COURSE STRUCTURE (2023-24)

FIRST YEAR (FIRST SEMESTER)

Sl. No.	CATEOGORY	COURSE CODE	Circuit Branch	Non-Circuit Branch	Contact Hrs. L-T-P	Credit	University Marks	Internal Evaluation
Theory								
1	BS	23BS1001	Mathematics - I	Mathematics – I	3-0-0	3	100	50
2	BS	23BS1002 / 23BS1003	Physics	Chemistry	3-0-0	3	100	50
3	ES	23ES1001 / 23ES1002	Basic Electrical Engineering	Basic Electronics	2-0-0	2	100	50
4	ES	23ES1003 / 23ES1004	Programming in C and Data Structure	Engineering Mechanics	3-0-0	3	100	50
5	ES	23ES1005 / 23ES1006	Basic Civil Engineering	Basic Mechanical Engineering	2-0-0	2	100	50
6	HS	23HS1001 / 23HS1002	Universal Human Values	English for Technical Writing	2-0-0	2	100	50
Sessional / Practical								
7	BS	23BS1201 / 23BS1202	Physics Laboratory	Chemistry Laboratory	0-0-3	1.5	-	100
8	ES	23ES1201 / 23ES1202	Basic Electrical Engineering Lab.	Basic Electronics Lab.	0-0-3	1.5	-	100
9	ES	23ES1203 / 23ES1204	Programming Lab.	Communicative English & Report Writing Lab.	0-0-3	1.5	-	100
10	ES	23ES1205 / 23ES1206	Engineering Graphics & Design Lab.	Workshop & Digital Manufacturing Lab.	0-0-3	1.5	-	100
11	MC	23MC1201	Sports / Yoga / NCC / NSS		0-0-2	1	-	100
Total					15-0-14	22	600	800

FIRST YEAR (SECOND SEMESTER)

Sl. No.	CATEOGORY	COURSE CODE	Circuit Branch	Non-Circuit Branch	Contact Hrs. L-T-P	Credit	University Marks	Internal Evaluation
Theory								
1	BS	23BS1001	Mathematics - II	Mathematics - II	3-0-0	3	100	50
2	BS	23BS1003 / 23BS1002	Chemistry	Physics	3-0-0	3	100	50
3	ES	23ES1002 / 23ES1001	Basic Electronics	Basic Electrical Engineering	2-0-0	2	100	50
4	ES	23ES1004 / 23ES1003	Engineering Mechanics	Programming in C and Data Structure	3-0-0	3	100	50
5	ES	23ES1006 / 23ES1005	Basic Mechanical Engineering	Basic Civil Engineering	2-0-0	2	100	50
6	HS	23HS1002 / 23HS1001	English for Technical Writing	Universal Human Values	2-0-0	2	100	50
Sessional / Practical								
7	BS	23BS1202 / 23BS1201	Chemistry Laboratory	Physics Laboratory	0-0-3	1.5	-	100
8	ES	23ES1202 / 23ES1201	Basic Electronics Lab.	Basic Electrical Engineering Lab.	0-0-3	1.5	-	100
9	ES	23ES1204 / 23ES1203	Communicative English & Report Writing Lab.	Programming Lab.	0-0-3	1.5	-	100
10	ES	23ES1206 / 23ES1205	Workshop & Digital Manufacturing Lab.	Engineering Graphics & Design Lab.	0-0-3	1.5	-	100
11	MC	23MC1202	Sports / Yoga / NCC / NSS		0-0-2	1	-	100
Total					15-0-14	22	600	800

Subject Code		**Total Contact Hour**	**40 hrs**
Semester	FIRST	**Total Credit**	**3**
Subject Name	**MATHEMATICS-I**		
Pre-requisites			

Course Objective	The goal of this course is to achieve conceptual understanding and to retain the best traditions of traditional calculus. The syllabus is designed to provide the basic tools of calculus mainly for the purpose of modeling the engineering problems mathematically and obtaining solutions. This is a foundation course which mainly deals with topics such as single variable and multivariable calculus and plays an important role in the understanding of science, engineering and also other disciplines.	
Syllabus		**Contact Hour**
Module - I	**Basic Calculus:** Applications of definite integrals to evaluate length of curves, areas of surfaces and volumes of surfaces of revolution, Improper integral (Definition and Elementary Examples),Beta and Gamma functions and their properties.	**8 hrs**
Module - II	**Single-variable Calculus (Differentiation):** Rolle's Theorem, Mean value theorem (Statement and applications), First derivative test for local extreme values of functions. Power series, Taylor and Maclaurin series.	**8hrs**
Module - III	**Multivariable Calculus (Differentiation):** Partial derivatives. Jacobians, Hessian Matrix. Maxima, Minima and saddle points. Method of Lagrange multipliers.	**8 hrs**
Module - IV	**Linear Algebra:** Vector Space, Basis and dimension, Linear Systems of Equations, Gauss elimination, Linear Dependence and Independence, Rank of a Matrix.	**8 hrs**
Module - V	**Linear Algebra:** Inverse of a matrix (Gauss-Jordan). Symmetric, skew-symmetric and orthogonal matrices. Eigen values and eigenvectors. Caley-Hamilton Theorem (Statement only)	**8 hrs**

Essential Reading:

1. G.B. Thomas and R.L. Finney, Calculus and Analytic geometry, 9th Edition, Pearson, 2002.
2. Erwin Kreyszig, Advanced Engineering Mathematics, 9th Edition, John Wiley & Sons, 2006.

Supplementary Reading:

1. Ramana B.V., Higher Engineering Mathematics, Tata McGraw Hill New Delhi, 11th Reprint, 2010.
2. Gilbert Strang, Introduction to Linear Algebra, 5th Edition, 2016.
3. Veerarajan T., Engineering Mathematics for first year, Tata McGraw-Hill, New Delhi, 2008.

Course Outcomes:

CO1: To apply differential and integral calculus to notions of curvature and to improper integrals. Apart from some other applications they will have a basic understanding of Beta and Gamma functions.

CO2: The fallouts of Rolle's Theorem that is fundamental to application of analysis to Engineering problems.

CO3: The tool of power series for learning advanced Engineering Mathematics.

CO4: To deal with functions of several variables that are essential in most branches of engineering.

CO5: Learn how to convert a real life problem into a matrix system and solve it

Subject Code		**Total Contact Hour**	**45 HR**
Semester	FIRST/SECOND	**Total Credit**	**3**
Subject Name	**PHYSICS**		
Pre-requisites			

Course Objective:
To enhance the fundamental knowledge in Physics and its applications relevant to various streams of Engineering and Technology.

Syllabus	Contact Hour
Module I: OSCILLATIONS Mechanical and electrical simple harmonic oscillators, damped harmonic oscillator – heavy, critical and light damping, energy decay in a damped harmonic oscillator, quality factor, forced mechanical and electrical oscillators, steady state motion of forced damped harmonic oscillator	**9 hrs**
Module II: WAVES AND OPTICS Concept of wave and Wave equation, Superposition of many harmonic waves, Concept of coherent sources (Division of wave front and division of amplitude), Interference in thin parallel film, Newton's ring: Determination of wavelength of light, Refractive index of liquid).Concept of diffraction (Huygen's Principle), Types of diffraction, Franhoffer diffraction due to single slit, diffraction grating (qualitatively).	**9 hrs**
Module III: ELCTROMAGNETISM **Vector calculus**: Gradient, Divergence, Curl (Mathematical concept), Gauss divergence theorem and Stoke's theorem(statement only), Derivation of Maxwell's electromagnetic equation in differential form and integral form, Electromagnetic wave equations for **E** and **B** in vacuum and conducting medium, transverse nature of EM waves.	**9 hrs**
Module IV: QUANTUM PHYSICS Wave particle duality, concept of phase velocity group velocity, relation between them, Matter waves (de Broglie hypothesis), Wave functions, Observables as operators, Eigen function and Eigen values, Normalization, Expectation values, Schrodinger equation (Time dependent and time independent), Particle in a box.	**9 hrs**
Module V: LASERS Introduction to Laser, Characteristics of Lasers, Einstein's coefficients and relation between them, Lasing action, Population inversion, Three and four level pumping schemes, Ruby Laser, He-Ne Laser.	**8 hrs**

Essential/ Supplementary Readings:
1. Ian G. Main, Oscillations and waves in physics, Cambridge University Press
2. H.J. Pain, The physics of vibrations and waves, John Wiley & Sons Ltd.
3. E. Hecht, Optics, Pearson Education Ltd.
4. A. Ghatak, Optics, McGraw Hill Publisher
5. O. Svelto, Principles of Lasers, Springer

Course Outcome: At the end of this course students will demonstrate the ability to

CO1: Demonstrate proficiency and perceptive of the basic concepts in physics.

CO2: Utilize the scientific and experimental methods to investigate and verify the concepts related tocontent knowledge.

CO3: Exploring the engineering applications and apply quantum mechanics to engineering Phenomena.

CO4: Identifying the relevant formulae and work out engineering problems.

CO5: Comprehend principle, concept, working and application of new technology and comparison ofresults with theoretical calculations.

CO-PO Mapping:

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

PHYSICS LABORATORY

List of Experiments:

1. Determination of acceleration due to gravity by using Bar pendulum
2. Determination of wave length of monochromatic light with the help of Newton's ring apparatus.
3. Determination of grating element of a diffraction grating using spectrometer
4. Study of resonance using sonometer for unknown frequency
5. Study of RLC Circuit
6. Determination of surface tension of water by capillary rise method
7. To draw the characteristics of a bipolar junction transistor
8. To determine the rigidity modulus of the material of a wire by using Barton's apparatus.
9. To determine e/m ratio
10. Magnetic field measurement from Helmholtz coil

Course Outcomes: Upon completion of the subject the students will demonstrate the ability to:

CO1	Express the idea of calculation of acceleration due to gravity at any place using the concept of oscillatory system and simple harmonic motion.
CO2	Demonstrate the working and operational technique to calculate the mechanical properties of fluid and other materials.
CO3	Evaluate the voltage, current, power and characteristics behaviour of the electronic devices.
CO4	Understanding the rigidity concept of solid materials.
CO5	Analyzing the electrical and magnetic field measurements and their applications.

Course Articulation Matrix

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

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High) -: No Correlation

CHEMISTRY

Module–I: PERIODIC PROPERTIES (9Hours)

Periodic Properties, Effective Nuclear Charge, Penetration of Orbitals, Variations of *s*, *p*, *d* and *f* Orbital Energies of Atoms in the Periodic Table, Electronic Configurations, Atomic andIonic Sizes, Ionization Energies, Electron Affinity and Electronegativity, Polarizability, Oxidation States.

Module–II: FREE ENERGY IN CHEMICAL EQUILIBRIA (9 Hours)

Concepts of Entropy, Entropy in Physical and Chemical Changes, Free Energy Concepts, Gibbs Helmholtz Equation, Free Energy Change and Criterion of Spontaneity of Chemical Equation and Chemical Equilibrium, Van't Hoff Equation.

Module–III: SPECTROSCOPIC TECHNIQUES AND APPLICATIONS (9 Hours)

Basic Terms and Principles of Spectroscopy

Molecular Rotational (Microwave) Spectroscopy: Basic Principle and Application toDiatomic Molecules, Selection Rules.

Molecular Vibrational (IR) Spectroscopy: Basic Principle, Types of Vibrations , VibrationalFrequency, Selection Rules.

Electronic (UV-Visible) Spectroscopy: Laws of Absorption, Basis Principle, Types ofElectronic Transitions, Chromophores and Auxochrome.

Module–IV: STEREOCHEMISTRY (9 Hours)

Structural and Stereoisomer (Geometrical and Optical), Symmetry and Chirality, Enantiomers, Diastereomers, Optical Activity, Configurational and Conformational Analysis,Representations of Three Dimensional Structures(E, Z and R,S only).

Module–V: ORGANIC REACTIONS AND SYNTHESIS (9 Hours)

Introduction to Reaction Intermediates {Carbocation, Carbanion, Free Radial (Formation, structure and stability)}, Reactions involving Substitution, Addition, Elimination (Examples and Mechanisms)

Essential Reading:

1. Engineering Chemistry: fundamental to Applications by Shikha Agarwal, CambridgeUniversity Press, Second Edition, 2019.
2. Engineering Chemistry by B. Rama Devi, P. Aparna, and PrasantaRath, CengageLearning, First Edition, 2023.

Supplementary Reading:

1. Atkins' Physical Chemistry by Peter Atkins, Julio de Paula, and James Keeler, OxfordUniversity Press, Eleventh Edition, 2018.
2. Principles of Physical Chemistry by B. R. Puri, L. R. Sharma, and Madan S. Pathania,Vishal Publishing, Forty Eighth Edition, 2021.
3. Fundamentals of Molecular Spectroscopy by C.N. Banwell and E.M. MacCash,5thEdition, McGraw-Hill Education, Fourth Edition, 2017.
4. Concise Inorganic Chemistry by J.D Lee, Oxford University Press; Fifth Edition, 2008.
5. Principles of Inorganic Chemistry by B.R. Puri, L.R. Sharma, and K.C. Kalia, VishalPublishing, Fifty Fifth Edition, 2020.
6. Stereochemistry: Conformation and Mechanism by P.S. Kalsi, New Age International,Eighth Edition, 2015.
7. Organic Chemistry Concepts and Applications by Jagdamba Singh, PragatiPrakashan,Eighth Edition, 2015.

8. Organic Chemistry byR.T. Morrison andR.N. Boyd, Pearson Education, Seventh Edition,2010.
9. Organic Chemistry: Structure and Function by P. Volhardt and N. Schore, WH Freeman;Eighth Edition, 2018.

Course Outcomes:

CO1: To demonstrate and realise the trend in various periodic properties associated withdifferent elements present in different groups and periods of modern periodic table.

CO2: To acquire the knowledge of free energy concept for the thermodynamics associatedwith chemical reactions and equilibriums.

CO3: To analyze and implement the concepts of spectroscopic techniques for identificationof various organic and inorganic compounds.

CO4: To evaluate and visualize the concept of configurations and conformations of variousorganic compounds

CO5: To assess the generation, reaction and identification of intermediates involved duringorganic reactions and their applications in different organic reaction mechanisms.

Course Articulation Matrix

	PO1	PO2	PO3	PO4	PO5	PO6
CO1	3	1	2	2	2	3
CO2	3	2	2	2	0	0
CO3	3	1	2	2	2	2
CO4	3	1	2	2	1	1
CO5	3	2	2	2	2	1

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High) -: No Correlation

Program Articulation Matrix Row for this Course

	PO1	PO2	PO3	PO4	PO5	PO6
Course	3	2	2	2	1	1

CHEMISTRY LABORATORY

Chemistry Laboratory (Any Ten Experiments):

1. Determination of the alkalinity in the given water sample.
2. Determination of the temporary and permanent hardness in the given water sample by complexometric titration using EDTA as standard solution.
3. Determination of amount of available chlorine in bleaching powder.
4. Standardization of potassium permanganate using sodium oxalate
5. Determination of amount of ferrous iron present in Mohr's salt.
6. Determination of the rate constant of a chemical reaction.
7. Estimation of calcium in Limestone
8. Determination of dissolved oxygen in water sample.
9. Determination of the partition coefficient of a chemical between two immiscible liquids.
10. Determination of the strength of given HCl solution by titrating it against NaOH solutionusing p^H meter.
11. Conduct metric titration of strong acid and strong base.
12. Determination of viscosity of lubricating oil by Redwood viscometer.
13. Determination of flash point of a given oil by Pensky-Martens flash point apparatus.
14. To find out the concentration of a given potassium permanganate solution spectrophotometric method.
15. Synthesis of Aspirin/Paracetamol.

Essential Reading:

1. Practical Chemistry by D.N. Bajpai, O.P. Pandey and S. Giri, S. Chand Publishing,Revised Edition, 2010.
2. Practical Physical Chemistry by B. Vishwanathan and P.S. Raghavan, Viva Books, FirstEdition, 2012.

Course Outcomes:

CO1: To analyze the alkalinity and hardness value of the water sample.

CO2: To analyze the concentration of copper present in the solution.

CO3: to analyse kinetics of the reactions.

CO4: To gain hands-on experiences of pH meter, conductometer, and spectrophotometer.

CO5: To analyze viscosity and flash point of lubricating oils.

Course Articulation Matrix

	PO1	PO2	PO3	PO4	PO5	PO6
CO1	3	2	3	2	2	2
CO2	3	2	3	2	2	2
CO3	3	2	3	2	2	2
CO4	3	2	3	2	2	2
CO5	3	2	3	2	2	2

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High) -: No Correlation

Program Articulation Matrix Row for this Course

	PO1	PO2	PO3	PO4	PO5	PO6
Course	3	2	3	2	2	2

Subject Code		**Total Contact Hour**	**40 hours**
Semester	FIRST/SECOND	**Total credit**	**3**
Subject Name	**Programming in C and Data Structure**		
Pre-requisites	**Fundamentals of Computers**		

Course Objectives:

- Learn fundamentals of C programming
- Learn various steps of program development and implementation
- Learn different Data Structures for structured programming approach
- Learn relation of memory and memory referencing with the program execution
- Learn to implant small projects

Syllabus

Module I: Fundamentals of C	**Hours- 10**
Problem-solving processes: Algorithms and Flow Chart. C as a Middle-level language, Structure of C program, Character set Identifiers, Keywords, Data Types, Constant and Variables, Statements, Input and Output statements, Operators and Expressions, Precedence of operators, Control Structures (If, If-else, Switch-case, For loop, While, do-While)	
Module II: Function, Array, Structure and Union	**Hours-9**
Functions (Built-in, user-defined), Recursive function. Array: 1 – D, 2 – D, Matrix operations, String, Passing Array to Function, Structure, Union	
Module III: Pointer & Dynamic Memory Allocation	**Hours-8**
Pointer Arithmetic, Parameter passing using pointers, Call by value vs. Call by reference, Passing parameters, pointer to pointer, pointer to function, Pointer to Structure, Array and pointers, Static vs. Dynamic memory, Pointer variables, Dynamic memory allocation functions [malloc (), calloc (), realloc (), free ()]	
Module IV: Data Structures	**Hours-7**
Introduction to Data Structure, Linear Linked List: Creation, Insertion, Deletion. Stack, Stack applications (Infix to postfix, postfix evaluation), Queue (linear & circular)	
Module V: Tree, Introduction to Sorting & Searching	**Hours-6**
Binary Tree, Binary Search Tree, Sorting (Bubble Sort, Quick Sort), Searching (Linear Search, Binary Search)	

Essential Readings:

1. Byron Gottfried, Schaum's Outline of Programming with C, McGraw-Hill
2. Programming in C, Pradip Dey, Manas Ghosh, Oxford Publication
3. Data Structures - (Schaum's Outlines), McGraw-Hill Education

Supplementary Readings:

1. Let us C- Yashwant Kanetkar, BPB Publications.
2. Programming with ANSI and Turbo C- Kamthane, A. N. Pearson Education
3. R. S. Salaria, Programming for Problem Solving, Khanna Publishing House
4. The C Programming Language – Brian W. Kernighan and Dennis M. Ritchie, Prentice Hall.
5. Data Structures Using C - Amiya Kumar Rath, Alok Kumar Jagadev, Scitech Publications

Course Outcomes:

The students will learn and able to

- Remember, understand and implement simple algorithms to C programs.
- Test and execute programs using function, array, structure and union.
- Analyze the relation of memory and memory referencing with the program execution.
- Apply different Data Structures for problem solving.
- Implement different sorting and searching algorithms.

Programming Lab		0-0-3: 1.5
Sl. No.	**Expt. No.**	**Experiment Details**
1	1	Write a program to print your Bio-data.
	2	Write a program in C to test the arithmetic operators.
	3	Write a program to find out the simple interest and compound interest with the given input data.
2	1	Write a program to test the logical, bitwise, unary and ternary operators with the given input data.
	2	Write a program to check an inputted year is leap year or not.
	3	Write a program to calculate the salary of an employee given his basic pay, DA, HRA and TA. Display the output in format of salary statement.
3	1	Write a program to enter the marks of a student in 4 subjects. Then calculate the total, Aggregate %, and display the grades obtained by the student.
	2	Write a program to enter a number from 1-7 and display the corresponding day of the week using switch case statement.
	3	Write a program using switch case that read 4 nos. and display a menu thatoffers 4 options: calculate total, calculate average, display the smallest, and the largest number.
4	1	Write a program to check a given number is palindrome or not.
	2	Write a program to generate prime numbers present between two given numbers.
	3	Write a program to print the following pyramid star pattern. 
5	1	Write a program that will accept an array, and find the largest number, smallest number, sum of the elements and average of the elements present in the array.
	2	Write program that will accept an array and sort the array in ascending order. Display both the unsorted and unsorted arrays.
	3	Write a program that will insert an element at a desired position of an array. Show the array before insertion and after insertion of the new element (Array, element and position will provided by the user)
6	1	Write a program to swap the value of two inputted variable using function. Show the initial value and value after swapping.
	2	Write a program to print the Fibonacci series using function.
	3	Write a program that will accept two matrices using function and multiply them using function and show the result using function.
7	1	Write a program to find the GCD among two given number using recursion.
	2	Write a program to accept student data in a structure and display the structure elements.
	3	Check a inputted string is palindrome or not using pointer.

8	1	Write a program to read and print an array of n numbers, then find out the smallest number and its position in the array. Perform all these operations using pointer and function.
	2	Write a program to implement realloc() and free().
	3	Declare a pointer; allocate a block of memory to it using Dynamic Memory Allocation. Input a set of integers to the allocated memory block. The display the set of numbers.
9	1	Write a program to implement insertion and deletion of an element using linked list.
	2	Write a program to implement Push and Pop operations in Stack.
	3	Write a program to implement insert and delete operations in Queue.
10	1	Write a program to implement Quick Sort algorithm using C.
	2	Write a program to search an element using Linear Search algorithm.
	3	Write a program to search an element using Binary Search algorithm.

ENGINEERING MECHANICS

Module-I **(10Hours)**

Concurrent forces on a plane: Composition, resolution and equilibrium of concurrent coplanar forces, method of moment. General case of forces on a plane: Composition and equilibrium of forces in a plane, plane trusses, method of joints and method of sections.

Module-II **(6 Hours)**

Friction: Fundamentals and Problems involving friction, Ladder, Wedges. Principle of virtual work.

Module - III **(8Hours)**

Parallel forces on a plane: General case of parallel forces, center of parallel forces and center of gravity, Centroid of plane and composite figures, Theorems of Pappus and Guildins. Moment of inertia: Plane figure with respect to an axis in its plane and perpendicular to the plane, Polar moment of inertia, parallel axis theorem.

Module – IV **(8 Hours)**

Rectilinear translation: Kinematics, Principle of dynamics, D Alembert‟s Principle, Principle of work and energy for a particle and a rigid body, Conservation of energy, Principle of impulse and momentum for a particle and a rigid body, Conservation of momentum, System of rigid bodies, Impact, direct and central impact, coefficient of restitution.

Module – V **(8 Hours)**

Curvilinear translation: Kinematics, Equation of motion, Projectile, D Alembert‟s principle of curvilinear motion. Kinematics of rotation of rigid body.

Essential Reading:

1. Engineering Mechanics: S. Timoshenko, D.H. Young, J.V. Rao, Sukumar Pati,5th Edition,2017 McGraw Hill.

Supplementary Reading:

1. Engineering Mechanics, Static and Dynamics, J. L. Meriam and L.G.Kraige, 9th Edition,2021, John Wiley & Sons, Inc.
2. Fundamental of Engineering mechanics, S Rajesekharan& G ShankaraSubramanium,3rd Edition, 2017, S. Chand .
3. Engineering mechanics: K. L. Kumar andVeenuKumar, 4th Edition,2017, Tata MC Graw Hill.

Upon completion of the subject the students will be able to:

CO1	Ability to analyze objects in static equilibrium including the determination of reactions, forces and moments.
CO2	Enrichfundamental concept offriction and demonstrate the analytical skills to solve the problems involving friction.
CO3	Assimilatingthe knowledge for determination of centroid and second moment of area of sectionsand their engineering applications.
CO4	To analyze the work done by forces, the energy transferred from one object to other and apply principle of work and energy conservation for realistic (/Practical) engineering problems.
CO5	Identify the various parameters in projectile motion. Apply the principle of dynamics to analyze the curvilinear motion of rigid bodies.

Course Articulation Matrix

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

Program Articulation Matrix Row for this Course

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

Workshop and Digital Manufacturing Laboratory

1. Preparation of job in fitting section/Study of lathe and turning operation
2. Preparation of job in black smith section/ Study of milling machine and milling operation.
3. Preparation of job in carpentry section/milling operation on CNC milling machine.
4. Study of CNC lathe machine and turning on CNC lathe.
5. Study of Robot (Pick and place and palletizing operation).
6. Study of additive manufacturing using 3D printer and product development.

1. **Carpentry Section**: Study of different Hand tools, measuring instruments and equipments used in Carpentry work. Safety precautions.

   Preparation of Job: Carpentry job involving different types of joint.

   Includes the operations: Measuring, Marking, Sawing, Planing, Chiseling, Mortesing, Tenoning, making Half-lap joint, Mortese & Tenon joint and Nail joint.

2. **Fitting Section**: Study of different Hand tools, measuring instruments and equipments used in Fitting work. Safety precautions. Study of Drilling Machine and Grinding Machine.

   Preparation of Job: Paper Wt. / Square or Rectangular joint (male-female joint) (any one)

   Includes the operations: Measuring, Marking, Filing, Sawing, Drilling, Tapping, Dieing and Punching.

3. **Black Smith Section**:Study of different Hand tools, equipments and Open hearth furnace used in Blacksmith work. Different types of heat treatment processes. Safety precautions.

   Preparation of Job: Weeding hook/ Chisel (any one)

   Includes the operations: Measuring, Marking, Cutting, Upsetting, Drawing down, Bending, Fullering and Quenching.

4. **Turning/ Milling Section(Conventional & CNC)**
   - **A.** Study of Lathe Machine, different parts of Lathe and different applications of Lathe. Study of different measuring & marking instruments.
   - **B.** Study of Milling Machine, different parts and applications of Milling Machine. Study of different measuring & marking instruments.
   - **C.** (i) Study of CNC Lathe Machine, different parts of CNC Lathe and its operation.
     (ii) Part programming for turning operations.
   - **D.** (i) Study of CNC Milling Machine, different parts of CNC Milling Machine and its operation.
     (ii) Part programming for milling operations.

5. **Robotics Lab:**
   - **A.** Study of Robot.
   - **B.** Pick and place operation, demonstration and explanation of code.
   - **C.** Palletizing operation, demonstration and explanation of code.

6. **Additive Lab**

   Study of 3D Printer and demonstration of its operation.

Course Outcomes: At the end of the course, the student will be able to:

CO1	Acquire knowledge of conventional & CNC (Lathe and Milling Machine). CNC code and part programming for Milling and Turning operations. Different types of hand tool, measuring instruments and machine tools used in Fitting, Carpentry & Smithy work.
CO2	Know about different types of operations and joints performed in different shops i.e. in Fitting and Carpentry.
CO3	Explore learning about forging temperature of different types of ferrous metals and different types of operation (e.g. upsetting, edging, flattening and bending etc.) carried out on hot metals to prepare jobs.
CO4	Acquire knowledge for the preparation of different types of jobs by using conventional/ CNC Lathe and Milling Machines (e.g. facing, step turning, knurling, drilling, boring, taper turning, thread cutting and different methods of indexing for machining gears.
CO5	Acquire skills in using different precision measuring and marking instruments. Understand the importance of safety precaution in different shops.

Course Articulation Matrix

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

BASIC ELECTRICAL ENGINEERING

MODULE-I (6 HOURS)

D.C Networks: Kirchoff's laws, node voltage and mesh current methods, delta-star and star-delta conversions, superposition principle, Thevenin's and Norton's theorems, Maximum Power Transfer Theorem.

MODULE-II (6 HOURS)

Single phase and three phase ac circuit: Average and effective values of sinusoids, solution of R, L, C series circuits, solution of series and parallel circuits, series -parallel resonance.
Line and phase quantities, Delta and star connections, solution of the balanced three phase circuits, measurement of power in three phase circuits.

MODULE-III (6 HOURS)

Magnet circuit & principle of electromechanical energy conversion: Review of fundamental laws of electromagnetic induction, Solution of simple magnetic circuits.
DC machine: Construction, types, emf equation of generator, torque equation of motor, speed control of DC motors

MODULE-IV (6 HOURS)

AC MACHINES: Single Phase Transformer: Construction, emf equation, no load and load operation, voltage regulation and efficiency.
Three Phase Induction Motor: Construction, principle of working, concept of slip, torque speed relation.
Principle of operation of Three Phase alternator.

MODULE-V (6 HOURS)

Introduction to Power System: General structure of electrical power systems, Concepts of Generation, Transmission and Distribution, Sources of Electrical Power

ESSENTIAL READING

[1]. G. Rizzoni, Principles and Applications of Electrical Engineering, TMH , 2017
[2]. Nagrath I.J. and D. P. Kothari, Basic Electrical Engineering, Tata McGraw Hill.

SUPPLEMENTARY READING

[1]. S. Parker Smith, "Problems in Electrical Engineering", Asia Publications, 10th Edition.
[2]. Edward Hughes (revised by Ian McKenzie Smith), "Electrical & Electronics Technology", Pearson Education Limited. Indian Reprint 2002, 10th Edition.

Course Outcomes:

Upon completion of the subject the students will demonstrate the ability to:

CO1	Implement principles of DC network, theorems and transients.
CO2	Analyze the concept of Single phase and three phase AC circuits.
CO3	Express the concept of magnetic circuit and DC machines.
CO4	Apply basic principles of AC machines and their working.
CO5	Demonstrate basic principles of power system

Course Articulation Matrix

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

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High) -: No Correlation

Program Articulation Matrix row for this Course

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
Course	3	3	2	1	1	2	1	-	-	-	-	1

BASIC ELECTRICAL ENGINEERING LABORATORY

List of Experiments

1. Preliminary: Preparation of symbol chart for various systems & components as per ISS, to study the constructional & operational features for Voltmeter, Ammeter, Wattmeter, Frequency meter, multi-meter and Rheostat, Study of safety rules.

2. Demonstration of cut-out sections of machines: dc machine (commutator-brush arrangement), induction machine (squirrel cage rotor), synchronous machine (field winging - slip ring arrangement) and single-phase induction machine.

3. Measurement of the armature & field resistance of D.C. Machine by volt-amp method.
4. Starting and speed control of a D.C. shunt motor
5. Study of BH Curve of ferromagnetic core.
6. Determination of open circuit characteristics (O.C.C) of D.C shunt generator when separately excited at different speeds and different excitation levels.
7. Calibration of a single-phase Energy Meter by direct loading.

8. Measurement of power & power factor of a single-phase circuit
9. Measurement of earth resistance and insulation resistance.
10. Verification of Thevenin and Norton's theorem

Course Outcomes

Upon completion of the subject the students will demonstrate the ability to:

CO1	Express the safety rules as per ISS and symbols of different electrical components and the use of various electrical instruments in the laboratory.
CO2	Demonstrate the working and operational characteristics of dc motor and dc generator.
CO3	Evaluate the voltage, current, power and power factor of choke coil and study BH curve of a ferromagnetic core.
CO4	Measure armature and field resistance of DC machines, earth resistance and insulation resistance and demonstrate the internal structure of different machines.
CO5	Analyze the connection and calibration of single phase energy meter

Course Articulation Matrix

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

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High) -: No Correlation

Program Articulation Matrix row for this Course

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
Course	3	3	2	1	3	2	1	1	3	3	1	1

BASIC ELECTRONICS (3-0-0) Credit-02

COURSE OBJECTIVE:

1. To impart the fundamentals of semiconductor devices and their applications to various circuits.
2. To impart the knowledge offundamentals of digital electronics and Integrated Circuits (IC).
3. To impart the knowledge of electronic measuring instruments and fundamentals of communication systems.

MODULE	CONTENT	HOURS
MODULE 1	SemiconductorPhysics:Properties of semiconductor, current flow in semiconductors, voltage -current characteristic of a p-n junctions, Rectifiers Bipolar junction Transistor (BJT): Device structure, types and modes of operation, static characteristic, BJT as a switch, BJT as an amplifier, conceptof biasing of BJT	**7**
MODULE 2	JFET: Physical structure, operation and static characteristics MOSFET: Physical structure, operation and characteristics ofD- andE-type MOSFET Integrated Circuits: Introduction to CMOS technology in VLSI,Introduction to Integrated circuits, Fabrication of monolithic IC, Integration of circuit components, Limitations of VLSI	**7**
MODULE 3	Feedback Amplifiers: General feedback structure, properties of negative feedback, four basic types of feedback topologies (Block diagram only) Operational Amplifier (OP-AMP): Ideal OP-AMP, inverting configuration, non-inverting configuration, OP-AMP Applications (Adder, Subtractor only)	**6**
MODULE 4	Digital Electronicsfundamentals-Number system (Decimal, Binary, Octal and Hexadecimal), conversion amongnumber systems, signed-binary numbers, binary addition, subtraction, multiplication and division, logic gates, laws of Boolean Algebra,simplification of expressions	**5**
MODULE 5	Electronic Instruments: Overview of CRO, DSO; principles of operation, waveform reconstruction, Comparison between CRO & DSO, applications of oscilloscope Principles of Communication Systems: Fundamentals of AM & FM, (Waveforms and general expressions only)	**5**
ESSENTIAL READING	1. Electronics Fundamentals and Applications, D. Chattopadhyay and P.C. Rakshit, New Age International Publications. (Selected portions fromchapters) 2. Electronic Devices & Circuit Theory, R.L. Boylestad and L.Nashelsky, PearsonEducation.	
SUPPLIMENTARY READING	1. Integrated Electronics, Millman and Halkias, TMHPublications. 2. Microelectronics Circuits, A.S Sedra, K.C. Smith, Oxford UniversityPress. 3. VLSI Design, Debaprasad Das, Oxford University Press. 4. Electrical & Electronics Measurement and Instrumentation, A.K. Sawhney, Dhanpat Rai & Co(Pvt.) Ltd	

COURSE OUTCOME: After completion of the course, students should be able to

1. Understand theoperationand application of semiconductor devices.
2. Analyze characteristics of FETs.
3. Apply the Feedback Amplifiers and Operational Amplifiers.
4. Remember the fundamentals of different Digital arithmetic operations

ELECTRONICS LAB (0-0-3) Credit-1.5

SESSIONAL OBJECTIVE:

1. To provide engineering skills for circuit design on breadboard with electronic components.
2. To impart the knowledge on digital fundamentals and digital circuit design.
3. To analyze various electronic circuits such as BJT, FET, OP-AMPs etc.

Experiment No.	CONTENT
1	Familiarity with electronic components and devices(Testing of semiconductor diode, Transistor, IC Pins connection) Digital Multimeter should be used.
2	Study and use of CRO to view waveforms and measure its Amplitude and Frequency.
3	V-I Characteristics of a Semiconductor Diode
4	V-I (Output) Characteristics of N-P-N/P-N-P Transistor in CE Configuration
5	Measurement of pinch off voltage and plot transfer characteristics and drain characteristics of JFET.
6	Transfer characteristics and drain characteristics of MOSFET.
7	OP-AMP: Inverting and Non-Inverting Configuration. Record of Waveforms.
8	Verification of Truth table of Logic gates (AND, OR,NOT, NAND, NOR, EX-OR)
9	Half Wave and Full Wave Rectifier without Capacitor filter. Record of Waveforms, Measurement of Average and RMS value.
10	Implementation of digital circuit using Universal gates.
SUPPLEMENTARY BOOKS	1. Integrated Electronics, Millman and Halkias, TMH Publications. 2. Electronic Devices & Circuit Theory, R.L Boylestad and L. Nashelsky, Pearson Education.

SESSIONAL OUTCOME: After completion of the sessional student should be able to

1. Acquire basic knowledge on electronic devices and components
2. Design different electronics circuits using semiconductor diodes.
3. Analyze and develop the characteristics of BJT and FET Circuits
4. Implement Operational amplifier circuits.
5. Acquire knowledge on basic digital logic gates.

BASIC MECHANICAL ENGINEERING 2-0-0

MODULE-I (11 classes)
Thermodynamics: Systems, Properties, Process, State, Cycle, Internal energy, Enthalpy, Zeroth Law, First law and Second Law of Thermodynamics, Basic Concept Entropy, Properties of ideal gas, Properties of pure substances, Enthalpy, Specific volume, Internal energy and dryness fraction of steam, use of Steam tables. Related numerical.

MODULE-2 (8 classes)

Application of Thermodynamics: Single stage air compressor, Steam Power Plant, I.C. Engines (Brief Description on working principles with Schematic diagrams only)

Elements of Fluid Mechanics and Heat Transfer
Properties used in Fluid Mechanics, Fluid Statics, Kinematics and Dynamics (Concepts only), Heat transfer and Classifications (Concepts only)

MODULE-3 (7 Classes)

Introduction to Manufacturing: Classification of engineering materials, Material Properties, Manufacturing processes: Welding, Casting, Forming (Basics only)

MODULE-4 (4 Classes)

Basic Power transmission devices: Belt, Gear drives, clutch, brakes. (Working principle only)
Introduction to Robotics: Robot anatomy, Joints and links and common robot configurations.

Essential Reading

i. Basic Mechanical Engineering by Pravin Kumar, Pearson
ii. Basic Mechanical Engineering by A R Israni, P K Shah, BS Publications
iii. Text book of Elements of Mechanical Engineering, S T Murthy, Universities press
iv. Basic and applied Thermodynamics by P. K. Nag, Tata McGraw Hill

Supplementary reading

i. Basic Mechanical Engineering by.D. Mishra, P. KParida, S.S.Sahoo, India Tech Publishing company
ii. Elements of Mechanical Engineering by J K Kittur and G D Gokak,Willey
iii. Basic Mechanical Engineering by BasantAgrawal, C M Agrawal,Willey
iv. Engineering Thermodynamics by P. Chattopadhaya, Oxford University Press

COURSE OUTCOMES

CO1: Comprehending the Law of Thermodynamics
CO2: Being aware of how crucial thermodynamics is to IC engines, power plants, refrigerators, and Heat Pump
CO3: Being aware of fluid mechanics and heat transfer concepts
CO4: Recognizing the functions of Engineering materials
CO5: Have a fundamental understanding of welding, Casting, Forming and other manufacturing techniques.
CO6: Recognizing fundamental power transfer mechanisms and aware of the fundamental robotics system.

Basic Civil Engineering

Module-I(6 Classes)

Introduction to Civil Engineering: Various disciplines of Civil engineering, Importance of Civil engineering in infrastructure development of the country, interdisciplinary nature of construction projects.

Residential Buildings: NBC Classification, Basic Components of a building: Basic requirement. Planning and Design of buildings: fundamental requirements, selection of sites, Introduction to building design: functional and structural design.

Foundations: Classification, Bearing Capacity of Soil and related terms (definition only)

Module-II(6 Classes)

Fundamental Properties of Construction Materials: Physical, mechanical and durability properties.

Construction materials: stone, bricks, cement, aggregate, mortar, concrete, timber, steel, non-ferrous metals, paint, plastic, glass, adhesive, tiles, composites(Definition, classification and application),

Module-III(6 Classes)

Importance of Transportation, Transportation modes i.e. Highway, railway, airways, water, pipe and conveyor – Basic Characteristics, advantages and disadvantages. Indian road transport system: Types of roads, classification of highway, urban roads: basic requirements and classification. Basic Components of a Road, Rigid and Flexible pavement (comparison only)

Module-IV(6 Classes)

Quantity of water: Sources of water, Per capita demand, drinking water standards, Public Water Supply System: Necessity and Basic lay out. Conventional water treatment process: Screening, Plain Sedimentation, Sedimentation aided with Coagulation, Filtration, and Disinfection (working principles only).

Module-V(6 Classes)

Irrigation: Importance of Irrigation, Classification of Irrigation projects, Irrigation system: Types, Field water distribution, Multipurpose river valley projects, Dams: Purpose, types. Layout of canal Irrigation system: components and definitions.

Essential Reading:

- Basic Civil engineering, Gopi, S., Pearson Publication
- Basic Civil Engineering, Bhavikatti, S. S., New Age.

Course Outcomes:

- Able to understand the basics of civil engineering and fundamental aspects of building.
- Able to get the brief overview of general aspect of building material.
- Able to get brief idea about transportation modes and planning.
- Able to get brief idea about drinking water standards and water treatment plant.
- Able to get brief idea about irrigation network system.

Engineering Graphics and Design Lab (with AutoCAD)

1) Introduction to AutoCAD: Basic commands, Code provision of IS-696 regarding Lines, Lettering and Dimensioning.
2) Drawing of Scales (Plane Scales, Diagonal Scales, Vernier Scales and Scales of Chords).
3) Construction of simple geometrical figures and Engineering curves.
4) Orthographic Projections:
   i) Projection of a point situated in various quadrants.
   ii) Projections of straight lines.
   iii) Projection of plane figures.
   iv) Projection of simple solids.
   v) Section of solid and Development of surfaces.
5) Isometric projection and perspective view.

Essential Reading:

1. N. D. Bhatt, ***Geometrical Drawing***, Charotar Book Stall, 2002.

Supplementary Reading:

1. K. Venugopal, ***Engineering Drawing and Graphics + AutoCAD***, New Age International (P) Limited. 4th Reprint: June, 2008.
2. K. L. Narayana and P. Kannaiah, ***Engineering Graphics***, Tata McGraw Hill Publishing Co. Ltd.
3. J. D. Bethune, ***Engineering Graphics with AutoCAD***, Pearson Education.

Subject Code		Total Contact Hour	**30**
Semester	**1st/2nd Semester**	Total Credit	**02**
Subject Name	**English for Technical Writing (2-0-0)**		
Pre-requisites	**None**		

Course Objective:

- To develop awareness about the complexity of the communication process.
- To provide learning environment to practice listening, speaking, reading and writingskills.
- To assist the students to carry on the tasks and activities through guided instructionsand materials.
- To develop effective writing skills so as enable students to write in a clear, concise, persuasive manner
- To acquaint students with a variety of forms of writing in professional world.
- To effectively integrate English language learning with employability skills and training.

Syllabus:

Module I - Fundamentals of Technical Communication	**Hours- 06**
➢ Process of communication, types of communication (Verbal & Non Verbal) ➢ Channels of business communication ➢ Barriers to communication. ➢ Bias free language ➢ Cross-cultural communication	
Module II- Communicative Grammar	**Hours - 06**
➢ Time and Tense ➢ Passive and active voice ➢ English Conditionals	
Module III - Sounds of English	**Hours- 06**
➢ Consonant sounds of English ➢ Vowel sounds of English ➢ Stress pattern: Syllable, Stress and Intonation. ➢ Problem sounds for Indian speakers	
Module IV - Professional Communication for Workplace	**Hours 06**
▫ Paragraph writing (The Seven Cs of Good Professional Writing) ▫ Formal Letter Writing ▫ Memo and Notice writing ▫ Agenda and Minute writing ▫ Report Writing	
Module V - Professional Communication for Employment	**Hours - 06**
➢ CV writing ➢ Interview skills	

Essential Reading:

1. Effective Technical Communication by M Ashraf Rizvi (Tata McGraw Hill)
2. Better English Pronunciations By J. D.O Conner (Cambridge University Press)

3. A Communicative Grammar of English by G.N. Leech and Jan Svartik (OUP)

Supplementary Reading:

1. Business Communication Today by Bovee, Thill and Chaterjee, Pearson.
2. Technical Communication: Principles and Practice by Meenakshi Raman and SangeetaSharma, Oxford University Press.
3. Communication Skills by Sanjay Kumar & Pushp Lata, Oxford University Press
4. An introduction to Professional English and Soft Skills by BK Das, et.al. Foundation Books
5. Spoken English: A Manual of Speech and Phonetics by R.K. Bansal, J B Harrison, OrientBlackswan

Course Outcome: At the end of this course students will demonstrate the ability to

CO1: Understand the concept and nature of communication and the objective of TechnicalCommunication relevant for the work place as Engineers.

CO2: Use suitable vocabulary and grammar with confidence and express their ideas both inspeech and writing.

CO3: Evaluate their efficacy as fluent and efficient communicators by learning the voice-dynamics.

Subject Code		Total Contact Hour	
Semester	**1st/2nd Semester**	Total Credit	**1.5**
Subject Name	**Communicative Enlish &Report writing lab**		
Pre-requisites	**None**		

Course Objective:

The purpose of the English lab is to involve students to actively participate in language learning exercises and get more practice than the traditional classroom environment. The primary role of the lab is to create an environment where students feel comfortable speaking the language theyare learning, and where they can get the help they need in their journey to learn English as asecond language. The lab further focuses

- To provide a platform to the students to develop their language skills.
- To strengthen their professional skills and To improve fluency in spoken English, to practice correct pronunciation and neutralize their mother tongue influence.
- To provide hands-on training in Speaking, Listening, reading and writing skills.
- To improve the fluency of students in spoken English and neutralize their mother tongue influence.

Syllabus:

Assignment I
➢ Self- introduction
Assignment II
➢ Professional presentation
Assignment III
➢ Power point presentation
Assignment IV
➢ Situational conversational practice/ Role play
Assignment V
➢ Review of a book/newspaper editorial/ movie
Assignment VI
➢ Cover letter and CV writing
Assignment VII
➢ Listening Practice
Assignment VIII
➢ Group Discussion
Assignment IX
➢ Mock Interview

Assignment X
➢ Reading Practice

Course Outcome: At the end of this course students will demonstrate the

CO1: To acquire strategic competence to use both spoken and written language in range a widecommunication strategies.

CO2: To maintain good linguistic competence- through accuracy in grammar, pronunciation and

CO3: Speak English with proper pronunciation and

CO4: Make effective oral presentations by interpreting and analysing data, pictures and videos andparticipate in Group Discussion on general topics

Second Year Engineering									
Third Semester									
	Theory						Practical		
Code	**Course Name**		**Hours/ week L/T**	**Credit Theory**	**University Marks**	**Internal Evaluation**	**Hours/ Week L/T**	**Credit Practical**	**Marks**
PC	Analog Electronics Circuits		3-0	3	100	50	2	1	50
PC	Network Theory		3-0	3	100	50	2	1	50
PC	Signal & Systems		3-0	3	100	50	2	1	50
PC	Digital Electronics		3-0	3	100	50	2	1	50
PC	Semiconductor Devices		3-1	4	100	50			
HS	Engineering Economics/ Organizational Behavior		2-1	3	100	50			
Total			19	19	600	300	8	4	200
Total Marks: 1100									
Total Credits: 23									
Honours		Probability and Random Processes	4	4	100	50			
Minor		Analog Electronic Circuits							

Semester : 3rd

1.	PET3D001 Honours(CP)	Probability and Random Processes	4-0-0	4
2.	PEK3E001 HS(O1)	Engineering Economics	3-0-0	3
3.	POB3E002 HS(O1)	Organizational Behavior	3-0-0	3
4.	PET3G001 Minor(CP)	Analog Electronic Circuits	4-0-0	4
5.	PET3I001 PC(CP)	Semiconductor Devices	4-0-0	4
6.	PET3I101 PC(CP)	Analog Electronic Circuits	3-0-1	4
7.	PET3I102 PC(CP)	Network Theory	3-0-1	4
8.	PET3I103 PC(CP)	Signal & Systems	3-0-1	4
9.	PET3I104 PC(CP)	Digital Electronics	3-0-1	4
				27

3rd Semester

PET3G001 ANALOG ELECTRONICS CIRCUIT (3-0-2)

MODULE – I **(12 Hours)**

MOS Field-Effect Transistor: Principle and Operation of FETs and MOSFETs; P-Channel and N-Channel MOSFET; Complimentary MOS; V-I Characteristics of E- MOSFET and D-MOSFET; MOSFET as an Amplifier and as a Switch. (4 Hours)

Biasing of BJTs: Load lines (AC and DC); Operating Points; Fixed Bias and Self Bias, DC Bias with Voltage Feedback; Bias Stabilization; Examples. (4 Hours)

Biasing of FETs and MOSFETs: Fixed Bias Configuration and Self Bias Configuration, Voltage Divider Bias and Design (4 Hours)

MODULE – II **(12 Hours)**

Small Signal Analysis of BJTs: Small-Signal Equivalent-Circuit Models; Small Signal Analysis of CE, CC, CB amplifiers. Effects of R_S and R_L on CE amplifier operation, Emitter Follower; Cascade amplifier, Darlington Connection and Current Mirror Circuits. (6 Hours)

Small Signal Analysis of FETs: Small-Signal Equivalent-Circuit Model, Small Signal Analysis of CS, CD, CG Amplifiers. Effects of R_{SIG} and R_L on CS Amplifier; Source Follower and Cascaded System. (6 Hours)

MODULE – III **(5 hours)**

High Frequency Response of FETs and BJTs: High Frequency equivalent models and frequency Response of BJTs and FETs; Frequency Response of CS Amplifier, Frequency Response of CE Amplifier. (5 Hours)

MODULE – IV (9 hours)

Feedback amplifier and Oscillators: Concepts of negative and positive feedback; Four Basic Feedback Topologies, Practical Feedback Circuits, Principle of Sinusoidal Oscillator, Wein-Bridge, Phase Shift and Crystal Oscillator Circuits. (4 Hours)

Operational Amplifier: Ideal Op-Amp, Differential Amplifier, Op-Amp Parameters, Non-inverting Configurations, Open-loop and Closed-loop Gains, Differentiator and Integrator, Instrumentation amplifier. (5Hours)

Additional Module (Terminal Examination-Internal) **(6 hours)**

Basic analysis of difference amplifier, Simulation of analog circuits i.e., different single and cascaded amplifier circuits, difference amplifier circuits and validating the theoretical parameters using PSpice and MULTISIM. Analysis op-amp IC circuits using LF411 and μA 741, Signal Generators using OPAMP: Square, triangle and ramp generator circuits using opamps - Effect of slew rate on waveform generation-introduction to analog simulation OPAMP as nonlinear element: comparator, Voltage controlled oscillator (VCO). Concept of Schmitt triggers circuit and sample/hold circuit using operational amplifier

Text Books

1. *Electronic Devices and Circuits theory, R.L. Boylestad and L. Nashelsky, Pearson Education, New Delhi , 9th/10th Edition,2013. (Selected portions of Chapter 4, 5, 6, 7, 8, 9, 10, 11, 12, and 14)*
2. *Milliman's Electronics Devices and Circuits, J. Milliman, C. Halkias, S. Jit., Tata McGraw Hill Education Pvt. Ltd., New Delhi, 2nd Edition,2008.*

Reference Books

1. *Microelectronics Circuits, Adel Sedra and Kenneth C Smith, Oxford University Press, New Delhi, 5th Edition, International Student Edition,2009. (Selected portion of Chapter 2,4, 5, 6, 8, 13, and 14)*
2. *Electronic Devices and Circuits, Jimmie J. Cathey adapted by Ajay Kumar Singh, Tata McGraw Hill Publishing Company Ltd., New Delhi, 3rd Edition, (For Problem Solving)*
3. *Electronics Circuits Analysis and Design, Donald A. Neamen, Tata McGraw Hill Publishing Company Ltd., New Delhi, 3rd Edition,2002.*
4. *Integrated Electronics: Analog and Digital Circuits and Systems, J. Milliman, C. Halkias, Tata McGraw Hill Publishing Company Ltd., New Delhi,2nd Edition.2004.*
5. *Microelectronic Circuits: Analysis and Design, M.H. Rashid, PWS Publishing Company, a division of Thomson Learning Inc. India Edition.*
6. *Electronic device and circuits, David A. Bell, Oxford University Press, 5thedition,2008.*
7. *Electronics devices and circuits, Anil.K.Maini, Wiley India Pvt.Ltd,2009*

ANALOG ELECTRONICS CIRCUIT LAB

List of Experiments

(At least 10 out of 12 experiments should be done)

1. Design and simulate BJT bias circuit and compare the results.

2. *Design and simulate JEET/MOSFET bias circuit and compare the results.*

3. *Design and simulate BJT common-emitter circuit and compare D.C and A.C performance:*

4. *Design and simulate JFET/MOSFET common-emitter circuit and compare D.C and A.C performance:*

5. *Determining the frequency response of a common-emitter amplifier: low frequency, high frequency and mid frequency response and compare with simulated results.*

6. *Differential amplifiers circuits: D.C bias and A.C operation without and with current source.*

7. *Study of Darlington connection and current mirror circuits.*

8. *OP-Amp Frequency Response and Compensation.*

9. *Application of Op-Amp as differentiator, integrator, square wave generator.*

10. *Obtain the band width of FET/ BJT using Square wave testing of an amplifier.*

11. *R.C phase shift oscillator/Wien-Bridge Oscillator using OP-Amp/Crystal Oscillator.*

12. *Class A and Class B Power Amplifier.*

3rd Semester

PET3I102 NETWORK THEORY

Module- I **[11 Hours]**

University Portion (80%)

Network Theorems: Superposition theorem, Thevenin's theorem, Norton's Theorem, Reciprocity Theorem, Maximum Power transfer theorem, Tellegen's theorem, Millman's theorem, Compensation theorem.Coupled Circuits: Coupled Circuits, Dot Convention for representing coupled circuits, Coefficient of coupling.

Resonance: Band Width and Q-factor for series and parallel resonant circuits.

College/Institute Portion (20%):

Electrical equivalent of magnetically Coupled Circuit, Tuned Couple Circuit: Single tuned and double tuned or related advanced topics as decided by the concerned faculty teaching the subject.

Module- II **[9 Hours]**

University Portion (80%)

Laplace Transform & its Application: Introduction to Laplace Transform, Laplace transform of some basic functions, Laplace transform of periodic functions, Inverse Laplace transform, Application of Laplace transform: Circuit Analysis (Steady State and Transient).

Two Port Network Functions& Responses: z, y, ABCD and h-parameters, Reciprocity and Symmetry, Interrelation of two-port parameters, Interconnection of two-port networks.

Network Functions: Significance of Poles and Zeros, Restriction on location of Poles and Zeros, Time domain behavior from Pole-Zero plots.

College/Institute Portion (20%):

Necessary conditions for transfer function, natural response of a network, Routh Hurwitz criterion of stability of network function or related advanced topics as decided by the concerned faculty teaching the subject.

Module- III **[5 Hours]**

University Portion (80%)

Fourier Series& its Application: Fourier series, Fourier analysis and evaluation of coefficients, Steady state response of network to periodic signals, Fourier transform and convergence, Fourier transform of some functions.

Passive Filter: Brief idea about network filters (Low pass, High pass, Band pass and Band elimination) and their frequency response

College/Institute Portion (20%):

Active filter-Butterworth, Chebyshev filter or related advanced topics as decided by the concerned faculty teaching the subject.

Module- IV **[5 Hours]**

University Portion (80%)

Network Synthesis: Realizability concept, Hurwitz property, positive realness, properties of positive real functions, Synthesis of R-L, R-C and L-C driving point functions in Foster and Cauer forms.

College/Institute Portion (20%):

Network Topology: Graph of a network, Concept of tree, Incidence matrix, Tie-set matrix, Cut-set matrix, Formulation and solution of network equilibrium equations on loop and node basis, Dual of a network or related advanced topics as decided by the concerned faculty teaching the subject.

Text Book:

1. *Fundamentals of Electric Circuits – Alexander & Sadiku – Tata McGraw Hil,5th Editionl.*
2. *Circuits & Networks: Analysis, Design and Synthesis- Sukhija & Nagsarkar- Oxford*

Reference Book(s):

1. *Network Analysis – M E Van Valkenburg – Pearson Education, 3rd Edition.*
2. *Network Synthesis – M E Van Valkenburg – Pearson Education.*
3. *Network Analysis and Synthesis – Franklin F. Kuo – Wiley Student Edition.*
4. *Linear Circuits Analysis and Synthesis – A Ramakalyan – Oxford University Press.*
5. *Problems & Solutions in Electric Circuit Analysis – Sivananda & Deepa – Jaico Book.*
6. *Theory and problem of electrical circuits, Schaum's Outline Series, TMH – Joseph A. Edminister, MahmoodMaqvi.*
7. *Electric Circuits – David A.Bell – Oxford, 7th Edition, 2015.*

NETWORK THEORY LAB

Select any 8 experiments from the list of 10 experiments

1. *Verification of Network Theorems using AC circuits. (Superposition, Thevenin, Norton, Maximum Power Transfer).*
2. *Study of DC and AC Transients for R-L, R-C & R-L-C circuits using storage oscilloscope.*
3. *Determination of circuit parameters: Open Circuit and Short Circuit parameters.*
4. *Determination of circuit parameters: Hybrid and Transmission parameters.*
5. *Frequency response of Low pass and High Pass Filters.*
6. *Frequency response of Band pass and Band Elimination Filters.*
7. *Determination of self inductance, mutual inductance and coupling coefficient of a single phase two winding transformer representing a coupled circuit.*
8. *Study of resonance in R-L-C series circuit using oscilloscope.*
9. *Study of resonance in R-L-C parallel circuit using oscilloscope.*
10. *Spectral analysis of a non-sinusoidal waveform.*

3rd Semester

PET3I103 SIGNALS & SYSTEMS

MODULE – I (10 Hours)

Discrete-Time Signals and Systems:
Discrete-Time Signals: Some Elementary Discrete-Time signals, Classification of Discrete-Time Signals, Simple Manipulation, Discrete-Time Systems : Input-Output Description, Block Diagram Representation, Classification, Interconnection; Analysis of Discrete-Time LTI Systems: Techniques, Response of LTI Systems, Properties of Convolution, Causal LTI Systems, Stability of LTI Systems; Discrete-Time Systems Described by Difference Equations; Implementation of Discrete-Time Systems. Correlation of Discrete-Time Signals: Cross correlation and Autocorrelation Sequences, Properties.

