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

BACHELOR OF TECHNOLOGY

FOR ADMISSION BATCH 2023-24

ELECTRONICS AND COMMUNICATION ENGINEERING / ELECTRONICS AND TELECOMMUNICATION ENGINEERING

SECOND YEAR (THIRD SEMESTER)

Sl. No.	Category	Course Code	Course	Contact Hrs. L-T-P	Credit	University Marks	Internal Evaluation
			Subject (Theory)				
1	BS	HSBS2001	Mathematics - III	3-0-0	3	100	50
2	PC	EOPC2001	Analog Electronic Circuits	3-0-0	3	100	50
3	PC	EEPC2001	Electrical Circuit Analysis	3-0-0	3	100	50
4	PC	EOPC2003	Signals and Systems	3-0-0	3	100	50
5	PC(ACC)	PCAC2001	Python Programming	3-0-0	2	100	50
		PCAC2002	Data Science Foundations				
		PCAC2003	Web and Application Development				
		PCAC2004	Cloud Computing Foundation				
		PCAC2005	Programming Internet of Things				
		PCAC2006	Robotics : Motion Planning				
		PCAC2007	IT Fundamentals for Cybersecurity - I				
6	HS	HSHS2001	Engineering Economics	3-0-0	2	100	50
		HSHS2002	Organizational Behaviour				
			Subject (Sessional / Practical)				
7	PC	EOPC2201	Analog Electronic Circuits Lab.	0-0-3	1.5	-	100
8	PC	EEPC2201	Electrical Circuit Analysis Lab.	0-0-3	1.5	-	100
9	PC	EOPC2203	Signals and Systems Lab.	0-0-3	1.5	-	100
10	PC(ACC)	PCAC2201	Python Programming Lab.	0-0-3	1.5	-	100
		PCAC2202	Data Science Foundations Lab.				
		PCAC2203	Web and Application Development Lab.				
		PCAC2204	Cloud Computing Foundation Lab.				
		PCAC2205	Programming Internet of Things Lab.				
		PCAC2206	Robotics : Motion Planning Lab.				
		PCAC2207	IT Fundamentals for Cybersecurity - I Lab				
			Total	**18-0-12**	**22**	**600**	700

Note: Click here to view/download the syllabus of the subjects.

HSBS2001 MATHEMATICS-III (3-0-0)

Module 1: Laplace Transforms (8 Hours)

Laplace transforms, inverse transforms, linearity, shifting, transforms of derivatives and integrals, solution of ODEs, unit step function, Dirac's delta function, differentiation and integration of transforms, convolution, integral equations.

Module 2: Fourier series & Applied PDE's (8 Hours)

Fourier series: Euler's formula, 2π and arbitrary periodic functions, even and odd functions. Elementary PDE's: Method of separation of variables (simple problems). One dimensional wave equation:solution by separation of variables, One dimensional heat equation: solution by Fourier series.

Module 3: Basic Probability (8 Hours)

Axiomatic definition of probability, Basic properties, conditioning and independence, Random variables (discrete and continuous), probability mass and density functions, cumulative distribution functions, moments of random variables, mean and variance.

Module 4: Probability Distributions (8 Hours)

Discrete Probability distributions: Binomial, Poisson and hyper-geometric distributions. ContinuousProbability distributions: exponential, uniform and normal distributions.

Module 5: Applied Statistics (8 Hours)

Random sampling, estimation of parameters, maximum likelihood estimation, confidence intervals. Regression and correlation analysis: fitting of straight lines (method of lest squares), correlation coefficientwith basic properties.

Text Books:

1. Advanced Engineering Mathematics by E. Kreyszig, John Willey & Sons Inc. 10th Edition.
2. Ronald E. Walpole, Raymond H. Myers, Sharon L. Myers & Keying Ye, "Probability & Statistics for Engineers & Scientists", Eighth Edition, 2007, Pearson Education Inc., NewDelhi.

Reference Books:

1. Ordinary and Partial Differential equations by J. Sinha Roy and S. Padhy, Kalyani Publishers.
2. Higher Engineering Mathematics by B. V. Ramana, McGraw Hill Education.
3. Engineering Mathematics by Pal and S. Bhunia, Oxford Publication.
   Stochastic Processes, 2nd Edition by Roy D. Yates, Rutgers and David J. Goodman, John Wiley and Sons, INC.

EOPC2001 ANALOG ELECTRONIC CIRCUIT (3-0-0)

COURSE OBJECTIVE:

1. Understand Bipolar Junction Transistors and Metal Oxide Semiconductors.
2. Analysis of DC biasing of Semiconductor Circuits using BJT and MOSFET.
3. Understand Input and Output characteristics of Single Stage Amplifier (both BJT and MOSFET).
4. Apprehend characteristics of Feedback and Power amplifier.

MODULE 1:

Biasing of BJT: DC Analysis, DC Load line, Operating Point, Fixed bias, Emitter bias, Voltage-divider bias, DC bias with voltage feedback, Bias stabilization. **[8hrs]**

Small Signals Modelling of BJT and their analysis: The r_e transistor model, Hybrid equivalent model, small signal analysis of CE, CC, CB amplifier, Emitter Follower; Cascade Amplifier, Darlington connectionsand Current Mirror Circuit.

MODULE 2:

Biasing of FET and MOSFET: Fixed bias configuration, Self-bias configuration, Voltage divider bias and design. **[8 hrs]**

Small Signal operation and models of FET and MOSFETs: Small signal equivalent models, Single-stage MOSFET Amplifiers: Common-Source (CS) amplifiers, Common-Source amplifiers with a source resistance, Common-Gate (CG) amplifiers, Common-Drain (CD) or Source follower amplifiers and cascaded system.

MODULE 3:

Frequency Response of BJTs and FETs: Low Frequency Response of BJTs (CE) Amplifier, Low Frequency Response of FETs (CS) Amplifier, Miller Effect Capacitance, HIgh Frequency Response of BJTs (CE) Amplifier, High Frequency Response of FETs (CS) Amplifier, Multi stage frequency effect, Square Wave testing of amplifiers. **[4 hrs]**

MODULE 4:

Operational Amplifiers: OP-AMP Specifications, DC offset parameters, frequency parameters, Gain-bandwidth, Slew rate, OP-AMP Applications:voltage buffer, differentiator, andIntegrator, Instrumentation amplifier. **[4hrs]**

MODULE 5:

Oscillators and power amplifiers: Positive feedback circuit as Oscillator, Barkhausen's criteria for oscillation, Oscillators (Wien Bridge Oscillator, R-C phase shift oscillator and Crystal Oscillator). **[6 hrs]**

Classification of Power Amplifiers, Power dissipation and power conversion efficiency of Class A, Class B amplifiers, Push-pull amplifier.

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

CO1: Understand BJT biasing and stabilization and analyse transistor re and hybrid models.

CO2: Understand the characteristics and configurations of single stage MOSFET amplifiers.

CO3: Design amplifier circuits using BJT, FET and study the low and high frequency response of BJT, FET amplifiers.

CO4: Understand operational amplifier's specifications, parameters, and its various applications.

CO5:Explain various oscillator circuits and power amplifiers.

TEXT BOOKS

1. Microelectronic Circuits – Sedra& Smith, International Student Edition
2. Electronic Devices and Circuit Theory – Robert L.Boylestad and LowisNashelsky, Pearson Publication, New Delhi, 10th edition

REFERENCE BOOKS

1. Millman's Integrated Electronics Jacob Millman and Christos Halkias, Chetan D Parikh, Mcgraw Hill
2. Electronic Devices – Floyd, Pearson Education

EEPC2001 ELECTRICAL CIRCUIT ANALYSIS (3-0-0)

Module I **8Hours**

Graph Theory: Graph of network. Trees. Cotrees and Loops. Number of possible trees of a graph. Incidence Matrix. Cut-set matrix. Tie-set and loop currents. Inter-relationship among various matrices.Concept of duality and dual networks.

Network Theorems (for both AC and DC networks): Superposition theorem. Thevenin's theorem. Norton's theorem. Maximum power transfer theorem. Reciprocity theorem. Compensation theorem. Millman's Theorem. Substitution Theorem. **9Hours**

Module II

Time Domain Analysis of First and Second-order networks: Source-free RC circuit. Source-free RL circuit. Singularity Functions. Step Response of an RC Circuit. Step Response of an RL Circuit. Initial and final conditions in network elements. The Source-Free Series RLC Circuit. The Source-Free Parallel RLC Circuit. Step Response of a Series RLC Circuit.Step Response of a Parallel RLC Circuit.

Coupled Circuit Analysis: DOT convention. coefficient of coupling. series and parallel coupled circuits. electrical equivalent of magnetically coupled circuits **6 Hours**

Module III

Laplace Transform: Definition of Laplace Transform. properties of Laplace transform. Inverse Laplace transform: (i) simple poles (ii) repeated poles (iii) complex poles. Gate Function. Impulse Function. Laplace Transform of periodic functions. Convolution Integral.

Electrical Circuit Analysis Using Laplace Transform: Representation ofCircuit Elements in s-domain. Circuit analysis in s-domain: With and without initial conditions. **8Hours**

Module IV

Resonance: Resonance in series and parallel RLC circuit. variation of current and voltage with frequency. selectivity and bandwidth. Q-factor.

Two Port Network Theory: Introduction. Characterization of Linear Time-invariant two-port networks. impedance parameters. admittance parameters. transmission and hybrid parameters. inter-relationship between the parameters. interconnections of two-port networks. Two-port symmetry.

Filters: Introduction to first-order and second-order passive and active filters. **5Hours**

Module V

Network Functions: Network functions. poles and zeroes. necessary condition for Driving point function. necessary condition for transfer function. Time domain behaviour from pole zero plot.

Passive network synthesis: Positive real function. Driving point and transfer impedance function. Cauer-I. Cauer-II. Foster-I and Foster-II forms. Driving point and transfer impedance function

Course Outcomes : This course will enable students to:

CO1:apply network theorems for the analysis of electrical circuits

CO2:analyse the transient and steady-state response of electrical circuits.

CO3:apply Laplace Transform for the analysis of electrical circuits.

CO4:analyse the behaviour of two-port networks and synthesis of passive two-port networks.

Text Book(s):

1. Charles K. Alexander. Matthew N. O. Sadiku. "Fundamentals of Electric Circuits" | 7th Edition. McGraw Hill Publication.
2. D. Roy Choudhury. "Networks and Systems". New Age International Publications. 1998.

