and also clustering.

Course Outcomes: Upon completion of this course, students will be able to:

1. Understand the concepts of pattern recognition.
2. Apply the parametric and linear models for classification.
3. Design algorithms using neural networks for machine learning problems.
4. Implementation of Support Vector Machines (SVM) algorithm for real time applications.
5. Evaluate various unsupervised clustering techniques.

Course Articulation Matrix

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	1	1	1	-	-	-	-	-	-	-	2	-	-
CO2	3	2	1	2	2	-	-	-	-	-	-	1	3	2	1
CO3	3	2	3	2	3	-	-	-	-	-	1	2	3	2	2
CO4	3	2	3	2	3	-	-	-	-	-	1	1	3	2	2
CO5	3	2	3	2	2	-	-	-	-	-	2	2	3	3	2

UNIT-I

Introduction to Pattern Recognition: Pattern Recognition Systems, applications, design cycle, learning and adaptation, examples, Probability Distributions, Bayesian Decision Theory, continuous Features, Minimum Error rate classification, Classifiers, Discriminant Functions and Decision surfaces, Bayesian Decision Theory- Discrete Features. Maximum-Likelihood and Bayesian parameter estimation: Maximum Likelihood estimation, Bayesian estimation.

UNIT-II

Linear Models: Linear Models for Regression: Linear Basis Function Models, The Bias -Variance Decomposition, Bayesian Linear Regression, Linear Models for Classification: Discriminant Functions, Probabilistic Generative Models, Probabilistic Discriminative Models, Bayesian Logistic Regression.

UNIT-III

Neural Network: Feed forward operation and classification: Multilayer Networks, back propagation algorithm: Network learning, Training protocols, Learning Curves, error surfaces, practical techniques for improving back propagation, additional networks and training methods, Adaboost, Deep Learning.

UNIT-IV

Linear Discriminant Functions: Decision surfaces: Two category case and multi category case, two-category Linearly separable case, Minimum- squared error procedures, the Ho-Kashyap procedures, linear programming algorithms, Support vector machines.

UNIT-V

Algorithm Independent Machine Learning: lack of inherent superiority of any classifier, bias and variance, re-sampling for classifier design, combining classifiers.

Unsupervised Learning and Clustering: k-means clustering, fuzzy k-means clustering, Hierarchical clustering.

Text Books:

1. C. Bishop, "Pattern Recognition and Machine Learning", Springer, 2006.
2. Richard O. Duda, Peter E. Hart and David G. Stork, "Pattern Classification", 2nd Edition John Wiley & Sons, 2001.

Suggested Reading:

1. B. Yagnanarayana, Artificial Neural Networks, Prentice Hall, New Delhi, 2007.

20IT O01

OBJECT ORIENTED ROGRAMMING USING JAVA

(Open Elective-I)

Instruction	3 L Hours per week
Duration of SEE	3 Hours
SEE	60 Marks
CIE	40 Marks
Credits	3

Prerequisites: Programming for problem solving.

Course Objectives: This course aims to:

1. To familiarize with fundamentals of object-oriented programming paradigm.
2. To impart the knowledge of string handling, interfaces, packages and inner classes.
3. To acquaint with Exception handling mechanisms and Multithreading.
4. To gain knowledge on collection framework, stream classes.
5. To familiarize web application environment using Servlets and JSP

Course Outcomes: Upon completion of this course, students will be able to:

1. To understand fundamentals of object-oriented programming paradigm.
2. To apply knowledge of string handling, interfaces, packages and inner classes.
3. To implement Exception handling mechanisms and Multithreading.
4. To demonstrate knowledge on collection framework, stream classes.
5. To develop web applications using Servlets and JSP.

Course Articulation Matrix

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	1	2	1	-	-	-	-	-	-	1	-	-	-	1	-
CO2	-	2	1	1	-	-	-	-	-	-	-	-	-	1	-
CO3	-	1	1	1	-	-	-	-	-	-	3	-	-	1	-
CO4	1	2	1	1	-	-	-	-	-	-	3	1	-	-	-
CO5	1	2	1	2	3	-	-	1	3	-	3	1	-	1	-

UNIT-I

OOP concepts: Data abstraction, encapsulation, inheritance, benefits of inheritance, polymorphism, classes and objects, Procedural and object oriented programming paradigms.

Introduction to Java: Java's Magic: The Byte code, The Java Buzzwords, Simple Java Programs, Java Primitive Types, Arrays: How to create and define arrays, Basic Operators, Control statements.

Introducing Classes: Declaring objects, methods, Constructors, this keyword, Method Overloading and Constructor Overloading, Objects as parameters, Returning objects, Use of static and final keywords.

UNIT-II

Inheritance: super and subclasses, Member access rules ,super keyword**,** Method overriding, Dynamic method dispatch , Abstract classes, using final with inheritance , Introduction to Object class.

Packages: Defining, Creating and Accessing a Package, Understanding CLASSPATH, importing packages.

Interfaces: Defining and implementing interfaces, Nested Interfaces. **Strings Handling:** String & StringBuffer classes, String Tokenizer class and Wrapper classes and conversion between Objects and primitives.

Inner classes in Java: Types of inner classes, Creating static / non-static inner classes, Local and anonymous inner classes.

UNIT-III

Exception Handling in Java: what are Exceptions? Exception types**,** Usage of try, catch, throw, throws and finally clauses,

writing your own exception classes. **Multi-threading in Java:** The java Thread Model, how to create threads, Thread class in java, Thread priorities, Thread synchronization.
Generics: What are Generics? Generic classes, bounded types, Generic methods and interfaces.

UNIT-IV
Collections Framework: Overview of Collection Framework, Commonly used Collection classes – Array List, Linked List, Hash Set, Linked Hash Set, Tree Set, Collection Interfaces –Collection, List, Set, Sorted Set, Accessing a collection via an Iteration, Storing user-defined classes in collections, Map Interfaces and
Classes, Using a comparator. Legacy classes – Vector, Hash table, The Enumeration interface.
Input/Output : How to read user input (from keyboard) using scanner class, Stream classes, Input Stream, Output Stream, File Input Stream, File Output Stream, Reader and Writer, File Reader, File Writer classes. File class.

UNIT-V
Java Servlets: Overview of Java Servlet API, Servlet Implementation, Servlet Configuration, Servlet Exceptions, Servlet Life cycle, Request and Response methods, Approaches to Session tracking, Servlet Context, Servlet Collaboration.
JSP Basics: Introduction to JSP, Directives, Scripting Elements, Standard Actions.
Databases: Connect servlet to MySQL, Connect JSP to MySQL.

Text Books:

1. Herbert Schildt, "Java: The Complete Reference", 8th Edition, Tata McGraw Hill Publications, 2011.
2. Kathy Sierra, Bryan Basham, Bert Bates, ―Head First Servlets and JSP‖, 2nd Edition, O'Reilly Media, Inc, 2008.

Suggested Reading:

1. E Balagurusamy "Programming with JAVA", 6th Edition , Tata McGraw-Hill Publishing company Ltd,2019.
2. Sachin Malhotra & Saurabh Choudhary, "Programming in Java", 2nd Edition, Oxford University Press, 2014.
3. C. Thomas Wu, "An introduction to Object-oriented programming with Java", 4th Edition, Tata McGraw-Hill Publishing company Ltd.,2010. 4. Kathy Sierra, Bert Bates, "Head First Java: A Brain-Friendly Guide"2nd Edition, O'Reilly,2005

Web Resources:
1. https://www.cse.iitb.ac.in/~nlp-ai/javalect_august2004.html.
2. http://nptel.ac.in/courses/106106147/
3. https://ocw.mit.edu/courses/electrical-engineering-and-computerscience/6-092- introduction-to-programming-in-java-january-iap-2010/lecture-notes/

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20CS O09

FUNDAMENTALS OF DBMS

(Open Elective-I)

Instruction	3 L Hours per week
Duration of SEE	3 Hours
SEE	60 Marks
CIE	40 Marks
Credits	3

Course Objectives: This course aims to:

1. To learn data models, conceptualize and depict a database system using E-R diagrams.
2. To understand the internal storage structures in a physical DB design.
3. To learn the fundamental concepts of transaction processing techniques.

Course Outcomes: Upon completion of this course, students will be able to:

1. Classify the difference between FMS and DBMS; describe the roles of different users and the structure of the DBMS. Design the database logically using ER modeling
2. Outline the schema of the relational database and key constraints. Develop queries using DDL, DML and DCL of SQL.
3. Identify the inference rules for functional dependencies and apply the principles of normal forms to decompose the relations in a database.
4. Summarize the concepts of dense, sparse, ISAM and B+ tree indexing and get familiar with states and properties of transactions.
5. Interpret the locking, time stamp, graph and validation-based protocols for concurrency control.
6. Summarize log-based recovery techniques to increase the robustness of the database, identify to resolve the deadlocks in the transactions.

Course Articulation Matrix

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	2	2	-	-	-	-	-	-	-	-	-	1	2	1
CO2	3	3	3	1	-	-	-		-	-	-	-	2	1	-
CO3	2	2	3	-	-	-	-	-	-	-	-	-	2	1	1
CO4	1	2	2	2	-	-	-	-	-	-	-	-	1	1	2
CO5	3	3	2	1	-	-	-	-	-	-	-	-	2	2	2

UNIT - I

Introduction: Database System Applications, Purpose of Database Systems, View of Data, Database Languages, Database Users and Administrators Database System Architecture, Application Architectures.

Database Design and E-R Model: Basic concepts, Constraints, E-R Diagrams, E-R Design Issues, Extended E-R Features, Specialization and Generalization.

UNIT - II

Relational Model: Structure of Relational Databases, Database Schema, Keys.

Structured Query Language: Overviews, SQL Data Types, SQL Queries, Data Manipulation Language Set Operations, Aggregate Functions, Data Definition Language, Integrity Constraints, Null Values, Views, Join Expression. Index Definition in SQL.

UNIT - III

Relational Database Design: Undesirable Properties in Relational Database Design, Functional Dependencies, Trivial and Nontrivial Dependencies, Closure of Set of Functional Dependencies, Closure of Set of Attributes, Irreducible Set of Functional Dependencies, Normalization – 1NF, 2NF, and 3NF, Dependency Preservation, BCNF, Comparison of BCNF and 3NF.

UNIT - IV

Indexing: Basic concepts, Dense and Sparse Indices, Secondary Indices, Tree-Structured Indexing, Indexed Sequential Access Method (ISAM), B+ Tree Index Files.

Transaction Management: Transaction Concept – ACID Properties, States of Transaction, Implementation of Atomicity and Durability, Serializability, Recoverability.

UNIT - V

Concurrency Control: Lock-Based Protocols, Timestamp-Based Protocols, Validation-Based Protocols.

Deadlocks Handling: Deadlock Prevention, Deadlock Detection and Recovery.

Recovery System: Failure Classification, Storage Structure, Recovery and Atomicity, Log-Based Recovery.

Text Books:

1. Abraham Silberschatz, Henry F Korth, S Sudarshan, "Database System Concepts", Sixth Edition, McGraw-Hill International Edition, 2011.
2. Date CJ, Kannan A, Swamynathan S, "An Introduction to Database Systems", Eight Edition, Pearson Education, 2006.

Suggested Reading:

1. Raghu Ramakrishnan, JohnnesGehrke, "Database Management Systems", Third Edition, McGraw Hill, 2003.
2. Ramez Elmasri, Durvasul VLN Somayazulu, Shamkant B Navathe, Shyam K Gupta, "Fundamentals of Database Systems", Fourth Edition, Pearson Education, 2006.

20ECC24

ELECTRONIC DESIGN AND AUTOMATION LAB

Instruction	2 P Hours per Week
Duration of SEE	3 Hours
SEE	50 Marks
CIE	50 Marks
Credits	1

Prerequisite: Digital design fundamentals and synthesis & simulation concepts

Course Objectives: This course aims to:

1. Simulate and synthesize combinational and sequential logic circuits
2. Simulate switch level modules
3. Learn implementation procedure for any design on FPGA and to study the speed, power and area constraints of FPGA/CPLD

Course Outcomes: Upon completion of this course, students will be able to:

1. Demonstrate the process steps required for simulation /synthesis
2. Develop HDL codes/scripts with appropriate syntax
3. Apply an appropriate modelling style to describe various combinational and sequential circuits in Verilog HDL
4. Examine the successful execution of the codes/ schematic using various Simulation Tools
5. Build various digital circuits on hardware boards like FPGA.

Course Articulation Matrix

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	-	-	-	1	1	-	-	2	2	-	-	2	1	3	1
CO2	-	-	-	1	2	-	-	2	2	-	-	2	1	3	1
CO3	1	1	1	1	2	-	-	2	2	-	-	2	1	3	1
CO4	-	-	-	1	3	-	-	2	2	-	-	2	1	3	1
CO5	-	-	-	1	1	-	-	2	2	-	-	2	1	3	1

List of Experiments

Part A

Write VERILOG Code, Simulate and Implement the following on FPGA:

1. Code Converters.
2. Encoders, Decoders, Priority Encoder and Comparator.
3. Registers/Counters.
4. Sequence Detector using Mealy and Moore type state machines.
5. Any application of UDP.
6. Tasks and Functions.

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Note:

1. All the codes should be implemented appropriately using Gate level, Dataflow and Behavioural Modelling.
2. All the programs should be simulated using test benches.

Part B

Switch Level Modelling of CMOS circuits: Basic Logic Gates: Inverter, NAND and NOR.

1. Half Adder and Half Subtractor.
2. 4x1 Multiplexer.
3. 2x4 Decoder.
4. Design of NAND Gate using Simulation tool.
5. Design of NOR Gate using Simulation tool.
6. Design and layout of Inverter using Simulation tool.

Structured Enquiry Program:

1. Design and simulate a high-speed adder using Verilog HDL

Open- ended Enquiry:

1. Simulate a design using System Vivado and implement the same on Zynq Evaluation Development Board.

Suggested Reading:

1. Michal D. Ciletti, "Advanced digital design with Verilog HDL", Pearson Edition, 2011.
2. Samir Palnitkar, "Verilog HDL-A Guide to Digital Design and Synthesis", Pearson 2nd edition, 2003.
3. Cadence Design Systems (Ireland) Ltd., "Cadence manual", 2013.

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20ECC25

MICROCONTROLLERS LAB

Instruction	2 P Hours per Week
Duration of SEE	3 Hours
SEE	50 Marks
CIE	50 Marks
Credits	1

Prerequisite: Basic knowledge of programming in C language.

Course Objectives: This course aims to:

1. Develop and understand the 8051 and ARM7 C programming
2. Understand the usage of Integrated Development Environment (Keil)
3. Control the operation of various peripherals using 8051 and ARM7 microcontroller

Course Outcomes: Upon completion of this course, students will be able to:

1. Develop the programs of 8051 and ARM using their respective instruction set.
2. Understand the usage of various debugging tools available to program different microcontrollers
3. Build code for 8051 and ARM7 to interface various input/output modules
4. Analyze the hardware and software interaction and integration.
5. Design and develop the 8051 and ARM 7 based embedded systems for various applications

Course Articulation Matrix

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PS01	PSO2	PSO3
CO1	2	2	2	3	-	-	-	-	-	-	-	-	2	2	-
CO2	3	2	3	3	3	-	-	-	-	-	-	-	3	2	2
CO3	2	3	2	3	3	-	-	-	-	-	-	2	3	3	2
CO4	3	2	3	3	3	-	-	-	-	-	-	2	2	2	3
CO5	3	2	3	3	3	2	1	-	2	-	1	2	3	2	3

List of Experiments

II. 8051 Programming

1. Familiarity and use of 8051 microcontroller trainer kit, Keil IDE and simple programs under different addressing modes.
2. Assembly programming using instruction set
3. Timer and counter operations and programming using 8051.
4. Interfacing applications using LED, switch, relay and buzzer.
5. Generation of waveforms using DAC by interfacing it with 8051.
6. Stepper motor interfacing.
7. LCD interfacing.
8. Development of Embedded 'C' Code based on the module specifications. (under Structured enquiry)

III. ARM7 Programming

1. Study and use of LPC214x Microcontroller trainer kit and simple programs using its instruction set
2. Interfacing applications using LED, switch, relay and buzzer.

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3. DC Motor interfacing.
4. Programming on-chip ADC.
5. Waveform generation using internal DAC.
6. Development of Embedded 'C' Code based on the module specifications. (under Structured enquiry)

IV. Design an experiment related to the Embedded Application of your choice using 8051/ARM based architectures. (under Open ended enquiry)

Suggested Reading:

1. Mazidi M.A, Mazidi JG & Rolin D. Mckinlay, "The 8051 Microcontroller & Embedded Systems using Assembly and C", 2/e, Pearson Education, 2007.
2. Philips semiconductors, "ARM 7 (LPC 214x) user manual", 2005.

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20ECC26

MINI PROJECT

Instruction	2P Hours per Week
Duration of SEE	--
SEE	--
CIE	50 Marks
Credits	1

Prerequisite: Knowledge of Electronic circuits and Communication systems

Course Objectives: This course aims to:

1. To enable students learning by practical realization.
2. To develop capability to analyse and solve real world problems.
3. To develop technical writing and presentation skills.

Course Outcomes: Upon completion of this course, students will be able to:

1. Formulate mini project proposal through literature survey.
2. Plan, design and analyze the proposed mini project.
3. To simulate and execute the mini project for validation.
4. Enhance oral presentation skills.
5. Prepare and submit the mini project report.

Course Articulation Matrix

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PS01	PSO2	PSO3
CO1	2	3	2	2	-	2	1	1	3	-	2	3	2	3	2
CO2	1	3	2	2	-	-	-	-	3	-	1	2	1	3	2
CO3	-	2	1	2	2	-	-	-	3	-	-	-	-	2	1
CO4	-	-	-	-	-	-	-	-	3	3	1	-	-	-	-
CO5	-	-	-	1	-	-	-	-	3	3	1	-	-	-	-

The students are required to choose emergent technology topic for mini project related to domain. The students have to design and simulate/ implement as per the given schedule. Students have to give oral presentation in presence of department review committee, finally report of the mini project work has to be submitted for evaluation.

Schedule

S. no	Description	Duration
1	Problem identification/selection	**2 weeks**
2	Preparation of abstract	**1 Week**
3	Design, implementation and testing of the project	**7 Weeks**
4	Documentation and mini project presentation	**4 Weeks**

Guidelines for the Evaluation

S. no	Description	Maximum Marks
1	Weekly Assessment	**20**
2	PPT preparation	**5**

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3	Presentation	**10**
4	Queries and Answers	**5**
5	Documentation of mini project	**10**
	Total	**50**

Guidelines:

1. Each student will be allotted to a faculty supervisor for mentoring.
2. Mini projects maybe targeted to achieve practical competences.
3. Mini projects shall have inter-disciplinary/ industry relevance.
4. All the results obtained are to be clearly presented and documented with the reasons/explanations.

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20EG C03

EMPLOYABILITY SKILLS

(BE/BTech V & VI semester - Common to all Branches)

Instruction	2 P Hours per Week
Duration of SEE	3 Hours
SEE	50 Marks
CIE	50 Marks
Credits	1

Prerequisite: No specific prerequisite is required

Course Objectives: This course aims to:

1. Learn the art of communication, participate in group discussions and case studies with confidence and to make effective presentations.
2. With- resume packaging, preparing them to face interviews.
3. Build an impressive personality through effective time management, leadership qualities, self-confidence and assertiveness.
4. Understand professional etiquette and to make them learn academic ethics and value system.
5. To be competent in verbal aptitude.

Course Outcomes: Upon completion of this course, students will be able to:

1. Become effective communicators, participate in group discussions with confidence and be able to make presentations in a professional context.
2. Write resumes, prepare and face interviews confidently.
3. Be assertive and set short term and long term goals, learn to mange time effectively and deal with stress.
4. Mak**e** the transition smoothly from campus to work, use media with etiquette and understand the academic ethics.
5. Enrich their vocabulary, frame accurate sentences and comprehend passages confidently.

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	-	-	-	-	-	-	-	-	2	2	2	-	-	-	1
CO2	-	-	-	-	-	-	-	-	-	2	-	-	-	-	-
CO3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1
CO4	-	2	-	-	-	-	-	2	-	-	2	-	-	-	1
CO5	-	-	-	-	-	2	-	-	-	-	-	-	-	-	1

UNIT I

Verbal Aptitude: Error Detection, Articles, Prepositions, Tenses, Concord and Transformation of Sentences-Jumbled Words/Sentences- Vocabulary, Synonyms, Antonyms, One Word Substitutes, Idioms and Phrases, Word/Sentence/Text Completion- Reading Comprehension.

UNIT II

Group Discussion & Presentation Skills: Dynamics of Group Discussion-Case Studies- Intervention, Summarizing, Modulation of Voice, Body Language, Relevance, Fluency and Accuracy, Coherence. Elements of Effective Presentation – Structure of a Presentation – Presentation tools – Body language - Preparing an Effective PPT

UNIT III

Behavioural Skills: Personal strength analysis-Effective Time Management- Goal Setting- Stress management- **Corporate Culture** – Grooming and etiquette-Statement of Purpose (SOP).

UNIT IV

Mini Project: Research-Hypothesis-Developing a Questionnaire-Data Collection-Analysis-General and Technical Report - Writing an Abstract –Technical Report Writing-Plagiarism-Project Seminar.

UNIT V

Interview Skills: Cover Letter and Résumé writing – Structure and Presentation, Planning, Defining the Career Objective, Projecting ones Strengths and Skill-sets – Interviews: Concept and Process, Pre-Interview Planning, Opening Strategies, Answering Strategies, Mock Interviews.

Text Books:

1. Leena Sen, "Communication Skills", Prentice-Hall of India, 2005
2. Dr. Shalini Verma, "Body Language - Your Success Mantra", S Chand, 2006
3. Edgar Thorpe and Showick Thorpe , "Objective English", 2nd edition, Pearson Education, 2007
4. Ramesh, Gopalswamy, and Mahadevan Ramesh, "The ACE of Soft Skills", New Delhi: Pearson, 2010

Suggested Reading:

1. Gulati and Sarvesh, " Corporate Soft Skills", New Delhi: Rupa and Co. , 2006
2. Van Emden, Joan, and Lucinda Becker, "Presentation Skills for Students", New York: Palgrave Macmillan, 2004
3. A Modern Approach to Verbal & Non-Verbal Reasoning by R S Aggarwal, 2018
4. Covey and Stephen R, "The Habits of Highly Effective People", New York: Free Press, 1989

18EC C26

COMPUTER NETWORKS

Instruction	3 L Hours per Week
Duration of SEE	3 Hours
SEE	70 Marks
CIE	30 Marks
Credits	3

Prerequisite: A course on digital communications is required.

Course Objectives:
This course aims to:

1. Understand the division of network functionalities into layers and familiar with the components required to build different types of networks
2. Study the required functionality at each layer
3. Learn the Routing, congestion control algorithms and application layer protocols.

Course Outcomes:
Upon completion of this course, students will be able to:

1. Relate the communication tasks with basic concept of networking, protocols and Service models at different layers.
2. Interpret the principle and function of each layer using protocols and services.
3. Model a network for random accessing to route the packets.
4. Examine the performance of network with routing algorithms and the congestion control approaches.
5. Explain the importance of protocols in each layer and layering concepts.

UNIT-I
Computer Networks and the Internet: Internet, Network Edge: Access Networksand Physical Media, The Network Core: Circuit Switching and Packet Switching, Protocol Layers and Their Service Models.