MODULE – II (10 Hours)

The Continuous-Time Fourier Series:
Basic Concepts and Development of the Fourier series; Calculation of the Fourier Series, Properties of the Fourier Series.

The Continuous-Time Fourier Transform:
Basic Concepts and Development of the Fourier Transform; Properties of the Continuous-Time Fourier Transform.

MODULE- III (10 Hours)

The Z-Transform and Its Application to the Analysis of LTI Systems:
The Z-Transform: The Direct Z-Transform, The Inverse Z-Transform; Properties of the Z-Transform; Rational Z-Transforms: Poles and Zeros, Pole Location and Time-Domain Behavior for Causal Signals, The System Function of a Linear Time-Invariant System; Inversion of the Z-Transforms: The Inversion of the Z-Transform by Power Series Expansion, The Inversion of the Z-Transform by Partial-Fraction Expansion; The One-sided Z-Transform: Definition and Properties, Solution of Difference Equations.

MODULE- IV (6 Hours)

The Discrete Fourier Transform: Its Properties and Applications:
Frequency Domain Sampling: The Discrete Fourier Transform; Properties of the DFT: Periodicity, Linearity, and Symmetry Properties, Multiplication of Two DFTs and Circular Convolution, Additional DFT Properties.

Additonal Module (Terminal Examination-Internal) (04 Hours)

Properties of Continuous-Time Systems:
Block Diagram and System Terminology; System Properties: Homogeneity, Time Invariance, Additivity, Linearity and Superposition, Stability, Causality.

Text Books

1. *Digital Signal Processing – Principles, Algorithms and Applications, John. G. Proakis and Dimitris. G. Manolakis, 4th Edition, Pearson.*
2. *Fundamentals of Signals and Systems - M. J. Roberts, TMH*
3. *Signal & Systems by Tarun Kumar Rawat, Oxford University Press.*

Reference Books

1. *Signals and Systems - P. Ramakrishna. Rao, TMH.*
2. *Signals and Systems – A NagoorKani, TMH*
3. *Signals and Systems, Chi-Tsong Chen, Oxford*
4. *Principles of Signal Processing and Linear Systems, B.P. Lathi, Oxford.*
5. *Principles of Linear Systems and Signals, B.P Lathi, Oxford*

3rd Semester

SIGNALS AND SYSTEMS LAB

List of Experiments:
(At least 10 out of 15 experiments should be done)

1. *Write a program to generate the discrete sequences (i) unit step (ii) unit impulse (iii) ramp (iv) periodic sinusoidal sequences. Plot all the sequences.*
2. *Find the Fourier transform of a square pulse .Plot its amplitude and phase spectrum.*
3. *Write a program to convolve two discrete time sequences. Plot all the sequences. Verify the result by analytical calculation.*
4. *Write a program to find the trigonometric Fourier series coefficients of a rectangular periodic signal. Reconstruct the signal by combining the Fourier series coefficients with appropriate weightings.*
5. *Write a program to find the trigonometric and exponential Fourier series coefficients of a periodic rectangular signal. Plot the discrete spectrum of the signal.*
6. *Generate a discrete time sequence by sampling a continuous time signal. Show that with sampling rates less than Nyquist rate, aliasing occurs while reconstructing the signal.*
7. *The signal x (t) is defined as below. The signal is sampled at a sampling rate of 1000 samples per second. Find the power content and power spectral density for this signal.*

$$x(t) = \begin{cases} \cos(2\pi \times 47t) + \cos(2\pi \times 219t), & 0 \le t \le 10 \\ 0 & otherwise \end{cases}$$

8. *Write a program to find the magnitude and phase response of first order low pass and high pass filter. Plot the responses in logarithmic scale.*
9. *Write a program to find the response of a low pass filter and high pass filter, when a speech signal is passed through these filters.*
10. *Write a program to find the autocorrelation and cross correlation of sequences.*
11. *Generate a uniformly distributed length 1000 random sequence in the range (0,1). Plot the histogram and the probability function for the sequence. Compute the mean and variance of the random signal.*
12. *Generate a Gaussian distributed length 1000 random sequence. Compute the mean and variance of the random signal by a suitable method.*
13. *Write a program to generate a random sinusoidal signal and plot four possible realizations of the random signal.*
14. *Generate a discrete time sequence of N=1000 i.i.d uniformly distributed random numbers in the interval (-0.5,-0.5) and compute the autocorrelation of the sequence.*
15. *Obtain and plot the power spectrum of the output process when a white random process is passed through a filter with specific impulse response*

3rd Semester

PET3I104 DIGITAL ELECTRONICS

University Level:

MODULE – I (12 Hours)

Number System: Introduction to various number systems and their Conversion. Arithmetic Operation using 1's and 2`s Compliments, Signed Binary and Floating Point Number Representation Introduction to Binary codes and their applications. (**5 Hours)**
Boolean Algebra and Logic Gates: Boolean algebra and identities, Complete Logic set, logic gates and truth tables. Universal logic gates, Algebraic Reductionand realization using logic gates **(3 Hours)**
Combinational Logic Design: Specifying the Problem, Canonical Logic Forms, Extracting Canonical Forms, EX-OR Equivalence Operations, Logic Array, K-Maps: Two, Three and Four variable K-maps, NAND and NOR Logic Implementations. **(4 Hours)**

MODULE – II (14 Hours)

Logic Components: Concept of Digital Components, Binary Adders, Subtraction and Multiplication, An Equality Detector and comparator, Line Decoder, encoders, Multiplexers and De-multiplexers. **(5 Hours)**
Synchronous Sequential logic Design: sequential circuits, storage elements: Latches (SR, D), Storage elements: Flip-Flops inclusion of Master-Slave, characteristics equation and state diagram of each FFs and Conversion of Flip-Flops. Analysis of Clocked Sequential circuits and Mealy and Moore Models of Finite State Machines **(6 Hours)**
Binary Counters : Introduction, Principle and design of synchronous and asynchronous counters, Design of MOD-N counters, Ring counters. Decade counters, State Diagram of binary counters (4 hour)

MODULE – III (12 hours)

Shift resistors: Principle of 4-bit shift resistors. Shifting principle, Timing Diagram, SISO, SIPO ,PISO and PIPO resistors. (4 hour)
Memory and Programmable Logic: Types of Memories, Memory Decoding, error detection and correction), RAM and ROMs. Programmable Logic Array, Programmable Array Logic, Sequential Programmable Devices. **(5 Hours)**
IC Logic Families: Properties DTL, RTL, TTL, I^2L and CMOS and its gate level implementation. A/D converters and D/A converters **(4 Hours)**
College Level (20%)
Basic hardware description language: Introduction to Verilog/VHDL programming language, Verilog/VHDL program of logic gates, adders, Substractors, Multiplexers, Comparators, Decoders flip-flops, counters, Shift resistors.
Text book:

1. *Digital Design, 3rd Edition, Moris M. Mano, Pearson Education.*
2. *Fundamentals of digital circuits, 8th edition, A. Anand Kumar, PHI*
3. *Digital Fundamentals, 5th Edition, T.L. Floyd and R.P. Jain, Pearson Education, New Delhi.*

Reference Book:

1. *Digital Systems – Principles and Applications, 10th Edition, Ronald J. Tocci, Neal S. Widemer and Gregory L. Moss, Pearson Education.*
2. *A First Course in Digital System Design: An Integrated Approach, India Edition, John P. Uyemura, PWS Publishing Company, a division of Thomson Learning Inc.*
3. *Digital Systems – Principles and Applications, 10th Edition, Ronald J. Tocci, Neal S. Widemer and Gregory L. Moss, Pearson Education.*

DIGITAL ELECTRONICS LAB

List of Experiments:

(At least 10 experiments should be done, Experiment No. 1 and 2 are compulsory and out of the balance 8 experiments at least 3 experiments has to be implemented through both Verilog /VHDL and hardware implementation as per choice of the student totaling to 6 and the rest 2 can be either through Verilog /VHDL or hardware implementation.)

1. *Digital Logic Gates: Investigate logic behavior of AND, OR, NAND, NOR, EX-OR, EX-NOR, Invert and Buffer gates, use of Universal NANDGate.*
2. *Gate-level minimization: Two level and multi level implementation of Booleanfunctions.*
3. *Combinational Circuits: design, assemble and test: adders and subtractors, code converters, gray code to binary and 7 segmentdisplay.*
4. *Design, implement and test a given design example with (i) NAND Gates only (ii) NOR Gates only and (iii) using minimum number ofGates.*
5. *Design with multiplexers andde-multiplexers.*
6. *Flip-Flop: assemble, test and investigate operation of SR, D & J-Kflip-flops.*
7. *Shift Registers: Design and investigate the operation of all types of shift registers with parallelload.*
8. *Counters: Design, assemble and test various ripple and synchronous counters - decimal counter, Binary counter with parallelload.*
9. *Memory Unit: Investigate the behaviour of RAM unit and its storage capacity – 16 X 4 RAM: testing, simulating and memoryexpansion.*
10. *Clock-pulse generator: design, implement andtest.*
11. *Parallel adder and accumulator: design, implement andtest.*
12. *Binary Multiplier: design and implement a circuit that multiplies 4-bit unsigned numbers to produce a 8-bitproduct.*
13. *Verilog/VHDL simulation and implementation of Experiments listed at Sl. No. 3 to 12*

3rd Semester

PET3I001 SEMICONDUCTOR DEVICES(3-1-0)

MODULE-I (10 Hours)

Introduction to the quantum theory of solids: Formation of energy bands; the k-space diagram (two and three dimensional representation), conductors, semiconductors and insulators.

Electrons and Holes in semiconductors: Silicon crystal structure; Donors and acceptors in the band model; electron effective mass; Density of states; Thermal equilibrium; and Fermi-Dirac distribution function for electrons and holes; Fermi energy. Equilibrium distribution of electrons & holes: derivation of *n* and *p* from D(E) and f(E), Fermi level and carrier concentrations; The *np* product and the intrinsic carrier concentration. General theory of *n* and *p;* Carrier concentrations at extremely high and low temperatures: complete ionization, partial ionization and freeze-out; Energy-band diagram and Fermi-level, Variation of E_F with doping concentration and temperature.

MODULE-II (10 Hours)

Motion and Recombination of Electrons and Holes: Carrier drift: Electron and hole mobilities; Mechanism of carrier scattering; Drift current and conductivity.

Motion and Recombination of Electrons and Holes (continued): Carrier diffusion: diffusion current, Total current density; relation between the energy diagram and potential, electric field; Einstein relationship between diffusion coefficient and mobility; Electron-hole recombination; Thermal generation.

PN Junction: Building blocks of the pn junction theory: Energy band diagram and depletion layer of a pn junction, Built-in potential; Depletion layer model: Field and potential in the depletion layer, depletion-layer width; Reverse-biased PN junction; Capacitance-voltage characteristics; Junction breakdown: peak electric field. Tunneling breakdown and avalanche breakdown; Carrier injection under forward bias-Quasi-equilibrium boundary condition; current continuity equation; Excess carriers in forward-biased pn junction; PN diode I-V characteristic, Charge storage.

MODULE-III (10 Hours)

The Bipolar Transistor: Introduction, Modes of operation; Minority Carrier distribution, Collector current, Base current, current gain, Base width Modulation by collector current, Breakdown mechanism, Equivalent Circuit Models – Ebers -Moll Model.

MODULE-IV (12 Hours)

Metal-Semiconductor Junction: Schottky Diodes: Built-in potential, Energy-band diagram, I-V characteristics, Comparison of the Schottky barrier diode and the pn-junction diode; Ohmic contacts: tunneling barrier, specific contact resistance**.**

MOS Capacitor: The MOS structure, Energy band diagrams, Flat-band condition and flat-band voltage, Surface accumulation, surface depletion, Threshold condition and threshold voltage, MOS C-V characteristics, Q_{inv} in MOSFET.

Additonal Module (Terminal Examination-Internal) (06 Hours)

MOS Transistor: Introduction to the MOSFET, Complementary MOS (CMOS) technology, V-I Characteristics; Surface mobilities and high-mobility FETs, JFET, MOSFET V_t; Body effect and steep retrograde doping, pinch-off voltage,

Text Books

1. *Semiconductor Physics and Devices-Donald A. Neamen, Tata McGraw Hill Publishing Company Limited, New Delhi, 3rd Edition.*
2. *Solid State Electronics Devices-Ben. G. Streetman and Sanjay Banarjee, Pearson Education, New Delhi, 6th Edition.*

Reference Books

1. *Modern Semiconductor Devices for Integrated Circuits-Chenming Calvin Hu, Pearson Education/Prentice Hall, 2009.*
2. *Physics of Semiconductor Devices-S.M. Sze and Kwok K. Ng, Wiley India Pvt. Limited, New Delhi, 3rd Edition.*
3. *Physics of Semiconductor Devices-Dillip K. Roy, University Press (India) Pvt. Ltd., Hyderabad, 2nd Edition*
4. *Semiconductor Physics and Devices- Fowler, Oxford University Press.*
5. *Solid State Electronics Devices-D.K. Bhattacharya and Rajnish Sharma, Oxford University Press, New Delhi, 2nd Edition*
6. *Fundamentals of Semiconductor Devices-M.K. Achuthan and K.N. Bhatt, Tata McGraw Hill Publishing Company Limited, New Delhi.*

3rd Semester

PEK3E001 ENGINEERING ECONOMICS

Theory L/T (Hours per week):2/1, Credit: 3

Module I (12 hours)

Engineering Economics- Nature, Scope, Basic problems of an economy, Micro Economics and Macro Economics.

Demand- Meaning of demand, Demand function, Law of Demand and its exceptions, Determinants of demand, Elasticity of demand & its measurement (Simple numerical problems to be solved), Supply-Meaning of supply, Law of supply and its exception, Determinants of supply, Elasticity of supply, Determination of market equilibrium (Simple numerical problems to be solved).

Production-Production function, Laws of returns: Law of variable proportion, Law of returns to scale

Module II (12 hours)

Cost and revenue concepts, Basic understanding of different market structures, Determination of equilibrium price under perfect competition (Simple numerical problems to be solved), Break Even Analysis-linear approach (Simple numerical problems to be solved).

Banking -Commercial bank, Functions of commercial bank, Central bank, Functions of Central Bank.

Inflation-Meaning of inflation, types, causes, measures to control inflation.

National Income-Definition, Concepts of national income, Method of measuring national income.

Module III (12 hours)

Time value of money- Interest - Simple and compound, nominal and effective rate of interest, Cash flow diagrams, Principles of economic equivalence.

Evaluation of engineering projects-Present worth method, Future worth method, Annual worth method, Internal rate of return method, Cost benefit analysis for public projects .

Depreciation- Depreciation of capital assert, Causes of depreciation, Methods of calculating depreciation (Straight line method, Declining balance method), After tax comparison of project.

Text Books

1. *Riggs, Bedworth and Randhwa, "Engineering Economics", McGraw Hill Education India*
2. *Principles of Economics, Deviga Vengedasalam; Karunagaran Madhavan, Oxford University Press.*
3. *Engineering Economy by William G.Sullivan, Elin M.Wicks, C. Patric Koelling, Pearson*
4. *R.Paneer Seelvan, " Engineering Economics", PHI*
5. *Ahuja,H.L., "Principles of Micro Economics" , S.Chand & Company Ltd*
6. *Jhingan,M.L., "Macro Economic Theory"*
7. *Macro Economics by S.P.Gupta, TMH*

3rd Semester

POB3E002 ORGANIZATIONAL BEHAVIOUR

Credit- 3 Class Hours - 40

Objectives:

1. To develop an understanding of the behavior of individuals and groups inside organizations
2. To enhance skills in understanding and appreciating individuals, interpersonal, and group process for increased effectiveness both within and outside of organizations.
3. To develop theoretical and practical insights and problem-solving capabilities for effectively managing the organizational processes.

Unit	Contents	Class Hours
01	**Fundamentals of OB**: Definition, scope and importance of OB, Relationship between OB and the individual, Evolution of OB, Theoretical framework (cognitive), behavioristic and social cognitive), Limitations of OB.	6
02	**Attitude:** Importance of attitude in an organization, Right Attitude, Components of attitude, Relationship between behavior and attitude, Developing Emotional intelligence at the workplace, Job attitude, Barriers to changing attitudes. **Personality and values:** Definition and importance of Personality for performance, The Myers-Briggs Type Indicator and The Big Five personality model, Significant personality traits suitable to the workplace (personality and job – fit theory), Personality Tests and their practical applications. **Perception:** Meaning and concept of perception, Factors influencing perception, Selective perception, Attribution theory, Perceptual process, Social perception (stereotyping and halo effect). **Motivation:** Definition & Concept of Motive & Motivation, The Content Theories of Motivation (Maslow's Need Hierarchy & Herzberg's Two Factor model Theory), The Process Theories (Vroom's expectancy Theory & Porter Lawler model), Contemporary Theories – Equity Theory of Work Motivation.	10

03	**Foundations of Group Behavior:** The Meaning of Group & Group behavior & Group Dynamics, Types of Groups, The Five – Stage Model of Group Development. **Managing Teams:** Why Work Teams, Work Teams in Organization, Developing Work Teams, Team Effectiveness & Team Building. **Leadership:** Concept of Leadership, Styles of Leadership, Trait Approach Contingency Leadership Approach, Contemporary leadership, Meaning and significance of contemporary leadership, Concept of transformations leadership, Contemporary theories of leadership, Success stories of today's Global and Indian leaders.	**9**
04	**Organizational Culture** : Meaning & Definition of Organizational Culture, creating & Sustaining Organizational Culture, Types of Culture (Strong vs. Weak Culture, Soft Vs. Hard Culture & Formal vs. Informal Culture), Creating Positive Organizational Culture, Concept of Workplace Spirituality.	**8**
05	**Organizational Change:** Meaning, Definition & Nature of Organizational Change, Types of Organizational Change, Forces that acts as stimulants to change. Implementing Organizational Change : How to overcome the Resistance to Change, Approaches to managing Organizational Change, Kurt Lewin's-Three step model, Seven Stage model of Change & Kotter's Eight-Step plan for Implementing Change, Leading the Change Process, Facilitating Change, Dealing with Individual & Group Resistance, Intervention Strategies for Facilitating Organizational Change, Methods of Implementing Organizational Change, Developing a Learning Organization.	**7**

Reference Books

1. *Understanding Organizational Behaviour, Parek, Oxford*
2. *Organizational Behaviour, Robbins, Judge, Sanghi, Pearson.*
3. *Organizational Behaviour, K. Awathappa,HPH.*
4. *Organizational Behaviour, VSP Rao, Excel*
5. *Introduction to Organizational Behaviour, Moorhead, Griffin, Cengage.*
6. *Organizational Behaviour, Hitt, Miller, Colella, Wiley*

3rd Semester

HONOURS SUBJECT
PET3D001 PROBABILITY AND RANDOM PROCESSES(4-0-0)

MODULE-I (06 Hours)

Probability: Probability introduced through Sets and Relative Frequency: Experiments and Sample Spaces, Discrete and Continuous Sample Spaces, Events, Probability Definitions and Axioms, Mathematical Model of Experiments, Probability as a Relative Frequency, Joint Probability, Conditional Probability, Total Probability, Bayes' Theorem, Independent Events:

MODULE-II (08 Hours)

The Random Variable : Definition of a Random Variable, Conditions for a Function to be a Random Variable, Discrete and Continuous, Mixed Random Variable, Distribution and Density functions, Properties, Binomial, Poisson, Uniform, Gaussian, Exponential, Rayleigh, Conditional Distribution, Methods of defining Conditioning Event, Conditional Density, Properties.

MODULE-III (08 Hours)

Operation on one Random Variable: Introduction, Expected Value of a Random Variable, Function of a Random Variable, Moments about the Origin, Central Moments, Variance and Skew, Chebychev's Inequality, Characteristic Function, Moment Generating Function, Transformations of a Random Variable: Monotonic Transformations for a Continuous Random Variable, Nonmonotonic Transformations of Continuous Random Variable, Transformation of a Discrete-Random-Variable.

MODULE-IV (10 Hours)

Multiple Random Variables: Vector Random Variables, Joint Distribution Function, Properties of Joint Distribution, Marginal Distribution Functions, Conditional Distribution and Density – Point Conditioning, Conditional Distribution and Density – Interval conditioning, Statistical Independence, Sum of Two Random Variables, Sum of Several Random Variables, Central Limit Theorem, (Proof not expected). Unequal Distribution, Equal-Distributions.

Additonal Module (Terminal Examination-Internal) (10 Hours)

Operations on Multiple Random Variables: Expected Value of a Function of Random Variables: Joint Moments about the Origin, Joint Central Moments, Joint Characteristic Functions, Jointly Gaussian Random Variables: Two Random Variables case, N Random Variable case, Properties, Transformations of Multiple Random Variables, Linear Transformations-of-Gaussian-Random-Variables.

Text Books

1. Probability, Random Variables & Random Signal Principles - Peyton Z. Peebles, TMH, 4th Edition, 2001.

Reference Books

1. *Probability, Random Variables and Stochastic Processes – Athanasios Papoulis and S. Unnikrishna Pillai, PHI, 4th Edition, 2002.*
2. *Communication Systems Analog & Digital – R.P. Singh and S.D. Sapre, TMH, 1995.*
3. *Probability and Random Processes with Application to Signal Processing – Henry Stark and John W. Woods, Pearson Education, 3rd Edition.*
4. *Probability Methods of Signal and System Analysis. George R. Cooper, Clave D. MC Gillem,Oxford,3rdEdition,1999.*
5. *Statistical Theory of Communication - S.P. Eugene Xavier, New Age Publications, 2003.*
6. *Fundamentals of applied Probability and Random Processes-Oliver C. Ibe, Elsevier Academic press.*
7. *Probability& Random Processes for Electrical Engineering" by Alberto Leon-Garcia, Pearson education, 2nd editi*

3rd Semester

PET3G001 ANALOG ELECTRONICS CIRCUIT Minor Subject)

MODULE – I **(12 Hours)**

MOS Field-Effect Transistor: Principle and Operation of FETs and MOSFETs; P-Channel and N-Channel MOSFET; Complimentary MOS; V-I Characteristics of E- MOSFET and D-MOSFET; MOSFET as an Amplifier and as a Switch. (4 Hours)

Biasing of BJTs: Load lines (AC and DC); Operating Points; Fixed Bias and Self Bias, DC Bias with Voltage Feedback; Bias Stabilization; Examples. (4 Hours)

Biasing of FETs and MOSFETs: Fixed Bias Configuration and Self Bias Configuration, Voltage Divider Bias and Design (4 Hours)

MODULE – II **(12 Hours)**

Small Signal Analysis of BJTs: Small-Signal Equivalent-Circuit Models; Small Signal Analysis of CE, CC, CB amplifiers. Effects of R_S and R_L on CE amplifier operation, Emitter Follower; Cascade amplifier, Darlington Connection and Current Mirror Circuits. (6 Hours)

Small Signal Analysis of FETs: Small-Signal Equivalent-Circuit Model, Small Signal Analysis of CS, CD, CG Amplifiers. Effects of R_{SIG} and R_L on CS Amplifier; Source Follower and Cascaded System. (6 Hours)

MODULE – III **(5 hours)**

High Frequency Response of FETs and BJTs: High Frequency equivalent models and frequency Response of BJTs and FETs; Frequency Response of CS Amplifier, Frequency Response of CE Amplifier. (5 Hours)

MODULE – IV (9 hours)

Feedback amplifier and Oscillators: Concepts of negative and positive feedback; Four Basic Feedback Topologies, Practical Feedback Circuits, Principle of Sinusoidal Oscillator, Wein-Bridge, Phase Shift and Crystal Oscillator Circuits. (4 Hours)

Operational Amplifier: Ideal Op-Amp, Differential Amplifier, Op-Amp Parameters, Non-inverting Configurations, Open-loop and Closed-loop Gains, Differentiator and Integrator, Instrumentation amplifier. (5Hours)

Additional Module (Terminal Examination-Internal) **(6 hours)**

Basic analysis of difference amplifier, Simulation of analog circuits i.e., different single and cascaded amplifier circuits, difference amplifier circuits and validating the theoretical parameters using PSpice and MULTISIM. Analysis op-amp IC circuits using LF411 and μA 741, Signal Generators using OPAMP: Square, triangle and ramp generator circuits using opamps - Effect of slew rate on waveform generation-introduction to analog simulation OPAMP as nonlinear element: comparator, Voltage controlled oscillator (VCO). Concept of Schmitt triggers circuit and sample/hold circuit using operational amplifier

Text Books

1. *Electronic Devices and Circuits theory, R.L. Boylestad and L. Nashelsky, Pearson Education, New Delhi , 9th/10th Edition,2013. (Selected portions of Chapter 4, 5, 6, 7, 8, 9, 10, 11, 12, and 14)*
2. *Milliman's Electronics Devices and Circuits, J. Milliman, C. Halkias, S. Jit., Tata McGraw Hill Education Pvt. Ltd., New Delhi, 2nd Edition,2008.*

Reference Books

1. *Microelectronics Circuits, Adel Sedra and Kenneth C Smith, Oxford University Press, New Delhi, 5th Edition, International Student Edition,2009. (Selected portion of Chapter 2,4, 5, 6, 8, 13, and 14)*
2. *Electronic Devices and Circuits, Jimmie J. Cathey adapted by Ajay Kumar Singh, Tata McGraw Hill Publishing Company Ltd., New Delhi, 3rd Edition, (For Problem Solving)*
3. *Electronics Circuits Analysis and Design, Donald A. Neamen, Tata McGraw Hill Publishing Company Ltd., New Delhi, 3rd Edition,2002.*
4. *Integrated Electronics: Analog and Digital Circuits and Systems, J. Milliman, C. Halkias, Tata McGraw Hill Publishing Company Ltd., New Delhi,2nd Edition.2004.*
5. *Microelectronic Circuits: Analysis and Design, M.H. Rashid, PWS Publishing Company, a division of Thomson Learning Inc. India Edition.*
6. *Electronic device and circuits, David A. Bell, Oxford University Press, 5thedition,2008.*
7. *Electronics devices and circuits, Anil.K.Maini, Wiley India Pvt.Ltd,2009*

Fourth Semester									
	Theory						Practical		
Code	**Course Name**		**Hours/ week L/T**	**Credit Theory**	**University Marks**	**Internal Evaluation**	**Hours/ Week L/T**	**Credit Practical**	**Marks**
HS	Purely Applied Mathematics for Specific Branch of Engineering		3-0	3	100	50			
PC	Electromagnetics Engg.		3-0	3	100	50	2	1	50
PC	Electrical Machines & Power Devices		3-0	3	100	50	2	1	50
PC	Electrical & Electronics Measurements		3-0	3	100	50	2	1	50
PC	Microprocessors & Microcontrollers		3-0	3	100	50	2	1	50
HS	Engineering Economics/ Organizational Behavior		2-1	3	100	50			
	*Skill Project and Hands on						6	3	100
Total			18	18	600	300	14	7	300
Total Marks: 1200									
Total Credits: 25									
Honours		Audio and Video Engineering	4	4	100	50			
Minor		Digital Electronic Circuits							

Semester : 4th

1.	PET4D001	Honours(CP)	Audio and Video Engineering	4-0-0	4
2.	PET4E001	HS(CP)	Purely Applied Mathematics for Specific Branch of Engineering	3-0-0	3
3.	PEK4E002	HS(O1)	Engineering Economics	3-0-0	3
4.	POB4E003	HS(O1)	Organizational Behavior	3-0-0	3
5.	PET4G001	Minor(CP)	Digital Electronic Circuits	4-0-0	4
6.	PET4I101	PC(CP)	Electromagnetics Engineering	3-0-1	4
7.	PET4I102	PC(CP)	Electrical Machines & Power Devices	3-0-1	4
8.	PET4I103	PC(CP)	Electrical & Electronics Measurement	3-0-1	4
9.	PET4I104	PC(CP)	Microprocessor & Microcontroller	3-0-1	4
10.	PET4I201	PC(CP)	Skill Project and Hands on	0-0-3	3
					29

4th semester

PET4I101 ELECTROMAGNETICS ENGINEERING

Module-I (10 Hours)

1. Cartesian, Cylindrical and Spherical Coordinate Systems; Scalar and Vector Fields; Line, Surface and Volume Integrals.
2. Coulomb's Law; The Electric Field Intensity; Electric Flux Density and Electric Flux; Gauss's Law; Divergence of Electric Flux Density: Point Form of Gauss's Law; The Divergence Theorem; The Potential Gradient; Energy Density; Poisson's and Laplace's Equations.
3. Ampere's Magnetic Circuital Law and its Applications; Curl of H; Stokes' Theorem; Divergence of B; Energy Stored in the Magnetic Field.

Module-II (8 Hours)

1. The Continuity Equation; Faraday's Law of Electromagnetic Induction; Conduction Current: Point Form of Ohm's Law, Convection Current; The Displacement Current;
2. Maxwell's Equations in Differential Form; Maxwell's Equations in Integral Form; Maxwell's Equations for Sinusoidal Variation of Fields with Time; Boundary Conditions; The Retarded Potential; The Poynting Vector; Poynting Vector for Fields Varying Sinusoid ally with Time

Module-III (8 Hours)

1. Solution of the One-Dimensional Wave Equation; Solution of Wave Equation for Sinusoid ally Time-Varying Fields; Polarization of Uniform Plane Waves; Fields on the Surface of a Perfect Conductor; Reflection of a Uniform Plane Wave Incident Normally on a Perfect Conductor and at the Interface of Two Dielectric Regions; The Standing Wave Ratio; Oblique Incidence of a Plane Wave at the Boundary between Two Regions; Oblique Incidence of a Plane Wave on a Flat Perfect Conductor and at the Boundary between Two Perfect Dielectric Regions;

Module-IV (8 Hours)

1. Types of Two-Conductor Transmission Lines; Circuit Model of a Uniform Two-Conductor Transmission Line; The Uniform Ideal Transmission Line; Wave Reflection at a Discontinuity in an Ideal Transmission Line; Matching of Transmission Lines with Load.

Additional Module (Terminal Examination-Internal) (8 Hours)

1. Formulation of Field Equations; Wave Types; the Parallel-Plate Waveguide; the Rectangular Waveguide.
2. Radiation Properties of a Current Element; Radiation Properties of a Half-Wave Dipole; Yagi–Uda Antenna; the Parabolic Reflector Antenna.
3. The Vector Magnetic Potential; Energy stored in a capacitor, Graphical field mapping; Continuity of Current in a Capacitor; Critical Angle of Incidence and Total Reflection; Brewster Angle.

Text Books

1. *Principles of Electromagnetic, S.C. Mahapatra, S. Mahapatra, McGraw Hill Education (India) Pvt. Ltd., New Delhi, 2nd Edition, 2015.*
2. *Principles of Electromagnetics, Mathew N.O. Sadiku & S.V. Kulkarni., Oxford University Press, 6th edition,2009.*
3. *Electromagnetic Waves and Radiating Systems, E.C. Jordan and K.G. Balmain, Pearson Education, New Delhi, 2nd Edition,2009.*
4. *Engineering Electromagnetic Essentials, B. N. Basu, University Press.*

Reference Books

1. *Engineering Electromagnetic, William H. Hayt & J. Buck, Tata McGraw Hill Publishing Company Ltd., New Delhi, 7th Edition,2006*
2. *Electromagnetic, Joseph A. Edminister, adapted by Vishnu Priye, Tata McGraw Hill Publishing Company Ltd., New Delhi, 2nd Edition.*
3. *Fundamentals of Electromagnetic for Engineering, First Impression, N. N. Rao, Pearson Education, New Delhi, 2009.*
4. *Fields and Waves in Communication Electronics, Simon Ramo, Wiley Publication, 3ed, 2007.*
5. *Electromagnetic Field Theory, Bhag Singh Guru, Cambridge Publication,3rd Edition, 2011.*

4th semester

PET4I102 ELECTRICAL MACHINES AND POWER DEVICES

Module- I(10 Hours)

1. **GENERAL PRINCIPLES OF DC MACHINES:** Constructional Features; Methods of Excitation; Expression for EMF Induced and Torque Developed in the Armature.
2. **DC GENERATORS:** No Load Characteristics for Separately Excited DC Generator and DC Shunt Generator, Conditions for Self Excitation; Critical Resistance and Critical Speed; Losses and Efficiency.

Module-II(8 Hours)

3. **DC MOTORS:** Speed Armature Current, Torque Armature Current and Speed Torque Characteristic for (i) Separately Excited DC Motor, (ii) DC Shunt Motor, (iii) DC Series Motor, and (iv) DC Compound Motor, Speed control and Starting of DC shunt and DC series motors, Brushless motors; Motor drive circuits.

Module-III (10 Hours)

4. **TRANSFORMERS:** Constructional Features; EMF Equation; Turns Ratio, Determination of Parameters From Tests (Open Circuit Test and Short Circuit Test), Equivalent Circuit, Losses and Efficiency; Introduction to Three Phase Transformers: Three Single Phase Transformers Connected as a Bank of Three Phase Transformer.
5. **THREE PHASE SYNCHRONOUS MACHINES:** Constructional Features; Principle of operation as Alternator and Synchronous Motor; Synchronous Impedance; Voltage Regulation by Synchronous Impedance Method; Power-Angle curve; Synchronization of Alternators; Torque Expression and Phasor Diagram for Synchronous Motor; Electrical Power and Mechanical Power; Starting of Synchronous Motor.

Module-IV (10 Hours)

6. **THREE PHASE INDUCTION MOTORS:** Constructional Features of Squirrel Cage Rotor type and Slip Ring/Wound Rotor type of Induction Motors, Principle of Operation; Concept of Slip, Slip Torque Characteristics; Starting of Squirrel Cage Rotor type and Slip Ring/Wound Rotor type of Induction Motors; Speed Control of Induction Motors.
7. **SINGLE PHASE INDUCTION MOTORS and COMMUTATOR MOTORS:** Revolving Field Theory; Split Phase (capacitor start and run) and Shaded Pole Starting of Single Phase Induction Motors; Speed Current, Torque Current and Speed Torque Characteristic for Single Phase AC Series Motor.

Additional Module (Terminal Examination-Internal) (6 Hours)

8. **POWER SEMICONDUCTOR DEVICES:** Switching and V-I characteristic of devices Thyristor family: SCR, DIAC, TRIAC, GTO; Different Triggering Methods of SCR.

Text Book

1. *Electric Machines, D P Kothari & I J Nagrath, Tata McGraw Hill, 4th edition,7 July 2010.*
2. *Electrical Machine, J.B.Gupta, S K Kataria and Sons publications, Reprint 2012 edition, 2012.*
3. *Electrical Machinery, P S Bimbhra, Khanna Publishers, 7th edition, 2009.*
4. *Power Electronics: Circuits, Devices and Applications, M H Rashid, Pearson Education, 4th edition.*

Reference Books

1. *Electrical Machine, Ashfaq Husain, Dhanpat Rai and Co. Publisher, 2nd edition, 2014.*
2. *Electrical Machines, Smarajit Ghosh, Pearson Education, 2nd edition. 2012*
3. *A Textbook of Electrical Technology: volume2 AC and DC machines, B.L. Theraja and A.K. Theraja, S. Chand publications, 1st June 2006.*
4. *Electrical Machines, Krishna Reddy, Scitech Publication.*
5. *Electric Machines and Drives, Ned Mohan, Wiley Publication,2013.*

PET4I103 ELECTRICAL AND ELECTRONICS MEASUREMENTS

Module-I (6 Hrs)

1. **Introduction**: (a) Measurement and Error: Definition, Accuracy and Precision; Significant Figures, Types of Errors. (b) Standards of Measurement: Classification of Standards, Electrical Standards, IEEE Standards.

Module-II (8 Hrs)

2. **Measurement of Resistance, Inductance and Capacitance**: (a) Resistance: Measurement of Low Resistance by Kelvin's Double Bridge, Measurement of Medium Resistance, Measurement of High Resistance, Measurement of Resistance of Insulating Materials, Portable Resistance Testing set (Mega ohm meter), Measurement of Insulation Resistance when Power is ON, Measurement of Resistance of Earth Connections. (b) Inductance: Measurement of Self Inductance by Ammeter and Voltmeter, and AC Bridges (Maxwell's, Hay's, and Anderson Bridges), Measurement of Mutual Inductance by Felici's Method. (c) Capacitance: Measurement of Capacitance by Ammeter and Voltmeter, and AC Bridges (Owen's, Schering & Wien's Bridge), Screening of Bridge Components and Wagnor Earthing Device.

Module- III (10 Hrs)

3. **Galvanometer:** Construction, Theory and Principle of operation of D' Arsonval, Vibration (Moving Magnet & Moving Coil types), and Ballistic Galvanometer, Influence of Resistance on Damping, Logarithmic decrement, Calibration of Galvanometers.
4. **Ammeter and Voltmeter:** Derivation for Deflecting Torque of; PMMC, MI (attraction and repulsion types), Electro Dynamometer and Induction Type Ammeters and Voltmeters.
5. **Potentiometer:** Principle of operation of DC Potentiometers (Crompton, Vernier, Constant Resistance and Deflectional Potentiometer); AC Potentiometers (Drysdale-Tinsley and Gall-Tinsley Potentiometer).

Module- IV (12 Hrs)

6. **Measurement of Power, Energy, Frequency and Power factor**: Measurement of single phase and three phase power by wattmeter, Construction, Theory and Principle of operation of (a) Electro-Dynamometer and Induction type Watt meters, (b) Single Phase and Poly Phase Induction Type Watt-hour meters, (c) Frequency Meters, and (d) Power Factor Meters.
7. **Current Transformer and Potential Transformer**: Construction, Theory, Characteristics and Testing of CTs and PTs.
8. **Electronic Instruments for Measuring Basic Parameters:** Amplified DC Meters, AC Voltmeters using Rectifiers, True RMS Voltmeter, Considerations for choosing an Analog Voltmeter, Digital Voltmeters (Block Diagrams only), Q-meter.

Additional Module (Terminal Examination- Internal) (8 Hrs.)

9. **Oscilloscope**: Digital Storage Oscilloscopes, Measurement of Frequency, Phase Angle, and Time Delay using Oscilloscope.
10. **Counters and Analyzers:** Introduction to Wave, Harmonic Distortion and Spectrum Analyzers, Frequency Counters, Computer Controlled Test Systems: Testing an Audio Amplifier.

Text Book(s)

1. *Electrical Measurements and Measuring Instruments, E.W Golding & F.C Widdis, Reem Publication, 5th Edition, (For sections 2 to 6: Selected Portions from Ch.-VI, VII, IX, XIX, XX, XXI & XXII).*
2. *Modern Electronic Instrumentation and Measurement Techniques, Albert D Helfrick & W. D Cooper, 2nd Edition Phi Learning (For sections 1, 7 to 9: Selected Portions from Ch.-1, 3, 6, 7, 9, 10, and 13).*
3. *Electronic Instrumentation and Measurements, David A. Bell, Oxford university press,3rd edition.*

Reference Book(s)

1. *A Course in Electrical and Electronic Measurements and Instrumentation, A K Sawhney, Puneet Swhney, Dhanpat Rai & Co, 2013*
2. *Electronic Instrumentation, H C Kalsi, Tata McGraw Hill, 2nd Edition*
3. *Elements of Electronic Instrumentation and Measurement, Joseph J. Carr, Pearson Education. 3rd Edition,*
4. *Electronic Measurement and Instrumentation, B. M. Oliver & J. M. Cage, Tata McGraw Hill.*
5. *Electrical Measurements, Krishna Reddy, Scitech Publication.*

4th semester

PET4I104 MICROPROCESSORS AND MICROCONTROLLERS

Module-I (10 Hours)

1. **Introduction to 8 bit and 16 bit Microprocessors-H/W architecture**
   Introduction to microprocessor, computer and its organization, Programming system; Address bus, data bus and control bus, Tristate bus; clock generation; Connecting Microprocessor to I/O devices; Data transfer schemes; Architectural advancements of microprocessors. Introductory System design using microprocessors; 8086 – Hardware Architecture; External memory addressing; Bus cycles; some important Companion Chips; Maximum mode bus cycle; 8086 system configuration; Memory Interfacing; Minimum mode system configuration, Interrupt processing.

Module -II (11 Hours)

1. **16-bit microprocessor instruction set and assembly language programming:**
   Programmer's model of 8086; operand types, operand addressing; assembler directives, instruction Set-Data transfer group, Arithmetic group, Logical group.

Module-III(12 Hours)

2. **Microprocessor peripheral interfacing:**
   Introduction; Generation of I/O ports; Programmable Peripheral Interface (PPI)-Intel 8255; Sample-and-Hold Circuit and Multiplexer; Keyboard and Display Interface; Keyboard and Display Controller (8279).

Module-IV (11 Hours)

3. **8-bit microcontroller- H/W architecture instruction set and programming:**
   Introduction to 8051 Micro-Controllers, Architecture; Memory Organization; Special Function register; Port Operation; Memory Interfacing, I/O Interfacing; Programming 8051 resources, interrupts; Programmer's model of 8051; Operand types, Operand addressing; Data transfer instructions, Arithmetic instructions, Logic instructions, Control transfer instructions; Programming.

Additional Module (Terminal Examination-Internal) (6 Hours)

5. 8086: Maximum mode system configuration, Direct memory access, Interfacing of D-to-A converter, A-to-D converter, CRT Terminal Interface, Printer Interface, Programming of 8051 timers, 8051 serial interface.

Text Book(s)

1. *Microprocessor Architecture, Programming and application with 8085, R.S. Gaonkar, PRI Penram International publishing PVT. Ltd., 5th Edition*
2. *Microprocessors and Interfacing, Programming and Hardware, Douglas V Hall, TMH Publication, 2006.*
3. *Microprocessors and Interfacing, N. Senthil Kumar, M. Saravanan, S. Jeevananthan and S.K. Shah, Oxford University Press.*
4. *The 8051 Microcontroller and Embedded Systems, Muhammad Ali Mazidi, Janice Gillispie Mazidi, Rolin D.M C Kinlay, Pearson Education, Second Edition, 2008.*

Reference Book(s)

1. *Microcontrollers: Principles and Application, Ajit Pal, PHI Publication*
2. *Microprocessors and Microcontrollers Architecture, programming and system design using 8085, 8086, 8051 and 8096, Krishna Kant, PHI Publication, 2007.*
3. *Advanced Microprocessors and Peripherals, A.K. Ray, K M Bhurchandi, TMH Publication, 2007.*
4. *Textbook of Microprocessor and Microcontroller, Thyagarajan, Scitech Publication.*

HONOURS SPECIALIZATION:

PET4D001 AUDIO & VIDEO ENGINEERING

Module I (10 Hours)

1. **Fundamentals of Colour Television**
   Color TV systems, fundamentals; mixing of colours; colour perception; chromaticity diagram; NTSC, PAL, SECAM systems; colour TV transmitter; (high level, low level); colour TV receivers; remote control; Fault finding and servicing equipments like Wobbuloscope; TV Pattern Generator and Field Strength meter.

Module II (10 Hours)

1. **Digital TV and Display Devices**
   Introduction to Digital TV; Digital TV signals and parameters; Digital TV Transmitters, MAC signals, advanced MAC signal transmission; Digital TV receivers; Basic principles of Digital Video compression techniques, MPEG Standards; Digital TV recording techniques; Display devices: LED, LCD, TFT, Plasma.

Module III (10 Hours)

2. **HDTV**
   HDTV standards and systems, HDTV transmitter and receiver/encoder; Digital TV satellite Systems; video on demand; CCTV, CATV, direct to home TV, set top box with recording facility, conditional access system (CAS), 3D TV systems; Digital broadcasting; case study (Cricket match, Marathon, Football match).

Module IV (10 Hours)

3. **Fundamentals of Audio-Video Recording**
   Methods of sound recording & reproduction, optical recording, CD recording; audio standards, Digital Sound Recording; CD/ DVD player, MP3 player, Blue Ray DVD Players, MPEG, MP3Player.
4. **Fundamentals of Acoustics**
   Studio acoustics and reverberation; P.A. system for auditorium; acoustic chambers; Cordless microphone system; special types of speakers & microphones; Digital Radio Receiver Satellite radio reception.

Additional Module (Terminal Examination-Internal) (10 Hours)

5. Advanced TV Systems

IP Audio and Video, IPTV systems, Mobile TV; Video transmission in 3G mobile System; IPod (MPEG4 Video player); Digital Video Recorders, Personal Video Recorders; Wi-Fi Audio /Video Transmitter and Receivers; Video Projectors, HD Video projectors; Video Intercom systems/ Video door phones.

Text Books

1. Television and Video Engineering, A. M Dhake, Tata McGraw Hill, 2nd edition, 2003.
2. Video Demystified, Keith jack, Penram International Publication.
3. Audio Video Systems, R.G. Gupta, TMH Publication, 2nd edition, 2010.

Reference Books

1. Color Television Theory and Practice, S. P. Bali, Tata McGraw Hill, 1st edition, 1994.
2. Basic TV and Video Systems, Bernard Grob, Charles E Herndon, TMH, 6th edition, 1998.
3. Modern Television Practice-Principles, Technology and Servicing, R R Gulati, New Age International Publisher, 2nd edition, 2004.
4. Television Engineering: Audio and Video Systems, D.S. Bormane, Wiley Publication,2015.
5. Speech and Audio Processing, Shaila D. Apte, Wiley Publication,2012.
6. Speech and Audio Signal Processing: Processing and Perception of Speech and Music, Ben Gold, Wiley Publication,2006.

ELECTROMAGNETICS ENGINEERING LAB

(08 Experiments from the following list)

1. *Wave-propagation in conductors and dielectrics using HFSS/CST/MATLAB.*
2. *Current and charge flow of electromagnetic wave in a rectangular waveguide using HFSS/CST/MATLAB.*
3. *Uniform Plane Wave Propagation in an Arbitrary Direction*
4. *Transverse Electric Waves in a Parallel-Plate Waveguide*
5. *To calculate Dispersion and Group Velocity*
6. *To design Rectangular Waveguide*
7. *To design cavity Resonator*
8. *To show the modes of a rectangular waveguide using HFSS.*
9. *To show azimuth and elevation patterns*
10. *To show the input and output impedence*
11. *SWR measurements of rectangular waveguide*
12. *Reflection of plane waves*

*HFSS – High Frequency Structure Simulator
*CST- Computer Simulation Tool

4th semester

ELECTRICAL MACHINES AND POWER DEVICES LAB

(08 Experiments from the following list)

1. *Determination of critical resistance and critical speed from no load test of a DC shunt generator.*
2. *Plotting of external and internal characteristics of a DC shunt generator.*
3. *Starting of DC shunt motors by 3-point/ 4-point starter.*
4. *Speed control of DC shunt motor by armature control and flux control method.*
5. *Determination of Efficiency by Open Circuit and Short Circuit test on single phase transformer.*
6. *Polarity test and Parallel operation of two single phase transformers.*
7. *Open circuit and Short circuit test of an alternator.*
8. *Load test of three phase induction motors.*
9. *Calculation of slip and efficiency of three phase squirrel cage induction motor at full load.*
10. *Starting of single phase induction motors*
11. *Study of the V-I characteristics of SCR, TRIAC and DIAC*

ELECTRICAL AND ELECTRONICS MEASUREMENTS LAB

(08 Experiments from the following list)

1. *Measurement of Low Resistance by Kelvin's Double Bridge Method.*
2. *Measurement of Self Inductance and Capacitance using Bridges.*
3. *Study of Galvanometer and Determination of Sensitivity and Galvanometer Constants.*
4. *Calibration of Voltmeters and Ammeters using Potentiometers.*
5. *Testing of Energy meters (Single phase type).*
6. *Measurement of Iron Loss from B-H Curve by using CRO.*
7. *Measurement of R, L, and C using Q-meter.*
8. *Measurement of Power in a single phase circuit by using CTs and PTs.*
9. *Measurement of Power and Power Factor in a three phase AC circuit by two-wattmeter method.*
10. *Design a digital voltmeter using signal processing circuit, ADC and display*
11. *Study of Spectrum Analyzers*

4th semester

MICROPROCESSORS AND MICROCONTROLLERS LAB

(08 Experiments from the following list)

1. *Programs for 16 bit arithmetic operations using 8086.*
2. *Programs for Sorting and Searching (Using 8086).*
3. *Programs for String manipulation operations (Using 8086).*
4. *Programs for Digital clock and Stop watch (Using 8086).*
5. *Interfacing ADC and DAC.*
6. *Parallel Communication between two MP Kits using Mode 1 and Mode 2 of 8255.*
7. *Interfacing and Programming 8279, 8259, and 8253.*
8. *Serial Communication between two MP Kits using 8251.*
9. *Interfacing and Programming of Stepper Motor and DC Motor Speed control.*
10. *Programming using Arithmetic, Logical and Bit Manipulation instructions of 8051microcontroller.*
11. *Programming and verifying Timer, Interrupts and UART operations in 8051*
12. *Communication between 8051 Microcontroller kit and PC.*
13. *A design problem using 8051 (A problem like multi-parameter data acquisition system, voltmeter, power meter, frequency counter, traffic simulation, digital clock, etc)*

Fifth Semester								
	Theory					Practical		
Code	**Course Name**	**Hours/ week L/T**	**Credit Theory**	**University Marks**	**Internal Evaluation**	**Hours/ week L/T**	**Credit Practical**	**Marks**
PC	Control Systems	3-0	3	100	50	2	1	50
PC	Digital signal Processing	3-0	3	100	50	2	1	50
PC	Analog Communication	3-0	3	100	50	2	1	50
PE	Fiber Optics & Optoelectronics Devices/Computer Architecture & Organization /Power Electronics/Electromagnetic Interference & Compatibility /Sensors & Transducers/Object Oriented Programming/Advanced Analog Electronic Circuits	3-1	4	100	50			
OE	JAVA Programming/Digital VLSI Design/Digital System design/Brain Computer Interfacing/ Optimization in Engineering	3-1	4	100	50			
PC	Advance Lab-I(VLSI & Embedded System Lab)					8	4	200
Total		17	17	500	250	14	7	350
Total Marks: 1100								
Total Credits: 24								
Honours	Electronic Devises & Modeling	4	4	100	50			
Minor	Analog and Digital Communication							

Semester : 5th

1.	PET5D001	Honours(CP)	Electronic Devises & Modeling	4-0-0	4
2.	PET5G001	Minor(CP)	Analog and Digital Communication	4-0-0	4
3.	PET5H001	OE(O2)	JAVA Programming	4-0-0	4
4.	PET5H002	OE(O2)	Digital VLSI Design	4-0-0	4
5.	PET5H003	OE(O2)	Digital System design	4-0-0	4
6.	PET5H004	OE(O2)	Brain Computer Interfacing	4-0-0	4
7.	PET5H005	OE(O2)	Optimization in Engineering	4-0-0	4
8.	PET5I101	PC(CP)	Control Systems	3-0-1	4
9.	PET5I102	PC(CP)	Digital signal Processing	3-0-1	4
10.	PET5I103	PC(CP)	Analog Communication	3-0-1	4
11.	PET5I201	PC(CP)	Advance Lab - I (VLSI & Embedded System Lab)	0-0-4	4
12.	PET5J001	PE(O3)	Fiber Optics & Optoelectronics Devices	4-0-0	4
13.	PET5J002	PE(O3)	Computer Architecture & Organization	4-0-0	4
14.	PET5J003	PE(O3)	Power Electronics	4-0-0	4
15.	PET5J004	PE(O3)	Electromagnetic Interference & Compatibility	4-0-0	4
16.	PET5J006	PE(O3)	Sensor & Transducers	4-0-0	4
17.	PET5J007	PE(O3)	Object Oriented Programming	4-0-0	4
18.	PET5J008	PE(O3)	Advanced Analog Electronic Circuit	4-0-0	4
					28

PET5I101 PROFESSIONAL COURSE (PC)
CONTROL SYSTEMS

Module-I

1. **Introduction to Control Systems :** Basic Concepts of Control Systems, Open loop and closed loop systems, Servo Mechanism/Tracking System, Regulators, Mathematical Models of Physical Systems: Differential Equations of Physical Systems: Mechanical Translational Systems, Mechanical Rotational systems, Gear Trains, Electrical Systems, Analogy between Mechanical and electrical quantities, Thermal systems, fluid systems, Derivation of Transfer functions, Block Diagram Algebra, Signal flow Graphs, Mason's Gain Formula.
2. **Feedback characteristics of Control Systems:** Effect of negative feedback on sensitivity, bandwidth, Disturbance, linearizing effect of feedback, Control Components: D.C. Servomotors.

Module-II

3. **Time response Analysis: Standard Test Signals**: Time response of first order systems to unit step and unit ramp inputs. Time Response of Second order systems to unit step input, Time Response specifications, Steady State Errors and Static Error Constants of different types of systems. Generalised error series and Generalised error coefficients, Stability and Algebraic Criteria, concept of stability, Necessary conditions of stability, Hurwitz stability criterion, Routh stability criterion, Application of the Routh stability criterion to linear feedback system, Relative stability by shifting the origin in s-plane.
4. **Root locus Technique:** Root locus concepts, Rules of Construction of Root locus, Determination of Roots from Root locus for a specified open loop gain, Root contours.

Module-III

5. **Frequency Response Analysis:** Frequency domain specifications, correlation between Time and Frequency Response with respect to second order system, Polar plots, Bode plot. Determination of Gain Margin and Phase Margin from Bode plot.
6. **Stability in frequency domain:** Principle of argument, Nyquist stability criterion, Application of Nyquist stability criterion for linear feedback system.

Module – IV

7. **Closed loop frequency response:** Constant M circles, Constant N-Circles, Nichol's chart.
8. **Controllers:** Concept of Proportional, Derivative and Integral Control actions, P, PD, PI, PID controllers. Zeigler-Nichols method of tuning PID controllers.

Additional Module (Terminal Examination-Internal)

9. **Control Components**: A.C. Servomotors, A.C. Tachometer, Synchros, Stepper Motors.
10. **Feedback characteristics of Control Systems:** Regenerative feedback.
11. **Root locus Technique:** Systems with transportation lag. Effect of adding open loop poles and zeros on Root locus.

Text Books

1. Modern Control Engineering, K. Ogata,PHI, 5th edition.
2. Control Systems Engg., I.J. Nagrath and M. Gopal, New Age International Publishers,5th Edition, (2010).
3. Modern Control Systems by Richard C.Dorf and Robert H. Bishop, Pearson, 11th Ed (2009).

Reference Books

1. Design of Feedback Control Systems, R.T. Stefani, B. Shahian, C.J. Savator, G.H. Hostetter, Oxford University Press, Fourth Edition (2009).
2. Control Systems (Principles and Design),M. Gopal, TMH,3rd edition (2008).
3. Analysis of Linear Control Systems, R.L. Narasimham, I.K. International Publications,2008
4. Principles of Control Systems, S.P. Eugene Xavier and J. Josheph Cyril Babu, S. Chand Co. Ltd, 2006.
5. Control Systems, A Nagoorkani, RBA Publication.
6. Control Systems, N.C. JAGAN, BSP BOOKS PVT LTD,3rd edition.

CONTROL AND INSTRUMENTATION LAB

(At least 10 experiments should be done)

List of Experiments:

Control:

1. Study of a dc motor driven position control system
2. Study of speed torque characteristics of two phase ac servomotor and determination of its transfer function
3. Obtain the frequency response of a lag and lead compensator
4. To observe the time response of a second order process with P, PI and PID control and apply PID control to servomotor
5. To study the characteristics of a relay and analyze the relay control system (Phase Plane)
6. To study and validate the controllers for a temperature control system
7. To study the position control system using Synchros

Instrumentation:

1. Measurement of unknown resistance, inductance and capacitance using bridges
2. To plot the displacement-voltage characteristics of the given LVDT
3. Measurement of temperature-voltage characteristics of J-type thermocouple
4. Use a strain gauge to plot the curve between strain applied to a beam and the output voltage
5. Study of resistance-voltage characteristics of Thermistors
6. To study on the interface of PLC with PC for data acquisition applications.