Reference Book(s):

1. W. H. Hayt and J. E. Kemmerly. "Engineering Circuit Analysis". McGraw Hill Education.2013.
2. M. E. Van Valkenburg. "Network Analysis". Prentice Hall. 2006.

EOPC2003 SIGNALS AND SYSTEMS (3-0-0)

- Course Objective:

  - To understand the fundamental characteristics of signals and systems
  - To understand signals and systems in terms of both the time and transform domains, taking advantage of the complementary insights and tools that these different perspectives provide.
  - To develop the mathematical skills to solve problems involving convolution, correlation, and sampling.

Module 1 Basics of continuous-time and discrete-Time Signals. Elementary signals (Impulse, Ramp, step, exponential). Classification of Discrete-Time Signals. Simple Manipulation of Discrete time signals. Discrete-Time Systems:Block Diagram Representation. Classification and Interconnection.	**7 Hours**
Module 2 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.	**8 Hours**
Module 3 Fourier series representation: Continuous time Fourier series (CTFS). Dirichlet conditions, properties of CTFS, discrete time Fourier series (DTFS), properties of DTFS .	**4 Hours**
Module 4 Sampling: Representation of a Continuous-Time Signal by Its Samples. The Sampling Theorem. Reconstruction of a Signal from Its Samples Using Interpolation. Aliasing. Discrete-Time Processing of Continuous-Time Signals	**4 Hours**
Module 5 The continuous-Time Fourier Transform (CTFT): Basic concepts of the Fourier Transform. Fourier Transform of periodic and Aperiodic signals. Properties of the continuous-Time Fourier Transform. The discrete time Fourier transform(DTFT): Fouriertransform of periodic and Aperiodic signals, properties of DTFT.	**7 Hours**

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

  - CO1: understand the basic properties of signals and systems in both continuous and discrete time.
  - CO2: classify systems based on their properties and determine the response of LTI system using convolution.
  - CO3: analyse the spectral characteristics of continuous-time periodic and aperiodic signals using Fourier analysis.
  - CO4: understand the process of sampling and the effects of under sampling.
  - CO5: apply the discrete time Fourier transform for analysis of discrete-time signals.

Text Books:

1. Digital Signal Processing – Principles, Algorithms and Applications, John. G. Proakis and Dimitris. G. Manolakis, 4th Edition, Pearson.
2. Signals & Systems by Alan V Oppenheim, A.S. Willsky and S.H. Nawab 2nd Edition, Pearson.
3. Signals and Systems by Simon Haykin and Barry Van Veen, 2nd Edition, Willey.
4. Fundamentals of Signals and Systems - M J Roberts, TMH

PCAC2005 PROGRAMMING INTERNET OF THINGS (3-0-0)

OVERALL COURSE OBJECTIVES: To empower students with a comprehensive understanding of IoT and Embedded Systems, Arduino and Raspberry Pi platforms, and C and Python programming. This will enable them to create innovative IoT designs and products and understand how these devices interact with the physical world. They will also learn debugging techniques and network protocols essential for embedded systems.

Module 1: Introduction to the Internet of Things and Embedded Systems [12 Hours]

This course explores the significant role of the "Internet of Things" (IoT) in the modern world and its future trends. It defines what IoT and embedded systems are, describes their impact on society, and enumerates their components. The lessons cover hardware and software interactions in an IoT device and the role of an operating system in supporting this software. The course highlights key components of networking, including an understanding of how to connect devices to the Internet, the structure of the Internet, and the meaning of a "network protocol". It also explains Mobile Ad-Hoc Networks (MANETs) in relation to IoT. While beneficial, this course does not include discussion forums.

Sub-Topic

Embedded Systems
Hardware and Software
Networking and the Internet
What Is the Internet of Things (IoT)?

Formative Assessments:

4 quizzes and 4 peer-review assignments.

Module 2: The Arduino Platform and C Programming [13 Hours]

This course provides in-depth knowledge about the Arduino platform, including the physical board, libraries, and the integrated development environment (IDE). It explores the role and usage of shields and touches on programming the Arduino using C code. The lessons delve into elements like reading board schematics, installing the Arduino IDE, understanding the significance of libraries, and running a program. The course provides a comprehensive understanding of C variables, types, common operators, conditionals, loops, functions, and the implications of global variables. Additionally, the course covers the Arduino build process, the role of tools in the IDE, the structure of an Arduino sketch, and accessing pins on the Arduino. It also covers embedded software debugging, common debugging architectures for embedded systems, and the UART Serial communication protocol. The course does not include discussion forums.

Sub-Topic

Arduino Environment
Arduino Programs
C Programming
Basic C Operators
Arduino Sketches

Formative Assessments:

4 quizzes and 4 peer-review assignments.

Module 3: The Raspberry Pi Platform and Python Programming for the Raspberry Pi [19 Hours]

The Raspberry Pi is a small, affordable single-board computer that you will use to design and develop fun and practical IoT devices while learning programming and computer hardware. In addition, you will learn how to set up the Raspberry Pi environment, get a Linux operating system running, and write and execute some basic Python code on the Raspberry Pi. You will also learn how to use Python-based IDE (integrated development environments) for the Raspberry Pi and how to trace and debug Python code on the device.

Sub-Topic

Raspberry Pi Processor
Operating System Benefits
Raspberry Pi Configuration
Navigating the Filesystem
Linux Graphic User Interface
Python on Raspberry Pi

Formative Assessments:

4 quizzes and 4 peer-review assignments.

LEARNING OUTCOMES: On successful completion of the course the students shall be able to:

1. Understand and define the key concepts of "Internet of Things" and its impact on society, focusing specifically on design considerations and components of IoT devices.
2. Master the composition and firmware programming of the Arduino development board, as well as the usage of "shields" and libraries.
3. Gain the ability to compile and run a program using C language, understanding variables, types, and operators specifically relevant to Arduino sketches.
4. Acquire knowledge on the Raspberry Pi setup and operation, including executing a Linux operating system.
5. Develop expertise in writing and executing basic Python code on Raspberry Pi, also learning to use Python-based IDEs and debugging Python code.
6. Understand the fundamental aspects of networking, including network protocol, structure of the Internet, and their specific implications in IoT devices.

HSHS2002 ORGANISATIONAL BEHAVIOUR (3-0-0)

Objectives:

The objective is to develop an understanding of the behavior of individuals and groups inside organizations and to enhance skills in understanding and appreciating individuals, interpersonal, and group process for increased effectiveness both within and outside of organizations. Further, it is 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 theResistance 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.

Course Outcomes:

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

1. Understand the basic concepts of OB, change management, organizational culture and their implementation in organizations.
2. Identify and examine team characteristics for improved organizational performance.
3. Apply theories and frameworks to solve problems and take effective decisions for organizational success.
4. Analyze group behavior and leadership styles for effective people management.
5. Evaluate individual personality types and group behaviours for improving organizational processes and practices.
6. Develop leadership competency to manage organizational situations.

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.

EOPC2201 ANALOG ELECTRONIC CIRCUIT LABORATORY (0-0-3)

COURSE OBJECTIVE:

1. To understand the operation of the various bias circuits of BJT, JFET and MOSFET.
2. To study the frequency response of BJT, JFET and MOSFET-amplifier.
3. To understand the operation of various power amplifier circuits and OPAMP circuits.
4. To plot and analyse the frequency response of OPAMP.
5. To analyse RC phase shift oscillator and square wave testing of amplifier.

List of Experiments (Any 10 experiments):

1. Design and simulate voltage divider biasing circuits using BJT-CE configuration and compare the results.
2. Design and simulate of voltage divider biasing circuits using JFEET-CS configuration.
3. Design and simulate of Self-biasing circuits of MOSFET.
4. Determine the frequency response of BJT CE- amplifier: low frequency, Mid-frequency and high frequency response.
5. Determine the frequency response of BJT emitter follower (CC-amplifier) circuit.
6. Determine the frequency response of JFET CS- amplifier Circuit.
7. Determine the frequency response of MOSFET CS- amplifier circuit.
8. Calculation of rise time, tilt and low cut off frequency by square wave testing of amplifier.
9. Study of OPAMP frequency response.
10. Study of integrator and differentiator circuits using OPAMP.
11. Study of RC phase shift oscillator using BJT/OPAMP.
12. Study of Class A, B power amplifier.
13. Study of Darlington connection and Current mirror circuits.

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

1. Understand about the operation of the various bias circuits of BJT, JFET and MOSFET.
2. Acquire knowledge on the frequency response of different amplifier circuits.
3. Learn the operation of integrator and differentiator circuits using OPAMP.
4. Analyse phase shift oscillators and square wave testing of amplifier.
5. Learn the operation of various power amplifier circuits.

EOPC2203 SIGNALS AND SYSTEMS LABORATORY (0-0-3)

Course Objectives:

- To understand basic signal operations
- To develop the student's ability to analyse signals and systems using software.
- To familiarize convolution and Frequency transformation

List of experiments:

(Any 10 Experiments)

1. Introduction to MATLAB and its basic toolboxes required for the analysis of signals and systems. To study use variables, vectors, Matrices & its functions in MATLAB. To Perform basic operations such as addition, subtraction, multiplication, division and transpose of vector and Matrix and plot its results.
2. Generation of basic continuous-time periodic signals, i.e., sine, cosine, square, etc. and plot its results in MATLAB.
3. Generation of basic continuous-time aperiodic signals, i.e., ramp, exponential, rectangular pulse, step, impulse, etc. and plot its results in MATLAB.
4. Computation of convolution of discrete-time periodic signals in MATLAB using program logic and inbuilt function.
5. Computation of convolution of discrete-time aperiodic signals in MATLAB using program logic and inbuilt function.
6. Implementation of a difference equation in MATLAB.
7. Generation of frequency response of an LTI system from its impulse response in MATLAB.
8. Computation of discrete-time Fourier series (DTFS) of fundamental signals in MATLAB.
9. Computation of discrete-time Fourier transform (DTFT) of fundamental signals in MATLAB.
10. Frequency domain analysis of decimation and interpolation of signals in MATLAB.
11. Computation of Cross correlation of sequence x(n) and y(n) verify the property in MATLAB.
12. Computation of auto correlation of sequence x(n) and y(n) verify the property in MATLAB.
13. Generation of randomly distributed random sequences of N=1000in the interval (-0.5 to +0.5) and find its mean and variance in MATLAB
14. Generation of Gaussian distributed random sequences of N=1000 in the interval and find its mean and variance in MATLAB.