UNIT-II
Link Layer and Local Area Networks: The Data Link Layer: Introduction,Services. ALOHA, Multiple Access Protocols: Channel portioning protocols, Random access protocols. IEEE 802 standards, Local Area Networks, addressing, Ethernet, Hubs, Switches.

UNIT-III
Network Layer and Routing: Introduction, Virtual circuit and Datagram networks,Router, Internet Protocol, Routing algorithms, Broadcast and Multicast routing.

UNIT-IV
Transport Layer: Introduction and Transport layer services. Connectionlesstransport - User Datagram Protocol, Connection-oriented transport – Transmission Control Protocol.
Principles of Congestion Control: The causes and cost of congestion Control, Approaches to congestion Control.

UNIT-V
Application Layer: Principles of network applications, The Web and Hyper TextTransfer Protocol, File transfer, Electronic mail, Domain name system, Peer-to-Peer file sharing, Socket programming, Layering concepts.

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Text Books:

1. J.F. Kurose and K. W. Ross, "Computer Networking – A top down approach featuring the Internet", Pearson Education, 3rd Edition, 2005.
2. Andrew Tanenbaum and D. Wetherall, "Computer networks", 5thEdition, Prentice-Hall, 2011
3. William Stallings, "Data and computer communications", Prentice Hall, 8th Edition,2007.

Suggested Reading:

1. B. A. Forouzan, "Data Communications and Networking", Tata McGraw Hill, 4th Edition,2007.
2. S. Keshav, "An Engineering Approach to Computer Networking", Pearson Education, Second Edition, 2001.
3. L. Peterson and B. Davie, "Computer Networks – A Systems Approach", Elsevier Morgan Kaufmann Publisher, 5th Edition, 2011.

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18EC C27

VLSI DESIGN

Instruction	3 L Hours per Week
Duration of SEE	3 Hours
SEE	70 Marks
CIE	30 Marks
Credits	3

Prerequisite: A prior knowledge of Verilog HDL and MOS Transistor Theory.

Course Objectives:
This course aims to:
1. Study the concepts of Verilog HDL, simulation and synthesis process/concepts.
2. Learn the various characteristics of MOS transistor, process steps in IC fabrication.
3. Learn the various concepts required to obtain the digital logic layout diagrams. To know various subsystem design concepts.

Course Outcomes:
Upon completion of this course, students will be able to:
1. Model a digital design using Advanced Verilog HDL constructs.
2. Analyse the characteristic behaviour of MOSFET and discuss CMOS circuit Design Process
3. Explain various process steps involved in IC fabrication.
4. Design various NMOS and CMOS based logic circuits.
5. Discuss the concepts of subsystem designs and Testing.

UNIT-I
Advanced Verilog HDL: Review of behavioural modelling**.** Functions and tasks Switch level Modelling, UDP, Design of Mealy and Moore state models using Verilog, Logic Synthesis, Synthesis Design flow, Gate level Netlist.

UNIT–II
Introduction to MOS Technology, Basic MOS Transistor action: Enhancement and Depletion Modes. Basic electrical properties of MOS, Threshold voltage and Body Effect.
MOS and CMOS circuit Design Process: MOS Layers, Stick diagrams, Lambda based Design rules and Layout diagrams.

UNIT–III
Process steps in IC fabrication Crystal growth and wafer preparation- Czochralski process- apparatus- silicon shaping, slicing and polishing- Diffusion, Ion implantation- Annealing process- Oxidation process- Lithography- Photolithography, electron beam and x-ray lithography- Chemical vapour deposition (CVD)- epitaxial growth- reactors- metallisation and packaging.

UNIT–IV
Design of MOS inverters with different loads. Basic Logic Gates with CMOS: INVERTER, NAND, NOR, AOI and OAI gates. Transmission gate logic circuits, BiCMOS inverter, D flip flop using Transmission gates.

UNIT–V
Subsystem Design: Multiplexor, Comparator, Shifters, Programmable Logic Arrays. Memories: 1T, 3T Dynamic RAM Cell, 6T Static RAM Cell. NOR and NAND based ROM Memory Design.
Testing: Introduction to Testing, Fault models, Controllability, Observability.

Text Books:
1. Samir Palnitkar, "Verilog HDL: A guide to Digital design and synthesis", 2/e, Pearson Education, 2008.
2. Kamran Eshraghian, Douglas A. Pucknell, SholehEshraghian, "Essentials of VLSI circuits and systems", PHI, 2011.
3. Neil H E Weste, David Harris, Ayan Banerjee "CMOS VLSI Design –A circuit and System Perspective", 3/e, Pearson Education, 2006.
4. S. M. Sze, VLSI Technology, McGraw-Hill, 2nd Edition, 1988.

Suggested Reading:
1. Michael D. Ciletti, "Advanced Digital Design with Verilog HDL", PHI, 2005.
2. John P. Uyemura, "Introduction to VLSI Circuits and systems", John Wiley & Sons, 2011.
3. Sung-Mo Kang & Yusuf Leblebici, CMOS Digital Integrated Circuits Analysis and Design, McGraw-Hill, 1998.

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18EC E15

CRYPTOGRAPHY AND BLOCKCHAIN TECHNOLOGY

(Program Elective-IV)

Instruction	3 L Hours per Week
Duration of SEE	3 Hours
SEE	70 Marks
CIE	30 Marks
Credits	3

Prerequisite: Data Structures and Algorithms, Introduction to Programming.

Course Objectives:
This course aims to:

1. Provide conceptual understanding of basic concepts of cryptography.
2. Describes the Blockchain technology and its applications.
3. Introduce cryptocurrency transactions using Blockchain technology.

Course Outcomes:
Upon completion of this course, students will be able to:

1. Comprehend the key concepts of fundamental cryptography techniques which are required for Blockchain Technology.
2. Describe the key concepts and compare various models of Blockchain Technology.
3. Understand consensus mechanism in Blockchain.
4. Acquire knowledge regarding cryptocurrency transactions and their validation.
5. Apply the concepts of Blockchain technology in real world scenario.

Unit-I

Overview of Cryptography: Introduction to Cryptography, History and development of cryptography; Cryptanalysis; Classical cryptosystems: shift, substitution and Vigenere ciphers; Attacks on shift, substitution and Vigenere ciphers; Designing a provably secure system, One -Time pads.

Basic Crypto Primitives: Cryptographic Hash Function, Properties of a hash function, Hash pointer and Merkle tree, Digital Signature, Public Key Cryptography: RSA Algorithm, Elliptical Curve Cryptography, A basic Cryptocurrency and example.

Unit-II

Introduction to Blockchain Technology:

Introduction to client-server architecture, distributed computing and their limitations. Evolution of Blockchain and how it is changing the landscape of digitalization, Block in a Blockchain, Working principles of blockchain technology.

Types of Blockchain: Public, Private and Consortium, Permissioned Model of Block chain, Public Ledgers, Smart Contracts, Transactions, Mining Mechanism, Consensus.

Unit-III

Introduction to digital wallet and types of wallets: Desktop, mobile and Meta mask/Browser based wallets.

Introduction to Bitcoin Blockchain, Working with Consensus in Bitcoin**:** Distributed consensus in open environments, Consensus in a Bitcoin network, Proof of Work (PoW), HashcashPoW, Bitcoin PoW, Attacks on PoW and the monopoly problem, Proof of Stake, Proof of Burn and Proof of Elapsed Time, The life of a Bitcoin Miner, Mining Difficulty, Mining Pool.

Unit-IV

Bitcoin versus Ethereum, Ethereum and Smart Contracts, The Turing Completeness of Smart Contract Languages and verifications, using smart contracts to enforce legal contracts, Introduction to Hyperledger and Truffle.

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Unit-V

Applications: Blockchain Technologies for IoT, Supply Chain Management in Agriculture using Blockchain and IoT.

Suggested Books

1. Paar Christof, Pelzl Jan, "Understanding Cryptography A Textbook for Students and Practitioners", Springer, 2010.
2. Joseph J. Bambara, Paul R. Allen, “Blockchain A Practical Guide to Developing Business, Law, and Technology Solutions”, 1st Edition, Mc. Graw Hill, 2018.
3. Daniel Drescher, “Block Chain Basics”, Apress; 1st edition, 2017.
4. Shiho Kim, Ganesh Chandra Deka, "Advanced Applications of Blockchain Technology", Springer, 2020.

Additional Reading

1. Imran Bashir, “Mastering Block Chain: Distributed Ledger Technology, Decentralization and Smart Contracts Explained”, Packt Publishing, 2018.
2. Ritesh Modi, “Solidity Programming Essentials: A Beginner’s Guide to Build Smart Contracts for Ethereum and Block Chain”, Packt Publishing, 2018.

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18EC E16

DSP PROCESSORS AND ARCHITECTURES

(Program Elective-IV)

Instruction	3 L Hours per Week
Duration of SEE	3 Hours
SEE	70 Marks
CIE	30 Marks
Credits	3

Prerequisite: Knowledge of Digital Signal Processing**.**

Course Objectives:

This course aims to:

1. Learn the architectural differences between DSP and General-purpose processor.
2. Study the fixed point.
3. Study the various applications of DSP Processors.

Course Outcomes:

Upon completion of this course, students will be able to:

1. Classify the differences between DSP Processor and General-Purpose processor.
2. Understand the basic architectural needs of Programmable DSPs
3. Explain the architecture features of TMS320C55XX processor.
4. Develop on interface with TMS320C55XX processor to external peripherals.
5. Design and implement of various signal processing algorithms using 55xx processor.

UNIT- I

Introduction to DSP Processors: Differences between DSP and other microprocessor architectures. Number formats- Fixed point, Floating point and block Floating point formats, IEEE-754 Floating point, Dynamic range and precision, Relation between data word size and instruction word size, Q-notation. Basic elements of real time DSP systems, DSP Hardware

UNIT-II

Fundamentals of Programmable DSPs: Multiplier and Multiplier Accumulator, Modified Bus structures and memory access in PDSPs – Multiple access memory, multiport memory, SIMD, VLIW Architectures, Pipelining, Special addressing modes in PDSPs, On-chip peripherals.

UNIT-III

Overview of TMS320C55X: Architecture of TMS320C55X Processor, Buses, Memory map, addressing modes, Instruction set, Pipeline and parallelism, Mixed C and Assembly language programming and on-chip peripherals.

UNIT-IV

Interfacing Memory and Parallel 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). Software Development Tools-Code Composer Studio (CCS), C compiler, Assembler and Linker.

UNIT-V

Application Programs: Implementation of algorithms on DSP processors – Sine wave generators, Convolution, Correlation, FFT, FIR filter, IIR filter, Decimation and Interpolation and sub band coding of signals.

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Text Books:

1. Sen M. Kuo and WoonSergGan, “Digital Signal Processors Architectures, Implementation and Application”, Pearson Practice Hall, 2013.
2. Avatar Singh and S. Srinivasan, “Digital Signal Processing Implementations Using DSP Microprocessors”, Thomson Brooks, 2012.

Suggested Reading:

1. B.Ventakaramani, M. Bhaskar, “Digital Signal Processors Architecture Programming and Applications”, Tata McGraw Hill, 10th reprint,2015.
2. RulphChassaing, “Digital Signal Processing and Application with the C6713 and C6416 DSK”, A John Wiley & sons, Inc, Publication,2005.
3. Sen M. Kuo, Bob H. Lee, Wenshun Tian, "Real Time Digital Signal Processing: Implementations and Applications”, Second Edition, John Wiley and sons ltd, 2006.

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18EC E21

DIGITAL IMAGE PROCESSING

(Program Elective-V)

Instruction	3 L Hours per Week
Duration of SEE	3 Hours
SEE	70 Marks
CIE	30 Marks
Credits	3

Course Objectives:

This course aims to:

1. Understand the image formation and its digital representation.
2. Learn representation of images in frequency domain and enhancement techniques.
3. Students would be able to solve the problems related to image compression and restoration.

Course Outcomes:

Upon completion of this course, students will be able to:

1. Describe basic concepts of image processing system.
2. Summarize and compare various digital image transform techniques.
3. Demonstrate and survey digital image enhancement in practical applications.
4. Analyse the case study related to various techniques of image restoration.
5. Apply compression techniques on digital image.

UNIT – I

Elements of Digital Image Processing Systems, Digital image representation, elements of visual perception, Image sampling and Quantization, Basic Relationships between pixels.

UNIT – II

Properties and Applications of Fourier Transform: FFT, Discrete cosine transform, Hadamard transform, Haar transform, Slant transform, DWT and Hotelling transform.

UNIT – III

Spatial Enhancement Techniques: Histogram equalization, direct histogram specification, Local enhancement. Frequency domain techniques: Low pass, High pass and Homomorphic Filtering, Image Zooming Techniques.

UNIT – IV

Image Degradation model, Algebraic approach to restoration, inverse filtering, Least mean square filter, Constrained least square restoration and interactive restoration. Speckle noise and its removal techniques.

UNIT – V

Redundancies for image compression, Huffman Coding, Arithmetic coding, Bit- plane coding, loss less and lossy predictive coding. Transform coding techniques: Zonal coding and Threshold coding.

Text Books:

1. Gonzalez R.C. and Woods R.E., “Digital Image Processing” 2/e, PHI, 2005.
2. A.K.Jain, “Fundamentals of Digital Image processing”, PHI, 1989.

Suggested Reading:

1. Madhuri A, Joshi, “Digital Image Processing: An algorithmic Approach”, PHI, 2006.
2. U Qidwai, C.H.Chen, “Digital Image Processing”,CRC Press, (Taylor & Francis), YesdeePublications,First Indian Reprint 2013.
3. S.Jayaraman, S.Esakkirajan and T.Veerakumar, "Digital Image Processing", Tata McGraw Hill publishers, 2009

18ECE22

EMBEDDED SYSTEMS

(Program Elective-V)

Instruction	3 L Hours per Week
Duration of SEE	3 Hours
SEE	70 Marks
CIE	30 Marks
Credits	3

Prerequisites: Computer Architecture, Microprocessors and Microcontrollers.

Course Objectives:

This course aims to:

1. Learn about fundamentals of the embedded systems
2. Understand the hardware and software details of the embedded systems.
3. Acquire knowledge on the serial, parallel and network communication protocols.

Course Outcomes:

Upon completion of this course, students will be able to:

1. Understand the fundamentals of the embedded systems
2. Analyze the hardware and software details of the embedded systems.
3. Design interfacing of the systems with other data handling / processing systems.
4. Evaluate the performance of an embedded system using various debugging tools.
5. Apply embedded design approach for various applications.

UNIT – I

Introduction to Embedded Systems: Embedded systems versus General Computing Systems, History of embedded systems, classifications, applications areas, characteristics and quality attributes of embedded systems, Design metrics and challenges in embedded system design.

UNIT – II

Embedded Hardware and Software: Processor embedded into a system, Processor selection for embedded system, embedded hardware units and devices in a system, embedded software in a system and an overview of programming languages, challenges and issues related to embedded software development.

UNIT – III

Communication Protocols: I^2C, CAN, Firewire-IEEE 1394 Bus standard, advanced serial high-speed buses. Parallel Bus device protocols: ISA, PCI, PCI-X, Internet Enabled Systems-Network protocols: Ethernet.

UNIT – IV

Embedded Software Development Process: Embedded System design and co-design issues in system development process, Design cycle in the development phase for an Embedded Systems.Embedded software development tools: Host and Target Machines, Linker/Locators for embedded software, Embedded Software into the Target system. Issues in hardware and software design and co-design

UNIT – V

Testing, Debugging Techniques and Applications: Integration and testing of embedded hardware, testing methods, debugging techniques, Laboratory tools and target hardware debugging: Logic Analyzer, simulator, emulator and In-circuit emulator, IDE Case Study: Embedded Systems design for automatic vending machines and digital camera.

Text Books:

1. Raj Kamal, "Embedded Systems-Architecture, Programming and Design",3/e, McGraw Hill Education,2015.
2. J.W. Valvano, "Embedded Microcomputer System: Real Time Interfacing", Brooks/Cole, 2000.

Suggested Reading:

1. Shibu K V, “Introduction to Embedded systems”, 1/e McGraw Hill Education,2009.
2. David E.Simon, “An Embedded software primer”, Pearson Education,2004.

18EC E24

5G COMMUNICATIONS

(Program Elective-V)

Instruction	3 L Hours per Week
Duration of SEE	3 Hours
SEE	70 Marks
CIE	30 Marks
Credits	3

Prerequisite: Knowledge of Mobile Cellular Communication.

Course Objectives:

This course aims to:

1. Understand the requirements & concepts of 5G.
2. Expose the architecture and radio access technologies of 5G.
3. Learn Massive MIMO concepts.

Course Outcomes:

Upon completion of this course, students will be able to:

1. Recall the requirements and used cases of 5G technology.
2. Illustrate the architecture of 5G.
3. Apply the 5G concepts to D2D communications.
4. Compare various Radio-Access Technologies.
5. Explain the concept of massive MIMO.

Unit-I

Overview of 5G: An Overview of 5G Requirements, 5G frequency bands: below 6GHz and above 6GHz, Spectrum Sharing for 5G: Introduction, Spectrum sharing scenario. Use cases and requirements: Autonomous vehicle control, Emergency communication, High-speed train, Shopping mall, Stadium, Smart city. 5G system concept: Extreme mobile broadband, Massive machine-type communication, Ultra-reliable machine-type communication.

Unit-II

5G Architecture: Introduction: NFV and SDN. Basics about RAN architecture, High-level requirements for the 5G architecture. Functional architecture and 5G flexibility: Functional split criteria, Functional split alternatives, Functional optimization for specific applications, Integration of LTE and new air interface to fulfill 5G requirements, Enhanced Multi-RAT coordination features. Physical architecture and 5G deployment: Deployment enablers, Flexible function placement in 5G deployments.

Unit-III

Device-to-device (D2D) communications:D2D: from 4G to 5G. Radio resource management for mobile broadband D2D.Multi-hop D2D communications for proximity and emergency services. Multi-operator D2D communication.

Unit - IV

5G Radio-Access Technologies: Access design principles for multi-user communications,Multi-carrier with filtering: a new waveform,Non-orthogonal schemes for efficient multiple access: NOMA, SCMA & IDMA.Radio access for dense deployments,Radio access for V2X communication,Radio access for massive machine-type communication.

Unit-V

Massive Multiple-Input Multiple-Output (MIMO) Systems: Introduction,Theoretical background: single user and multi-user MIMO, capacity of massive MIMO,Resource allocation and transceiver algorithms for massive MIMO,Fundamentals of baseband and RF implementations in massive MIMO.

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Text Books:

1. Wei Xiang, Kan Zheng, Xuemin (Sherman) Shen, "5G Mobile Communications", Springerpublications-2016.
2. AfifOsseiran, Jose F. Monserrat, Patrick Marsch, "5G Mobile and Wireless Communications Technology" Cambridge University Press-2016.

Suggested Reading:

1. Jonathan Rodriguez, "Fundamentals of 5G Mobile Networks" first edition, John Wiley & Sons, 2015.
2. Saad Z. Asif, "5G Mobile Communications Concepts and Technologies" CRC Press, 2019.
3. Angeliki Alexiou, "5G Wireless Technologies", IET Publications, 2017.

18ME O04

ENTREPRENEURSHIP

(Open Elective-II)

Instruction	3 L Hours per Week
Duration of SEE	3 Hours
SEE	70 Marks
CIE	30 Marks
Credits	3

Course Objectives:

This course aims to:

1. Concept and procedure of idea generation.
2. The nature of industry and related opportunities and challenges.
3. Elements of business plan and its procedure.
4. Project management and its techniques.
5. Behavioral issues and Time management.

Course Outcomes:

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

1. Understand the concept and essence ofentrepreneurship.
2. Identify business opportunities and natureof enterprise.
3. Analyze the feasibility of newbusiness plan.
4. Apply project management techniques like PERT and CPM for effective planning and executionofprojects.
5. Use behavioural, leadership and time management aspects inentrepreneurialjourney

UNIT-I

Entrepreneurship: Definition, functions of entrepreneurship, qualities of entrepreneurs, identification and characteristics of entrepreneurs, entrepreneur vs. intrapreneur, first generation entrepreneurs, women entrepreneurs, conception and evaluation of ideas and their sources.

UNIT-II

Indian industrial environment: Competence, opportunities and challenges, entrepreneurship and economic growth, small scale industry in India, objectives, linkage among small, medium and heavy industries, types of enterprises, corporate social responsibility.

UNIT-III

Business plan: Introduction, elements of business plan and its salient features, business model canvas, technical analysis, profitability and financial analysis, marketing analysis, feasibility studies, executive summary, selection of technology and collaborative interactions.

UNIT-IV

Project Management: During construction phase, project organization, project planning and control using CPM, PERT techniques, Human aspects of project management, Assessment of tax burden

UNIT-V

Behavioral Aspects of Entrepreneurs: Personality, determinants, attributes and models, Leadership concepts and models, Values and attitudes, Motivation aspects,Time Management: Approaches of time management, their strengths and weaknesses. Time management matrix and the urgency addiction.

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Text Books:

1. Vasant Desai, "Dynamics of Entrepreneurial Development and Management", Himalaya Publishing House, 1997.
2. Prasanna Chandra, "Project-Planning, Analysis, Selection, Implementation and Review", Tata McGrawHill Publishing Company Ltd. 1995.
3. S.S. Khanka, "Entrepreneurial Development", S. Chand & Co. Pvt. Ltd., New Delhi

Suggested Reading:

1. Robert D. Hisrich, Michael P. Peters, "Entrepreneurship", 5/e, Tata Me Graw Hill Publishing Company Ltd., 2005
2. Stephen R. Covey and A. Roger Merrill, "First Things First", Simon and Schuster Publication, 1994.

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18CS O06

FUNDAMENTALS OF DBMS

(Open Elective-II)

Instruction	3 L Hours per Week
Duration of SEE	3 Hours
SEE	70 Marks
CIE	30 Marks
Credits	3

Pre-requisites: File Structures.

Course Objectives:

This course aims to:

1. Learn data models, conceptualize and depict a database system using E-R diagram.
2. Understand the internal storage structures in a physical DB design.
3. Know the fundamental concepts of transaction processing techniques.

Course Outcomes:

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

1. Classify the difference between FMS and DBMS; describe the roles of different users and the structure of the DBMS. Design the database logically using ER modeling
2. Outline the schema of the relational database and key constraints. Develop queries using DDL, DML and DCL of SQL.
3. Identify the inference rules for functional dependencies and apply the principles of normal forms to decompose the relations in a database.
4. Summarize the concepts of dense, sparse, ISAM and B+ tree indexing and get familiar with states and properties of transactions.
5. Interpret the locking, time stamp, graph and validation-based protocols for concurrency control.
6. Summarize log-based recovery techniques to increase the robustness of the database, identify to resolve the deadlocks in the transactions.

UNIT - I

Introduction: Database System Applications, Purpose of Database Systems, View of Data, Database Languages, Database Users and Administrators Database System Architecture, Application Architectures.

Database Design and E-R Model: Basic concepts, Constraints, E-R Diagrams, E-R Design Issues, Extended E-R Features, Specialization and Generalization.

UNIT - II

Relational Model: Structure of Relational Databases, Database Schema, Keys.

Structured Query Language: Overviews, SQL Data Types, SQL Queries, Data Manipulation Language Set Operations, Aggregate Functions, Data Definition Language, Integrity Constraints, Null Values, Views, Join Expression. Index Definition in SQL.