PET5I102 DIGITAL SIGNAL PROCESSING

MODULE – I

1. **The Z-Transform and Its Application to the Analysis of LTI Systems:**

   The Z-Transform: The Direct Z-Transform, The Inverse Z-Transform; Properties of the Z-Transform; Inversion of the Z-Transforms: The Inversion of the Z-Transform by Power Series Expansion, The Inversion of the Z-Transform by Partial-Fraction Expansion; Analysis of Linear Time-Invariant Systems in the z-Domain: Response of Systems with rational System Functions.

2. **The Discrete Fourier Transform: Its Properties and Applications:**
   Frequency Domain Sampling: Frequency-Domain Sampling and Reconstruction of Discrete-Time Signals, The Discrete Fourier Transform, The DFT as a Linear Transformation, Relationship of the DFT to other Transforms; Properties of the DFT: Periodicity, Linearity, and Symmetry Properties, Multiplication of Two DFTs and Circular Convolution, Additional DFT Properties; Linear Filtering Methods Based on the DFT: Use of the DFT in Linear Filtering, The Discrete Cosine Transform: Forward DCT, Inverse DCT, DCT as an Orthogonal Transform.

MODULE – II

3. **Implementation of Discrete-Time Systems:**
   Structure for the Realization of Discrete-Time Systems, Structure for FIR Systems: Direct-Form Structure, Cascade-Form Structures, Frequency-Sampling Structures; Structure for IIR Systems: Direct-Form Structures, Signal Flow Graphs and Transposed Structures, Cascade-Form Structures, Parallel-Form Structures.

4. **Design of Digital Filters:**
   General Considerations: Causality and Its Implications, Characteristics of Practical Frequency-Selective Filters; Design of FIR Filters: Symmetric and Antisymmetric FIR Filters, Design of Linear-Phase FIR Filters by using Windows, Design of Linear-Phase FIR Filters by the Frequency-Sampling Method; Design of IIR Filters from Analog Filters: IIR Filter Design by Impulse Invariance, IIR Filter Design by the Bilinear Transformation.

MODULE- III

5. **Efficient Computation of the DFT: Fast Fourier Transform Algorithm**
   Efficient Computation of the DFT: FFT Algorithms: Direct Computation of the DFT,Radix-2 FFT Algorithms: Decimation-In-Time (DIT), Decimation-In-Time (DIF); Applications of FFT Algorithms: Efficient Computation of the DFT of two Real Sequences, Efficient Computation of the DFT a 2N-Point Real Sequence.

MODULE – IV

6. **Adaptive Filters:**
   Application of Adaptive Filters: System Identification or System Modeling, Adaptive Channel Equalization, Adaptive Line Enhancer, Adaptive Noise Cancelling; Adaptive

Direct-Form FIR Filters-The LMS Algorithm: Minimum Mean Square Error Criterion, The LMS Algorithm.

Additional Module (Terminal Examination-Internal)

1. **The Z-Transform and Its Application to the Analysis of LTI Systems:**Transient and Steady-State Responses, Causality and Stability, Pole-Zero Cancellations.
2. **The Discrete Fourier Transform: Its Properties and Applications:**Filtering of Long Data Sequences; Frequency Analysis of Signals using the DFT.
3. **Efficient Computation of the DFT:** Use of the FFT Algorithm in Linear Filtering and Correlation.

Text Books

1. Digital Signal Processing Principles, Algorithms and Applications, J. G. Proakis and D. G. Manolakis, 4th Edition, Pearson.
2. Digital Signal Processing, Tarun Kumar Rawat, Oxford University Press.

Reference Books

1. Digital Signal Processing: a Computer-Based Approach, Sanjit K. Mitra, TMH
2. Digital Signal Processing, S. Salivahan, A. Vallavraj and C. Gnanapriya, TMH.
3. Digital Signal Processing, Manson H. Hayes, Schaum's Outlines, TMH.
4. Digital Signal Processing: A Modern Introduction, Ashok K Ambardar, Cengage Learning.
5. Modern Digital Signal Processing, Roberto Cristi, Cengage Learning.
6. Digital Signal Processing: Fundamentals and Applications, Li Tan, Jean Jiang, Academic Press, Elsevier.
7. Digital Signal Processing: A MATLAB-Based Approach, Vinay K. Ingle and John G. Proakis, Cengage Learning.
8. Fundamentals of Digital Signal Processing using MATLAB, Robert J. Schilling and Sandra L. Harris, Cengage Learning.

DIGITAL SIGNAL PROCESSING LAB

(At least 10 experiments should be done)

1. Familiarization with the architecture of a standard DSP kit (Preferably TMS 320C6XXX DSP kit of Texas Instruments)
2. Generation of various types of waveforms (sine, cosine, square, triangular etc.) using MATLAB and DSP kit.
3. Linear convolution of sequences (without using the inbuilt conv. function in MATLAB) and verification of linear convolution using DSP kit.
4. Circular convolution of two sequences and comparison of the result with the result obtained from linear convolution using MATLAB and DSP kit.
5. (i) Computation of autocorrelation of a sequence, cross correlation of two sequences using MATLAB.

   (ii) Computation of the power spectral density of a sequence using MATLAB also implementing the same in a DSP kit.
6. Finding the convolution of a periodic sequence using DFT and IDFT in MATLAB.
7. (i) Implementation of FFT algorithm by decimation in time and decimation in frequency using MATLAB.

   (ii) Finding the FFT of a given 1-D signal using DSP kit and plotting the same.
8. Design and implementation of FIR (lowpass and highpass) Filters using windowing techniques (rectangular window, triangular window and Kaiser window) in MATLAB and DSP kit.
9. Design and implementation of IIR (lowpass and highpass) Filters (Butterworth and Chebyshev) in MATLAB and DSP kit.
10. (i) Convolution of long duration sequences using overlap add, overlap save using MATLAB.

    (ii) Implementation of noise cancellation using adaptive filters on a DSP kit.

PET5I103 ANALOG COMMUNICATION (3-0-2)

MODULE-I

1. **SIGNALS AND SPECTRA:** An Overview of Electronic Communication Systems, Signal and its Properties, Fourier series Expansion and its Use, The Fourier Transform, Orthogonal Representation of Signal.
2. **RANDOM VARIABLES AND PROCESSES:** Probability, Random variables, Useful Probability Density functions, Useful Properties and Certain Application Issues.
3. **AMPLITUDE MODULATION SYSTEMS:** Need for Frequency translation, Amplitude Modulation (Double Side Band with Carrier DSB-C), Single Sideband Modulation (SSB) Other AM Techniques and Frequency Division Multiplexing.

MODULE-II

4. **ANGLE MODULATION:** Angle Modulation, Tone Modulated FM Signal, Arbitrary Modulated FM signal, FM Modulators and Demodulators, Approximately Compatible SSB Systems.
5. **PULSE MODULATION AND DIGITAL TRANSMISSION OF ANALOG SIGNAL:**Analog to Digital (Noisy Channel and Role of Repeater), Pulse Amplitude Modulation and Concept of Time division multiplexing, Digital Representation of Analog Signal

MODULE-III

6. **MATHEMATICAL REPRESENTATION OF NOISE:** Some Sources of Noise, Frequency-domain Representation of Noise, Superposition of Noises, Linear Filtering of Noise.
7. **NOISE IN AMPLITUDE MODULATION SYSTEM:** Framework for Amplitude Demodulation, Single Sideband Suppressed Carrier (SSB-SC), Double Sideband Suppressed Carrier (DSB-SC), Double Sideband with Carrier (DSB-C).

MODULE-IV

8. **NOISE IN FREQUENCY MODULATION SYSTEM:** An FM Receiving System, Calculation of Signal to Noise Ratio, Comparison of FM and AM, Pre emphasis and De-emphasis and SNR Improvement, Noise in Phase Modulation and Multiplexing Issues, The FM Demodulator using Feedback (FMFB).

Additional Module (Terminal Examination-Internal)

1. AMPLITUDE MODULATION SYSTEMS:Radio Transmitter and Receiver.
2. PULSE MODULATION: Pulse Width Modulation and Pulse Position Modulation.
3. SYSTEM NOISE IN FREQUENCY MODULATION:Threshold in Frequency Modulation, Calculation of Threshold in an FM Discriminator.

Text Books

1. Principles of Communication System, H. Taub, D. L Schilling, G. Saha, Tata McGraw Hill, 3rd Edition, 2008.

2. Modern Digital and Analog Communication Systems, B.P. Lathi,Zhi Ding, Oxford University Press, 4th edition 2010.

Reference Books

1. Communication System Engineering, MasoudSalehi, John G. Proakis, PHI, Pearson Education, Second Edition 2002.
2. Analog Communication, V. Chandra Sekar, Oxford University Press 2010.
3. Communication Systems S.Haykin, john Wiley& sons 4th edition 2001.
4. Communication Systems, B. P.Lathi, BS Publications, 2001.

ANALOG COMMUNICATION LAB

(At least 10 experiments should be done)

1. Analyze and plot the spectrum of following signals with aid of spectrum analyzer: Sine wave, square wave, triangle wave, saw-tooth wave of frequencies 1 KHz, 10 KHz, 50 KHz, 100KKz and 1 MHz.
2. Analyze the process of frequency division multiplexing and frequency division de-multiplexing.
3. Study and design of AM modulator and demodulator. (Full AM, SSB, DSBSC, SSBSC)
4. Study of FM modulation and Demodulation Techniques.
4. Observer the process of PAM, quantization and determination of quantization noise.
5. Multiplex 2-4 PAM/ PPM and PWM signals.

6. Using MATLAB/ LABVIEW generate a carrier and a modulating signal. Modulate the carrier using AM. Show the waveform in time domain and analyze its frequency spectrum. Repeat the simulation for modulating signal being square, triangular and other forms waveform.
7. Using MATLAB/ LABVIEW generate a carrier and a modulating signal. Modulate the carrier using FM. Show the waveform in time domain and analyze its frequency spectrum. Repeat the simulation for modulating signal being square, triangular and other forms waveform.
8. Using Lab-View software simulates AM modulation and demodulation system.
9. Using Lab-View software simulate FM modulation and demodulation system.
10. Design a receiver to demodulate and receive the signal from AM radio station.
11. Design a receiver to demodulate and receive the signal from the local FM radio station.

(Verify the process of modulation and demodulation in simulation environment. Analyze frequency spectrum of the signal after modulation and demodulation. Observe the modulated and demodulated signals for different forms of modulation signal)

PROFESSIONAL ELECTIVES (PE):

PET5J001 FIBER OPTICS AND OPTOELECTRONIC DEVICES

MODULE- I

1. Fundamental of fiber optics, Different generations of optical fiber communication systems. Optical fiber structure, Fiber types, step index fiber and graded index fiber, ray propagation, total internal reflection, Numerical Aperature, acceptance angle. Wave propagation in a cylindrical wave guides, modal concept, V-number, power flow in step index fiber and graded index fiber, attenuation (absorbtion, scattering and bending) and dispersion (inter and intramodal, chromatic, wave guide and polarization) in fiber, dispersion shifted and dispersion flattened fiber

MODULE-II

2. Fiber fabrication, Double crucible method, Fiber optic cables, Connector and splice. Losses during coupling between source to fiber, fiber to fiber. Schemes for coupling improvement. Optoelectronic Sources, LED, ILD, light source materials, Radiation Pattern modulation capability.

MODULE- III

3. Optoelectronic Detector, PIN AND APD, Responsivity, Band width, Detector noise equivalent circuit and SNR calculation.
4. Optoelectronic Modulators, Basic principle, Electro optic and Acoustoptic modulators.

MODULE – IV

5. Optical Amplifier, Semiconductor optical Amplifier and Erbium Doped Fiber Amplifier.

Additional Module (Terminal Examination-Internal)

1. WDM components-couplers, isolators, circulators, filters. Optical switching-self electro optic effect Device, switching speed and energy

Text Books

1. Optical Fiber Communications, Keiser G, Tata McGraw Hill Education Private Limited, 4th Edition.
2. Optical Fiber Communication Principles and practice, Senior J, Prentice Hall of India.
3. Fiber optics and Optoelectronics, R.P.Khare, Oxford University Press.
4. Fiber-Optic Communication Systems, G P Agarwal,4th edition, John wiley& sons publication, 2011.

Reference Books

1. Fiber optic communications, Joseph C Palais, fourth edition, Pearson Education.
2. Semiconductor Optoelectronic Devices, PallabBhatttacharya, second edition, Pearson Education.

PET5J002 COMPUTER ARCHITECTURE AND ORGANISATION

MODULE-I

1. **Introduction**

   Computing and Computers, Evolution of Computers, VLSI, System Design- Register Level, Processor Level, CPU Organization, Data Representation, Fixed – Point Numbers, Floating Point Numbers, Instruction Formats, Instruction Types. Addressing modes.

2. Fixed Point Arithmetic, Addition, Subtraction, Multiplication and division, Combinational and Sequential ALUs, Carry look ahead adder, Robertson algorithm, booth's algorithm, non-restoring division algorithm, Floating Point Arithmetic, Coprocessor, Pipeline Processing, Pipeline Design, Modified booth's Algorithm.

MODULE-II

3. **Control Design**

   Hardwired Control, Micro programmed Control, Multiplier Control Unit, CPU Control Unit, Pipeline Control, Instruction Pipelines, Pipeline Performance, Superscalar Processing, Nano Programming

MODULE–III

4. **System Organization**

   Communication methods, Buses, Bus Control, Bus Interfacing, Bus arbitration, IO and system control, IO interface circuits, Handshaking, DMA and interrupts, vectored interrupts, PCI interrupts, pipeline interrupts, IOP organization, operation systems, multiprocessors, fault tolerance.

MODULE –IV

5. **Memory Organization**

   Random access memories, serial-access memories, RAM Interfaces, Magnetic Surface Recording, Optical Memories, multilevel memories, Cache & Virtual Memory, Memory Allocation, Associative Memory

Additional Module (Terminal Examination-Internal)

1. **System Organization:** RISC and CISC processors, Superscalar and vector processor.

Textbooks

1. Computer System Architecture,M Morris, R Mano, Prentice-Hall of India, 2000
2. Computer architecture and Organisation,John P. Hayes, Tata McGraw-Hill, Third edition, 1998.
3. Computer Organisation, V.CarlHamacher, Zvonko G. Varanesic and Safwat G. Zaky, Fifth edition, McGraw-Hill Inc, 1996.
4. Computer architecture and Organisation, S.R Sarangi,Tata McGraw-Hill, First edition, 2015.
5. Computer Organisation and Design, David A Patterson and John L Hennessy, 4th edition.

References Books

1. Computer Architecture,BParhami, Oxford University Press, BEH 2002.
2. Computer Organization and Design, P.PalChaudhuri, 2nd edition,PHI,2007

PET5J003 POWER ELECTRONICS

MODULE-I

1. **Power electronics devices:**
   Characteristics of power devices – characteristics of SCR, diac, triac, SCS, GTO, PUJT, power transistors – power FETs – LASCR – two transistor model of SCR – Protection of thyristors against over voltage – over current, dv/dt and di/dt.
2. **Triggering techniques:**
   Turn on circuits for SCR – triggering with single pulse and train of pulses synchronizing with supply – triggering with microprocessor – forced commutation – different techniques – series and parallel operations of SCRs.

MODULE-II

3. **Controlled rectifiers:**
   Converters – single phase – three phase – half controlled and fully controlled rectifiers – Waveforms of load voltage and line current under constant load current – effect of transformer leakage inductance – dual converter

MODULOE-III

4. **Inverters:**
   Voltage and current source inverters, resonant, Series inverter, PWM inverter. AC and DC choppers – DC to DC converters – Buck, boost and buck – boost.

MDULOE-IV

5. **Industrial applications**
   DC motor drives – Induction and synchronous motor drives – switched reluctance and brushless motor drives.

<u>Additional Module</u> (Terminal Examination-Internal)

6. Battery charger – SMPS – UPS – induction and dielectric heating.

Text Books

1. Power Electronics Circuits, Devices and Applications, M Rashid, PHI, 3rd Edition. 2004.
2. Power Electronics, M.D. Singh and K.B. Khanchandani, TMH,2nd Edition, 2007.

Reference Books

1. Power Electronics, P C Sen, TMH, 1987.
2. Thyristorised Power Controllers, G K Dubey, Wiley Eastern 1986.
3. Power Electronics – Principles and Applications, JVithayathil, McGraw-Hill, 1995.
4. Power Electronics,V.R. Moorthy, Oxford University Press, 2005

PET5J004 ELECTROMAGNETIC INTERFERENCE AND COMPATIBILITY

MODULE-I

1. **Overview of EMI/EMC:**
   Electromagnetic environment, History, Concepts and definitions, Overview of EMI/EMC, Natural and Nuclear sources of EMI, conducted and radiated EMI, Transient EMI, Time domain Vs Frequency domain EMI, Units of measurement parameters.

2. **EMI Coupling Principles:**
   Electromagnetic emissions, noise from relays and switches, Nonlinearities in circuits, passive inter-modulation, cross talk in transmission lines, transients in power supply lines, Conducted, Radiated and Transient Coupling, Common Impedance Ground Coupling,

MODULE-II

3. **Radiated and Conducted Interference Measurements:**
   EMI Test Instruments/ Systems, Anechoic chamber, TEM cell, GH TEM Cell, characterization of conduction currents/voltages, conducted EM noise on power lines, conducted EMI from equipment, Immunity to conducted EMI, detectors and measurements, EMI Shielded Chamber, Open Area Test Site, TEM Cell, Sensors/ Injectors/ Couplers, Test beds for ESD and EFT.

MODULE-III

4. **EMI Control Techniques:**
   Principles and types of grounding, shielding and bonding, characterization of filters, power lines filter design shielding, Isolation Transformer, Transient Suppressors, Cable Routing, Signal Control, Component Selection and Mounting, PCB Traces Cross Talk.

MODULE-IV

5. Impedance Control, Power Distribution Decoupling, Zoning, Motherboard Designs and Propagation Delay Performance Models.

<u>Additional Module</u> (Terminal Examination-Internal)

6. Radiated Common Mode and Ground Loop Coupling, Radiated Differential Mode Coupling, Cable to Cable Coupling, Power Mains and Power Supply coupling.

Reference Books

1. Engineering EMC Principles, Measurements and Technologies,V.P.Kodali, IEEE Press, 1996.
2. Noise Reduction Techniques in Electronic Systems, Henry W. Ott, John Wiley and Sons, New York, 1988.
3. Introduction to Electromagnetic Compatibility ,C.R.Paul, John Wiley and Sons, 1992
4. Principles of Electromagnetic Compatibility, Bernhard Keiser, Artech house, 3rdEd,1986

PET5J006 SENSORS AND TRANSDUCERS

MODULE–I

Elements of a general measurement system; Static Characteristics: systematic characteristics, statistical characteristics, calibration; Dynamic characteristics of measurement systems: transfer functions of typical sensing elements, step and frequency response of first and second order elements, and dynamic error in measurement systems.

MODULE–II

Sensing elements: Resistive sensing elements: potentiometers, Resistance Temperature Detector (RTD), thermistors, strain gages. Capacitive sensing elements: variable separation, area and dielectric; Inductive sensing elements: variable reluctance and LVDT displacement sensors.

MODULE–III

Signal Conditioning Elements: Deflection bridges: design of resistive and reactivebridges, push-pull configuration for improvement of linearity and sensitivity Amplifiers: Operational amplifiers-ideal and non-ideal performances, inverting, non-inverting and differential amplifiers, instrumentation amplifier, filters. A.C. carrier systems, phase sensitive demodulators and its applications in instrumentation.

MODULE–IV

Thermoelectric sensing elements: laws, thermocouple characteristics, installation problems, cold junction compensation. IC temperature sensor Elastic sensing elements: Bourdon tube, bellows, and diaphragms for pressure sensing, force and torque measurement.

<u>Additional Module</u> (Terminal Examination-Internal)

Electromagnetic sensing elements: velocity sensors

Text Books:

1. Principles of Measurement Systems, J.P. Bentley, Pearson Education, New Delhi, 3rd Edition 2007.

2. Introduction to Measurement and Instrumentation, A.K. Ghosh , PHI Learning, 3rd Edition,2009.

3. Transducers and Instrumentation, D.V.S. Murthy, PHI Learning, New Delhi, 2009.

Reference Books:

1. Measurement Systems Application and Design, E.O. Doeblin, McGraw-Hill, 4th Edition.

2. Instrumentation for Engineering Measurements, J.W. Dally, W.F. Riley and K.G. McConnel , John Wiley, NY,2nd edition 2003.

3. Industrial Instrumentation, T.R. Padmanabhan, Springer, London, 2000.

PET5J007 OBJECT ORIENTED PROGRAMMING (3-1-0)

MODULE- I

1. **Introduction to object oriented programming**: user defined types, structures, unions, polymorphism, encapsulation. Getting started with C++ syntax, data-type, variables, strings, functions, default values in functions, recursion, namespaces, operators, flow control, arrays and pointers.

MODULE-II

2. **Abstraction mechanism:** Classes, private, public, constructors, destructors, member data, member functions, inline function, friend functions, static members, and references. Inheritance: Class hierarchy, derived classes, single inheritance, multiple, multilevel, hybrid inheritance, role of virtual base class, constructor and destructor execution, base initialization using derived class constructors.

3. **Polymorphism:** Binding, Static binding, Dynamic binding, Static polymorphism: Function Overloading, Ambiguity in function overloading, Dynamic polymorphism: Base class pointer, object slicing, late binding, method overriding with virtual functions, pure virtual functions, abstract classes.

Module-III

4. **Dynamic memory:** Dynamic memory management, new and delete operators, object copying, copy constructor, assignment operator, virtual destructor.
5. **Template**: template classes, template functions.

Module-IV

6. **Operator overloading:** This pointer, applications of this pointer, Operator function, member and non member operator function, operator overloading, I/O operators.
7. **Exception handling:** Try, throw, and catch, exceptions and derived classes, function exception declaration.

Additional Module (Terminal Examination-Internal)

1. **Namespaces:** user defined namespaces, namespaces provided by library.

Text Books:

1. Object Oriented Programming with C++, E. Balagurusamy, McGraw-Hill Education.
2. ANSI and Turbo C++,Ashoke N. Kamthane, Pearson Education.
3. Object Oriented Programming with C++,ReemaThareja, Oxford University Press.

Reference Books:

1. C++ the Complete Reference**,** HSchildt, McGraw-Hill Education.
2. C++ and Object Oriented Programming,DJana, PHI Learning.
3. Mastering C++, K RVenugopal, McGraw-Hill Education.
4. Object Oriented Programming with C++,Rajiv Sahay, Oxford.

PET5J008 ADVANCED ANALOG ELECTRONIC CIRCUITS(3-1-0)

MODULE-I

1. **Active Filters** :Active Filters, Frequency response of Major Active filters, First order low-pass Butterworth filter: Filter Design, Frequency Scaling, Second-order low-pass Butterworth filter: First-order high-pass Butterworth filter, Second-order high-pass Butterworth filter, Band-pass filters: Wide band-pass Filter, Narrow Band-Pass Filter, Band-reject filters: Wide Band-Reject Filter, Narrow Band-Reject Filter, All-Pass filter.
2. **Oscillators:** Oscillators: Oscillator Principles, Oscillator Types, Quadrature Oscillator, Saw tooth wave generator, Voltage-controlled oscillator.
3. **Comparators:** Comparators: basic comparator, zero-crossing detector, Schmitt trigger, comparator characteristics, limitations of Op-Amp as comparators, voltage limiters.

MODULE-II

4. **BistableMultivibrator:** BistableMultivibrator, fixed-bias bistable multi vibrator, Loading, self-biased transistor binary, commutating capacitors, Triggering the binary, Unsymmetrical Triggering of the bistablemultivibrator, Triggering Un symmetrically through a Unilateral Device, Triggering, Triggering of a Bistable Multi Symmetrically without the Use of Auxiliary Symmetrical Diodes, Schmitt Trigger Circuit (Emitter-coupled BistableMultivibrator
5. **Monostable and AstableMultivibrator:** MonostableMultivibrator, Gate Width of a Collector-Coupled MonostableMultivibrator, Waveforms of the Collector-Coupled MonostableMultivibrator, Emitter-Coupled MonostableMultivibrator, Triggering of the MonostableMultivibrator. Astable Collector-Coupled Multivibrator, Emitter-coupled Astablemultivibrator.
6. **Wideband amplifiers**: Wideband amplifiers: The Hybrid-π, High-frequency, Small-signal, Common-emitter Model, RC-Coupled Amplifier, Frequency Response of a Transistor Stage-The Short-Circuit Current Gain, Current Gain with Resistive Load, Transistor Amplifier Response taking Source Impedance into Account, Transient Response of a Transistor Stage.

MODULE-III

7. **Negative Resistance Switching Devices:** Voltage Controllable Negative resistance devices, Tunnel Diode operation and characteristics, MonostableAstable, Bistable circuits using tunnel diode, Voltage controlled Negative Resistance Switching Circuits.
8. **Voltage and Current Time Base Generators:** Time-Base Generators, General features of a Time-base signal, Methods of generating a voltage time-base waveform,

Exponential sweep circuit, Miller and bootstrap time base generators-Basic principles, Transistor miller time base generator, Transistor bootstrap time base generator, Current Time-Base Generators, A Simple Current sweep, Linearity Correction through adjustment of driving waveform, Transistor current time base generator.

MODULE-IV

9. **Specialized IC Applications:** IC 555 Timer: IC 555 Timer as a MonostableMultivibrator and its applications, IC 555 Timer as AstableMultivibrator and its applications. Phase Locked Loop: Operating principle of PLL, Phase detectors, Exclusive-OR phase detector, Monolithic phase detector, Instrumentation Amplifier and its applications.

Additional Module (Terminal Examination-Internal)

10. Cascaded CE Transistor Stages, Rise-time Response of Cascaded Stages, Shunt Compensation of a TransistorStage in a Cascade, Rise Time of Cascaded Compensated Stages, Low frequency Compensation.

Text Books

1. Pulse, Digital and switching Waveforms, Jacob Millman, Herbert Taub and MS PrakashRao, TMH Publication, Second Edition.
2. Pulse, Switching and Digital Circuits,David A. Bell, Oxford University Press, Fifth Edition.
3. OP-Amps and Linear Integrated Circuits, Ramakant A. Gayakwad, PHI Publication.
4. Pulse & Digital Circuits, K.VenkataRao, K Rama Sudha& G ManmadhaRao, Pearson Education, 2010.

Reference Books

1. OP-Amps and Linear Integrated Circuits, Robert F. Coughlin, Frederick F. Driscoll, Pearson Education Publication.
2. Pulse and Digital Circuits, A. Anand Kumar, PHI.

OPEN ELECTIVES (OE):

PET5H001 JAVA PROGRAMMING (3-1-0)

MODULE – I

1. Introduction to Java and Java programming Environment. Object Oriented Programming. Fundamental Programming Structure: Data Types, variable, Typecasting Arrays, Operators and their precedence. Control Flow: Java's Selection statements (if, switch, iteration, statement, while, do-while, for, Nested loop).Concept of Objects and Classes, Using Exiting Classes building your own classes, constructor overloading, static, final, this keyword .
2. Inheritance: Using Super to Call Super class constructor, Method overriding, Dynamic method Dispatch, Using Abstract Classes, Using final with inheritance, The Object Class.
3. Packages & Interfaces: Packages, Access Protection, Importing package, Interface, Implementing Interfaces, variables in Interfaces, Interfaces can be extended.
4. Exception Handling: Fundamentals, Types Checked , Unchecked exceptions, Using try & catch, Multiple catch, throw, throws, finally, Java's Built in exceptions, user defined exception.

Module - II

5. Multi Threading: Java Thread Model, Thread Priorities, Synchronization, Creating a thread, Creating Multiple threads, Using is Alive ( ) and join ( ), wait () & notify ( ).
6. String Handling: String constructors, String length, Character Extraction, String Comparison, Modifying a string
7. Java I/O: Classes& Interfaces, Stream classes, Byte streams, Character streams, Serialization. JDBC: Fundamentals, Type I, Type II, Type III, Type IV drivers.

Module - III

8. Applets: Basics, Architecture, Skeleton, The HTML APPLET Tag, Passing Parameters to Applets, Applet context and show documents ().
9. Event Handing: Delegation Event model, Event Classes, Event Listener Interfaces, Adapter classes.
10. AWT: AWT Classes window fundamentals, component, container, panel, Window, Frame , Canvas, Creating a frame window in an Applet , working with Graphics , Control Fundamentals , Layout managers, Handling Events by Extending AWT components.Core java API package, reflection, Remote method Invocation (RMI)

Module – IV

11. Swing: J applet, Icons & Labels, Text fields, Buttons, Combo boxes, Tabbed panes, Scroll panes, Trees, Tables. Exploring Java-Lang: Simple type wrappers, Runtime memory management, object (using clone () and the cloneable Interface), Thread, Thread Group, Runnable.

Additional Module (Terminal Examination-Internal)

12. Networking: Basics, Socket overview, networking classes, & interfaces, TCP/IP client sockets, who is, URL format, URL connection, TCP/IP Server Sockets.

Text Books

1. Introduction to Java Programming, Y Daniel Liang, Pearson Education, 7th Edition.
2. Java The complete reference, Herbert Schildt, TMH, 5th Edition.

Reference Books

1. Programming with JAVA,E Balagurusamy,TMH, 4th edition.
2. Programming with Java, Jaya MaheshBhave& SunilPatekar, Pearson Education.
3. Big Java, Cay S Horstman, Willey India, 2nd Edition.
4. Java Programming Advanced Topics, Joe Wigglesworth, Cengage Learning.
5. Java How to Program, H.M. Deitel& Paul J. Deitel, PHI, 8th Edition
6. Theory and Problems of Programming with JAVA, John Hubbard, TMH.
7. Programming in java, Sachin Malhotra &SauravChoudhary, Oxford University Press, 2nd Edition 2004.

PET5H002 DIGITAL VLSI DESIGN (3-1-0)

Module-I

1. **Introduction:** Historical Perspective, VLSI Design Methodologies, VLSI Design Flow,Design Hierarchy, Concept of Regularity, Modularity and Locality, VLSI Design Styles, Computer-Aided Design Technology.
2. **Fabrication of MOSFETs:** Introduction, Fabrication Processes Flow – Basic Concepts The CMOS n-Well Process, Layout Design Rules, Stick Diagrams, Full-Customs Mask Layout Design.
3. **MOS Transistor:** The Metal Oxide Semiconductor (MOS) Structure, The MOS Systemunder External Bias, Structure and Operation of MOS Transistor (MOSFET), MOSFET Current-Voltage Characteristics, MOSFET Scaling and Small-Geometry Effects, MOSFET Capacitance.

Module – II

4. **MOS Inverters – Static Characteristics:** Introduction, Resistive-Load Inverters, Inverterswith n-Type MOSFET Load, CMOS Inverter.
5. **MOS Inverters – Switching Characteristics and Interconnect Effects:** Introduction, Delay-Time Definitions, Calculation of Delay-Times, Inverter Design with Delay Constraints, Estimation of Interconnect Parasitics, Calculation of Interconnect Delay, Switching Power Dissipation of CMOS Inverters.
6. **Combinational MOS Logic Circuits:** Introduction, MOS Logic Circuits with Depletion NMOS Loads, CMOS Logic Circuits, Complex Logic Circuits, CMOS Transmission Gates (Pass Gates).

Module – III

7. **Sequential MOS Logic Circuits:** Introduction, Behaviour of Bistable Elements, SR LatchCircuits, Clocked Latch and Flip-Flop Circuits, CMOS D-Latch and Edge-Triggered Flip-
   Flop.
8. **Dynamic Logic Circuits:** Introduction, Basic Principles of Pass Transistor Circuits,Voltage Bootstrapping, Synchronous Dynamic Circuit Techniques, Dynamic CMOS Circuit Techniques, High Performance Dynamic CMOS Circuits.

Module – IV

9. **Design for Testability:** Introduction, Fault Types and Models, Ad Hoc Testable DesignTechniques, Scan-Based Techniques, Built-In Self-Test (BIST) Techniques, Current Monitoring I_{DDQ} Test.

Additional Module (Terminal Examination-Internal)

10. **Semiconductor Memories:** Introduction, Dynamic Random Access Memory (DRAM), Static Random Access Memory (SRAM), Non-volatile Memory, Flash Memory.

Text Books

1. *CMOS Digital Integrated Circuits: Analysis andDesign*, Sung-Mo Kang and Yusuf Leblebici, Tata McGraw-Hill Publishing Company Limited, 3rdEdn, 2003.
2. Principles of CMOS VLSI Design – a SystemsPerspective, K. Eshraghian and N.H.E. Weste, Addison Wesley,2nd Edition, 1993.

Reference Books

1. Digital Integrated Circuits– *A Design Perspective*, Jan M. Rabaey, AnanthaChandrakasan, BorivojeNikolic, PHI, 2nd Edn.
2. Modern VLSI Design System – *on – Chip Design*, Wayne Wolf, PHI, 3rd Edn.
3. VLSI Design, Debaprasad Das, Oxford University Press, New Delhi, 2010.
4. CMOS Logic Circuit Design, John P. Uyemura, Springer, 2001.
5. Digital Integrated Circuit Design, Ken Martin, Oxford University Press, 2000.
6. VLSI Design Technique forAnalog and Digital Circuits, R LGEIGER, TMH.
7. Algorithms for VLSI Physical Design Automation, Naveed SHERWANI, BSP BOOKS PVT Ltd., 3rd Edition.
8. Introduction to VLSI Systems a logic, Circuits and System, Ming BOLin, BSP BOOKS PVT LTD.

PET5H003 DIGITAL SYSTEM DESIGN

MODULE-I

1. **Combinational Logic:** Review of adders, Subtractor, Multipliers, Multiplexers, ROM, PLA, PAL and PLD.
2. **Synchronous Sequential Logic:** Flip-flops, Triggering of flip-flops, Analysis of clocked sequential circuits, State reduction and assignment, Flip-flop excitation tables, Design procedure, Design of counters,

MODULE-II

3. **Finite State Machines:** Finite state model, Memory elements and their excitation functions, Synthesis of Synchronous sequential circuits, Capabilities and limitations of FSM, Design, Modeling and Simulation of Moore and Mealy machines.

MODULE-III

4. **Asynchronous Sequential Logic:** Analysis Procedure, Circuits with latches, Design procedure, Reduction of state and flow tables, Race-free state assignment, Hazards, Design examples.

Module – IV

5. **Designing with Programmable Logic Devices and Programmable Gate Arrays:** Read only memories, Programmable logic arrays, Programmable array logic, Designing with FPGAs, Xilinx series FPGA

Additional Module (Terminal Examination-Internal)

6. **Algorithmic State Machines**: ASM chart, Timing considerations, Control implementation, Control Design with multiplexers, PLAs, etc.

Text Books

1. VHDL: Programming by Example, Douglas L Perry, TMH, 3rd Edition, 2008.
2. Fundamentals of Digital Logic with VHDL design, Stephen Brown, ZvonkoVranesic, TMH, 3rd Edition, 2008.
3. Digital Design Principles, William I Fletcher, Prentice Hall of India, 3rd edition-1980.
4. Reference Books
5. Digital System Design Using VHDL, Chales H. Roth, Cengage Learning India, 2nd Edition,2012.
6. Digital System Design, John Wakerley, Pearson Education, 4th Edition,2008.
7. VHDL, ZainalabedinNavabbi, McGraw Hill Publication, 6th Edition, 2007.

PET5H004 BRAIN COMPUTER INTERFACING

MODULE-I

1. Anatomy and physiology of the human brain, Brain signal processing: Laplacian Filtering, Nearest Neighbour Filtering, Time-domain features including Hzorth parameters, Frequency domain features including power spectral density.

MODULE-II

2. **Feature Selection:** Principal Component Analysis, Independent Component Analysis, Common spatial patterns. EEG Classification: Linear Discriminant Analysis, Quadratic Discriminant analysis.

MODULE-III

3. Applications in rehabilitative robotics, olfactory perceptual-ability detection, cognitive failure detection in driving and detection of true emotion or deception using Brain-Computer Interfacing.

MODULE-IV

4. Neural Classifier using Gradient Descent Learning and Back-propagation algorithm, Linear and Kernelized Support Vector Machines

Additional Module (Terminal Examination-Internal)

5. Time-frequency correlated features including wavelets

Reference Books

1. BRAIN-COMPUTER INTERFACING: AN INTRODUCTION, RAJESH P.N. RAO, CAMBRIDGE UNIVERSITY PRESS, 1ST EDITION.
2. Brain-Computer Interfaces: Principles and Practice, Jonathan Wolpaw and Elizabeth Winter Wolpaw, Oxford University Press.

PET5H005 OPTIMIZATION IN ENGINEERING

MODULE-I

1. Idea of Engineering optimization problems, Classification of optimization algorithms, modeling of problems and principle of modeling.
2. **Linear programming:** Formulation of LPP, Graphical solution, Simplex method, Big-M method, Revised simplex method, Duality theory and its application, Dual simplex method , Sensitivity analysis in linear programming

MODULE-II

3. **Transportation problems:** Finding an initial basic feasible solution by Northwest Corner rule, Least Cost rule, Vogel's approximation method, Degeneracy, Optimality test, MODI method, Stepping stone method
4. **Assignment problems:** Hungarian method for solution of Assignment problemsInteger Programming:Branch and Bound algorithm for solution of integer Programming Problems

MODULE-III

5. **Non-linear programming:** Introduction to non-linear programming. **Unconstraint optimization:** Fibonacci and Golden Section Search method.
6. **Constrained optimization with equality constraint:** Lagrange multiplier, Projected gradient method
7. **Constrained optimization with inequality constraint:** Kuhn-Tucker condition, Quadratic programming.

MODULE-IV

8. **Queuing models:** General characteristics, Markovian queuing model, M/M/1 model, Limited queue capacity, multiple server, Finite sources, Queue discipline.

Additional Module (Terminal Examination-Internal)

9. Introduction to Genetic Algorithm.

Text Books

1. Operations Research- Principle and Practice, A. Ravindran, D. T. Philips, J. Solberg, Second edition, Wiley India Pvt Ltd.
2. Operation Research, Prabhakar Pai ,Oxford University Press
3. Optimization for Engineering Design, Kalyanmoy Deb, PHI Learning Pvt Ltd.
4. OperationsResearch, H.A.Taha, A.M.Natarajan, P.Balasubramanie, A.Tamilarasi, Pearson Education, Eighth Edition.
5. Engineering Optimization, S S Rao, New Age International(P) Ltd, 2003.

Reference Books

1. Linear and Non-linear Optimization, **S**tephen G. Nash, A. Sofer, McGraw Hill,2nd Edition.
2. Engineering Optimization, A.Ravindran, K.M.Ragsdell, G.V.Reklaitis, Wiley India Pvt. Ltd, Second edition.
3. Operations Research, F.S.Hiller, G.J.Lieberman, Tata McGraw Hill, Eighth Edition, 2005.
4. Operations Research, P.K.Gupta, D.S.Hira, S.Chand and Company Ltd, 2014.

ADVANCE LAB:

VLSI AND EMBEDDED SYSTEMS LAB

(All the experiments should be done)

VLSI Experiment List:

1. Design of schematic and simple layout for CMOS Inverter & perform parasitic extraction and simulation.
2. Design of schematic and simple layout for CMOS NAND gate & perform parasitic extraction and simulation.
3. Design of schematic and simple layout for CMOS NOR gate & perform parasitic extraction and simulation.
4. Plotting of VTC curve of CMOS inverter using p-SPICE.
5. Modelling and transient analysis of 2-inputs NAND & NOR gates using p-SPICE.
6. Design & implementation of 16-bit Arithmetic & Logic unit using VHDL.

Embedded Systems Experiment list:

1. Study of ARM7 & ARM9 Bit Processor Architecture and Pin Diagram.
2. Study of Interrupt structure in ARM Processors.
3. Write ARM Processor program to Flash LED.
4. Interfacing of an LCD Display.
5. Write a program to interface an ADC.
6. Write a program to control a Stepper Motor.
7. Write a program to control the speed of DC motor.
8. Interface relays and write a program to control them.
9. Interface ZIGBEE with ARM to control more external devices.
10. Interfacing RFID module with ARM Microcontroller.

HONOUR SUBJECT

PET5D001 ELECTRONICS DEVICES AND MODELING

MODULE – I

1. **PN–Junction Diode and Schottky Diode:** DC Current-Voltage Characteristics, Static Model, Large-Signal Model, Small-Signal Model, Schottky Diode and its Implementation in SPICE2, Temperature and Area Effects on the Diode Model Parameters, SPICE3, HSPICE and PSPICE Models

MODULE– II

2. **Metal-Oxide-Semiconductor Transistor (MOST):** Structure and Operating Regions of the MOST, LEVEL1 Static Model, LEVEL2 Static Model, LEVEL1 and LEVEL2 Large-Signal Model, LEVEL3 Static Model, LEVEL3 Large-Signal Model, The Effect of Series Resistances, Small-Signal Models, The Effect of Temperature.

MODULE–III

3. **BJT Parameter Measurements:** Input and Model Parameters, Parameter Measurements**,**
4. **MOST Parameter Measurements:** LEVEL1 Model Parameters, LEVEL2 Model (Long-Channel) Parameters, LEVEL2 Model (Short-Channel) Parameters, LEVEL3 Model Parameters, Measurements of Capacitance, BSIM Model Parameter Extraction **Noise and Distortions:** Noise, Distortion.

MODULE–IV

5. **Bipolar Junction Transistor (BJT):** Transistor Conversions and Symbols, Ebers-Moll Static Model, Ebers-Moll Large-Signal Model, Ebers-Moll Small-Signal Model, Gummel-Poon Static Model, Gummel-Poon Large-Signal Model, Gummel-Poon Small-Signal Model, Temperature and Area Effects on the BJT Model Parameters, Power BJT Model, SPICE3, HSPICE and PSPICE Models.

Additional Module (Terminal Examination-Internal)

6. BSIM1, BSIM2, SPICE3, HSPICE and PSPICE Models

Textbooks

1. Semiconductor Device Modeling with SPICE,Giuseppe Massobrio and Paolo Antognetti, Tata McGraw-Hill Education, 2nd edition, 2010.

Reference Books

1. Device Electronics for Integrated Circuits, Richard S. Muller, Theodore I. Kamins, and Mansun Chan, John Wiley and Sons, New York, 3rd edn.,2003.
2. Devices for Integrated Circuits: Silicon and III-V Compound Semiconductors, H. Craig Casey, John Wiley, New York, 1999.
3. Semiconductor Material and Device Characterization, Dieter K. Schroder, John Wiley and Sons, New York, 1990.

MINOR SUBJECT

PET5G001 ANALOG AND DIGITAL COMMUNICATION

OBJECTIVES:

The student should be made to:

- Understand analog and digital communication techniques
- Learn data and pulse communication techniques.
- Be familiarized with source and Error control coding.
- Gain knowledge on multi-user radio communication.

UNIT I ANALOG COMMUNICATION

Noise: Source of Noise - External Noise - Internal Noise- Noise Calculation. Introduction to Communication Systems: Modulation – Types - Need for Modulation. Theory of Amplitude Modulation - Evolution and Description of SSB Techniques - Theory of Frequency and Phase Modulation – Comparison of various Analog Communication System (AM – FM – PM).

UNIT II DIGITAL COMMUNICATION

Amplitude Shift Keying (ASK) – Frequency Shift Keying (FSK) Minimum Shift Keying (MSK) – Phase Shift Keying (PSK) – BPSK – QPSK – 8 PSK – 16 PSK - Quadrature Amplitude Modulation (QAM) – 8 QAM – 16 QAM – Bandwidth Efficiency– Comparison of various Digital Communication System (ASK – FSK – PSK – QAM).

UNIT III DATA AND PULSE COMMUNICATION

Data Communication: History of Data Communication - Standards Organizations for Data Communication- Data Communication Circuits - Data Communication Codes - Error Detection and Correction Techniques - Data communication Hardware - serial and parallel interfaces. Pulse Communication: Pulse Amplitude Modulation (PAM) – Pulse Time Modulation (PTM) – Pulse code Modulation (PCM) - Comparison of various Pulse Communication System (PAM – PTM – PCM)

UNIT IV SOURCE AND ERROR CONTROL CODING

Entropy, Source encoding theorem, Shannon fano coding, Huffman coding, mutual information, channel capacity, channel coding theorem, Error Control Coding, linear block codes, cyclic codes, convolution codes, viterbi decoding algorithm.

UNIT V MULTI-USER RADIO COMMUNICATION

Advanced Mobile Phone System (AMPS) - Global System for Mobile Communications (GSM) - Code division multiple access (CDMA) – Cellular Concept and Frequency Reuse - Channel Assignment and Hand off - Overview of Multiple Access Schemes - Satellite Communication - Bluetooth.

OUTCOMES:

At the end of the course, the student should be able to:

- Apply analog and digital communication techniques.
- Use data and pulse communication techniques.
- Analyze Source and Error control coding.
- Utilize multi-user radio communication.

TEXT BOOK:

1. Wayne Tomasi, “Advanced Electronic Communication Systems”, 6th Edition, Pearson Education, 2009.

REFERENCES:

1. Simon Haykin, “Communication Systems”, 4th Edition, John Wiley & Sons, 2004 35
2. Rappaport T.S, "Wireless Communications: Principles and Practice", 2nd Edition, Pearson Education, 2007
3. H.Taub, D L Schilling and G Saha,”Principles of Communication”, 3 rd Edition, Pearson Education, 2007.
4. B.P.Lathi, “Modern Analog and Digital Communication Systems”, 3 rd Edition, Oxford University Press, 2007.
5. Blake, “Electronic Communication Systems”, Thomson Delmar Publications, 2002.
6. Martin S.Roden, “Analog and Digital Communication System”, 3 rd Edition, Prentice Hall of India, 2002.
7. B.Sklar, “Digital Communication Fundamentals and Applications” 2 nd Edition Pearson Education 2007.

Sixth Semester									
	Theory						Practical		
Code	**Course Name**		**Hours/ Week L/T**	**Credit Theory**	**University Marks**	**Internal Evaluation**	**Hours/ Week L/T**	**Credit Practical**	**Marks**
PC	Digital Communication		3-0	3	100	50	2	1	50
PC	High Frequency Engineering		3-0	3	100	50	2	1	50
PE	Information Theory & Coding/Computer Network & Data Communication/Mobile Communication/Biomedical Electronics/Industrial Electronics/Robotics & computer Vision/Pattern Analysis & Machine Intelligence/Analog VLSI Design		3-1	4	100	50			
PE	Cryptography & Network Security/Advance Digital Signal Processing/Operation System/Antennas & Wave Propagation/Speech Propagation/Telecommunication System Modelling & Simulation		3-1	4	100	50			
MC & GS	Environmental Science & Engineering		3-0	3	100	50			
OE	Industrial Lecture #						3	1	50
HS	Business Communication & Skill for Interview # #		2-0	1		50	4	2	100
MC	Yoga						2	1	50
Total			19	18	500	300	13	6	300
Total Marks: 1100									
Total Credits: 24									
Honours		Software Define Radio Architecture System and Function	4	4	100	50			
Minor		Signal & Systems							

SEMESTER : 6TH

SL. NO.	SUBJECT CODE	CATEGORY	SUBJECT NAME	L-T-P	CREDIT
1.	PET6D001	HONOURS(CP)	SOFTWARE DEFINE RADIO ARCHITECTURE SYSTEM AND FUNCTION	4-0-0	4
2.	PET6E101	HS(CP)	BUSINESS COMMUNICATION & SKILL FOR INTERVIEW	1-0-2	3
3.	PET6G001	MINOR(CP)	SIGNAL & SYSTEMS	4-0-0	4
4.	PET6H301	OE(CP)	INDUSTRIAL LECTURE #	0-0-1	1
5.	PET6I101	PC(CP)	DIGITAL COMMUNICATION	3-0-1	4
6.	PET6I102	PC(CP)	HIGH FREQUENCY ENGINEERING	3-0-1	4
7.	PET6J001	PE(O1)	INFORMATION THEORY & CODING	4-0-0	4
8.	PET6J002	PE(O1)	COMPUTER NETWORK AND DATA COMMUNICATION	4-0-0	4
9.	PET6J003	PE(O1)	MOBILE COMMUNICATION	4-0-0	4
10.	PET6J004	PE(O1)	BIOMEDICAL ELECTRONICS	4-0-0	4
11.	PET6J005	PE(O1)	INDUSTRIAL ELECTRONICS	4-0-0	4
12.	PET6J006	PE(O1)	ROBOTICS & COMPUTER VISION	4-0-0	4
13.	PET6J007	PE(O1)	PATTERN ANALYSIS & MACHINE INTELLIGENCE	4-0-0	4
14.	PET6J008	PE(O1)	ANALOG VLSI DESIGN	4-0-0	4
15.	PET6J009	PE(O2)	CRYPTOGRAPHY & NETWORK SECURITY	4-0-0	4
16.	PET6J010	PE(O2)	ADVANCE DIGITAL SIGNAL PROCESSING	4-0-0	4
17.	PET6J011	PE(O2)	OPERATION SYSTEM	4-0-0	4
18.	PET6J012	PE(O2)	ANTENNAS AND WAVE PROPAGATION	4-0-0	4
19.	PET6J013	PE(O2)	SPEECH PROPAGATION	4-0-0	4
20.	PET6J014	PE(O2)	TELECOMMUNICATION SYSTEM MODELLING & SIMULATION	4-0-0	4
					28

PET6I101 DIGITAL COMMUNICATION

MODULE – I (19 HOURS)

Sampling Theorem, Some applications of sampling theorem.

Digital Representation of Analog Signal - Quantization of Signals, Quantization error, PCM, Electrical representation of binary digits, PCM System, Companding (4); Line coding, scrambling, T1 Digital System, Multiplexing T1 lines – The T2, T3 and T4 lines (3); Differential PCM- Linear predicted design, Delta Modulation, and Adaptive Delta Modulation.

Noise in PCM and DM - Calculation of Quantization Noise, Output Signal Power, Thermal Noise, Output SNR in PCM, Quantization noise in Delta Modulation, output signal power, output SNR, Comparison with PCM and DM.

MODULE – II (7 HOURS)

Digital Modulation Technique- Generation, Transmission, Reception; Spectrum and Geometrical Representation in the Signal Space of BPSK, DPSK, QPSK, QASK, M-ary PSK, BFSK, M-ary FSK, and Minimum Shifting Keying (MSK).

MODULE – III (8 HOURS)

Principle of Digital Data Transmission- Digital Communication Systems – Source, Line coder, Multiplexer, Regenerative repeater; Line Coding- PSD of various line codes, polar signalling, constructing a DC Null in PSD by pulse shaping, On Off signalling, Bipolar signalling; Pulse shaping – ISI and effect, Nyquist first criterion for zero ISI; Scrambling, Digital receiver and regenerative repeaters; Equalizers, Timing extraction, Detection error, Eye Diagram.

MODULE-IV (4 HOURS)

Data Transmission- A base band signal Receiver, Peak signal to RMS noise output voltage ratio, probability of error, optimum threshold, optimum receiver for both base band and pass band: calculation of optimum filter transfer function, optimum filter realization using Matched filter, Probability error of the matched filter, optimum filter realization using correlator.

ADDITIONAL MODULE (TERMINAL EXAMINATION-INTERNAL)

1. **Multiple Access Techniques**- FDMA, TDMA, CDMA, OFDM, MIMO

TEXT BOOKS

1. Modern Digital and Analog Communication Systems, B.P. Lathi, Z Ding and Hari Mohan Gupta , Oxford University Press, New Delhi.2017.
2. Principles of Communication Systems, H Taub, D L Schilling and G Saha, TMH Education Pvt Ltd, 4th Edition 2013.
3. An Introduction to Analog and Digital communications, Simon Haykin, Wiley Publication, 2nd edition, 2007

REFERENCE BOOKS

1. Digital and Analog Communication System, Leon W. Couch-II, Prentice Hall of India, Pearson Education, 6th Edition 2001.
2. Digital and Analog Communication System, K. Sam Shanmugam, Wiley India Pvt. Ltd 2006.
3. Digital Communications – Fundamentals and applications, Bernard Sklar, Pearson education Publication, 2nd Edition, 2009.
4. R N Mutagi, Digital Communication- Theory, Techniques and Applications, Oxford University Press

DIGITAL COMMUNICATION TECHNIQUES LAB

(At least 10 experiments should be done)

List of Experiments:

1. Study the functioning of PCM and Delta modulator; Demonstrate the process of PCM modulation and Delta modulation.
2. Modulation generation and detection Signal generator CRO
3. To study Time division multiplexing.
4. To study the different channel coding and decoding technique.
5. Generation and reception of different types of signals like ASK, PSK, FSK.
6. To transmit and receive three separate signal audio, video, tone simultaneously through satellite link.
7. To transmit PC data through satellite link using a satellite communication demonstration unit.
8. Experimentally compare different forms of BPSK, QPSK, and OQPSK and analyze their Spectrum with spectrum analyzer.
9. Spreading and dispreading using additive white Gaussian noise generation/ Gold code and other forms of spreading techniques.
10. Transmit different types of signals using ISDN system.
11. Analyze the process of data communication in LAN using LAN trainer and compare the performance different media access techniques.

PET6I102 HIGH FREQUENCY ENGINEERING (3-0-2)

MODULE-I (10 HOURS)

Microwave Tubes- Limitations of conventional tubes, construction, operation; Properties of Klystron Amplifier, reflex Klystron, Magnetron, Travelling Wave Tube (TWT); Backward Wave Oscillator (BWO); Crossed field amplifiers.

MODULE-II (10 HOURS)

Microwave Solid State Devices- Limitation of conventional solid state devices at Microwaves; Transistors (Bipolar, FET); Diodes (Tunnel, Varactor, PIN), Transferred Electron Devices (Gunn diode); Avalanche transit time effect (IMPATT, TRAPATT, SBD); Microwave Amplification by Stimulated Emission of Radiation (MASER).

MODULE-III (10 HOURS)

Microwave Components- Analysis of Microwave components using s-parameters, Junctions (E, H, Hybrid), Directional coupler; Bends and Corners; Microwave posts, S.S. tuners, Attenuators, Phase shifter, Ferrite devices (Isolator, Circulator, Gyrator); Cavity resonator.

MODULE-IV (12 HOURS)

Introduction to Radar Systems- Basic Principle-Block diagram and operation of Radar; Radar range Equation; Pulse Repetition Frequency (PRF) and Range Ambiguities.
Doppler Radars- Doppler determination of velocity, Continuous Wave (CW) radar and its limitations, Frequency Modulated Continuous Wave (FMCW) radar, Basic principle and operation of Moving Target Indicator (MTI) radar, Delay line cancellers, Blind speeds and staggered PRFs.
Scanning and Tracking Techniques- Various scanning techniques (Horizontal, vertical, spiral, palmer, raster, nodding); Angle tracking systems (Lobe switching, conical scan, mono pulse),

ADDITIONAL MODULE (TERMINAL EXAMINATION-INTERNAL)

Microwave Measurements- Power measurements using calorimeters and bolometer; Measurement of Standing Wave Ratio (SWR), Frequency and wavelength; Microwave bridges; Matched termination.
Applications of Radar; Range tracking systems, Doppler (velocity) tracking systems.

TEXT BOOKS

1. Microwave Engineering, David M. Pozer, Fourth Edition, Wiley Publications, 2011
2. Microwave Engineering, Sushrut Das, Oxford University Press, 2014.
3. Introduction to radar systems, Merill I. Skolink, McGraw Hill Publications, Second Edition, 2001
4. Microwave and Radar Engineering, G. S. Rao, Pearson India Publisher, 2014

REFERENCE BOOKS

1. Microwave devices and Circuits, Samuel Liao, Pearson Education Publisher, Third Edition,1990
2. Foundation of Microwave Engg, R.E. Collin, Second Edition,Wiley Publications, 2007
3. Microwave devices and Radar Engg, M. Kulkarni; Umesh Publications, Fifth Edition,1998
4. Microwave Engineering, Subol Kar, University Press.

HIGH FREQUENCY ENGINEERING LAB

(At least 10 experiments should be done)

LIST OF EXPERIMENTS:

1. Study of microwave components and instruments.
2. Measurement of crystal characteristics and proof of the square law characteristics of the diode.
3. Measurement of klystron characteristics.
4. Measurement of VSWR and standing wave ratio.
5. Measurement of Dielectric constants.
6. Measurement of Directivity and coupling coefficient of a directional coupler.
7. Measurement of Q of a cavity.
8. Calibration of the attenuation constant of an attenuator.
9. Determination of the radiation characteristics and gain of an antenna.
10. Determination of the phase-shift of a phase shifter.
11. Determination of the standing wave pattern on a transmission line and finding the length and position of the short circuited stub.