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

CO1:analyse different signals using simulation tools.

CO2:develop signal processing operations

CO3: Examine the properties of FT

CO4: analyse frequency domain representation of signals using Fourier series and Fourier transform

CO5: apply signal analysis to real time application.

PCAC2205 PROGRAMMING INTERNET OF THINGS LAB. (0-0-3)

Module Title	Lab Name	Details
Introduction to the Internet of Things and Embedded Systems	Wireshark	Download and install Wireshark on a computer. Start Wireshark and start a packet capture. Open a browser on your computer and go to any webpage. Stop the Wireshark packet capture and examine it to find the first TCP packet which is recorded and whose source is your computer. Find the port number, P, used on your computer. Use the Wireshark filter to show only the messages to/from this port (tcp.port == P). Select the message and make sure that the Packet Details Pane is visible and showing the following information: 1) the Internet Protocol header with the Src and Dst IP addresses, and 2) the Transmission Control Protocol header with the Src Port number and Dst Port numbers. Print the screen image and submit it for grading. Also, submit one page which states your machine's IP address at the time of capture, and the port number that you found being used for the TCP connection on your computer.
The Arduino Platform and C Programming	Install Arduino IDE	install the Arduino IDE on your computer, compile the "Blink" example, upload the example to the board, and ensure that the LED blinks.
	Program to compute Fibonacci sequence	Write a program in C that computes and prints out the first six digits in the Fibonacci sequence.
	Arduino Blink	Write a program that causes the built-in LED connected to pin 13 on the Arduino to blink, alternating between fast blinks and slow blinks. The LED should blink 5 times quickly and then it should blink 5 more times slowly. The LED should continue to blink in this alternating fashion for as long as the Arduino receives power.
	Serial on Arduino	Write a program that allows the user to control the LED connected to pin 13 of the Arduino. When the program is started, the LED should be off. The user should open the serial monitor to communicate with the Arduino. If the user sends the character '1' through the serial monitor then the LED should turn on. If the user sends the character '0' through the serial monitor then the LED should turn off.
The Raspberry Pi Platform and Python Programming for the Raspberry Pi	Raspberry Pi setup	Setup your Raspberry Pi by usingNOOBSto install Raspbian on the micro SD card. Boot your Raspberry Pi to the desktop and take a picture (with a regular camera/phone) of the desktop. Submit the picture as evidence that you completed the task.
		Boot the Raspberry Pi and install the "scrot" program to take screen shots. You can install it by typing "sudo apt-get install scrot" in a terminal window. Use the scrot program to take a screenshot of your Raspberry Pi.
	Use Python shell	Write a Python program that prompts the user to input 3 numbers, one at a time. The Python program should put the numbers in a list, sort the list, and print the sorted list.
	Circuit using Raspberry Pi	Build a circuit using your Raspberry Pi that causes an LED to blink when a push button is NOT pressed. However, the LED should stay on continually when the push button IS pressed. Your video should show the LED blinking when the push button is not pressed, and it should show that the LED is constantly on while the button is pressed.

EEPC2201 ELECTRICAL CIRCUIT ANALYSIS LAB (0-0-3)

Sl. No	Name of the Experiments (Any 08 Experiments)	Hrs.
1.	Validation of Network Theorems using AC circuits (Superposition, Thevenin, Norton, Maximum power transfer)	3
2.	Study of DC and AC transients for R-L, R-C & R-L-C circuits using digital storage oscilloscope	3
3.	Determination of two port network parameters (open circuit and short circuit parameters)	3
4.	Determination of two port network parameters(hybrid and transmission parameters).	3
5.	Frequency response of low pass and high pass filters.	3
6.	Frequency response of band pass and band elimination filters.	3
7.	Determination of self-inductance, mutual-inductance and coupling coefficient of a single-phase two winding transformer representing a coupled circuit.	3
8.	Study of series and parallel connected magnetically coupled circuits	3
9.	Study of resonance in R-L-C series circuit using oscilloscope.	3
10.	Study of resonance in R-L-C parallel circuit using oscilloscope.	3

Course Outcomes: This course will enable students to:

CO1: validate Superposition, Thevenin, Norton, and Maximum Power Transfer theorems in AC networks.

CO2: interpret the transient responses of R-L, R-C, and R-L-C circuits using a digital storage oscilloscope.

CO3: characterize a given two port network using open circuit, short circuit, hybrid and transmission parameters.

CO4: interpret the frequency response plot of low pass, high pass, band pass, and band elimination filters.

CO5: validate the self-inductance, mutual inductance, and coupling coefficient of a single-phase two winding transformer.

CO6: interpret the response of resonance in R-L-C series and parallel circuits using an oscilloscope

All the above experiments are also to be performed in simulation environment preferably using open-source softwares(MULTISIM, PSIM, PSPICE, LTSPICE etc) and through virtual lab platforms

BACHELOR OF TECHNOLOGY

ELECTRONICS AND COMMUNICATION ENGINEERING / ELECTRONICS AND TELECOMMUNICATION ENGINEERING

SECOND YEAR (FOURTH SEMESTER)

W.E.F. ADMISSION BATCH 2023-24

Sl. No.	Category	Course Code	Course	Contact Hrs. L-T-P	Credit	University Marks	Internal Evaluation
			Subject (Theory)				
1	PC	EOPC2005	Electromagnetic Theory	3-0-0	3	100	50
2	PC	EOPC2006	Digital Systems Design	3-0-0	3	100	50
3	PC	EOPC2007	Control System	3-0-0	3	100	50
4	PC	EOPC2008	Principles of Communication Systems	3-0-0	3	100	50
5	PC(ACC)	PCAC2008	Machine Learning Techniques and Applications	3-0-0	2	100	50
		PCAC2009	Big Data Integration and Management				
		PCAC2010	Application Development - Tools & Technologies				
		PCAC2011	Cloud Infrastructure & Applications				
		PCAC2012	Internet of Things and Cloud				
		PCAC2013	Robotics : Mobility & Design				
		PCAC2014	IT Fundamentals for Cybersecurity - II				
6	HS	HSHS2002	Organizational Behaviour	3-0-0	2	100	50
		HSHS2001	Engineering Economics				
			Subject (Sessional / Practical)				
7	PC	EOPC2205	Digital Systems Design Lab.	0-0-3	1.5	-	100
8	PC	EOPC2206	Control System Lab.	0-0-3	1.5	-	100
9	PC	EOPC2207	Principles of Communication Systems Lab.	0-0-3	1.5	-	100
10	PC	EOPC2208	Python Lab.	0-0-3	1.5	-	100
			Total	**18-0-12**	**22**	**600**	**700**

Note : Minimum four (04) weeks of Summer Course / Training / Internship / Skill Course / etc. after 4th Semester.

Click here to view/download the syllabus of the subjects.

EOPC2005 ELECTROMAGNETIC THEORY (3-0-0)

Course Objectives : This course aims to provide students with a comprehensive understanding of electromagnetic theory, including coordinate systems, vector calculus, electrostatics, magnetostatics, and electromagnetic wave propagation. Students will explore foundational principles, numerical techniques for solving boundary value problems, and applications such as transmission line modeling and wave reflection. Emphasis is placed on applying theoretical concepts to analyze and investigate practical scenarios, enabling learners to connect cause-and-effect relationships within electromagnetic systems effectively. The course prepares students to grasp advanced electromagnetic principles and apply them to engineering and scientific challenges.

Module 1 (6 Hours)
Coordinate systems & Transformation: Cartesian, Cylindrical and Spherical Coordinate Systems.
Vector Calculus: Differential length, Area & volume, Line, Surface and Volume Integrals, Del operator, Gradient of a scalar, Divergence of a vector & divergence theorem, curl of a vector & Stoke's theorem, laplacian of a scalar, Maxwell's equations.

Module 2 (8 Hours)
Electrostatic Fields: Coulomb's Law, Electric Field Intensity, Electric Fields duetopoint, line, surface and volume charge, Electric Flux Density, Gauss's Law–Maxwell's Equation, Applications of Gauss's Law, Electric Potential, Relationship between E and V–Maxwell's Equation. An Electric Dipole & Flux Lines, Energy Density in Electrostatic Fields., Electrostatic Boundary – Value Problems: Possion's & Laplace's Equations, Uniqueness theorem, General procedures for solving position's or Laplace's Equation, Greens functions,

Module 3 (6 Hours)
Magnetostatic Fields: Magnetic Field Intensity, Biot-Savart's Law, Ampere's circuit law-Maxwell Equation, applications of Ampere's law, Magnetic Flux Density-Maxwell's equations. Maxwell's equation for static fields, Magnetic Scalar and Vector potentials. Polarizations of waves

Module 4 (6 Hours)
Electromagnetic Fields and Wave Propagation: Faraday's Law, Transformer & Motional Electromagnetic Forces, Displacement Current, Maxwell's Equation in Final forms, Time Varying Potentials, Time-Harmonic Field. Electromagnetic Wave Propagation: Wave Propagation in lossy Dielectrics, Plane Waves in loss less Dielectrics, Power & pointing vector

Module 5 (4 Hours)
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.

Course Outcomes
After the completion of this course, students will be able to:
1. Understand basic theories of electromagnetics.
2. Understand numerical techniques to solve a boundary value problem.
3. Describe the various aspect of electromagnetic theory
4. Analyze the two-conductor transmission line model.
5. Apply the knowledge to investigate the cause and effect qualitatively

Text Book:
1. Principles of Electromagnetics, Mathew N.O. Sadiku & S.V. Kulkarni., Oxford University Press, 6th edition
2. Electromagnetic Waves and Radiating Systems, E.C. Jordan and K.G. Balmain, Pearson Education, New Delhi, 2nd Edition

Reference Book:
1. C.R.Paul, K.W.Whites, S.A.Nasor, Introductionto Electromagnetic Fields, 3rd, TMH.
2. W.H.Hyat, Electromagnetic Field Theory, 7thEd,TMH.
3. RogerF. Harrington,Time-harmonic electromagnetic fields, McGraw-Hill
4. Principles of Electromagnetic, S.C. Mahapatra, &S. Mahapatra, McGraw Hill Education (India) Pvt. Ltd., New Delhi, 2nd Edition.