UNIT - III

Relational Database Design: Undesirable Properties in Relational Database Design, Functional Dependencies, Trivial and Nontrivial Dependencies, Closure of Set of Functional Dependencies, Closure of Set of Attributes, Irreducible Set of Functional Dependencies, Normalization – 1NF, 2NF, and 3NF, Dependency Preservation, BCNF, Comparison of BCNF and 3NF.

UNIT - IV

Indexing: Basic concepts, Dense and Sparse Indices, Secondary Indices, Tree-Structured Indexing, Indexed Sequential Access Method (ISAM), B+ Tree Index Files.

Transaction Management: Transaction Concept – ACID Properties, States of Transaction, Implementation of Atomicity and Durability, Serializability, Recoverability.

UNIT - V

Concurrency Control: Lock-Based Protocols, Timestamp-Based Protocols, Validation-Based Protocols.

Deadlocks Handling: Deadlock Prevention, Deadlock Detection and Recovery.

Recovery System: Failure Classification, Storage Structure, Recovery and Atomicity, Log-Based Recovery.

Text Books:

1. Abraham Silberschatz, Henry F Korth, S Sudarshan, "Database System Concepts", Sixth Edition, McGraw-Hill International Edition, 2011.
2. Date CJ, Kannan A, Swamynathan S, "An Introduction to Database Systems", Eight Edition, Pearson Education, 2006.

Suggested Reading:

1. Raghu Ramakrishnan, JohnnesGehrke, "Database Management Systems", Third Edition, McGraw Hill, 2003.
2. RamezElmasri, Durvasul VLN Somayazulu, Shamkant B Navathe, Shyam K Gupta, "Fundamentals of Database Systems", Fourth Edition, Pearson Education,2006.

18IT O02

PYTHON PROGRAMMING

(Open Elective-II)

Instruction	3 L Hours per Week
Duration of SEE	3 Hours
SEE	70 Marks
CIE	30 Marks
Credits	3

Course Objectives:

This course aims to:

1. Facilitate learning to use lists, tuples and dictionaries in Python programs.
2. Familiarize with Python file handling.
3. Impart knowledge of exception handling in Python.
4. Introduce GUI Programming.
5. Familiarize with data visualization.

Course Outcomes:

Upon completing this course, students will be able to:

1. Understand the fundamental concepts and control structures of python programming.
2. Write user defined iterative & recursive functions, identify appropriate predefined functions and perform file handling Operations.
3. Use suitable data structures such as sequences, dictionaries and sets in python programming.
4. Apply concepts of OOP, exception handling and build regular expressions using Python.
5. Design and Develop GUI based applications and visualize the data.

UNIT-I

Introduction to Python Programming: Using Python, The IDLE Programming Environment, Input and Output Processing, Displaying Output with the Print Function, Comments, Variables, Reading Input from the Keyboard, Performing Calculations, More About Data Output: New line, Item Separator, Escape Characters, Formatting parameters.

Decision Structures and Boolean Logic: if, if-else, if-elif-else Statements, Nested Decision Structures, Comparing Strings, Logical Operators, Boolean Variables.

Repetition Structures: Introduction, while loop, for loop, Sentinels, Input Validation Loops, Nested Loops.

UNIT-II

Functions: Introduction, Defining and Calling a Function, designing a Program to Use Functions, Local Variables, Passing Arguments to Functions, Global Variables and Global Constants, Value-Returning Functions Generating Random Numbers, Writing Our Own Value-Returning Functions, the math Module, Random Module, Time Module and Storing Functions in Modules.

Python File Input-Output: Opening and closing file, various types of file modes, reading and writing to files, manipulating directories

UNIT-III

Lists and Tuples: Sequences, Introduction to Lists, List slicing, Finding Items in Lists with the in Operator, List Methods and Useful Built-in Functions, Copying Lists, Processing Lists, Two-Dimensional Lists, Tuples.

Strings: Basic String Operations, String Slicing, Testing, Searching, and Manipulating Strings.

Dictionaries and Sets: Dictionaries, Sets, Serializing Objects.

Recursion: Introduction, Problem Solving with Recursion, Examples of Recursive Algorithms.

UNIT-IV

Classes and Object-Oriented Programming: Procedural and Object-Oriented Programming, Classes, Working with Instances, Techniques for Designing Classes

Exception Handling: What is exception, various keywords to handle exception such try, catch, except, else, finally, raise

Regular Expressions: The match() Function, The search() Function, The sub() Function, The findall() and finditer() Functions, Flag Options

UNIT-V

GUI Programming: Graphical User Interfaces, Using the tkinter Module, Display text with Label Widgets, Organizing Widgets with Frames, Button Widgets and Info Dialog Boxes, Getting Input with Entry Widget, Using Labels as Output Fields, Radio Buttons, Check Buttons.

Introduction to Plotting in Python – Basic Plots- Line and Scatter Plot, box plot, bar plots, Histograms and plotting data contained in files.

Text Book:

1. Tony Gaddis, "Starting Out with Python", 3rd Edition, Pearson, 2015.

Suggested Reading:

1. ReemaThareja "Python Programming", Oxford Press, 2017
2. Kenneth A. Lambert, "Fundamentals of Python", Delmar Cengage Learning, 2013.
3. Fabio Nelli, "Python Data Analytics (With Pandas, NumPy, and Matplotlib)", Apress, 2nd Edition, 2018.
4. James Payne, "Beginning Python using Python 2.6 and Python 3", wrox programmer to programmer, 2010.
5. Paul Gries, "Practical Programming: An Introduction to Computer Science using Python", 3rd Edition, 2016.

Web Resource:

1. https://www.python.org/

18EC C28

COMPUTER NETWORKS LAB

Instruction	2 P Hours per Week
Duration of SEE	2 Hours
SEE	35 Marks
CIE	15 Marks
Credits	1

Prerequisite: Knowledge on Digital communications and familiarity with anyone programming language like C.

Course Objectives:

This course aims to:

1. Understand Link layer concepts.
2. Understand routing algorithms in Network layer.
3. Understand the network simulator environment and visualize a network topology and observe its performance.

Course Outcomes:

Upon completion of this course, students will be able to:

1. Apply fundamental principles of computer networking.
2. Examine the performance of design issues of Link layer.
3. Construct a network and measure its performance with different routing algorithms.
4. Create a wired and wireless Network using NS-2.
5. Analyze performance of various Network protocols using NS-2

List of Experiments

1. Implement the data link layer framing methods such as character, character stuffing and bit stuffing.
2. Implementation of Error Detection / Error Correction Techniques.
3. Construct Dijkstra's algorithm to compute the shortest path through a graph.
4. Create a subnet graph with weights indicating delay between the nodes and find routing table for any one node using link state routing algorithm.
5. Construct a broadcast tree using a subnet.
6. Create a wired network and data transmission between the nodes with at least four nodes using NS2.
7. Implementation of Stop & Wait Protocol using NS2
8. Implementation of Go Back N Protocol using NS2
9. Implementation of Selective Reject/Repeat Protocol using NS2
10. Implementation of Distance Vector Routing Protocol using NS2
11. Creation of a wireless network and data transmission between the nodes with at least four nodes using NS2.
12. Simulation of the data transfer between the nodes using TCP/UDP using for loop in NS2.

Additional Experiments based on

Structured Inquiry

13. Evaluate the performance of Data link/Network/Transport layer protocols.

Open-ended Inquiry

14. Design a Wireless Ad hoc Network and evaluate its performance.

Suggested Reading:

1. Behrouz A. Forouzan, "Data Communication and Networking", 4thEdition, McGraw-Hill Forouzan Networking Series, McGraw-Hill, 2007.
2. S. Keshav, "An Engineering Approach to Computer Networking", 2ndEdition, Addison-Wesley Professional Pearson Education, 2001.

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18EC C29

ELECTRONIC DESIGN AND AUTOMATION LAB

Instruction	2 P Hours per Week
Duration of SEE	2 Hours
SEE	35 Marks
CIE	15 Marks
Credits	1

Prerequisite: Digital design fundamentals and synthesis & simulation concepts

Course Objectives:

This course aims to:

1. Simulate and synthesize combinational and sequential logic circuits
2. Simulate switch level modules
3. Learn implementation procedure for any design on FPGA and to study the speed, power and area constraints of FPGA/CPLD

Course Outcomes:

Upon completion of this course, students will be able to:

1. Demonstrate the process steps required for simulation /synthesis
2. Develop HDL codes/scripts with appropriate syntax
3. Apply an appropriate modelling style to describe various combinational and sequential circuits in Verilog HDL
4. Examine the successful execution of the codes/ schematic using various Simulation Tools
5. Build various digital circuits on hardware boards like FPGA.

List of Experiments

Part A

Write VERILOG Code, Simulate and Implement the following on FPGA:

1. Code Converters.
2. Encoders, Decoders, Priority Encoder and Comparator.
3. Registers/Counters.
4. Sequence Detector using Mealy and Moore type state machines.
5. Any application of UDP.
6. Tasks and Functions.

Note:

1. All the codes should be implemented appropriately using Gate level, Dataflow and Behavioural Modelling.
2. All the programs should be simulated using test benches.

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Part B

Switch Level Modelling of CMOS circuits:

1. Basic Logic Gates: Inverter, NAND and NOR.
2. Half Adder and Half Subtractor.
3. 4x1 Multiplexer.
4. 2x4 Decoder.
5. Design of NAND Gate using Simulation tool.
6. Design of NOR Gate using Simulation tool.
7. Design and layout of Inverter using Simulation tool.

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Structured Enquiry Program:

1. Design and simulate a high-speed adder using Verilog HDL

Open- ended Enquiry:

1. Simulate a design using System Vivado and implement the same on Zynq Evaluation Development Board.

Suggested Reading:

1. Michal D.Ciletti, "Advanced digital design with Verilog HDL", Pearson Edition, 2011.
2. Samir Palnitkar, "Verilog HDL-A Guide to Digital Design and Synthesis",Pearson 2nd edition, 2003.
3. Cadence Design Systems (Ireland) Ltd., "Cadence manual", 2013.

18EC C30

ELECTRONICS MEASUREMENT AND SIMULATION LAB

Instruction	2 P Hours per Week
Duration of SEE	2 Hours
SEE	35 Marks
CIE	15 Marks
Credits	1

Prerequisite: Concepts of Electronic Instrumentation and expected to have logical and programming skills.

Course Objectives:

This course aims to:

1. Demonstrate various Bridges & transducers using hardware set ups.
2. Understand the importance and applications of virtual instrumentation
3. Develop real time applications using LabVIEW.

Course Outcomes:

Upon completion of this course, students will be able to:

1. Understanding of the operational features of various analog and digital test and measurement equipment.
2. Analysis of various standard bridges and ability to measure temperature
3. Learn how to develop basic applications in the LabVIEW graphical programming environment.
4. Develop ability for programming in LabVIEW using various data structures, program structures, plotting the graphs and charts for system monitoring, processing and controlling.
5. Apply knowledge of mathematics and engineering to formulate and study or solve engineering problems, including problems at the interface of engineering.

List of Experiments

1. Designing DC bridge for Resistance measurement (Quarter, Half and Full bridge).
2. Designing of AC bridge circuit for capacitance measurement.
3. Designing of signal conditioning circuit for Temperature measurement
4. Experimental study for the characteristics of ADC and DAC.
5. Familiarization with LabVIEW simulation tool.
6. Loops, Structures and Math-script in LabVIEW.
7. Implementation of Combinational circuits (Multiplexer and Demultiplexer) using my RIO.
8. Design of Sequential circuits (Flip flops and counters) with LabVIEW.
9. FIR and IIR Filter design in LabVIEW.
10. Implementation of Analog modulation and Demodulation schemes (AM and FM) using myRIO.
11. Digital carrier modulation and demodulation schemes (ASK, FSK and PSK) with LabVIEW
12. State variable analysis with LabVIEW.
13. Frequency domain analysis (Nyquist and Bode plots) with LabVIEW.
14. Sensor data acquisition using myDAQ.
15. Voltage / Current Sweep generation using myDAQ.

Additional Experiments based on

Structured enquiry

a) Digital IIR Notch filter design / ALU design / PLL design using LabVIEW

Open-ended enquiry

b) Develop any application in Control Systems/Signal Processing/ Communication Systems using LabVIEW

Suggested Reading:

1. Nakra B.C, and Chaudhry K.K, "Instrumentation Measurement and analysis", Tata McGraw Hill Publications, 2013.
2. Jeffrey Travis, Jim Kring, "LabVIEW for Everyone: Graphical programming Made Easy and Fun", 3rd Edition, Prentice Hall, 2007.

18ECC31

PROJECT:PART - 1

Instruction	4 P Hours per Week
Duration of SEE	--
SEE	--
CIE	50 Marks
Credits	2

Prerequisite: Knowledge of preparing slides by using power point presentations, Capable of searching for suitable literature and Presentation skills.

Course Objectives:
This course aims to:

1. The student takes up investigative study in the broad field of Engineering / Technology, either fully theoretical/practical or involving both theoretical and practical.
2. The work to be assigned by the Department on an individual basis or two/three students in a group, under the guidance of a supervisor.
3. This is expected to provide a good initiation for the student(s) towards R&D.

Course Outcomes:
Upon completion of this course, students will be able to:

1. List the various approaches to the selected problem.
2. Interpret the advantages and disadvantages of various approaches.
3. Apply the selected approach for simulating / modelling / designing the problem.
4. Analyse and write a report on the results of the simulation / modelling of the problem selected.
5. Justify and present the results of the simulation / model / design before the departmental committee.

The objective of Project Part-1 is to enable the student take up investigative study in the broad field of Engineering/Technology, either fully theoretical/practical or involving both theoretical and practical work to be assigned by the Department on an individual basis or two/three students in a group, under the guidance of a supervisor. This is expected to provide a good initiation for the student(s) towards R&D. The work shall include:

1. Survey and study of published literature on the assigned topic;
2. Working out a preliminary Approach to the Problem relating to the assigned topic;
3. Conducting preliminary Analysis/Modelling/Simulation/Experiment/Design/Feasibility;
4. Preparing a Written Report on the Study conducted for Presentation to the Department;
5. Final Seminar, as oral Presentation before a departmental Committee.

Guidelines for the award of Marks: Max. Marks: 50

Evaluation by	Max. Marks	Evaluation Criteria / Parameter
Supervisor	20	Project Status / Review
	5	Report
Departmental Committee	5	Relevance of the Topic
	5	PPT Preparation
	5	Presentation
	5	Question and Answers
	5	Report Preparation

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18EC C32

INDUSTRIAL VISIT

Instruction	Industrial Visits
Sessional/Examination	*Grade

Course Objectives:

The objective of the Course is to:

1. Physically see the process of manufacturing procedure and steps involved.
2. Collect the information in respect of materials, sources and supply.
3. Understand the sequential stages involved in manufacturing process.
4. Understand the procedure to write the 'industry visit' technical report by compiling all the information collected during the visit.
5. Understand the safety procedures and precautions followed in industry, confidentiality of the process and man power required.

Course Outcomes:

Upon completion of this course, students will be able to:

1. Know the importance of visiting an engineering industry from the point of view of process of manufactory procedures and setup.
2. Summarize the required information with regard to materials, source of supply in respect to the product.
3. Know the stages in manufactory of a product.
4. Prepare the 'industry visit' technical report covering the details of visit and its importance.
5. Visualize the safety precautions to be followed in industry, confidentiality of the product processing as the man power required.

Students are expected to visit at least two industries during the semesters 4^{th} and 7^{th} and submit a detailed technical report on the study visit to the department. The department should evaluate the report through a Committee consisting of Head of the Department and two more faculty members to award the Grades *.

*Satisfactory/Unsatisfactory.

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18ECE25

IOT AND ITS APPLICATIONS

(Program Elective-VI)

Instruction	3 L Hours per Week
Duration of SEE	3 Hours
SEE	70 Marks
CIE	30 Marks
Credits	3

Prerequisite: Knowledge on Programming and Problem Solving, Computer Organization and Embedded systems.

Course Objectives:

This course aims to:

1. Provide an overview of Internet of Things, building blocks of IoT and the real-world applications.
2. Introduce Python Programming language and packages.
3. Introduce Raspberry Pi device, its interfaces and Django Framework.

Course Outcomes:

Upon completion of this course, students will be able to:

1. Understand the terminology, enabling technologies and applications of IoT
2. Apply the concept of M2M and understand the basics of modern networking with the concepts of SDN and NFV.
3. Understand the basics of Python Scripting Language which is used in many IoT devices.
4. Describe the steps involved in IoT system design methodology.
5. Design simple IoT systems using Raspberry Pi board with sensors, actuators and develop web applications using python-based framework called Django.

UNIT-I

Introduction and Concepts: Introduction to Internet of Things, Definitions and Characteristics of IoT, Physical Design of IoT: Things in IoT, IoT Protocols, Logical Design of IoT, IoT Functional Blocks, IoT Communication Models, IoT Communication APIs, IoT Enabling Technologies, Wireless Sensor Networks, Cloud Computing, Communication Protocols, IoT Levels & Deployment Templates.

UNIT-II

Domain Specific IoTs: IoT applications for Home Automation, Cities, Environment, Energy, Retail, Logistics, Agriculture, Industry, health and Lifestyle.

IoT and M2M: Introduction, M2M, Differences between IoT and M2M, Software Defined Networking, Network Function Virtualization.

UNIT-III

Introduction to Python: Motivation for using Python for designing IoT systems, Language features of Python, Data types: Numbers, Strings, Lists, Tuples, Dictionaries, Type Conversions, Data Structures: Control of flow-if, for, while, range, break/continue, pass, functions, modules, packaging, Python packages of Interest for IoT: JSON, XML, HTTPLib, URLLib, SMTPLib.

UNIT-IV

IoTPlatforms Design Methodology: Introduction, IoT Design Methodology Steps-Purpose and Requirements Specification, Process Specification, Domain Model Specification, Information Model Specification, Service Specifications, IoT Level Specification, Functional View Specification, Operational View Specification, Device and Component Integration, Application Development, Case Study on IoT System for Weather Monitoring.

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UNIT-V

IoTPhysical Devices and End Points: Basic building blocks of an IoT device, Raspberry Pi- about the Raspberry Pi board, Raspberry Pi interfaces, Serial, SPI, I2C.

IoT Physical Servers and Cloud Offerings: Introduction to cloud storage models and Communication APIs, WAMP: AutoBahn for IoT, Xivelycloud for IoT.

Python Web Application Framework: Django Framework-Roles of Model, Template and View

Text Books:

1. ArshdeepBahga and Vijay Madisetti, “Internet of Things - A Hands-on Approach”,Universities Press, 2015.
2. Tony Gaddis, “Starting out with Python”, 3rd edition, Pearson, 2015.

Suggested Reading:

1. Francis daCosta, “Rethinking the Internet of Things: A Scalable Approach to Connecting Everything”, 1st edition, press Publications, 2013.
2. Matt Richardson, Shawn Wallace, O'Reilly, “Getting Started with Raspberry Pi”, SPD, 2014.
3. Pethuru Raj and Anupama C. Raman, "The Internet of Things: Enabling Technologies, Platforms, and Use Cases", 1st edition, 2017

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18ECE27

PRINCIPLES OF WIRELESS SENSOR NETWORKS

(Program Elective-VI)

Instruction	3 L Hours per Week
Duration of SEE	3 Hours
SEE	70 Marks
CIE	30 Marks
Credits	3

Prerequisite: The student must have taken a course on data communication and computer networks.

Course Objectives:

This course aims to:

1. Obtain a broad understanding about the network architecture of wireless sensor network, characteristics of wireless sensor networks and sensor nodes.
2. Understand different constraints of wireless sensor network, like coverage, power management etc. and the principles of data transmission, clustering algorithm and routing protocols.
3. Design and development of new network architecture and MAC protocols.

Course Outcomes:

Upon completion of this course, students will be able to:

1. Recall the features, characteristics, Technology, Data transmission, protocols and design issues of wireless Sensor networks.
2. Illustrate the function of Network architecture, Routing, Protocol structure, and node problems
3. Apply the appropriate protocols and routing algorithms to solve issues in Network.
4. Analyze data processing, aggregation and routing, Protocol overheads, Throughput, Security challenges in a WSN.
5. Compare the performance of WSN in terms of topologies, technology, protocols, design principles, and security

UNIT–I

Introduction to Wireless Sensor Networks.: Features, Design challenges, Network architecture, Applications, Sensor deployment mechanism, Topologies and characteristics of Wireless Sensor Networks, Advantages of WSN.

UNIT–II

Network and Component Technologies: Mobile Adhoc Networks (MANETs)**,** Sensors, Coverage, Physical layer, Sensor platforms, Reliable data transport, Radio energy consumption model, Power management, Synchronization, Localization.

UNIT–III

Data Transmission and Routing: Data processing and aggregation, Data storage, Node discovery algorithms, Wireless sensor network routing, Proactive and Reactive routing.

UNIT–IV

Protocols: Frame structure, Network clustering protocols, Medium access control protocols, Multi-hop communication protocols, Congestion control and rate control protocols, Protocol overheads.

UNIT–V

Dependability Issues: Collisions, Collision avoidance mechanism, Hidden node and exposed node problems, Data congestions, Throughput, Security challenges. Design Principles of WSNs, Concepts of Gateway.

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Text Books:

1. Holger Karl and Andreas Willig, "Protocols and Architectures for Wireless Sensor Networks", Wiley-2011.
2. Yan Zhang, Jijun Luo, Honglin Hu, "Wireless Mesh Networking, Architecture, Protocols and Standards", 1st edition, Auerbach Publications, 2006.
3. Edgar H. Callaway Jr. and Edgar H. Callaway, "Wireless Sensor Networks: Architectures and Protocols", 1st edition, Auerbach Publications, 2003.

Suggested Reading:

1. Yang, Shuang-Hua, "Wireless Sensor Networks Principles, Design and Applications", Springer, 2014.
2. KazemSohraby, Daniel Minoli, TaiebZnati, "Wireless Sensor Networks: Technology, Protocolsand Applications", Wiley, 2007.
3. Mohammad S. Obaidat, SudipMisra, "Principles of Wireless Sensor Networks", Cambridge University Press, 2014.

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18EGO02

GENDER SENSITIZATION

(Open Elective-III)

Instruction	3 L Hours per week
Duration of SEE	3 Hours
SEE	70 Marks
CIE	30 Marks
Credits	3

Course Objectives

This course aims to:

1. Sensibility regarding issues of gender in contemporaryIndia.
2. A critical perspective on the socialization of men and women.
3. Popular debates on the politics and economics of work while helping them reflect critically on gender violence.

Course Outcomes

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

1. Understand the difference between "Sex" and "Gender" and be able to explain socially constructed theories of identity.
2. Recognize shifting definitions of "Man" and "Women" in relation to evolving notions of "Masculinity" and "Femininity".
3. Appreciate women's contributions to society historically, culturally and politically.
4. Analyze the contemporary system of privilege and oppressions, with special attention to the ways gender intersects with race, class, sexuality, ethnicity, ability, religion, and nationality.
5. Demonstrate an understanding of personal life, the workplace, the community and active civic engagement through classroom learning.

UNIT- I

Understanding Gender:
Gender: Why Should We Study It? (Towards a World of Equals: Unit -1)
Socialization: Making Women, Making Men (Towards a World of Equals: Unit -2)
Introduction. Preparing for Womanhood. Growing up Male. First lessons in Caste. Different Masculinities.