PROFESSIONAL ELECTIVES (PE-I)

PET6J001 INFORMATION THEORY & CODING

MODULE-I

Basic Concepts of Information Theory- The concept of Amount of Information, Average Information, Entropy, Information rate, Mutual information; Shannon's Theorem, Channel capacity; BSC and other channels, Capacity of a Gaussian Channel, Bandwidth – S/N Trade-off; Introduction to Channel Capacity & Coding; Channel Models, Channel Capacity Theorem, Shannon Limit.

MODULE-II

Introduction to Error Control Coding- Linear Block Codes- Introduction to Linear Block codes, Syndrome and Error detection, Minimum distance of block code, Hamming Code.

Cyclic Codes- Description of Cyclic codes, Generator and parity check matrices of cyclic codes, error detection decoding of cyclic codes.

BCH Codes- Description of codes; Decoding of BCH codes; Implementation of error connection.

MODULE-III

Convolution Codes- Encoding of convolution codes; structural properties of Convolution codes; Distance Properties of convolution codes.

Automatic Repeat Request Strategies- Stop and wait, Go back and selective repeat ARQ strategies, Hybrid ARQ Schemes.

MODULE-IV

Discrete Messages and information content- The Concept of amount of Information, Average Information, Entropy; Information rate, Source coding to increase average information per bit; Shanon-Fano coding; Huffman source coding algorithm, Lempel Ziv source coding algorithm.

ADDITIONAL MODULE (TERMINAL EXAMINATION-INTERNAL)

Shanon's Theorem- Channel Capacity, Capacity of Gaussian channel, Bandwidth – S/N Trade off; Use of Orthogonal Signals to attain Shannon's limit; Matched Filter Reception, calculation of error probability, Efficiency of orthogonal Signal transmission.

TEXT BOOKS

1. Information Theory, Coding and Cryptography, Ranjan Bose, TMH Publication
2. Introduction to Error Control Codes, S Gravano, Oxford University Press
3. Digital Communications – Fundamentals and applications, Bernard Sklar, Pearson education Publication, 2nd Edition, 2009.

REFERENCE BOOKS

1. Information Coding Techniques, R. Avudaiammal, Tat McGraw-Hill Education Pvt. Ltd., 2nd Edition New Delhi
2. Information Theory, F.M Reza: McGraw Hill
3. Error Control Coding, Shu Lin& J Costeib:, PHI

PET6J002 COMPUTER NETWORK AND DATA COMMUNICATION

Module – I (12 Hrs)

Overview of Data Communication Networks, Protocols and standards, OSI Reference model, TCP/IP Protocol.

Physical Layer: Analog Signals, Digital Signals, Data Rate Limits, Transmission Impairment, Data rate limit, Digital Transmission: Digital-to-Digital conversion, Analog-to-Digital conversion, Transmission modes, Analog Transmission: Digital-to-Analog conversion, Analog-to-Analog conversion, Multiplexing: Frequency Division Multiplexing (FDM), Wave Division Multiplexing (WDM), Time Division Multiplexing (TDM), Transmission Media: Guided Media (Twisted-Pair Cable, Coaxial Cable and Fiber-Optic Cable) and unguided media (wireless), Switching: Circuit Switched Network, Datagram Network, Virtual-Circuit Network , Telephone Network, Dial-up Modems and Digital Subscriber Lines.

Module – II (10 Hrs)

Error Detection and correction: Types of Errors, Error Detection mechanism (Linear codes, CRC, Checksum), Error Correction mechanism: Hamming Encoding.

Data Link Control and Protocols: Flow and Error Control, Stop-and-Wait ARQ. Go-Back-N ARQ, Selective Repeat ARQ, HDLC and Point-to-Point Protocol

Multiple Access: Random Access (ALOHA, CSMA, CSMA/CD, CSMA/CA), Controlled Access (Polling, Reservation, Token Passing), Channelization (FDMA, TDMA, CDMA).

Wired LANs (Ethernet): Traditional Ethernet, Fast Ethernet, Gigabit Ethernet.

Module – III (10 Hrs)

Wireless LANs: IEEE 802.11 and Bluetooth.

Connecting Devices: Passive Hub, Repeater, Active Hub, Bridge, Two layers Switch, Router, Three layers Switch, Gateway.

Virtual Circuit Networks: Frame Relay, Architecture & layers, ATM: Design goals, Architecture & layers.

Network Layer: IPV4 addresses, IPV6 addresses, Internet Protocol: Internetworking, IPV4 datagram, IPV6 packet format and advantages. Network Layer Protocols: ARP, RARP, IGMP and ICMP. Routing: Unicast Routing Protocols and Multicast Routing Protocols.

Transport Layer: Process to Process Delivery, User Datagram Protocol (UDP) and Transmission Control Protocol (TCP).

Module – IV (08Hrs)

Domain Name System (DNS): Name Space, Domain Name Space, DNS in Internet, Resolution and Dynamic Domain Name System (DDNS), Remote logging, Electronic Mail (SMTP) and file transfer (FTP), WWW: Architecture & Web document, HTTP: Transaction & Persistent vs. Nonpersistent connection.

Introduction to Wi-Fi and Li-Fi Technology.

Text Books:

1. Data Communications and Networking, Behrouz A. Forouzan, Tata McGraw-Hill.
2. Computer Networks, A. S. Tannenbum, D. Wetherall, Prentice Hall, Imprint of Pearson.
3. Data Communication and Networks, Bhushan Trivedi, Oxford University Press.

Reference Book:

1. Network for Computer Scientists & Engineers, Zheng, Oxford University Press.
2. Computer Networks A system Approach, Larry L, Peterson and Bruce S. Davie, Elsevier.
3. Computer Networks, Natalia Olifer, Victor Olifer, Willey India.
4. Data and Computer Communications, William Stallings, Prentice Hall, Imprint of Pearson.

PET6J003 MOBILE COMMUNICATION

MODULE-I

Fundamentals of Cellular Communications- Introduction, Cellular Systems, Hexagonal Cell Geometry, Co-channel Interference Ratio, Cellular System Design in Worst-Case Scenario with an Omni directional Antenna, Co-channel Interference Reduction, Directional Antennas in Seven-Cell Reuse Pattern, Cell Splitting, Adjacent Channel Interference (ACI), Segmentation.

MODULE-II

An Overview of Wireless Systems- Introduction, First and Second Generation Cellular Systems, Cellular Communications from 1G to 3G, Wireless 4G Systems; Future Wireless Networks Radio Propagation, Propagation Path-Loss Models- Introduction, Free-space Attenuation, Attenuation over Reflecting Surfaces, Radio wave Propagation, Characteristics of Wireless Channel, Signal Fading Statistics, Propagation Path-loss Models, Cost 231 Model.

MODULE-III

Wireless Application and Standards- Fundamentals of WLAN transmission technology, WLAN applications, IEEE 802.11, 802.11 systems performance; WiMAX standards, WiFi standards, Zigbee.

MODULE-IV

Multiple Access Techniques- Introduction, Narrowband Channelized Systems, Comparisons of FDMA, TDMA and DS-CDMA, Comparison of DS-CDMA vs. TDMA; System Capacity, Multicarrier DS-CDMA (MC-DS-CDMA).

ADDITIONAL MODULE (TERMINAL EXAMINATION-INTERNAL)

Modulation schemes- Introduction to modulation, Phase Shift Keying, Quadrature Amplitude Modulation, M-ary Frequency Shift Keying, Synchronization, Equalization Spread Spectrum(SS) and CDMA Systems- Introduction, Concept of Spread Spectrum, System Processing Gain, Requirements of Direct-Sequence Spread Spectrum, Frequency-Hopping Spread Spectrum Systems.

TEXT BOOKS

1. Wireless Communication and Networking, Essential Reading, V K Garg, Morgan Kaufman Publishers India; 2008
2. Wireless and Mobile Communication, Upena Dalal and Manoj K. Shukla, Oxford University Press, 2016
3. Wireless communication & networks, Upena Dalal, Oxford University Press, 2014

REFERENCE BOOKS

1. Wireless Communications, T S Rappaport, Pearson Education, India
2. Mobile Communication Engineering – Theory and Applications, W C Y Lee, TMH
3. Wireless Communications, T L Singhal, Tata McGraw Hill, 2010
4. Wireless communication, A Goldsmith, Cambridge

PET6J004 BIOMEDICAL ELECTRONICS

MODULE-I

Bioelectric Signals and Electrodes- Sources of biomedical signals, basic medical instrumentation system, PC based medical instruments, general constraints in design of medical instrumentation systems; origin of bioelectric signals, Electrocardiogram (ECG), Electroencephalogram (EEG), Electromyogram (EMG), Electrooculogram (EOG); Electrode-tissue interface, polarization, skin contact impedance, motion artifacts, Silver Chloride electrodes, Electrodes for ECG, Electrodes for EEG, Electrodes of EMG, Electrical conductivity of electrode jellies and creams, microelectrodes; Electrocardiograph-block diagram, ECG leads, effects of artifacts, multi-channel,

MODULE-II

Pacemakers & Defibrillator- Need for cardiac pacemaker, external pacemaker, implantable pacemakers-types, ventricular synchronous demand pacemaker, programmable pacemaker, power sources for implantable pacemakers; Need for defibrillator, DC defibrillator, automatic external defibrillator, implantable defibrillators.

MODULE-III

Blood Flow & Cardiac Output Measurement- Electromagnetic blood flow meter-principle, square wave electromagnetic flow meter, Doppler shift ultrasonic flow meter
Advanced Diagnostic & Therapeutic Instruments- Principle of surgical diathermy &surgical diathermy machine, Electro diagnosis-Electrotherapy-functional block diagram and working, interferential current therapy.

MODULE-IV

Biosensors- Electrochemical transducers, Electrode potential and reference electrodes, potentiometric sensors, amperometric sensors, electrochemical gas sensors; chemical transducers of acoustic and thermal principles. Biosensors – Enzyme based biosensors, immune sensors, and microbial sensors.

ADDITIONAL MODULE (TERMINAL EXAMINATION-INTERNAL)

1. ECG machine, vector cardiograph, phono cardiograph-origin of heart sounds; Microphones and amplifiers for PCG; Artificial kidney-Principle and haemodialysis machine; Continuous measurement of chemical quantities.

TEXT BOOK

1. Biomedical signal processing :Principles and Technique, D.C Reddy Tata McGraw- Hill Education Pvt.Ltd, 2005

PET6J006 ROBOTICS AND COMPUTER VISION

MODULE-I

Robotics Fundamentals- Components, degrees of freedom, joints, reference frames, characteristics.
Kinematics- Transformations and their representation using matrix, forward and inverse kinematic equations; Denavit- Hardenberg representation, degeneracy and dexterity.

MODULE-II

Computer Vision Fundamentals- Relationships to other fields, image geometry, definitions, levels of computation.
Binary image processing- Geometric processing, binary algorithms (e.g., component labelling, distance transforms, medial axis)

MODULE-III

Regions and segmentations- Thresholding, region representation, split and-merge.
Hough Transform- Theory and applications

MODULE-IV

Differential motions and velocities- Jacobian, differential motions of a frame, Jacobian and the differential operator.
Image filtering- Histograms, linear systems, mean and median filters, Gaussian smoothing

ADDITIONAL MODULE (TERMINAL EXAMINATION-INTERNAL)

1. **Trajectory Planning-** Joint-space and Cartesian-space trajectories.
2. **Edge detection**- Gradients, first and second derivative operators

TEXT BOOKS

1. Industrial Robotics Technology Programming and Applications, M.P.Groover, McGraw-Hill, 2001.

PET6J007 PATTERN ANALYSIS AND MACHINE INTELLIGENCE

MODULE-I

1. **Statistical Pattern Classification-**Linear discriminant analysis, Bayesian classification, model-free technique including the K-nearest neighbours method.

MODULE-II

2. **Feature Minimization Techniques-** Principal component analysis, Independent component analysis.
3. **Intelligent Search-** Problem solving by search, Heuristic search.

MODULE-III

4. **Reasoning Using Logic-** Propositional and predicate logic, unification and resolution principle, deductive and abductive reasoning, fuzzy reasoning.
5. **Perception-** Visual and linguistic perception.

MODULE-IV

6. **Clustering Techniques-** K-means, Fuzzy C-means, SOFM Neural net, Hopfield neural net.
7. **Machine Learning Techniques-** Decision tree learning, analogy based learning, inductive learning, Q-learning.

ADDITIONAL MODULE (TERMINAL EXAMINATION-INTERNAL)

8. **Neural Classifiers-** Perceptron, Multi-layered perceptrons and back propagation algorithm, support vector machine classifier.

TEXT BOOK

1. Pattern Recognition and machine learning – Christopher M.Bishop, Springer
2. Pattern Recognition-J.P. Marques de sa, Springer,2001
3. Artificial Intelligence –Stuart Russel, Peter Norvig-third edition

PET6J008 ANALOG VLSI DESIGN

MODULE – I (10 HOURS)

1. **Introduction to Analog Design-** General Concepts, Levels of Abstraction, Robust Analog Design.
2. **Single-Stage Amplifiers-** Basic Concepts, Common-Source Stage, Common-Source Stage with Resistive Load, CS Stage with Diode-Connected Load, CS Stage with Current-Source Load, CS Stage with Triode Load, CS Stage with Source Degeneration, Source Follower, Common-Gate Stage, Cascode Stage, Folded Cascode.
3. **Differential Amplifiers-** Single-Ended and Differential Operation, Basic Differential Pair, Qualitative Analysis, Quantitative Analysis, Common-Mode Response, Differential Pair with MOS Loads, Gilbert Cell.

MODULE – II (12 HOURS)

4. **Passive and Active Current Mirrors-** Basic Current Mirrors, Cascode Current Mirrors, Active Current Mirrors, Large-Signal Analysis, Small-Signal Analysis, Common-Mode Properties.
5. **Band gap References-** General Considerations, Supply-Independent Biasing, Temperature-Independent References, Negative-TC Voltage, Positive-TC Voltage, Bandgap Reference.

MODULE-III (7 HOURS)

6. **Operational Amplifiers-** General Considerations, Performance Parameters, One-Stage Op Amps, Two-Stage Op Amps, Gain Boosting, Comparison, Common-Mode Feedback, Input Range Limitations, Slew Rate, Power Supply Rejection.
7. **Frequency Response of Amplifiers-** General Considerations, Miller Effect, Association of Poles with Nodes, Common-Source Stage, Source Followers, Common-Gate Stage, Cascode Stage, Differential Pair.

MODULE – IV (7 HOURS)

8. **Feedback-** General Considerations, Properties of Feedback Circuits, Types of Amplifiers, Feedback Topologies, Voltage-Voltage Feedback, Current-Voltage Feedback, Voltage-Current Feedback, Current-Current Feedback, Effect of Loading, Two-Port Network Models, Loading in Voltage-Voltage Feedback, Loading in Current-Voltage Feedback, Loading in Voltage-Current Feedback, Loading in Current-Current Feedback, Summary of Loading Effects, Effect of Feedback on Noise.

ADDITIONAL MODULE (TERMINAL EXAMINATION-INTERNAL)

9. **Oscillators-** General Considerations, Ring Oscillators, LC Oscillators, Crossed-Coupled Oscillator, Colpitts Oscillator, One-Port Oscillators, Voltage-Controlled Oscillators, Tuning in Ring Oscillators, Tuning in LC Oscillators, Mathematical Model of VCOs.

TEXT BOOKS

1. Design of Analog CMOS Integrated Circuits, Behzad Razavi, Tata McGraw-Hill Publishing Company Limited, 2002.
2. CMOS Analog Circuit Design, D. Holberg and P. Allen, Oxford University Press, 2013.

REFERENCE BOOKS

1. Analysis and Design of Analog Integrated Circuits,P. Gray, P. Hurst, S. Lewis, and R. Meyer, John Wiley, 4th Edition, 2001.
2. Fundamentals of Microelectronics, BehzadRazavi, John Wiley, 1st Edition, 2008.
3. Analog Integrated Circuit Design, D. Johns and K. Martin, John Wiley, 1997.
4. Design of Analog Integrated Circuits and Systems, K.R. Laker and W.M.C. Sansen, McGraw-Hill, Inc., 1994.
5. Microelectronic Circuits, A. Sedra and K.C. Smith, Oxford University Press,5th Edition, 2004.

PET6J009 CRYPTOGRAPHY AND NETWORK SECURITY

MODULE-I

Security Problems- Security problem in computing; Security Attacks; Security Services; Security Mechanisms; OSI security attack-Standards and standard setting organizations.

MODULE-II

Data Security- Basic encryption and decryption; Substitution, Transposition, Block ciphers, Data encryption, standard encryption and decryption; Differential and linear crypto analysis; Advanced encryption; Block cipher models-Triple DES with two keys-Stream cipher, RC4- RSA algorithm, Diffie-Hellman key exchange algorithm.

MODULE- III

Network Security- IP security overview, IP security architecture, Authentication header, Encapsulating security pay load, combining security association, Key management-Web security considerations, Secure socket layer, Secure electronic transaction.

MODULE- IV

Message Authentication- Hash Functions, MD5-Hash algorithm, SHA 512 logic; Authentication Protocols, Digital signature standards.

ADDITIONAL MODULE (TERMINAL EXAMINATION-INTERNAL)

System Security: Intruders and intrusion detection-Malicious software, Viruses and related threats, virus counter measures, distributed denial of services attack-Firewalls design principles-Trusted systems.

TEXT BOOKS

1. Cryptography and Network Security – Principles & Practice, William Stallings, Pearson Education, 3rd edition, 2002.
2. Everyday Cryptography- Fundamental Principles and Applications, Keith M. Martin, Oxford University Press

REFERENCE BOOKS

1. Security in Computing, Charles P. Pleeger, PHI Learning, 1998.
2. Cryptography and Network Security, Behrouz Forouzan, Tata McGraw-Hill, 1st edition, 2007.
3. Cryptography & Network Security, Atul Kahate, TMH, 2nd edition, 2008.

PET6J010 ADVANCE DIGITAL SIGNAL PROCESSING

Module:-1

Multirate Digital Signal Processing: Introduction, Decimation by a factor D, Interpolation by a factor I, Sampling rate Conversion by a rational factor I/D, Implementation of Sampling rate Conversion, Multistage implementation of Sampling rate Conversion, Sampling rate Conversion of Band pass Signals, Sampling rate Conversion by an Arbitrary Factor, Digital Filter Banks, Two-channel Quadrature Mirror Filter Bank.

Module:-2

Linear Prediction and Optimum Linear Filters: Random Signals, Correlation Functions, and Power Spectra , Innovation Representation of a Stationary Random Process, Forward and Backward Linear Prediction, Solution of the normal equations: The Levinson-Durbin Algorithm. Properties of the Linear Prediction Error filters. Wiener filters for filtering and Prediction.

Adaptive Filters: Applications of Adaptive filters, Adaptive Direct-Form FIR filters-The LMS Algorithm.

Module:-3

Power Spectrum Estimation: Estimation of Spectra from Finite Duration Observations of Signals, Nonparametric Methods for Power Spectrum estimation, Relationship between the Autocorrelation and the model parameters. Bayes Theorem, Maximum Likelyhood detection.

Module:-4

The Yule-Walker Method for the AR Model Parameters, The Burg Method for the AR model Parameters, Unconstrained Least-Squares Method for the AR model parameters, MA Model for Power Spectrum Estimation, ARMA model for Power Spectrum Estimation.

Additional Module (Terminal Examination-Internal)

Filter Bank Methods, Eigenanalysis Algorithms for Spectrum Estimation

Text Book:

1. *Digital Signal Processing, John G.Proakis, Dimitris G. Manolakis, Pearson Education, New Delhi, 4th Edition, 2013.*

Reference Book:

1. *Adaptive Filter Theory, Simon Haykin, Pearson Education, 5th Edition 2017.*
2. *Adaptive Signal Processing, Bernard Widrow, Samuel D Stearns, Pearson Education,*

PROFESSIONAL ELECTIVES (PE-II)

PET6J011 OPERATING SYSTEM

MODULE-I

1. **Introduction to operating system-** About an Operating System, Simple Batch Systems, Multiprogramming and Time Sharing systems; Personal Computer Systems, Parallel Systems, Distributed Systems and Real time Systems.
2. **Operating System Structures**- Operating System Services, System components, Protection system, Operating System Services, system calls.
3. **Process management**- Process Concept, Process Scheduling, Operation on Processes, Inter process communication, Examples of IPC Systems, Multithreading Models, Threading Issues, Process Scheduling Basic concepts, scheduling criteria, scheduling algorithms,

MODULE-II

4. **Process coordination-** Synchronization; The Critical section problem, Peterson's solution, Synchronization hardware, Semaphores, Classical problems of synchronization, Monitors.
5. **Deadlocks-** System model, Deadlock Characterization Methods for Handling Deadlocks, Deadlock Prevention, Deadlock avoidance, Deadlock Detection, recovery from Deadlock.

MODULE-III

6. **Memory management**- Memory Management strategies, Logical versus Physical Address space, swapping, contiguous Allocation, Paging, Segmentation
7. **Virtual Memory-** Background, Demand paging, performance of Demand paging, Page Replacement, Page Replacement Algorithms; Allocation of frames, Thrashing, Demand Segmentation.

MODULE-IV

8. **Storage management-** File System Concept, Access Methods, File System Structure, File System Structure, File System Implementation, Directory implementation, Efficiency and Performance, Recovery, Overview of Mass Storage Structure, Disk Structure, Disk Scheduling, Disk Management, Swap-Space Management, I/O System Overview, I/O Hardware, Application I/O Interface, Kernel I/O Subsystem, Transforming I/O Request to Hardware Operation.

ADDITIONAL MODULE (TERMINAL EXAMINATION-INTERNAL)

9. Thread Scheduling,
10. **Case studies**; The LINUX System, Windows , POSIX compliant

TEXT BOOKS

1. Operating System Concepts**,** Abraham Silberschatz, Peter Baer Galvin, Greg Gagne, Wiley-India, 8thEdition, 2009.
2. Principles of Operating Systems, Naresh Chauhan, Oxford University Presss,1st Edition,2014
3. Modern Operating Systems**,** Andrew S. Tanenbaum and HerbertBos, Pearson publication, 3rdEdition, 2014.

REFERENCE BOOKS

1. Operating Systems**:** A Spiral Approach, Elmasri, Carrick, Levine, McGraw-Hill, TMH Edition,2009.
2. Understanding Operating Systems **,**Ida MFlynn, Ann McHoes, Cengage Learning,7th Edition,2013.
3. Operating Systems **,**Pabitra Pal Choudhury, PHI, Eastern Economy Edition,2009.
4. Operating Systems**,** William Stallings, PHI,5th Edition,2007.
5. Operating Systems**,** H.M. Deitel, P. J. Deitel, D. R. Choffnes, Pearson, 3rd Edition,2002.

PET6J012 ANTENNAS & WAVE PROPAGATION

MODULE- I

Electromagnetic radiation and antenna fundamentals- Review of electromagnetic theory: Vector potential, Solution of wave equation, retarded case, Hertizian dipole. Antenna characteristics: Radiation pattern, Beam solid angle, Directivity, Gain, Input impedance, Polarization, Bandwidth, Reciprocity, Equivalence of Radiation patterns, Equivalence of Impedances, Effective aperture, Vector effective length, Antenna temperature.

MODULE-II

Wire antennas- Short dipole, Radiation resistance and Directivity, Half wave Dipole, Monopole, Small loop antennas. Antenna Arrays: Linear Array and Pattern Multiplication, Two-element Array, Uniform Array, Polynomial representation, Array with non-uniform Excitation-Binomial Array

MODULE- III

Aperture Antennas- Magnetic Current and its fields, Uniqueness theorem, Field equivalence principle, Duality principle, Method of Images, Pattern properties, Slot antenna, Horn Antenna, Pyramidal Horn Antenna, Reflector Antenna-Flat reflector, Corner Reflector, Common curved reflector shapes, Lens Antenna

MODULE- IV

Special Antennas-Long wire, V and Rhombic Antenna, Yagi-Uda Antenna, Turnstile Antenna, Helical Antenna- Axial mode helix, Normal mode helix, Biconical Antenna, Log periodic Dipole Array, Spiral Antenna, Microstrip Patch Antennas.

Antenna Measurements- Radiation Pattern measurement, Gain and Directivity Measurements, Anechoic Chamber measurement.

ADDITIONAL MODULE (TERMINAL EXAMINATION-INTERNAL)

Radio wave propagation- Calculation of Great Circle Distance between any two points on earth, Ground Wave Propagation, Free-space Propagation, Ground Reflection, Surface waves, Diffraction, Wave propagation in complex Environments, Tropospheric Propagation, Tropospheric Scatter. Ionospheric propagation: Structure of ionosphere, Sky waves, skip distance, Virtual height, Critical frequency, MUF, Electrical properties of ionosphere, Effects of earth's magnetic fields, Faraday rotation, Whistlers.

TEXT BOOKS

1. **Electromagnetic Waves and Radiating Systems**, E. C. Jordan and K. G. Balmain Pearson Education Publications,1968
2. **Antennas and Wave Propagation**, A.R.Harish, M. Sachidanada, Oxford University Press,2007
3. **Antenna Theory Analysis and Design,** C. A. Ballanis, John Wiley Publications, Second Edition,2005

REFERENCES BOOKS

1. **Antennas for all Applications**,J.D.Kraus, Ronald J Marhefka and Ahmad S Khan, Tata McGraw-Hill Book Company. Third Edition,2008
2. **Antenna Wave Propagation**, G.S.N.Raju, Pearson Education,2006
3. **Antenna and Radio Wave Propagation**, R. E. Collin, McGraw Hill Publications,1985.
4. **Antenna Analysis and Design**,W.L Stutzman and G.A. Thiele, John WileyPublications,2012

PET6J013 SPEECH PROCESSING

MODULE- I

Mechanics of speech- Speech production: Mechanism of speech production, Acoustic phonetics - Digital models for speech signals - Representations of speech waveform: Sampling speech signals, basics of quantization, delta modulation, and Differential PCM - Auditory perception: psycho acoustics.

MODULE- II

Time domain methods for speech processing- Time domain parameters of Speech signal – Methods for extracting the parameters Energy, Average Magnitude, Zero crossing Rate – Silence Discrimination using ZCR and energy – Short Time Auto Correlation Function – Pitch period estimation using Auto Correlation Function.

MODULE- III

Frequency domain method for speech processing- Short Time Fourier analysis: Fourier transform and linear filtering interpretations, Sampling rates - Spectrographic displays - Pitch and formant extraction - Analysis by Synthesis - Analysis synthesis systems: Phase vocoder, Channel Homomorphicvocoder speech analysis: Cepstral analysis of Speech, Formant Estimation, Homomorphic and speech vocoder.

MODULE- IV

Linear predictive analysis of speech- Basic Principles of linear predictive analysis – Auto correlation method – Covariance method – Solution of LPC equations – Cholesky method – Durbin's Recursive algorithm,
Application of LPC parameters – Pitch detection using LPC parameters – Formant analysis – VELP – CELP.

ADDITIONAL MODULE (TERMINAL EXAMINATION-INTERNAL)

Application of speech & audio signal processing- Algorithms: Dynamic time warping, K-means clusering and Vector quantization, Gaussian mixture modeling, hidden Markov modeling - Automatic Speech Recognition: Feature Extraction for ASR, Deterministic sequence recognition, Statistical Sequence recognition, Language models - Speaker identification and verification – Voice response system – Speech synthesis: basics of articulatory, source-filter, and concatenative synthesis – VOIP

TEXT BOOKS

1. Discrete-Time Speech Signal Processing, Thomas F, Quatieri, Prentice Hall / Pearson Education, 2004.

REFERENCE BOOKS

1. Speech and Audio Signal Processing, Ben Gold and Nelson Morgan, John Wiley and Sons Inc., Singapore, 2004
2. Digital Processing of Speech signals, L.R.Rabiner and R.W.Schaffer, Prentice Hall 1979
3. Fundamentals of Speech Recognition, L.R. Rabiner and B. H. Juang, Prentice Hall, 1993.
4. Discrete Time Processing of Speech Signals, J.R. Deller, J.H.L. Hansen and J.G. Proakis, John Wiley, IEEE Press, 1999.
5. Speech Communication Human and Machine, Douglas O Shaughnessy.S BSP BOOKS PVT LTD, 2nd edition.

PET6J014 TELE COMMUNICATION SYSTEM MODELING AND SIMULATION

MODULE-I

Simulation methodology- Introduction, Aspects of methodology, Performance Estimation, Sampling frequency, Low pass equivalent models for band pass signals, multicarrier signals, Non-linear and time varying systems, Post processing, Basic Graphical techniques and estimations

MODULE-II

Simulation of random variables random process- Generation of random numbers and sequence, Gaussian and uniform random numbers Correlated random sequences, Testing of random numbers generators, Stationary and uncorrelated noise, Goodness of fit test.

MODULE-III

Modelling of communication systems- Radio frequency and optical sources, Analog and Digital signals, Communication channel and models, Free space channels, Multipath channel and discrete channel noise and interference.

MODULE-IV

Quality of estimator, Estimation of SNR, Probability density function and bit error rate, Monte Carlo method, Importance sampling method, Extreme value theory.

ADDITIONAL MODULE (TERMINAL EXAMINATION-INTERNAL)

Simulation and modeling methodology- Simulation environment, Modelling considerations, Performance evaluation techniques, error source simulation, Validation

TEXT BOOKS

1. Simulation of communication Systems: Modeling, Methodology and Techniques, MC. Jeruchim, P.Balaban and Sam K Shanmugam, , Plenum Press, New York, 2001.

REFERENCE BOOKS

1. Simulation Modeling and Analysis, Averill.M.Law and W. David Kelton, McGraw Hill Inc., 2000.
2. System Simulation, Geoffrey Gorden, 2nd Edition, Prentice Hall of India, 1992.
3. Performance Analysis of Digital Communication Systems,W.Turin, Computer Science Press, New York, 1990.
4. Discrete Event System Simulation, Jerry banks and John S.Carson, Prentice Hall of India, 1984
5. Principles of Communication Systems Simulation, William H. Tranter, K. Sam shanmugam, Theodore S. Rappaport, K. KurtL. Kosbar, Pearson Education (Singapore) Pvt Ltd, 2004. .

PMG6M001 ENVIRONMENTAL SCIENCE AND ENGINEERING

Module I

Multidisciplinary nature of environmental studies

Definition, scope and importance, Need for public awareness.

Natural Resources:

Renewable and non-renewable resources:

Natural resources and associated problems.

a) Forest resources: Use and over-exploitation, deforestation, case studies. Timber extraction, mining, dams and their effects on forest and tribal people.

b) Water resources: Use and over-utilization of surface and ground water, floods, drought, conflicts over water, dams-benefits and problems.

c) Mineral resources: Use and exploitation, environmental effects of extracting and using mineral resources, case studies.

d) Food resources: World food problems, changes caused by agriculture and overgrazing, effects of modern agriculture, fertilizer-pesticide problems, water logging, salinity, case studies.

e) Energy resources: Growing energy needs, renewable and non renewable energy sources, use of alternate energy sources. Case studies.

f) Land resources: Land as a resource, land degradation, man induced landslides, soil erosion and desertification.

- Role of an individual in conservation of natural resources.
- Equitable use of resoureces for sustainable lifestyles.

Module II

Ecosystems

Concept of an ecosystem.

- Structure and function of an ecosystem.
- Producers, consumers and decomposers.
- Energy flow in the ecosystem.
- Ecological succession.
- Food chains, food webs and ecological pyramids.
- Introduction, types, characteristic features, structure and function of the following ecosystem :-

a) Forest ecosystem

b) Grassland ecosystem

c) Desert ecosystem

d) Aquatic ecosystems (ponds, streams, lakes, rivers, oceans, estuaries)

Environmental Pollution Definition

- Cause, effects and control measures of :-

a) Air pollution

b) Water pollution

c) Soil pollution

d) Marine pollution

e) Noise pollution

f) Thermal pollution

g) Nuclear hazards

- Solid waste Management: Causes, effects and control measures of urban and industrial wastes.
- Role of an individual in prevention of pollution.
- Pollution case studies.
- Disaster management: floods, earthquake, cyclone and landslides.

Module III

Social Issues and the Environment

- From Unsustainable to Sustainable development
- Urban problems related to energy
- Water conservation, rain water harvesting, watershed management
- Resettlement and rahabilitation of people; its problems and concerns. Case Studies
- Environmental ethics : Issues and possible solutions.
- Climate change, global warming, acid rain, ozone layer depletion, nuclear accidents and holocaust. Case Studies.
- Wasteland reclamation.
- Consumerism and waste products.
- Environment Protection Act.
- Air (Prevention and Control of Pollution) Act.
- Water (Prevention and control of Pollution) Act
- Wildlife Protection Act
- Forest Conservation Act
- Issues involved in enforcement of environmental legislation.
- Public awareness.

Module IV

Human Population and the Environment

- Population growth, variation among nations.
- Population explosion – Family Welfare Programme.
- Environment and human health.
- Human Rights.
- Value Education.
- HIV/AIDS.
- Women and Child Welfare.
- Role of Information Technology in Environment and human health.
- Case Studies.

References

1. Agarwal, K.C. 2001 Environmental Biology, Nidi Publ. Ltd. Bikaner.
2. R. Rajagopalan, Environmental Studies, Oxford University Press
3. Ajith Sankar, Environmental Mangement, Oxford University Press
4. Bharucha Erach, The Biodiversity of India, Mapin Publishing Pvt. Ltd., Ahmedabad – 380 013, India, Email:mapin@icenet.net (R)
5. Brunner R.C., 1989, Hazardous Waste Incineration, McGraw Hill Inc. 480p
6. Clark R.S., Marine Pollution, Clanderson Press Oxford (TB)
7. Cunningham, W.P. Cooper, T.H. Gorhani, E & Hepworth, M.T. 2001, Environmental Encyclopedia, Jaico Publ. House, Mumabai, 1196p
8. De A.K., Environmental Chemistry, Wiley Eastern Ltd.
9. Down to Earth, Centre for Science and Environment (R)

PEN6E101 BUSINESS COMMUNICATION AND SKILL FOR INTERVIEW

Course Objectives

- To develop communication competence in prospective engineers.
- To enable them to convey thoughts and ideas with clarity and focus.
- To develop report writing skills.
- To equip them to face interview & Group Discussion.
- To inculcate critical thinking process.
- To prepare them on problem solving skills.
- To provide symbolic, verbal, and graphical interpretations of statements in a problem description.
- To understand team dynamics & effectiveness.
- To create an awareness on Engineering Ethics and Human Values.
- To install Moral and Social Values, Loyalty and also to learn to appreciate the rights of others.
- To learn leadership qualities and practice them.

MODULE I

Communication Skill: Introduction to Communication, The Process of Communication, Barriers to Communication, Listening Skills, Writing Skills, Technical Writing, Letter Writing, Job Application, Report Writing, Non-verbal Communication and Body Language, Interview Skills, Group Discussion, Presentation Skills, Technology-based Communication.

MODULE II

Critical Thinking & Problem Solving: Creativity, Lateral thinking, Critical thinking, Multiple Intelligence, Problem Solving, Six thinking hats, Mind Mapping & Analytical Thinking.

Teamwork: Groups, Teams, Group Vs Teams, Team formation process, Stages of Group, Group Dynamics, Managing Team Performance & Team Conflicts.

MODULE III

Ethics, Moral & Professional Values: Human Values, Civic Rights, Engineering Ethics, Engineering as Social Experimentation, Environmental Ethics, Global Issues, Code of Ethics like ASME, ASCE, IEEE.

MODULE IV

Leadership Skills: Leadership, Levels of Leadership, Making of a leader, Types of leadership, Transactions Vs Transformational Leadership, VUCA Leaders, DART Leadership, Leadership Grid & leadership Formulation.

Expected outcome:

The students will be able to

- Communicate effectively.
- Make effective presentations.
- Write different types of reports.
- Face interview & group discussion.
- Critically think on a particular problem.
- Solve problems.
- Work in Group & Teams

- Handle Engineering Ethics and Human Values.
- Become an effective leader.

References:

1. Barun K. Mitra; (2011), "Personality Development & Soft Skills", First Edition; Oxford Publishers.
2. Kalyana; (2015) "Soft Skill for Managers"; First Edition; Wiley Publishing Ltd.
3. Larry James (2016); "The First Book of Life Skills"; First Edition; Embassy Books.
4. Shalini Verma (2014); "Development of Life Skills and Professional Practice"; First Edition; Sultan Chand (G/L) & Company
5. John C. Maxwell (2014); "The 5 Levels of Leadership", Centre Street, A division of Hachette Book Group Inc.

HONOURS SPECIALIZATION:

MINOR SPECIALIZATION:

PET6G001 SIGNALS & SYSTEMS

MODULE – I (10 HOURS)

1. Discrete-Time Signals and Systems:
   Discrete-Time Signals: Some Elementary Discrete-Time signals, Classification of Discrete-Time Signals, Simple Manipulation, Discrete-Time Systems : Input-Output Description, Block Diagram Representation, Classification, Interconnection; Analysis of Discrete-Time LTI Systems: Techniques, Response of LTI Systems, Properties of Convolution, Causal LTI Systems, Stability of LTI Systems; Discrete-Time Systems Described by Difference Equations; Implementation of Discrete-Time Systems. Correlation of Discrete-Time Signals: Cross correlation and Autocorrelation Sequences, Properties.

MODULE – II (10 HOURS)

1. The Continuous-Time Fourier Series:
   Basic Concepts and Development of the Fourier series; Calculation of the Fourier Series, Properties of the Fourier Series.
2. The Continuous-Time Fourier Transform:
   Basic Concepts and Development of the Fourier Transform; Properties of the Continuous-Time Fourier Transform.

MODULE- III (10 HOURS)

1. The Z-Transform and Its Application to the Analysis of LTI Systems:
   The Z-Transform: The Direct Z-Transform, The Inverse Z-Transform; Properties of the Z-Transform; Rational Z-Transforms: Poles and Zeros, Pole Location and Time-Domain Behavior for Causal Signals, The System Function of a Linear Time-Invariant System; Inversion of the Z-Transforms: The Inversion of the Z-Transform by Power Series Expansion, The Inversion of the Z-Transform by Partial-Fraction Expansion; The One-sided Z-Transform: Definition and Properties, Solution of Difference Equations.

MODULE- IV (6 HOURS)

1. The Discrete Fourier Transform: Its Properties and Applications:

Frequency Domain Sampling: The Discrete Fourier Transform; Properties of the DFT: Periodicity, Linearity, and Symmetry Properties, Multiplication of Two DFTs and Circular Convolution, Additional DFT Properties.

ADDITONAL MODULE (TERMINAL EXAMINATION-INTERNAL) (04 HOURS)

1. Properties of Continuous-Time Systems:
   Block Diagram and System Terminology; System Properties: Homogeneity, Time Invariance, Additivity, Linearity and Superposition, Stability, Causality.

TEXT BOOKS

1. Digital Signal Processing – Principles, Algorithms and Applications, John. G. Proakis and Dimitris. G. Manolakis, 4th Edition, Pearson.
2. Fundamentals of Signals and Systems - M. J. Roberts, TMH

REFERENCE BOOKS

1. Signals and Systems - P. Ramakrishna. Rao, TMH.
2. Signals and Systems – A NagoorKani, TMH
3. Signals and Systems, Chi-Tsong Chen, Oxford
4. Principles of Signal Processing and Linear Systems, B.P. Lathi, Oxford.
5. Principles of Linear Systems and Signals, B.P Lathi, Oxford

HONOURS SPECIALIZATION:

PET6D001 SOFTWARE DEFINED RADIO ARCHITECTURE SYSTEM AND FUNCTION

MODULE-1(10 HRS)

Introduction to SDR: The Need for Software Radios. What Is a Software Radio? Characteristics and Benefits of a Software Radio. Design Principles of a Software Radio.

Radio frequency implementation issues: The Purpose of the RF Front-End. Dynamic Range: The Principal Challenge of Receiver Design. RF Receiver Front-End Topologies. Enhanced Flexibility of the RF Chain with Software Radios. Importance of the Components to Overall Performance. Transmitter Architectures and Their Issues. Noise and Distortion in the RF Chain. ADC and DAC Distortion.

MODULE-2(10 HRS)

Multirate signal processing: Introduction. Sample Rate Conversion Principles. Polyshase Filters. Digital Filter Banks. Timing Recovery in Digital Receivers Using Multirate Digital Filters.

Digital generation of signals: Introduction. Comparison of Direct Digital Synthesis with Analog Signal Synthesis. Approaches to Direct Digital Synthesis. Analysis of Spurious Signals. Spurious Components due to Periodic Jitter. Band pass Signal Generation. Performance of Direct Digital Synthesis Systems. Hybrid DDS-PLL Systems. Applications of direct Digital Synthesis. Generation of Random Sequences. ROM Compression Techniques.

MODULE-3 (10HRS)

Analog to digital and digital to analog conversion: Parameters of ideal data converters; Parameters of practical data converters; Techniques to improve data converter performance; Common ADC and DAC architectures

Smart antennas: Vector channel modeling; Benefits of smart antennas; Structures for Beamforming Systems; Smart Antenna Algorithms. Diversity and Space-Time

Adaptive Signal Processing; Algorithms for Transmit STAP; Hardware Implementation of Smart Antennas; Array Calibration.

MODULE-4 (6 HRS)

Digital hardware choices: Introduction; Key Hardware Elements; DSP Processors; Field Programmable Gate Arrays; Trade-Offs in Using DSPs, FPGAs, and ASICs; Power Management Issues; Using a Combination of DSPs, FPGAs, and ASICs.

ADDITONAL MODULE (TERMINAL EXAMINATION-INTERNAL) (04 HOURS)

Object-oriented representation of radios and network resources: Networks; Object-Oriented Programming; Object Brokers; Mobile Application Environments; Joint Tactical Radio System

TEXT BOOKS

1. Software Radio: A Modern Approach to Radio Engineering, Jeffrey H. Reed, Prentice Hall PTR; May 2002, ISBN: 0130811580

REFERENCE BOOKS

1. Software Radio Architecture: Object-Oriented Approaches to Wireless Systems Engineering by Joseph Mitola Wiley-Interscience; 1st edition 2000
2. Software Defined Radio: Architectures, Systems and Functions: M. Dillinger, K. Madani, N. Alonistioti, John Wiley & Sons, 05-Aug-2005

Seventh Semester								
	Theory					Practical		
Code	**Course Name**	**Hours/ week L/T**	**Credit Theory**	**University Marks**	**Internal Evaluation**	**Hours/ week L/T**	**Credit Practical**	**Marks**
GS	Nano Science & Bio Technology	3-1	4	100	50			
PE	Wireless Communication Systems/Satellite Communication Systems/Digital Image Processing/Adaptive Signal Processing/Advanced Control Systems/Embedded System Design/Electronics Design Automation/Database Management System	3-1	4	100	50			
PE	Wireless Sensor Networks/Optical Communication Networking/System Design Using Integrated Circuits/CMOS based Design/Mobile Computing/Biomedical Signal Processing	3-1	4	100	50			
OE	Soft Computing */ Other subjects	3-1	4	100	50			
PC	Advance Lab-II/ Project					8	4	200
	Projects on Internet of Things					8	4	200
Total		16	16	400	200	16	8	400
Total Marks: 1000								
Total Credits: 24								
Honours	Telecommunication Network and Optimization	4	4	100	50			
Minor	VLSI Design							

Semester : 7th

1.	PET7C001 GS(CP)	Nano & Bioscience	4-0-0	4
2.	PET7D001 Honours(CP)	Telecommunication Network and Optimization	4-0-0	4
3.	PET7G001 Minor(CP)	VLSI Design	4-0-0	4
4.	PET7H001 OE(O4)	Soft Computing	4-0-0	4
5.	PET7H002 OE(O4)	Other subjects	4-0-0	4
6.	PET7H201 FE(CP)	Projects on Internet of Things	0-0-4	4
7.	PET7I201 PC(O3)	Advance Lab - II	0-0-4	4
8.	PET7I202 PC(O3)	Project	0-0-4	4
9.	PET7J001 PE(O1)	Wireless Communication Systems	4-0-0	4
10.	PET7J002 PE(O1)	Satellite Communication Systems	4-0-0	4
11.	PET7J003 PE(O1)	Digital Image Processing	4-0-0	4
12.	PET7J004 PE(O1)	Adaptive Signal Processing	4-0-0	4
13.	PET7J005 PE(O1)	Advanced Control Systems	4-0-0	4
14.	PET7J006 PE(O1)	Embedded System Design	4-0-0	4
15.	PET7J007 PE(O1)	Electronics Design Automation	4-0-0	4
16.	PET7J008 PE(O1)	Database Management Systems	4-0-0	4
17.	PET7J009 PE(O2)	Wireless Sensor Networks	4-0-0	4
18.	PET7J010 PE(O2)	Optical Communication Networking	4-0-0	4
19.	PET7J011 PE(O2)	System Design Using Integrated Circuits	4-0-0	4
20.	PET7J012 PE(O2)	CMOS based Design	4-0-0	4
21.	PET7J013 PE(O2)	Mobile Computing	4-0-0	4
22.	PET7J014 PE(O2)	Biomedical Signal Processing	4-0-0	4
				28

7th Semester

PET7C001 NANO SCIENCE & BIO TECHNOLOGY

"will be uploaded soon"

PET7H001 SOFT COMPUTING

MODULE – I (8 hours)

Basic tools of soft Computing: Fuzzy logic, Neural Networks and Evolutionary Computing, Approximations of Multivariate functions, Non – linear Error surface and optimization.

MODULE – II (8 hours)

Fuzzy Logic Systems: Basics of fuzzy logic theory, Crisp and fuzzy sets; Basic set operations; Fuzzy relations, Composition of Fuzzy relations, Fuzzy inference, Zadeh's compositional rule of inference; Defuzzificaiton ; Fuzzy logic control; Mamdani and Takagi and Sugeno architectures. Applications to pattern recognition.

MODULE—III (16 hrs)

Neural networks: Single layer networks, Perceptron; Activation functions; Adalinc- its training and capabilities, weights learning, Multilayer perceptrons; error back propagation, generalized delta rule; Radial basis function networks and least square training algorithm, Kohenen self – organizing map and learning vector quantization networks; Recurrent neural networks, Simulated annealing neural networks; Adaptive neuro-fuzzy information; systems (ANFIS),

MODULE—IV (08 hrs)

Evolutionary Computing: Genetic algorithms: Basic concepts, encoding, fitness function, reproduction. Differences of GA and traditional optimization methods. Basic genetic, basic evolutionary programming concepts Applications, hybrid evolutionary algorithms.

ADDITIONAL MODULE (Terminal Examination-Internal)

Applications to Different Engineering problems.

Text Books

1) *F. O. Karry and C. de Silva, "Soft Computing and Intelligent Systems Design – Theory, Tools and Applications". Pearson Education. (Printed in India).*

Reference Books

2) J. S. R. Jang. C. T. SUN and E. Mizutani, "Neuro-fuzzy and soft-computing". PHI Pvt. Ltd., New Delhi.

3) Fredric M. Ham and Ivica Kostanic, "Principle of Neuro Computing for Science and Engineering", Tata McGraw Hill.

4) S. Haykins, "Neural networks: a comprehensive foundation". Pearson Education, India.

5) V. Keeman, "Learning and Soft computing", Pearson Education, India.

6) R. C. Eberhart and Y. Shi, "Computational Intelligence Concepts to Implementation". Morgan Kaufmann Publishers (Indian Reprint).

7th Semester

SOFT COMPUTING LAB
(All the experiments are compulsory)

List of experiments:

1) Study of fundamental of Fuzzy Logic and Basic Operations.
2) Study of Fuzzy Weighted Average and Application.
3) Solve a given problem (operations) using Fuzzy logic in MATLAB.
4) Solve a given problem (Max-Min composition) using Fuzzy logic in MATLAB.
5) Study of Neural Networks and Perceptron Example.
6) Study of Radial Basis Function and Application
7) Study of Probabilistic Neural Networks and Application.
8) Study of GA tool in MATLAB.
9) Development of genetic algorithms for domain specific Engineering applications.
10) Development of different evolutionary algorithms for domain specific Engineering applications.

7th Semester

PROFESSIONAL ELECTIVES (PE-I):

PET7J001 WIRELESS COMMUNICATION SYSTEMS

MODULE-I

History of wireless communication: Concept of mobile and personal communication, wireless cellular platform, the design fundamentals of cellular networks, frequency reuse, spectrum capacity enhancement techniques, co-channel and adjacent channel interference, location management, handoff management; Concept of mobile IP for mobility management issues.

MODULE-II

Propagation Models for Wireless Networks: Two-ray ground reflection model, a micro-cell propagation model, a macro-cell propagation model, shadowing model, large scale path loss and shadowing, multi path effects in mobile communication, linear time variant channel model; Concept of coherent bandwidth, Coherent time, Doppler Shift - Effect of velocity of the mobile, models for multi path reception, mobile communication antennas.

MODULE-III

Multiple access techniques in wireless communications: frequency division multiple access technology (FDMA), time division multiple access (TDMA), space division multiple access (SDMA), code division multiple access (CDMA); spectral efficiency of different wireless access technologies, spectral efficiency in FDMA system, spectral efficiency in TDMA system, spectral efficiency for DS-CDMA system.

MODULE-IV

Second Generation Mobile Networks-GSM: Architecture and protocols, access technology, call set up procedure, 2.5 G networks; evolution to GPRS, concept of data communication on GPRS, session management and PDP Context, data transfer through GPRS network and routing.

ADDITIONAL MODULE (Terminal Examination-Internal)

Evolution of modern mobile wireless communication systems: Personal area networks (PAN), Public wide-area wireless networks, wireless Local Area Networks; Brief introduction to 3G – The universal mobile telecommunication system (UMTS) Basic idea of satellite mobile communication systems.

Text Books

1) Wireless Communications- Principles and Practice, T S Rappaport, Pearson Education India, Second Edition 2003

2) Wireless Communication and Networks, Upen Dalal, Oxford university Press, First Edition, 2015.

3) Wireless Communication and Networks 3G and Beyond, Iti Saha Misra, Tata McGraw Hill Education Pvt. Ltd, Second Edition, 2009.

4) Mobile Communication Engineering – Theory and Applications W C Y Lee, TMH Publication, Second Edition, 2008.

Reference Books

1) Fundamentals of Wireless communication , David Tse and Pramod Viswanath, Cambridge University Press, 2005

2) Wireless Communication, Andrea Goldsmith, Cambridge University Press, 2005

7th Semester

PET7J008 DATABASE MANAGEMENT SYSTEM

MODULE-I

Introduction - Evolution of database systems, overview of database management systems.

Entity-relationship model - Basic Concepts, Constraints, Keys, Design Issues, Entity-Relationship Diagrams, The Unified Modeling Language (UML), Class Diagrams.

MODULE-II

Relational Model - Structures of relational databases, integrity constraints; Logical database design – ER to relational, relational algebra, relational calculus, functional dependencies, multi-valued dependencies, normal forms, Decompositions into normalized relations.

MODULE-III

SQL – Simple queries, queries with more than one relation, sub queries, full relation operations, Database modifications, View definitions.

MODULE-IV

Issues in Physical Database Design – physical data storage, raid disk organization technique; file structures – sequential file organization, indices, b-trees, hash tables.

ADDITIONAL MODULE (Terminal Examination-Internal)

Details of Relational Algebra – Basic operators, extended operators, constraints.

Text Books

1. Data Base Management System Raghu Ramakrishnan, McGraw-Hill , 3rd edition,2002 .
2. Reading in Data Base Systems, Joseph M. Hellerstein, The MIT Press,4th Edition,2005.

Reference Books

1) Database system concepts, Abraham Silberschatz, Henry F Korth and Sudharshan S McGraw Hill Publishin Company Limited,1St Edition,2004.
2) Database Management System - Post, Gerald V ,Tata McGraw-Hill, 2004.
3) Fundamentals of Database Syste,Elmasri,R.A.,Navathe,Shyam B.Narosa Publishing House,2nd Edition ,1997.
4) An introduction to Database Systems - Bipin C Desai Galgotia Publication ,4th Edition, 2005

7th Semester

PET7J007 ELECTRONIC DESIGN AUTOMATION

MODULE-I

MOSFET small signal model, MOSFET parasitic capacitance value and modification in model. Scaling of MOS structure; SPICE level -1, level-2 and level 3 model; BSIM and CSIM models; Comparison between models. Layout generation, Design checking rules, Lamda, beta rule, routing: auto routing,

MODULE-II

Advance programming using VHDL. Component level programming. Library files, type\ declaration and usage, parameter types and overloading, types and type related issues, predefined and user-defined attributes, package declaration and usage.

MODULE-III

Introduction to CADENCE, Use of CADENCE, Basic modeling using CADENCE, Layout generation using CADENCE. Introduction to low power IC design using CAD tools,

MODULE-IV

Delta delay modeling, insertion and transport delay. Use of signal drivers. Multiple processes

ADDITIONAL MODULE (Terminal Examination-Internal)

Device floor planning basics, Case study of a low power OPAMP design and layout generation.

Text book

1) Electronics Design Automation: Synthesis, verification & Test (System on Silicon)- Laung-Terng Wang, Morgan Kaufmann,2009

2) Essential Electronics design Automation (EDA)- Mark D.Birnbaum, Prentice Hall,2004

7th Semester

PET7J003 DIGITAL IMAGE PROCESSING

MODULE-I

Fundamentals – Steps in digital image processing, sampling and quantization, relationship between pixels, imaging geometry

Image Transforms – Fourier Transform, Discrete Fourier Transform, Fast Fourier Transform, Discrete Cosine Transform, Walsh Transform, Hadamard Transform, Hotelling Transform.

MODULE-II

Image Enhancement – Point processing, spatial filtering (smoothing and sharpening filters), enhancement in frequency domain.

Filtering in the Frequency Domain: preliminary concepts, 2D DFT and its properties, basic filtering in the frequency domain, image smoothing and sharpening.

MODULE-III

Image Restoration and Reconstruction: Image restoration/degradation model, noise models, restoration in the presence of noise only, estimating the degradation function.

Color Image Processing: Color models, Color transformation.

MODULE-IV

Wavelets and Multi-resolution Processing: multiresolution expansions, wavelet transforms in one and two dimension.

Image Compression: Fundamentals, Some basic compression methods (Chapt: 8 of Text book 1)

ADDITIONAL MODULE (Terminal Examination-Internal)

Morphological Image Processing: Erosion and Dilation, opening and closing.

Text books

1) Digital Image Processing, R.C. Gonzalez, R.E. Woods, Pearson Education , 3rd Edition, 2007

2) Digital Image Processing, S. Sridhar, Oxford University Press,2011

3) Digital Image Processing And Analysis, B. Chanda, Dutta D. Majumder ,PHI

Reference Books

1) Digital Image Processing using MATLAB, Rafael C. Gonzalez, Richard E. Woods Pearson Education, Inc., Seventh Edition, 2004.

2) Digital Image Processing, William K. Pratt, John Wiley, New York, 2002

7th Semester

PET7J002 SATELLITE COMMUNICATION SYSTEMS

MODULE-I (12 Hours)

Introduction to satellite communication: Orbital mechanics and parameters look angle determination, Launches and Lunch vehicle, Orbital effects in communication system performance. Attitude and orbit control system (AOCS), TT&C, Description of spacecraft System ; Transponders,

Satellite Link Design: Basics of transmission theory, system noise temperature and G/T ratio, Uplink and Downlink design, design of satellite links for specified (C/N) performance.

MODULE–II (10 Hours)

Analog telephone and television transmission: Energy dispersal, digital transmission

Multiple Accesses: Multiplexing techniques for satellite links, Comprehensive study on FDMA, TDMA and CDMA; Spread Spectrum Transmission and Reception; Estimating Channel requirements, SPADE, Random access

MODULE-III (12 Hours)

5. Propagation on satellite: Earth paths and influence on link design; Quantifying attenuation and depolarization, hydrometric & non hydrometric effects, ionosphere effects, rain and ice effects.

Satellite Antennas: Types of antenna and relationships; Basic Antennas Theory – linear, rectangular & circular aperture; Gain, pointing loss,

MODULE-IV

Earth station Technology: Earth station design; Design of large antennas – Cassegrain antennas, optimizing gain of large antenna, antenna temperature, feed system for large cassegrain antennas,

Design of small earth station antennas: Front fed paraboloid reflector antennas, offset fed antennas, beam steering, Global Beam Antenna, equipment for earth station.

ADDITIONAL MODULE (Terminal Examination-Internal)

Equipment reliability and space qualification.