EOPC2006 DIGITAL SYSTEM DESIGN (3-0-0)

Course Objective:

To provide a comprehensive understanding of number systems, binary codes, and their applications in digital electronics.

- To develop skills in Boolean algebra and logic gate analysis for solving digital logic problems.
- To equip students with knowledge of combinational and sequential logic design techniques.
- To introduce students to memory systems, programmable logic, and hardware description languages like Verilog/VHDL.

MODULE – I (6 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.

Boolean Algebra and Logic Gates: Boolean algebra and identities, Complete Logic set, logic gates and truth tables. Universal logic gates, Algebraic Reduction and realization using logic gates.

MODULE – II (8 Hours)

Combinational Logic Design: Sum of product & product of sums, K-Maps: Two, Three and Four variable K-maps, Quine-McCluskey's method, NAND and NOR Logic Implementations.

Logic Components: Concept of Digital Components, Binary Adders, Subtraction and Multiplication, An Equality Detector and Comparator, Decoder, Encoders, Multiplexers and De-multiplexers.

MODULE – III (6Hours)

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 (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.

Shift registers: Principle of 4-bit shift registers. Shifting principle, Timing Diagram, SISO, SIPO, PISO and PIPO registers.

MODULE – V (4 Hours)

Programmable Logic Devices: Operation and Circuit implementation of PROM, PAL, PLA.

IC Logic Families: Properties DTL, RTL, TTLand 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, Subtractors, Multiplexers, Comparators, Decoders flip-flops, counters, Shift resistors.

Course Outcomes:

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

CO1: Understand the representation of number systems, binary codes, and Boolean algebra for logic circuit design.

CO2: Design and simplify combinational logic circuits using tools like K-maps and Quine-McCluskey methods.

CO3: Analyze and construct sequential circuits using flip-flops, state diagrams, and finite state machine models.

CO4: Design counters, shift registers, and memory components while understanding programmable logic devices.

CO5: Develop, simulate, and implement basic digital systems using Verilog/VHDL programming.

Books:

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.

EOPC2007 CONTROL SYSTEM (3-0-0)

Program Objectives: This course will enable students to:

1. To obtain mathematical models from the first principal equations of dynamical systems.
2. To carry out the performance assessment of a linear system using time-domain techniques.
3. To carry out stability analysis of a linear system using frequency-domain techniques.
4. To design compensators and controllers that meet design specifications for the transfer function-based model.
5. To obtain the state-space model of linear time-invariant systems.

Module I (8 Hours)

Introduction to Control System: Motivation, Open-loop versus Closed Loop Control System, Examples of Control System, Block Diagram of Control System, Principle of Feedback Control System.Mathematical Modelling and Representation of Systems: Mathematical Modelling of Electrical Systems (RLC Series and Parallel Circuits), Mechanical Systems (Mass-Spring-Damper System, Rotational Mechanical System). Analogous System: Force (Torque)-Voltage Analogy and Force (Torque)-Current Analogy.Introduction to Laplace Transformation and Important Formulas. Transfer Functions: Open-Loop and Closed-Loop Transfer Functions. Block Diagram Algebra: Block Diagram Reduction Techniques, Signal flow graph, Mason's gain formula.

Module II (6Hours)

Transient and Steady State Analysis of Linear Time-Invariant (LTI) Systems:Introduction to LTI systems, Standard Test Signals, Time Response of First Order System, Time Response of Second Order System, Time Response Specifications. Steady-State Error and Error Constants. Effect of Adding Zeroes to a System. Performance Indices: ISE, ITSE, IAE, ITAE Indices Comparison.

Module III (8Hours)

Frequency Domain Stability Analysis of LTI System: Routh Hurwitz Criteria, Stability Analysis using Root Locus, Stability Analysis using Bode Plot and Nyquist Criteria.

Module IV (4Hours)

Controller and Compensator Design: P, PI, and PID Controller Design, Lag, Lead and Lead-Lag Compensator Design.

Module V (4Hours)

Analysis of Control Systems in State Space: Introduction, State-Space Representations of Transfer-Function Systems, Solving the Time-Invariant State Space Model, Controllability and Observability.

EOPC2008 PRINCIPLES OF COMMUNICATION SYSTEMS (3-0-0)

urse Objectives

- To build concepts on the operation of analog and digital communication systems.
- To build fundamental concepts so that students can design some basic communication systems on their own.
- To introduce concepts on applications of communication systems in the industry.
- To introduce concepts on applications of communication systems in research.

Module I (4 Hours)

Spectral Analysis: Energy Signal, Power Signal, Fourier series, Fourier transform, Energy Spectral Density, Power spectral density, Convolution, Parseval's theorem, Auto and Cross correlations.

Module-II(8 Hours)

Analog Modulation: Concept Of Modulation, Amplitude modulation: Double-Sideband Suppressed Carrier, Double-Sideband Full Carrier, Single Sideband and vestigial sideband modulation; Demodulation: Carrier Recovery in AM, coherent Demodulation, Envelope Detector, Square-Law Demodulator, spectrum of AM signal, Superheterodyne Receiver.

Module-3 (6 Hours)

Frequency Modulation System: Phase and frequency modulation and their relationship, frequency deviation, spectrum of FM signal, BW of FM signal, the effect of modulation on BW, narrowband FM, Armstrong and parameter variation methodsofFM generation.

Module-IV (6 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-V (6 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.

Course Outcomes

After the completion of this course, students will be able to:
CO1: Understand the importance of Fourier analysis to communication systems.
CO2: Understand fundamental concepts of analog and digital communication systems.
CO3: Describe various components of communication systems in the time domain and frequency domain.
CO4: Investigate and compare the performance of different communication systems.
CO5: Apply the knowledge to design some basic communication systems on their own.

Essential Reading

- B.P. Lathi, Zhi Ding, Modern Analog and Digital communication Systems, Oxford , 4th Edition 2011
- Michael Moher, Simon Haykin, Communications Systems, Wiley , 5th Edition 2009
- Sanjay Sharma, Communication System,Katson books, 4th Edition,2007

BIJU PATNAIK UNIVERSITY OF TECHNOLOGY, ODISHA

ROURKELA

PCAC2012 INTERNET OF THINGS AND CLOUD (3-0-0)

OVERALL COURSE OBJECTIVES: To provide learners with an in-depth understanding of the evolution of Internet of Things and related technologies, equip them with the skills to utilize advanced technology platforms like DragonBoard™ and AWS, and allow them to apply these skills in developing innovative IoT-enabled applications and systems.

LEARNING OUTCOMES: On successful completion of the course the students shall be able to:

1. Understand, compare, and explain how telephony and media delivery networks operate.
2. Understand circuit switched networks and packet switched networks and their trade-offs.
3. Comprehend key innovations that have transformed the communication, entertainment, and consumer electronics industry.
4. Describe the DragonBoard™ 410c peripherals, I/O expansion capabilities, computing capabilities, and connectivity capabilities.
5. Use Linux terminal for embedded purposes and configure integrated development environment (IDE) for software development.
6. Understand and utilize various AWS cloud services such as EC2, IoT and more, to build and integrate projects that leverage the cloud.

COURSE CONTENT:

Module 1: Internet of Things: How did we get here? [21 Hours]

This course explores the convergence of multiple disciplines that have led to the advent of present-day smartphones and the Internet of Things. The lessons explore the evolution of telephony networks, broadcast networks, and consumer electronics, along with the impact of the internet, multimedia content, smartphones, and apps. It also covers the emerging, interconnected platform: the Internet of Things. Upon completion, learners will understand how peer-to-peer networks differ from broadcast networks, the tradeoffs between circuit-switched and packet-switched networks, and the workings of several key innovations and digital services. The course provides an important grounding for anyone interested in the technological development of the Internet of Things, and further resources for a more in-depth exploration of the topics.

Sub-Topics

Circuit Switched Networks
Computer Telephony
Features and Apps
Future Outlook
Packet Switched Networks
Wireless Technologies

Formative Assessments:

16 quizzes.

Module 2: Internet of Things V2: DragonBoard™ bring up and community ecosystem [21 Hours]

This course is designed for individuals seeking to develop the skills needed to prototype embedded products using advanced technologies. The course utilizes the DragonBoard™ 410c single board computer (SBC) to provide a hardware and software development environment for Internet of Things specialization courses. Ideal for learners interested in using Linux for embedded purposes, pursuing a career in the design and development of Internet of Things products, or those involved in entrepreneurial, innovative, or DIY communities, this course offers both theoretical knowledge and hands-on development practice. Key learning outcomes include understanding the DragonBoard™ 410c peripherals, navigating a Linux terminal, configuring an integrated development environment (IDE) for software development, utilizing Git and

GitHub for version control, and creating projects that interface with sensors and actuators through GP and Arduino.

Sub-Topics
Advanced Projects and Code
Changing your Operating System (Supplemental / Optional)
DragonBoard Bringup and Ecosystem
Mezzanines and Sensors (Canned Demos w/ software)
Rescuing your Bricked Board (Supplemental / Optional)

Formative Assessments:

5 quizzes and 1 peer-review assignment.

Module 3: Internet of Things V2: Setting up and Using Cloud Services [10 Hours]

This course provides an introduction to Amazon Web Services (AWS) and its significance, enabling learners to make informed design decisions about which services to use. The course covers interfacing with the AWS cloud, developing software for data sending and receiving, and how to structure projects with diverse services. Upon completion, learners will have a clear understanding of the cloud, be able to install and configure the AWS CLI and SDK on a Linux system, utilize various AWS services such as EC2, IoT, etc., build projects heavily leveraging the cloud, and integrate the cloud into embedded systems.

Sub-Topics
Advanced Projects and Code - Deep dive
Systems Architecture

Cloud 101 for Dragonboard 410c
Real projects using AWS Cloud services

Formative Assessments:

3 quizzes and 1 peer-review assignment.

ASSESSMENT:

For summative assessments, Coursera will provide question banks for which exams can be conducted on the Coursera platform or the faculty will create their own assessments.

Note: If a Course or Specialization becomes unavailable prior to the end of the Term, Coursera may replace such Course or Specialization with a reasonable alternative Course or Specialization.