UNIT- II

Gender and Biology:
Missing Women: Sex Selection and Its Consequences (Towards a World of Equals: Unit -4)
Declining Sex Ratio. Demographic Consequences.
Gender Spectrum: Beyond the Binary (Towards a World of Equals: Unit -10) Two or Many? Struggles with Discrimination.

UNIT- III

Gender and Labour:
Housework: The Invisible Labour (Towards a World of Equals: Unit -3)
"My Mother doesn't Work." "Share the Load."
Women's Work: Its Politics and Economics (Towards a World of Equals: Unit -7)
Fact and Fiction. Unrecognized and Unaccounted work. Additional Reading: Wages and Conditions of Work.

UNIT-IV

Issues of Violence
Sexual Harassment: Say No! (Towards a World of Equals: Unit -6)
Sexual Harassment, not Eve-teasing- Coping with Everyday Harassment- Further Reading: "Chupulu".
Domestic Violence: Speaking Out (Towards a World of Equals: Unit -8)
Is Home a Safe Place? -When Women Unite [Film]. Rebuilding Lives. Additional Reading:New Forums for Justice.
Thinking about Sexual Violence (Towards a World of Equals: Unit -11)
Blaming the Victim - "I Fought for my Life…." - Additional Reading: The Caste Face ofViolence.

UNIT – V

Just Relationships: Being Together as Equals (Towards a World of Equals: Unit -12)
Mary Kom and Onler. Love and Acid just do not Mix. Love Letters. Mothers and Fathers.
Additional Reading: Rosa Parks-The Brave Heart.

TextBooks:

1. A.Suneetha, Uma Bhrugubanda, DuggiralaVasanta, Rama Melkote,VasudhaNagaraj, AsmaRasheed, GoguShyamala, DeepaSreenivas and Susie Tharu "Towards a World of Equals: A Bilingual Textbook on Gender" published by Telugu Akademi, Hyderabad, Telangana State, 2015.

Suggested Reading:

1. Menon, Nivedita. Seeing like a Feminist. New Delhi: Zubaan-Penguin Books, 2012.
2. Abdulali Sohaila. "I Fought for My Life…and Won. "Available online at: http://www.thealternative.in/lifestyle/i-fought-for-my-lifeand-won-sohaila-abdulal/

Web Resources:

1. https://aifs.gov.au/publications/gender-equality-and-violence-against-women/introduction
2. https://theconversation.com/achieving-gender-equality-in-india

Note: Since it is an Interdisciplinary Course, Resource Persons can be drawn from the fieldsof English Literature or Sociology or Political Science or any other qualified faculty who hasexpertise in this field from engineering departments.

18CS O10

MACHINE LEARNING USING PYTHON

(Open Elective-III)

Instruction	3 L Hours per week
Duration of SEE	3 Hours
SEE	70 Marks
CIE	30 Marks
Credits	3

Course Objectives:

This course aims to:

1. Get an idea of Machine Learning algorithms to solve real world problems.
2. Study various machine learning algorithms.
3. Analyze data using machine learning techniques.

Course Outcomes:

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

1. Define the basic concepts related to Python and Machine Learning
2. Describe the feature engineering methods, regression techniques and classification methods
3. Apply Python packages for data visualization. text and time series data analysis using NLP toolkit
4. Evaluate and interpret the results of the various machine learning techniques
5. Solve real world problems using deep learning framework

UNIT - I

Introduction to Machine Learning: Introduction, Machine Learning process.

Introduction to Python: Features, sources and installation of Python, IDEs, Basics of Python, Data Structures and loops.

UNIT - II

Feature Engineering: Introduction to Features and need of feature Engineering, Feature extraction and selection, Feature Engineering Methods, Feature Engineering with Python.

Data Visualization: Various charts, histograms, plots.

UNIT - III

Regression: Simple and multiple regressions, Model assessment, various types of errors, errors, ridge regression, Lasso regression, non-parameter regression.

Classification: Linear classification, logistic regression, Decision Trees, Random Forest, Naïve Bayes.

UNIT - IV

Unsupervised Learning: Clustering, K-Means clustering, Hierarchical clustering.

Text Analysis: Basic text analysis with Python, regular expressions, NLP, text classification.

Time Series Analysis: Date and time handling, window functions, correlation, time series forecasting.

UNIT - V

Neural Network and Deep Learning: Neural network- gradient descent, activation functions, parameter initialization, optimizer, loss function, deep learning, deep learning architecture, memory, deep learning framework.

Recommender System: Recommendation engines, collaborative filtering.

Text Books:

1. Abhishek Vijavargia "Machine Learning using Python", BPB Publications, 1st Edition, 2018
2. Tom Mitchel "Machine Learning", Tata McGraw Hill, 2017
3. Reema Thareja "Python Programming", Oxford Press, 2017.

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Suggested Reading:

1. Yuxi Liu, Python Machine Learning by Example, 2nd Edition, PACT, 2017.

Online Resources:

1. https://www.guru99.com/machine-learning-tutorial.html
2. https://www.tutorialspoint.com/machine_learning_with_python/index.htm
3. https://www.tutorialspoint.com/python/
4. https://docs.python.org/3/tutorial/
5. https://www.geeksforgeeks.org/machine-learning/

18EC C33

TECHNICAL SEMINAR

Instruction	3 P Hours per Week
Duration of SEE	--
SEE	--
CIE	50 Marks
Credits	1

Prerequisite: Student must have completed Project: Part - 1

Course Objectives:

1. To introduce students to critical reading, understanding, summarizing, explaining and preparing report on state-of-the-art topics in a broad area of his/her specialization.
2. Seminar topics may be chosen by the students with advice from the faculty members and the student shall read further relevant articles in the domain.
3. Documenting the seminar report in a prescribed format.

Course Outcomes:
Upon completion of this course, students will be able to:

1. Collect, Organize, Analyze and Consolidate information about emerging technologies from the literature.
2. Exhibit effective communication skills, stage courage, and confidence.
3. Demonstrate intrapersonal skills.
4. Explain new innovations/inventions in the relevant field.
5. Prepare and experience in writing the Seminar Report in a prescribed format.

The goal of a seminar is to introduce students to critical reading, understanding, summarizing, explaining and preparing report on state-of-the-art topics in a broad area of his/ her specialization. Seminar topics may be chosen by the students with advice from the faculty members and the student shall read further relevant articles in the domain.

The seminar must be clearly structured and the power point presentation shall include following aspects:

1. Introduction to the field
2. Literature survey
3. Consolidation of available information
4. Summary and Conclusions
5. References

Each student is required to:

1. Submit a one-page synopsis of the seminar talk for display on the notice board.
2. Deliver the seminar for a maximum duration of 30 minutes, where the presentation should be for 20 minutes in PowerPoint, followed by Question and Answers session for 10 minutes.
3. Submit the detailed report of the seminar in spiral bound in a précised format as suggested by the department.

Seminars are to be scheduled from 3rd week to the last week of the semester and any change in schedule shall be discouraged.

For the award of sessional marks, the students are judged by three (3) faculty members and are based on oral and written presentations as well as their involvement in the discussions during the oral presentation.

Note: Topic of the seminar shall be preferably from any peer reviewed recent Journal publications.

Guidelines for awarding marks (CIE): Max. Marks: 50		
S.No	**Description**	**Max. Marks**
1	Contents and relevance	10
2	Presentation skills	10
3	Preparation of PPT slides	05
4	Questions and answers	05
5	Report in a prescribed format	20

18ECC34

PROJECT: PART-2

Instruction	10 PHours per Week
Duration of SEE	Viva Voce
SEE	100 Marks
CIE	100 Marks
Credits	10

Prerequisite: Student must have earned the credit of 'Project: Part - 1'.

Course Objectives:

1. The object of Project: Part2 is to enable the student extend further the investigative study, either fully theoretical/practical or involving both theoretical and practical work.
2. The work shall be carried out under the guidance of a Supervisor from the Department alone or jointly with a Supervisor drawn from R&D laboratory/Industry.
3. Preparing an Action Plan for conducting the investigation, including team work;

Course Outcomes:

Upon completion of this course, students will be able to:

1. Recall the details of the approach for the selected problem.
2. Interpret the approach to the problem relating to the assigned topic.
3. Determine the action plan to conduct investigation.
4. Analyze and present the model / simulation /design as needed.
5. Evaluate, present and report the results of the analysis and justify the same.

The objective of 'Project: Part-2' is to enable the student extend further the investigative study taken up, either fully theoretical/practical or involving both theoretical and practical work, under the guidance of a Supervisor from the Department alone or jointly with a Supervisor drawn from R&D laboratory/Industry. This is expected to provide a good training for the student(s) in R&D work and technical leadership. The assignment to normally include:

1. In depth study of the topic assigned;
2. Review and finalization of the Approach to the Problem relating to the assigned topic;
3. Preparing an Action Plan for conducting the investigation, including team work;
4. Detailed Analysis/Modelling/Simulation/Design/Problem Solving/Experiment as needed;
5. Final development of product/process, testing, results, conclusions and future directions;
6. Preparing a paper for Conference presentation/ Publication in Journals, if possible;
7. Preparing a Dissertation in the standard format for being evaluated by the Department.
8. Final Seminar presentation before Departmental Committee.

Guidelines for awarding marks in CIE: (**Max. Marks: 100**)

Evaluation by	Max. Marks	Evaluation Criteria / Parameter
Department Review Committee	10	Review 1
	15	Review 2
	25	Submission
Supervisor	10	Regularity and Punctuality
	10	Work Progress
	10	Quality of the work which may lead to publications
	10	Report Preparation
	10	Analytical / Programming / Experimental Skills

Guidelines for awarding marks in **SEE**: (**Max. Marks: 100**)

Evaluation by	Max. Marks	Evaluation Criteria / Parameter
External and Internal Examiners together	20	Power Point Presentation
	40	Thesis Evaluation
	20	Quality of the project • Innovations • Applications • Live Research Projects • Scope for future study • Application to society
	20	Viva-Voce

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20EC C102

ADVANCED DIGITAL SIGNAL PROCESSING

Instruction	3 L Hours per Week
Duration of SEE	3 Hours
SEE	60 Marks
CIE	40 Marks
Credits	3

Prerequisite: The knowledge of DSP is required.

Course Objectives:
This course aims to:

1. Analyze digital IIR and FIR filters for the given specifications.
2. Understand the basic concepts of Multirate digital signal processing.
3. Learn the various parametric and non-parametric spectral estimation methods.

Course Outcomes:
Upon completion of this course, students will be able to:

1. Design digital filters for the given specifications.
2. Interpret the concepts of Multirate digital signal processing.
3. Understand the concepts of linear prediction filters.
4. Analyze various Power Spectral Estimation methods for random signals
5. Develop the various applications of Digital signal processing.

UNIT-I

Review of Digital Filters: FFT Algorithms, review of digital filter design and structures-Basic FIR/IIR filter design &structures, design techniques of linear phase FIR filters, IIR filters by impulse invariance, bilinear transformation, Cascaded, lattice structures and parallel realization of FIR and IIR filters.

UNIT-II

Multirate DSP: Introduction, Decimator and Interpolator, Sampling rate conversion, multistage decimator and interpolator,polyphase filters, Uniform digital filter banks, two channel Quadrature Mirror Filter bank- perfect reconstruction conditions.

UNIT-III

Linear Prediction &Optimum Linear Filters: Introduction to discrete random signals, Power Density spectrum, Ergodic process. Forward-backward linear prediction filters, solution of normal equations, AR Lattice and ARMA Lattice-Ladder Filters, FIR and IIR Wiener filters.

UNIT-IV

Power Spectrum Estimation: Estimation of Spectra from Finite-Duration Observations of Signals, NonparametricMethods for Power Spectrum Estimation-Bartlett and Welch methods. Parametric methods for Power Spectrum Estimation-Yule Walker method and Burg method. Minimum-Variance Spectral Estimation, Eigen analysis Algorithms for Spectrum Estimation, Piserenko method and MUSIC algorithm.

UNIT-V

Applications of Digital Signal Processing: Dual-Tone Multi frequency Signal Detection, Spectral analysis of sinusoidal signals, Non-stationary signals and Random signals, sub band coding of speech signals, JPEG-2000, Trans multiplexers, Introduction to wavelets.

Text Books:

1. J.G.Proakis and D.G.Manolakis, "Digital signal processing: Principles, Algorithm andApplications", 4th Edition, Prentice Hall, 2007.
2. Sanjit. K. Mitra, "Digital signal processing", 3rd edition, McGraw Hill,2006.

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Suggested Reading:

1. Emmanuel Ifeachor, Barrie W.Jervis, "Digital signal Processing, A Practical Approach", 2nd edition, Pearson, 2011.
2. Roberto Cristi, "Modern Digital signal Processing", Cengage learning, 2012.

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20EC C104

WIRELESS AND MOBILE COMMUNICATION

Instruction	3 L Hours per Week
Duration of SEE	3 Hours
SEE	60 Marks
CIE	40 Marks
Credits	3

Prerequisite: Requires concepts of Electromagnetic theory, Antennas and Wave propagation and Digital Communication.

Course Objectives:
This course aims to:

1. Facilitate the understanding of the basics of Cellular System design Fundamentals and Large-scale propagation models
2. Provide the concepts of small-scale fading and Equalization.
3. Build knowledge on multiple access techniques, GSM and Cellular Standards.

Course Outcomes:
Upon completion of this course, students will be able to:

1. Understand and apply frequency-reuse concept in mobile communications, and to analyze its effects on interference, system capacity, handoff techniques.
2. Analyze path loss and interference for wireless telephony and their influences on a mobile-communication system's performance.
3. Distinguish various multiple-access techniques for mobile communications and their advantages and disadvantages.
4. Evaluate GSM and CDMA systems by functioning with knowledge of forward and reverse channel details, advantages and disadvantages of using these technologies.
5. Devising the higher generation Cellular standards 3G, 4G & 5G.

UNIT-I
The Cellular Concept System Design Fundamentals: Frequency reuse, Frequency management, Channel Assignment Strategies, Handoff Strategies, Co-channel Interference, Adjacent channel interference, Power control for Reducing Interference, Cell Splitting and Sectoring.

UNIT-II
Mobile Radio Propagation Large Scale Path Loss: Free space propagation model, Reflection, Ground Reflection (Two-Ray) model, Diffraction: Knife – edge Diffraction Model, Scattering, Practical link budget design using path loss models: Log Normal Shadowing, Determination of percentage of coverage area, Outdoor propagation models: Okumura and Hata models, Indoor propagation models: Partition losses (same floor), Partition losses between floors, Signal penetration into buildings.

UNIT-III
Mobile Radio Propagation Small Scale Fading and Multipath: Impulse response model, Spread Spectrum Sliding Correlator Channel Sounding, Parameters of Mobile Multipath Channels, Types of Small-Scale Fading: Flat Fading, Frequency selective Fading, Fast Fading and Slow Fading.

UNIT-IV
Equalization: Fundamentals of Equalization, Training a Generic Adaptive Equalizer, Equalizers in Communication Receiver, Linear Equalizers, Non-Linear Equalizers: Decision Feedback Equalization (DFE), Maximum Likelihood Sequence Estimation (MLSE) Equalizer, Algorithms for Adaptive Equalization: Zero Forcing Algorithm and Least Mean Square Algorithm.

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UNIT-V

Multiple Access Techniques: FDMA, TDMA and CDMA. Comparison of these technologies based on their signal separation, Advantages and Disadvantages.

GSM System: Architecture and Interfaces, Subsystems, Logical channels, HSCSD, GPRS and EDGE.

IS-95 System: Architecture, Air interface, Physical and Logical channels, Evolution of CDMA One to CDMA 2000.

Higher Generation Cellular Standards: 3G, 4G, VoLTE, UMTS, Introduction to 5G.

Text Books:

1. T.S.Rappaport, "Wireless Communications Principles and Practice", 2nd edition, PHI,2002.
2. William C.Y.Lee, "Mobile Cellular Telecommunications Analog and Digital Systems", 2nd edition, TMH, 1995.
3. V.K.Garg and J.E.Wilkes, "Principle and Application of GSM", Pearson Education, 5th edition, 2008.

Suggested Reading:

1. V.K.Garg, "IS-95 CDMA & CDMA 2000", Pearson Education, 4th edition, 2009.
2. AshaMehrotra, "A GSM system Engineering" Artech House Publishers Boston, London,1997.

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20ME M103

RESEARCH METHODOLOGY AND IPR

(Mandatory Course)

Instruction	2 L Hours per Week
Duration of SEE	2 Hours
SEE	60 Marks
CIE	40 Marks
Credits	2

Course Objectives:

This course aims to:

1. Motivate to choose research as career
2. Formulate the research problem, prepare the research design
3. Identify various sources for literature review and data collection report writing
4. Equip with good methods to analyze the collected data
5. Know about IPR copyrights

Course Outcomes:

Upon completion of this course, students will be able to:

1. Define research problem, review and asses the quality of literature from various sources
2. Improve the style and format of writing a report for technical paper/ Journal report, understand and develop various research designs
3. Collect the data by various methods: observation, interview, questionnaires
4. Analyze problem by statistical techniques: ANOVA, F-test, Chi-square
5. Understand apply for patent and copyrights

UNIT-I

Research Methodology: Research Methodology: Objectives and Motivation of Research, Types of Research, research approaches, Significance of Research, Research Methods verses Methodology, Research Process, Criteria of Good Research, Problems Encountered by Researchers in India, Benefits to the society in general. Defining the Research Problem: Selection of Research Problem, Necessity of Defining the Problem

UNIT-II

Literature Survey Report Writing: Literature Survey: Importance and purpose of Literature Survey, Sources of Information, Assessment of Quality of Journals and Articles, Information through Internet. Report writing: Meaning of interpretation, layout of research report, Types of reports, Mechanics of writing a report. Research Proposal Preparation: Writing a Research Proposal and Research Report, Writing Research Grant Proposal

UNIT-III

Research Design: Research Design: Meaning of Research Design, Need of Research Design, Feature of a Good Design, Important Concepts Related to Research Design, Different Research Designs, Basic Principles of Experimental Design, Developing a Research Plan, Steps in sample design, types of sample designs.

UNIT-IV

Data Collection and Analysis: Data Collection: Methods of data collection, importance of Parametric, non-parametric test, testing of variance of two normal population, use of Chi-square, ANOVA, F-test, z-test

UNIT-V

Patents and Copyright: Patent: Macro economic impact of the patent system, Patent document, how to protect your inventions. Granting of patent, Rights of a patent, how extensive is patent protection. Copyright: What is copyright. What is covered by copyright? How long does copyright last? Why protect copyright? Related Rights: what are related rights? Enforcement of Intellectual Property Rights: Infringement of intellectual property rights, Case studies of patents and IP Protection

Text Books:

1. C.R Kothari, "Research Methodology, Methods & Technique"; New Age International Publishers, 2004
2. R. Ganesan, "Research Methodology for Engineers", MJP Publishers, 2011
3. Y.P. Agarwal, "Statistical Methods: Concepts, Application and Computation", Sterling Publs., Pvt., Ltd., New Delhi, 2004.

Suggested Reading:

1. AjitParulekar and Sarita D' Souza, "Indian Patents Law – Legal & Business Implications"; Macmillan India ltd, 2006
2. B. L.Wadehra; "Law Relating to Patents, Trade Marks, Copyright, Designs & Geographical Indications"; Universal law Publishing Pvt. Ltd., India 2000.
3. P. Narayanan; "Law of Copyright and Industrial Designs"; Eastern law House, Delhi 2010

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20EC E103

GLOBAL NAVIGATION SATELLITE SYSTEMS

(Program Elective)

Instruction	3 L Hours per Week
Duration of SEE	3 Hours
SEE	60 Marks
CIE	40 Marks
Credits	3

Prerequisite: A prior knowledge of fundamental concepts of satellite communication is required.

Course Objectives:

This course aims to:

1. Explain the basic principles of various positioning techniques and introduce GPS operating principle, signal structure.
2. Make the students to understand errors affecting GNSS performance and analyze various parameters of RINEX data.
3. Make the students appreciate the significance of other GNSS systems, principle of DGPS and augmentation systems.

Course Outcomes:

Upon completion of this course, students will be able to:

1. Apply the concepts of satellite communications in understanding the principle of operation of various navigation systems and GPS fundamentals.
2. Analyze GPS signal structure and receiver functioning and compare coordinate systems and datum.
3. Interpret the effect of various error sources and satellite geometry on the performance of GNSS and explain the necessity of GPS modernization and importance of integration aspects.
4. Develop data processing methods using observation and navigation data for GPS and DGPS.
5. Compare other global and regional navigational systems and assess the performance of various augmentation systems.

UNIT-I:

GPS Fundamentals: INS, Trilateration, Hyperbolic navigation, Transit, GPS principle of operation, architecture, operating frequencies, orbits, Keplerian elements.Solar and Sidereal days, GPS and UTC Time.

UNIT-II:

GPS Signals: Signal structure, C/A and P-Code, ECEF and ECI coordinate systems and WGS 84 and Indian Datums, Important components of receiver and specifications, link budget.

UNIT-III:

GPS Error Models: Ionospheric error, Tropospheric error, Ephemeris error, Clock errors, Satellite and receiver instrumental biases, Antenna Phase center variation, multipath; estimation of Total Electron Content (TEC) using dual frequency measurements, Various DOPs, UERE. Spoofing and Anti-spoofing: Future GPS satellites, new signals and their benefits GPS integration – GPS/GIS, GPS/INS, GPS/pseudolite, GPS/cellular.

UNIT-IV:

GPS Data Processing, DGPS and Applications: RINEX Navigation and Observation formats, Code and carrier phase observables, linear combination and derived observables, Ambiguity resolution, cycle slips, Position estimation. Principle of operation of DGPS, architecture and errors.

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UNIT-V:

Other Constellations and Augmentation Systems: Other satellite navigation constellations: GLONASS, Galileo, Beidou and QZSS.

IRNSS: Architecture, signals, advantages and limitations,

SBAS and GBAS: Relative advantages of SBAS and GBAS, Wide area augmentation system (WAAS) architecture, GAGAN, EGNOS and MSAS. Local area augmentation system (LAAS) concept.

Text Books:

1. B.HofmannWollenhof, H.Lichtenegger, and J.Collins, "GPS Theory and Practice", Springer Wien, New York, 2000.
2. PratapMisra and Per Enge, "Global Positioning System Signals, Measurements, and Performance", Ganga-Jamuna Press, Massachusetts, 2001.

Suggested Reading:

1. Ahmed El-Rabbany, "Introduction to GPS", Artech House, Boston, 2002.
2. Bradford W. Parkinson and James J. Spilker, "Global Positioning System: Theory and Applications", Volume II, American Institute of Aeronautics and Astronautics, Inc., Washington, 1996.

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20EC E112

SOFTWARE DEFINED AND COGNITIVE RADIO

(Program Elective)

Instruction	3 L Hours per Week
Duration of SEE	3 Hours
SEE	60 Marks
CIE	40 Marks
Credits	3

Prerequisite: A prior knowledge of signal processing, Communication and spectral knowledge is required.

Course Objectives:

This course aims to:

1. Make the students understand the difference between Superhetrodyne Radio and Software defined Radio
2. Differentiate between Cognitive Radio (CR) and SDR and study their architectures.
3. Make the students know about the CR signal processing Techniques and applications.