Application of Satellite communication: Network distribution and direct broad casting TV, fundamentals of mobile communication satellite

Text Books

1) Satellite Communication, T. Pratt, C. Bostian, John Wiley Co, 2nd Edition.

2) Satellite Communication, Principles & Applications, R.N.Mutagi, Oxford University Press, 1st Edition, 2016

Reference Books

1. Digital Communication with Satellite and Fiber Optic Application, HarlodKolimbins, PHI
2. Satellite Communication, Robert M. Gagliardi, CBS Publishers
3. Satellitte Communication Systems, Richharia. BSP BOOKS PVT LTD.
4. Satellitte Communication Engg., MichealKolawole, BSP BOOKS PVT LTD

7th Semester

PET7J004 ADAPTIVE SIGNAL PROCESSING

MODULE–I (10 Hours)
Introduction: Adaptive Systems – Definition and characteristics, General properties, Open and Closed Loop Adaptations, Applications.

The Adaptive Linear Combiner: Performance function, Gradient and Mean Square Error, Examples.

MODULE – II (14 Hours)
Theory of Adaptation with Stationary Signals: Properties of the Quadratic Performance Surface, Significance of eigen values, eigen vectors, correlation matrix.

Searching the Performance Surface: A simple gradient search algorithm, Stability and Rate of convergence, the learning curve.

MODULE-III (16 Hours)
Gradient Estimation and its effects on Adoption: The performance penalty, Variance of the gradient estimate, Misadjustment.

Adaptive Algorithms and Structures: The LMS Algorithm, Convergence, learning Curve, Performance analysis, Filtered X LMS algorithm,

MODULE-IV
Applications: Adaptive Modelling and System Identification using adaptive filter, Inverse Adaptive Modelling, Deconvolution, and equalization using adaptive filter.

ADDITIONAL MODULE (Terminal Examination-Internal)
Adaptive Control Systems using Filtered X LMS Algorithm, Adaptive Noise Cancellation using Adaptive filter

Text Books

1. *Adaptive Signal Processing*, Bernard Widrow and Samuel D. Stearns, Pearson Education, 2nd impression, 2009.

Reference Books

2. *Adaptive Filter Theory*, Simon Haykin, Pearson Education, 4th Edn.

7th Semester

PET7J005 ADVANCED CONTROL SYSTEMS

MODULE-I (15 Hours)

Discrete - Time Control Systems:

Introduction: Discrete Time Control Systems and Continuous Time Control Systems, Sampling Process.

Digital Control Systems: Sample and Hold, Analog to digital conversion, Digital to analog conversion.

The Z-transform: Discrete-Time Signals, The Z-transform, Z-transform of Elementary functions, Important properties and Theorems of the Z-transform. The inverse Z-transform, Z Transform method for solving Difference Equations.

Z-Plane Analysis of Discrete Time Control Systems:

Impulse sampling & Data Hold, Reconstruction of Original signals from sampled signals: Sampling theorem, folding, aliasing.

Pulse Transfer function: Starred Laplace Transform of the signal involving Both ordinary and starred Laplace Transforms; General procedures for obtaining pulse Transfer functions, Pulse Transfer function of open loop and closed loop systems.

Mapping between the s-plane and the z-plane, Stability analysis of closed loop systems in the z-plane: Stability analysis by use of the Bilinear Transformation and Routh stability critgion, Jury stability Test.

MODULE-II (15 Hours)

State Variable Analysis & Design:

Introduction: Concepts of State, State Variables and State Model (of continuous time systems): State Model of Linear Systems, State Model for Single-Input-Single-Output Linear Systems, Linearization of the State Equation.

State Models for Linear Continuous – Time Systems: State-Space Representation Using Physical Variables, State – space Representation Using Phase Variables, Phase variable formulations for transfer function with poles and zeros, State – space Representation using Canonical Variables, Derivation of Transfer Function for State Model.

Diagonalization: Eigen values and Eigen vectors, Generalized Eigen vectors.

7th Semester

MODULE -III (12 Hours)

Solution of State Equations: Properties of the State Transition Matrix, Computation of State Transition Matrix, Computation by Techniques Based on the Cayley-Hamilton Theorem, Sylvester's Expansion theorem.

Concepts of Controllability and Observability: Controllability, Observability, Effect of Pole-zero Cancellation in Transfer Function.

Pole Placement by State Feedback, **Observer Systems**. **State Variables and Linear Discrete – Time Systems:** State Models from Linear Difference Equations/z-transfer Functions, Solution of State Equations (Discrete Case), An Efficient Method of Discretization and Solution, Linear Transformation of State Vector (Discrete-Time Case), Derivation of z-Transfer Function from Discrete-Time State Model.

MODULE-IV

Nonlinear Systems:

Introduction: Behaviour of Non linear Systems, Investigation of nonlinear systems.

Common Physical Non Linearities: Saturation, Friction, Backlash, Relay, Multivariable Nonlinearity.

The Phase Plane Method:

Basic Concepts, Singular Points: Nodal Point, Saddle Point, Focus Point, Centre or Vortex Point

Stability of Non Linear Systems: Limit Cycles,

Construction of Phase Trajectories: Construction by Analytical Method, Construction by Graphical Methods.

The Describing Function Method:

Basic Concepts: Derivation of Describing Functions: Dead-zone and Saturation, Relay with Dead-zone and Hysteresis, Backlash.

Stability Analysis by Describing Function Method: Relay with Dead Zone, Relay with Hysteresis, Stability Analysis by Gain-phase Plots.

ADDITIONAL MODULE (Terminal Examination-Internal)

Jump Resonance. Liapunov's Stability Analysis:

Introduction, Liapunov's Stability Criterion: Basic Stability Theorem, Liapunov Functions, Instability.

Direct Method of Liapunov& the Linear System: Methods of constructing Liapunov functions for Non linear Systems.

Text Books

1. Discrete-Time Control System, K.Ogata, PHI ,2nd Edition, 2009.
2. Control Systems Engineering, I.J. Nagrath and M.Gopal, New Age International (P) Ltd. Publishers, 5th Edition, 2007/ 2009.

Reference books

1) Design of Feedback Control Systems, Stefani,
2) , Oxford University Press, Fourth Edition,2009.
3) Modern Control Systems, K.Ogata, PHI, 5th Edition,2010.
4) Modern Control Systems Richard C. Dorf. And Robert, H.Bishop, Pearson Education Inc. Publication, 11th Edition,2008.
5) Control Systems (Principles & Design), M.Gopal, Tata Mc. Graw Hill Publishing Company Ltd, 3rd Edition,2008.
6) Control Systems Engineering, Norman S.Nise, Wiley India (P) Ltd, 4th Edition,2008.

7th Semester

PET7J006 EMBEDDED SYSTEM DESIGN

MODULE – I **(8 Hours)**

Embedded System: Understanding the Basic Concepts:

Introduction to Embedded System: Embedded Systems Vs General Computing Systems, History of Embedded Systems, Classification of Embedded Systems.

The Typical Embedded System: Core of the Embedded System, Memory, Sensors and Actuators, Communication Interface, Embedded Firmware, Other System Components, PCB and Passive Components.

Characteristics and Quality Attributes of Embedded System.

Hardware Software Co-Design and Program Modelling: Fundamental Issues in Hardware Software Co-Design.

MODULE – II **(8 Hours)**

Design and Development of Embedded Product:

Embedded Hardware Design and Development: Analog Electronic Components, Digital Electronic Components, VLSI and Integrated Circuit Design, Electronic Design Automation (EDA) Tools.

Embedded Firmware Design and Development: Embedded firmware Design Approaches, Embedded firmware Development Languages.

MODULE – III **(8 Hours)**

Real Time Operating System (RTOS) based Embedded System Design: Operating System Basics, Types of Operating Systems, Tasks, Process and Threads, Multiprocessing and Multitasking, Task Scheduling, Threads, Processes and Scheduling: Putting them altogether, Task Communication, Task Synchronisation, Device Drivers, How to choose an RTOS.

MODULE – IV **(8 Hours)**

Design and Development of Embedded Systems:

Integration and Testing of Embedded Hardware and Firmware: Integration of Hardware & Firmware, Board Power up.

The Embedded System Development Environment: Integrated Development Environment (IDE), Types of files generated on cross-compilation, Disassembler/Decompiler, Simulators, Emulators & Debugging, Target Hardware Debugging.

Embedded Product Development Life Cycle (EDLC): Definition and Objectives of EDLC, Different Phases of EDLC, EDLC Approaches (Modelling the EDLC).

ADDITIONAL MODULE (Terminal Examination-Internal) (8 Hours)

Major Application Areas of Embedded Systems.

Embedded Systems: Application and Domain Specific: Washing Machine: Application Specific Embedded System, Automotive: Domain Specific Example for Embedded System; Computational Models in Embedded Design, Introduction to Unified Modelling Language (UML), Hardware Software Trade-offs; Programming in Embedded 'C'.

An Introduction to Embedded System Design with VxWorks and MicroC/OS-II (μCOS-II) RTOS: VxWorks, MicroC/OS-II (μCOS-II); Boundary Scan;

Product Enclosure Design & Development: Product Enclosure Design Tools, Product Enclosure Development Techniques.

Trends in the Embedded Industry: Processor Trends in Embedded System, Embedded OS Trends, Development Language Trends, Open standards, Frameworks and Alliances, Bottlenecks.

Text Book:

1) Introduction to Embedded Systems, Shibu K.V., TMH Private Limited, New Delhi, 2009.

Reference Book:

2) An Embedded Software Primer, David E. Simon, Addison Wesley, 1999.

3) The Art of Designing Embedded Systems, Jack Ganssle, Newnes, 2000

4) Embedded Microprocessor System Design, K. Short, Prentice Hall, 1998.

5) Embedded System Applications, C. Baron, J. Geffroy and G. Motet, Kluwer, 1997.

6) Embedded Systems – Architecture, Programming and Design, Raj Kamal, Tata McGraw Hill Publishing Company Limited, New Delhi, 12th reprint 2007.

7) Embedded system design. Modeling synthesis and verification, Daniel Gajski. BSP BOOKS PVT LTD.

7th Semester

PROFESSIONAL ELECTIVES (PE-II)

PET7J009 WIRELESS SENSOR NETWORK

MODULE-I **(8 Hours)**

Sensor Network Concept: Introduction, Networked wireless sensor devices, Advantages of Sensor networks, Applications, Key design challenges.

Network deployment: Structured versus randomized deployment, Network topology, Connectivity, Connectivity using power control, Coverage metrics, Mobile deployment.

MODULE-II **(6 Hours)**

Localization and Tracking: Issues and approaches, Problem formulations: Sensing model, collaborative localization. Coarse-grained and Fine-grained node localization. Tracking multiple objects.

MODULE-III **(8 Hours)**

Wireless Communications: Link quality, shadowing and fading effects

Medium-access and sleep scheduling: Traditional MAC protocols, Energy efficiency in MAC protocols, Asynchronous sleep techniques, Sleep-scheduled techniques, and Contention-free protocols.

MODULE-IV **(6 Hours)**

Routing: Metric-based approaches, Multi-path routing, Lifetime-maximizing energy-aware routing techniques, Geographic routing.

Sensor network Databases: Data-centric routing, Data-gathering with compression,

ADDITIONAL MODULE (Terminal Examination Internal) **(8 Hours)**

State space decomposition; Synchronization: Issues and Traditional approaches, Fine-grained clock synchronization, and Coarse-grained data synchronization; Querying; Data-centric storage and retrieval; the database perspective on sensor networks; Security: Privacy issues, Attacks and countermeasures.

Text Books

1) Wireless Sensor Networks: An Information Processing Approach- by Feng Zhao, Leonidas Guibas , Morgan Kaufmann Series in Networking 2004.

References Books

2) Networking Wireless Sensors: Bhaskar Krismachari, Cambridge University Press

3) Wireless Sensor Networks: Edited by C.S Raghavendra, Krishna M, Sivalingam, TaiebZnati, Springer.

4) Wireless Sensor Networks: Technology, Protocols, and Applications: Kazem Sohraby, Daniel Minoli, TaiebZnati, Wiley Inter Science.

7th Semester

PET7J010 OPTICAL COMMUNICATION AND NETWORKING

MODULE-I **(9 Hours)**

Introduction: Introduction, Ray theory transmission,Total internal reflection-Acceptance angle,Numerical aperture; Skew rays; Electromagnetic mode theory of optical propagation: EM waves, modes in Planar guide, phase and group velocity; cylindrical fibers , SM fibers.

MODULE-II **(9 Hours)**

Transmission characteristics of optical fibers: Attenuation – Material absorption losses in silica glass fibers, Linear and Non linear Scattering losses, Fiber Bend losses; Mid band and far band infrared transmission; Intra and inter Modal Dispersion – Over all Fiber Dispersion; Polarization: non linear Phenomena; Optical fiber connectors, Fiber alignment and Joint Losses; Fiber Splices, Fiber connectors, Expanded Beam Connectors : Fiber Couplers.

MODULE-III **(9 Hours)**

Sources and detectors: Optical sources: Light Emitting Diodes, LED structures, surface and edge emitters, mono and hetero structures: internal; quantum efficiency; injection laser diode structures; comparison of LED and ILD Optical Detectors: PIN Photo detectors, Avalanche photo diodes, construction, characteristics and properties; Comparison of performance; Photo detector noise :Noise sources , Signal to Noise ratio , Detector response time.

MODULE-IV **(9 Hours)**

Fiber optic receiver and measurements: Fundamental receiver operation, Pre amplifiers, Error sources: Receiver Configuration Probability of Error Quantum limit; Fiber Attenuation measurements, Dispersion measurements, Fiber Refractive index profile measurements, Fiber cut- off Wave length Measurements, Fiber Numerical Aperture Measurements, Fiber diameter measurements.

ADDITIONAL MODULE (Terminal Examination-Internal) **(9 Hours)**

Optical networks: Basic Networks, SONET / SDH, Broadcast and select WDM Networks; Wavelength Routed Networks; Nonlinear effects on Network performance, Performance of WDM + EDFA system, Solutions; Optical CDMA; Ultra High Capacity Networks.

Text Books

1. Optical Fiber Communication, John M. Senior, Pearson Education, Second Edition, 2007.
2. Optical Fiber Communication, Gerd Keiser, McGraw Hill, Third Edition, 2000.
3. Optical Network, Rajib Ramaswamy & Kumar Sivarajan,M.K. Publication,2nd edition.

Reference Books

1. Optical Communication System, J. Gower, Prentice Hall of India, 2001.
2. Optical Networks, Rajiv Rama swami, Elsevier ,Second Edition, , 2004. 3. Fiber-optic communication systems, Govind P. Agrawal, John Wiley & sons, third edition, , 2004.
3. Fiber Optics and Optoelectronics, R.P. Khare, Oxford University Press, 2007.
4. Optical Communication Network, Viswanath Mukherjee, McGraw Hill Publication,2000.

7th Semester

PET7J011 SYSTEM DESIGN USING INTEGRATED CIRCUITS

MODULE- I **(8 Hours)**

Linear IC- Operational amplifier: Introduction to linear ICs, Operational amplifier IC741, Block diagram and characteristics, DC and AC performance; Open loop configurations, Feedback configurations, Inverting, non inverting and differential amplifier, Summer, Subtractor, Integrator, Differentiator, Zero crossing detector, Schmitt trigger, Window detector; Astable and monostable multivibrators; V-I and I-V converters; Filter and its types, Instrumentation amplifier, Precision rectifiers, Logarithmic and antilog amplifiers; multiplier; Op amp voltage regulator, IC linear voltage regulator (series 7800 and 7900 ICs).

MODULE- II **(8 Hours)**

Other LICs and Data Converters: 555 timer, Block diagram and features, Astable multivibrator, applications, Square wave oscillator, Ramp generator, Triangular waveform generator and Voltage to frequency converter; Monostable multivibrator, applications, Frequency divider, PWM and PPM generators. XR2240 Programmable

Timer/Counter,Block diagram and operation, applications,Free running oscillator and frequency synthesizer; PLL565, Principle, Building blocks, applications, Frequency multiplication, Frequency translation, AM and FM detection. Data converters, DAC characteristics, Binary weighted DAC, R-2R DAC, Monolithic DAC-08, ADC characteristics, Flash ADC, Successive approximation ADC, dual slope integrating type ADC, Monolithic ADC AD670,Variable Voltage Regulators(LM317).

MODULE- III **(8 Hours)**

Digital Integrated Circuits: Digital IC characteristics, Digital IC families,RTL and DTL, HTL, I2L, TTL, ECL, MOS and CMOS logic circuits, Comparison of digital IC families.

MODULE- IV **(8 Hours)**

Design of sequential machines: Analysis and design of synchronous sequential machines, Mealey and Moore machines, State table, State diagram, State reduction and assignments, Analysis and design of asynchronous sequential logic, Race conditions, Design problems from specifications, Hazards in combinational and sequential circuits.

ADDITIONAL MODULE (Terminal Examination-Internal) **(8 Hours)**

Processor and control unit design: Registers, Register transfer logic, inter register transfer, bus transfer and memory transfer, Arithmetic logic and shift micro operations, Macro operations; Processor logic design, Processor organization, Bus organization, Processor unit employing a scratch pad memory, Accumulator, Design of ALU, Design of status register, Design of processor unit with control variables, Design of accumulator , Control logic design, Single flip flop/state method, Sequence register and decoder method, PLA control, Micro program control.

Text Books

1. Operational Amplifiers and Linear Integrated Circuits, Robert. F. Coughlin and Frederick F. Driscoll, PHI Learning Pvt. Ltd, Sixth Edition, 2008.

2. Digital Logic and Computer design, M. Morris Mano, PHI Learning Pvt. Ltd, 2008

Reference Books

1. Opamp and Linear Integrated Circuits, Ramakant A. Gayakwad, PHI Learning Pvt. Ltd, Fourth Edition, 2008.

2. Digital Design, M. Morris Mano and Michael D. Ciletti, PHI Learning Pvt. Ltd, Fourth Edition,2008.

7th Semester

PET7J012 CMOS BASED DESIGN

MODULE-I **(8 Hours)**

Introduction to MOS Device-MOS Transistor, MOS models;MOS Transistor under static conditions; threshold voltage; Resistive operation, saturation region,;channel length modulation; body effect; DC transfer characteristics; Tristate inverters, velocity saturation; Hot carrier effect, drain current Vs voltage charts, sub threshold conduction; MOS structure capacitance; CMOS logic, fabrication and layout, stick diagrams.

MODULE-II **(8 Hours)**

CMOS Processing-CMOS technologies, wafer formation photolithography channel formation, isolation, gate oxide, gate source, drain formation, contacts and metallization; layout design rules, design rule checking.

MODULE-III **(8 Hours)**

Circuit Characterization & Performance Estimation-Delay estimation; transistor sizing; power dissipation; Sheet resistance, area capacitance, design margin, reliability; Scaling models, scaling factor for device parameters, Advantages and Limitations of scaling.

MODULE-IV **(6 Hours)**

Design of Combinational Logic-Static CMOS design, complementary CMOS, static properties, complementary CMOS design, Power consumption in CMOS logic gates, dynamic or glitching transitions, Design to reduce switching activity; Radioed logic, DC VSL, pass transistor logic.

ADDITIONAL MODULE (Terminal Examination-Internal) **(6 Hours)**

Differential pass transistor logic;sizing of level restorer, sizing in pass transistor; Dynamic CMOS design; Domino logic, optimization of Domino logic; NPCMOS; Designing logic for reduced supply voltages.

Reference Books

1. CMOS VLSI DESIGN-Nail H.E. Weste & David Harris, Ayan Banerjee,Pearson Education,4th edition,2011
2. CMOS Digital integrated circuits , Sung-Mo-Kanga and Yusuf Leblebici,TataMc Graw Hill New Delhi -2003.
3. Modern VLSI Design,Wayne Wolf, Prentice Hall -2nd Edition, 1998.
4. CMOS VLSI Design: A Circuits and Systems Perspective, Nail H.E. Weste & David Money Harris,- Addison Wesley, 3rd edition,2005.

7th Semester

PET7J013 MOBILE COMPUTING

MODULE – I **(10 Hours)**

Introduction to Personal Communications Services (PCS): PCS Architecture, mobility management, Networks signaling; Global System for Mobile Communication (GSM) System.

Overview: GSM Architecture, Mobility management, Network signaling; General Packet Radio Services (GPRS): GPRS Architecture, GPRS Network Nodes, Mobile Data Communication; WLANs (Wireless LANs) IEEE 802.II standard.

MODULE–II **(14 Hours)**

Wireless Application Protocol (WAP): The Mobile Internet standard, WAP Gateway and Protocols, wireless mark up Languages (WML).

Wireless Local Loop (WLL): Introduction to WLL Architecture, wireless Local Loop Technologies. Third Generation (3G) Mobile Services: Introduction to International Mobile Telecommunications 2000 (IMT 2000) Vision.

MODULE–III **(4 Hours)**

Global Mobile Satellite Systems; case studies of the IRIDIUM, ICO and GLOBALSTAR systems.

MODULE-IV **(8 Hours)**

Wireless Enterprise Networks: Introduction to Virtual Networks, Blue tooth technology, Blue tooth Protocols; Server-side programming in Java, Pervasive web application architecture, Device independent example application.

ADDITIONAL MODULE (Terminal Examination-Internal) **(6 Hours)**

Wideband Code Division Multiple Access (W-CDMA) and CDMA 2000; Mobile IP.

Text Books

1. Mobile Communication, J. Schiller, Pearson Education,2nd Edition,2003
2. Mobile Computing, Raj Kamal, Oxford University Press
3. Pervasive Computing, Burkhardt, Pearson Education,2002.
4. Mobile Computing, Talukder, TMH, 2nd Edition,2010.

Reference Books

1. Wireless Communication & Networking, Garg, Elsevier,1st Edition,2007.
2. Mobile Computing,P.K. Patra, S.K. Dash, Scitech Publications,2011
3. Principles of Mobile Computing, Hansmann, Merk, Springer, 2nd Edition,2003.
4. Third Generation Mobile Telecommunication Systems, P. Stavronlakis, Springer,1st Edition,2001.
5. The Wireless Application Protocol, Sandeep Singhal, Pearson Education,2000.

7th Semester

PET7J014 BIOMEDICAL SIGNAL PROCESSING

MODULE-I **(8 Hours)**

Introduction to Biomedical Signals: Tasks in Biomedical Signal Processing, Computer Aided Diagnosis, Examples of Biomedical signals: ECG, EEG, EMG etc., Review of linear systems, Fourier Transform and Time Frequency Analysis (Wavelet) of biomedical signals, Processing of Random & Stochastic signals, spectral estimation.

MODULE-II **(8 Hours)**

Cardio-logical Signal Processing: Pre-processing, QRS Detection Methods, Rhythm analysis, Arrhythmia Detection Algorithms, Automated ECG Analysis, ECG Pattern Recognition, Heart rate variability analysis.

MODULE-III **(8 Hours)**

Adaptive Noise Canceling: Principles of Adaptive Noise Canceling, Adaptive Noise Canceling with the LMS adaptation, Algorithm, Noise Canceling Method to Enhance ECG Monitoring, Fetal ECG Monitoring.

MODULE-IV **(8 Hours)**

Neurological Signal Processing: Modeling of EEG Signals, Detection of spikes and spindles, Detection of Alpha, Beta and Gamma Waves, Auto Regressive (A.R.) modeling of seizure EEG, Sleep Stage analysis, Inverse Filtering.

ADDITIONAL MODULE (Terminal Examination-Internal) **(6 Hours)**

Properties and effects of noise in biomedical instruments;Filtering in biomedical instruments; Least squares and polynomial modeling;

Reference Books

1. Biomedical Signal Processing: Principles and techniques, D.C.Reddy, Tata McGraw Hill, New Delhi, 2005.
2. Biomedical Signal Processing, Willis J Tompkins, Prentice Hall, 1993
3. Biomedical Signal Analysis, R. Rangayan, Wiley, 2002.
4. Biomedical Signal Processing & Signal Modeling, Eugene N. Bruce, Wiley, 2001.
5. Biomedical Signal and Image Processing, K. Najarian and R. Splinter, The CRC Press, Second Edition.

7th Semester

MATHEMATICS FOR COMMUNICATION ENGINEERS

MODULE–I **(10 hours)**

Introduction and Foundations: Mathematical Models, Models for Linear Systems andSignals, Adaptive Filtering, Gaussian Random Variables and Random Processes, Markov and Hidden Markov Models [Moon: 1.3 to 1.7]

Vector Spaces and Linear Algebra: Metric Spaces, Vector Spaces, Norms and NormedVector Spaces, Inner Products and Inner Product Spaces, Induced Norms, The Cauchy-Schwarz Inequality, Orthogonal Subspaces, Projections and Orthogonal Projections, Projection Theorem Orthogonalization of Vectors. [Moon: 2.1 to 2.6, 2.10, 2.13, 2.14, and 2.15].

MODULE – II **(10 hours)**

Representation and Approximation in Vector Spaces: The Approximation Problem inHilbert Space, The Orthogonality Principle, Matrix Representation of Least-Squares Problems, Linear Regression, Least-Squares Filtering, Minimum Mean-Square Estimation, Minimum Mean-Squared Error (MMSE) Filtering, Comparison of Least Squares and Minimum Mean Squares. [Moon: 3.1, 3.2, 3.4, 3.8 to 3.12]

Some Important Matrix Factorization: The LU Factorization, TheCholeskyFactorization, Unitary Matrices and the QR Factorization. [Moon: 5.1 to 5.3]

Eigenvalues and Eigenvectors: Eigen Values and Linear Systems, Linear Dependenceof Eigenvectors, Diagonalization of a Matrix. [Moon: 6.1 to 6.3]

MODULE–III **(10 hours)**

The Singular Value Decomposition: Theory of the SVD, Matrix Structure from the SVD,Pseudo-inverses and the SVD, Rank-Reducing Approximations: Effective Rank, System Identification Using the SVD. [Moon: 7.1 to 7.3 and 7.5]

Introduction to Detection and Estimation, and Mathematical Notation: Detection and Estimation Theory, Some Notational Conventions, Conditional Expectation, Sufficient Statistics, Exponential Families. [Moon: 10.1 to 10.3, 10.5, and 10.6]

MODULE–IV **(10 hours)**

Detection Theory: Introduction to Hypothesis Testing, Neyman-Pearson Theory, Neyman

Pearson testing with Composite Binary Hypotheses, Bayes Decession Theory, Some M-ary Problems, Maximum–Likelihood Detection. [Moon: 11.1 to 11.6]

ADDITIONAL MODULE (Terminal Examination-Internal) (6 Hours)

Estimation Theory: The Maximum-Likelihood Principle, ML Esimates and Sufficiency, Applications of ML Estimation, Bayes Estimation Theory, Bayes risk [Moon: 12.1 to 12.6].

Text Books

1. Mathematical Methods and Algorithms for Signal Processing, Todd K.Moon and W. C. Stirling, Pearson Education,1999.

Reference Books

2. Probability and Random Processes with Application to Signal Processing, Henry Stark, John Woods,4th edition, Pearson Education, 2011.
3. Probability, Random Variables and Random Process, P. Z. Peebles, McGraw Hill Publications,2002.
4. Introduction to Linear Algebra, Gilbert Strang, Cambridge Press, Fifth Edition, 2009.
5. Fundamentals of Statistical Signal Processing, Estimation Theory, S. Kay, Pearson Publication, 1993.

7th Semester

OPEN ELECTIVE

OPERATION RESEARCH

MODULE-I

Introduction to Operations Research: Definition, scope, objectives, phases, models and limitations of Operations Research, Linear Programming Problem, Formulation of LPP, Graphical solution of LPP, Simplex method, slack, surplus and artificial variables, Concept of duality, big-M method two phase method, dual simplex method, degeneracy and unbound solutions, procedure for resolving degenerate cases.

MODULE-II

Transportation Problem: Formulation of transportation model, Optimality Methods, Unbalanced transportation problem, Basic feasible solution, Northwest corner rule, least cost method, Vogel's approximation method, Applications of Transportation problems, Assignment Problem, Formulation, unbalanced assignment problem, Traveling salesman problem, Optimality test, the stepping stone method, MODI method.

MODULE-III

Sequencing Models: Johnsons algorithm, Processing n Jobs through 2 Machines, Processing n Jobs through 3 Machines, Processing 2 Jobs through m machines, Processing n Jobs through m Machines, Graphical solutions priority rules.

MODULE-IV

Dynamic programming: Characteristics of dynamic programming, Dynamic programming approach for Priority Management employment smoothening, capital budgeting, Stage Coach/Shortest Path, cargo loading and Reliability problems.

ADDITIONAL MODULE (Terminal Examination-Internal)

Games Theory: Competitive games, rectangular game, saddle point, minimax (maximin) method of optimal strategies, value of the game. Solution of games with saddle points, dominance principle. Rectangular games without saddle point – mixed strategy for 2 X 2 games.

Text Books

1. Operations Research, P. SankaraIyer, Tata McGraw-Hill, 2008.
2. Operations Research, A.M. Natarajan, P. Balasubramani, A. Tamilarasi, Pearson Education, 2005.

Reference Books

1) Operations Research and Introduction, Taha H. A, Pearson Education edition.
2) Operations Research, S. D. Sharma ,Kedarnath Ramnath & Co 2002
3) Operation Research Theory & Applications, J K Sharma, Macmillan India Ltd, 2007
4) Operation Research, P K Gupta and D S Hira, S. Chand & co,2007

7th Semester

INTERNET TECHNOLOGY AND APPLICATIONS

MODULE – I
The Internet and WWW:

Understanding the WWW and the Internet, Emergence of Web, Web Servers, Web Browsers, Protocols, Building Web Sites

HTML:

Planning for designing Web pages, Model and structure for a Website, Developing Websites, Basic HTML using images links, Lists, Tables and Forms, Frames for designing a good interactive website

MODULE – II
JAVA Script:

Programming Fundamentals, Statements, Expressions, Operators, Popup Boxes, Control Statements, Try…. Catch Statement, Throw Statement, Objects of Java script: Date object, array object, Boolean object, math object

MODULE – III
DOM:

HTML DOM, inner HTML, Dynamic HTML (DHTML), DHTML form, XML DOM

CGI/PERL:

Introduction to CGI, Testing & Debugging Perl CGI Script, Using Scalar variables and operators in Perl

MODULE – IV
Java Applet:

Introduction to Java, Writing Java Applets, Life cycle of applet

ADDITIONAL MODULE (Terminal Examination-Internal)
CSS:
External Style Sheets, Internal Style Sheets, Inline Style, The class selector, div & span tag

Textbooks

1) Web Warrior Guide to Web Design Technologies, Don Gosselin, Joel Sklar& others, Cengage Learning

Reference Books

1) Web Programming: Building Internet Applications, Chris Bates, Wiley Dreamtech
2) Programming the World Wide Web, Robert W Sebesta, Pearson
3) Web Technologies, Uttam K Roy, Oxford
4) Web Technology: A developer perspective, Gopalan&Akilandeswari, PHI

7th Semester

INDUSTRIAL AUTOMATION AND CONTROL

MODULE-I **(12 Hours)**

Process Control: Introduction: Process Definition, Feedback Control, PID Control, Multivariable Control. (Chapter 1 of Text Book 1)

PID Controller Tuning: Introduction, Zeigler-Nichols Tuning Method (Based on Ultimate Gain and Period, and Process Reaction Curve), Digital PID Controllers. (Chapter 13 of Text Book 2)

MODULE-II **(15 Hours)**

Special Control Structures: Cascade Control, Feed forward Control, Feed forward-Feedback Control Configuration, Ratio Control, Selective Control, Adaptive Control, Adaptive Control Configuration. (Chapter 10 and 11 of Text book 3)

Actuators: Introduction, Pneumatic Actuation, Hydraulic Actuation, Electric Actuation.

MODULE-III **(10 Hours)**

Motor Actuators and Control Valves. (Chapter 8 of Text Book 1)

Industrial Automation: Programmable Logic Controllers: Introduction, Principles of operation, Architecture, Programming (Programming Languages, Ladder Diagram, Boolean Mnemonics)

MODULE - IV

Distributed Control: Distributed vs. Centralized, Advantages, Functional Requirements, System Architecture.

Real-time Programming: Multi-tasking, Task Management, Inter-task Communication, Real-time Operating System. (Chapter 9 of Text Book 1)

ADDITIONAL MODULE (Terminal Examination-Internal)

Distributed Control Systems (DCS), Communication options in DCS.

Text Books

1) Krishna Kant, "Computer-Based Industrial Control", PHI, 2009.

2) M. Gopal, "Digital Control and State Variable Methods" Tata McGraw Hill, 2003.

3) SurekhaBhanot, Process Control: Principles and Applications, Oxford university Press, 2010

Reference Books

1) Smith Carlos and Corripio, "Principles and Practice of Automatic Process Control", John Wiley & Sons, 2006.
2) Jon Stenerson, "Industrial Automation and Process Control", Prentice Hall, 2003.
3) C. Johnson, "Process Control Instrumentation Technology", PHI, New Delhi
4) D.R. Coughnowr, "Process System analysis and Control", McGraw Hill.

7th Semester

COMPILER DESIGN

MODULE-I

The structure of a compiler, Lexical Analyzer: regular expression, finite automata, NFA, DFA, minimizing the number of states of a DFA, implementation issues

MODULE-II

Introduction to LEX. Syntactic specification of a programming language, context-free grammar, derivation and parse trees, ambiguity. Basic Parsing Techniques: shift reduce parsing, operator-precedence parsing. Top Down parsing, LL (1) parsers.

MODULE-III

Bottom up Parsing, LR parsers, LR (0) items, construction of SLR parsing table. Introductio canonical LR parsing, LALR parsing table. Use of ambiguous grammars for LR parser implementation

MODULE-IV

Introduction to YACC.Syntax Directed TranslationIntermediate code, postfix notation, three address codes – quadruples and triples. Translation of assignment statement, Boolean expressions, control structures, arrays. Run-time Storage Administration and symbol table management

ADDITIONAL MODULE (Terminal Examination-Internal)

Data-flow analysis, Code Optimizations.

Text Books

1) Principle of Compiler Design- by Alfred Aho and Jeffrey Ullmen, Addison-Wesley

2) Compiler Design-by Muneeswaran, Oxford University Press.

Reference book

1) Principles of compiler design by Raghavan, TMH

7th Semester

MULTIMEDIA SYSTEMS

MODULE- I
Multimedia components:

Introduction - Multimedia skills - Multimedia components and their characteristics Text, sound, images, graphics, animation, video, hardware

MODULE-II
Audio and video compression:

Audio compression–DPCM-Adaptive PCM –adaptive predictive coding-linear Predictive coding-code excited LPC-perpetual coding Video compression –principles-H.261-H.263- MPEG 1, 2, 4

MODULE-III
Text and image compression:

Compression principles-source encoders and destination encoders-lossless and lossy compression-entropy. Encoding –source encoding -text compression –static Huffman coding dynamic coding –arithmetic coding –Lempel ziv-welsh Compression-image compression.

MODULE-IV
VoIP technology:

Basics of IP transport, VoIP challenges, H.323/ SIP –Network Architecture, Protocols, Call establishment and release, VoIP and SS7, Quality of Service- CODEC Methods- VOIP applicability

ADDITIONAL MODULE (Terminal Examination-Internal)
Multimedia networking:

Multimedia networking -Applications-streamed stored and audio-making the best Effort service-protocols for real time interactive Applications-distributing multimedia-beyond best effort service-secluding and policing Mechanisms-integrated services-differentiated Services-RSVP

Text books

1. Fred HAlshall "Multimedia communication - applications, networks, protocol sand standards", Pearson education, 2007.
2. Tay Vaughan, "Multideai: making it work", 7/e, TMH 2007
3. Kurose and W.Ross" Computer Networking "a Top down approach, Pearson education

Reference Books

1. Marcus goncalves "Voice over IP Networks", McGraw hill
2. KR. Rao, Z S Bojkovic, D A Milovanovic, "Multimedia
3. Communication Systems: Techniques, Standards, and Networks", Pearson Education 2007
4. R. Steimnetz, K. Nahrstedt, "Multimedia Computing, Communications and Applications", Pearson Education
5. Ranjan Parekh, "Principles of Multimedia", TMH 2006

7th Semester

ENGINEERING ACOUSTICS

MODULE-I

Acoustics waves: Acoustics waves - Linear wave equation – sound in fluids – Harmonic plane waves – Energy density – Acoustics intensity – Specific acoustic impedance – spherical waves – Describer scales.

Reflection and Transmission: Transmission from one fluid to another normal and oblique incidence – method of images.

MODULE-II

Radiation and reception of acoustic waves: Radiation from a pulsating sphere – Acoustic reciprocity – continuous line source - radiation impedance - Fundamental properties of transducers.

Absorption and attenuation of sound: Absorption from viscosity – complex sound speed and absorption – classical absorption coefficient

MODULE-III

Pipes resonators and filters: Resonance in pipes - standing wave pattern absorption of sound in pipes – long wavelength limit – Helmoltz resonator - acoustic impedance - reflection and transmission of waves in pipe - acoustic filters – low pass, high pass and band pass.

Noise, Signal detection, Hearing and speech: Noise, spectrum level and band level – combing band levels and tones – detecting signals in noise – detection threshold – the ear – fundamental properties of hearing – loudness level and loudness – pitch and frequency – voice.

MODULE-IV

Architectural acoustics: Sound in endosure – A simple model for the growth of sound in a room – reverberation time -Sabine, sound absorption materials – measurement of the acoustic output of sound sources in live rooms – acoustics factor in architectural design.

Environmental Acoustics: Weighted sound levels speech interference – highway noise – noise induced hearing loss – noise and architectural design specification and measurement of some isolation design of portions.

ADDITIONAL MODULE (Terminal Examination-Internal)

Transduction: Transducer as an electives network – canonical equation for the two simple transducers transmitters – moving coil loud speaker – loudspeaker cabinets – horn loud speaker, receivers – condenser – microphone – moving coil electrodynamics microphone piezoelectric microphone – calibration of receivers

Text book

2) Lawrence E.Kinsler, Austin, R.Frey, Alan B.Coppens, James V.Sanders, Fundamentals of Acoustics, 4th edition, Wiley, 2000.

Reference Book

3) L.Beranek , "Acoustics" - Tata McGraw-Hill

7th Semester

REMOTE SENSING

3-1-0

MODULE I

Remote sensing: Definition – Components of Remote Sensing – Energy, Sensor, Interacting Body - Active and Passive Remote Sensing – Platforms – Aerial and Space Platforms – Balloons, Helicopters, Aircraft and Satellites – Synoptivity and Repetivity – Electro Magnetic Radiation (EMR) – EMR spectrum – Visible, Infra Red (IR), Near IR, Middle IR, Thermal IR and Microwave – Black Body Radiation - Planck's law – Stefan-Boltzman law.

MODULE-II

EMR interaction with atmosphere and earth materials: Atmospheric characteristics – Scattering of EMR – Raleigh, Mie, Non-selective and Raman Scattering – EMR Interaction with Water vapour and ozone – Atmospheric Windows – Significance of Atmospheric windows – EMR interaction with Earth Surface Materials – Radiance, Irradiance, Incident, Reflected, Absorbed and Transmitted Energy Reflectance – Specular and Diffuse Reflection Surfaces- Spectral Signature – Spectral Signature curves – EMR interaction with water, soil and Earth Surface: Imaging spectrometry and spectral characteristics.

MODULE-III

Optical and microwave remote sensing: Satellites - Classification – Based on Orbits and Purpose – Satellite Sensors - Resolution – Description of Multi Spectral Scanning – Along and Across Track Scanners Description of Sensors in Landsat, SPOT, IRS series – Current Satellites - Radar – Speckle Back Scattering – Side Looking Airborne Radar – Synthetic Aperture Radar – Radiometer – Geometrical characteristics ; Sonar remote sensing systems.

MODULE-IV

Geographic information system: GIS – Components of GIS – Hardware, Software and Organizational Context – Data – Spatial and Non-Spatial – Maps – Types of Maps – Projection – Types of Projection - Data Input – Digitizer, Scanner – Editing – Raster and Vector data structures – Comparison of Raster and Vector data structure – Analysis using Raster and Vector data – Retrieval, Reclassification, Overlaying, Buffering – Data Output – Printers and Plotters

ADDITIONAL MODULE (Terminal Examination-Internal)

Miscellaneous topics: Visual Interpretation of Satellite Images – Elements of Interpretation - Interpretation Keys Characteristics of Digital Satellite Image – Image enhancement – Filtering – Classification - Integration of GIS and Remote Sensing – Application of Remote Sensing and GIS – Urban Applications- Integration of GIS and Remote Sensing – Application of Remote Sensing and GIS – Water resources – Urban Analysis – Watershed Management – Resources Information Systems. Global positioning system – an introduction.

Text books

1) M.G. Srinivas (Edited by), Remote Sensing Applications, Narosa Publishing House, 2001. (Units 1 & 2).

2) Anji Reddy, Remote Sensing and Geographical Information Systems, BS Publications 2001 (Units 3, 4 & 5).

Reference Books

1) Jensen, J.R., Remote sensing of the environment, Prentice Hall, 2000.

2) Kang-Tsung Chang, "Introduction to Geographic Information Systems", TMH, 2002

3) Lille sand T.M. and Kiefer R.W., "Remote Sensing and Image Interpretation", John Wiley and Sons, Inc, New York, 1987.

4) Burrough P A, "Principle of GIS for land resource assessment", Oxford MischaelHord, "Remote Sensing Methods and Applications", John Wiley & Sons, New York, 1986.

5) Singal, "Remote Sensing", Tata McGraw-Hill, New Delhi, 1990.

6) Floyd F. Sabins, Remote sensing, "Principles and interpretation", W H Freeman and Company 1996.

7th Semester

ADVANCE LAB-II

NETWORKING LAB

List of Experiments:

1) Study and measurement of attenuation and loss in optical fiber.
2) Study and measurement of bending loss in optical fiber.
3) Study and measurement of numerical aperture of optical fiber.
4) Measurement of optical power using optical power meter.
5) To Study the transmission of TDM signal through optical fiber.
6) To determine the bit rate of the optical fiber link.
7) Study of various multiplexing techniques.
8) Investigate the Power versus current curves and spectrum of different Lasers and observe the effects of different cavity characteristics.
9) Investigate the characteristics of PIN and Avalanche Photodiodes and understand the usage of the Light wave Analyzer component.
10) Investigate the effect of loss on optical system performance and characterize the system with the power budget equation. Use Opti System to optimize the fiber length of a communication system.
11) Determine the optical modes that exist for multimode step index fibers and investigate their performance on optical systems.
12) Characterize analytically and through simulation the effects of dispersion on optical systems.
13) Study the characteristics of EDFAs alone and in a system. Reanalyze the importance of receiver noise and the effect of amplification on the quality of an optical system.
14) Characterize analytically and through simulation the effects of nonlinearity on optical systems.
15) Investigate the method for measuring the BER accurately and the distortions present in coherent modulators.
16) Build a coherent receiver based on the 90-degree optical hybrid and further investigate the QAM format.
17) To determine the BER of wireless system using M-ARY (BPSK, QPSK, 8PSK, 16PSK) technique
18) To determine the BER of wireless system using QAM technique

7th Semester

HONOURS SPECIALIZATION:

PET7D001 TELECOMMUNICATION NETWORKS AND OPTIMIZATIONS

4-0-0

MODULE-I

Network architectures – topology and hierarchy – evolution – layered architecture; Network Design Issues – application of graph theory – simplex algorithm and linear programming – binary and mixed integer linear programming;

MODULE-II

Core Networks – Routing principles – Shortest path algorithm – minimum spanning tree problem – flow control – max flow min cut theory – min cost network flow program – load balancing and optimization – congestion control .

MODULE-III

Advanced routing – Steiner trees and multicast – centralized routing (PCE), software defined network – distributed routing on ad-hoc networks, power aware MANET - reliability and route optimization.

MODULE-IV

Access Networks – Data link layer and media access control technologies – wireless and optical access – resource scheduling and optimization – Bipartite graph and stable matching algorithms – case studies (10);

ADDITIONAL MODULE (Terminal Examination-Internal)

Access core interface – case studies (5).

Text Books

1. Network Optimization by V. K. Balakrishnan
2. Linear Network Optimization: Algorithms and Codes by D. Bertsekas
3. Mathematical Aspects of Network Routing Optimization by C. A. S. Oliveira, P. M. Pardalos

Reference Books

1. Network Flows: Theory, Algorithm and Application by R. K. Ahuja, C. L. Magnanti, James B.
2. Optimization Algorithm for Networks and Graphs – vol. 1 by J. R. Evans, E. Mineka
3. Integer Programming and Network Models – H. A. Eiselt, C. L. Sandblom
4. Interconnections - R. Perlman 8. Computer Networks A. S. Tanenbaum

7th Semester

MINOR SPECIALIZATION:

PET7G001 VLSI DESIGN

4-0-0

MODULE–I (08 Hrs)

Introduction: Historical Perspective, VLSI Design Methodologies, VLSI Design Flow, Design Hierarchy, Concept of Regularity, Modularity and Locality, VLSI Design Styles, Computer-Aided Design Technology.

Fabrication of MOSFETs: Introduction, Fabrication Processes Flow – Basic Concepts, The CMOS n-Well Process, Layout Design Rules, Stick Diagrams, Full-Customs Mask Layout Design.

MODULE –II (14 Hrs)

MOS Transistor: The Metal Oxide Semiconductor (MOS) Structure, The MOS System under External Bias, Structure and Operation of MOS Transistor (MOSFET), MOSFET Current-Voltage Characteristics, MOSFET Scaling and Small-Geometry Effects, MOSFET Capacitance. (Chapter 1 to 3 of Text Book 1 and for Stick Diagram Text Book 2)

MOS Inverters – Static Characteristics: Introduction, Resistive-Load Inverters, Inverters with n-Type MOSFET Load, CMOS Inverter.

MOS Inverters – Switching Characteristics and Interconnect Effects: Introduction, Delay-Time Definitions, Calculation of Delay-Times, Inverter Design with Delay Constraints, Estimation of Interconnect Parasitics, Calculation of Interconnect Delay, Switching Power Dissipation of CMOS Inverters.

MODULE – III (18 Hrs)

Combinational MOS Logic Circuits: Introduction, MOS Logic Circuits with Depletion nMOS Loads, CMOS Logic Circuits, Complex Logic Circuits, CMOS Transmission Gates (Pass Gates). (Chapter 5 to 7 of Text Book 1)

Sequential MOS Logic Circuits: Introduction, Behaviour of Bistable Elements, SR Latch Circuits, Clocked Latch and Flip-Flop Circuits, CMOS D-Latch and Edge-Triggered Flip-Flop.

MODULE - IV

Dynamic Logic Circuits: Introduction, Basic Principles of Pass Transistor Circuits, Voltage Bootstrapping, Synchronous Dynamic Circuit Techniques, Dynamic CMOS Circuit Techniques, High Performance Dynamic CMOS Circuits.

Semiconductor Memories: Introduction, Dynamic Random Access Memory (DRAM), Static Random Access Memory (SRAM), Non-volatile Memory, Flash Memory.

7th Semester

ADDITIONAL MODULE (Terminal Examination-Internal)

Design for Testability: Introduction, Fault Types and Models, Ad Hoc Testable Design Techniques, Scan-Based Techniques, Built-In Self-Test (BIST) Techniques, Current Monitoring I_{DDQ} Test.

Text Books

1. Sung-Mo Kang and Yusuf Leblebici, *CMOS Digital Integrated Circuits: Analysis and Design*, 3rd Edn. Tata McGraw-Hill Publishing Company Limited, 2003.
2. K. Eshraghian and N.H.E. Weste, *Principles of CMOS VLSI Design – a Systems Perspective*, 2nd Edn. Addison Wesley, 1993.

Reference Books

1. Jan M. Rabaey, AnanthaChandrakasan, BorivojeNikolic, *Digital Integrated Circuits – A Design Perspective*, 2nd Edn. PHI.
2. Wayne Wolf, *Modern VLSI Design System – on – Chip Design*, 3rd Edn. PHI
3. Debaprasad Das, *VLSI Design*, Oxford University Press, New Delhi, 2010.
4. John P. Uyemura, *CMOS Logic Circuit Design*, Springer (Kluwer Academic Publishers), 2001.
5. Ken Martin, *Digital Integrated Circuit Design*, Oxford University Press, 2000.

BIJU PATNAIK UNIVERSITY OF TECHNOLOGY, ODISHA
ROURKELA

Curriculum and Syllabus

Of

B.Tech (*ECE/ETC*) from the Batch 2018-19

Semester (3rd)

Director, Curriculum Development
Biju Patnaik University of Technology, Odisha
Rourkela

Third Semester							
Theory							
Sl No	**Category**	**Course Code**	**Course Title**	**L-T-P**	**Credit**	**University Marks**	**Internal Evaluation**
1	BS	RMA3A001	Mathematics - III	3-0-0	3	100	50
2	ES	ROP3B001	Object Oriented Programming Using JAVA	3-0-0	3	100	50
3	HS	REN3E001 / ROB3E002	Engineering Economics / Organisational Behaviour	3-0-0	3	100	50
4	PC	REC3C001	Analog Electronic Circuits	3-0-0	3	100	50
5	PC	REC3C002	Signals and Systems	3-0-0	3	100	50
6	MC*	RES3F001	Environment Science	3-0-0	0	—	100 (Pass mark is 37)
Total Credit (Theory)					15		
Total Marks						**500**	**250**
Practical							
1	PC	REC3C201	Analog Electronic Circuits Lab.	0-0-3	2		100
2	PC	REC3C202	Signals and Systems Lab using Software	0-0-3	2		100
3	ES	ROP3B201	OOP Using JAVA Lab.	0-0-3	2		100
4	PSI	RIP3H201	Evaluation of Internship - I	0-0-3	1		100
Total Credit (Practical)					7		
Total Semester Credit					**22**		
Total Marks							**400**

***Mandatory Non-Credit Courses (MC) result will be reflected with Pass (P) / Fail (F) grade. Thus the grade obtained will not be affecting the grade point average. However it shall appear on the grade sheet as per AICTE rule.**

Director, Curriculum Development
Biju Patnaik University of Technology, Odisha
Rourkela

3rd Semester	RMA3A001	MATHEMATICS – III	L-T-P 3-0-0	3 CREDITS

Module-I (10 Hours)

Solution of Non-linear equation in one variable (Bisection, Secant, Newton Rapson Method, Fixed Point Iteration method). Numerical Solutions of system of Linear equations (Gauss-Seidel, Successive Over Relaxation, Doolittle method, Crouts method, Choleskys Method).
Interpolation: Newton's forward and backward interpolation, Newton divided difference interpolation, Lagrange Interpolation.

Module-II (8 Hours)

Numerical Differentiation, integration and Solution of Differential Equations: Numerical Differentiation, The trapezoidal rule, The Simpson's rule, Gauss Integration formulas. Solution of ordinary differential equation: Euler's method, Improvement of Euler's method, Runge-Kutta methods, multi step methods, Methods for system and higher order ordinary differential equations.

Module-III (8 Hours)

Sample Space, Probability, Conditional Probability, Independent Events, Bayes' Theorem, Random variables, Probability distributions, Expectations, Mean and variance, Moments.

Module-IV (9 Hours)

Bernoulli Trials, Binomial, Poisson, Hyper Geometirc Distribution, Uniform., Exponential and Normal distribution, Bivariate Distributions.

Module-V (10 Hours)

Correlation and Regression Analysis, Rank Correlation, Maximum Likely hood estimate, Method of Moments, Confidence intervals mean and variance of a Normal Distribution, p-value. Testing of hypothesis: test for goodness of fit, Test for single mean and variance of a Normal Distribution.

Books:

1. E. Kreyszig," Advanced Engineering Mathematics:,Tenth Edition, Wiley India
2. S.Pal and S.C. Bhunia, "Engineering Mathematics" Oxford University Press
3. Jay L. Devore, "Probability and Statistics for Engineering and Sciences", Seventh Edition, Thomson/CENGAGE Learning India Pvt. Ltd
4. R. E. Walpole, R. h. Myers, S. L. Myers, K. E. Ye; "Probability and Statistics, Pearson".
5. R. L. Burden, J. D. Faires, " Numerical Analysis, Cenage Learning India Pvt. Ltd"
6. B.V.RAMANA,"Higher Engineering Mathematics"Tata Magraw Hill

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3rd Semester	ROP3B001	OBJECT ORIENTED PROGRAMMING USING JAVA	L-T-P 3-0-0	3 CREDITS

Module-I (10 Hrs)

Chapter 1-: An introduction to programming.

Different types of programming languages, Description of Compiler and Interpreter, Advantage of Object Oriented Programming, Object Oriented Programming, Features of Object Oriented Programming.

Chapter 2-: Introduction to Java.

What is Java?, Why Java?, History behind Java, Different versions of Java, Difference between C/C++ and Java, Features of Java, First Java Program, Prerequisites Before start writing a java program, Writing the program, Compiling the program, How Java program compiles?, Executing the program, How Java program executes?, What is JVM and its significance in executing a program?, Architecture of JVM.

Chapter 3-: Understanding First Program and a step forward, Understanding every term of the program, Java Tokens, Datatypes, Operators, What are Operators?, Different types of Operators, Typecasting, Control Structures and Arrays, Different types of control structures, Conditional Statements, Loops/ Iterators, Jumping Statements, Java Arrays, Multidimensional Arrays, Taking Input from keyboard, Command Line Arguments, Using Scanner Class, Using Buffered Reader class.

Module-II: (08 Hrs.)

Chapter 1-: Introduction to Classes and Objects.

Classes, Methods, Objects, Description of data hiding and data encapsulation, Constructors, Use of static Keyword in Java, Use of this Keyword in Java, Array of Objects, Concept of Access Modifiers (Public, Private, Protected, Default).

Chapter 2-: Inheritance

Understanding Inheritance, Types of Inheritance and Java supported Inheritance, Significance of Inheritance, Constructor call in Inheritance, Use of super keyword in Java, Polymorphism, Understanding Polymorphism, Types of polymorphism, Significance of Polymorphism in Java, Method Overloading, Constructor Overloading, Method Overriding, Dynamic Method Dispatching.

Chapter 3-: String Manipulations.

Introduction to different classes, String class, String Buffer, String Builder, String Tokenizer, Concept of Wrapper Classes, Introduction to wrapper classes, Different predefined wrapper classes, Predefined Constructors for the wrapper classes. Conversion of types from one type (Object) to another type (Primitive) and Vice versa, Concept of Auto boxing and unboxing.

Module-III: (09 Hrs.)

Chapter 1:-Data Abstraction

Basics of Data Abstraction, Understanding Abstract classes, Understanding Interfaces, Multiple Inheritance Using Interfaces, Packages, Introduction to Packages, Java API Packages, User-Defined Packages, Accessing Packages, Error and Exception Handling, Introduction to error and exception, Types of exceptions and difference between the types, Runtime Stack Mechanism, Hierarchy of Exception classes, Default exception handling in Java, User defined/Customized

Exception Handling, Understanding different keywords (try, catch, finally, throw, throws), User defined exception classes, Commonly used Exceptions and their details.

Chapter 2:-Multithreading

Introduction of Multithreading/Multitasking, Ways to define a Thread in Java, Thread naming and Priorities, Thread execution prevention methods. (yield(), join(), sleep()), Concept of Synchronisation, Inter Thread Communication, Basics of Deadlock, Demon Thread, Improvement in Multithreading, Inner Classes, Introduction, Member inner class, Static inner class, Local inner class, Anonymous inner class.

Module-IV: (10 Hrs.)

Chapter 1:-IO Streams (java.io package)

Introduction, Byte Stream and Character Stream, Files and Random Access Files, Serialization, Collection Frame Work (java.util), Introduction, Util Package interfaces, List, Set, Map etc, List interfaces and its classes, Setter interfaces and its classes.

Chapter 2:-Applet

Introduction, Life Cycle of an Applet, GUI with an Applet, Abstract Window Toolkit (AWT), Introduction to GUI, Description of Components and Containers, Component/Container hierarchy, Understanding different Components/Container classes and their constructors, Event Handling, Different mechanisms of Event Handling, Listener Interfaces, Adapter classes.

Module-V: (08 Hrs.)

Chapter 1:-Swing (JFC)

Introduction Diff b/w awt and swing, Components Hierarchy, Panes, Individual Swings Components JLabel, JButton, JTextField, JTextArea.

Chapter 2:-JavaFX

Getting started with JavaFX, Graphics, User Interface Components, Effects, Animation, and Media, Application Logic, Interoperability, JavaFX Scene Builder 2, Getting Started with scene Builder.

Working with scene Builder.

Books :-

1. Programming in Java. Second Edition. OXFORD HIGHER EDUCATION. (SACHIN MALHOTRA/SAURAV CHOUDHARY)
2. CORE JAVA For Beginners. (Rashmi Kanta Das), Vikas Publication
3. JAVA Complete Reference (9th Edition) Herbalt Schelidt.