HSHS2001 ENGINEERING ECONOMICS (3-0-0)

Objectives:
To provide basic concept of micro and macro economics, engineering economics and their application in engineering economy. Further, to develop the ability to account for time value of money using engineering economy factors and formulas.

Module - I (05 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 (O8 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 publicprojects.
Depreciation- Depreciation of capital assert, Causes of depreciation, Methods of calculatingdepreciation - 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 students will be able to

CO1	Remembering : Define the basic concept of micro and macro economics, engineering economics and their application in engineering economy.
CO2	Understanding : Evaluate numerically the effects of changes in demand and supply on price determination of products and services.
CO3	Analyze : the macroeconomic environment and financial systems of the country and its impact on business, society and enterprise.
CO4	Develop : the ability to account for time value of money using engineering economy factors and formulas.
CO5	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.

EOPC2205 DIGITAL SYSTEM DESIGN (0-0-3)

Course Objectives

1. To familiarize students with the basic concepts of digital logic gates and Boolean function minimization.
2. To enable students to design, assemble, test, and implement combinational and sequential digital circuits.
3. To develop skills in hardware implementation and Verilog/VHDL programming for digital circuit simulation and testing.
4. To provide hands-on experience in using programmable logic devices and analyzing the behavior of memory units and digital components.

List of Experiments

(At least 10 experiments should be conducted. Experiment Nos. 1 and 2 are compulsory. Out of the remaining 8 experiments, at least 3 must be implemented using both Verilog/VHDL and hardware as per the student's choice, totalling 6. The remaining 2 experiments can be implemented either through Verilog/VHDL or hardware.)

1. Digital Logic Gates: Investigate the logic behavior of AND, OR, NAND, NOR, EX-OR, EX-NOR, Inverter, and Buffer gates, and demonstrate the use of the Universal NAND gate.
2. Gate-Level Minimization: Implement and verify two-level and multi-level Boolean functions.
3. Combinational Circuits: Design, assemble, and test adders and subtractors, code converters, gray code to binary converters, and 7-segment displays.
4. Minimal Gate Designs: Design, implement, and test a given example using (i) NAND gates only, (ii) NOR gates only, and (iii) the minimum number of gates.
5. Multiplexers and De-Multiplexers: Design circuits using multiplexers and de-multiplexers.
6. Flip-Flops: Assemble, test, and investigate the operation of SR, D, and J-K flip-flops.
7. Shift Registers: Design and analyze the operation of various types of shift registers with parallel load.
8. Counters: Design, assemble, and test various ripple and synchronous counters, including decimal counters and binary counters with parallel load.
9. Clock-Pulse Generator: Design, implement, and test a clock-pulse generator circuit.
10. Parallel Adder and Accumulator: Design, implement, and test a parallel adder and accumulator.
11. Binary Multiplier: Design and implement a circuit to multiply two 4-bit unsigned numbers to produce an 8-bit product.
12. Verilog/VHDL Simulation and Implementation: Simulate and implement experiments from Sl. Nos. 3 to 11 using Verilog/VHDL.

Course Outcomes

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

CO1: Investigate the logic behavior of digital gates and implement universal gates in digital circuits.

CO2: Simplify and implement Boolean functions at the gate level using two-level and multi-level minimization techniques.

CO3: Design and test combinational circuits, including adders, subtractors, code converters, and 7-segment displays.

CO4: Implement sequential circuits such as flip-flops, counters, and shift registers, and analyze their operation.

CO5: Develop and simulate digital circuits using Verilog/VHDL and implement them in hardware.

CO6: Analyze the behavior of memory units and programmable logic devices.

EOPC2206 CONTROL SYSTEM LABORATORY (0-0-3)

Course Learning/Program Objectives:This course will enable students to:

PO1 Analyse DC motor position control system.

PO2 Investigate speed-torque characteristics of 2-phase AC servomotor and derive its transfer function.

PO3 Obtain frequency response of lag and lead compensators.

PO4 Study time response of second-order process with P, PI, and PID control, and implement PID control for servomotor.

PO5 Determine system transfer function using transfer function analyser.

Sl. No	Name of the Experiment	Hrs.
1.	Study of a dc motor driven position control system.	3
2.	Study of speed torque characteristics of two-phase AC servomotor and determination of its transfer function.	3
3.	Obtain the frequency response of a lag and lead compensator.	3
4.	To observe the time response of a second order process with P, PI and PID control and apply PID control to servomotor	3
5.	To determine the transfer function of a system (network) using transfer function analyser.	3
6.	To study and validate the controllers for a temperature control system	3
7.	To study the position control system using Synchroscope.	3
8.	To Analyse the Time Domain specifications of Under damped second order systemusing MATLAB.	3
9.	To analyse the stability of the system by using Root locususing MATLAB.	3
10.	To analyse the stability of the given linear system using Bode plotusing MATLAB.	3

Course Outcomes: On completion of this course, students are able to:

CO1 Analyse and assess the position control system of DC motors to evaluate system performance.

CO2 Investigate the speed-torque characteristics of a two-phase AC servomotor and derive its transfer function.

CO3 Design and evaluate the frequency response of lag and lead compensators for performance enhancement.

CO4 Observe and analyse the time response of second-order processes using P, PI, and PID controllers and implement PID control for a servomotor.

CO5 Determine and validate the transfer function of a system using a transfer function analyser.

Course Outcomes (COs)	PO1	PO2	PO3	PO4	PO5
CO1 (Analyse DC motor position control systems)	3	-	-	-	-
CO2 (Investigate speed-torque characteristics and derive transfer functions of AC servomotors)	-	3	-	-	-
CO3 (Obtain frequency response of lag and lead compensators.)	-	-	3	-	-
CO4 (Study time response and implement PID control for servomotors.)	-	-	-	3	-
CO5 (Determine transfer function using transfer function analyzer.)	-	-	-	-	3

EOPC2207 PRINCIPLES OF COMMUNICATION SYSTEMS LAB. (0-0-3)

Course Objective

- To provide hands-on experience in the principles and practices of analog and digital communication systems.
- To enable students to analyze, design, and simulate communication processes using hardware and software tools.

(At least 10 experiments should be conducted)

1. Analyse 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.
5. Observer the process of PAM, quantization and determination of quantization noise.
6. Multiplex 2-4 PAM/ PPM and PWM signals.
7. Verification of Sampling Theorem.
8. Study the functioning of PCM and Delta modulator; Demonstrate the process ofPCM modulation and Delta modulation.
9. Study of PLL as FM demodulator.
10. 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.
11. 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.
12. Using Lab-View software simulates AM/FM modulation and demodulation system.
13. Using MATLAB/LABVIEW study the pre-emphasis and de-emphasis.
14. Using MATLAB.LABVIEW study the Spectrum Analysis of Modulated Signal Using Spectrum Analyzer.

Course Outcome

- Understanding and application of modulation and demodulation techniques.
- Proficiency in signal processing and spectrum analysis.
- Practical skills in implementing communication systems using MATLAB/LabVIEW.
- Ability to validate theoretical concepts through simulation and experimentation.

EOPC2207 PRINCIPLES OF COMMUNICATION SYSTEMS LAB. (0-0-3)

Course Objective

- To provide hands-on experience in the principles and practices of analog and digital communication systems.
- To enable students to analyze, design, and simulate communication processes using hardware and software tools.

(At least 10 experiments should be conducted)

1. Analyse 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.
5. Observer the process of PAM, quantization and determination of quantization noise.
6. Multiplex 2-4 PAM/ PPM and PWM signals.
7. Verification of Sampling Theorem.
8. Study the functioning of PCM and Delta modulator; Demonstrate the process ofPCM modulation and Delta modulation.
9. Study of PLL as FM demodulator.
10. 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.
11. 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.
12. Using Lab-View software simulates AM/FM modulation and demodulation system.
13. Using MATLAB/LABVIEW study the pre-emphasis and de-emphasis.
14. Using MATLAB.LABVIEW study the Spectrum Analysis of Modulated Signal Using Spectrum Analyzer.

Course Outcome

- Understanding and application of modulation and demodulation techniques.
- Proficiency in signal processing and spectrum analysis.
- Practical skills in implementing communication systems using MATLAB/LabVIEW.
- Ability to validate theoretical concepts through simulation and experimentation.

BACHELOR OF TECHNOLOGY

ELECTRONICS AND COMMUNICATION ENGINEERING / ELECTRONICS AND TELECOMMUNICATION ENGINEERING

THIRD YEAR (FIFTH SEMESTER)

W.E.F. ADMISSION BATCH 2023-24

Sl. No.	Category	Course Code	Course	Contact Hrs. L-T-P	Credit	University Marks	Internal Evaluation
Subject (Theory)							
1	PC	ECPC3001	Microprocessor & Microcontroller	3-0-0	3	100	50
2	PC	EOPC3002	Digital Signal Processing	3-0-0	3	100	50
3	PC	EOPC3003	Electronics Measurement & Instrumentation	3-0-0	3	100	50
4	PE	EOPE3001	Wireless Communication	3-0-0	3	100	50
		EOPE3002	Semiconductor Devices				
		EOPE3003	Digital Image Processing				
		EOPE3004	Microwave Engineering				
		-	-				
		-	-				
		-	-				
5	HS	HSHS3002	Entrepreneurship Development	3-0-0	2	100	50
		HSHS3003	Professional Ethics				
6	MC	MCMC3001	Environmental Engineering	3-0-0	2	100	50
		MCMC3002	Industrial Safety Engineering				
Subject (Sessional / Practical)							
7	PC	EOPC3201	Microprocessor & Microcontroller Laboratory	0-0-3	1.5	-	100
8	PC	EOPC3202	Digital Signal Processing Laboratory	0-0-3	1.5	-	100
9	PC	EOPC3203	Electronics Measurement & Instrumentation Laboratory	0-0-3	1.5	-	100
10	PSI	EOPS3201	Seminar on SIRE - I	0-0-3	1.5	-	100
			Total	**18-0-12**	**22**	**600**	**700**

Click here to view/download the syllabus of the subjects.

ECPC3001 MICROPROCESSORS AND MICROCONTROLLERS (3-0-0)

Course Objectives:
This course provides a comprehensive understanding of microprocessor and microcontroller architectures, focusing on the 8086, 8051, and ARM. Students will learn assembly/C programming, peripheral interfacing, and system design. Practical skills include using simulation tools (Keil, Proteus) to develop and debug embedded applications for real-world problem-solving.