Course Outcomes:

Upon completion of this course, students will be able to:

1. Explain the difference between the super-heterodyne receiver, Software Defined Radio and Cognitive Radio.
2. Analyze the different architectures of SDR and CR used for real time systems.
3. Evaluate and choose the various spectrum sensing methods based on application.
4. Implement various signal processing techniques for CR networks.
5. Choose the USRP and WARP boards based on the facilities required for a CR application.

UNIT-I

Introduction to SDR: What is Software-Defined Radio, The Requirement for Software-Defined Radio, Legacy Systems, The Benefits of Multi-standard Terminals, Economies of Scale, Global Roaming, Service Upgrading, Adaptive Modulation and Coding, Operational Requirements, Key Requirements, Reconfiguration Mechanisms, Handset Model, New Base-Station and Network, Architectures, Separation of Digital and RF, Tower-Top Mounting, BTS Hoteling, Smart Antenna Systems, Smart Antenna System Architectures.

UNIT-II

Basic Architecture of a Software Defined Radio: Software Defined Radio Architectures, Ideal Software Defined Radio Architecture, Required Hardware Specifications, Digital Aspects of a Software Defined Radio, Digital Hardware, Alternative Digital Processing Options for BTS Applications, Alternative Digital Processing Options for Handset Applications, Current Technology Limitations, A/D Signal-to-Noise Ratio and Power Consumption, Impact of Superconducting Technologies on Future SDR Systems.

UNIT-III

Signal Processing Devices and Architectures: General Purpose Processors, Digital Signal Processors, Field Programmable Gate Arrays, Specialized Processing Units, Tilera Tile Processor, Application-Specific Integrated Circuits, Hybrid Solutions, Choosing a DSP Solution. GPP-Based SDR, Non real time Radios, High-Throughput GPP-Based SDR, FPGA-Based SDR, Separate Configurations, Multi-Waveform Configuration.

UNIT-IV

Cognitive Radio: Techniques and signal processingHistory and background, Communication policy and Spectrum Management, Cognitive radio cycle, Cognitive radio architecture, SDR architecture for cognitive radio, Spectrum sensing Single node sensing: energy detection, cyclo-stationary and wavelet-based sensing- problem formulation and performance analysis based on probability of detection versus SNR. Cooperative sensing: different fusion rules, wideband spectrum sensing- problem formulation and performance analysis based on probability of detection versus SNR.

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UNIT-V

Cognitive Radio: Hardware and Applications: Spectrum allocation models. Spectrum handoff, Cognitive radio performance analysis.Hardware platforms for Cognitive radio (USRP and WARP), details of USRP board, Applications of Cognitive radio

Text Books:

1. Peter B. Kenington,"RF and Baseband Techniques for Software Defined Radio", Artech House, Inc © 2005.
2. Eugene Grayver,"Implementing Software Defined Radio", Springer, New York Heidelberg Dordrecht London, ISBN 978-1-4419-9332-8 2013.
3. Bruce A. Fette, "Cognitive Radio Technology", Elsevier, ISBN 10: 0-7506-7952-2, 2006.

Suggesting Reading:

1. Hüseyin Arslan, "Cognitive Radio, Software Defined Radio and Adaptive Wireless Systems", Springer, ISBN 978-1-4020-5541-6 (HB), 2007.

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20EGA101

ENGLISH FOR RESEARCH PAPER WRITING

(Audit Course)

Instruction	2 L Hours per Week
Duration of SEE	2 Hours
SEE	50 Marks
CIE	--
Credits	Non-Credit

Course Objectives:

This course aims to:

1. To the various purposes of Research Papers and help them infer the benefits and limitations of research.
2. To developing the content, formulating a structure and illustrating the format of writing a research paper.
3. In differentiating between qualitative and quantitative research types.
4. To constructing paragraphs and developing thesis statement.
5. To producing original research papers while avoiding plagiarism.

Course Outcomes:

Upon completion of this course, students will be able to:

1. Illustrate the nuances of research paper writing and draw conclusions about the benefits and limitations of research.
2. Classify different types of research papers and organize the format and citation of sources.
3. Review the literature and categorize between different types of research.
4. Draft paragraphs and write thesis statement in a scientific manner.
5. Develop an original research paper while acquiring the knowledge of how and where to publish their papers.

UNIT-I

Academic Writing

Meaning & Definition of a research paper– Purpose of a research paper – Scope – Benefits – Limitations – outcomes.

UNIT-II

Research Paper Format

Title – Abstract – Introduction – Discussion – Findings – Conclusion – Style of Indentation – Font size/Font types – Indexing – Citation of sources.

UNIT-III

Research Methodology

Methods (Qualitative – Quantitative) Review of Literature. Criticizing, Paraphrasing & Plagiarism.

UNIT-IV

Process of Writing a Research Paper

Choosing a topic - Thesis Statement – Outline – Organizing notes - Language of Research – Word order, Paragraphs – Writing first draft–Revising/Editing - The final draft and proof reading.IEEE Style.

UNIT-V

Research Paper Publication

Reputed Journals – National/International – ISSN No, No. of volumes, Scopus Index/UGC Journals – Freepublications - Paid Journal publications – /Advantages/Benefits

Text Book:

1. C. R Kothari, Gaurav, Garg, Research Methodology Methods and Techniques, New Age International Publishers. 4th Edition.

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Suggested Reading:

1. Day R, "How to Write and Publish a Scientific Paper", Cambridge University Press, 2006.
2. MLA "Hand book for writers of Research Papers", East West Press Pvt. Ltd, New Delhi, 7th Edition.
3. Lipson, Charles(2011), Cite Right: A Quick Guide to Citation Styles; MLA, APA, Chicago,The Sciences, Professions, and more (2nd Edition). Chicago [u.a]: University of Chicago Press.

Online Resources:

1. NPTEL: https://onlinecourses.nptel.ac.in/noc18_mg13/preview
2. NPTEL: https://nptel.ac.in/courses/121/106/121106007/
3. https://www.classcentral.com/course/swayam-introduction-to-research-5221

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20EC C106

ADVANCED DIGITAL SIGNAL PROCESSINGLAB

Instruction	4 P Hours per Week
Duration of SEE	--
SEE	--
CIE	50 Marks
Credits	2

Prerequisite: The knowledge of signal processing algorithms and MATLAB are required.

Course Objectives:
This course aims to:
1. Simulation of FFT, Multirate concepts using MATLAB.
2. Spectral analysis of noisy signals using MATLAB.
3. Implementation of digitalfilters using MATLAB.

Course Outcomes:
Upon completion of this course, students will be able to:
1. Implement FFT algorithms for linear filtering and correlation using MATLAB.
2. Design and realize of the digital filters using MATLAB.
3. Experiment with multirate techniques using MATLAB.
4. Perform parametric and non-parametric estimation of PSD using MATLAB.
5. Design and Implement the adaptive filters using MATLAB.

List of Experiments:
1. FFT of input sequence and comparison with DFT.
2. Design of IIR Butterworth, Chebyshev type-I &II, Elliptic LPF, HPF, BPF &BSF and calculate Group delay.
3. Design of FIR LPF, HPF, BPF &BSF using windows. Multiband FIR filter and calculate Group delay.
4. State space matrix representation from difference equation
5. Solution of normal equation using Levinson Durbin
6. Decimation and Interpolation using rational factors
7. Design a Multistage decimator multirate filter
8. Maximally decimated analysis DFT filter bank
9. Cascade and parallel realization of digital IIR filter
10. Convolution and M fold Decimation.
11. Parametric Estimation of PSD
12. Nonparametric Estimation of PSD
13. Design of Adaptive filter using LMS algorithm.

Sample Mini Projects:

1. Design the best IIR band pass filter to meet the given specifications:
   Pass band cut off frequencies: [500 600] Hz
   Stop band cut off frequencies: [525 675] Hz
   Pass band ripple: ≤ 2dB
   Stop band attenuation: ≥ 60dB
   Phase response: Approximately linear in pass band Consider Butterworth, Chebyshev, Elliptic and Bessel filters
2. Design a three stage multirate filter to meet the given specifications:
   Pass band cut off frequency: 450 Hz
   Stop band cut off frequency: 500 Hz
   Pass band ripple: ≤ 3dB
   Stop band attenuation: ≥ 40dB
   Sampling frequency: 40 KHz
   Compare with single stage filter.

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3. Consider a clean speech signal of length 5000 samples and compute the Power Spectrum. Now add 0dB random noise. Compute the power spectrum using Welch and Eigen value Estimation method and also compare with the original spectrum.

4. Design a speech signal compression using octave filter banks and also calculate the compression ratio.

Suggested Reading:

1. Vinay K. Ingle and John G. Proakis, "Digital Signal Processing using MATLAB", 4th edition, Cengage learning, 2011.

20EC C108

WIRELESS AND MOBILE COMMUNICATION LAB

Instruction	4 P Hours per Week
Duration of SEE	--
SEE	--
CIE	50 Marks
Credits	2

Prerequisite: Requires concepts of Electromagnetic theory, Antennas & Wave propagation and Digital Communication.

Course Objectives:
This course aims to:

1. Facilitate the experimental setup for understanding the Cellular concepts and experiments using GSM and CDMA.
2. Provide the facility to learn AT commands in 3G networks andDSSS technique for CDMA to observe various spread spectrum parameters.
3. Build knowledge on concepts of software radio by studying building blocks such as Baseband and RF section.

Course Outcomes:
Upon completion of this course, students will be able to:

1. Appraising Cellular concepts, GSM and CDMA networks.
2. Experimenting with GSM handset and fault insertion techniques.
3. Illustrate 3G communication system by means of various AT commands usage in GSM.
4. Testing on DSSS kit for implementing CDMA concept.
5. Develop concepts of Software Radio in real time environment

List of Experiments:

1. Study of DSSS technique for CDMA to observe effect of PN codes, Chip rate, Spreading factor and Processing gain.
2. Study of GSM handset for various signaling and Fault insertion techniques (Major GSM handset sections: clock, SIM card, charging, LCD module, Keyboard, User interface).
3. Study Transmitter and Receiver sections in Mobile Handset and also measure GMSK modulated signal.
4. Study various GSM AT Commands such as SMS and HTTP.
5. Study File system by AT commands in 3G network.
6. Establishing Call Setup, Estimation of Coverage area and Capacity in GSM and CDMA.
7. Develop concepts of Software radio by studying building blocks such as Baseband and RF section.
8. Develop Convolutional Encoder, Interleaver and De-Interleaver in Software Radio.
9. Study and analyze different modulation techniques in time and frequency domains using SDR Kit.
10. Estimation of GPS satellite position using RINEX data.
11. Estimation of key performance parameters of IRNSS L5 and S1 band signals.
12. Estimation of user position using GNSS Single Frequency receiver.

Suggested Reading:

1. T.S.Rappaport, "Wireless Communications Principles and Practice", 2nd edition, PHI, 2002.

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20EC C101

ADVANCED COMMUNICATION NETWORKS

Instruction	3 L Hours per Week
Duration of SEE	3 Hours
SEE	60 Marks
CIE	40 Marks
Credits	3

Prerequisite: Students should have in depth knowledge of Computer Networks.

Course Objectives:
This course aims to:
1. Familiarize the student with the basic taxonomy and terminology of the computer networking area.
2. Provide the student with knowledge of advanced networking concepts and techniques.
3. Provide the student with knowledge of Real Time Communications over Internet and Packet Scheduling.

Course Outcomes:
Upon completion of this course, students will be able to:
1. Recall the concepts and Issues of Real Time Communications over Internet.
2. Classify protocols and algorithms for Communication Networks.
3. Identify the mechanisms for Quality of Service in networking.
4. Analyze IP addressing challenges and services in Internet
5. Explain the different versions of IP Protocols, IP switching and MPLS Protocols.

UNIT-I
Overview of Internet Concepts, Challenges and History: Overview of -ATM. TCP/IPCongestion and Flow Control in Internet; Throughput analysis of TCP congestion control, TCP for high bandwidth delay networks and Fairness issues in TCP.

UNIT-II
Issues of Real Time Communications over Internet: Adaptive applications, Latency and throughput, Integrated Services Model (IntServ), Resource reservation Protocol. Characterization of Traffic by LinearlyBounded Arrival Processes (LBAP), Leaky bucket algorithm and its properties.

UNIT-III
Packet Scheduling Algorithms-Requirements and Choices: Scheduling guaranteed service Connections, GPS, WFQ and Rate proportional algorithms, High speed scheduler design; Theory of Latency Rate servers and delay bounds in packet switched networks for LBAP traffic; Active Queue Management - RED, WRED and Virtual clock, Control theoretic analysis of active queue management.

UNIT-IV
IP Address Lookup-Challenges: Packet classification algorithms and Flow Identification, Grid of Tries, Cross producting and controlled prefix expansion algorithm.Admission control in Internet: Concept of Effective bandwidth, Measurement based admission control; Differentiated Services in Internet (DiffServ), DiffServ architecture and framework.

UNIT-V
IPV4, IPV6, IP tunneling, IP switching and MPLS, Overview of IP over ATM and its Evolution to IP switching; MPLS architecture and framework, MPLS Protocols, Traffic Engineering issues in MPLS.

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Text Books:

1. J.F. Kurose & K.W. Ross, "Computer Networking- A top down approach featuring the internet", Pearson, sixth edition, 2013.
2. Nader F. Mir, "Computer and Communication Networks", second edition, 2015.

Suggested Reading:

1. Anurag Kumar, D. Manjunath and Joy Kuri, "Communication Networking: An Analytical Approach", Morgan Kaufman Publishers, 2004.
2. Jean Wairand and PravinVaraiya, "High Performance Communications Networks", 2nd edition, 2000.

20EC C103

ANTENNAS AND RADIATING SYSTEMS

Instruction	3 L Hours per Week
Duration of SEE	3 Hours
SEE	60 Marks
CIE	40 Marks
Credits	3

Prerequisite: Students should have prior knowledge of Electromagnetic waves.

Course Objectives:
This course aims to:
1. The basic principles of an antenna and its parameters for characterizing its performance.
2. The fundamental concepts of various types of antennas, arrays for customizing the pattern parameters.
3. The concept of aperture and microstrip antennas.

Course Outcomes:
Upon completion of this course, students will be able to:
1. Understand the radiation parameters of an antenna.
2. Apply the concept of current distribution to analyze the antennas.
3. Analyze the linear arrays for uniform distribution.
4. Appraise the characteristics of broad side, end fire arrays and non-uniform arrays.
5. Learn the aperture antennas using Huygen's principle, image theory and Microstrip antennas.

UNIT-I
Radiation Mechanism, Fundamental Parameters of Antennas: Radiation Pattern, Radiation Power Density, Radiation Intensity, Directivity, Gain, Antenna efficiency, Beam efficiency, Bandwidth, Polarization, Input Impedance, Region separation, Antenna Temperature, Antenna vector effective length, Friis Transmission equation, Significance of current distribution.

UNIT-II
Infinitesimal dipole, Analysis of Finite length dipole, half wave dipole, Ground effects, Small Circular loop, Circular loop with non-uniform current distribution.

UNIT-III
Linear Arrays: Two element array, N-Element array: Uniform Amplitude and spacing, Broadside and End fire arrays, Super directivity, planar array, Design consideration, Introduction to linear arrays with non-uniform distributions: Binomial and Tschebyscheff distribution.

UNIT-IV
Aperture Antennas: Huygen's Field Equivalence principle, Image theory, radiation equations, Rectangular Aperture. Horn Antennas: E-Plane, H-plane horns and Pyramidal horn antennas.

UNIT-V
Reflector Antennas: Plane reflector, parabolic reflector, Efficiency calculation of parabolic reflector antenna, Cassegrain reflectors.
Microstrip Antennas: Basic Characteristics, feeding mechanisms, Rectangular Patch design using TL method and Circular Patch design using cavity model method.

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Text Books:

1. Constantine A. Balanis, "Antenna Theory: Analysis and Design," 4th Edition, John Wiley, 2016
2. Edward C. Jordan and Kenneth G. Balmain, "Electromagnetic Waves and Radiating Systems," 2nd Edition, PHI, 2009
3. John D. Krauss, Ronald J. Marhefka& Ahmad S. Khan, "Antennas and Wave Propagation," 4th Edition, TMH, 2010

Suggested Reading:

1. Dennis Roody and John Coolen, "Electronic Communications", 4th Edition, Prentice Hall, 2008.
2. R.C.Johnson and H.Jasik, "Antenna Engineering hand book", Mc-Graw Hill, 1984.
3. I.J.Bhal and P.Bhartia, "Micro-strip antennas", Artech house, 1980.

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20EC E111

SIGNAL INTELLIGENCE SYSTEMS

(Program Elective)

Instruction	3 L Hours per Week
Duration of SEE	3 Hours
SEE	60 Marks
CIE	40 Marks
Credits	3

Prerequisite: Basic knowledge of Radar, Communication and Antenna concepts are required.

Course Objectives:

This course aims to:

1. Elucidate the concepts of electronic intelligence using the fundamentals of radar and localization techniques with necessary mathematical analysis.
2. Explain the operating principles of COMINT Systems based on various localization and position fixing techniques.
3. Provide salient features of EW Systems and Electronic Jamming.

Course Outcomes:

Upon completion of this course, students will be able to:

1. Apply the knowledge of Communication and Antenna concepts in understanding the operating principles of Radar and Drones.
2. Discuss the salient features of EW Systems and identify the type of Electronic Jamming.
3. Analyze the intricacies of ELINT Systems.
4. Estimate the DF and position of ELINT/COMINT Systems for simple cases.
5. Interpret the type of modulation of COMINT systems.

UNIT-I

Principles of RADAR and DRONES: Radar Range equation, probability of false alarm, probability of detection, Radar cross section fluctuations, Blind speed, Pulse Repetition Frequency (PRF), Unambiguous range, Principles and Classification of Drones and their applications.

UNIT-II

Communication EW Systems and Techniques for Electronic Jamming: Introduction, Information warfare, Electronic warfare: Electronic support, Electronic attack, Electronic Protect. Typical EW System Configuration. Electronic attack: A General Description of the Basic Elements of Electronic Jamming, Communication jamming, jammer deployment, narrow band/partial-band jamming, barrage jamming, follower jammer, jamming LPI targets. Spoofing: Spoofing generation, detection and anti-spoofing.

UNIT-III

Electronic Intelligent (ELINT) Systems: Electronic Intelligence Defined, The Importance of Intercepting and Analyzing Radar Signals, Limitations Due to Noise, Probability of Intercept Problems. Inferring Radar Capabilities from observed Signal Parameters, Receivers for Radar Interception, Major ELINT Signal Parameters, the Impact of LPI Radar on ELINT.

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UNIT-IV

Direction Finding: Direction Finding, Instantaneous Direction Finding. Amplitude Comparison AOA Measurement, Phase Interferometers.

Position Fixing Position fixing algorithms: Eliminating Wild Bearings, Stansfield Fix Algorithm, Mean-Squared Distance Algorithm. Single-site location techniques: Fix accuracy, fix coverage. Time of Arrival, Time difference of Arrival: Position-Fixing using TDOA Measurements, Differential Doppler.

UNIT-V

Communication Intelligent (COMINT) Systems: Encryption: Cryptologic Architectures, Pretty Good Privacy, Digital Signatures, Decryption, Recognition of Modulation: Analogue Modulated Signal Recognition Algorithms (AMRAs): Classification of each segment, Classification of a signal frame, Digitally Modulated Signal Recognition Algorithms (DMRAs): Classification of each segment, Classification of a signal frame.

Text Books:

1. Richard G. Wiley, "ELINT: The Interception and analysis of Radar Signals", Artech House Inc., 2006.
2. Richard A. Poisel, "Introduction to Communication Electronic Warfare Systems", 2nd edition, Artech house, Inc., 2008.

Suggested Reading:

1. Sergei A. Vakin, Lev N. Shustov, Robert H. Dunwell "Fundamentals of Electronic Warfare", Artech House, Inc., 2001.
2. ElsayedElsayedAzzouz, Asoke Kumar Nandi, "Automatic Modulation Recognition of Communication Signals", Springer Science+Business Media, B.V, 1996.

20EC E106

INTERNET OF THINGS

(Program Elective)

Instruction	3 L Hours per Week
Duration of SEE	3 Hours
SEE	60 Marks
CIE	40 Marks
Credits	3

Prerequisite: Knowledge onProgramming and Problem Solving, Computer Organization and embedded systems.

Course Objectives:

This course aims to:

1. Provide an overview of Internet of Things, building blocks of IoT and the real-world applications.
2. Introduce Python Programming language and packages.
3. Introduce Raspberry Pi device, its interfaces and Django Framework.

Course Outcomes:

Upon completion of this course, students will be able to:

1. Understand the terminology, enabling technologies and applications of IoT
2. Apply the concept of M2M and understand the basics of modern networking with the concepts of SDN and NFV.
3. Understand the basics of Python Scripting Language which is used in many IoT devices.
4. Describe the steps involved in IoT system design methodology.
5. Design simple IoT systems using Raspberry Pi board with sensors, actuators and develop web applications using python-based framework called Django.

UNIT-I

Introduction and Concepts: Introduction to Internet of Things, definitions and characteristics of IoT, physical design of IoT-Things in IoT, IoT Protocols, Logical Design of IoT-IoT Functional Blocks, IoT Communication Models, IoT Communication APIs, IOT Enabling TechnologiesWireless Sensor Networks, Cloud Computing, Big Data Analytics, Communication Protocols, Embedded Systems, IoT Levels & Deployment Templates.

UNIT-II

Domain Specific IoTs: IoT applications for Home Automation, Cities, Environment, Energy, Retail, Logistics, Agriculture, Industry, health and Lifestyle

IoT and M2M: Introduction, M2M, Differences between IoT and M2M, Software Defined Networking, Network Function Virtualization.

UNIT-III

Introduction to Python: Motivation for using Python for designing IoT systems, Language features of Python, Data types- Numbers, Strings, Lists, Tuples, Dictionaries, Type Conversions, Data Structures: Control of flow-if, for, while, range, break/continue, pass, functions, modules, packaging, file handling, data/time operations, classes, Exception handling, Python packages of Interest for IoT - JSON, XML, HTTPLib, URLLib and SMTPLib.

UNIT-IV

IoT Platforms Design Methodology: Introduction, IoT Design Methodology Steps-Purpose and Requirements Specification, Process Specification, Domain Model Specification, Information Model Specification, Service Specifications, IoT Level Specification, Functional View Specification, Operational View Specification, Device and Component Integration, Application Development, Case Study on IoT System for Weather Monitoring.

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UNIT-V

IoT Physical Devices and End Points: Basic building blocks of an IoT device, Raspberry Pi-About theRaspberry Pi board, Raspberry Pi Interfaces-Serial, SPI, I2C, Other IoT Devices-pcDuino, BeagleBone Black, Cubieboard

IoT Physical Servers and Cloud Offerings: Introduction to cloud storage models and Communication APIs, WAMP-AutoBahn for IoT, Xivelycloud for IoT

Python Web Application Framework: Django Framework-Roles of Model, Template and View

Text Books:

1. ArshdeepBahga and Vijay Madisetti, “Internet of Things - A Hands-on Approach, Universities Press", 2015.
2. Bill Lubanovic "Introducing Python: Modern Computing in Simple Packages", O’Reilly Media, Inc, USA, 2015.

Suggested Reading:

1. Francis daCosta, “Rethinking the Internet of Things: A Scalable Approach to Connecting Everything”, 1st edition, Apress Publications, 2013.
2. Matt Richardson andShawn Wallace O'Reilly, “Getting Started with Raspberry Pi”, SPD, 2014.