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3rd Semester	ROP3B201	OOP USING JAVA LAB.	L-T-P 0-0-3	2 CREDITS

JAVA programs on:

1. Introduction, Compiling & executing a java program.
2. Data types & variables, decision control structures: if, nested if etc.
3. Loop control structures: do, while, for etc.
4. Classes and objects.
5. Data abstraction & data hiding, inheritance, polymorphism.
6. Threads, exception handlings and applet programs
7. Interfaces and inner classes, wrapper classes, generics

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3rd Semester	REN3E001	ENGINEERING ECONOMICS	L-T-P 3-0-0	3 CREDITS

Module - I (08 hours)

Engineering Economics- Nature, Scope, Basic problems of an economy, Micro Economics and Macro Economics.
Demand - Meaning of demand, Demand function, Law of Demand and its exceptions, Determinants of demand, Elasticity of demand & its measurement (Simple numerical problems to be solved), Demand Forecasting – Meaning
Supply-Meaning of supply, Law of supply and its exception, Determinants of supply, Elasticity of supply, Determination of market equilibrium (Simple numerical problems to be solved).

Module - II (08 hours)

Production - Production function, Laws of returns: Law of variable proportion, Law of returns to scale
Cost and Revenue Concepts - Total Costs, Fixed cost, Variable cost, Total revenue, Average revenue and Marginal revenue, Cost-Output Relationships in the Short Run, and Cost-Output Relationships in the Long Run, Analysis of cost minimization.

Module III (08 hours)

Market - Basic understanding of different market structures, Determination of equilibrium price under perfect competition (Simple numerical problems to be solved), Break Even Analysis-linear approach (Simple numerical problems to be solved).

Module - IV (12 hours)

Time Value of Money- Interest - Simple and compound, nominal and effective rate of interest, Cash flow diagrams, Principles of economic equivalence.
Evaluation of Engineering Projects-Present worth method, Future worth method, Annual worth method, Internal rate of return method, Cost benefit analysis for public projects.
Depreciation- Depreciation of capital assert, Causes of depreciation, Methods of calculating depreciation - Straight line method, Declining balance method, SOYD method, After tax comparison of project.

Module –V (06 Hours)

Inflation-Meaning of inflation, types, causes, measures to control inflation.
National Income-Definition, Concepts of national income, Method of measuring national income.
Banking -Commercial bank, Functions of commercial bank, Central bank, Functions of Central Bank.

Books:

1. Principles of Economics by Deviga Vengedasalam and Karaunagaran Madhavan, Oxford

2. Riggs, Bedworth and Randhwa, "Engineering Economics", McGraw Hill Education India
3. C. S. Park, Contemporary Engineering Economics, 6th Edition, Pearson Education, 2015.
4. Engineering Economy by William G.Sullivan, Elin M.Wicks, C. Patric Koelling, Pearson
5. R.Paneer Seelvan, " Engineering Economics", PHI
6. Ahuja,H.L., "Principles of Micro Economics" , S.Chand & Company Ltd
7. Jhingan,M.L., "Macro Economic Theory"
8. Macro Economics by S.P.Gupta, TMH

Course Outcomes of Engineering Economics

At the end of the course the engineering graduates will be able to

1. **Remembering** : Define the basic concept of micro and macro economics, engineering economics and their application in engineering economy.

2. **Understanding** : Evaluate numerically the effects of changes in demand and supply on price determination of products and services.

3. **Analyze :** the macroeconomic environment and financial systems of the country and its impact on business, society and enterprise.

4. **Develop :** the ability to account for time value of money using engineering economy factors and formulas.

5. **Apply:** knowledge of mathematics, economics and engineering principles to solve engineering problems and to analyze decision alternatives in engineering projects considering upon depreciation, taxes and inflation.

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3rd Semester	ROB3E002	ORGANISATIONAL BEHAVIOUR	L-T-P 3-0-0	3 CREDITS

Objectives:

1. To develop an understanding of the behavior of individuals and groups inside organizations
2. To enhance skills in understanding and appreciating individuals, interpersonal, and group process for increased effectiveness both within and outside of organizations.
3. To develop theoretical and practical insights and problem-solving capabilities for effectively managing the organizational processes.

Module-I: **(06 Hrs.)**

Fundamentals of OB: Definition, scope and importance of OB, Relationship between OB and the individual, Evolution of OB, Theoretical framework (cognitive), behavioristic and social cognitive), Limitations of OB.

Module-II: **(12 Hrs.)**

Attitude: Importance of attitude in an organization, Right Attitude, Components of attitude, Relationship between behavior and attitude, Developing Emotional intelligence at the workplace, Job attitude, Barriers to changing attitudes.
Personality and values: Definition and importance of Personality for performance, The Myers-Briggs Type Indicator and The Big Five personality model, Significant personality traits suitable to the workplace (personality and job – fit theory), Personality Tests and their practical applications.
Perception: Meaning and concept of perception, Factors influencing perception, Selective perception, Attribution theory, Perceptual process, Social perception (stereotyping and halo effect).
Motivation: Definition & Concept of Motive & Motivation, The Content Theories of Motivation (Maslow's Need Hierarchy & Herzberg's Two Factor model Theory), The Process Theories (Vroom's expectancy Theory & Porter Lawler model), Contemporary Theories – Equity Theory of Work Motivation.

Module-III: **(10 Hrs.)**

Foundations of Group Behavior: The Meaning of Group & Group behavior & Group Dynamics, Types of Groups, The Five – Stage Model of Group Development.
Managing Teams: Why Work Teams, Work Teams in Organization, Developing Work Teams, Team Effectiveness & Team Building.
Leadership: Concept of Leadership, Styles of Leadership, Trait Approach Contingency Leadership Approach, Contemporary leadership, Meaning and significance of contemporary leadership, Concept of transformations leadership, Contemporary theories of leadership, Success stories of today's Global and Indian leaders.

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Module-IV: **(08 Hrs.)**

Organizational Culture : Meaning & Definition of Organizational Culture, creating & Sustaining Organizational Culture, Types of Culture (Strong vs. Weak Culture, Soft Vs. Hard Culture & Formal vs. Informal Culture), Creating Positive Organizational Culture, Concept of Workplace Spirituality.

Module-V: **(09 Hrs.)**

Organizational Change: Meaning, Definition & Nature of Organizational Change, Types of Organizational Change, Forces that acts as stimulants to change.
Implementing Organizational Change : How to overcome the Resistance to Change, Approaches to managing Organizational Change, Kurt Lewin's-Three step model, Seven Stage model of Change & Kotter's Eight-Step plan for Implementing Change, Leading the Change Process, Facilitating Change, Dealing with Individual & Group Resistance, Intervention Strategies for Facilitating Organizational Change, Methods of Implementing Organizational Change, Developing a Learning Organization.

Books:

1. Understanding Organizational Behaviour, Parek, Oxford
2. Organizational Behaviour, Robbins, Judge, Sanghi, Pearson.
3. Organizational Behaviour, K. Awathappa,HPH.
4. Organizational Behaviour, VSP Rao, Excel
5. Introduction to Organizational Behaviour, Moorhead, Griffin, Cengage.
6. Organizational Behaviour, Hitt, Miller, Colella, Wiley

3rd Semester	REC3C001	Analog Electronic Circuits	L-T-P 3-0-0	3 CREDITS

MODULE – I **(12 Hours)**

MOS Field-Effect Transistor: Principle and Operation of FETs and MOSFETs; P-Channel and N-Channel MOSFET; Complimentary MOS; V-I Characteristics of E- MOSFET and D-MOSFET; MOSFET as an Amplifier and as a Switch.
Biasing of BJTs: Load lines (AC and DC); Operating Points; Fixed Bias and Self Bias, DC Bias with Voltage Feedback; Bias Stabilization; Examples.
Biasing of FETs and MOSFETs: Fixed Bias Configuration and Self Bias Configuration, Voltage Divider Bias and Design

MODULE – II **(12 Hours)**

Small Signal Analysis of BJTs: Small-Signal Equivalent-Circuit Models; Small Signal Analysis of CE, CC, CB amplifiers. Effects of R_S and R_L on CE amplifier operation, Emitter Follower; Cascade amplifier, Darlington Connection and Current Mirror Circuits.
Small Signal Analysis of FETs: Small-Signal Equivalent-Circuit Model, Small Signal Analysis of CS, CD, CG Amplifiers. Effects of R_{SIG} and R_L on CS Amplifier; Source Follower and Cascaded System.

MODULE – III **(8 hours)**

High Frequency Response of FETs and BJTs: High Frequency equivalent models and frequency Response of BJTs and FETs; Frequency Response of CS Amplifier, Frequency Response of CE Amplifier.

MODULE – IV **(6 hours)**

Feedback amplifier and Oscillators: Concepts of negative and positive feedback; Four Basic Feedback Topologies, Practical Feedback Circuits, Principle of Sinusoidal Oscillator, Wein-Bridge, Phase Shift and Crystal Oscillator Circuits, Power Amplifier (Class A, B, AB, C).

MODULE – V **(7 hours)**

Operational Amplifier: Ideal Op-Amp, Differential Amplifier, Op-Amp Parameters, Non-inverting Configurations, Open-loop and Closed-loop Gains, Differentiator and Integrator, Instrumentation amplifier.

Books:

- *Microelectronics Circuits, Adel Sedra and Kenneth C Smith, Oxford University Press, New Delhi, 5th Edition, International Student Edition,2009. (Selected portion of Chapter 2,4, 5, 6, 8, 13, and 14)*
- *Electronic Devices and Circuits theory, R.L. Boylestad and L. Nashelsky, Pearson Education, New Delhi , 9th/10th Edition,2013. (Selected portions of Chapter 4, 5, 6, 7, 8, 9,*

10, 11, 12, and 14)

- *Milliman's Electronics Devices and Circuits, J. Milliman, C. Halkias, S. Jit., Tata McGraw Hill Education Pvt. Ltd., New Delhi, 2nd Edition,2008.*
- *Electronic Devices and Circuits, Jimmie J. Cathey adapted by Ajay Kumar Singh, Tata McGraw Hill Publishing Company Ltd., New Delhi, 3rd Edition, (For Problem Solving)*
- *Electronics Circuits Analysis and Design, Donald A. Neamen, Tata McGraw Hill Publishing Company Ltd., New Delhi, 3rd Edition,2002.*
- *Integrated Electronics: Analog and Digital Circuits and Systems, J. Milliman, C. Halkias, Tata McGraw Hill Publishing Company Ltd., New Delhi,2nd Edition.2004.*
- *Microelectronic Circuits: Analysis and Design, M.H. Rashid, PWS Publishing Company, a division of Thomson Learning Inc. India Edition.*
- *Electronic device and circuits, David A. Bell, Oxford University Press, 5th edition,2008.*
- *Electronics devices and circuits, Anil.K.Maini, Wiley India Pvt.Ltd,2009*

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3rd Semester	REC3C201	Analog Electronic Circuits Lab.	L-T-P 0-0-3	2 CREDITS

List of Experiments

(At least 10 out of 12 experiments should be done)

1. Design and simulate BJT bias circuit and compare the results.
2. *Design and simulate JEET/MOSFET bias circuit and compare the results.*
3. *Design and simulate BJT common-emitter circuit and compare D.C and A.C performance:*
4. *Design and simulate JFET/MOSFET common-emitter circuit and compare D.C and A.C performance:*
5. *Determining the frequency response of a common-emitter amplifier: low frequency, high frequency and mid frequency response and compare with simulated results.*
6. *Differential amplifiers circuits: D.C bias and A.C operation without and with current source.*
7. *Study of Darlington connection and current mirror circuits.*
8. *OP-Amp Frequency Response and Compensation.*
9. *Application of Op-Amp as differentiator, integrator, square wave generator.*
10. *Obtain the band width of FET/ BJT using Square wave testing of an amplifier.*
11. *R.C phase shift oscillator/Wien-Bridge Oscillator using OP-Amp/Crystal Oscillator.*
12. *Class A and Class B Power Amplifier.*

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3rd Semester	REC3C002	Signals and Systems	L-T-P 3-0-0	3 CREDITS

MODULE – I (7 Hours)

Discrete-Time Signals and Systems:

Discrete-Time Signals: Some Elementary Discrete-Time signals, Classification of Discrete-Time Signals, Simple Manipulation, Discrete-Time Systems : Input-Output Description, Block Diagram Representation, Classification, Interconnection.

MODULE – II (8 Hours)

Analysis of Discrete-Time LTI Systems: Techniques, Response of LTI Systems, Properties of Convolution, Causal LTI Systems, Stability of LTI Systems; Discrete-Time Systems Described by Difference Equations; Implementation of Discrete-Time Systems. Correlation of Discrete-Time Signals: Cross correlation and Autocorrelation Sequences, Properties.

MODULE – III (10 Hours)

The Continuous-Time Fourier Series:

Basic Concepts and Development of the Fourier series; Calculation of the Fourier Series, Properties of the Fourier Series.

The Continuous-Time Fourier Transform:

Basic Concepts and Development of the Fourier Transform; Properties of the Continuous-Time Fourier Transform.

MODULE- IV (10 Hours)

The Z-Transform and Its Application to the Analysis of LTI Systems:

The Z-Transform: The Direct Z-Transform, The Inverse Z-Transform; Properties of the Z-Transform; Rational Z-Transforms: Poles and Zeros, Pole Location and Time-Domain Behavior for Causal Signals, The System Function of a Linear Time-Invariant System; Inversion of the Z-Transforms: The Inversion of the Z-Transform by Power Series Expansion, The Inversion of the Z-Transform by Partial-Fraction Expansion; The One-sided Z-Transform: Definition and Properties, Solution of Difference Equations.

MODULE- V (10 Hours)

The Discrete Fourier Transform: Its Properties and Applications:

Frequency Domain Sampling: The Discrete Fourier Transform; Properties of the DFT: Periodicity, Linearity, and Symmetry Properties, Multiplication of Two DFTs and Circular Convolution, Additional DFT Properties.

Books:

1. *Digital Signal Processing – Principles, Algorithms and Applications, John. G. Proakis and Dimitris. G. Manolakis, 4th Edition, Pearson.*
2. *Fundamentals of Signals and Systems - M. J. Roberts, TMH*
3. *Signal & Systems by Tarun Kumar Rawat, Oxford University Press.*
4. *Signals and Systems – A NagoorKani, TMH*
5. *Signals and Systems, Chi-Tsong Chen, Oxford*
6. *Principles of Signal Processing and Linear Systems, B.P. Lathi, Oxford.*
7. *Principles of Linear Systems and Signals, B.P Lathi, Oxford*

3rd Semester	REC3C202	Signals and Systems Lab using Software	L-T-P 0-0-3	2 CREDITS

List of Experiments:
(At least 10 out of 15 experiments should be done)

1. *Write a program to generate the discrete sequences (i) unit step (ii) unit impulse (iii) ramp (iv) periodic sinusoidal sequences. Plot all the sequences.*
2. *Find the Fourier transform of a square pulse .Plot its amplitude and phase spectrum.*
3. *Write a program to convolve two discrete time sequences. Plot all the sequences. Verify the result by analytical calculation.*
4. *Write a program to find the trigonometric Fourier series coefficients of a rectangular periodic signal. Reconstruct the signal by combining the Fourier series coefficients with appropriate weightings.*
5. *Write a program to find the trigonometric and exponential Fourier series coefficients of a periodic rectangular signal. Plot the discrete spectrum of the signal.*
6. *Generate a discrete time sequence by sampling a continuous time signal. Show that with sampling rates less than Nyquist rate, aliasing occurs while reconstructing the signal.*
7. *The signal x (t) is defined as below. The signal is sampled at a sampling rate of 1000 samples per second. Find the power content and power spectral density for this signal.*

$$x(t) = \begin{cases} \cos(2\pi \times 47t) + \cos(2\pi \times 219t), & 0 \le t \le 10 \\ 0 & otherwise \end{cases}$$

8. *Write a program to find the magnitude and phase response of first order low pass and high pass filter. Plot the responses in logarithmic scale.*
9. *Write a program to find the response of a low pass filter and high pass filter, when a speech signal is passed through these filters.*
10. *Write a program to find the autocorrelation and cross correlation of sequences.*
11. *Generate a uniformly distributed length 1000 random sequence in the range (0,1). Plot the histogram and the probability function for the sequence. Compute the mean and variance of the random signal.*
12. *Generate a Gaussian distributed length 1000 random sequence. Compute the mean and variance of the random signal by a suitable method.*
13. *Write a program to generate a random sinusoidal signal and plot four possible realizations of the random signal.*
14. *Generate a discrete time sequence of N=1000 i.i.d uniformly distributed random numbers in the interval (-0.5,-0.5) and compute the autocorrelation of the sequence.*
15. *Obtain and plot the power spectrum of the output process when a white random process is passed through a filter with specific impulse response*

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3rd Semester	RES3F001	ENVIORMENT SCIENCE	L-T-P 3-0-0	0 CREDIT

We as human being are not an entity separate from the environment around us rather we are a constituent seamlessly integrated and co-exist with the environment around us. We are not an entity so separate from the environment that we can think of mastering and controlling it rather we must understand that each and every action of ours reflects on the environment and vice versa. Ancient wisdom drawn from Vedas about environment and its sustenance reflects these ethos. There is a direct application of this wisdom even in modern times. Idea of an activity based course on environment protection is to sensitize the students on the above issues through following two type of activities.

(a) Awareness Activities:

i) Small group meetings about water management, promotion of recycle use, generation of less waste, avoiding electricity waste
ii) Slogan making event
iii) Poster making event
iv) Cycle rally
v) Lectures from experts

(b) Actual Activities:

i) Plantation
ii) Gifting a tree to see its full growth
iii) Cleanliness drive
iv) Drive for segregation of waste
v) To live some big environmentalist for a week or so to understand his work
vi) To work in kitchen garden for mess
vii) To know about the different varieties of plants
viii) Shutting down the fans and ACs of the campus for an hour or so

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Tentative Curriculum and Syllabus

of

B.Tech (*ECE / ETC)* from the Batch 2018-19

Semester (4th)

Fourth Semester							
Theory							
Sl No	**Category**	**Course Code**	**Course Title**	**L-T-P**	**Credit**	**University Marks**	**Internal Evaluation**
1	PC	REC4C001	Electromagnetic Theory	3-0-0	3	100	50
2	PC	REC4C002	Digital Systems Design	3-0-0	3	100	50
3	HS	REN4E001 / ROB4E002	Engineering Economics / Organisational Behaviour	3-0-0	3	100	50
4	PC	REC4C003	Network Theory	3-0-0	3	100	50
5	PE	REC4D001	Semiconductor Devices	3-0-0	3	100	50
		REC4D002	Power Electronics				
		REC4D003	Sensors and Transducers				
6	OE	REC4G001	Probability Theory And Stochastic Process	3-0-0	3	100	50
		REC4G002	Data Structure				
		REC4G003	Brain Control Interface				
6	MC*	RCN4F001	Constitution of India	3-0-0	0	__	100 (Pass mark is 37)
Total Credit (Theory)					**18**		
Total Marks						**600**	**300**
Practical							
1	PC	REC4C201	Electronic Device Laboratory	0-0-3	2		100
2	PC	REC4C202	Digital System Design Laboratory	0-0-3	2		100
3	PC	REC4C203	Network Theory Laboratory	0-0-3	2		100
Total Credit (Practical)					**6**		
Total Semester Credit					**24**		
Total Marks							**300**

***Mandatory Non-Credit Courses (MC) result will be reflected with Pass (P) / Fail (F) grade. Thus the grade obtained will not be affecting the grade point average. However it shall appear on the grade sheet as per AICTE rule.**

4th Semester	**REC4C001**	**Electromagnetic Theory**	**L-T-P 3-0-0**	**3 CREDITS**

Module-I (10 Hours)

1. Cartesian, Cylindrical and Spherical Coordinate Systems; Scalar and Vector Fields; Line, Surface and Volume Integrals.
2. Coulomb's Law; The Electric Field Intensity; Electric Flux Density and Electric Flux; Gauss's Law; Divergence of Electric Flux Density: Point Form of Gauss's Law; The Divergence Theorem; The Potential Gradient; Energy Density; Poisson's and Laplace's Equations.
3. Ampere's Magnetic Circuital Law and its Applications; Curl of H; Stokes' Theorem; Divergence of B; Energy Stored in the Magnetic Field.

Module-II (9 Hours)

1. The Continuity Equation; Faraday's Law of Electromagnetic Induction; Conduction Current: Point Form of Ohm's Law, Convection Current; The Displacement Current;
2. Maxwell's Equations in Differential Form; Maxwell's Equations in Integral Form; Maxwell's Equations for Sinusoidal Variation of Fields with Time; Boundary Conditions; The Retarded Potential; The Poynting Vector; Poynting Vector for Fields Varying Sinusoid ally with Time.

Module-III (10 Hours)

1. Solution of the One-Dimensional Wave Equation; Solution of Wave Equation for Sinusoid ally Time-Varying Fields; Polarization of Uniform Plane Waves; Fields on the Surface of a Perfect Conductor; Reflection of a Uniform Plane Wave Incident Normally on a Perfect Conductor and at the Interface of Two Dielectric Regions; The Standing Wave Ratio; Oblique Incidence of a Plane Wave at the Boundary between Two Regions; Oblique Incidence of a Plane Wave on a Flat Perfect Conductor and at the Boundary between Two Perfect Dielectric Regions.

Module-IV (8 Hours)

1. Types of Two-Conductor Transmission Lines; Circuit Model of a Uniform Two-Conductor Transmission Line; The Uniform Ideal Transmission Line; Wave Reflection at a Discontinuity in an Ideal Transmission Line; Matching of Transmission Lines with Load.

Module-V (8 Hours)

1. Formulation of Field Equations; Wave Types; the Parallel-Plate Waveguide; the Rectangular Waveguide. TE and TM modes of propagation in a Rectangular waveguide
2. Radiation Properties of a Current Element; Radiation Properties of a Half-Wave Dipole; Yagi–Uda Antenna; the Parabolic Reflector Antenna.

Books:

- Principles of Electromagnetic, S.C. Mahapatra, S. Mahapatra, McGraw Hill Education (India) Pvt. Ltd., New Delhi, 2nd Edition, 2015.
- Principles of Electromagnetics**,**Mathew N.O. Sadiku & S.V. Kulkarni., Oxford University Press, 6th edition,2009.
- Electromagnetic Waves and Radiating Systems, E.C. Jordan and K.G. Balmain, Pearson Education, New Delhi, 2nd Edition,2009.
- Engineering Electromagnetic Essentials, B. N. Basu, University Press.
- Engineering Electromagnetic Essentials, Nathan Ida, Springer
- Engineering Electromagnetic, William H. Hayt & J. Buck, Tata McGraw Hill Publishing
- Company Ltd., New Delhi, 7th Edition,2006
- Electromagnetic, Joseph A. Edminister, adapted by Vishnu Priye, Tata McGraw Hill
- Publishing Company Ltd., New Delhi, 2nd Edition.
- Fundamentals of Electromagnetic for Engineering, First Impression, N. N. Rao, Pearson Education, New Delhi, 2009.
- Fields and Waves in Communication Electronics, Simon Ramo, Wiley Publication, 3ed, 2007.
- Electromagnetic Field Theory, Bhag Singh Guru, Cambridge Publication,3rd Edition, 2011.

4th Semester	**REC4C201**	**Electronic Device Laboratory**	**L-T-P 0-0-3**	**2 CREDITS**

Laboratory Experiments: (Minimum 8 experiments)

1. *Wave-propagation in conductors and dielectrics using HFSS/CST/MATLAB.*
2. *Current and charge flow of electromagnetic wave in a rectangular waveguide using HFSS/CST/MATLAB.*
3. *Uniform Plane Wave Propagation in an Arbitrary Direction*
4. *Transverse Electric Waves in a Parallel-Plate Waveguide*
5. *To calculate Dispersion and Group Velocity*
6. *To design Rectangular Waveguide*
7. *To design cavity Resonator*
8. *To show the modes of a rectangular waveguide using HFSS.*
9. *To show azimuth and elevation patterns*
10. *To show the input and output impedence*
11. *SWR measurements of rectangular waveguide*
12. *Reflection of plane waves*

*HFSS – High Frequency Structure Simulator
*CST- Computer Simulation Tool

4th Semester	**REC4C002**	**Digital Systems Design**	**L-T-P 3-0-0**	**3 CREDITS**

MODULE – I (10 Hours)

Revision of Number System: Introduction to various number systems and their Conversion. Arithmetic Operation using 1's and 2`s Compliments, Signed Binary and Floating Point Number Representation Introduction to Binary codes and their applications.

Revision Boolean Algebra and Logic Gates: Boolean algebra and identities, Complete Logic set, logic gates and truth tables. Universal logic gates, Algebraic Reductionand realization using logic gates

MODULE – II (11 Hours)

Combinational Logic Design: Specifying the Problem, Canonical Logic Forms, Extracting Canonical Forms, EX-OR Equivalence Operations, Logic Array, K-Maps: Two, Three and Four variable K-maps, NAND and NOR Logic Implementations.

Logic Components: Concept of Digital Components, Binary Adders, Subtraction and Multiplication, An Equality Detector and comparator, Line Decoder, encoders, Multiplexers and De-multiplexers.

MODULE – III (8 Hours)

Synchronous Sequential logic Design: sequential circuits, storage elements: Latches (SR, D), Storage elements: Flip-Flops inclusion of Master-Slave, characteristics equation and state diagram of each FFs and Conversion of Flip-Flops. Analysis of Clocked Sequential circuits and Mealy and Moore Models of Finite State Machines**.**

MODULE – IV (9 Hours)

Binary Counters : Introduction, Principle and design of synchronous and asynchronous counters, Design of MOD-N counters, Ring counters. Decade counters, State Diagram of binary counters.
Shift resistors: Principle of 4-bit shift resistors. Shifting principle, Timing Diagram, SISO, SIPO, PISO and PIPO resistors.

Memory and Programmable Logic: Types of Memories, Memory Decoding, error detection and correction), RAM and ROMs. Programmable Logic Array, Programmable Array Logic, Sequential Programmable Devices.

MODULE – V (7 Hours)

IC Logic Families: Properties DTL, RTL, TTL, I^2L and CMOS and its gate level implementation. A/D converters and D/A converters**.**

College Level (20%)
Basic hardware description language: Introduction to Verilog/VHDL programming language, Verilog/VHDL program of logic gates, adders, Substractors, Multiplexers, Comparators, Decoders flip-flops, counters, Shift resistors.

Books:

- Digital Design, 3rd Edition, Moris M. Mano, Pearson Education.
- Fundamentals of digital circuits, 8th edition, A. Anand Kumar, PHI
- Digital Fundamentals, 5th Edition, T.L. Floyd and R.P. Jain, Pearson Education, New Delhi.
- Digital Electronics, G. K. Kharate, Oxford University Press.
- Digital Systems – Principles and Applications, 10th Edition, Ronald J. Tocci, Neal S. Widemer and Gregory L. Moss, Pearson Education.
- A First Course in Digital System Design: An Integrated Approach, India Edition, John P. Uyemura, PWS Publishing Company, a division of Thomson Learning Inc.
- Digital Systems – Principles and Applications, 10th Edition, Ronald J. Tocci, Neal S. Widemer and Gregory L. Moss, Pearson Education.

4th Semester	**REC4C202**	**Digital System Design Laboratory**	**L-T-P 0-0-3**	**2 CREDITS**

List of Experiments

(At least 10 experiments should be done, Experiment No. 1 and 2 are compulsory and out of the balance 8 experiments at least 3 experiments has to be implemented through both Verilog /VHDL and hardware implementation as per choice of the student totaling to 6 and the rest 2 can be either through Verilog /VHDL or hardware implementation.)

1. Digital Logic Gates: Investigate logic behavior of AND, OR, NAND, NOR, EX-OR, EX-NOR, Invert and Buffer gates, use of Universal NANDGate.
2. Gate-level minimization: Two level and multi level implementation of Booleanfunctions.
3. Combinational Circuits: design, assemble and test: adders and subtractors, code converters, gray code to binary and 7 segmentdisplay.
4. Design, implement and test a given design example with (i) NAND Gates only (ii) NOR Gates only and (iii) using minimum number ofGates.
5. Design with multiplexers andde-multiplexers.
6. Flip-Flop: assemble, test and investigate operation of SR, D & J-Kflip-flops.
7. Shift Registers: Design and investigate the operation of all types of shift registers with parallelload.
8. Counters: Design, assemble and test various ripple and synchronous counters - decimal counter, Binary counter with parallelload.
9. Memory Unit: Investigate the behaviour of RAM unit and its storage capacity – 16 X 4 RAM: testing, simulating and memoryexpansion.
10. Clock-pulse generator: design, implement andtest.
11. Parallel adder and accumulator: design, implement andtest.
12. Binary Multiplier: design and implement a circuit that multiplies 4-bit unsigned numbers to produce a 8-bitproduct.
13. Verilog/VHDL simulation and implementation of Experiments listed at Sl. No. 3 to 12

4th Semester	REN4E001	ENGINEERING ECONOMICS	L-T-P 3-0-0	3 CREDITS

Module - I (08 hours)

Engineering Economics- Nature, Scope, Basic problems of an economy, Micro Economics and Macro Economics.
Demand - Meaning of demand, Demand function, Law of Demand and its exceptions, Determinants of demand, Elasticity of demand & its measurement (Simple numerical problems to be solved), Demand Forecasting – Meaning
Supply-Meaning of supply, Law of supply and its exception, Determinants of supply, Elasticity of supply, Determination of market equilibrium (Simple numerical problems to be solved).

Module - II (08 hours)

Production - Production function, Laws of returns: Law of variable proportion, Law of returns to scale
Cost and Revenue Concepts - Total Costs, Fixed cost, Variable cost, Total revenue, Average revenue and Marginal revenue, Cost-Output Relationships in the Short Run, and Cost-Output Relationships in the Long Run, Analysis of cost minimization.

Module III (08 hours)

Market - Basic understanding of different market structures, Determination of equilibrium price under perfect competition (Simple numerical problems to be solved), Break Even Analysis-linear approach (Simple numerical problems to be solved).

Module - IV (12 hours)

Time Value of Money- Interest - Simple and compound, nominal and effective rate of interest, Cash flow diagrams, Principles of economic equivalence.
Evaluation of Engineering Projects-Present worth method, Future worth method, Annual worth method, Internal rate of return method, Cost benefit analysis for public projects.
Depreciation- Depreciation of capital assert, Causes of depreciation, Methods of calculating depreciation - Straight line method, Declining balance method, SOYD method, After tax comparison of project.

Module –V (06 Hours)

Inflation-Meaning of inflation, types, causes, measures to control inflation.
National Income-Definition, Concepts of national income, Method of measuring national income.
Banking -Commercial bank, Functions of commercial bank, Central bank, Functions of Central Bank.

Books:

1. Principles of Economics by Deviga Vengedasalam and Karaunagaran Madhavan, Oxford
2. Riggs, Bedworth and Randhwa, “Engineering Economics”, McGraw Hill Education India
3. C. S. Park, Contemporary Engineering Economics, 6th Edition, Pearson Education, 2015.
4. Engineering Economy by William G.Sullivan, Elin M.Wicks, C. Patric Koelling, Pearson
5. R.Paneer Seelvan, “ Engineering Economics”, PHI
6. Ahuja,H.L., “Principles of Micro Economics” , S.Chand & Company Ltd
7. Jhingan,M.L., “Macro Economic Theory”

8. Macro Economics by S.P.Gupta, TMH

Course Outcomes of Engineering Economics

At the end of the course the engineering graduates will be able to

1. **Remembering** : Define the basic concept of micro and macro economics, engineering economics and their application in engineering economy.
2. **Understanding** : Evaluate numerically the effects of changes in demand and supply on price determination of products and services.
3. **Analyze :** the macroeconomic environment and financial systems of the country and its impact on business, society and enterprise.
4. **Develop :** the ability to account for time value of money using engineering economy factors and formulas.
5. **Apply:** knowledge of mathematics, economics and engineering principles to solve engineering problems and to analyze decision alternatives in engineering projects considering upon depreciation, taxes and inflation.

4th Semester	ROB4E002	ORGANISATIONAL BEHAVIOUR	L-T-P 3-0-0	3 CREDITS

Objectives:

1. To develop an understanding of the behavior of individuals and groups inside organizations
2. To enhance skills in understanding and appreciating individuals, interpersonal, and group process for increased effectiveness both within and outside of organizations.
3. To develop theoretical and practical insights and problem-solving capabilities for effectively managing the organizational processes.

Module-I: **(06 Hrs.)**

Fundamentals of OB: Definition, scope and importance of OB, Relationship between OB and the individual, Evolution of OB, Theoretical framework (cognitive), behavioristic and social cognitive), Limitations of OB.

Module-II: **(12 Hrs.)**

Attitude: Importance of attitude in an organization, Right Attitude, Components of attitude, Relationship between behavior and attitude, Developing Emotional intelligence at the workplace, Job attitude, Barriers to changing attitudes.
Personality and values: Definition and importance of Personality for performance, The Myers-Briggs Type Indicator and The Big Five personality model, Significant personality traits suitable to the workplace (personality and job – fit theory), Personality Tests and their practical applications.
Perception: Meaning and concept of perception, Factors influencing perception, Selective perception, Attribution theory, Perceptual process, Social perception (stereotyping and halo effect).
Motivation: Definition & Concept of Motive & Motivation, The Content Theories of Motivation (Maslow's Need Hierarchy & Herzberg's Two Factor model Theory), The Process Theories (Vroom's expectancy Theory & Porter Lawler model), Contemporary Theories – Equity Theory of Work Motivation.

Module-III: **(10 Hrs.)**

Foundations of Group Behavior: The Meaning of Group & Group behavior & Group Dynamics, Types of Groups, The Five – Stage Model of Group Development.
Managing Teams: Why Work Teams, Work Teams in Organization, Developing Work Teams, Team Effectiveness & Team Building.
Leadership: Concept of Leadership, Styles of Leadership, Trait Approach Contingency Leadership Approach, Contemporary leadership, Meaning and significance of contemporary leadership, Concept of transformations leadership, Contemporary theories of leadership, Success stories of today's Global and Indian leaders.

Module-IV: **(08 Hrs.)**

Organizational Culture : Meaning & Definition of Organizational Culture, creating & Sustaining Organizational Culture, Types of Culture (Strong vs. Weak Culture, Soft Vs. Hard Culture & Formal vs. Informal Culture), Creating Positive Organizational Culture, Concept of Workplace Spirituality.

Module-V: **(09 Hrs.)**

Organizational Change: Meaning, Definition & Nature of Organizational Change, Types of Organizational Change, Forces that acts as stimulants to change.
Implementing Organizational Change : How to overcome the Resistance to Change, Approaches to managing Organizational Change, Kurt Lewin's-Three step model, Seven Stage model of Change & Kotter's Eight-Step plan for Implementing Change, Leading the Change Process, Facilitating Change, Dealing with Individual & Group Resistance, Intervention Strategies for Facilitating Organizational Change, Methods of Implementing Organizational Change, Developing a Learning Organization.

Books:

1. Understanding Organizational Behaviour, Parek, Oxford
2. Organizational Behaviour, Robbins, Judge, Sanghi, Pearson.
3. Organizational Behaviour, K. Awathappa,HPH.
4. Organizational Behaviour, VSP Rao, Excel
5. Introduction to Organizational Behaviour, Moorhead, Griffin, Cengage.
6. Organizational Behaviour, Hitt, Miller, Colella, Wiley

4th Semester	REC4C003	Network Theory	L-T-P 3-0-0	3 CREDITS

Course Outcomes:

At the end of this course, students will demonstrate the ability to

- Apply network theorems for the analysis of electrical circuits.
- Obtain the transient and steady-state response of electrical circuits.
- Analyse circuits in the sinusoidal steady-state (single-phase and three-phase).
- Analyse two port circuit behavior.

Module-I: **(10 Hrs.)**

Network Theorems:Superposition theorem, Thevenin theorem, Norton theorem, Maximum power transfer theorem, Reciprocity theorem, Compensation theorem. Analysis with dependent current and voltage sources. Node and Mesh Analysis. Concept of duality and dual networks.

MODULE – II (09 Hrs.)

Solution of First and Second order networks: Solution of first and second order differential equations for Series and parallel R-L, R-C, R-L-C circuits, initial and final conditions in network elements, forced and free response, time constants, steady state and transient state response.

MODULE – III (09 Hrs.)

Sinusoidal steady state analysis: Representation of sine function as rotating phasor, phasor diagrams, impedances and admittances, AC circuit analysis, effective or RMS values, average power and complex power. Three-phase circuits. Mutual coupled circuits, Dot Convention in coupled circuits, Ideal Transformer.

MODULE – IV (08 Hrs.)

Electrical Circuit Analysis Using Laplace Transforms: Review of Laplace Transform, Analysis of electrical circuits using Laplace Transform for standard inputs, convolution integral, inverse Laplace transform, transformed network with initial conditions. Transfer function representation. Poles and Zeros. Frequency response (magnitude and phase plots), series and parallel resonances

MODULE – V (09 Hrs.)

Two Port Network and Network Functions: Two Port Networks, terminal pairs, relationship of two port variables, impedance parameters, admittance parameters, transmission parameters and hybrid parameters, interconnections of two port networks.

Books:

- M. E. Van Valkenburg, "Network Analysis", Prentice Hall, 2006.
- D. Roy Choudhury, "Networks and Systems", New Age International Publications, 1998.
- W. H. Hayt and J. E. Kemmerly, "Engineering Circuit Analysis", McGraw Hill Education, 2013.
- C. K. Alexander and M. N. O. Sadiku, "Electric Circuits", McGraw Hill Education, 2004.
- K. V. V. Murthy and M. S. Kamath, "Basic Circuit Analysis", Jaico Publishers, 1999.

- Network Synthesis – M E Van Valkenburg – Pearson Education.

- Network Analysis and Synthesis – Franklin F. Kuo – Wiley Student Edition.
- Linear Circuits Analysis and Synthesis – A Ramakalyan – Oxford University Press.
- Problems & Solutions in Electric Circuit Analysis – Sivananda & Deepa – Jaico Book.
- Theory and problem of electrical circuits, Schaum's Outline Series, TMH – Joseph A. Edminister, MahmoodMaqvi.
- Electric Circuits – David A.Bell – Oxford, 7th Edition, 2015.

4th Semester	**REC4C203**	**Network Theory Laboratory**	**L-T-P 0-0-3**	**2 CREDITS**

List of Experiments:
(At least 08 out of 10 experiments should be done)

1. Verification of Network Theorems using AC circuits. (Superposition, Thevenin, Norton, Maximum Power Transfer).
2. Study of DC and AC Transients for R-L, R-C & R-L-C circuits using storage oscilloscope.
3. Determination of circuit parameters: Open Circuit and Short Circuit parameters.
4. Determination of circuit parameters: Hybrid and Transmission parameters.
5. Frequency response of Low pass and High Pass Filters.
6. Frequency response of Band pass and Band Elimination Filters.
7. Determination of self inductance, mutual inductance and coupling coefficient of a single phase two winding transformer representing a coupled circuit.
8. Study of resonance in R-L-C series circuit using oscilloscope.
9. Study of resonance in R-L-C parallel circuit using oscilloscope.
10. Spectral analysis of a non-sinusoidal waveform.

4th Semester	REC4D001	Semiconductor Devices	L-T-P 3-0-0	3 CREDITS

MODULE-I (08 Hours)

Introduction to the quantum theory of solids: Formation of energy bands; the k-space diagram (two and three dimensional representation), conductors, semiconductors and insulators.

Electrons and Holes in semiconductors: Silicon crystal structure; Donors and acceptors in the band model; electron effective mass; Density of states; Thermal equilibrium; and Fermi-Dirac distribution function for electrons and holes; Fermi energy. Equilibrium distribution of electrons & holes: derivation of *n* and *p* from D(E) and f(E), Fermi level and carrier concentrations.

MODULE-I (09 Hours)

The *np* product and the intrinsic carrier concentration. General theory of *n* and *p;* Carrier concentrations at extremely high and low temperatures: complete ionization, partial ionization and freeze-out; Energy-band diagram and Fermi-level, Variation of E_F with doping concentration and temperature.

Motion and Recombination of Electrons and Holes: Carrier drift: Electron and hole mobilities; Mechanism of carrier scattering; Drift current and conductivity.

MODULE-III (10 Hours)

Motion and Recombination of Electrons and Holes (continued): Carrier diffusion: diffusion current, Total current density; relation between the energy diagram and potential, electric field; Einstein relationship between diffusion coefficient and mobility; Electron-hole recombination; Thermal generation.

PN Junction: Building blocks of the pn junction theory: Energy band diagram and depletion layer of a pn junction, Built-in potential; Depletion layer model: Field and potential in the depletion layer, depletion-layer width; Reverse-biased PN junction; Capacitance-voltage characteristics; Junction breakdown: peak electric field. Tunneling breakdown and avalanche breakdown; Carrier injection under forward bias-Quasi-equilibrium boundary condition; current continuity equation; Excess carriers in forward-biased pn junction; PN diode I-V characteristic, Charge storage.

MODULE-IV (08 Hours)

The Bipolar Transistor: Introduction, Modes of operation; Minority Carrier distribution, Collector current, Base current, current gain, Base width Modulation by collector current, Breakdown mechanism, Equivalent Circuit Models – Ebers -Moll Model.

MODULE-V (10 Hours)

Metal-Semiconductor Junction: Schottky Diodes: Built-in potential, Energy-band diagram, I-V characteristics, Comparison of the Schottky barrier diode and the pn-junction diode; Ohmic contacts: tunneling barrier, specific contact resistance**.**

MOS Capacitor: The MOS structure, Energy band diagrams, Flat-band condition and flat-band voltage, Surface accumulation, surface depletion, Threshold condition and threshold voltage, MOS C-V characteristics, Q_{inv} in MOSFET.

Books:

- Semiconductor Physics and Devices-Donald A. Neamen, Tata McGraw Hill Publishing Company Limited, New Delhi, 3rd Edition.
- Solid State Electronics Devices-Ben. G. Streetman and Sanjay Banarjee, Pearson Education, New Delhi, 6th Edition.
- Modern Semiconductor Devices for Integrated Circuits-Chenming Calvin Hu, Pearson Education/Prentice Hall, 2009.
- Physics of Semiconductor Devices-S.M. Sze and Kwok K. Ng, Wiley India Pvt. Limited, New Delhi, 3rd Edition.
- Physics of Semiconductor Devices-Dillip K. Roy, University Press (India) Pvt. Ltd., Hyderabad, 2nd Edition
- Semiconductor Physics and Devices- Fowler, Oxford University Press.
- Solid State Electronics Devices-D.K. Bhattacharya and Rajnish Sharma, Oxford University Press, New Delhi, 2nd Edition
- Fundamentals of Semiconductor Devices-M.K. Achuthan and K.N. Bhatt, Tata McGraw Hill Publishing Company Limited, New Delhi.

4th Semester	**REC4D002**	**Power Electronics**	**L-T-P 3-0-0**	**3 CREDITS**

Course Outcomes:

At the end of this course students will demonstrate the ability to

- Understand the differences between signal level and power level devices.
- Ability to analyze various single phase and three phase power converter circuits and understand their applications.
- Ability to analyze the operation of DC-DC choppers and their applications.
- Ability to analyze the operation of voltage source inverters and their applications.

Module-I: Power switching devices (8 Hours)

Diode, Thyristor, MOSFET, IGBT: I-V Characteristics; Firing circuit for thyristor; Voltage and current commutation of a thyristor; Gate drive circuits for MOSFET and IGBT.

Module-II: Thyristor rectifiers (9 Hours)

Single-phase half-wave and full-wave rectifiers, Single-phase full-bridge thyristor rectifier with R- load and highly inductive load; Three-phase full-bridge thyristor rectifier with R-load and highly inductive load; Input current wave shape and power factor.

Module-III: DC-DC buck converter (8 Hours)

Elementary chopper with an active switch and diode, concepts of duty ratio and average voltage, power circuit of a buck converter, analysis and waveforms at steady state, duty ratio control of output voltage.

Module-IV: DC-DC boost converter (8 Hours)

Power circuit of a boost converter, analysis and waveforms at steady state, relation between duty ratio and average output voltage.

Module-V: Single-phase voltage source inverter (12 Hours)

Power circuit of single-phase voltage source inverter, switch states and instantaneous output voltage, square wave operation of the inverter, concept of average voltage over a switching cycle, bipolar sinusoidal modulation and unipolar sinusoidal modulation, modulation index and output voltage

Power circuit of a three-phase voltage source inverter, switch states, instantaneous output voltages, average output voltages over a sub-cycle, three-phase sinusoidal modulation

Books:

- M. H. Rashid, "*Power electronics: circuits, devices, and applications*", Pearson Education India, 2009.
- N. Mohan and T. M. Undeland, "Power Electronics: Converters, Applications and Design", John Wiley & Sons, 2007.
- R. W. Erickson and D. Maksimovic, "Fundamentals of Power Electronics", Springer Science & Business Media, 2007.
- L. Umanand, "Power Electronics: Essentials and Applications", Wiley India, 2009.

4th Semester	REC4D003	Sensors and Transducers	L-T-P 3-0-0	3 CREDITS

MODULE–I (12 Hours)

Elements of a general measurement system; Static Characteristics: systematic characteristics, statistical characteristics, calibration; Dynamic characteristics of measurement systems: transfer functions of typical sensing elements, step and frequency response of first and second order elements, and dynamic error in measurement systems.

MODULE–II (10 Hours)

Sensing elements: Resistive sensing elements: potentiometers, Resistance Temperature Detector (RTD), thermistors, strain gages. Capacitive sensing elements: variable separation, area and dielectric; Inductive sensing elements: variable reluctance and LVDT displacement sensors.

MODULE–III (10 Hours)

Signal Conditioning Elements: Deflection bridges: design of resistive and reactivebridges, push-pull configuration for improvement of linearity and sensitivity Amplifiers: Operational amplifiers-ideal and non-ideal performances, inverting, non-inverting and differential amplifiers, instrumentation amplifier, filters. A.C. carrier systems, phase sensitive demodulators and its applications in instrumentation.

MODULE–IV (8 Hours)

Thermoelectric sensing elements: laws, thermocouple characteristics, installation problems, cold junction compensation. IC temperature sensor Elastic sensing elements: Bourdon tube, bellows, and diaphragms for pressure sensing, force and torque measurement.

MODULE–V (5 Hours)

Electromagnetic sensing elements: velocity sensors

Books:

- Principles of Measurement Systems, J.P. Bentley, Pearson Education, New Delhi, 3rd Edition 2007.
- Introduction to Measurement and Instrumentation, A.K. Ghosh , PHI Learning, 3rd Edition,2009.
- Transducers and Instrumentation, D.V.S. Murthy, PHI Learning, New Delhi, 2009.
- Measurement Systems Application and Design, E.O. Doeblin, McGraw-Hill, 4th Edition.
- Instrumentation for Engineering Measurements, J.W. Dally, W.F. Riley and K.G. McConnel , John Wiley, NY,2nd edition 2003.
- Industrial Instrumentation, T.R. Padmanabhan, Springer, London, 2000.

4th Semester	REC4G001	Probability Theory And Stochastic Process	L-T-P 3-0-0	3 CREDITS

MODULE – I (12 Hours)

Sets and set operations; Probability space; Conditional probability and Bayes theorem;Combinatorial probability and sampling models.

MODULE – II (12 Hours)

Discrete random variables, probability mass function, probability distribution function,example random variables and distributions; Continuous random variables, probability density function, probability distribution function, example distributions;

MODULE – III (8 hours)

Joint distributions, functions of one and two random variables, moments of randomvariables; Conditional distribution, densities and moments; Characteristic functions of a random variable; Markov, Chebyshev and Chernoff bounds.

MODULE – IV (7 hours)

Random sequences and modes of convergence (everywhere, almost everywhere,probability, distribution and mean square); Limit theorems; Strong and weak laws of large numbers, central limit theorem.

MODULE – V (6 hours)

Random process. Stationary processes. Mean and covariance functions. Ergodicity.Transmission of random process through LTI. Power spectral density.

Books:

- H. Stark and J. Woods, ``Probability and Random Processes with Applications to Signal Processing," Third Edition, Pearson Education
- A.Papoulis and S. Unnikrishnan Pillai, ``Probability, Random Variables and Stochastic Processes," Fourth Edition, McGraw Hill.
- K. L. Chung, Introduction to Probability Theory with Stochastic Processes, Springer International
- P. G. Hoel, S. C. Port and C. J. Stone, Introduction to Probability, UBS Publishers,
- P. G. Hoel, S. C. Port and C. J. Stone, Introduction to Stochastic Processes, UBS Publishers
- S. Ross, Introduction to Stochastic Models, Harcourt Asia, Academic Press.

Course Outcomes:

At the end of this course students will demonstrate the ability to

1. Understand representation of random signals
2. Investigate characteristics of random processes
3. Make use of theorems related to random signals
4. To understand propagation of random signals in LTI systems.

4th Semester	REC4G002	Data Structure	L-T-P 3-0-0	3 CREDITS

Module - I (12 Hrs.)

Introduction: Basic Terminologies: Elementary Data Organizations, Data Structure Operations: insertion, deletion, traversal etc.; Analysis of an Algorithm, Asymptotic Notations, Time-Space trade off.
Searching: Linear Search and Binary Search Techniques and their complexity analysis.

Module – II (08 Hrs.)

Stacks and Queues: ADT Stack and its operations: Algorithms and their complexity analysis, Applications of Stacks: Expression Conversion and evaluation – corresponding algorithms and complexity analysis. ADT queue, Types of Queue: Simple Queue, Circular Queue, Priority Queue; Operations on each types of Queues: Algorithms and their analysis.

Module - III (08 Hrs.)

Linked Lists: Singly linked lists: Representation in memory, Algorithms of several operations: Traversing, Searching, Insertion into, Deletion from linked list; Linked representation of Stack and Queue, Header nodes, Doubly linked list: operations on it and algorithmic analysis; Circular Linked Lists: all operations their algorithms and the complexity analysis.

Module - IV (10 Hrs.)

Sorting and Hashing: Objective and properties of different sorting algorithms: Selection Sort, Bubble Sort, Insertion Sort, Quick Sort, Merge Sort, Heap Sort; Performance and Comparison among all the methods, Hashing.

Module - V (07 Hrs.)

Trees: Basic Tree Terminologies, Different types of Trees: Binary Tree, Threaded Binary Tree, Binary Search Tree, AVL Tree; Tree operations on each of the trees and their algorithms with complexity analysis. Applications of Binary Trees. B Tree, B+ Tree: definitions, algorithms and analysis.

Graph: Basic Terminologies and Representations, Graph search and traversal algorithms and complexity analysis.

Books:

- "Fundamentals of Data Structures", Illustrated Edition by Ellis Horowitz, Sartaj Sahni, Computer Science Press.
- Algorithms, Data Structures, and Problem Solving with C++", Illustrated Edition by Mark Allen Weiss, Addison-Wesley Publishing Company
- "How to Solve it by Computer", 2nd Impression by R.G. Dromey, Pearson Education.

4th Semester	REC4G003	Brain Control Interface	L-T-P 3-0-0	3 CREDITS

Module - I (10 Hrs.)

Introduction to Brain Control Interface
Fundamentals of BCI – Structure of BCI system – Classification of BCI: Invasive, Non-invasive and Partially invasive BCI-Brain signal acquisition, Signal Preprocessing, Artifacts removal.

Module – II (10 Hrs.)

Electrophysiological Sources
Sensorimotor activity –Neuronal activity in motor cortex and related areas- Electric and magnetic fields produced by the brain- signals reflecting brain metabolic activity- Mu rhythm, Movement Related Potentials – Slow Cortical Potentials - P300 Event related potential - Visual Evoked Potential - Activity of
Neural Cells - Multiple Neuromechanisms

Module - III (10 Hrs.)

Feature Extraction Methods
Time/Space Methods – Fourier Transform, Wavelets, AR, MA, ARMA models, Bandpass filtering, Template matching, Kalman filter, PCA, Laplacian filter – Linear and Non-Linear Features.

Module - IV (07 Hrs.)

Feature Translation Methods
Linear Discriminant Analysis –Nearest neighbours, Support Vector Machines - Regression – Learning Vector Quantization – Gaussian Mixture Modeling – Hidden Markov Modeling –
Neural Networks.

Module - V (08 Hrs.)

Applications of BCI
Study of BCI Competition III – Dataset I, II, III, IV and V, Functional restoration using Neuroprosthesis - Functional Electrical Stimulation, Visual Feedback and control - External
device controllers, Case study: Brain actuated control of mobile Robot. Ethical issues in BCI research

Books:

- Jonathan Wolpaw,Elizabeth Winter Wolpaw,'Brain Computer Interfaces: Principles and practice", Edition 1, Oxford University Press, USA, January 2012
- Special Issue on Brain Control Interfaces, IEEE Transactions on Neural Systems and Rehabilitation Engineering, Vol 14, June 2006.
- R. Spehlmann, "EEG Primer", Elsevier Biomedical Press, 1981.
- Bernhard Graimann, Brendan Allison, Gert Pfurtscheller, "Brain-Computer Interfaces: Revolutionizing Human-Computer Interaction", Springer, 2010
- Ali Bashashati, Mehrdad Fatourechi, Rabab K Ward, Gary E Birch," A survey of signal Processing algorithms in brain–computer interfaces based on electrical

brain signals" JOURNAL OF NEURAL ENGINEERING, VOL.4, 2007, PP.32-57

- Arnon Kohen, "Biomedical Signal Processing", Vol I and II, CRC Press Inc, Boca Rato, Florida.
- Bishop C.M., "Neural networks for Pattern Recognition", Oxford, Clarendon Press, 1995.
- Andrew Webb, "Statistical Pattern Recognition", Wiley International, Second Edition, 2002.
- Torsten Felzer, "On the possibility of Developing a Brain Computer Interface", Technical Report, Technical University of Darmstadt, Germany,2001.
- Wolpaw J.R, N.Birbaumer et al, "Brain control interface for Communication and control", Clinical Neurophysiology, 113, 2002.
- Jose del R.Millan et al, "Non-invasive brain actuated control of a mobile robot by human
- EEG", IEEE Transactions on biomedical Engineering, Vol 51, No.6, 2004 June.
- S.Coyle, T.Ward et al, "On the suitability of near infra red systems for next generation Brain Computer interfaces", Physiological Measurement, 25, 2004.
- Carlo Tomasi, "Estimating Gaussian Mixture Densities with EM – A Tutorial", Duke University, 2000.
- R.Dugad, U.B Desai, "A Tutorial on Hidden Markov Modeling", Signal Processing and Artificial Neural Networks Laboratory, IIT Bombay, 1996.
- http:://ida.first.fhg.de/projects/bci/competition_iii

Course Outcomes:

Capable of acquiring the brain signal in the format required for the specific application

1. Well prepared for preprocessing the signal for signal enhancement
2. Ability to extract the dominant and required features and classify the signal for applications

4th Semester	RCN4F001	Constitution of India	L-T-P 3-0-0	0 CREDIT

Basic features and fundamental principles

The Constitution of India is the supreme law of India. Parliament of India can not make any law which violates the Fundamental Rights enumerated under the Part III of the Constitution. The Parliament of India has been empowered to amend the Constitution under Article 368, however, it cannot use this power to change the "basic structure" of the constitution, which has been ruled and explained by the Supreme Court of India in its historical judgments. The Constitution of India reflects the idea of "Constitutionalism" – a modern and progressive concept historically developed by the thinkers of "liberalism" – an ideology which has been recognized as one of the most popular political ideology and result of historical struggles against arbitrary use of sovereign power by state. The historic revolutions in France, England, America and particularly European Renaissance and Reformation movement have resulted into progressive legal reforms in the form of "constitutionalism" in many countries. The Constitution of India was made by borrowing models and principles from many countries including United Kingdom and America.

The Constitution of India is not only a legal document but it also reflects social, political and economic perspectives of the Indian Society. It reflects India's legacy of "diversity". It has been said that Indian constitution reflects ideals of its freedom movement, however, few critics have argued that it does not truly incorporate our own ancient legal heritage and cultural values. No law can be "static" and therefore the Constitution of India has also been amended more than one hundred times. These amendments reflect political, social and economic developments since the year 1950. The Indian judiciary and particularly the Supreme Court of India has played an historic role as the guardian of people. It has been protecting not only basic ideals of the Constitution but also strengthened the same through progressive interpretations of the text of the Constitution. The judicial activism of the Supreme Court of India and its historic contributions has been recognized throughout the world and it gradually made it "as one of the strongest court in the world".