Module-I: 8086 Microprocessor Architecture and Programming (07 hours)
Register Organisation of 8086, Architecture of 8086, Pin Configuration of 8086, Memory Organisation, Minimum/Maximum Mode Configuration, Machine Language Instruction Format, Addressing Modes, Instruction Set, Assembler Directives, Assembly Language Programming, Interrupts and its Handling.

Module-II: 8086 Interfacing and Peripherals (08 hours)
8255 PPI: Modes 0, 1, 2 – Programming and Interfacing, 8253 Programmable Interval Timer, 8279 Keyboard/Display Controller, 8259 Programmable Interrupt Controller, Interfacing ADC and DAC, 8251 USART, Stepper Motor Interfacing, Memory Interfacing and I/O-mapped I/O.

Module-III: 8051 Microcontroller Architecture and Programming (06 hours)
8051 Architecture and Pin Configuration, I/O Ports, Memory Organization and Stack, Instruction Set: Data Transfer, Arithmetic, Logical, Branching, and Bit Manipulation, Assembly Programming of 8051, Embedded C Basics For 8051.

Module-IV: 8051 Interfacing and Applications (06 hours)
Programming Timers/Counters, Interrupts in 8051, Interfacing LEDs, Switches, 16x2 LCD, and Sensor Interfacing, Serial Communication.
Module 5: Introduction to ARM Microcontrollers (3 hours)
RISC vs CISC concepts, Basics of ARM Architecture and Instruction Set, Pipelining concept.

Course Outcomes:
By the end of this course, students will be able to:
CO1: Apply foundational knowledge of electronics, digital systems, and embedded systems to analyze microprocessor/microcontroller-based problems.
CO2: Identify and analyze engineering problems in processor and peripheral interfacing, and propose effective solutions.
CO3: Design embedded system solutions using microcontrollers for real-world applications, considering functional and practical constraints.
CO4: Conduct experiments with microcontrollers, evaluate outputs, and interpret results for debugging and performance analysis.
CO5: Use software tools (e.g., Keil, Proteus, MPLAB, STM32Cube IDE) and hardware kits for simulation, testing, and development of microcontroller-based applications.

Text Books:

1. Advanced Microprocessors and Peripherals, A.K. Ray, K M Bhurchandi, TMH Publication, 2007.
2. The 8051 Microcontroller and Embedded Systems, Muhammad Ali Mazidi, Janice Gillispie Mazidi, Rolin D.M C Kinlay, Pearson Education, Second Edition, 2008.
3. ARM System Developer's Guide – Sloss, Symes and Wright, Published by ELSEVIER INDIA, 2014.

References:

1. Microprocessors and Interfacing, Programming and Hardware, Douglas V Hall, TMH Publication, 2006.
2. Microcontrollers: Principles and Application, Ajit Pal, PHI Publication.
3. The Definitive Guide To ARM CORTEX M3 And CORTEX M4 Processors by Joseph Yiu, Newnes Publication, 3rd edition.

EOPC3002 DIGITAL SIGNAL PROCESSING (3-0-0)

Course Objectives:
This course introduces fundamental concepts of digital signal processing, covering signal representation, z-transforms, and discrete-time systems. Students will analyze LTI systems using DFT/FFT, design FIR/IIR filters (window method, bilinear transformation), and implement adaptive filters. Emphasis is placed on practical applications, including spectral estimation and digital filter realization.

Module-I: (06 hours)
Signals: Representation of signals on orthogonal basis, sampling and reconstruction of signals, Discrete time signals/sequences, Discrete time systems. Analysis and response (convolution sum) of discrete - time linear LTI system, Correlation of discrete time Signal.
The z-transform, Analysis of LTI systems using z-transform, Properties of z-transform.

Module-II: (06 hours)
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.
Frequency analysis of LTI systems: Discrete Fourier transform (DFT), frequency domain sampling, Properties of DFT, Frequency

Module-III: (06 hours)
Efficient computation of DFT: circular convolution, circular correlation, linear filtering methods based on DFT.
Fast Fourier transform (FFT): Decimation in time (DIT) algorithm, Decimation in frequency (DIF) algorithm, Application of FFT.

Module-IV: (08 hours)
Realization of FIR and IIR systems using direct forms and cascaded forms. Design of Digital filters: General considerations. Design of FIR filters: window method.
Design of IIR filters: Impulse invariance method, bilinear transformation method for analog filters.

Module-V: (04 hours)
Basic adaptive filter: Structure of Adaptive FIR filter, System Modeling and Inverse Modelling. Application of DSP.

Course Outcome:
Upon completion of the course, the students will be able to:
CO1: Analyze and characterize signals and systems.
CO2: Analyze digital systems in time and frequency domain.
CO3: Demonstrate digital system characterization through DFT and FFT.
CO4: Implement digital filters and systems.
CO5: Demonstrate adaptive signal spectral estimation methods

Text Books:

1. Digital Signal Processing – Principles, Algorithms and Applications by J. G. Proakis and D. G. Manolakis, Pearson.tion, Sammuel Y, Liao, Perason Education
2. Digital Signal Processing - Dr. Shalia D. Apte, Willey Publication
3. Digital Signal Processing: Tarun Kumar Rawat, Oxford University Press.
4. Digital Signal Processing – S. Salivahan, A. Vallavraj and C. Gnanapriya, Tata McGrawHill.
5. Digital Signal Processing – Manson H. Hayes (Schaum's Outlines) Adapted by Subrata Bhattacharya, Tata McGraw Hill.

EOPC3003 ELECTRONICS MEASUREMENT & INSTRUMENTATION (3-0-0)

Course Objectives:

1. This course enables the students to help students grasp how to use instruments for electronic measurement.
2. This course enables the students to be knowledgeable about CRO and various Function Generator circuit.
3. This course enables the students to be familiar with Frequency Counter design and usage.
4. This course enables the students to understand Data Acquiring Systems and Interfacing.

Module-I: (08 hrs)

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: (05hrs)

Cathode Ray Oscilloscope: Block diagram of CRO, cathode ray tube, Deflection amplifier, Vertical deflection system, horizontal deflection systems, Oscilloscope probes, Measurements with CRO-voltage, frequency and phase measurements, Digital storage Oscilloscope.

Module-III: (05 hrs)

Signal Generator: Sine-wave generator, pulse and square wave generator, Triangular wave generator, Frequency synthesized signal generator, Frequency divider generator, Function generators.

Module-IV: (06 hrs)

Frequency And Time Interval Measurement: Simple frequency counter, extending frequency range of counter, Automatic computing counter, Phase detector, Spectrum analyzer, Network analyzer.

Module-V (06 hrs)

Analog And Digital Data Acquisition Systems: Introduction, Signal conditioning of input, Single channel and multi-channel data acquisition systems, Data conversion, ADC, DAC, IEEE-488 GPIB Bus.

Course Outcomes:

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

CO1: Understand the significance of instrument specification.
CO2: Become familiar with the CRO measurement instrument's design, operation, and usage.
CO3: Investigate various methods for standard signal generation.
CO4: Examine the different frequency measurement tools.
CO5: Understand the hardware needed for data acquisition systems.

Essential Reading

1. D. A. Bell, Electronic Instrumentation and Measurement, PHI
2. H. S. Kalsi, Electronic Instrumentation, TMH
3. A. K. Sawhney, Electrical and Electronics Measurements and Instrumentation, Dhanpat Rai , 2003

Supplementary Reading

1. A. D. Helfrick, W. D. Cooper, Modern Electronic Instrumentation and Measurement Techniques, PHI
2. D. Patranabis, Principles of Electronic Instrumentation, PHI
3. J. P. Bentley, , Principles of Measurement Systems, Longman Group Ltd. (Pearson Education) , 1995

EOPE3001 WIRELESS COMMUNICATION (3-0-0)

Course Objectives:

This course explores wireless communication fundamentals, covering channel characteristics, fading models (Rayleigh, Rician), and digital modulation performance. Students will analyze diversity techniques, multiple access methods (TDMA, CDMA, OFDMA), and cellular network principles. Emphasis is placed on modern standards (LTE, 5G-NR), including mmWave, Massive MIMO, and capacity optimization for resource-efficient system design.

Module-I: (05 hours)

Wireless Channel Fundamentals: Wireless channel characteristics, Path loss and shadowing models, Time-varying channel impulse response, Narrowband vs. wideband fading channels, Introduction to statistical fading models.

Module-II: (08 hours)

Fading Models and Digital Modulation Performance: Detailed fading models: Rayleigh, Rician, Flat and frequency-selective fading, Performance of digital modulation schemes (e.g., BPSK, QAM) over fading channels, Link-level performance evaluation in wireless channels.

Module-III: (06 hours)

Diversity Techniques and Performance Analysis: Time, frequency, and space diversity, receive diversity techniques: Selective Combining (SC), Maximal Ratio Combining (MRC), Equal Gain Combining (EGC), Transmit diversity (e.g., Alamouti scheme), Performance analysis in Rayleigh fading channels.

Module-IV: (04 hours)

Multiple Access and Cellular Network Fundamentals: Multiple Access Techniques: TDMA, FDMA, CDMA, OFDMA, Cellular network concepts: Frequency reuse, spatial reuse, Co-channel interference, Spectral efficiency and Grade of Service (GoS), Capacity improvement: Cell splitting and sectorization.

Module-V: (07 hours)

Channel Capacity and Evolution of Cellular Standards: Channel capacity: AWGN, Flat and frequency-selective fading, Multi-user capacity and opportunistic communication, Uplink (MAC) and downlink (broadcast) channel capacity, Overview of cellular standards: LTE and LTE-Advanced, 5G-NR architecture and features: slicing, beamforming, Understand the significance of the mmWave spectrum in 5G and beyond, Explain the principle of Massive MIMO and spatial multiplexing.

Course Outcome:

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

CO1: Classify the wireless channel of a given wireless communication system into the available analytical or empirical models

CO2: Apply appropriate techniques to mitigate the impact of channel impairments

CO3: Analyse the capacity and reliability of wireless communication systems

CO4: Design and Develop resource efficient and eco-friendly wireless technologies.

CO5: Design and assess modern wireless communication systems considering channel capacity, standard evolution (LTE/5G), and resource efficiency.