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20EC A101

VALUE EDUCATION

(Audit Course)

Instruction	2 L Hours per Week
Duration of SEE	2 Hours
SEE	50 Marks
CIE	--
Credits	Non-Credit

Course Objectives:

This course aims to

1. Understand the need and importance of Values for self-development and for National development.
2. Imbibe good human values and Morals
3. Cultivate individual and National character.

Course outcomes:

After completion of the Course, Students will be able to

1. Summarize classification of values and values for self-development.
2. Identify the importance of values in personal and professional life.
3. Apply the importance of social values for better career and relationships.
4. Compile the values from holy books for personal and social responsibility.
5. Discuss concept of soul and reincarnation, values Dharma, Karma and Guna.

UNIT-I

Human Values, Ethics and Morals: Concept of Values, Indian concept of humanism, human values; Values for self-development, Social values, individual attitudes; Work ethics, moral and non- moral behavior, standards and principles based on religion, culture and tradition.

UNIT-II

Value Cultivation, and Self-Management: Need and Importance of cultivation of values such as Sense-of Duty, Devotion to work, Self-reliance, Confidence, Concentration, Integrity & discipline, and Truthfulness.

UNIT-III

Spiritual Outlook and Social Values: Personality and Behavior, Scientific attitude and Spiritual (soul) outlook; Cultivation of Social Values Such as Positive Thinking, Punctuality, Love & Kindness, avoiding fault finding in others, Reduction of anger, forgiveness, Dignity of labour, True friendship, Universal brotherhood and religious tolerance.

UNIT-IV

Values in Holy Books : Self-management and Good health; and internal & external Cleanliness, Holy books versus Blind faith, Character and Competence, Equality, Nonviolence, Humility, Role of Women.

UNIT-V

Dharma, Karma and Guna: Concept of soul; Science of Reincarnation, Character and Conduct, Concept of Dharma; Cause and Effect based Karma Theory; The qualities of Devine and Devilish; Satwic, Rajasic and Tamasicgunas.

Text Books:

1. Chakroborty, S.K. “Values & Ethics for organizations Theory and practice”, Oxford University Press, New Delhi, 1998.
2. Jaya DayalGoyandaka, “Srimad Bhagavad Gita”, withSanskrit Text, Word meaning and Prose meaning, Gita Press, Gorakhpur, 2017.

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20EC C105

ADVANCED COMMUNICATION NETWORKS LAB

Instruction	4 P Hours per Week
Duration of SEE	--
SEE	--
CIE	50 Marks
Credits	2

Prerequisite: Students should have in depth knowledge of Computer Networks.

Course Objectives:
This course aims to:
1. Provide the student with knowledge sub-netting and routing mechanisms.
2. Provide the student with knowledge of basic routing protocols for Network design and implementation.
3. Provide the student with knowledge configuring User Datagram Protocol.

Course Outcomes:
Upon completion of this course, students will be able to:
1. Identify the different types of network devices and their functions within a network.
2. Understand and build the skills of sub-netting and routing mechanisms.
3. Understand basic protocols of computer networks, and how they can be used to assist in Network design and implementation.
4. Configure a network using Linux and a mail server for IMAP/POP protocols
5. Design and configure UDP Client Server

List of Assignments:
1. Study of Networking Commands (Ping, Tracert, TELNET, nslookup, netstat, ARP, RARP) and Network Configuration Files.
2. Linux Network Configuration.
   a. Configuring NIC's IP Address.
   b. Determining IP Address and MAC Address using if-config command.
   c. Changing IP Address using if-config.
   d. Static IP Address and Configuration by Editing.
   e. Determining IP Address using DHCP.
   f. Configuring Hostname in /etc/hosts file.
3. Design TCP iterative Client and Server application to reverse the given input sentence.
4. Design a TCP concurrent Server to convert a given text into upper case using multiplexing system call "select".
5. Design UDP Client Server to transfer a file.
6. Configure a DHCP Server to serve contiguous IP addresses to a pool of four IP deviceswitha default gateway and a default DNS address. Integrate the DHCP server with aBOOTP demon to automatically serve Windows and Linux OS Binaries based on clientMAC address.
7. Configure DNS: Make a caching DNS client, and a DNS Proxy; implement reverseDNS and forward DNS, using TCP dump/Wire shark characterize traffic when theDNS server is up and when it is down.
8. Configure a mail server for IMAP/POP protocols and write a simple SMTP client inC/C++/Java client to send and receive mails.
9. Configure FTP Server on a Linux/Windows machine using an FTP client/SFTP clientCharacterize file transfer rate for a cluster of small files 100k each and a video file of700mb.Use a TFTP client and repeat the experiment.
10. Signaling and QoS of labeled paths using RSVP in MPLS.
11. Find shortest paths through provider network for RSVP and BGP.
12. Understand configuration, forwarding tables, and debugging of MPLS.

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Suggested Reading:

1. J.F. Kurose & K.W. Ross, "Computer Networking- A top down approach featuring the internet", Pearson, Sixth Edition, 2013.
2. Nader F. Mir, Computer and Communication Networks, second edition, 2015.

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20EC C107

ANTENNAS AND RADIATING SYSTEMS LAB

Instruction	4 P Hours per Week
Duration of SEE	--
SEE	--
CIE	50 Marks
Credits	2

Prerequisite: The knowledge of antennas is essential.

Course Objectives:
This course aims to:

1. Understand the characteristics and radiation pattern of Infinitesimal antenna.
2. Simulate various antennas.
3. Study the effect of change in different parameters on antenna arrays.

Course Outcomes:
Upon completion of this course, students will be able to:

1. Determine specifications, design, construct and test antenna.
2. Explore and use tools for designing, analyzing and testing antennas.
3. Apply the concept of current distribution to find the field patterns.
4. Estimate the effect of the height of the monopole antenna on the radiation characteristics.
5. Study the effect of the variation of phase difference 'beta' between the elements of the array and case studies.

List of Experiments:

1. Simulation of half wave dipole antenna.
2. Simulation of change of the radius and length of dipole wire on frequency of resonance ofantenna.
3. Simulationofquarterwave, fullwaveantennaandcomparisonoftheir parameters.
4. Simulation ofmonopole antenna with and without groundplane.
5. Study the effect of the height of the monopole antenna on the radiation characteristics of the antenna.
6. Simulation of a half wave dipole antennaarray.
7. Study the effect of change in distance between elements of array on radiation pattern of dipole array.
8. Study the effect of the variation of phase difference 'beta' between the elements of the array on the radiation pattern of the dipole array.

Note: The above experiments are to be carried out by using any appropriate simulation software.

Suggested Reading:

1. Li Ming Yang,"HFSS antenna design", 2nd edition,Electronic Industry Press, 2014.

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20EC C109

MINI PROJECT WITH SEMINAR

Instruction	4 P Hours per Week
Duration of SEE	--
SEE	--
CIE	50 Marks
Credits	2

Prerequisite: Knowledge of preparing slides by using power point presentations, Capable of searching for suitable literature and Presentation skills.

Course Objectives:
This course aims to:

1. The mini-project shall contain a clear statement of the research objectives, background of work, literature review, techniques used, prospective deliverables, and detailed discussion on results, conclusions and references.
2. To expose and practice of searching and referring the required literature.
3. This is expected to provide a good initiation for the student(s) towards R&D.

Course Outcomes:
Upon completion of this course, students will be able to:

1. Familiarize in searching the suitable literature in the chosen field.
2. Develop skills to understand and summarize the contents from the literature.
3. Ability to synthesize knowledge/ skills previously gained and applied in execution of a chosen technical problem.
4. Enhance oral presentation skills through power point presentations.
5. Learn and present the findings of their technical solution in a written report.

Guidelines:

1. As part of the curriculum in the II - Semester of the Program each student shall do a mini project, generally comprising about three to four weeks of prior reading, twelve weeks of active research, and finally a presentation of their work for assessment.
2. Each student will be allotted to a faculty supervisor for mentoring.
3. Mini projects should present students with an accessible challenge on which to demonstrate competence in research techniques, plus the opportunity to contribute something more original.
4. Mini projects shall have inter-disciplinary/ industry relevance.
5. The students can select a mathematical modeling based/Experimental investigations or Numerical modeling.
6. All the investigations are clearly stated and documented with the reasons/explanations.
7. The mini-project shall contain a clear statement of the research objectives, background of work, literature review, techniques used, prospective deliverables, detailed discussion on results, conclusions and references.

Departmental Committee: Supervisor and two faculty coordinators

Guidelines forawarding Marks inCIE:	Max. Marks: 50	
Evaluation by	**Max. Marks**	**Evaluation Criteria / Parameter**
Supervisor	20	Progress and Review
	05	Report
Departmental Committee	05	Relevance of the Topic
	05	PPT Preparation
	05	Presentation
	05	Question and Answers
	05	Report Preparation

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20EC E108

MIMO WIRELESS COMMUNICATIONS

(Program Elective)

Instruction	3 L Hours per Week
Duration of SEE	3 Hours
SEE	60 Marks
CIE	40 Marks
Credits	3

Prerequisite: Knowledge on communication systems, antenna and wave propagation.

Course Objectives:

This course aims to:

1. Understand the basic principles and need of MIMO systems
2. Analyze the MIMO system in terms of space-time coding and various beam forming methodologies.
3. Channel estimation for single carrier and multiple carrier systems.

Course Outcomes:

Upon completion of this course, students will be able to:

1. Recall Concepts of MIMO, Diversity, generic MIMO problem and Channel Estimation in wireless communication system.
2. Compare the diversity techniques, Propagation channels, Channel dispersion and Channel Estimation techniques.
3. Apply Diversity Techniques and Pre-Coding techniques in MIMO
4. Analyze channel modeling and propagation, MIMO Capacity, space-time coding.
5. Explain the MIMO in LTE and Channel Estimation techniques.

UNIT-I

Introduction to Multiantenna Systems, Motivation, Types of Multi-Antenna Systems: Switched beam, Adaptive Array, MIMO vs. Multi-Antenna Systems.

UNIT-II

Diversity, exploiting multipath diversity, receive diversity, transmit diversity, Delay diversity, Space time codes, The Alamouti scheme, the rake receiver, combining techniques, Spatial Multiplexing, Spectral efficiency and capacity, Transmitting independent streams in parallel, Mathematical notation.

UNIT-III

The generic MIMO problem, Eigenvalues and eigenvectors, Pre-coding and combining in MIMO systems, Advantages and Disadvantages of pre-coding and combining, Codebooks for MIMO, Beam forming, Beam forming principles, Interference cancellation, Switched beam former, Adaptive beam former, Narrowband beam former, Wideband beam former.

UNIT-IV

MIMO in LTE, Pre-coding for spatial multiplexing, Pre-coding for transmit diversity, Propagation Channels, Time & frequency channel dispersion, AWGN and multipath propagation channels, Delay spread values and time variations, Fast and slow fading environment, Narrowband and wideband channels, MIMO channel models.

UNIT-V

Channel Estimation, Channel estimation techniques, Estimation and tracking, Training Based channel estimation, Blind channel estimation, MMSE channel estimation, Channel estimation in single carrier systems.

Text Books:

1. Claude Oestges and Bruno Clerckx, "MIMO Wireless Communications: From Real-worldPropagation to Space-time Code Design", Academic Press, 1st edition, 2010.
2. MohinderJanakiraman, “Space - Time Codes and MIMO Systems”, Artech House Publishers, 2004.

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Suggested Reading:

1. Jerry R.Hampton, "Introduction to MIMO Communications", Cambridge university press, 1st Edition, 2014.
2. Joseph C.Liberti and Jr. Bellcore, Theodore S. Rappaport "Smart Antennas for Wireless Communications", IS-95 and third generation CDMA applications,Prentice Hall, 1st Edition, 1999.

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20CS O101

BUSINESS ANALYTICS

(Open Elective)

Instruction	3 L Hours per Week
Duration of SEE	3 Hours
SEE	60 Marks
CIE	40 Marks
Credits	3

Course Objectives:

This course aims to:

1. Understanding the basic concepts of business analytics and applications
2. Study various business analytics methods including predictive, prescriptive and prescriptive analytics
3. Prepare the students to model business data using various data mining, decision making methods

Course Outcomes:

Upon completing this course, students will be able to:

1. Identify and describe complex business problems in terms of analytical models.
2. Apply appropriate analytical methods to find solutions to business problems that achieve stated objectives.
3. Interpret various metrics, measures used in business analytics
4. Illustrate various descriptive, predictive and prescriptive methods and techniques
5. Model the business data using various business analytical methods and techniques
6. Create viable solutions to decision making problems

UNIT-I

Introduction to Business Analytics: Introduction to Business Analytics, need and science of data driven (DD) decision making, Descriptive, predictive, prescriptive analytics and techniques, Big data analytics, Web and Social media analytics, Machine Learning algorithms, framework for decision making, challenges in DD decision making and future.

UNIT-II

Descriptive Analytics: Introduction, data types and scales, types of measurement scales, population and samples, measures of central tendency, percentile, decile and quadrille, measures of variation, measures of shape-skewness, data visualization

UNIT-III

Forecasting Techniques: Introduction, time-series data and components, forecasting accuracy, moving average method, single exponential smoothing, Holt's method, Holt-Winter model, Croston's forecasting method, regression model for forecasting, Auto regression models, auto-regressive moving process, ARIMA, Theil's coefficient

UNIT-IV

Decision Trees: CHAID, Classification and Regression tree, splitting criteria, Ensemble and method and random forest. **Clustering**: Distance and similarity measures used in clustering, Clustering algorithms, K-Means and Hierarchical algorithms, **Prescriptive Analytics**- Linear Programming (LP) and LP model building,

UNIT-V

Six Sigma: Introduction, introduction, origin, 3-Sigma Vs Six-Sigma process, cost of poor quality, sigma score, industry applications, six sigma measures, DPMO, yield, sigma score, DMAIC methodology, Six Sigma toolbox

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Text Books:

1. U Dinesh Kumar, "Data Analytics", Wiley Publications, 1st Edition, 2017
2. Marc J. Schniederjans, Dara G. Schniederjans, Christopher M. Starkey, "Business analytics Principles, Concepts, and Applications with SAS", Associate Publishers, 2015.

Suggested Reading:

1. S. Christian Albright, Wayne L. Winston, "Business Analytics - Data Analysis and Decision Making", 5th Edition, Cengage, 2015.

Web Resources:

1. https://onlinecourses.nptel.ac.in/noc18-mg11/preview
2. https://nptel.ac.in/courses/110105089/

20EC C110

Industrial Project /Dissertation Phase I

Instruction	20 P Hours per Week
Duration of SEE	--
SEE	--
CIE	100 Marks
Credits	10

Prerequisite: Preferably, student must have completed 'Mini Project with Seminar successfully.

Course Objectives:
This course aims to:

1. The Dissertation Phase-I (Project work) will preferably be a problem with research potential and should involve scientific research, design, generation/collection and analysis of data, determining solution and must preferably bring out the student contribution(s).
2. To expose and learn the required simulation software/experimental techniques.
3. To carry out the work in a research environment or in an industrial environment

Course Outcomes:
Upon completion of this course, students will be able to:

1. Survey the literature such as books, national/international refereed journals and contact resource persons for the selected topic of research/project field.
2. Consolidate the literature survey and will be motivated to define the title of the project, able to decide the aim(s), objectives and design specifications of the project.
3. Learn the required software/ computational/analytical tools for implementations.
4. Document a report comprising of summary of literature survey, detailed objectives, project specifications, or computer aided design, proof of concept/functionality, part of results if any.
5. Get aquatinted to work in a research environment or in an industrial environment

Guidelines:

1. The Project work will preferably be a problem with research potential and should involve scientific research, design, generation/collection and analysis of data, determining solution and must preferably bring out the individual contribution.
2. Seminar should be based on the area in which the candidate has undertaken the dissertation work.
3. The CIE shall include reviews and the preparation of report consisting of a detailed problemstatement and a literature review.
4. The preliminary results (if available) of the problem may also be discussed in the report.
5. The work has to be presented in front of the committee consists of Head, Chairperson-BoS, Supervisor and Project coordinator.
6. The candidate has to be in regular contact with his supervisor and the topic of dissertation must be mutually decided by the guide and student.

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Guidelines for awarding Marks in CIE:		Max. Marks: 100
Evaluation by	**Max. Marks**	**Evaluation Criteria / Parameter**
Supervisor	30	Project Status / Review(s)
	20	Report
Departmental Review Committee	10	Relevance of the Topic
	10	PPT Preparation(s)
	10	Presentation(s)
	10	Question and Answers
	10	Report Preparation

Note: Departmental Review Committee has to assess the progress of the student for every two weeks.

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20EC C111

Industrial Project /Dissertation Phase II

Instruction	32 PHours per Week
Duration of SEE	Viva - Voce
SEE	100 Marks
CIE	100 Marks
Credits	16

Prerequisite: Student must have earned the credit of 'Industrial project/Dissertation phase 1'.

Course Objectives:
This course aims to:

1. Industrial project/Dissertation phase 2 is the continuation of Industrial project/Dissertation phase 1
2. Implementation of Project objectives.
3. Presentation of periodic reviews of the objectives and preparing of Dissertation in a prescribed format

Course Outcomes:
At the end of the course:

1. Capable to select from different methodologies, methods and forms of analysis to produce a suitable research design, and justify their design.
2. Plan experiments for a critical comparison of outputs or to verify the obtained analytical/simulation results with the experimental results available in the literature.
3. Develop attitude of lifelong learning and will develop interpersonal skills to deal with people working in diversified field.
4. Learn to write technical reports and research papers to publish at national and international level.
5. Develop strong communication skills to defend their work in front of technically qualified audience.

Guidelines:

1. It is a continuation of Project work started in semester III.
2. The student has to submit the report in prescribed format and also present a seminar.
3. The dissertation should be presented in standard format as provided by the department.
4. The candidate has to prepare a detailed project report consisting of introduction of the problem, problem statement, literature review, objectives of the work, methodology (experimental set up or numerical details as the case may be) of solution and results and discussion.
5. The report must bring out the conclusions of the work and future scope for the study. The work has to be presented in front of the examiners panel consisting of an approved external examiner, an internal examiner (HoD and BoS Chair Person) guide/co-guide.
6. The candidate has to be in regular contact with his/her guide/co-guide.

Guidelines for awarding marks in CIE:		Max. Marks: 100
Evaluation by	**Max. Marks**	**Evaluation Criteria / Parameter**
Departmental Review Committee	05	Review 1
	10	Review 2
	10	Review 3
	15	Final presentation with the draft copy of the report
	10	Submission of the report in a standard format
Supervisor	10	Regularity and Punctuality
	10	Work Progress
	10	Quality of the work which may lead to publications
	10	Analytical / Programming / Experimental Skills Preparation
	10	Report preparation in a standard format

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Guidelines for awarding marks in SEE:		Max. Marks: 100
Evaluation by	**Max. Marks**	**Evaluation Criteria / Parameter**
External and Internal Examiner(s) together	20	Power Point Presentation
	40	Quality of thesis and evaluation
	20	Quality of the project • Innovations • Applications • Live Research Projects • Scope for future study • Application to society
	20	Viva-Voce

Note: Departmental Review Committee has to assess the progress of the student for every two weeks

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DEPARTMENT OF ECE
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20ECC201

ANALOG AND DIGITAL CMOS VLSI DESIGN

Instruction	3L Hours per week
Duration of SEE	3 Hours
SEE	60 Marks
CIE	40 Marks
Credits	3

Pre-requisites: Analog and Digital design concepts.

Course Objectives:
This course aims to:

1. Characteristic behavior of MOSFET, CMOSFET, FINFET, TFET, Meta Gate Technology.
2. Physical design concepts.
3. Design of Analog and digital circuits.

Course Outcomes:
Upon completion of this course, students will be able to:

1. Understand MOS structure, it's Behavior & fabrication process, various step in physical design flow of CMOScircuits, second order effects in MOS &ESD Models.
2. Design various types of combinational logic circuits and sequential logic circuits
3. Recall various advanced technologies in VLSI industry, the scaling issues, etc.
4. Analyze various analog amplifiers, Current mirror circuits and OP AMP
5. Design Basic Amplifiers, Current Mirrors, basic OPAMP, OP-AMP with different compensations

UNIT-I

Technology Scaling and Road map, Scaling issues, Standard 4 mask NMOS Fabrication process, Review: Basic MOS structure and its static behavior, Stick diagram and Layout, Inverter: Static CMOS inverter, Switching threshold and noise margin concepts and their evaluation of dynamic behavior, Power consumption.

UNIT-II

Physical Design Flow: Floor planning, Placement, Routing, CTS, Power analysis and IR drop estimation-static and dynamic ESD protection-human body model, Machine model, Combinational logic: Static CMOS design, Logic effort, Ratioed logic, Pass transistor logic, Dynamic logic Speed and power dissipation in dynamic logic Cascading dynamic gates, CMOS transmission gate logic.

UNIT-III

Sequential Logic: Static latches and registers, MUX based latches, Static SR flip-flops, Master-slave edge-triggered register, Dynamic latches and registers, advanced technologies: Giga-scale dilemma, Short channel effects, High–k, Metal Gate Technology.

UNIT-IV

Introduction to Analog Design, Second order effects MOS small signal model, Single Stage Amplifier: Common Source Amplifier, CS Stage with Source Degeneration, Common Drain Amplifier & Common Gate Stage (resistive load) Current Mirrors: Basic Current Mirrors, Cascode Mirrors, Special Current Mirror, Single Stage Amplifier: Common Source Amplifier with Current source load, Triode load,CM Load, Frequency response of CS stage, Source follower, Common gate stage, Gilbert cell.

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UNIT-V

MOS Difference Pair (One Stage OPAMP), Operational Amplifiers: Two stage OPAMP, Fully differential amplifiers, Slew rate, PSRR, Compensation of two- stage OPAMP, op-amp based comparator, switched capacitor. Introduction to data converters-specifications.

Text Books:

1. J P Rabaey, A P Chandrakasan, B Nikolic, "Digital Integrated circuits: A design perspective", Prentice Hall electronics and VLSI series, 2nd edition 2003
2. David Johns, Ken Martin, "Analog Integrated Circuit Design", John Wiley & sons. 2004
3. Jacob Baker.R.et.al., "CMOS Circuit Design", IEEE Press, Prentice Hall, India, 2000

Suggested Reading:

1. Paul. R. Gray & Robert G. Major, "Analysis and Design of Analog Integrated Circuits", John Wiley & sons. 2004
2. Kang, S. and Leblebici, Y., "CMOS Digital Integrated Circuits, Analysis and Design", TMH, 3rdEdition 2003
3. BehzadRazavi, "Design of Analog CMOS Integrated Circuits", Tata McGraw Hill. 2002

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20ECC203

MICROCONTROLLERS AND PROGRAMMABLE DIGITAL SIGNAL PROCESSORS

Instruction	3L Hours per week
Duration of SEE	3 Hours
SEE	60 Marks
CIE	40 Marks
Credits	3

Prerequisite: Microprocessor and its interfacing

Course Objectives:

This course aims to:

1. LearnaboutARMMicrocontrollerarchitecturalfeatures
2. UnderstandtheARM'C'Programmingforvariousapplications
3. Study the DSP processor fundamentals and its developmenttools

Course outcomes:

Upon completion of this course, students will be able to:

1. Compare and select ARM processor core based on requirements of embeddedapplication
2. AnalyzevariousfeaturesofARMCortex-M SeriesProcessor
3. AbletointerfacevariousI/OdevicestoARM7microcontrollers.
4. UnderstandthebasicarchitecturalneedsofProgrammableDSPs
5. ApplysmallapplicationsonDSPprocessor-basedplatform

UNIT-I

BackgroundofARMandARMArchitecture:ABriefhistory,Architecture Versions, Registers, pipeline, exception, interrupts and the vector table; core extensions, Introduction to ARM instruction set, Introduction to Thumb instructions,IntroductiontoARMCProgramming.