Course content

1. Meaning of the constitution law and constitutionalism
2. Historical perspective of the Constitution of India
3. Salient features and characteristics of the Constitution of India
4. Scheme of the fundamental rights
5. The scheme of the Fundamental Duties and its legal status
6. The Directive Principles of State Policy – Its importance and implementation
7. Federal structure and distribution of legislative and financial powers between the Union and the States
8. Parliamentary Form of Government in India – The constitution powers and status of the President of India
9. Amendment of the Constitutional Powers and Procedure
10. The historical perspectives of the constitutional amendments in India

11. Emergency Provisions : National Emergency, President Rule, Financial Emergency
12. Local Self Government – Constitutional Scheme in India
13. Scheme of the Fundamental Right to Equality
14. Scheme of the Fundamental Right to certain Freedom under Article 19
15. Scope of the Right to Life and Personal Liberty under Article 21.

BIJU PATNAIK UNIVERSITY OF TECHNOLOGY, ODISHA

ROURKELA

Curriculum and Syllabus

B. Tech (*Electronics and Communication / Electronics and Telecommunication Engineering)* for the Batch

2018-19

Semester (5^{th})

B. Tech in Electronics and Communication / Electronics and Telecommunication Engineering (Admission Batch: 2018-2019)

5th Semester

Theory					
Sl. No.	Category	Course Code	Course Title	L-T-P	Credit
1	PC 11		Analog and Digital Communication	3-0-0	3
2	PC 12		Digital Signal Processing	3-0-0	3
3	PC 13		Microprocessors & Microcontrollers	3-0-0	3
4	PE 2		Fiber Optics & Opto Electronics Devices	3-0-0	3
			Computer Architecture and Organisation	3-0-0	
			Control System	3-0-0	
5	PE 3		Advance Electronic Circuits	3-0-0	3
			Electronics Instrumentation and Measurement	3-0-0	
			Digital VLSI Design	3-0-0	
6	MC 5		Universal Human Values		0
Total Credit (Theory)					**15**
Practical					
1	PC 14		Analog and Digital Communication Lab	0-0-3	2
2	PC 15		Digital Signal Processing Lab	0-0-3	2
3	PC 16		Microprocessors & Microcontrollers Lab	0-0-3	2
4	PSI 2		Evaluation of Summer Internship	0-0-3	1
Total Credit (Practical)					**7**
Total Semester Credit					**22**

5Th Semester

Analog and Digital Communication

Module I: **(4 hours)**

Review of signals and systems, Frequency domain representation of signals, Principles of Amplitude Modulation Systems- DSB, SSB and VSB modulations. Angle Modulation, Representation of FM and PM signals, Spectral characteristics of angle modulated signals.

Module II: **(10 hours)**

Review of probability and random process. Gaussian and white noise characteristics, Noise in amplitude modulation systems, Noise in Frequency modulation systems. Pre-emphasis and Deemphasis, Threshold effect in angle modulation.

Module III: **(12 hours)**

Pulse modulation. Sampling process. Pulse Amplitude and Pulse code modulation (PCM), Differential pulse code modulation. Delta modulation, Noise considerations in PCM, Time Division multiplexing, Digital Multiplexers.

Module IV: **(6 hours)**

Elements of Detection Theory, Optimum detection of signals in noise, Coherent communication with waveforms- Probability of Error evaluations. Base band Pulse Transmission- Inter symbol Interference and Nyquist criterion. Pass band Digital Modulation schemes- Phase Shift Keying, Frequency Shift Keying, Quadrature Amplitude Modulation, Continuous Phase Modulation and Minimum Shift Keying.

Module V: **(10 hours)**

Digital Modulation trade-offs. Optimum demodulation of digital signals over band-limited channels- Maximum likelihood sequence detection (Viterbi receiver). Equalization Techniques. Synchronization and Carrier Recovery for Digital modulation.

Books:

[1] Haykin S., "Communications Systems", John Wiley and Sons, 2001.

[2] Proakis J. G. and Salehi M., "Communication Systems Engineering", Pearson Education, 2002.

[3] Taub H. and Schilling D.L., "Principles of Communication Systems", Tata McGraw Hill,2001.

[4] Wozencraft J. M. and Jacobs I. M., "Principles of Communication Engineering", John Wiley, 1965.

[5] Barry J. R., Lee E. A. and Messerschmitt D. G., ``Digital Communication", Kluwer Academic Publishers, 2004.

[6] Proakis J.G., " Digital Communications", 4th Edition, McGraw Hill, 2000.

Digital Learning Resources:

Course Name:	Analog communication
Course Link:	https://nptel.ac.in/noc/courses/noc19/SEM2/noc19-ee46
Course Instructor:	Prof. Goutam Das, IIT Kharagpur

Course Name:	Modern Digital Communication Techniques
Course Link:	https://nptel.ac.in/courses/117/105/117105144/
Course Instructor:	Prof. S.S. Das, IIT Kharagpur

Course Name:	Communication Engineering
Course Link:	https://nptel.ac.in/courses/117/102/117102059/
Course Instructor:	Prof. Surendra Prasad, IIT Delhi

5Th Semester

Digital Signal Processing

Module-I: **(08 hours)**

Discrete Time System: Basic Discrete Time Signals and their classifications, Discrete times systems and their classifications, Stability of discrete time system, Analysis and response (convolution sum) of discrete - time linear LTI system, Recursive and Non-recursive discrete time system, impulse response of LTI system, Correlation of discrete time Signal.

Module-II: **(08 hours)**

Z-Transform and Its Application to the Analysis of LTI Systems: Z-Transform, Direct Z-Transform, Properties of the Z- Transform, Inverse Z-Transform, Inversion Z-Transform by Power Series Expansion, Inversion of the Z-Transform by Partial-Fraction Expansion, Analysis of Linear Time Invariant Systems in the z-Domain.

Module-III: **(12 hours)**

Discrete Fourier Transform: Frequency-Domain Sampling and Reconstruction of Discrete-Time Signals, Discrete Fourier Transform, DFT as a Linear Transformation, Relationship of DFT to other Transforms, Properties of DFT: Periodicity, Linearity, and Symmetry Properties, Multiplication of Two DFTs and Circular Convolution, Use of DFT in Linear Filtering, Filtering of Long Data Sequences.
Efficient Computation of DFT: FFT Algorithms, Direct Computation of the DFT, Radix-2 FFT Algorithms, Decimation-In-Time (DIT), Decimation-In-Time (DIF).

Module-IV: **(10 hours)**

Structure and Implementation of FIR and IIR Filter: Structure for the Realization of Discrete-Time Systems, Structure of FIR Systems: Direct- Form Structure, Cascade-Form Structure, Frequency Sampling Structure, Design of FIR Filters: Symmetric and Antisymmetric FIR Filters, Design of Linear-Phase FIR Filters by using Windows, Design of Linear-Phase FIR Filters by Frequency Sampling Method. Structure for IIR Systems: Direct-Form Structure, Signal Flow Graphs and Transposed Structure, Cascade-Form Structure, Parallel-Form Structure. Design of IIR Filters.

Module-V: **(07 hours)**

Analog Filters: IIR Filter Design by Impulse Invariance, IIR Filter Design by the Bilinear Transformation. Basic adaptive filter: Structure of Adaptive FIR filter, System Modelling and Inverse Modeling, Matlab realization of DFT, FFT, Z-transform, IIR, FIR and adaptive filter.

Books:

[1] Digital Signal Processing – Principles, Algorithms and Applications by J. G. Proakis and D Manolakis, Pearson.
[2] Digital Signal Processing: Tarun Kumar Rawat, Oxford University Press.
[3] Digital Signal Processing – S. Salivahan, A. Vallavraj and C. Gnanapriya, Tata McGrawHill.
[4] Digital Signal Processing – Manson H. Hayes (Schaum's Outlines) Adapted by Subrata Bhatt Tata McGraw Hill.
[5] Digital Signal Processing - Dr. Shalia D. Apte, Willey Publication

Digital Learning Resources:

Course Name: Digital Signal Processing
Course Link: https://nptel.ac.in/courses/117/105/117105144/

Course Instructor: Prof. Govind Sharma, IIT Kanpur

Course Name: Digital Signal Processing
Course Link: https://nptel.ac.in/courses/117/105/117105144/
Course Instructor: Prof. S.C. Dutta Roy, IIT Delhi

5Th Semester

Microprocessors and Microcontrollers

Module I:

Introduction to 8 bit and 16 bit Microprocessors-H/W architecture: (10 Hours)

Introduction to microprocessor, computer and its organization, Programming system; Address bus, data bus and control bus, Tristate bus; clock generation; Connecting Microprocessor to I/O devices; Data transfer schemes; Architectural advancements of microprocessors. Introductory System design using microprocessors; 8086 – Hardware Architecture; External memory addressing; Bus cycles; some important Companion Chips; Maximum mode bus cycle; 8086 system configuration; Memory Interfacing; Minimum mode system configuration, Interrupt processing.

Module II:

16-bit microprocessor instruction set and assembly language programming: (08 Hours)

Programmer's model of 8086; operand types, operand addressing; assembler directives, instruction Set-Data transfer group, Arithmetic group, Logical group.

Module III:

Microprocessor peripheral interfacing: (08 Hours)

Introduction; Generation of I/O ports; Programmable Peripheral Interface (PPI) - Intel 8255; Sample-and-Hold Circuit and Multiplexer; Keyboard and Display Interface; Keyboard and Display Controller (8279).

Module IV:

8-bit microcontroller- H/W architecture instruction set and programming: (12 Hours)

Introduction to 8051 Micro-Controllers, Architecture; Memory Organization; Special Function register; Port Operation; Memory Interfacing, I/O Interfacing; Programming 8051 resources, interrupts; Programmer's model of 8051; Operand types, Operand addressing; Data transfer instructions, Arithmetic instructions, Logic instructions, Control transfer instructions; Programming.

Module V: **(10 Hours)**

Maximum mode system configuration, Direct memory access, Interfacing of D- to-A converter, A-to-D converter, CRT Terminal Interface, Printer Interface, Programming of 8051 timers, 8051 serial interface. Introduction to 80386 and 80486 Microprocessor family.

Books:

[1] Microprocessor Architecture, Programming and application with 8085, R.S. Gaonkar, PRI Penram International publishing PVT. Ltd., 5th Edition

[2] Microprocessors and Interfacing, Programming and Hardware, Douglas V Hall, TMH Publication, 2006.

[3] Microprocessors and Interfacing, N. Senthil Kumar, M. Saravanan, S. Jeevananthan

and S.K. Shah, Oxford University Press.
[4] The 8051 Microcontroller and Embedded Systems, Muhammad Ali Mazidi, Janice Gillispie Mazidi, Rolin D.M C Kinlay, Pearson Education, Second Edition, 2008.
[5] Microcontrollers: Principles and Application, Ajit Pal, PHI Publication
[6] Microprocessors and Microcontrollers Architecture, programming and system design using 8085, 8086, 8051 and 8096, Krishna Kant, PHI Publication, 2007.
[7] Advanced Microprocessors and Peripherals, A.K. Ray, K M Bhurchandi, TMH Publication, 2007.
[8] Textbook of Microprocessor and Microcontroller, Thyagarajan, Scitech Publication.

Digital Learning Resources:

Course Name:	Microcontrollers and Applications
Course Link:	https://nptel.ac.in/courses/117/104/117104072/
Course Instructor:	Prof. S. P Das, IIT Kanpur

5Th Semester

Fiber Optics & Opto Electronics Devices

Module I: **(12 Hours)**

Fundamental of fiber optics, Different generations of optical fiber communication systems. Optical fiber structure, Fiber types, step index fiber and graded index fiber, ray propagation, total internal reflection, Numerical Aperture, acceptance angle. Wave propagation in a cylindrical wave guides, modal concept, V-number, power flow in step index fiber and graded index fiber, attenuation (absorption, scattering and bending) and dispersion (inter and intramodal, chromatic, wave guide and polarization) in fiber, dispersion shifted and dispersion flattened fiber.

Module II: **(12 Hours)**

Fiber fabrication, Double crucible method, Fiber optic cables, Connector and splice. Losses during coupling between source to fiber, fiber to fiber. Schemes for coupling improvement. Optoelectronic Sources, LED, ILD, light source materials, Radiation Pattern modulation capability.

Module III: **(06 Hours)**

Optoelectronic Detector, PIN AND APD, Responsivity, Band width, Detector noise equivalent circuit and SNR calculation.

Optoelectronic Modulators, Basic principle, Electro optic and Acoustoptic modulators.

Module IV:

Optical Amplifier, Semiconductor optical Amplifier and Erbium Doped Fiber Amplifier.

Module V:

WDM components-couplers, isolators, circulators, filters. Optical switching- self electro optic effect Device, switching speed and energy

Books:

[1] Optical Fiber Communications, Keiser G, Tata McGraw Hill Education Private Limited, 4th Edition.

[2] Optical Fiber Communication Principles and practice, Senior J, Prentice Hall of India.

[3] Fiber-Optic Communication Systems, G P Agarwal,4th edition, John wiley & sons publication,2011.

[4] Fiber optic communications, Joseph C Palais, fourth edition, Pearson Education.

[5] Semiconductor Optoelectronic Devices, Pallab Bhatttacharya, second edition, Pearson Education.

[6] Fiber optics and Optoelectronics, R.P. Khare, Oxford University Press.

Digital Learning Resources:

Course Name:	Fibre Optics
Course Link:	https://nptel.ac.in/courses/115/107/115107095/
Course Instructor:	Prof. V. Rastogi, IIT Roorkee

Course Name:	Fibre Optics
Course Link:	https://nptel.ac.in/courses/115/107/115107095/
Course Instructor:	Prof. V. Rastogi, IIT Roorkee

5Th Semester

Computer Organisation and Architecture

MODULE-I **(08 Hours)**

Functional blocks of a computer: CPU, memory, input-output subsystems, control unit. Instruction set architecture of a CPU–registers, instruction execution cycle, RTL interpretation of instructions, addressing modes, instruction set. Case study – instruction sets of some common CPUs.

MODULE-II **(08 Hours)**

Data representation: signed number representation, fixed and floating point representations, character representation. Computer arithmetic – integer addition and subtraction, ripple carry adder, carry look-ahead adder, etc. multiplication – shift and add, Booth multiplier, carry save multiplier, etc. Division restoring and non restoring techniques, floating point arithmetic.

MODULE–III **(08 Hours)**

Introduction to x86 architecture. CPU control unit design: hardwired and micro-programmed design approaches, Case study – design of a simple hypothetical CPU. Memory system design: semiconductor memory technologies, memory organization. Peripheral devices and their characteristics: Input-output subsystems, I/O device interface, I/O transfers–program controlled, interrupt driven and DMA, privileged and non-privileged instructions, software interrupts and exceptions. Programs and processes–role of interrupts in process state transitions, I/O device interfaces – SCII, USB

MODULE –IV **(08 Hours)**

Memory organization: Memory interleaving, concept of hierarchical memory organization, cache memory, cache size vs. block size, mapping functions, replacement algorithms, write policies.

Books:

[1] "Computer Organization and Design: The Hardware/Software Interface", 5th Edition by David A. Patterson and John L. Hennessy, Elsevier.

[2] "Computer Organization and Embedded Systems", 6th Edition by CarlHamacher, McGraw Hill Higher Education

[3] "Computer Architecture and Organization", 3rd Edition by John P. Hayes, WCB/McGraw-Hill

[4] "Computer Organization and Architecture: Designing for Performance", 10th Edition by William Stallings, Pearson Education.

[5] "Computer System Design and Architecture", 2nd Edition by Vincent P. Heuring and Harry F. Jordan, Pearson Education.

Digital Learning Resources:

Course Name:	Computer Architecture and Organisation
Course Link:	https://nptel.ac.in/courses/106/105/106105163/
Course Instructor:	Prof. Indranil Sengupta and Prof. Kamalika Datta, IIT Kharagpur

Course Name:	Computer Organisation and Architecture
Course Link:	https://nptel.ac.in/courses/106/106/106106166
Course Instructor:	Prof. V. Kamakoti, IIT Madras

Course Name:	Computer Organisation
Course Link:	https://nptel.ac.in/courses/106/106/106106092
Course Instructor:	Prof. S. Raman, IIT Madras

Course Name:	Computer Organisation and Architecture
Course Link:	https://nptel.ac.in/courses/106/104/106104073
Course Instructor:	Prof. B. Raman, IIT Kanpur

Course Name:	Computer Organisation and Architecture
Course Link:	https://nptel.ac.in/courses/106/103/106103068
Course Instructor:	Prof. J.K Deka, IIT Guwahati

Course Name:	Computer Organisation and Architecture- A Pedagogical Aspect
Course Link:	https://nptel.ac.in/courses/106/103/106103180
Course Instructor:	Prof. J.K Deka, Dr. S. Biswas and Prof. A. Sarkar, IIT Guwahati

5Th Semester

Control System

Module I: **(5 hours)**

Industrial Control examples. Mathematical models of physical systems. Control hardware and their models. Transfer function models of linear time-invariant systems. Feedback Control: Open-Loop and Closed-loop systems. Benefits of Negative Feedback. Block diagram algebra. Signal Flow Graph and Mason's Gain formula.

Module II: **(10 hours)**

Standard test signals. Time response of first and second order systems for standard test inputs. Application of initial and final value theorem. Design specifications for second-order systems based on the time-response. Concept of Stability. Routh-Hurwitz Criteria. Relative Stability analysis. Root-Locus technique. Construction of Root-loci.

Module III: **(7 hours)**

Relationship between time and frequency response, Polar plots, Bode plots. Nyquist stability criterion. Relative stability using Nyquist stability criterion – gain and phase margins. Closed-loop frequency response: Constant M Circle, Constant N Circle, Nichols Chart.

Module IV: **(10 hours)**

Stability, steady-state accuracy, transient accuracy, disturbance rejection, insensitivity and robustness of control systems. Root-loci method of feedback controller design. Design specifications in frequency-domain. Frequency-domain methods of design. Application of Proportional, Integral and Derivative Controllers, Tuning of PID controllers, Lead and Lag and Lag-Lead compensator design.

Module V: **(10 hours)**

Concepts of state variables. State space model. Diagonalization of State Matrix. Solution of state equations. Eigenvalues and Stability Analysis. Concept of controllability and observability. Pole-placement by state feedback. Discrete-time systems. Difference Equations. State-space models of linear discrete-time systems. Stability of linear discrete-time systems.

Books:

[1] I. J. Nagrath and M. Gopal, "Control Systems Engineering", New Age International, 2009.

[2] K. Ogata, "Modern Control Engineering", Prentice Hall, 1991

[3] M. Gopal, "Control Systems: Principles and Design", McGraw Hill Education, 1997.

[4] B. C. Kuo, "Automatic Control System", Prentice Hall, 1995.

Digital Learning Resources:

Course Name:	Control System Engineering
Course Link:	https://nptel.ac.in/courses/108/102/108102043/
Course Instructor:	Prof. M Gopal, IIT Delhi

Course Name:	Control Systems
Course Link:	https://nptel.ac.in/courses/107/106/107106081/
Course Instructor:	Prof. C.S.Shankar Ram, IIT Madras

5Th Semester

Advance Electronics Circuits

Module-I: **(10 Hours)**

Active Filters :Active Filters, Frequency response of Major Active filters, First order low-pass Butterworth filter: Filter Design, Frequency Scaling, Second-order low- pass Butterworth filter: First-order high-pass Butterworth filter, Second-order high- pass Butterworth filter, Band-pass filters: Wide band-pass Filter, Narrow Band-Pass Filter, Band-reject filters: Wide Band-Reject Filter, Narrow Band-Reject Filter, All- Pass filter.

Oscillators: Oscillators: Oscillator Principles, Oscillator Types, Quadrature Oscillator, Saw tooth wave generator, Voltage-controlled oscillator.

Comparators: Comparators: basic comparator, zero-crossing detector, Schmitt trigger, comparator characteristics, limitations of Op-Amp as comparators, voltage limiters.

Module-II: **(10 Hours)**

Bistable Multivibrator: Bistable Multivibrator, fixed-bias bistable multi vibrator, Loading, self-biased transistor binary, commutating capacitors, Triggering the binary, Unsymmetrical Triggering of the bistable multivibrator, Triggering Un symmetrically through a Unilateral Device, Triggering, Triggering of a Bistable Multi Symmetrically without the Use of Auxiliary Symmetrical Diodes, Schmitt Trigger Circuit (Emitter-coupled Bistable Multivibrator

Monostable and Astable Multivibrator: Monostable Multivibrator, Gate width of a Collector-Coupled Monostable Multivibrator, wave form of the Collector-Coupled Monostable Multivibrator, Emitter -Coupled Monostable Multivibrator, triggering of the Monostable Multivibrator, Astable Collector-Coupled Multivibrator, Emitter -Coupled Astable Multivibrator

Wideband amplifiers: Wideband amplifiers: The Hybrid-π, High-frequency, Small- signal, Common-emitter Model, RC-Coupled Amplifier, Frequency Response of a Transistor Stage-The Short-Circuit Current Gain, Current Gain with Resistive Load, Transistor Amplifier Response taking Source Impedance into Account, Transient Response of a Transistor Stage.

Module-III: **(10 Hours)**

Negative Resistance Switching Devices: Voltage Controllable Negative resistance devices, Tunnel Diode operation and characteristics, Monostable Astable, Bistable circuits using tunnel diode, Voltage controlled Negative Resistance Switching Circuits.

Voltage and Current Time Base Generators: Time-Base Generators, General features of a Time-base signal, Methods of generating a voltage time-base waveform, Exponential sweep circuit, Miller and bootstrap time base generators-Basic principles, Transistor miller time base generator, Transistor bootstrap time base generator, Current Time-Base Generators, A Simple Current sweep, Linearity Correction through adjustment of driving waveform, Transistor current time base generator.

Module IV **(10 Hours)**

Specialized IC Applications: IC 555 Timer: IC 555 Timer as a Monostable Multivibrator and its applications, IC 555 Timer as Astable Multivibrator and its applications. Phase Locked Loop: Operating principle of PLL, Phase detectors, Exclusive-OR phase detector, Monolithic phase detector, Instrumentation Amplifier and its applications.

Module V

Cascaded CE Transistor Stages, Rise-time Response of Cascaded Stages, Shunt Compensation of a Transistor Stage in a Cascade, Rise Time of Cascaded Compensated Stages, Low frequency Compensation.

Books:

[1] Pulse, Digital and switching Waveforms, Jacob Millman, Herbert Taub and MS Prakash Rao, TMH Publication, Second Edition.

[2] Pulse, Switching and Digital Circuits,David A. Bell, Oxford University Press, Fifth Edition.

[3] OP-Amps and Linear Integrated Circuits, Ramakant A. Gayakwad, PHI Publication.

[4] Pulse & Digital Circuits, K.Venkata Rao, K Rama Sudha& G Manmadha Rao, Pearson Education, 2010.

[5] OP-Amps and Linear Integrated Circuits, Robert F. Coughlin, Frederick F. Driscoll, Pearson Education Publication.

[6] Pulse and Digital Circuits**,** A. Anand Kumar, PHI.

Digital Learning Resources:

5Th Semester

Electronics Instrumentation & Measurements

Module-I (12 Hours)

Basics of Measurements: Accuracy, Precision, resolution, reliability, repeatability, validity, Errors and their analysis, Standards of measurement. Bridge Measurement: DC bridges- wheat stone bridge, AC bridges – Kelvin, Hay, Maxwell, Schering and Wien bridges, Wagner ground Connection. Electronic Instruments for Measuring Basic Parameters: Amplified DC meter, AC Voltmeter, True- RMS responding Voltmeter, Electronic multi-meter, Digital voltmeter, Vector Voltmeter.

Module-II (12 Hours)

Oscilloscopes: Cathode Ray Tube, Vertical and Horizontal Deflection Systems, Delay lines, Probes and Transducers, Specification of an Oscilloscope. Oscilloscope measurement Techniques, Special Oscilloscopes – Storage Oscilloscope, Sampling Oscilloscope, Signal Generators: Sine wave generator, Frequency – Synthesized Signal Generator, Sweep frequency Generator. Pulse and square wave generators. Function Generators.

Module-III (10 Hours)

Signal Analysis: Wave Analyzer, Spectrum Analyzer. Frequency Counters: Simple Frequency Counter; Measurement errors; extending frequency range of counters Transducers: Types, Strain Gages, Displacement Transducers.

Module-IV (6 Hours)

Digital Data Acquisition System: Interfacing transducers to Electronics Control and Measuring System. Instrumentation Amplifier, Isolation Amplifier. An Introduction to Computer-Controlled Test Systems.IEEE-488 GPIB Bus

Books:

[1]. Modern Electronics Instrumentation & Measurement Techniques, by Albert D.Helstrick and William D.Cooper, Pearson Education.

[2]. Elements of Electronics Instrumentation and Measurement-3rd Edition by Joshph J. Carr. Pearson Education.

[3]. Electronics Instruments and Instrumentation Technology – Anand, PHI

[4] Doebelin, E.O., Measurement systems, McGraw Hill, Fourth edition, Singapore, 1990.

[5] A Course in Electrical and Electronic Measurements and Instrumentation, A K Sawhney, Puneet Swhney, Dhanpat Rai & Co

Digital Learning Resources:

Course Name:	Electrical Measurement and Electronics Instrument
Course Link:	https://nptel.ac.in/courses/108/105/108105153
Course Instructor:	Prof. Avisek Chatterjee, IIT, Kharagpur

5Th Semester

Digital VLSI Design

MODULE-I

Introduction: Historical Perspective, VLSI Design Methodologies, VLSI Design Flow, Design Hierarchy, Concept of Regularity, Modularity and Locality, VLSI Design Styles, Computer-Aided Design Technology.

Fabrication of MOSFETs: Introduction, Fabrication Processes Flow – Basic Concepts, The CMOS n-Well Process, Layout Design Rules, Stick Diagrams, Full Customs Mask Layout Design.

MOS Transistor: The Metal Oxide Semiconductor (MOS) Structure, The MOS System under External Bias, Structure and Operation of MOS Transistor (MOSFET), MOSFET Current-Voltage Characteristics, MOSFET Scaling and Small-Geometry Effects, MOSFET Capacitance.

MODULE-II

MOS Inverters – Static Characteristics: Introduction, Resistive-Load Inverters, Inverters with n-Type MOSFET Load, CMOS Inverter.

MOS Inverters – Switching Characteristics and Interconnect Effects: Introduction, Delay-Time Definitions, Calculation of Delay-Times, Inverter Design with Delay Constraints, Estimation of Interconnect Parasitics, Calculation of Interconnect Delay, Switching Power Dissipation of CMOS Inverters.

Combinational MOS Logic Circuits: Introduction, MOS Logic Circuits with Depletion NMOS Loads, CMOS Logic Circuits, Complex Logic Circuits, CMOS Transmission Gates (Pass Gates).

MODULE-III

Sequential MOS Logic Circuits: Introduction, Behaviour of Bistable Elements, SR Latch Circuits, Clocked Latch and Flip-Flop Circuits, CMOS D-Latch and Edge Triggered Flip Flop.

Dynamic Logic Circuits: Introduction, Basic Principles of Pass Transistor Circuits, Voltage Bootstrapping, Synchronous Dynamic Circuit Techniques, Dynamic CMOS Circuit Techniques, High Performance Dynamic CMOS Circuits.

MODULE-IV

Design for Testability: Introduction, Fault Types and Models, Ad Hoc Testable Design Techniques, Scan-Based Techniques, Built-In Self-Test (BIST) Techniques, Current Monitoring IDDQ Test.

MODULE-V

Semiconductor Memories: Introduction, Dynamic Random Access Memory (DRAM), Static Random Access Memory (SRAM), Non-volatile Memory, Flash Memory.

Books:

[1] *CMOS Digital Integrated Circuits: Analysis and Design*, Sung-Mo Kang and Yusuf Leblebici, Tata McGraw-Hill Publishing Company Limited, 3rdEdn, 2003.

[2] Principles of CMOS VLSI Design – a Systems Perspective, K. Eshraghian and N.H.E. Weste, Addison Wesley,2nd Edition, 1993.

[3] Digital Integrated Circuits– *A Design Perspective***,** Jan M. Rabaey, Anantha Chandrakasan, Borivoje Nikolic, PHI, 2nd Edn.

[4] Modern VLSI Design System – *on – Chip Design*, Wayne Wolf, PHI, 3rd Edn.
[5] VLSI Design, Debaprasad Das, Oxford University Press, New Delhi, 2010.
[6] CMOS Logic Circuit Design, John P. Uyemura, Springer, 2001.
[7] Digital Integrated Circuit Design, Ken Martin, Oxford University Press, 2000.
[8] VLSI Design Technique forAnalog and Digital Circuits, R L Geiger, TMH.

Digital Learning Resources:

Course Name:	VLSI Design
Course Link:	https://nptel.ac.in/courses/117/101/117101058/
Course Instructor:	Prof. A.N. Chandorkar, IIT Bombay

Course Name:	Digital VLSI Testing
Course Link:	https://nptel.ac.in/courses/117/105/117105137/
Course Instructor:	Prof. S, Chattopadhyay, IIT Kharagpur

Course Name:	VLSI Technology
Course Link:	https://nptel.ac.in/courses/117/106/117106093/
Course Instructor:	Dr. Nandita Dasgupta, IIT Madras

5Th Semester

Universal Human Values

(Self, Society and Nature)

Pre-requisites: Universal Human Values: Self & Family (desirable); 4-day Harmony-2 Workshop (co-requisite). Please refer to AICTE Model Curriculum-Vol-II.

1. Objective:

The objective of the course is four-fold:

A. Sensitization of student towards issues in society and nature.
B. Understanding (or developing clarity) of nature, society and larger systems, on the basis of human relationships and resolved individuals.
C. Strengthening of self reflection.
D. Development of commitment and courage to act.

(For elaboration on some of the above, consult course description for Universal Human Values 1: Self and Family, AICTE Model Curriculum-VOL-II).

2. Course Topics :

In this Universal Human Values course, the focus is more on understanding society and nature on the basis of self and human relationships.

i) Purpose and motivation for the course.
ii) Recapitulation (from the previous course) on ideas of self, pre-conditioning, and natural acceptance.
iii) Harmony in the self. Understanding human being as co-existence of self and body. Identifying needs and satisfying needs of self and body. Self-observations. Handling peer pressure.
iv) Recapitulation on relationships. Nine universal values in relationships. Reflecting on relationships in family. Hostel and institute as extended family. Real life examples.
v) Teacher-student relationship. Shraddha. Guidance. Goal of education.
vi) Harmony in nature. Four orders of nature – material order, plant order, animal order and human order. Salient features of each. Human being as cause of imbalance in nature. (Film **"Home"** can be used.)
vii) Human being as cause of imbalance in nature. Depletion of resources – water, food, mineral resources. Pollution. Role of technology. Mutual enrichment not just recycling.
viii) Prosperity arising out of material goods and understanding of self. Separation of needs of the self and needs of the body. Right utilization of resources. lkekU; vkdka{kk ,oa egRokdka{kk, Understanding the purpose they try to fulfil.

ix) Recapitulation on society. Five major dimensions of human society. Fulfilment of the individual as major goal. Justice in society. Equality in human relationships as naturally acceptable. Establishment of society with abhaya (absence of fear).

x) Ethical human conduct. Values, character and netikataa.

xi) Professional ethics. Conduct as an engineer or scientist.

Analog and Digital Communication Laboratory

List of Experiments

Analog Communication: (Any five)

1. Analyze and plot the spectrum of following signals with aid of spectrum analyzer: Sine wave, square wave, triangle wave, saw-tooth wave of frequencies 1 KHz, 10 KHz, 50 KHz, 100KKz and 1 MHz.
2. Analyze the process of frequency division multiplexing and frequency division demultiplexing.
3. Study and design of AM modulator and demodulator. (Full AM, SSB, DSBSC, SSBSC)
4. Study of FM modulation and Demodulation Techniques.
4. Observer the process of PAM, quantization and determination of quantization noise.
5. Multiplex 2-4 PAM/ PPM and PWM signals.
6. Using MATLAB/ LABVIEW generate a carrier and a modulating signal. Modulate the carrier using AM. Show the waveform in time domain and analyze its frequency spectrum. Repeat the simulation for modulating signal being square, triangular and other forms waveform.
7. Using MATLAB/ LABVIEW generate a carrier and a modulating signal. Modulate the carrier using FM. Show the waveform in time domain and analyze its frequency spectrum. Repeat the simulation for modulating signal being square, triangular and other forms waveform.
8. Using Lab-View software simulates AM/FM modulation and demodulation system.

Digital Communication: (Any five)

1. Study the functioning of PCM and Delta modulator; Demonstrate the process of PCM modulation and Delta modulation.
2. Modulation generation and detection Signal generator CRO
3. To study Time division multiplexing.
4. To study the different channel coding and decoding technique.
5. Generation and reception of different types of signals like ASK, PSK, FSK.
6. To transmit and receive three separate signal audio, video, tone simultaneously through satellite link.
7. To transmit PC data through satellite link using a satellite communication demonstration unit.
8. Experimentally compare different forms of BPSK, QPSK, and OQPSK and analyze their Spectrum with spectrum analyzer.

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Digital Signal Processing Laboratory

List of Experiments

1. Familiarization with the architecture of a standard DSP kit (Preferably TMS 320C6XXX DSP kit of Texas Instruments)
2. Generation of various types of waveforms (sine, cosine, square, triangular etc.) using MATLAB and DSP kit.
3. Linear convolution of sequences (without using the inbuilt conv. function in MATLAB) and verification of linear convolution using DSP kit.
4. Circular convolution of two sequences and comparison of the result with the result obtained from linear convolution using MATLAB and DSP kit.
5. (i) Computation of autocorrelation of a sequence, cross correlation of two sequences using MATLAB.
   (ii) Computation of the power spectral density of a sequence using MATLAB also implementing the same in a DSP kit.
6. Finding the convolution of a periodic sequence using DFT and IDFT in MATLAB.
7. (i) Implementation of FFT algorithm by decimation in time and decimation in frequency using MATLAB.
   (ii) Finding the FFT of a given 1-D signal using DSP kit and plotting the same.
8. Design and implementation of FIR (lowpass and highpass) Filters using windowing techniques (rectangular window, triangular window and Kaiser window) in MATLAB and DSP kit.
9. Design and implementation of IIR (lowpass and highpass) Filters (Butterworth and Chebyshev) in MATLAB and DSP kit.
10. (i) Convolution of long duration sequences using overlap add, overlap save using MATLAB.
    (ii) Implementation of noise cancellation using adaptive filters on a DSP kit.

Digital Learning Resources:

Virtual Lab Link: http://vp-dei.vlabs.ac.in/Dreamweaver/list.html

Microprocessors and Microcontrollers Laboratory

List of Experiments

(Perform any 10 Experiments)

1. Programs for 16-bit arithmetic operations using 8086.
2. Programs for Sorting and Searching (Using 8086).
3. Programs for String manipulation operations (Using 8086).
4. Programs for Digital clock and Stop watch (Using 8086).
5. Interfacing ADC and DAC.
6. Parallel Communication between two MP Kits using Mode 1 and Mode 2 of 8255.
7. Interfacing and Programming 8279, 8259, and 8253.
8. Serial Communication between two MP Kits using 8251.
9. Interfacing and Programming of Stepper Motor and DC Motor Speed control.
10. Programming using Arithmetic, Logical and Bit Manipulation instructions of 8051microcontroller.
11. Programming and verifying Timer, Interrupts and UART operations in 8051
12. Communication between 8051 Microcontroller kit and PC.
13. A design problem using 8051 (A problem like multi-parameter data acquisition system, voltmeter, power meter, frequency counter, traffic simulation, digital clock, etc)

Digital Learning Resources:

Virtual Lab Link: http://202.3.77.143/virtuallab/login.php

BIJU PATNAIK UNIVERSITY OF TECHNOLOGY, ODISHA

ROURKELA

Curriculum and Syllabus

B. Tech (Electronics and Communication Engineering/ Electronics and Tele Communication Engineering) from the Admission Batch

2018-19

Semester (6th)

Sixth Semester							
Theory							
Sl. No.	**Category**	**Course Code**	**Course Title**	**L-T-P**	**Credit**	**University Marks**	**Internal Evaluation**
1	PC	RCS6C001	Microwave Engineering	3-0-0	3	100	50
2	PC	RCS6C002	Wireless Communication	3-0-0	3	100	50
3	BS		Optimization in Engineering	3-0-0	3	100	50
4	PE		Antenna Engineering	3-0-0	3	100	50
			Micro Electronic Mechanical Systems	3-0-0			
			Biomedical Instrumentation	3-0-0			
5	OE		Artificial Intelligence and Machine Learning	3-0-0	3	100	50
			Renewable Power Generation Systems	3-0-0			
			Data Communication and Computer Networks	3-0-0			
6	MC*	RIK6F001	Essence of Indian Knowledge Tradition - I	3-0-0	0	-	100 (Pass mark is 37)
Total Credit (Theory)					**15**		
Total Marks						**500**	**250**
Practical							
1	PC	RCS6C201	Microwave Engineering Lab	0-0-3	2		100
2	PC	RCS6C202	Wireless Communication Lab	0-0-3	2		100
3	PSI		Future-ready Contributor Program	0-0-3	2		100
4	PSI		Seminar - I	0-0-3	1		100
Total Credit (Practical)					**7**		
Total Semester Credit					**22**		
Total Marks							**400**
SUMMER ENTERNSHIP TRAINING FOR 45 DAYS							

***Mandatory Non-Credit Courses (MC) result will be reflected with Pass (P) / Fail (F) grade. Thus the grade obtained will not be affecting the grade point average. However it shall appear on the grade sheet as per AICTE rule.**

6th Semester	RCS6C001	Microwave Engineering	L-T-P 3-0-0	3 Credits

Module I: **(10 hours)**

High Frequency Transmission lines and Wave guides : The Lumped –Element Circuit model for a Transmission line. Wave propagation. The lossless line. Field Analysis of Co-ax Transmission Lines. R, L. C. G parameters of Co-ax& Two wire Transmission Lines. Terminated lossless transmission line. Transmission line as circuit element. The Smith Chart. Solution of Transmission line problems using Smith Chart. Single Stub and Double Stub matching. Lowloss line.

Wave guides : Rectangular waveguide, Field solution for TE and TM modes, Field patterns power flow through waveguide. Attenuation due to conductor and dielectric losses. Design of Rectangular waveguide to support Dominant TE10 only.

Module II: **(10 hours)**

TEM mode in Co-ax line. Cylindrical waveguide - Dominant Mode. Design of Cylindrical Waveguide to support Dominant TE11 mode. Microwave Resonator : Rectangular Waveguide Cavities. Resonant frequencies and of Cavity Supporting. Dominant mode only. Excitation of waveguide and Resonators (in princle only) Waveguide Components: Power Dividers and Directional Couplers : Basic Properties. The T-Junction Power Divider. Waveguide Directional Couplers. Fixed and Precision Variable Attenuator. Ferrite, Fermle Isolator . Principle of Operationing.

Module III: **(8 hours)**

Principle of Operation as an amplifier at high frequency, HEMT Amplifier, Concept of Doherty Amplifier and its use at high frequency, Gunn Oscillator Principle and performance Simple Analysis Electron – field interaction, Mixer: Linear Mixer Operation, active devices to use as mixer

Module IV: **(6 hours)**

Microwave Antennas: Horn Antennas : E-And H- Plane Horns. Radiation Patterns. Pyramidal Horn. Gain of Horn Antenna. Paraboloid Reflector Antenna – Simple Analysis , Radiation Pattern in principal Planes. Gain and Bandwidth of Reflector Antenna. Microwave Propagation : Line of sight propagation. Attenuation of Microwaves by Atmospheric gases, Water Vapour & Precipitates. Microwave Measurement : Measurement of Admittance . Measurement of Gain of a Horn Antenna.

Books:

[1] Microwave Engineering by D. M. Pozor , 2nd Edition. John Willy & Sons. Selected portions from Chapter 2, 3, 4, 6, 7 & 9.
[2] Principles of Microwave Engineering By Reich, Oudong and Others.
[3] Microwave Device and Circuit, 3rd Edition, Sammuel Y., Liao, Perason
[4] Microwave Devices and Circuits, G S N Raju

Digital Learning Resources:

Course Name:	Microwave Engineering
Course Link:	https://nptel.ac.in/courses/108/103/108103141/
Course Instructor:	Dr. Ratnajit Bhattacharjee, IIT, Guwahati

Course Name:	Microwave Theory and Techniques
Course Link:	https://nptel.ac.in/courses/108/101/108101112/
Course Instructor:	Prof. Girish Kumar, IIT, Bombay

6th Semester		Wireless Communication	L-T-P 3-0-0	3 Credits

Module I: **(5 hours)**

History of wireless communication: Concept of mobile and personal communication, wireless cellular platform, the design fundamentals of cellular networks, frequency reuse, spectrum capacity enhancement techniques, co-channel and adjacent channel interference, location management, handoff management; Concept of mobile IP for mobility management issues.

Module II: **(10 hours)**

Propagation Models for Wireless Networks: Two-ray ground reflection model, a micro-cell propagation model, a macro-cell propagation model, shadowing model, large scale path loss and shadowing, multi path effects in mobile communication, linear time variant channel model; Concept of coherent bandwidth, Coherent time, Doppler Shift - Effect of velocity of the mobile, models for multi path reception, mobile communication antennas.

Module III: **(7 hours)**

Multiple access techniques in wireless communications: frequency division multiple access technology (FDMA), time division multiple access (TDMA), space division multiple access (SDMA), code division multiple access (CDMA); spectral efficiency of different wireless access technologies, spectral efficiency in FDMA system, spectral efficiency in TDMA system, spectral efficiency for DS-CDMA system.

Module IV: **(10 hours)**

Second Generation Mobile Networks-GSM: Architecture and protocols, access technology, call set up procedure, 2.5 G networks; evolution to GPRS, concept of data communication on GPRS, session management and PDP Context, data transfer through GPRS network and routing, concept of LTE, WiMax, 4G and 5G

Module V: **(8 hours)**

Applications of different RF bands: ranges • Brief about various applications of RF technology like WiFi, Bluetooth, Air traffic control, GPS navigation system, satellite systems, mobile networks, radio astronomy and remote sensing, 5G technology. • LTE-WiFi Radio Level Aggregation (LWA).

Books:

[1] Wireless Communications- Principles and Practice, T S Rappaport, Pearson Education India, Second Edition.
[2] Wireless Communication and Networks, Upen Dalal, Oxford university Press, First Edition, 2015.
[3] Wireless Communication and Networks 3G and Beyond, Iti Saha Misra, Tata McGraw Hill Education Pvt. Ltd, Second Edition, 2009.
[4] Mobile Communication Engineering – Theory and Applications W C Y Lee, TMH Publication, Second Edition, 2008.
[5] Wireless Communication, Andrea Goldsmith, Cambridge University Press, 2005
[6] Fundamentals of Wireless Communication, David Tse and Pramod Viswanath, Cambridge University Press, 2005

Digital Learning Resources:

Course Name:	Wireless Communication
Course Link:	https://nptel.ac.in/courses/117/102/117102062/
Course Instructor:	Prof. Ranjan Bose, IIT, Delhi

Course Name:	Introduction to Wireless and Cellular Communication
Course Link:	https://nptel.ac.in/courses/108/106/106106167/
Course Instructor:	Prof. David KoilPillai, IIT, Madras

6th Semester		Optimization in Engineering	L-T-P 3-0-0	3 Credits

Module I: **(10 Hours)**

Idea of Engineering optimization problems, Classification of optimization algorithms, modeling of problems and principle of modeling. Linear Programming: Formulation of LPP, Graphical solution, Simplex method, Big-M method, Revised simplex method, Duality theory and its application, Dual simplex method, Sensitivity analysis in linear programming.

Module II: **(10 Hours)**

Transportation problems: Finding an initial basic feasible solution by Northwest Corner rule, Least Cost rule, Vogel's approximation method, Degeneracy, Optimality test, MODI method, Stepping stone method. **Assignment problems:** Hungarian method for solution of Assignment problems. Integer Programming: Branch and Bound algorithm for solution of integer programming problems.

Module III: **(12 Hours)**

Non-linear programming: Introduction to non-linear programming. Unconstraint optimization: Fibonacci and Golden Section Search method. Constrained optimization with equality constraint: Lagrange multiplier, Projected gradient method. Constrained optimization with inequality constraint: Kuhn-Tucker condition, Quadratic programming.

Module IV: **(6 Hours)**

Queuing models: General characteristics, Markovian queuing model, M/M/1 model, Limited queue capacity, multiple server, Finite sources, Queue discipline.

Books:

[1] Operations Research- Principle and Practice, A. Ravindran, D. T. Philips, J. Solberg, Second edition, Wiley India Pvt Ltd.
[2] Operation Research, Prabhakar Pai ,Oxford University Press
[3] Optimization for Engineering Design, Kalyanmoy Deb, PHI Learning Pvt Ltd.
[4] Operations Research, H.A.Taha, A.M.Natarajan, P.Balasubramanie, A.Tamilarasi, Pearson Education, Eighth Edition.
[5] Engineering Optimization, S S Rao, New Age International Pvt Ltd, 2003.
[6] Linear and Non-linear Optimization, **S**tephen G. Nash, A. Sofer, McGraw Hill, 2nd Edition.
[7] Engineering Optimization, A.Ravindran, K.M.Ragsdell, G.V.Reklaitis, Wiley India Pvt. Ltd, Second edition.
[8] Operations Research, F.S.Hiller, G.J.Lieberman, Tata McGraw Hill, Eighth Edition, 2005.
[9] Operations Research, P.K.Gupta, D.S.Hira, S.Chand and Company Ltd, 2014.

Digital Learning Resources:

Course Name	Constrained and Unconstrained Optimization
Course Link	https://nptel.ac.in/courses/111/105/111105100/
Course Instructor	Prof. A. Goswami and Prof. D. Chakraborty, IIT Kharagpur

6th Semester		Antenna Engineering	L-T-P 3-0-0	3 Credits

Module-I: **(10 Hours)**

Principles of Radiation, Retarded Vector Magnetic Potential. Radiation field from Current element. Radiation Resistance, Current Distribution, on a thin Wire. Half wave dipole and Quarter wave monopole. Two-element array. Principle of Pattern Multiplication. Linear Array. Broadside and end fire patterns. Antenna Gain, effective length of an antenna. Input Impedance. Balun.

Module-II: **(10 Hours)**

Folded Dipole, Yagi Antenna. Frequency Independent Antenna. Log Periodic Dipole array. Secondary Sources and Aperture Antennas . Magnetic Current. Principles of Images. The Equivalence Theorem. Radiation form Huygen's Sources. Radiation from open end of a Co-axial line. Aperture in an absorbing screen. Radiation through an aperture in a perfectly conducting screen. Babinet's Principle– Complementary Screen. A thin slot in an infinite Screen. Slot antenna on a rectangular wave guide wall.

Module-III: **(8 Hours)**

Horn Antennas – Pyramidal &Sectoral Horn. Radiation Pattern and Gain of horn antenna. Parabolic Reflector Antenna Principle, analysis, Radiation Pattern and Gain. Principles of Casse grain Antenna. Inducted EMF method of Calculating Input Impedance of wire antenna. Mutual Impedance between two dipoles.

Module IV **(8 Hours)**

Microstrip Antenna – Basic Characteristics, Rectangular Patch, Circular Patch, Microship Array Antenna. Electronic Scanning Antenna- Phase Scanning, Frequency Scanning and Beam switching Antenna Measurements – Radiation Pattern, Gain and Input Impedance. 5G Antenna

Books:

[1] Electromagnetic Wave and Radiating Systems by E. C Jordan and K. G. Balmain, 2nd Edition , PHI. Ch. 10,11,12,13,14 and 15.
[2] Antennas Theory - Analysis and Design By C Balamis, 2nd Edition, John Willey & Sons. Selected portion Ch. 11,12,13, 15 and 16.
[3] Antenna Engineering by J. D. Krauss.
[4] Antenna Engineering by W. L. Weeks
[5] Antennas and Wave Propagation by G. S. N. Raju, Pearson Education.
[6] Antenna & Wave Propagation by R.E. Collins.

Digital Learning Resources:

Course Name: Antennas
Course Link: https://nptel.ac.in/courses/108/101/108101092/
Course Instructor: Prof. Girish Kumar, IIT, Bombay

Course Name: Analysis and Design Principles of Microwave Antennas
Course Link: https://nptel.ac.in/courses/108/105/108105114/
Course Instructor: Dr. Amitabha Bhattacharya, IIT Kharagpur

6th Semester		Micro Electronic Mechanical Systems	L-T-P 3-0-0	3 Credits

Module-I: **(12 hours)**

Introduction and Emergence of MEMS, Scaling issues, materials for MEMS, Thin film deposition, Photolithography, doping, wet and dry etching

Micromachining Techniques: Surface and Bulk micro machining, wafer bonding, surface micro machining and LIGA process, Silicon as material for micromachining, (Chapter 3 and Section 8.2 of Book 1, Chapter 2 of Book 2)

Module-II: **(12 hours)**

MEMS devices, Engineering Mechanics for Micro System Modeling and Design – static bending of thin plates, Mechanical vibrational analysis, Thermo mechanical analysis, fracture mechanics analysis, thin film mechanics, Mechanics of deformable bodies, Energy method, Estimation of stiffness and damping for different micro-structures, Modeling of electromechanical systems, Pull-in voltage, Theory and design: Micro Pressure Sensor, micro accelerometer – capacitive and piezoresistive, micro actuator.(Section 4.1 to 4.3 and 6.2.2 of Book 1, Section 3.4 of Book 2)

Module-III: **(12 hours)**

MEMS Applications: Mechanical sensors and actuators: Piezoresistive pressure sensors, MEMS capacitive accelerometer, Optical Gyroscopes: Micro-lens, Micro-mirror, Optical Switch Radiofrequency MEMS: Inductor, Varactor, Filter, Resonator.

Microfluidics: Capillary action, Micro pumping, Electro wetting, Lab-on-a-chip.

Electronic interfaces, design, simulation and layout of MEMS devices using CAD tools. (Section 10.1to 10.8 of Book 2)

Books:

[1] G.K. Ananthsuresh, K.J. Vinoy, S. Gopalakrishnan, K.N. Bhat and V.K. Atre: Micro and Smart Systems, Wiley India, New Delhi, 2010.

[2] N.P. Mahalik: MEMS, Tata McGraw-Hill, New Delhi, 2007.

[3] T. Hsu: MEMS and Microsystems: Design and Manufacture, Tata McGraw-Hill, New Delhi, 2002.

[4] Gabriel M. Rebeiz: RF MEMS Theory, design &Technology, Wiley India Education,2010.

Digital Learning Resources:

Course Name: MEMS and Microsystems
Course Link: https://nptel.ac.in/courses/117/105/117105082/
Course Instructor: Prof. Santiram Kal, IIT Kharagpur

6th Semester		Biomedical Instrumentation	L-T-P 3-0-0	3 Credits

Module-I: **(13 Hours)**

Introduction to Bioengineering, Biochemical Engineering, Biomedical Engineering, Sources of Biomedical Signals, Basic medical Instrumentation systems and their need, use of microprocessors in medical instruments, PC based medical Instruments, general constraints in design of medical Instrumentation system & Regulation of Medical devices.

Bioelectrical Signals & Electrodes: Origin of Bioelectric Signals, Electrocardiogram, Electroencephalogram, Electromyogram, Electrode-Tissue Interface, Polarization, Skin Contact Impedance, Motion Artifacts.

Module-II: **(10 Hours)**

Electrodes for ECG: Limb Electrode, Floating Electrodes, Pre-gelled disposable Electrodes, Electrodes for EEG, Electrodes for EMG.

Physiological Transducers: Introduction to Transducers, Classification of Transducers, Performance characteristics of Transducers, Displacement, Position and flow and pressure Transducers.

Strain gauge pressure transducers, Thermocouples, Electrical Resistance Thermometer, The mister, Photovoltaic transducers, Photo emissive Cells & Biosensors (Biochemical sensors).

Module-III: **(10 Hours)**

Recording Systems: Basic Recording systems, General considerations for Signal conditioners, Preamplifiers, Differential Amplifier, Isolation Amplifier, Electrostatic and Electromagnetic Coupling to AC Signals, Proper Grounding (Common Impedance Coupling)

Books:

[1] Hand Book of Biomedical Instrumentation by R.S. Khandpur,-2nd Edition, Tata McGrawHill, 2003.
[2] Introduction to Biomedical Engineering by Michael M.Domach,Pearson Education Inc,-2004.
[3] Biomedical Instrumentation and Measurements- by Leslie Cromwell, Fred J. Weibell, Erich A. Pfeiffer, 2ndEdition, PHI learning Pvt. Ltd
[4] Introduction to Biomedical equipment technology,4e. By JOSEPH.J.CAAR &JOHN M.BROWN (Pearson education publication).
[5] Medical Instrumentation-application & design. 3e – By JOHN.G.WEBSTER John Wiley & Sons publications.

Digital Learning Resources:

Course Name: Biomedical Signal Processing
Course Link: https://nptel.ac.in/courses/108/105/108105101/
Course Instructor: Prof. Sudipta Mukhopadhyay , IIT Kharagpur

6th Semester		Artificial Intelligence and Machine Learning	L-T-P 3-0-0	3 Credits

Module-I: **(12 hours)**

INTRODUCTION –The Foundations of Artificial Intelligence; - INTELLIGENT AGENTS – Agents and Environments, Good Behaviour: The Concept of Rationality, the Nature of Environments, the Structure of Agents, SOLVING PROBLEMS BY SEARCH – Problem-Solving Agents, Formulating problems, Searching for Solutions, Uninformed Search Strategies, Breadth-first search, Depth-first search, Searching with Partial Information, Informed (Heuristic) Search Strategies, Greedy best-first search, A* Search, CSP, Means-End-Analysis.

Module-II: **(12 hours)**

ADVERSARIAL SEARCH – Games, The Mini-Max algorithm, optimal decisions in multiplayer games, Alpha-Beta Pruning, Evaluation functions, Cutting off search, LOGICAL AGENTS – Knowledge-Based agents, Logic, Propositional Logic, Reasoning Patterns in Propositional Logic, Resolution, Forward and Backward chaining - FIRST ORDER LOGIC – Syntax and Semantics of First-Order Logic, Using First-Order Logic , Knowledge Engineering in First-Order Logic - INFERENCE IN FIRST ORDER LOGIC – Propositional vs. First-Order Inference, Unification and Lifting, Forward Chaining, Backward Chaining, Resolution

Module-III: **(6 hours)**

UNCERTAINTY – Acting under Uncertainty, Basic Probability Notation, The Axioms of Probability, Inference Using Full Joint Distributions, Independence, Bayes' Rule and its Use, PROBABILISTIC REASONING – Representing Knowledge in an Uncertain Domain, The Semantics of Bayesian Networks, Efficient Representation of Conditional Distribution, Exact Inference in Bayesian Networks, Approximate Inference in Bayesian Networks

Module-IV: **(10 hours)**

LEARNING METHODS – Statistical Learning, Learning with Complete Data, Learning with Hidden Variables, Rote Learning, Learning by Taking Advice, Learning in Problem-solving, learning from Examples: Induction, Explanation-based Learning, Discovery, Analogy, Formal Learning Theory, Neural Net Learning and Genetic Learning. Expert Systems: Representing and Using Domain Knowledge, Expert System Shells, Explanation, Knowledge Acquisition.

Books:

[1] Elaine Rich, Kevin Knight, & Shivashankar B Nair, Artificial Intelligence, McGraw Hill,3rd ed.,2009

[2] Stuart Russell, Peter Norvig, *Artificial Intelligence -A Modern Approach*, 2/e, Pearson, 2003.

[3] Nils J Nilsson, *Artificial Intelligence: A New Synthesis*, Morgan Kaufmann Publications,2000

[4] Introduction to Artificial Intelligence & Expert Systems, Dan W Patterson, PHI.,2010

[5] S Kaushik, Artificial Intelligence, Cengage Learning, 1st ed.2011

Digital Learning Resources:

Course Name:	Artificial Intelligence Search Methods For Problem Solving
Course Link:	https://swayam.gov.in/nd1_noc20_cs81/preview
Course Instructor:	Prof. D. Khemani, IIT Madras

	Fundamentals of Artificial Intelligence
Course Name:	
Course Link:	https://swayam.gov.in/nd1_noc20_me88/preview
Course Instructor:	Prof. S. M. Hazarika, IIT Guwahati
Course Name:	Introduction to Machine Learning
Course Link:	https://nptel.ac.in/courses/106/105/106105152
Course Instructor:	Prof. S. Sarkar, IIT Kharagpur
Course Name:	Machine Learning
Course Link:	https://nptel.ac.in/courses/106/106/106106202
Course Instructor:	Prof. Carl Gustaf Jansson, IIT Madras

6th Semester		Renewable Power Generation Systems	L-T-P 3-0-0	3 Credits

Module I: **(15 Hours)**

Introduction: Conventional energy Sources and its Impacts, Non-conventional energy– seasonal variations and availability, Renewable energy – sources and features, Distributed energy systems and dispersed generation (DG). Solar Energy: Solar processes and spectral composition of solar radiation. Solar Thermal system-Solar collectors, Types and performance characteristics, Applications-Solar water heating systems (active & passive), Solar space heating & cooling systems, Solar desalination systems, Solar cooker. Solar photovoltaic system-Operating principle, Photovoltaic cell concepts, Cell, module, array, Losses in Solar Cell, Effects of Shadowing-Partial and Complete Shadowing, Series and parallel connections, Cell mismatching, Maximum power point tracking, Applications-Battery charging, Pumping, Lighting, Peltier cooling. Modelling of PV cell.