Text Books:

1. Andrea Goldsmith, "Wireless Communications", Cambridge University press, 2006.
2. David Tse and Pramod Viswanath, "Fundamentals of Wireless Communication", Cambridge University Press, South Asian Edition, 2006
3. T.S. Rappaport, "Wireless Communication, Principles and Practice", PHI, 2002.
4. Simon Haykin and Michael Moher, "Modern Wireless Communications", Pearson Education, 2007

Supplementary Reading:

1. A. Goldsmith, "Wireless Communications: From Fundamentals to 5G"
2. T. S. Rappaport, "Millimeter Wave Wireless Communications"
3. 3GPP documents on 5G NR (Optional for advanced learners)

EOPE3002 SEMICONDUCTOR DEVICES (3-0-0)

Course Objectives:

This course provides fundamental knowledge of semiconductor physics, covering energy bands, carrier concentration, and transport mechanisms (drift/diffusion). Students will analyze PN junctions, BJTs, MOSFETs, and photonic devices (LEDs, solar cells). Emphasis is placed on device operation, performance evaluation, and design considerations for electronic and optoelectronic applications.

Module-I: (08 Hrs)

Semiconductors: Energy Band and Charge Carriers in semiconductors, Types of semiconductors, Charge carriers, Intrinsic and extrinsic materials. Carrier concentration: Fermi Level, Electron and hole concentration equilibrium, Temperature dependence of carrier concentration, Compensation and charge neutrality. Conductivity and mobility, Effect of temperature, Doping and high electric field.

Module-II: (04 Hrs)

Excess Carriers in Semiconductor: Drift, Diffusion: Current equation, Einstein's Relationship, Continuity equation Generation & Recombination: Mechanisms, Minority Carrier Lifetime.

Module-III: (06 Hrs)

P-N Junctions: Principles, DC model, Capacitance of Reverse bias PN junction, store charge effects, Metal Semiconductor contacts: Schottky diode, Ohmic Contact MOS Capacitor MOSFET: Principles, C-V Characteristics, Second order effects.

Module-IV: (06 Hrs)

Bipolar Junction Transistors (BJT): Fundamentals of BJT operation. Minority carrier distribution, Solution of diffusion equation in base region, Terminal current, Current transfer ratio, Ebers-Moll equations, Charge control analysis. BJT switching: Cut off, Saturation, Switching cycle.

Module-V: (06 Hrs)

Photonics: LED: Radiative transition, Emission spectra, Luminous efficiency and LED materials, Solar cell and photodetectors: Ideal conversion efficiency, Fill factor, Equivalent circuit, Voc, Isc and Load resistance, Spectral response. Reverse saturation current in photodetector.

Course Outcomes:

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

CO1: Explain the atomic structure of solids and the basic physics of semiconductor materials.
CO2: Describe various properties of semiconductor materials using mathematical equations.
CO3: Apply the knowledge of semiconductors to illustrate the functioning of the different electronic devices.
CO4: Evaluate the performance of the different electronic devices
CO5: Describe the working and design considerations for the various photonic devices.

Text Books:

1. Streetman, B. and Banerjee, S., Solid State Electronics, Prentice Hall India, (2006)
2. Sze, S.M., Physics of Semiconductor Devices, John Wiley, (1981)

Supplementary Reading:

1. S. Dimitrijev, Principles of Semiconductor Devices, Oxford University Press, 2005
2. M.S.Tyagi, Introduction to Semiconductor Materials and Devices, Wiley Student Edition

EOPE3003 DIGITAL IMAGE PROCESSING (3-0-0)

Course Objectives:
This course introduces fundamental concepts of digital image processing, covering image representation, enhancement (spatial/frequency domain), restoration, and compression. Students will learn morphological operations, segmentation techniques, and color image processing. Emphasis is placed on practical applications, including noise reduction, edge detection, and recent advancements in the field.

Module-I: (05 hours)
Introduction to image processing: Overview of Image Processing, Image Processing and Related Fields, Digital Image Representation, Types of Images, Digital Image Processing Operations, Fundamental Steps in Image Processing, Image processing Applications.
Digital imaging system: Physical and Biological Aspects of Image Acquisition, Review of Digital Camera, Sampling and Quantization, Image Quality, Image Storage and File Formats.

Module-II: (08 hours)
Image enhancement in spatial domain: Some basic gray level transformations, Histogram processing, Smoothing and Sharpening spatial filters.
Image enhancement in frequency domain: Smoothing and Sharpening frequency domain filters, Homomorphic filtering.

Module-III: (05 hours)
Image restoration: Noise models, Restoration in the presence of noise only-spatial filtering, Estimating the degradation functions, Inverse filtering.

Module-IV: (09 hours)
Image compression: Image compression models, Loss-less and Lossy compression.
Morphological image processing: Dilation and erosion, Opening and closing, some basic morphological algorithms.
Image segmentation: Detection of discontinuities, Edge linking and boundary detection, Thresholding, Region based segmentation.

Module-V: (04 hours)
Colour image processing fundamentals: Devices for Colour Imaging, Colour Image Storage and Processing, Colour Models, Colour Quantization, Recent developments.

Course Outcome:
Upon completion of the course, the students will be able to:
CO1: Understand the basics of image processing, image types, digital representation, and applications.
CO2: Apply spatial and frequency domain techniques for image enhancement.
CO3: Analyze and implement noise models and restoration techniques for degraded images.
CO4: Demonstrate understanding of image compression techniques and perform basic morphological and segmentation operations.
CO5: Explain colour image processing concepts, devices, and recent developments in the field.

Text Books:
1. R. C. Gonzalez and R. E. Woods, Digital Image Processing, Pearson Education, 2006
2. S. Sridhar, Digital Image Processing, Oxford University Press, 2012

Supplementary Reading:
1. A.K. Jain, Fundamentals of Digital Image Processing, Pearson Education, 2007.

EOPE3004 MICROWAVE ENGINEERING (3-0-0)

Course Objectives:
This course provides fundamental knowledge of microwave engineering, covering transmission lines, waveguides (rectangular/cylindrical), and resonator design. Students will learn impedance matching (Smith Chart), analyze microwave components (couplers, attenuators), and study propagation effects. Emphasis is placed on antenna design (dipole, horn) and practical applications in high-frequency circuits and systems.

Module-I: (10 hours)
High Frequency Transmission lines: The Lumped–Element Circuit model for a Transmission line. Wave propagation. The lossless line. Field Analysis of Co-axial Transmission Lines. R, L, C, G parameters of Co-axial & 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. Low loss line.

Module-II: (10 hours)
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.
TEM mode in Co-axial 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.

Module-III: (06 hours)
Excitation of waveguide and Resonators (in principle only) Waveguide Components: Power Dividers and Directional Couplers: Basic Properties. The T-Junction Power Divider. Waveguide Directional Couplers.

Module-IV: (04 hours)
Fixed and Precision Variable Attenuator, Isolator, Circulator (Principle of Operation only). Gunn Oscillator Principle and performance. Simple Analysis electron field interaction.

Module-V: (04 hours)
Microwave Propagation: Line of sight propagation. Attenuation of Microwaves by Atmospheric gases, Water Vapour & Precipitates.
Antenna Analysis and Design: Dipole, Monopole, Loop, Antenna arrays and Pattern synthesis, Horn Antennas: E-And H- Plane Horns. Radiation Patterns. Pyramidal Horn. Gain of Horn Antenna.

Course Outcome:
Upon completion of the course, the students will be able to:
CO1: Understand the basic principles of Microwave Engineering.
CO2: Design rectangular and cylindrical waveguides at high frequency.
CO3: Understand the behaviour of microwave circuits and systems
CO4: Apply the basic principles of high frequency microwave circuits like filters and amplifiers
CO5: Demonstrate microwave propagation in atmospheric condition
CO6: Analyse various antennas like dipole, monopole, loop, broadband and aperture antennas

Text Books:
1. Microwave Engineering by D.M.Pozor, 2nd Edition, John Willy & Sons.
2. Microwave Devices and Circuits, 3rd Edition, Sammuel Y, Liao, Perason Education

Supplementary Reading:
1. R. E. Collin, Foundations Microwave Engineering, John Wiley & Sons, Inc.
2. Microwave Engineering, A Das & S Das,TMH.
3. Microwave Devices and Circuits, G S N Raju

HSHS3002 ENTREPRENEURSHIP DEVELOPMENT (3-0-0)

Course Objectives –

1. To explain concept of entrepreneurship and build and understanding about business situation in which entrepreneurs act.
2. To explain classification and type of entrepreneurs and the process of entrepreneurial project development
3. To discuss the steps in venture development and new trends in entrepreneurship.
4. The more focus is given on creativity and innovation.

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: (08 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.

Course Outcomes

After completion of this course, students

CO1: will aware about foundation of entrepreneurship development and its theories
CO2: will identify the type of entrepreneur and the steps involved in a entrepreneurial venture.
CO3: will understand various steps involved in starting a venture and to explore marketing methods & new trends in entrepreneurship.
CO4: Think creative and innovative

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

HSHS3003 PROFESSIONAL ETHICS (3-0-0)

Course Objectives :
This course aims to develop students' understanding of ethical principles, moral reasoning, and professional responsibilities. It introduces ethical theories, value systems, and the role of ethics in engineering and global contexts. The course prepares students to identify, analyze, and resolve ethical dilemmas in professional and societal scenarios with integrity.

MODULE-I (6 Hours)
Introduction to Ethics:
Basic terms- Moral, Ethics, Ethical dilemma, Emotional intelligence
Moral development theories of Kohlberg and Piaget
View on ethics by Aristotle
Governing factors of an individual's value system
Personal and professional ethics

MODULE-II (6 Hours)
Profession and Professionalism:
Clarification of the concepts: Profession, Professional, Professionalism, Professional accountability, Professional risks, Profession and Craftsmanship, Conflict of interest, Distinguishing features of a professional, Role and responsibilities of professionals, Professionals' duties towards the organization and vice-a-versa, Ethical Theories: Various ethical theories and their application- Consequentialism, Deontology, Virtue theory, Rights Theory, Casuist theory
Ethical terms: Moral absolutism, Moral Relativism, Moral Pluralism etc.; Resolving Ethical Dilemma

MODULE-III (6 Hours)
Ethics in Engineering:
Purpose and concept of Engineering Ethics
Engineering as social experimentation
Types of inquiry
Issues in engineering ethics
Engineers' Responsibility and Safety:
Safety, Risk, Understanding the risk, Over estimating the risk, Risk-benefit analysis
Causes of an accident and identification of the preventive measures to be taken
Case Studies

MODULE-IV (6 Hours)
Global Ethical Issues:
Different ethical issues in business, environment, IT, Bioethics, Intellectual Property Rights (IPR), Research, Media, CSR etc.
Ethical Codes:
Meaning and the significance of ethical codes
The limitations of ethical codes.