UNIT-II

LPC21XX Microcontroller: Salient features of LPC 21XX, Pin description, ArchitecturalOverview.Peripherals: DescriptionofGeneral-PurposeInput/Output(GPIO)ports,PincontrolBlock.Features,Pindescription,Registerdescription andoperationofPLL,Timers,PWM,Interfacing:LED,Relay,Buzzer,LCD,DAC,DCmotor.Communicationprotocols:Brie foverviewonI2C,SPIandCAN.

UNIT-III

ARM Cortex-M3 Processor: The Thumb-2 Technology and Instruction Set Architecture,Programmingmodel-Registers,Operationmodes,ExceptionsandInterrupts,VectorTables,MemoryMap,Applications.

UNIT-IV

ProgrammableDSP(P-DSP)Processors: Basicarchitecturalfeatures-VLIWarchitecture,DSPcomputationalbuildingblocks,BusandMemoryarchitecture, Address generation unit, speed issues, Fixed and Floating-point data paths, IntroductiontoTIDSPProcessorfamily.IntroductiontoFPGAbasedDSPsystem design.

TMS320C67XX: Features of C67XX Processors, Internal Architecture, Functional units and operation, Data paths, Cross paths, Control Register File.

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UNIT-V

TMS320C67XX Assembly Language Instructions: Functional Unit and its Instructions, Addressing modes, Fixed point Instructions, Conditional Operations, Parallel Operations, Floating point instructions.

TMS320C67XX Application Development Tools: Code composer studio (CCS), Application programs in C67XX Code development in both C and Assembly language.

Text Books:

1. JosephYiu,"ThedefinitiveguidetoARMCortex-M3",Elsevier,2nd Edition,2010
2. Andrew N. SLOSS, Domonic Symes, Chris Wright "ARM System Developers Guide-Designingand optimizing system software" ELSEVIER1st Edition2004.
3. Avatar Singh and S. Srinivasan, "Digital Signal Processing Implementations Using DSP Microprocessors", Thomson Brooks, 2004.

Suggested Reading:

1. B. Ventakaramani, M. Bhaskar, "Digital Signal Processes, Architecture Processing and Applications", Tata McGraw Hill, 2002.
2. RulphChassing, "Digital Signal Processing and Applications with the C6713 and C6416 DSK" A John Wiley & Sons, Inc., Publications.

20ME M103

RESEARCH METHODOLOGY AND IPR

(Mandatory Course)

Instruction	2L Hours per week
Duration of SEE	2 Hours
SEE	60 Marks
CIE	40 Marks
Credits	2

Course Objectives:

This course aims to:

1. Motivate to choose research as career
2. Formulate the research problem, prepare the research design
3. Identify various sources for literature review and data collection report writing
4. Equip with good methods to analyze the collected data
5. Know about IPR copyrights

Course Outcomes:

Upon completion of this course, students will be able to:

1. Define research problem, review and asses the quality of literature from various sources
2. Improve the style and format of writing a report for technical paper/ Journal report, understand and develop various research designs
3. Collect the data by various methods: observation, interview, questionnaires
4. Analyze problem by statistical techniques: ANOVA, F-test, Chi-square
5. Understand apply for patent and copyrights

UNIT-I

Research Methodology: Research Methodology: Objectives and Motivation of Research, Types of Research, research approaches, Significance of Research, Research Methods verses Methodology, Research Process, Criteria of Good Research, Problems Encountered by Researchers in India, Benefits to the society in general. Defining the Research Problem: Selection of Research Problem, Necessity of Defining the Problem

UNIT-II

Literature Survey Report Writing: Literature Survey: Importance and purpose of Literature Survey, Sources of Information, Assessment of Quality of Journals and Articles, Information through Internet. Report writing: Meaning of interpretation, layout of research report, Types of reports, Mechanics of writing a report. Research Proposal Preparation: Writing a Research Proposal and Research Report, Writing Research Grant Proposal

UNIT-III

Research Design: Research Design: Meaning of Research Design, Need of Research Design, Feature of a Good Design, Important Concepts Related to Research Design, Different Research Designs, Basic Principles of Experimental Design, Developing a Research Plan, Steps in sample design, types of sample designs.

UNIT-IV

Data Collection and Analysis: Data Collection: Methods of data collection, importance of Parametric, non-parametric test, testing of variance of two normal population, use of Chi-square, ANOVA, F-test, z-test

UNIT-V

Patents and Copyright: Patent: Macro economic impact of the patent system, Patent document, How to protect your inventions. Granting of patent, Rights of a patent, how extensive is patent protection. Copyright: What is copyright. What is covered by copyright? How long does copyright last? Why protect copyright? Related Rights: what are related rights? Enforcement of Intellectual Property Rights: Infringement of intellectual property rights, Case studies of patents and IP Protection

Text Books:

1. C.R Kothari, "Research Methodology, Methods & Technique"; New Age International Publishers, 2004
2. R. Ganesan, "Research Methodology for Engineers", MJP Publishers, 2011
3. Y.P. Agarwal, "Statistical Methods: Concepts, Application and Computation", Sterling Publs., Pvt., Ltd., New Delhi, 2004

Suggested Reading:

1. AjitParulekar and Sarita D' Souza, "Indian Patents Law – Legal & Business Implications"; Macmillan India ltd, 2006
2. B. L.Wadehra; "Law Relating to Patents, Trade Marks, Copyright, Designs & Geographical Indications"; Universal law Publishing Pvt. Ltd., India 2000.
3. P. Narayanan; "Law of Copyright and Industrial Designs"; Eastern law House, Delhi 2010.

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20ECE201

ADVANCED COMPUTER ORGANIZATION

(Program Elective)

Instruction	3L Hours per week
Duration of SEE	3 Hours
SEE	60 Marks
CIE	40 Marks
Credits	3

Prerequisite: Fundamentals of Computer architecture.

Course Objectives:

This course aims to:

1. Learn about processor design for computer system
2. Understand the memory organization of the computer
3. Study the I/O organization and parallel computer systems

Course Outcomes:

Upon completion of this course, students will be able to:

1. Analyze the computer arithmetic operations.
2. Design of control unit of the computer
3. Understand the memory organization of the computer
4. Interface various I/O modules to the computer system
5. Analyze the multiprocessor environment and various buses for the computer system

UNIT– I:

Processor Design: CPU Organization, Data Representation, Instruction Formats, Data Path Design: Fixed Point Arithmetic and Floating-Point Arithmetic, Instruction Pipelining, Super Scalar techniques, linear pipeline processors, Super scalar and super pipeline design, Multi vector and SIMD computers.

UNIT– II:

Control Unit Design:

Basic Concepts: Basic control unit of the computer system. Hardwired Control Unit Designapproach, Micro-programmed Control Unit- Design Approach, Micro program sequencer, Case studies based on both the approaches.

UNIT – III:

Memory Organization:

Internal memory, computer memory system overview, the memory Hierarchy, Random access memories, Cache memory, Elements of cache design, Virtual memory- protection and examples of virtual memory, Replacement Policies.

UNIT– IV:

I/O Organization: Accessing I/O Devices, Programmed I-O, Interrupts, DMA, Bus Arbitration; Synchronous bus and asynchronous bus, Interface circuits, Parallel port, Serial port, standard I/O interfaces, IO Processor, PCI bus, SCSI bus, USB busprotocols.

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UNIT– V:

Parallel Computer Systems:

Instruction Level Parallelism (ILP) – Concept and Challenges, Dynamic Scheduling, Limitations on ILP, Thread Level Parallelism, Multi-processors – Characteristics, Symmetric and Distributive Shared Memory Architecture, Vector Processors and Supercomputers.

Text Books:

1. Carl Hamacher, Vranesic, Zaky, "Computer Organization", 5th edition, MGH, 2010
2. William Stallings, "Computer Organization and Architecture designing for Performance", 7th edition, PHI, 2007.

Suggested Reading:

1. John L. Hennessy and David A. Patterson, "Computer Architecture", A quantitative Approach, 3rd Edition, Elsevier, 2005.
2. Hayes John P, "Computer Architecture and organization" 3rd Edition, MGH, 1998.

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20ECE213

VLSI TECHNOLOGY AND PHYSICAL DESIGN AUTOMATION

(Program Elective)

Instruction	3 L Hours per week
Duration of SEE	3 Hours
SEE	60 Marks
CIE	40 Marks
Credits	3

Prerequisite: Basic knowledge on semiconductor physics and MOS transistors followed by analog and digital Fundamentals is required.

Course Objectives:

This course aims to:

1. Model passive and active devices suiting advances in IC fabrication technology.
2. Create learning, development and testing environment to meet ever challenging needs in the field of Chip Design.
3. Communicate effectively and convey ideas using innovative engineering using appropriate EDA tools

Course outcomes:

Upon completion of this course, students will be able to:

1. Explain various technology aspects of VLSI Physical design.
2. Demonstrate CMOS IC fabrication process.
3. Apply Design rules in the construction of layouts of a given design.
4. Choose appropriate Automation algorithm for partitioning, floor planning, placement and routing.
5. Identify EDA/CAD tools for Automation of VLSI Physical design automation.

UNIT-I

Introduction to VLSI Technology and Fabrication Process: Various layers of IC, Wafer preparation and crystal growth, Oxidation, CVD, Lithography, Etching, Ion implantation, Diffusion techniques.

UNIT-II

Concepts and Scope of Physical Design: Typical structures of passive and active components, CMOS fabrication process- n-Well, P-Well and Twin Tub, CMOS parasitic- Latch-up and its prevention.

UNIT-III

Cell Concepts and Design Rules: Cell based layout design, fabrication errors, alignment sequence and alignment inaccuracy, Interconnects, Contacts, Vias, SCMOS design rules, Lambda based design rules, Stick diagrams, Hierarchical stick diagrams, Layouts.

UNIT-IV

General Purpose Methods for Combinational Optimization: Partitioning, Placement, Discrete methods of global and local placements, Routing, local and Global routing via minimization, Over the cell routing, Single layer and two-layer routing, Clock and power routing.

UNIT-V

EDA/CAD Tools: Layout editors, Circuit extractors, Automatic layout tools, Modeling and extraction of circuit Parameters from physical layout, Compaction algorithms, physical automations of FPGAs.

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Text Books:

1. J.D.Plummer, M.D.Deal and P.B.Griffin, "The Silicon VLSI Technology Fundamentals", Practice and modeling, Pearson Education 2009.
2. N.A. Sherwani, "Algorithms for VLSI Physical Design Automation", 2002.

Suggested Reading:

1. Modern VLSI Design (System on Chip), Woyne Wolf, Pearson Education, 2002.
2. S.H. Gerez, "Algorithms for VLSI Design Automation", 1998.

20EG A101

ENGLISH FOR RESEARCH PAPER WRITING

(Audit Course)

Instruction	2L Hours per week
Duration of SEE	2 Hours
SEE	50 Marks
CIE	--
Credits	Non-Credit

Course Objectives:

This course aims to:

1. To the various purposes of Research Papers and help them infer the benefits and limitations of research.
2. To developing the content, formulating a structure and illustrating the format of writing a research paper.
3. In differentiating between qualitative and quantitative research types.
4. To constructing paragraphs and developing thesis statement.
5. To producing original research papers while avoiding plagiarism.

Course Outcomes:

Upon completion of this course, students will be able to:

1. Illustrate the nuances of research paper writing and draw conclusions about the benefits and limitations of research.
2. Classify different types of research papers and organize the format and citation of sources.
3. Review the literature and categorize between different types of research.
4. Draft paragraphs and write thesis statement in a scientific manner.
5. Develop an original research paper while acquiring the knowledge of how and where to publish their papers.

UNIT-I

Academic Writing

Meaning & Definition of a research paper– Purpose of a research paper – Scope – Benefits – Limitations – outcomes.

UNIT-II

Research Paper Format

Title – Abstract – Introduction – Discussion – Findings – Conclusion – Style of Indentation – Font size/Font types – Indexing – Citation of sources.

UNIT-III

Research Methodology

Methods (Qualitative – Quantitative) Review of Literature. Criticizing, Paraphrasing & Plagiarism.

UNIT-IV

Process of Writing a Research Paper

Choosing a topic - Thesis Statement – Outline – Organizing notes - Language of Research – Word order, Paragraphs – Writing first draft–Revising/Editing - The final draft and proof reading. IEEE Style.

UNIT-V

Research Paper Publication

Reputed Journals – National/International – ISSN No, No. of volumes, Scopus Index/UGC Journals – Free publications - Paid Journal publications – /Advantages/Benefits

Text Book:

1. C. R Kothari, Gaurav, Garg, Research Methodology Methods and Techniques, New Age International Publishers. 4th Edition.

Suggested Reading:

1. Day R, "How to Write and Publish a Scientific Paper", Cambridge University Press, 2006.
2. MLA "Hand book for writers of Research Papers", East West Press Pvt. Ltd, New Delhi, 7th Edition.
3. Lipson, Charles (2011), Cite Right: A Quick Guide to Citation Styles; MLA, APA, Chicago, The Sciences, Professions, and more (2nd Edition). Chicago [u.a] : Univ of Chicago Press.

Online Resources:

1. NPTEL: https://onlinecourses.nptel.ac.in/noc18_mg13/preview
2. NPTEL: https://nptel.ac.in/courses/121/106/121106007/
3. https://www.classcentral.com/course/swayam-introduction-to-research-5221

20ECC205

ANALOG AND DIGITAL CMOS VLSI DESIGN LAB

Instruction	4P Hours per week
Duration of SEE	--
SEE	--
CIE	50 Marks
Credits	2

Pre-requisites: Analog and Digital design concepts.

Course Objectives:

This course aims to:

1. Understand Characteristics behavior of MOSFET.
2. Analyze performance of Differential amplifiers
3. Verify layout of basic digital circuits

Course Outcomes:

Upon completion of this course, students will be able to:

1. Verify the characteristics of MOSFET and design entry in the tool.
2. Understand and evaluate the design specs and library files of tool.
3. Apply the concept of theory and design in the lab implementation.
4. Analyze and calculation, power and delay from the graphs.
5. Compare performance of different circuits with the simulation results.

List of Experiments:

1. Characteristics of MOSFET.
2. Calculation of rise time and fall time for CMOS inverter.
3. To build a three stage and five stage ring oscillator circuit in 0.18um and 0.13um technology and compare its frequencies and time period.
4. NMOS Common Source Amplifier.
5. Design of Differential Amplifier.
6. Design of Operational Amplifier.
7. Draw the layout of Inverter Circuit.

Suggested Reading:

1. Cadence Design Systems (Ireland) Ltd., “Cadence manual”, 2013.

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20ECC206

MICROCONTROLLERS AND PROGRAMMABLE DIGITAL SIGNAL PROCESSORS LAB

Instruction	4P Hours per week
Duration of SEE	--
SEE	--
CIE	50 Marks
Credits	2

Prerequisite: Programming in'C' and basics of ARM Microcontroller.

Course Objectives:

This course aims to:

1. Write the ARM 'C' programming for applications
2. Understand the interfacing of various modules with ARM 7/ ARM Cortex-M3
3. Develop assembly and C Programming for DSP processors

Course Outcomes:

Upon completion of this course, students will be able to:

1. Install, configure and utilize tool sets for developing applications based on ARM processorcore.
2. DesignanddeveloptheARM7 basedembeddedsystemsforvarious applications.
3. DevelopapplicationprogramsonARMandDSPdevelopmentboards both in assembly and C.
4. DesignandImplementthedigitalfiltersonDSP6713processor.
5. Analyze the hardware and software interaction andintegration.

List of Assignments:

Part A

ExperimentstobecarriedoutonARM7/Cortex-M 3 developmentboards

1. BlinkanLEDwithsoftwaredelay,delaygeneratedusingtheSysTicktimer.
2. Systemclockreal-timealterationusingthePLLmodules.
3. ControlintensityofanLEDusingPWMimplementedinsoftwareandhardware.
4. ControlanLEDusingswitchbypollingmethod,byinterruptmethod and flash the LED once every five switchpresses.
5. UART EchoTest.
6. Take analog readings on rotation of rotary potentiometer connected to an ADCchannel.
7. TemperatureindicationonanRGBLED.
8. Mimic light intensity sensed by the light sensor by varying the blinkingrateofanLED.
9. Evaluate the various sleep modes by putting core in sleep and deep sleep modes.
10. System reset using watchdog timer in case something goeswrong.
11. Sample soundusingamicro-phoneanddisplaysoundlevelsonLEDs.

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20ECC202

EMBEDDED SYSTEM DESIGN USING RTOS

Instruction	3L Hours per week
Duration of SEE	3 Hours
SEE	60 Marks
CIE	40 Marks
Credits	3

Prerequisites: The prior knowledge on the basics of operating systems.

Course Objectives:
This course aims to:

1. Understand the basic concepts of the UNIX operating system and POSIX Standards.
2. Know the importance of hard/soft Real-Time Systems and to familiarize the cases for tasks, semaphores, queues, pipes, and event flags.
3. Study the basics of the kernel objects and memory management in VxWorks and to know about real-time applications development tools.

Course Outcomes:
Upon completion of this course, students will be able to:

1. Understand the concepts of UNIX operating system and process management.
2. Describe the POSIX standards for real time systems and compare hard and soft real time systems.
3. Analyze various scheduling algorithms and application to real time systems.
4. Illustrate the concepts of real time operating system and VxWorks.
5. Elucidate the concepts software development tools and RTOS comparison.

UNIT-I:
Brief Review of UNIX Operating Systems: UNIX Kernel File system concepts of Process Concurrent Execution &Interrupts. Process management – forks & execution. Programming with system calls, Process Scheduling, Shell programming and filters.Portable Operating system Interface (POSIX) IEEE Standard 1003.13 & POSIX real time profile. POSIX versus traditional Unix Signals.Overheads and timing predictability.

UNIT-II:
Hard versus Soft Real-time systems: Examples, Jobs & Processors, Hard and Soft timing constraints, Hard Real – time systems, SoftReal time systems. Classical Uniprocessor Scheduling algorithms –RMS, Preemptive EDF, Allowing for Preemptive and Exclusion condition.

UNIT-III:
Concept of Embedded operating systems, Differences between Traditional OS and RTOS, Real time system concepts, RTOS Kernel & Issues in Multitasking Task Assignment, Task switching, Foreground ISRs and Background Tasks, critical section, Reentrant Functions, Inter-process Communication (IPC)- IPC through Semaphores, Mutex, Mailboxes, Message queues or pipes and Event Flags.

UNIT-IV:
VxWorks –POSIX Real Time Extensions, timeout features, Task Creation, Semaphores (Binary, Counting), Mutex, Mailbox, Message Queues, Memory Management – Virtual to Physical Address Mapping.

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UNIT-V:

Debugging tools and cross development environment, Software Logic analyzer, ICEs. Comparison of RTOS – VxWorks, µC/OS-II and RT Linux for Embedded Applications.

Text Books:

1. Jane W.S.Liu,"Real Time Systems", Pearson Education, Asia, 2001.
2. Wind River Systems, "VxWorks Programrs Guide", Wind River Systems Inc.1997.
3. Jean. J. Labrose, "MicroC/OS-II", The CMP Books, 2002.

Suggested Reading:

1. Betchof, D.R., "Programming with POSIX threads", Addison Wesley Longman, 1997.
2. C.M.Krishna and G.Shin, "Real Time Systems", McGraw-Hill Companies Inc., McGraw Hill International Editions, 1997

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20EC C204

VLSI DESIGN VERIFICATION AND TESTING

Instruction	3 L Hours per Week
Duration of SEE	3 Hours
SEE	60 Marks
CIE	40 Marks
Credits	3

Pre-requisite: Knowledge on Analog and Digital CMOS VLSI Design, C and C++ Language concepts.

Course Objectives:

This course aims to:

1. The concepts of verification and testing.
2. Data types and OOPs concepts.
3. Randomization in System Verilog.

Course Outcomes:

Upon completion of this course, students will be able to:

1. Recipe of front-end design verification techniques and create reusable test bench environments.
2. Understanding various data types used in System Verilog
3. Demonstrating OOPs concepts to System Verilog verification
4. Application of Randomization concept in System Verilog
5. Interface a System Verilog testbench with System C

UNIT-I

Verification Guidelines: Verification Process, Basic test bench functionality, directed testing, Methodology basics, Constrained-Random stimulus, Functional coverage, test bench components, Layered test bench, Building layered test bench, Simulation environment phases, Maximum code reuse, test bench performance.

UNIT-II

Data Types: Built-in data types, Fixed-size arrays, Dynamic arrays, Queues, Associative Arrays, Linked lists, Array methods, choosing a storage type, creating new types with typedef, Creating user-defined structures, Type conversion, Enumerated types, Constants strings, Expression width. Procedural statements and routines: Procedural statements, tasks, functions and void functions, Routine arguments, returning from a routine, local data storage, Time values.

UNIT-III

Basic OOPS: Introduction, think of nouns, not verbs, your first class, where to define a class, OOP terminology, creating new objects, Object de-allocation, using objects, Static variables vs. Global variables, Class methods, defining methods outside of the class, scoping rules, Using one class inside another.

UNIT-IV

Connecting the test bench and design: Separating the test bench and design, Interface constructs, Stimulus timing, Interface driving and sampling, connecting it all together, Top-level scope Program Module interactions. System Verilog Assertions, understanding dynamic objects, copying objects, Public vs. Local, straying off course building a test bench.

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UNIT-V

Randomization: Introduction, What to randomize, Randomization in System Verilog, Constraint details solution probabilities, Controlling multiple constraint blocks, Valid constraints, In-line constraints, The pre randomize and post randomize functions, Random number functions, Constraints tips and techniques, Common randomization problems, Iterative and array constraints, Atomic stimulus generation vs. Scenario generation, Random control, Random number generators, Random device configuration.

Text Books:

1. Chris Spears, "System Verilog for Verification", Springer, 2nd Edition 2006.
2. M. Bushnell and V. D. Agrawal, "Essentials of Electronic Testing for Digital, Memory and Mixed-Signal VLSI Circuits", Kluwer Academic Publishers 2002.

Suggested Reading:

1. Writing test benches using System Verilog By Janick Bergeron Edition: illustrated Published by Birkhäuser, 2006 ISBN 0387292217, 9780387292212
2. System Verilog for Verification: A Guide to Learning the Test bench Language Features by Chris Spear Edition: 2, Published by Springer, 2008 ISBN 0387765298, 9780387765297

20EC E205

LOW POWER VLSI DESIGN

(Program Elective)

Instruction	3L Hours per week
Duration of SEE	3 Hours
SEE	60 Marks
CIE	40 Marks
Credits	3

Pre-requisites: Students should have prior knowledge of Analog and Digital CMOS VLSI Design.

Course Objectives:

This course aims to:

1. Know the sources of power dissipation and need for low power designs for emerging technologies.
2. Understand the concepts of Low power design techniques for digital circuits.
3. Analyze the power dissipations of memory and processor systems and able to adopt suitable methods for power reduction.