Module II: **(10 Hours)**

Wind Energy: Wind energy, Wind energy conversion; Wind power density, efficiency limit for wind energy conversion, types of converters, aerodynamics of wind rotors, power ~ speed and torque speed characteristics of wind turbines, wind turbine control systems; conversion to electrical power: induction and synchronous generators, grid connected and self excited induction generator operation, constant voltage and constant frequency generation with power electronic control single and double output systems, reactive power compensation, Characteristics of wind powerplant, Concept of DFIG.

Module III: **(9 Hours)**

Biomass Power: Principles of biomass conversion, Combustion and fermentation, Anaerobic digestion, Types of biogas digester, Wood gassifier, Pyrolysis, Applications. Bio gas, Wood stoves,Bio diesel, Combustion engine, Application.

Module IV: **(6 Hours)**

Hybrid Systems: Need for Hybrid Systems, Range and type of Hybrid systems, Case studies of Diesel-PV, Wind-PV, Microhydel-PV, Biomass-Diesel systems, electric and hybrid electric vehicles.

Books:

[1] Godfrey Boyle "Renewable Energy- Power for a Sustainable Future",Oxford University Press.
[2] B.H.Khan, "Non-Conventional Energy Resources", Tata McGraw Hill, 2009.
[3] S. N. Bhadra, D. Kastha, S. Banerjee, "Wind Electrical Systems", Oxford University Press, 2005.
[4] S. A. Abbasi, N. Abbasi, "Renewable Energy Sources and Their Environmental Impact", Prentice Hall of India, New Delhi, 2006.

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Digital Learning Resources:

Course Name: Energy Resources and Technology
Course Link: https://nptel.ac.in/courses/108/105/108105058/
Course Instructor: Prof. S Banerjee, IIT Kharagpur

6th Semester		Data Communication and Computer Networks	L-T-P 3-0-0	3 Credits

Module – I (10 Hrs)

Overview of Data Communication Networks, Protocols and standards, OSI Reference model, TCP/IP Protocol. Physical Layer: Analog Signals, Digital Signals, Data Rate Limits, Transmission Impairment, Data rate limit, Digital Transmission: Digital-to-Digital conversion, Analog-to-Digital conversion, Transmission modes, Analog Transmission: Digital-to-Analog conversion, Analog-to-Analog conversion, Multiplexing: Frequency Division Multiplexing (FDM), Wave Division Multiplexing (WDM), Time Division Multiplexing (TDM), Transmission Media: Guided Media (Twisted-Pair Cable, Coaxial Cable and Fiber-Optic Cable) and unguided media (wireless), Switching: Circuit Switched Network, Datagram Network, Virtual-Circuit Network , Telephone Network, Dial-up Modems and Digital Subscriber Lines.

Module – II (09 Hrs)

Error Detection and correction: Types of Errors, Error Detection mechanism (Linear codes, CRC, Checksum), Error Correction mechanism: Hamming Encoding. Data Link Control and Protocols: Flow and Error Control, Stop-and-Wait ARQ. Go-Back-N ARQ, Selective Repeat ARQ, HDLC and Point-to-Point Protocol Multiple Access: Random Access (ALOHA, CSMA, CSMA/CD, CSMA/CA), Controlled Access (Polling, Reservation, Token Passing), Channelization (FDMA, TDMA, CDMA). Wired LANs (Ethernet): Traditional Ethernet, Fast Ethernet, Gigabit Ethernet.

Module – III (09 Hrs)

Wireless LANs: IEEE 802.11 and Bluetooth. Connecting Devices: Passive Hub, Repeater, Active Hub, Bridge, Two layers Switch, Router, Three layers Switch, Gateway. Virtual Circuit Networks: Frame Relay, Architecture & layers, ATM: Design goals, Architecture & layers. Network Layer: IPV4 addresses, IPV6 addresses, Internet Protocol: Internetworking, IPV4 datagram, IPV6 packet format and advantages. Network Layer Protocols: ARP, RARP, IGMP and ICMP. Routing: Unicast Routing Protocols and Multicast Routing Protocols. Transport Layer: Process to Process Delivery, User Datagram Protocol (UDP) and Transmission Control Protocol (TCP).

Module – IV (08Hrs)

Domain Name System (DNS): Name Space, Domain Name Space, DNS in Internet, Resolution and Dynamic Domain Name System (DDNS), Remote logging, Electronic Mail (SMTP) and file transfer (FTP), WWW: Architecture & Web document, HTTP: Transaction & Persistent vs. Non-persistent connection. Introduction to Wi-Fi and Li-Fi Technology.

Books:

1. Data Communications and Networking, Behrouz A. Forouzan, Tata McGraw-Hill.

2. Computer Networks, A. S. Tannenbum, D. Wetherall, Prentice Hall, Imprint of Pearson.

3. Computer Networks A system Approach, Larry L, Peterson and Bruce S. Davie, Elsevier.

4. Computer Networks, Natalia Olifer, Victor Olifer, Willey India.

5. Data and Computer Communications, William Stallings, Prentice Hall, Imprint of Pearson.

Digital Learning Resources:

Course Name:	Data Communication
Course Link:	https://nptel.ac.in/courses/106/105/106105082/
Course Instructor:	Prof. A. Pal , IIT Kharagpur

Course Name:	Computer Networks
Course Link:	https://nptel.ac.in/courses/106/105/106105080/
Course Instructor:	Prof. A. Pal , IIT Kharagpur

6th Semester	RIK6F001	Essence of Indian Knowledge Tradition-1	L-T-P 3-0-0	0 Credits

Course Objective:

The course aims at imparting basic principles of thought process, reasoning and inferencing. Sustainability is at the core of Indian Traditional Knowledge Systems connecting society and nature. Holistic life style of Yogic-science and wisdom capsules in Sanskrit literature are also important in modern society with rapid technological advancements and societal disruptions. The course focuses on introduction to Indian Knowledge System, Indian perspective of modern scientific world-view and basic principles of Yoga and holistic health care system.

Course Outcomes:

- Ability to understand, connect up and explain basics of Indian Traditional knowledge modern scientific perspective.

Course Content:

- Basic Structure of Indian Knowledge System (i) वेद, (ii) उपवेद (आयुर्वेद, धनुर्वेद, गान्धर्वेद, स्थापत्य आदि) (iii) वेदांग (शिक्षा, कल्प, निरुत, व्याकरण, ज्योतिष छंद), (iv) उपाङ्ग (धर्म शास्त्र, मीमांसा, पुराण, तर्कशास्त्र)
- Modern Science and Indian Knowledge System
- Yoga and Holistic Health care
- Case Studies.

Books:

1. V. Sivaramakrishna (Ed.), Cultural Heritage of India-Course Material, Bharatiya Vidya Bhavan, Mumbai, 5th Edition, 2014

2. Swami Jitatmanand, Modern Physics and Vedant, Bharatiya Vidya Bhavan

3. Fritzof Capra, Tao of Physics

4. Fritzof Capra, The wave of Life

5. V N Jha (Eng. Trans,), Tarkasangraha of Annam Bhatta, Inernational Chinmay Foundation, Velliarnad, Amaku,am

6. Yoga Sutra of Patanjali, Ramakrishna Mission, Kolkatta

7. GN Jha (Eng. Trans.) Ed. R N Jha, Yoga-darshanam with Vyasa Bhashya, Vidyanidhi Prakasham, Delhi, 2016

8. RN Jha, Science of Consciousness Psychotherapy and Yoga Practices, Vidyanidhi Prakasham, Delhi, 2016 9. P R Sharma (English translation), Shodashang Hridayam

6th Semester	RCS6C201	Microwave Engineering Lab	L-T-P 0-0-3	2 Credits

(Any Ten of the following experiments are to be performed with X-band/S-band/ Ku- band Microwave components.}

1. Reflex Klystron Characteristics
2. Gun Diode Characteristics
3. Directional Coupler Characteristics
4. Measurement of Voltage Standing Wave Ratio.
5. Radiation Pattern Measurement of a Horn Antenna
6. Impedance, Wavelength and Frequency Measurement.
7. Determination of Polarization of Horn antenna.
8. Measurement of Scattering Parameters.
9. Coupling Measurement of H-plane, E-Plane and Magic Tee junctions.
10. Measurement of Dielectric Constant.
11. Measurement of Phase shift.
12. Scattering parameters of Circulator /Isolators.

Digital Learning Resources:

Virtual Lab Link:

6th Semester	RCS6C202	Wireless Communication Lab	L-T-P 0-0-3	2 Credits

List of Experiments

1. Evaluate the impact of path loss and shadowing in estimation of received signal power in mobile cellular communication using fading channel mobile communication virtual lab.

2. Calculate the boundary coverage probability in a cellular system using fading channel mobile communication virtual lab.

3. Demonstrate the impact the received power levels for hand-off in case of mobile cellular communication using fading channel mobile communication virtual lab.

4. Estimate the impact of sectoring in increasing cellular system capacity using fading channel mobile communication virtual lab.

5. Examine the impact of co-channel interference on the value of SIR in mobile cellular communication using fading channel mobile communication virtual lab.

6. Setting up of LTE 2x2 MIMO system for establishing two way communication.

7.Study of pure ALOHA and slotted ALOHA protocols for WLAN System.

8. Configure ZigBee module as an end device and, set up a communication link with two ZigBee modules.

9. Study of RFID system and its applications.

10. Using IE3D, design a rectangular micro strip patch antenna for inset feed for operating frequency of 1.88 GHz, relative permittivity of 4.4 and length of 31 mils.

11. Using GPS system, study the graphical representation of geographical position using Survey plotting.

12. Study the PN sequence and examine Gold code with variable sequence length and analyze its correlation. Also set up voice communication using DSSS scheme using CDMA trainer kit (ST-2131-A).

Optional Experiments

1. Study the GPRS system and use it for sending an e-mail through WI-GPRS trainer.

2. Study the GSM modem and its different module for phone book, setting up a call, sending SMS and identifying call history using AT commands.

3. Interfacing of GSM modem with control unit.

4. Design a patch antenna using IE3D using different parameters.

Digital Learning Resources:

Virtual Lab Link: http://vlabs.iitb.ac.in/vlabs-dev/labs/dblab/index.php

6th Semester		**Future-ready Contributor Program**	**L-T-P 0-0-3**	**2 Credits**

Outcomes: The Future-ready Contributor Program aims to accomplish the following outcomes in the lives of students–

- Improve the employability of students by giving them the right work ethic and thinking that employers are looking for.
- Build their confidence with which they can go into any job and contribute meaningfully.
- Improve their ability to engage better in the workplace and to be able to handle the challenges that come up there.
- Build their career-worthiness and help them develop into future-ready contributors with ability to navigate a career in a volatile, changing world.
- Widen their choices of career and success, so that they are able to open up more opportunities for themselves and take up unconventional career pathways.
- Enable them recognize how they as technical professionals, can participate and make a positive contribution to their communities and to their state.

The Program content is also designed to expose students to real-world workplace scenarios and sensitize them to some of the challenges faced in society around them, especially in the local communities around them and in their own state of Odisha.

The Contributor Program syllabus has been evolved and fine-tuned over several years, to –

a) address the changing need and contemporary challenges being faced by industry and what employers of today are looking for in the people they hire;
b) working extensively with universities and students and an appreciation of their challenges and concerns;
c) guided by the higher ideas and principles of practical Vedanta in work.

Sr. No.		Content	Total Hrs
1	**Part 1 : Developing self-efficacy and basic inner strength**	**Who is a Future-ready Contributor?** *In this topic, students understand the new work environment, expectations from future workforce, and importance of being a future-ready contributor. This enables students to transform their expectation of themselves in work*	3 hrs lab sessions (discovery-based facilitator led)
2		**Self-esteem & Growth Identity** *In this topic, students learn how to develop a deeper and more resilient self esteem and how to adopt a growth identity/ mindset, that is more appropriate to the demands of the future workplace.*	Same as above
3		**Become a Creator of one's destiny** *In a "victim stance", we see the career environment as full of difficulties and hurdles. We feel powerless or blame our circumstances for not having many opportunities. This makes us fearful of uncertainty and makes us settle for jobs where we remain mediocre. In this topic, students discover the "creator of destiny stance" to challenges and situations. This stance helps them take ownership & responsibility to shape destiny, build a new future & find answers to challenges; and stop being complainers.*	Same as above
4	**Part 2 : Building ability to make more effective career choices**	**Achieving Sustainable Success** *In this topic, students discover how to achieve sustainable or lasting success, by making themselves success-worthy. Where their focus shifts to building one's "engine of success" rather than being on chasing the "fruits of success". This is important, because over a lifetime of work, all people go through ups and downs – where the fruits are not in their control. People who are focused on the fruits of success, fall prey to disappointment, loss in motivation, quitting too early, trying to find shortcuts – when fruits don't come. Whereas people focused on building their engine of success continue to contribute steadily, irrespective of whether fruits come or not. This helps them make better choices in life, that leads to steady success & long-term career fulfillment in an uncertain world.*	Same as above
5		**Career Development Pathways for a changing world**	Same as above

		In this topic, students explore a range of diverse "career development models" and the possibilities for contribution each opens up to them. This helps them open up hidden opportunities that such an environment offers. And free themselves from a herd mentality when making career choices.	
6		**Make an impact in every part of one's life** *In this topic, students learn how to expand the contribution possible in any role they have. This helps them take charge of own career growth & discover their power to contribute in any role or job.*	Same as above
7	**Part 3 : Building ability to become solution and value creating individuals in the world**	**Think Solutions** *The market environment in which organizations are operating, is becoming increasingly dynamic and uncertain. So, employers are increasingly seeking out people who can innovate and figure out solutions in the face of any challenge (unlike in the past when it was the people who were most efficient and productive, who were valued by organizations). At the heart of innovation lies this way of thinking of "finding solutions" rather than "seeing problems or roadblocks". Students learn how to build this way of thinking, in this topic.*	Same as above
8		**Value Thinking** *Companies are also looking for employees who do not just work hard, or work efficiently or productively - but those who will make a valuable difference to the fortunes of the company. This difference may come from innovation, but it may also come from focusing on the right things and identifying what really matters – both to the company and to the customers. In this topic, students learn how to build this capability.*	Same as above
9		**Engaging Deeply** *The environment we live in is becoming increasingly complex because more and more things are getting interconnected, new fields are emerging, technologies are rapidly changing, capabilities and knowledge one is trained in will become fast obsolete. In such a scenario, the student's ability to quickly understand and master what is going on, dive deep, get involved in any area, rapidly learn new capabilities that a job demands, is*	Same as above

		important. In this topic, students learn how to engage deeply. Learning how to dive deep, to quickly understand what is going on, get involved in any area, and rapidly learn.	
10	**Part 4 : Building ability to work collaboratively and as good citizens of organizations and the country**	**Enlightened self-interest & collaboration at work** *The changing nature of work in organizations and in the global environment, is increasingly demanding that people work more collaboratively towards shared goals and more sustainable goals. A key to working successfully when multiple stakeholders are involved, is "thinking in enlightened self-interest". In this topic, students learn how to widen their thinking from "narrow self-interest" to "enlightened self-interest" to work more effectively in teams & collaboratives.*	Same as above
11		**Human-centered thinking & Empathy** *In this topic, students learn to recognize & respond to human needs and challenges – the way of thinking at the heart of user-centric designs & customer-centricity.*	Same as above
12		**Trust Conduct** *The biggest currency in a sustainable career is "trust" i.e. being trusted by team members, bosses, customers. When we are trusted, people listen to us, they are willing to give us the chance to grow, give us the space to make mistakes, and work seamlessly with each other without always having to "prove ourselves". In this topic, students learn how to build trust with people they engage with.*	Same as above
Contribution Project Lab Sessions		*3 Contribution projects that help them apply contributor thinking. After students complete their project work (beyond the classroom), each project ends with this 3 hr lab session where they build their project output and present.*	9 hrs (3 hr lab sessions for each of 3 projects)
Project work		*The above Contribution Projects require research, and may need field work beyond the classroom that students are expected to do.*	Beyond classroom

Lab Sessions:

- Students will have to attend twelve discovery-based lab sessions to build new models of thinking & capacities (3 hrs per module)
- They will work closely with their peers to discuss and understand these new models of thinking.
- Their learning will be facilitated by trained college faculty.

Contribution Projects

- Three contribution projects that help them apply contributor thinking
- These will require research and also may need field work
- Each ends with a 3 hr lab session where they build their project output and present

BIJUPATNAIKUNIVERSITY OF TECHNOLOGY, ODISHA

ROURKELA

Curriculum and Syllabus

B. Tech (Electronics and Communication Engineering/ Electronics and Tele Communication Engineering) from the Admission Batch

2018-19

Semester (7^{th})

Seventh Semester							
Theory							
Sl No	**Category**	**Course Code**	**Course Title**	**L-T-P**	**Credit**	**University Marks**	**Internal Evaluation**
1	HS	RED7E001	Entrepreneurship Development	3-0-0	3	100	50
2	PE	REC7D001	Digital Image Processing	3-0-0	3	100	50
		REC7D002	Embedded Systems				
		REC7D003	Advanced Digital Signal Processing				
3	PE	REC7D004	Image and Video Processing	3-0-0	3	100	50
		REC7D005	Adaptive Digital Signal Processing				
		REC7D006	Radar and TV Engineering				
4	OE	RIT7D001	Internet of Things	3-0-0	3	100	50
		RCS7D006	Deep Learning				
		REI7D003	Mechatronics				
5	OE	REV5D004	Disaster Management	3-0-0	3	100	50
		RIP7E002	Intellectual Property Right				
		RGT6A003	Green Technology				
6	OE	RIT7D002	Bigdata Analytics	3-0-0	3	100	50
		RCS7D005	Computer Vision				
		RCS7D007	Soft Computing				
7	MC*	RIK7F001	Essence of Indian Knowledge Tradition - II	3-0-0	0		100 (Pass Mark is 37)
Total Credit (Theory)					**18**		
Total Marks						**600**	**300**
Practical							
1	PSI	RMP7H201	Minor Project	0-0-6	3		200
2	PSI	RSM7H202	Seminar - II	0-0-3	1		100
3	PSI	RCV7H203	Comprehensive Viva	0-0-3	1		100
Total Credit (Practical)					**5**		
Total Semester Credit					**23**		
Total Marks							**400**

***Mandatory Non-Credit Courses (MC) result will be reflected with Pass (P) / Fail (F) grade. Thus the grade obtained will not be affecting the grade point average. However it shall appear on the grade sheet as per AICTE rule.**

7th Semester	RED7E001	Entrepreneurship Development	L-T-P 3-0-0	3 Credits

Module I: **(10 hours)**

Entrepreneurship: Concept of entrepreneurship and intrapreneurship, Types of Entrepreneurs, Nature and Importance, Entrepreneurial Traits and Skills, Entrepreneurial Motivation and Achievement, Entrepreneurial Personality

Module II: **(8 hours)**

Entrepreneurial Environment, Identification of Opportunities, Converting Business Opportunities into reality. Start-ups and business incubation, Setting up a Small Enterprise. Issues relating to location, Environmental Problems and Environmental pollution Act, Industrial Policies and Regulations

Module III: **(10 hours)**

Need to know about Accounting, Working capital Management, Marketing Management, Human Resources Management, and Labour Laws. Organizational support services - Central and State Government, Incentives and Subsidies.

Module IV: **(12 hours)**

Sickness of Small-Scale Industries, Causes and symptoms of sickness, cures of sickness, Role of Banks and Governments in reviving industries.

Books:

[1] Entrepreneurship Development and Management, Vasant Desai, HPH
[2] Entrepreneurship Management, Bholanath Dutta, Excel Books
[3] Entrepreneurial Development, Sangeeta Sharma, PHI
[4] Entrepreneurship, Rajeev Roy, Oxford University Press

Digital Learning Resources:

Course Name: Entrepreneurship
Course Link: https://nptel.ac.in/courses/110/106/110106141/
Course Instructor: Prof. C Bhaktavatsala Rao, IIT Roorkee

Course Name: Entrepreneurship Essentials
Course Link: https://nptel.ac.in/courses/127/105/127105007/
Course Instructor: Prof. Manoj Kumar Mondal, IIT Kharagpur

7th Semester	**REC7D001**	**Digital Image Processing**	**L-T-P 3-0-0**	**3 Credits**

Module-I

Fundamentals – Steps in digital image processing, sampling and quantization, relationship between pixels, imaging geometry Image Transforms – Fourier Transform, Discrete Fourier Transform, Fast Fourier Transform, Discrete Cosine Transform, Walsh Transform, Hadamard Transform, Hotelling Transform.

Module-II

Image Enhancement – Point processing, spatial filtering (smoothing and sharpening filters), enhancement in frequency domain. Filtering in the Frequency Domain: preliminary concepts, 2D DFT and its properties,basic filtering in the frequency domain, image smoothing and sharpening.

Module-III

Image Restoration and Reconstruction: Image restoration/degradation model, noisemodels, restoration in the presence of noise only, estimating the degradation function. Color Image Processing: Color models, Color transformation.

Module-IV

Wavelets and Multi-resolution Processing: multiresolution expansions, wavelettransforms in one and two dimensions. Image Compression: Fundamentals, Some basic compression methods (Chapter 8 of Book 1)

Books

1. Digital Image Processing, R.C. Gonzalez, R.E. Woods, Pearson Education , 3rd Edition, 2007
2. Digital Image Processing, S. Sridhar, Oxford University Press,2011
3. Digital Image Processing And Analysis, B. Chanda, Dutta D. Majumder ,PHI
4. Digital Image Processing using MATLAB, Rafael C. Gonzalez, Richard E. Woods Pearson Education, Inc., Seventh Edition, 2004.
5. Digital Image Processing, S. Sridhar, Oxford University Press,2011 3. Digital Image Processing, William K. Pratt, John Wiley, New York, 2002

Digital Learning Resources:

Course Name:	Digital Image Processing
Course Link:	https://nptel.ac.in/courses/117/105/117105135/
Course Instructor:	Prof. P.K. Biswas, IIT Kharagpur

7^{th} Semester	REC7D002	Embedded Systems	L-T-P 3-0-0	3 Credits

Module-I **(12 hrs)**

Hardware Concepts Embedded System: Application and characteristics of embedded systems, Overview of Processors and hardware units in embedded system, embedded software in a system, Examples of Embedded system.

ARM:ARM pipeline, Instruction Set Architecture ISA: Registers, Data Processing Instructions, Data Transfer Instructions, Multiplication's instructions, Software interrupt, Conditional execution, branch instruction, Swap instruction, THUMB instructions.

Module-II **(8hrs)**

Devices and device drivers: I/O devices, Serial peripheral interfaces,IIC, RS232C, RS422, RS485, Universal serial bus, USB Interface, USB Connector IrDA, CAN, Bluetooth, ISA, PCI, PCI -X and advance busses, Device drivers.

Module –III **(9 hrs)**

Real Time Operating System (RTOS): Real-Time Task Scheduling: Some important concepts, Types of real-time tasks and their characteristics, Task scheduling, Clock-Driven scheduling, Hybrid schedulers, Event-Driven scheduling, Earliest Deadline First (EDF) scheduling, Rate monotonic algorithm (RMA)

Module –IV **(8 hrs)**

Modelling Techniques: Software and programming concept: Processor selection for an embedded system, State chart, SDL, Petri-Nets, Unified Modeling Language (UML). Hardware software codesign. Hardware and software partitioning: K-L partitioning, Partitioning using genetic algorithm,

Module –V **(8 hrs)**

Low power embedded system design: Dynamic power dissipation, Static power dissipation, Power reduction techniques, system level power management. Software design for low power devices.

Books:

[1] "Embedded system architecture, programming and design" By Raj Kamal, TMH.

[2] "Embedded System Design" by SantanuChattopadhay, PHI

[3] Frank Vahid and Tony Givargis, Embedded Systems Design – A unified Hardware /Software Introduction, John Wiley, 2002.

[4] "Hardware software co-design of Embedded systems" By Ralf Niemann, Kulwer Academic.

[5] "Embedded real time system programming" By Sriram V Iyer, Pankaj Gupta, TMH.

Digital Learning Resources:

Course Name: Embedded Systems
Course Link: https://nptel.ac.in/courses/108/102/108102045/
Course Instructor: Prof. Santanu Chaudhary, IIT Delhi

Course Name: Embedded Systems
Course Link: https://nptel.ac.in/courses/108/105/108105057/
Course Instructor: Prof. Amit Patra et al, IIT Kharagpur

Course Name: Embedded Systems Design
Course Link: https://nptel.ac.in/courses/106/105/106105159/
Course Instructor: Prof. Anupam Basu, IIT Kharagpur

7^{th} Semester	REC7D004	Image and Video Processing	L-T-P 3-0-0	3 Credits

Module –I

Fundamentals of Image processing and Image Transforms: Basic steps of Image processing system sampling and quantization of an Image – Basic relationship between pixels Image Transforms: 2 – D Discrete Fourier Transform, Discrete Cosine Transform (DCT), Discrete Wavelet transforms

Module –II

Image Processing Techniques: Image Enhancement: Spatial Domain methods: Histogram Processing, Fundamentals of Spatial Filtering, Smoothing Spatial filters, Sharpening Spatial filters Frequency Domain methods: Basics of filtering in frequency domain, image smoothing, image sharpening, selective filtering Image Segmentation: Segmentation concepts, point, line and Edge detection, Thresholding, region based segmentation

Module –III

Image Compression: Image compression fundamentals – coding Redundancy, spatial and temporal redundancy. Compression models : Lossy and Lossless, Huffmann coding, Arithmetic coding, LZW coding, run length coding, Bit Plane coding, transform coding, predictive coding , wavelet coding, JPEG standards

Module –IV

Basic Steps of Video Processing: Analog video, Digital Video, Time varying Image Formation models : 3D motion models, Geometric Image formation , Photometric Image formation, sampling of video signals, filtering operations

Module –V

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

Books:

1. Gonzaleze and Woods , "Digital Image Processing", 3rd edition , Pearson
2. Yao wang, JoemOstarmann and Ya – quin Zhang, "Video processing and communication",1st edition , PHI
3. M. Tekalp , "Digital video Processing", Prentice Hall International

7^{th} Semester	REC7D005	Adaptive Digital Signal Processing	L-T-P 3-0-0	3 Credits

MODULE–I (8 Hours)

Introduction: Adaptive Systems – Definition and characteristics, General properties, Open andClosed Loop Adaptations, Applications.
The Adaptive Linear Combiner: Performance function, Gradient and Mean Square Error, Examples.

MODULE – II (10 Hours)

Theory of Adaptation with Stationary Signals: Properties of the Quadratic PerformanceSurface, Significance of eigen values, eigen vectors, correlation matrix.
Searching the Performance Surface: A simple gradient search algorithm, Stability and Rate ofconvergence, the learning curve.

MODULE-III (10 Hours)

Gradient Estimation and its effects on Adoption: The performance penalty, Variance of thegradient estimate, Misadjustment.Adaptive Algorithms and Structures: The LMS Algorithm, Convergence, learning Curve,Performance analysis, Filtered X LMS algorithm,

MODULE-IV

Applications: Adaptive Modelling and System Identification using adaptive filter, InverseAdaptive Modelling, Deconvolution, and equalization using adaptive filter.

Books
1. *Adaptive Signal Processing*, Bernard Widrow and Samuel D. Stearns, Pearson Education, 2nd impression, 2009.
2. *Adaptive Filter Theory*, Simon Haykin, Pearson Education, 4th Edn.

7^{th} Semester	REC7D006	Radar and TV Engineering	L-T-P 3-0-0	3 Credits

Module I

Radar : The Radar equation-Pulse Radar-CW Radar-CW Radar with non zero IF, equation for Doppler frequency- FM-CW Radar using sideband superhetrodyne receiver, MTI Radar-Delay line canceller, MTI Radar with power amplifier & power oscillator, Non coherent MTI Radar, Pulse Doppler Radar, Radar Transmitters. Radar Modulator-Block diagram. Radar receivers- noise figure, low noise front ends, Mixers – Different types of Displays – Duplexers- Branch type and balanced type. Navigation- Loop Antenna, Radio compass. Hyperbolic Systems of Navigation, LORAN – A. Distance Measuring Equipment . Instrument Landing System – Localizer, Glide Slope, Marker beacons.

Module II

Television: Scanning, Blanking and synchronisation, Picture signal - composite video signalVestigial sideband transmission-Principle of CCD Camera - Monochrome picture tube-Monochrome TV receivers- RF tuner ,VHF tuner- Video amplifier, IF section, Vestigial sideband correction- Video detectors, Sound signal separation, AGC, sync separation, horizontal and vertical deflection circuits, EHT generation. Colour TV system: Principle of colour signal transmission and reception, PAL, NTSC, SECAM (block schematic description), Picture tube – delta gun.

Module III

Digital TV: Digitized Video, Source coding of Digitized Video – Compression of Frames – DCT based – (JPED), Compression of Moving Pictures (MPEG). Basic blocks of MPEG2 and MPE4. Digital Video Broadcasting (DVB) – Modulation: QAM – (DVB-S, DVB-C), OFDM for Terrestrial Digital TV (DVB –T). Reception of Digital TV Signals (Cable, Satellite and terrestrial). Digital TV over IP, Digital terrestrial TV for mobile. Display Technologies – basic working of Plasma, LCD and LED Displays.

Books:

1. Merrill I. Skolnik: Introduction to Radar Systems,3/e, Tata McGraw Hill,
2. N.S.Nagaraja: Elements of Electronic Navigation, 2/e, Tata McGraw Hill
3. R.R. Gulati: Monochroeme and Colour Television. New Age international, 2008.
4. Herve Benoit, Digital Television Satellite, Cable, Terrestrial, IPTV, Mobile TV in the DVB Framework, 3/e, Focal Press, Elsevier, 2008
5. Shlomo Ovadia: Broadband Cable TV Access Networks, PH-PTR, 2001
6. Byron Edde: Radar Principles, Technology & Applications, Pearson Education.
7. Mark E Long: ―The Digital Satlitte TV Hand Book‖, Butterworth-Heinemann.
8. K.R.Rao, J.O.Hwang, Techniques and standards for Image,Video and Audio coding,Prentice Hall,1996
9. John Arnold, Michael Frater, Mark Pickering,Digital Television Technology and Standards, John Wiley & Sons, Inc, 2007
10. Robert L. Hartwig,Basic TV Technology: Digital and Analog, 4/e, Focal Press, Elsevier, 2005

6^{th} Semester	RIT7D001	Internet of Things	L-T-P 3-0-0	3 Credits

Module-1

Introduction-Definition & 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, Big Data Analytics , Communication Protocols , Embedded Systems, IoT Levels & Deployment Templates.

Module-2

Domain Specific IoTs

Home Automation: Smart Lighting, Smart Appliances, Intrusion Detection, Smoke/Gas Detectors, Cities-Smart Parking, Smart Lighting, Smart Roads, Structural Health Monitoring, Surveillance, Emergency Response,

Environment-Weather Monitoring, Air Pollution Monitoring, Noise Pollution Monitoring, Forest Fire Detection , River Floods Detection , **Energy-** Smart Grids , Renewable Energy Systems , Prognostics , Retail-Inventory Management , Smart Payments , Smart Vending Machines , **Logistics-**Route Generation & Scheduling , Fleet Tracking , Shipment Monitoring , Remote Vehicle Diagnostics, **Agriculture-**Smart Irrigation ,Green House Control ,**Industry** -Machine Diagnosis & Prognosis Indoor Air Quality Monitoring ,Health & Lifestyle -Health & Fitness Monitoring, Wearable Electronics

IoT and M2M Introduction, M2M-Difference between IoT and M2M, SDN and NFV for IoT-Software Defined Networking , Network Function Virtualization

Module-3

IoT Platforms Design Methodology

IoT Design Methodology-Purpose & Requirements Specification, Process Specification, Domain Model Specification, Information Model Specification , Service Specifications , IoT Level Specification, Functional View Specification , Operational View Specification , Device & Component Integration , Application Development, Case Study on IoT System for Weather Monitoring, Motivation for Using Python

IoT Physical Devices & Endpoints

What is an IoT Device-Basic building blocks of an IoT Device, Exemplary Device: Raspberry Pi, About the Board, Linux on Raspberry Pi , Raspberry Pi Interfaces – Serial, SPI , I2C , Programming Raspberry Pi with Python-Controlling LED with Raspberry Pi , Interfacing an LED and Switch with Raspberry Pi ,Interfacing a Light Sensor (LDR) with Raspberry Pi , Other IoT Devices- pcDuino, Beagle Bone Black , Cubieboard

Module-4

IoT &Beyond : Use of Big Data and Visualization in IoT, Industry 4.0 Concepts. Overview of RFID, Low-power design (Bluetooth Low Energy), range extension techniques (data mining and mesh networking), and dataintensive IoT for continuous recognition applications. Overview of Android / IOS App Development tools & Internet Of Everything

Books:

1. Internet of Things, A Hands on Approach, by ArshdeepBahga& Vijay audisetti, University Press.
2. The Internet of Things, by Michael Millen, Pearson

7th Semester	RCS7D006	Deep Learning	L-T-P 3-0-0	3 CREDITS

MODULE-I:

Introduction to TensorFlow : Computational Graph, Key highlights, Creating a Graph, Regression example, Gradient Descent, TensorBoard, Modularity, Sharing Variables,KerasPerceptrons: What is a Perceptron, XOR Gate

MODULE-III:

Activation Functions : Sigmoid,ReLU, Hyperbolic Fns,Softmax Artificial Neural Networks : Introduction, Perceptron Training Rule, Gradient Descent Rule

MODULE-II:

Gradient Descent and Backpropagation: Gradient Descent, Stochastic Gradient Descent, Backpropagation, Some problems in ANN Optimization and Regularization :Overfitting and Capacity, Cross Validation, Feature Selection, Regularization, Hyperparameters

MODULE-IV:

Introduction to Convolutional Neural Networks: Introduction to CNNs, Kernel filter, Principles behind CNNs, Multiple Filters, CNN applications Introduction to Recurrent Neural Networks: Introduction to RNNs, Unfolded RNNs, Seq2Seq RNNs, LSTM, RNN applications

MODULE-V:

Deep Learning applications: Image Processing, Natural Language Processing, Speech Recognition, Video Analytics

Book

1. Goodfellow, I., Bengio,Y., and Courville, A., Deep Learning, MIT Press, 2016.

2. Bishop, C. ,M., Pattern Recognition and Machine Learning, Springer, 2006.
3. Yegnanarayana, B., Artificial Neural Networks PHI Learning Pvt. Ltd, 2009.
4. Golub, G.,H., and Van Loan,C.,F., Matrix Computations, JHU Press,2013.
5. Satish Kumar, Neural Networks: A Classroom Approach, Tata McGraw-Hill Education, 2004.

7th Semester	**REI7D003**	**Mechatronics**	**L-T-P 3-0-0**	**3 CREDITS**

MODULE-I **(10Hours)**

Evolution of Mechatronics, components of mechatronic system, types of mechatronic products, Signal theory, signal analysis and processing, Laplace transformation, Z-transformation modulation and de-modulation. Electrical components and electronic device – Resister, inductor and capacitor, reactance and impedance. Basic electronics devices junction diodes, Bipolar transistors

MODULE-II (08Hours)

Basic Digital Technology: Digital number system, Binary number system, Hexadecimal number system, Binary addition, Boolean Algebra, Logic function, Universal GATES, FLIP-FLOP, Registers counters. System modelling: Frequency response, Mechanical system, electrical system, Thermal system, Fluid system

MODULE-III(10Hours)

Actuators- Electric motors; D.C. Motors, Stepper motor, Hydraulic actuators, Pneumatic actuators Transducer and Sensors: Principles, difference between transducer and sensors, transducer types – photo emissive, photo conductive, photovoltaic, thermistors, Thermocouple, Inductive, capacitive, Peizoelectric, Hall effect transducers, Ionization transducer, Encoders- Incremental encoder, Optical encoder, Bimetallic strip, Strain gauge, load cell. Programmable Logic controller: Basic Structure - Programming: Ladder diagram Timers, Internal Relays and Counters - Shift Registers - Master and Jump Controls, data handling, Analog input / output, PLC Selection &Application. Microprocessor ad Microcontroller: Microprocessor based Digital control, registers, Program counter, Intel - 8085 microprocessor

Books:

[1] A Text Books of Mechatronics, R.K.Rajput, S.Chand& company
[2] Mechatronics, N.G. P.C Mahalik, Tata McGraw Hill
[3] Mechatronics, D.G. Alciator, M.B. Histand, Tata McGraw Hill
[4] Mechatronics, A.Smaili& F Mrad, Oxford University Press
[5] Mechatronics, K.P.ramchandran, G,K Vijay Raghavan, M. S Balachandran
[6] Mechatronics An Intigrated approach, Clarence W de Sliva, CRC Press

Digital Learning Resources:

Course Name: Mechatronics
Course Link: https://nptel.ac.in/courses/112/107/112107298/
Course Instructor: Prof. Pushparaj Mani Pathak, IIT Roorkee

7^{th} Semester	REV5D004	Disaster Management	L-T-P 3-0-0	3 CREDITS

Module I **(12 Hours)**

Understanding Disaster: Concept of Disaster - Different approaches- Concept of Risk - Levels of Disasters - Disaster Phenomena and Events (Global, national and regional) Hazards and Vulnerabilities: Natural and man-made hazards; response time, frequency and forewarning levels of different hazards - Characteristics and damage potential or natural hazards; hazard assessment - Dimensions of vulnerability factors; vulnerability assessment - Vulnerability and disaster risk - Vulnerabilities to flood and earthquake hazards

Module II **(6 Hours)**

Disaster Management Mechanism: Concepts of risk management and crisis managements - Disaster Management Cycle - Response and Recovery - Development, Prevention, Mitigation and Preparedness - Planning for Relief

Module III **(6 Hours)**

Capacity Building: Capacity Building: Concept - Structural and Non-structural Measures Capacity Assessment; Strengthening Capacity for Reducing Risk - Counter-Disaster Resources and their utility in Disaster Management - Legislative Support at the state and national levels

Module IV **(12 Hours)**

Coping with Disaster: Coping Strategies; alternative adjustment processes - Changing Concepts of disaster management - Industrial Safety Plan; Safety norms and survival kits - Mass media and disaster management

Planning for disaster management: Strategies for disaster management planning - Steps for formulating a disaster risk reduction plan - Disaster management Act and Policy in India - Organizational structure for disaster management in India - Preparation of state and district disaster management plans

Books:

[1] Manual on Disaster Management, National Disaster Management, Agency Govt of India.
[2] Disaster Management by Mrinalini Pandey Wiley 2014.
[3] Disaster Science and Management by T. Bhattacharya, McGraw Hill Education (India) Pvt Ltd Wiley 2015
[4] Disaster Science and Management by T. Bhattacharya, McGraw Hill Education (India) Pvt Ltd Wiley 2015
[5] Earth and Atmospheric Disasters Management, N. Pandharinath, CK Rajan, BS

Publications 2009.

[6] National Disaster Management Plan, Ministry of Home affairs, Government of India http://www.ndma.gov.in/images/policyplan/dmplan/draftndmp.pdf

7th Semester	RIP7E002	Intellectual Property Right	L-T-P 3-0-0	3 CREDITS

MODULE-I **(12Hours)**

Introduction: Intellectual property: meaning, nature and significance, need for intellectual property Right (IPR), IPR in India – Genesis and development, IPR in abroad, Examples: - Biotechnology Research and Intellectual Property Rights Management. What is a patent, what can be protected by a patent, why should I apply for a patent? Patent Law, Patentability requirements, non-Patentable subject matters, Layout of the Patents. Procedure for domestic and international filing of applications, Restoration, Surrender and Revocations of Patents, Rights of Patentee and Working of Patent, Licensing and Enforcing Intellectual Property.

MODULE-II **(10Hours)**

Copyrights: Copyright: meaning, scope; What is covered by copyright? How long does copyright last? Why protects copyright? Related rights, Rights covered by copyright. Ownership: Duration, Division, Transfer and Termination of Transfers.

MODULE-III (10Hours)

Infringement and Remedies: Literal and non-literal infringement, Role of claims, Doctrines on infringement: Equivalent doctrine, Pith and Marrow doctrine, Comparative test. Defences: Gillette Defence, General grounds, Patents granted with conditions, Parallel import. Remedies: Civil, Administrative.

MODULE-IV (08Hours)

State Law: Trade Secret, Contract, Misappropriation, Right of Publicity Trademarks, Trade Secret - Overview, Requirements, Misappropriation of Trade Secret, Departing Employees, Remedies, Criminal Liability, Misappropriation, Clickwrap Agreements, Idea Submissions; Right of Publicity, Federal Pre-emption, Review.

Books:

[1] W. R. Cornish and D. Llewellyn, Intellectual Property: Patents, Copyrights, Trade Marks and Allied Rights, Sweet & Maxwell.
[2] Lionel Bently and Brad Sherman, Intellectual Property Law, Oxford University Press.
[3] P. Narayanan, Intellectual Property Law, Eastern Law House
[4] B. L. Wadehra, Law Relating to Intellectual Property, Universal Law Publishing Co.
[5] V. K. Ahuja, Law Relating to Intellectual Property Rights, LexisNexis

[6] AjitParulekar and Sarita D'Souza, Indian Patents Law – Legal & Business Implications;Macmillan India ltd, 2006
[7] P. Narayanan; Law of Copyright and Industrial Designs; Eastern law House, Delhi, 2010.

Reference:

[1] The Copyright Act, 1957
[2] The Patent Act, 1970
[3] The Trade Marks Act, 1999
[4] The Designs Act, 2000
[5] The Geographical Indication of Goods Act, 1999
[6] The Protection of Plant Varieties and Farmers' Rights Act, 2001
[7] The Semiconductor Integrated Circuits Layout Design Act, 2000

Digital Learning Resources:

Course Name:	Intellectual Property
Course Link:	https://nptel.ac.in/courses/109/106/109106137/
Course Instructor:	Prof. Feroze Ali, IIT Madras

7th Semester	RGT6A003	Green Technology	L-T-P 3-0-0	3 CREDITS

Module I: (12 Hrs)

Global Warming and its effect:- Introduction and physical definition of global warming, the New Carbon Problem: Accumulation, Long Half-Life, Heating Potential, Carbon Emission Factors, Carbon Absorption in Nature, The Global Emission Situation and its effect in India, The Kyoto and Other Protocols and its view in India, Effect of climate change and its impact.
Planning for the Future to reduce global warming:- Steps taken to Control Carbon Emissions universally, Use of Promotional and Punitive Mechanisms for Reducing Carbon in Atmosphere, The General Approach in Planning for the Future, Developing Countrywide Adaptive Measures for Safety of Local People, Developing Mitigative Measures for Global Reduction of Carbon, India's National Action Plan on Climate Change (NAPCC) till date, National Mission for a Green India, The MRV Debate.

Module II: (8 Hrs)

Opportunities in Control of Carbon Emissions and Accumulation:- Essential Steps for Control of Carbon Emissions and Accumulation, Procedure to develop own Priorities and Business Opportunities in India for control of carbon emissions and accumulation, Needs a Mix of Green and Traditional Power Sources in India, A Logical Approach for Carbon Reduction, Need in India —More Forests, Less Deforestation and payment rates procedure for controlling carbon emissions and its Promotional Mechanisms at India. Green Technologies for Energy Production: - Various Technologies Available for Energy Production, Cost Comparison of a Few Typical Systems for Power Generation, Sources of Energy Production Already in Use, Alternative Methods Ready for Use, Green Technologies Needing some Prior R&D Work.

Module III: **(10 Hrs)**

Green Technologies for Personal and Citywide Application: - Measures to be taken for Green city, Carbon Emission Reduction at Personal Level, Carbon Emission Reduction at Local Authority and Citywide Level, Carbon Emissions from Imports. Green Technologies for Specific Applications:- Promotion of 'Green' Buildings, Guidelines, The Energy Conservation Building Code (ECBC), Green Hotels and Hospitals, Green Technologies for Transport, Green Roads, Ports and Harbours, Industries, Carbon, Carbon Emissions from a Few Selected Industries in India, The Changing Scenario in Cities, Need for Wider Application to Town Planning and Area Re-Development Projects, 'Green' Infrastructure for Municipal Services, Bringing up Indian Villages, Green Services for Crematoria, Spreading Message to all Stakeholders.

Module IV: **(10 Hrs)**

Some High-tech Measures for Reducing Carbon Emissions: - Use of Solar Power with Satellite-Based Systems, Use of Carbon Capture and Storage (Sequestration), Microorganisms, A Quick SWOT Analysis.Recommended Plan of Action: - India's National Action Plan Take Us to a Low-Carbon Path, The Missions Help Develop Awareness, few case studies on Projects undertakenby Various Countries, Adaptive Measures Essential for Indian People to Cope with Climate Change

Books

[1] Green Technologies, Soli J. Arceivala, McGraw Hill Education
[2] Green Technologies and Environmental Sustainability edited by Ritu Singh, Sanjeev Kumar

Digital Learning Resources:

Course Name: Sustainable Materials and Green Buildings
Course Link:https://nptel.ac.in/courses/105/102/105102195/
Course Instructor:Dr. B. Bhattacharjee, IIT Delhi

7th Semester	RIT7D002	Bigdata Analytics	L-T-P 3-0-0	3 CREDITS

Module-1

Introduction to Big Data: Types of Digital Data-Characteristics of Data – Evolution of Big Data - Definition of Big Data - Challenges with Big Data - 3Vs of Big Data - Non Definitional traits of Big Data - Business Intelligence vs. Big Data - Data warehouse and Hadoop environment - Coexistence. Big Data Analytics: Classification of analytics - Data Science - Terminologies in Big Data - CAP Theorem - BASE Concept. NoSQL: Types of Databases – Advantages – NewSQL - SQL vs. NOSQL vs NewSQL. Introduction to Hadoop: Features – Advantages – Versions - Overview of Hadoop Eco systems - Hadoop distributions - Hadoop vs. SQL – RDBMS vs. Hadoop - Hadoop Components – Architecture – HDFS - Map Reduce: Mapper – Reducer – Combiner – Partitioner – Searching – Sorting - Compression. Hadoop 2 (YARN): Architecture - Interacting with Hadoop Eco systems.

Module-2

No SQL databases: Mongo DB: Introduction – Features - Data types - Mongo DB Query language - CRUD operations – Arrays - Functions: Count – Sort – Limit – Skip – Aggregate - Map Reduce. Cursors – Indexes - Mongo Import – Mongo Export. Cassandra: Introduction – Features - Data types – CQLSH - Key spaces - CRUD operations – Collections – Counter – TTL - Alter commands - Import and Export - Querying System tables.

Module-3

Hadoop Eco systems: Hive – Architecture - data type - File format – HQL – SerDe - User defined functions - Pig: Features – Anatomy - Pig on Hadoop - Pig Philosophy - Pig Latin overview - Data types - Running pig - Execution modes of Pig - HDFS commands - Relational operators - Eval Functions - Complex data type - Piggy Bank - User defined Functions - Parameter substitution - Diagnostic operator. Jasper Report: Introduction - Connecting to Mongo DB - Connecting to Cassandra - Introduction to Machine learning: Linear Regression – Clustering - Collaborative filtering - Association rule mining - Decision tree.

Books:

1. Seema Acharya, Subhashini Chellappan, "Big Data and Analytics", Wiley Publication, 2015.
2. Judith Hurwitz, Alan Nugent, Dr. Fern Halper, Marcia Kaufman, "Big Data for Dummies", John Wiley & Sons, Inc., 2013.
3. Tom White, "Hadoop: The Definitive Guide", O'Reilly Publications, 2011.
4. Kyle Banker, "Mongo DB in Action", Manning Publications Company, 2012.
5. Russell Bradberry, Eric Blow, "Practical Cassandra A developers Approach", Pearson Education, 2014.

7th Semester	RCS7D005	Computer Vision	L-T-P 3-0-0	3 CREDITS

Module I: (8 Hrs)

Image formation and camera calibration: Introduction to computer vision, geometric camera models, orthographic and perspective projections, weak perspective projection, intrinsic and extrinsic camera parameters, linear and nonlinear approaches of camera calibration.

Module II: (6 Hrs)

Feature detection and matching: Edge detection, interest points and corners, local image features, feature matching and Hough transform, model fitting and RANSAC, scale invariant feature matching.

Module III: (12 Hrs)

Stereo Vision: Stereo camera geometry and epipolar constraints, essential and fundamental matrix, image rectification, local methods for stereo matching: correlation and multi-scale approaches, global methods for stereo matching: order constraints and dynamic programming, smoothness and graph-based energy minimization, optical flow.

Module IV: (10 Hrs)

Shape from Shading: Modeling pixel brightness, reflection at surfaces, the Lambertian and specular model, area sources, photometric stereo: shape from multiple shaded images, modeling inter-reflection, shape from one shaded image.

Module V: (6 Hrs)

Structure from motion: Camera self-calibration, Euclidean structure and motion from two images, Euclidean structure and motion from multiple images, structure and motion from weak-perspective and multiple cameras.

Books:

1. Forsyth, D. A. and Ponce, J., "Computer Vision: A Modern Approach", Prentice Hall, 2nd Ed.
2. Szeliki, R., "Computer Vision: Algorithms and Applications", Springer.
3. Hartley, R. and Zisserman, A., "Multiple View Geometry in Computer Vision", Cambridge University Press.

7^{th} Semester	RCS7D007	Soft Computing	L-T-P 3-0-0	3 CREDITS

Module I: (14 Hrs)

Basic tools of soft Computing: Fuzzy logic, Neural Networks and Evolutionary Computing, Approximations of Multivariate functions, Non - linear Error surface and optimization

Fuzzy Logic Systems: Basics of fuzzy logic theory, Crisp and fuzzy sets; Basic set operations; Fuzzy relations, Composition of Fuzzy relations, Fuzzy inference, Zadeh's compositional rule of inference; Defuzzification; Fuzzy logic control; Mamdani and Takagi and Sugeno architectures. Applications to pattern recognition.

Module II: (14 Hrs)

Neural networks: Single layer networks, Perceptron; Activation functions; Adaline- its training and capabilities, weights learning, Multilayer perceptrons; error back propagation, generalized delta rule; Radial basis function networks and least square training algorithm,

Kohenen self - organizing map and learning vector quantization networks; Recurrent neural networks, Simulated annealing neural networks; Adaptive neuro-fuzzy information; systems (ANFIS).

Module III: (8 Hrs)

Evolutionary Computing: Genetic algorithms: Basic concepts, encoding, fitness function, reproduction. Differences of GA and traditional optimization methods. Basic genetic, basic evolutionary programming concepts Applications, hybrid evolutionary algorithms.

Books:

1. F. O. Karry and C. de Silva, "Soft Computing and Intelligent Systems Design - Theory, Tools and Applications". Pearson Education.(Printed in India).
2. J. S. R. Jang. C. T. Sun and E. Mizutani, "Neuro-fuzzy and soft-computing". PHI Pvt. Ltd., New Delhi.
3. Fredric M. Ham and Ivica Kostanic, "Principle of Neuro Computing for Science and Engineering", Tata McGraw Hill.
4. S. Haykins, "Neural networks: a comprehensive foundation". Pearson Education, India. 4) V. Keeman,"Learning and Soft computing", Pearson Education, India.
5. R. C. Eberhart and Y. Shi, "Computational Intelligence Concepts to Implementation". Morgan Kaufmann Publishers (Indian Reprint).

7^{th} Semester	REC7D003	Advanced Digital Signal Processing	L-T-P 3-0-0	3 CREDITS

Module-I: **(10 hours)**

Multirate Digital Signal Processing: Introduction, Decimation by a factor D, Interpolation bya factor I, Sampling rate Conversion by a rational factor I/D, Implementation of Samplingrate Conversion, Multistage implementation of Sampling rate Conversion, Sampling rateConversion of Band pass Signals, Sampling rate Conversion by an Arbitrary Factor, DigitalFilter Banks, Two-channel Quadrature Mirror Filter Bank.

Module-II: **(10 hours)**

Linear Prediction and Optimum Linear Filters: Random Signals, Correlation Functions, andPower Spectra, Innovation Representation of a Stationary Random Process, Forward andBackward Linear Prediction, Solution of the normal equations: The Levinson-DurbinAlgorithm. Properties of the Linear Prediction Error filters. Wiener filters for filtering andPrediction. Adaptive Filters: Applications of Adaptive filters, Adaptive Direct-Form FIR filters- The LMS Algorithm.

Module-III: **(10 hours)**

Power Spectrum Estimation: Estimation of Spectra from Finite Duration Observations ofSignals, Nonparametric Methods for Power Spectrum estimation, Relationship between theAutocorrelation and the model parameters. Bayes Theorem, Maximum Likelihooddetection.

Module-IV: **(10 hours)**

The Yule-Walker Method for the AR Model Parameters, The Burg Method for the AR modelParameters, Unconstrained Least-Squares Method for the AR model parameters, MA Modelfor Power Spectrum Estimation, ARMA model for Power Spectrum Estimation.

Books:

[1] Digital Signal Processing, John G.Proakis, Dimitris G. Manolakis, Pearson Education, New Delhi, 4th Edition, 2013.
[2] Adaptive Filter Theory, Simon Haykin, Pearson Education, 5th Edition 2017.
[3] Adaptive Signal Processing, Bernard Widrow, Samuel D Stearns, Pearson Education

Digital Learning Resources:

Course Name: Advance Digital Signal Processing
Course Link: https://nptel.ac.in/courses/117/101/117101001/
Course Instructor: Prof. V.M. Gadre, IIT Bombay

7th Semester	RIK7F001	Essence of Indian Knowledge Tradition - II	L-T-P 3-0-0	3 CREDITS

Course Objectives:

1. To facilitate the students with the concepts of Indian traditional knowledge and to make them understand the Importance of roots of knowledge system.
2. To make the students understand the traditional knowledge and analyse it and apply it to their day to day life

Course Outcomes :

At the end of the Course, Student will be able to:

1. Identify the concept of Traditional knowledge and its importance.
2. Explain the need and importance of protecting traditional knowledge.
3. IIllustrate the various enactments related to the protection of traditional knowledge.
4. Interpret the concepts of Intellectual property to protect the traditional knowledge.
5. Explain the importance of Traditional knowledge in Agriculture and Medicine.

Module-1:

Introduction to traditional knowledge: Define traditional knowledge, nature and characteristics, scope and importance, kinds of traditional knowledge, Indigenous Knowledge (IK), characteristics, traditional knowledge vis-a-vis indigenous knowledge, traditional knowledge Vs western knowledge traditional knowledge

Module-2:

Protection of traditional knowledge:The need for protecting traditional knowledge Significance of TK Protection, value of TK in global economy, Role of Government to harness TK.

Module-3:

Legal framework and TK: The Scheduled Tribes and Other Traditional Forest Dwellers (Recognition of Forest Rights) Act, 2006, Plant Varieties Protection and Farmer's Rights Act, 2001 (PPVFR Act); The Biological Diversity Act 2002 and Rules 2004, the protection of traditional knowledge bill, 2016.

Module-4:

Traditional knowledge and intellectual property: Systems of traditional knowledge protection, Legal concepts for the protection of traditional knowledge, Patents and traditional knowledge, Strategies to increase protection of traditional knowledge

Module-5:

Traditional Knowledge in Different Sectors: Traditional knowledge and engineering, Traditional medicine system, TK in agriculture, Traditional societies depend on it for their food and healthcare needs, Importance of conservation and sustainable development of environment, Management of biodiversity, Food security of the country and protection of TK

Books:

1. Traditional Knowledge System in India, by Amit Jha, 2009.

2. Traditional Knowledge System in India by Amit Jha Atlantic publishers, 2002.

3. "Knowledge Traditions and Practices of India" Kapil Kapoor, Michel Danino.

Digital Learning Resources:

Course Name:	Ayurvedic Inheritance of India
Course Link:	https://nptel.ac.in/courses/121/106/121106003/
Course Instructor:	Dr M. S. Valiathan, IIT, Madras

https://www.youtube.com/watch?v=LZP1StpYEPM