Course Outcomes:

Upon completion of this course, students will be able to:

1. Identify sources of power dissipation in a given VLSI Circuit
2. Analyze and apply various low power circuit techniques for combinational and sequential circuits
3. Demonstrate understanding of clock distribution for Low Power
4. Explain power minimization techniques for arithmetic and memory subsystem
5. Elaborate Microprocessor Design System concepts for Low Power

UNIT-I:

Technology & Circuit Design Levels: Sources of power dissipation in digital ICs, degree of freedom, recurring themes in low-power, emerging low power approaches, dynamic dissipation in CMOS, effects of V_{dd}&V_t on speed, constraints on Vt reduction, transistor sizing & optimal gate oxide thickness, impact of technology scaling, technology innovations.

UNIT-II:

Low Power Circuit Techniques: Power consumption in circuits, flip-flops & latches, high capacitance nodes, energy recovery, reversible pipelines, high performance approaches.

UNIT-III:

Low Power Clock Distribution: Power dissipation in clock distribution, single driver Versus distributed buffers, buffers & device sizing under process variations, zero skew vs Tolerable skew, chip & package co-design of clock network.

UNIT-IV:

Logic Synthesis for Low Power estimation techniques: Power minimization techniques, Low power arithmetic components-circuit design styles, adders, multipliers. Low Power Memory Design: Sources & reduction of power dissipation in memory subsystem, sources of power dissipation in DRAM & SRAM.

UNIT-V:

Low Power Microprocessor Design System: power management support, architectural tradeoffs for power, choosing the supply voltage, low-power clocking, implementation problem for low power, comparison of microprocessors for power & performance.

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Text Books:

1. Jan M. Rabaey and MassoudPedram, “Low Power Design Methodologies”, Kluwer Academic, 1996
2. Kaushik Roy, Sharat Prasad, “Low power CMOS VLSI circuit design”, John Wiley sons, Inc., 2000.

Suggested Reading:

1. J.B.Kulo and J.H Lou, “Low voltage CMOS VLSI Circuits”, Wiley, 1999.
2. Gary Yeap, “Practical low power digital VLSI design”, Kluwer, 1998.
3. A.P.Chandrasekaran and R.W.Broadersen, “Low power digital CMOS design”, Kluwer,1995

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20EC E210

SOC DESIGN

(Program Elective)

Instruction	3L Hours per week
Duration of SEE	3 Hours
SEE	60 Marks
CIE	40 Marks
Credits	3

Pre-requisites: Concept of Embedded Systems, Microprocessors, microcontrollers and ASIC.

Course Objectives:
This course aims to:

1. Introduce students to various approaches of SoC design, ADLs and GNR.
2. Introduce various techniques used for Low power SoC Design
3. Demonstrate various simulation methods and synthesis techniques for SoCs.

Course Outcomes:
Upon completion of this course, students will be able to:

1. Understand the conceptsrelated to SoC like NISC, ASIP, ADL, GNR, Reconfiguration, Clock Gating, DVS etc.
2. Differentiate between various design strategies like ASIC and SOC etc.
3. Distinguish between various types of Processors like CISC, RISC, NISC and ASIP.HDL and ADL
4. Design a simple SOC for reconfigurability / low power / ASIP / NISC etc. and synthesize simple blocks using Graph Theory.
5. Simulate and synthesize the Design using various simulation models.

UNIT 1

ASIC and NISC Overview: Overview-Overview of ASIC types, design strategies, CISC, RISC and NISC approaches for SOC architectural issues and its impact on SoC design methodologies, Application Specific Instruction Processor (ASIP) concepts, NISC-NISC Control Words methodology, NISC Applications and Advantages.

UNIT 2

ADL (for ASIP&NISC) and GNR: Architecture Description Languages (ADL) for design and verification of Application Specific Instruction-set Processors (ASIP), NISC-design flow, modeling NISC architectures and systems,
Generic Netlist Representation -A formal language for specification, compilation and synthesis of embedded processors.

UNIT 3

Low power SoC design: Low power SoC design / Digital system, Low power system perspective-power gating, clock gating, adaptive voltage scaling (AVS), Static voltage scaling, Dynamic clock frequency and voltage scaling (DCFS), building block optimization, power down techniques, power consumption verification.

UNIT 4

Simulation: Different simulation modes, behavioral, functional, static timing, gate level,switch level, transistor/circuit simulation, design of verification vectors.FPGA, Reconfigurable systems, SoC related modeling of data path design and control logic, Minimization of interconnects impact, clock tree design issues.

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UNIT 5

Synthesis: Role and Concept of graph theory and its relevance to synthesizable constructs, Walks, trails paths, connectivity, components, mapping/visualization, nodal and admittance graph. Technology independent and technology dependent approaches for synthesis, optimization constraints, Synthesis report analysis. HDL coding techniques for minimization of power consumption.Designof NISC for DCT application.

Text Books:

1. Michael J. Flynn and Wayne Luk, "Computer System Design: Systemon-Chip". Wiley, 2011.
2. B. Al Hashimi, "System on chip-Next generation electronics", The IET, 2006.

Suggested Reading:

1. Hubert Kaeslin, "Digital Integrated Circuit Design: From VLSI Architectures to CMOS Fabrication", CambridgeUniversity Press, 2008.
2. RochitRajsuman, "System-on- a-chip: Design and test", Advantest America R & D Center, 2000.
3. P Mishra and N Dutt, "Processor Description Languages", Morgan Kaufmann, 2008

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20EC A101

VALUE EDUCATION

(Audit Course)

Instruction	2 L Hours per Week
Duration of SEE	2 Hours
SEE	50 Marks
CIE	--
Credits	Non-Credit

Course Objectives:

This course aims to

1. Understand the need and importance of Values for self-development and for National development.
2. Imbibe good human values and Morals
3. Cultivate individual and National character.

Course outcomes:

After completion of the Course, Students will be able to

1. Summarize classification of values and values for self-development.
2. Identify the importance of values in personal and professional life.
3. Apply the importance of social values for better career and relationships.
4. Compile the values from holy books for personal and social responsibility.
5. Discuss concept of soul and reincarnation, values Dharma, Karma and Guna.

UNIT-I

Human Values, Ethics and Morals: Concept of Values, Indian concept of humanism, human values; Values for self-development, Social values, individual attitudes; Work ethics, moral and non- moral behavior, standards and principles based on religion, culture and tradition.

UNIT-II

Value Cultivation, and Self-Management: Need and Importance of cultivation of values such as Sense-of Duty, Devotion to work, Self-reliance, Confidence, Concentration, Integrity & discipline, and Truthfulness.

UNIT-III

Spiritual Outlook and Social Values: Personality and Behavior, Scientific attitude and Spiritual (soul) outlook; Cultivation of Social Values Such as Positive Thinking, Punctuality, Love & Kindness, avoiding fault finding in others, Reduction of anger, forgiveness, Dignity of labor, True friendship, Universal brotherhood and religious tolerance.

UNIT-IV

Values in Holy Books : Self-management and Good health; and internal & external Cleanliness, Holy books versus Blind faith, Character and Competence, Equality, Nonviolence, Humility, Role of Women.

UNIT-V

Dharma, Karma and Guna: Concept of soul; Science of Reincarnation, Character and Conduct, Concept of Dharma; Cause and Effect based Karma Theory; The qualities of Devine and Devilish; Satwic, Rajasic and Tamasic gunas.

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Text Books:

1. Chakroborty, S.K. “Values & Ethics for organizations Theory and practice”, Oxford University Press, New Delhi, 1998.
2. Jaya DayalGoyandaka, “Srimad Bhagavad Gita”, withSanskrit Text, Word meaning and Prose meaning, Gita Press, Gorakhpur, 2017.

20ECC207

RTL SIMULATION AND SYNTHESIS WITH PLDs LAB

Instruction	4P Hours per week
Duration of SEE	--
SEE	--
CIE	50 Marks
Credits	2

Pre-requisites: Digital Design and Verilog HDL programming skills.

Course Objectives:
This course aims to:

1. The simulation of combinational and sequential circuits.
2. FSM based designs.
3. Implementation of DFT and FFTs.

Course Outcomes:
Upon completion of this course, students will be able to:

1. Demonstrate the process steps required for simulation /synthesis.
2. Design and simulate various combinational and sequential circuits using HDL.
3. Develop an RTL code for various real time applications.
4. Synthesize an RTL code for several digital designs.
5. Build a prototype for various digital circuits with PLDs.

Design entry by Verilog, Programmable Logic Devices, Introduction to ASIC Design Flow, FPGA, SoC, Floor planning, Placement, Clock tree synthesis, Routing, Physical verification, Power analysis, ESD protection. Static Timing analysis, Meta-stability, Clock issues, Need and design strategies for multi-clock domain designs, IP and Prototyping, Design for testability.

List of Experiments:

1. Verilog implementation of 8:1 Mux/Demux, Full Adder, 8-bit Magnitude comparator,
2. Encoder/decoder, Priority encoder, D-FF, 4-bit Shift registers (SISO, SIPO, PISO, Bidirectional) 3-bit Synchronous Counters, Binary to Gray converter, Parity generator.
3. Sequence generator/detectors, Synchronous FSM – Mealy and Moore machines.
4. Vending machines - Traffic Light controller, ATM, elevator control.
5. PCI Bus & arbiter and downloading on FPGA.
6. UART/ USART implementation in Verilog.
7. Realization of single port SRAM in Verilog.
8. Verilog implementation of Arithmetic circuits like serial adder/subtractor, parallel adder/subtractor, serial/parallel multiplier.
9. Discrete Fourier transform/Fast Fourier Transform algorithm in Verilog.

Suggested Reading:

1. Samir Palnitkar, “Verilog HDL, a guide to digital design and synthesis”, Prentice Hall 2003.
2. Doug Amos, Austin Lesea, Rene Richter, “FPGA based prototyping methodology manual”, Xilinx, 2011.
3. Bob Zeidman, “Designing with FPGAs & CPLDs”, CMP Books, 2002.

20ECC208

RTOS AND VLSI DESIGN VERIFICATION LAB

Instruction	4P Hours per week
Duration of SEE	--
SEE	--
CIE	50 Marks
Credits	2

Pre-requisites: Basics of operating system,basics of embedded systemand verification concepts.

Course Objectives:
This course aims to:

1. Understand the concepts of RTOs
2. Illustrate the concept of task scheduling
3. Verify layout of basic digital circuits

Course Outcomes:
Upon completion of this course, students will be able to:

1. Verify a few important OOPs concepts
2. Compile and Run various design constructs using CAD tool
3. Develop self-checking test benches using SystemVerilog
4. Understand the programming concepts of RTOS
5. Analyze Multitasking, IPC and scheduling concepts

RTOS programming:

1. Introduction to RTOS (VxWorks) and its basic functions
2. RTOS Timer programming (VxWorks)
3. RTOS Task function programming (VxWorks)
4. Multitasking using round robin scheduling
5. IPC using message queues
6. IPC using semaphore
7. IPC using mail box
8.

Verification (Mentor Graphics Tools)

1. Sparse memory
2. Semaphore
3. Mail box
4. Classes
5. Polymorphism
6. Coverage
7. Assertions

Suggested reading:

1. Silberschatz, Galvin, Gange“Operating Systems Concepts” 8/e , Wiley Education, 2007.
2. Wind River Systems Inc., “VxWorks Programmers Guide”, 1997.

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20EC C209

MINI PROJECT WITH SEMINAR

Instruction	4 P Hours per Week
Duration of SEE	--
SEE	--
CIE	50 Marks
Credits	2

Prerequisite: Knowledge of preparing slides by using power point presentations, Capable of searching for suitable literature and Presentation skills.

Course Objectives:
This course aims to:

1. The mini-project shall contain a clear statement of the research objectives, background of work, literature review, techniques used, prospective deliverables, and detailed discussion on results, conclusions and references.
2. To expose and practice of searching and referring the required literature.
3. This is expected to provide a good initiation for the student(s) towards R&D.

Course Outcomes:
Upon completion of this course, students will be able to:

1. Familiarize in searching the suitable literature in the chosen field.
2. Develop skills to understand and summarize the contents from the literature.
3. Ability to synthesize knowledge/ skills previously gained and applied in execution of a chosen technical problem.
4. Enhance oral presentation skills through power point presentations.
5. Learn and present the findings of their technical solution in a written report.

Guidelines:

1. As part of the curriculum in the II - Semester of the Program each student shalldo a mini project, generally comprising about three to four weeks of prior reading, twelve weeks of active research, and finally a presentation of their work for assessment.
2. Each student will be allotted to a faculty supervisor for mentoring.
3. Mini projects should present students with an accessible challenge on which to demonstrate competence in research techniques, plus the opportunity to contribute something more original.
4. Mini projects shall have inter-disciplinary/ industry relevance.
5. The students can select a mathematical modeling based/Experimental investigations or Numerical modeling.
6. All the investigations are clearly stated and documented with the reasons/explanations.
7. The mini project shall contain a clear statement of the research objectives, background of work, literature review, techniques used, prospective deliverables, and detailed discussion on results, conclusions and references.

Departmental committee: Supervisor and two faculty coordinators

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Guidelines for awardingmarks in CIE: 50		Max. Marks:
Evaluation by	**Max. Marks**	**Evaluation Criteria / Parameter**
Supervisor	20	Progress and Review
	05	Report
Departmental Committee	05	Relevance of the Topic
	05	PPT Preparation
	05	Presentation
	05	Question and Answers
	05	Report Preparation

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20ECE204

FPGA AND CPLD ARCHITECTURES

(Program Elective)

Instruction	3L Hours per week
Duration of SEE	3 Hours
SEE	60 Marks
CIE	40 Marks
Credits	3

Pre-requisites: Knowledge of Digital design using Multiplexers and Look-up tables.

Course Objectives:
This course aims to:

1. Study various PLD, CPLDs and FPGA Architectures and its features.
2. Understand the different programming technologies, placement and routing.
3. Study the design tools for FPGA and ASICs.

Course Outcomes:
Upon completion of this course, students will be able to:

1. Explain the concepts of PLDs, CPLDs and FPGAs.
2. Analyze and compare the various architectures of CPLD and FPGA and its programming technologies.
3. Implement various logic functions on PLDs, CPLDs and FPGAs.
4. Understand the concepts of placement and routing algorithms and classifying ASICs.
5. Demonstrate VLSI tool flow for CPLDs and FPGAs.

UNIT-I:
Programmable Logic Devices: Introduction, Evolution: Programmable read only memory (PROM), programmable logic array (PLA) and programmable array logic (PAL). Implementation with PLDs, Programming technologies. Design flow for CPLDs & FPGAs.

UNIT-II:
CPLDs: Complex Programmable Logic Devices: Architecture and features of Altera max 7000 series CPLD, AMD Mach 4 and Xilinx 9500 series.
FPGAs: Field Programmable Gate Arrays: Logic blocks, routing architecture and features of Xilinx XC4000, Spartan II, Virtex II and Actel Act1, Act2, Act3 FPGAs.

UNIT-III:
Advance FPGAs: Architectures and Features of Xilinx Spartan- 6, Virtex-6, and AlterasStartix FPGAs. Introduction to Xilinx Zynq board.

UNIT-IV:
Placement: objectives, placement algorithms: Min-cut-Based placement, Iterative Improvement placement, Simulated Annealing.Routing: objectives, Segmented Channel Routing, Maze Routing, Routability estimation, computing signal delay in RC tree networks.

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UNIT-V:

Digital Front End and back End tools for FPGAs and ASICs, FPGA implementation steps.Verification: introduction, logic simulation, design validation, timing verification.Testing concepts: failures, mechanisms and faults, fault coverage, ATPG methods and programmability failures.

Text Books:

1. S. Brown, R. Francis, J. Rose, Z.Vransic, "Field Programmable Gate array", BSP,2007.
2. P.K. Chan & S. Mourad, "Digital Design Using Field Programmable Gate Array", Pearson Education 2009.

Suggested Reading:

1. S. Trimberger, Edr., "Field Programmable Gate Array Technology", Kluwer Academic Publications, 1994**.**

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20CS O101

BUSINESS ANALYTICS

(Open Elective)

Instruction	3 L Hours per week
Duration of SEE	3 Hours
SEE	60 Marks
CIE	40 Marks
Credits	3

Course Objectives:

This course aims to:

1. Understanding the basic concepts of business analytics and applications
2. Study various business analytics methods including predictive, prescriptive and prescriptive analytics
3. Prepare the students to model business data using various data mining, decision making methods

Course Outcomes:

Upon completing this course, students will be able to:

1. Identify and describe complex business problems in terms of analytical models.
2. Apply appropriate analytical methods to find solutions to business problems that achieve stated objectives.
3. Interpret various metrics, measures used in business analytics
4. Illustrate various descriptive, predictive and prescriptive methods and techniques
5. Model the business data using various business analytical methods and techniques
6. Create viable solutions to decision making problems

UNIT-I

Introduction to Business Analytics: Introduction to Business Analytics, need and science of data driven (DD) decision making, Descriptive, predictive, prescriptive analytics and techniques, Big data analytics, Web and Social media analytics, Machine Learning algorithms, framework for decision making, challenges in DD decision making and future.

UNIT-II

Descriptive Analytics: Introduction, data types and scales, types of measurement scales, population and samples, measures of central tendency, percentile, decile and quadrille, measures of variation, measures of shape-skewness, data visualization

UNIT-III

Forecasting Techniques: Introduction, time-series data and components, forecasting accuracy, moving average method, single exponential smoothing, Holt's method, Holt-Winter model, Croston's forecasting method, regression model for forecasting, Auto regression models, auto-regressive moving process, ARIMA, Theil's coefficient

UNIT-IV

Decision Trees: CHAID, Classification and Regression tree, splitting criteria, Ensemble and method and random forest. Clustering: Distance and similarity measures used in clustering, Clustering algorithms, K-Means and Hierarchical algorithms, Prescriptive Analytics- Linear Programming (LP) and LP model building,

UNIT-V

Six Sigma: Introduction, introduction, origin, 3-Sigma Vs Six-Sigma process, cost of poor quality, sigma score, industry applications, six sigma measures, DPMO, yield, sigma score, DMAIC methodology, Six Sigma toolbox

Text Books:

1. U Dinesh Kumar, "Data Analytics", Wiley Publications, 1st Edition, 2017
2. Marc J. Schniederjans, Dara G. Schniederjans, Christopher M. Starkey, "Business analytics Principles, Concepts, and Applications with SAS", Associate Publishers, 2015.

Suggested Reading:

1. S. Christian Albright, Wayne L. Winston, "Business Analytics - Data Analysis and Decision Making", 5th Edition, Cengage, 2015.

Web Resources:

1. https://onlinecourses.nptel.ac.in/noc18-mg11/preview
2. https://nptel.ac.in/courses/110105089/

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20EC C210

INDUSTRIAL PROJECT /DISSERTATION PHASE I

Instruction	20 P Hours per Week
Duration of SEE	
SEE	--
CIE	100 Marks
Credits	10

Prerequisite: Preferably, student must have completed 'Mini Project with Seminar' successfully.

Course Objectives:
This course aims to:

1. The 'Industrial project/Dissertation Phase 1(Project work) will preferably be a problem with research potential and should involve scientific research, design, generation/collection and analysis of data, determining solution and must preferably bring out the student contribution(s).
2. To expose and learn the required simulation software/experimental techniques.
3. To carry out the work in a research environment or in an industrial environment

Course Outcomes:
Upon completion of this course, students will be able to:

1. Survey the literature such as books, national/international refereed journals and contact resource persons for the selected topic of research/project field.
2. Consolidate the literature survey and will be motivated to define the title of the project, able to decide the aim(s), objectives and design specifications of the project.
3. Learn the required software/ computational/analytical tools for implementations.
4. Document a report comprising of summary of literature survey, detailed objectives, project specifications, or computer aided design, proof of concept/functionality, and part of results if any.
5. Get aquatinted to work in a research environment or in an industrial environment

Guidelines:

1. The Project work will preferably be a problem with research potential and should involve scientific research, design, generation/collection and analysis of data, determining solution and must preferably bring out the individual contribution.
2. Seminar should be based on the area in which the candidate has undertaken the dissertation work.
3. The CIE shall include reviews and the preparation of report consisting of a detailed problem statement and a literature review.
4. The preliminary results (if available) of the problem may also be discussed in the report.
5. The work has to be presented in front of the committee consists of Head, Chairperson-BoS, Supervisor and Project coordinator.
6. The candidate has to be in regular contact with his supervisor and the topic of dissertation must be mutually decided by the guide and student.

Guidelines for awarding Marks in CIE: Max. Marks: 100		
Evaluation by	**Max. Marks**	**Evaluation Criteria / Parameter**
Supervisor	30	Project Status / Review(s)
	20	Report
Departmental Review Committee	10	Relevance of the Topic
	10	PPT Preparation(s)
	10	Presentation(s)
	10	Question and Answers
	10	Report Preparation

Note: Departmental Review committee has to assess the progress of the student for every two weeks.

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20EC C211

INDUSTRIAL PROJECT /DISSERTATION PHASE II

Instruction	32 P Hours per Week
Duration of SEE	Viva - Voce
SEE	100 Marks
CIE	100 Marks
Credits	16

Prerequisite: Student must have earned the credit of 'Industrial project/Dissertation Phase 1'.

Course Objectives:

This course aims to:

1. Industrial project/Dissertation Phase 2 is the continuation of Industrial project/Dissertation Phase 1
2. Implementation of Project objectives.
3. Presentation of periodic reviews of the objectives and preparing of Dissertation in a prescribed format.

Course Outcomes:

Upon completion of this course, students will be able to:

1. Capable to select from different methodologies, methods and forms of analysis to produce a suitable research design, and justify their design.
2. Plan experiments for a critical comparison of outputs or to verify the obtained analytical/simulation results with the experimental results available in the literature.
3. Develop attitude of lifelong learning and will develop interpersonal skills to deal with people working in diversified field.
4. Learn to write technical reports and research papers to publish at national and international level.
5. Develop strong communication skills to defend their work in front of technically qualified audience.

Guidelines:

1. It is a continuation of Project work started in semester III.
2. The student has to submit the report in prescribed format and also present a seminar.
3. The dissertation should be presented in standard format as provided by the department.
4. The candidate has to prepare a detailed project report consisting of introduction of the problem, problem statement, literature review, objectives of the work, methodology (experimental set up or numerical details as the case may be) of solution and results and discussion.
5. The report must bring out the conclusions of the work and future scope for the study.
   The work has to be presented in front of the examiners panel consisting of an approved external examiner, an internal examiner (HoD and BoSChair Person) guide/co-guide.
6. The candidate has to be in regular contact with his/her guide/co-guide.

Guidelines for awarding marks in CIE: Max. Marks: 100		
Evaluation by	**Max. Marks**	**Evaluation Criteria / Parameter**
Departmental Review Committee	05	Review 1
	10	Review 2
	10	Review 3
	15	Final presentation with the draft copy of the report
	10	Submission of the report in a standard format
Supervisor	10	Regularity and Punctuality
	10	Work Progress
	10	Quality of the work which may lead to publications
	10	Analytical / Programming / Experimental Skills Preparation
	10	Report preparation in a standard format

Guidelines for awarding marks in SEE: Marks: 100		Max.
Evaluation by	**Max. Marks**	**Evaluation Criteria / Parameter**
External and Internal Examiner(s) together	20	Power Point Presentation
	40	Quality of thesis and evaluation
	20	Quality of the project • Innovations • Applications • Live Research Projects • Scope for future study • Application to society
	20	Viva-Voce

Note: Departmental Review committee has to assess the progress of the student for every two weeks.

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