Course Outcome
CO1: Define key ethical terms
CO2: Identify factors influencing value systems
CO3: Describe professional concepts
CO4: Explain the purpose of engineering ethics

BOOKS FOR REFERENCE:

1. R. Subramanian, "Professional Ethics", Oxford University Press
2. Mike W. Martin and Roland Schinzinger, "Ethics in Engineering", Tata McGraw Hill
3. Charles E Harris, Michael S Pritchard and Michael J Rabins, "Engineering Ethics - Concepts and Cases", Thompson Learning
4. Daniel Albuquerque, "Business Ethics", Oxford University Press
5. Edmund G. Seebauer and Robert L. Barry, "Fundamentals of Ethics", Oxford University Press

MCMC3001 ENVIRONMENTAL ENGINEERING (3-0-0)

Course Objectives:

- To acquire basic knowledge of source of water and various treatment processes
- To determine the sewage quantity, and understand its treatment and disposal
- To Identify and value the effect of the pollutants in atmosphere
- To formulate strategies to solid waste management

Module-I: (08 Hrs)

Water: Sources of Water and quality issues, water quality requirement for different beneficial uses, Water quality standards, water quality indices, water safety plans, Water Supply systems, Need for planned water supply schemes, Water demand industrial and agricultural water requirements, Components of water supply system; Transmission of water, Distribution system, Various valves used in W/S systems, service reservoirs and design. Water Treatment: aeration, sedimentation, coagulation flocculation, filtration, disinfection, advanced treatments like adsorption, ion exchange, membrane processes.

Module-II: (08 Hrs)

Sewage- Domestic and Storm water, Quantity of Sewage, Sewage flow variations. Conveyance of sewage- Sewers, shapes design parameters, operation and maintenance of sewers, Sewage pumping; Sewerage, Sewer appurtenances, Design of sewerage systems. Small bore systems, Storm Water- Quantification and design of Storm water; Sewage and Sullage, Pollution due to improper disposal of sewage, National River cleaning plans, Wastewater treatment, aerobic and anaerobic treatment systems, suspended and attached growth systems, recycling of sewage – quality requirements for various purposes.

Module-III: (08 Hrs)

Air - Composition and properties of air, Quantification of air pollutants, monitoring of air pollutants, Air pollution- Occupational hazards, Urban air pollution automobile pollution, Chemistry of combustion, Automobile engines, quality of fuel, operating conditions and interrelationship. Air quality standards, Control measures for Air pollution, construction and limitations

Module-IV: (08 Hrs)

Noise-Basic concept, measurement and various control methods. Solid waste Management-Municipal solid waste, Composition and various chemical and physical parameters of MSW, MSW management: Collection, transport, treatment and disposal of MSW. Special MSW: waste from commercial establishments and other urban areas, solid waste from construction activities, biomedical wastes, Effects of solid waste on environment: effects on air, soil, water surface and ground health hazards. Disposal of solid waste-segregation, reduction at source, recovery and recycle. Disposal methods- Integrated solid waste management. Hazardous waste: Types and nature of hazardous waste as per the HW Schedules of regulating authorities.

Course Outcomes:

After successfully studying this course, students will able to:

- Understand the impact of humans on environment and environment on humans
- Identify and value the effect of the pollutants on the environment: atmosphere, water and soil
- Formulate strategies to control, reduce and monitor pollution
- Determine the most appropriate technique for the treatment of water, wastewater solid waste and contaminated air

Books

- Introduction to Environmental Engineering and Science by Gilbert Masters, Prentice Hall, New Jersey.
- Introduction to Environmental Engineering by P. Aarne Vesilind, Susan M. Morgan, Thompson /Brooks/Cole; Second Edition 2008.
- Peavy, H.s, Rowe, D.R, Tchobanoglous, G. Environmental Engineering, Mc-Graw -Hill International Editions, New York 1985.
- MetCalf and Eddy. Wastewater Engineering, Treatment, Disposal and Reuse, Tata McGraw-Hill, New Delhi

MCMC3002 INDUSTRIAL SAFETY ENGINEERING (3-0-0)

Course Objectives:

1. Students will be able to recognize and evaluate occupational safety and health hazards in the workplace, and to determine appropriate hazard controls following the hierarchy of controls.
2. Students will furthermore be able to analyze the effects of workplace exposures, injuries and illnesses, fatalities and the methods to prevent incidents using the hierarchy of controls, effective safety and health management systems and task-oriented training.

Course Outcomes:
By the end of this course, a student should:

CO1: Evaluate workplace to determine the existence of occupational safety and health hazards
CO2: Identify relevant regulatory and national consensus standards along with best practices that are applicable.
CO3: Select appropriate control methodologies based on the hierarchy of controls
CO4: Analyze injury and illness data for trends

Module-I: (07 hrs)
Industrial safety: Accident, causes, types, results and control, mechanical and electrical hazards, types, causes and preventive steps/procedure, describe salient points of factories act 1948 for health and safety, wash rooms, drinking water layouts, light, cleanliness, fire, guarding, pressure vessels, etc, Safety color codes. Fire prevention and firefighting, equipment and methods.

Module-II: (07 hrs)
Fundamentals of maintenance engineering: Definition and aim of maintenance engineering, Primary and secondary functions and responsibility of maintenance department, Types of maintenance, Types and applications of tools used for maintenance, Maintenance cost & its relation with replacement economy, Service life of equipment.

Module-III: (07 hrs)
Wear and Corrosion and their prevention: Wear- types, causes, effects, wear reduction methods, lubricants-types and applications, Lubrication methods, general sketch, working and applications, i. Screw down grease cup, ii. Pressure grease gun, iii. Splash lubrication, iv. Gravity lubrication, v. Wick feed lubrication vi. Side feed lubrication, vii. Ring lubrication, Definition, principle and factors affecting the corrosion. Types of corrosion, corrosion prevention methods.

Module-IV: (07 hrs)
Fault tracing: Fault tracing-concept and importance, decision tree concept, need and applications, sequence of fault-finding activities, show as decision tree, draw decision tree for problems in machine tools, hydraulic, pneumatic, automotive, thermal and electrical equipment's like, I. Any one machine tool, ii. Pump iii. Air compressor, iv. Internal combustion engine, v. Boiler, vi. Electrical motors, Types of faults in machine tools and their general causes.

Module-V: (08 hrs)
Periodic and preventive maintenance: Periodic inspection-concept and need, degreasing, cleaning and repairing schemes, overhauling of mechanical components, overhauling of electrical motor, common troubles and remedies of electric motor, repair complexities and its use, definition, need, steps and advantages of preventive maintenance. Steps/procedure for periodic and preventive maintenance of: I. Machine tools, ii. Pumps, iii. Air compressors, iv. Diesel generating (DG) sets, Program and schedule of preventive maintenance of mechanical and electrical equipment, advantages of preventive maintenance. Repair cycle concept and importance.

Books:

1. Maintenance Engineering Handbook, Higgins & Morrow, Da Information Services.
2. Maintenance Engineering, H. P. Garg, S. Chand and Company.
3. Pump-hydraulic Compressors, Audels, McGraw Hill Publication.
4. Foundation Engineering Handbook, Winterkorn, Hans, Chapman & Hall London.

EOPC3201 MICROPROCESSOR AND MICROCONTROLLER LABORATORY (0-0-3)

This lab-based course provides hands-on experience with 8086 microprocessors and 8051/Arduino microcontrollers. Students will develop programs for arithmetic, sorting, and interfacing (ADC/DAC, motors), implement communication protocols (parallel/serial), and design embedded systems (IoT sensors, security applications). Emphasis is placed on hardware-software integration, debugging, and using development tools for practical problem-solving.

(Any Ten of the following experiments are to be performed)

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 with 8086.
6. Parallel Communication between two Micro Processor Kits using Mode 1 and Mode 2 of 8255.
7. Interfacing and Programming 8279, 8259, and 8253 with 8086.
8. Serial Communication between two Micro Processor Kits using 8251.
9. Interfacing and Programming of Stepper Motor and DC Motor Speed control with 8086.
10. Programming using Arithmetic, Logical and Bit Manipulation instructions of 8051microcontroller.
11. Programming and verifying Timer, Interrupts and UART operations in 8051
12. A design problem using 8051 (A problem like multi-parameter data acquisition system, elevator simulation, traffic simulation, digital clock using LED matrix, etc)
13. To measure the distance of the obstacle using ultrasonic sensor and Arduino and display the distance on the LCD/Graphical LCD.
14. To read different parameters like temperature, humidity, motion etc. interfaced with Arduino uno/any microcontroller and send these data to the server (like Raspberry Pi) through wireless communication interfaces like Bluetooth, Wi-Fi, ZigBee, etc and store in the database for analytics.
15. To design/simulate a security system using RFID module and alert the authorities via SMS (GSM module) with geocoordinates (GPS module) during unauthorised access. Course

Outcomes:

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

CO1: Apply theoretical knowledge of microprocessors and microcontrollers to develop low-level code and interface with external devices.

CO2: Identify and analyse interfacing problems and debugging issues during hardware-software integration.

CO3: Design functional embedded systems like clocks, control systems, and smart sensors using Microprocessor/Microcontroller Units and analyse performance parameters such as timing, delay, and communication accuracy during system testing.

CO4: Use development tools like Keil, Proteus, STM32CubeIDE, and MPLAB to simulate, debug, and test embedded systems.

CO5: Adapt multiple microcontroller platforms, communication standards, and development environments.

EOPC3202 DIGITAL SIGNAL PROCESSING LABORATORY (0-0-3)

Course Objectives:

This laboratory course provides hands-on experience in digital signal processing using MATLAB and DSP kits. Students will generate waveforms, implement convolution (linear/circular), compute FFT, and design FIR/IIR filters. Emphasis is placed on spectral analysis, noise cancellation, and practical implementation of DSP algorithms to analyze and process real-world signals.

(Any Ten of the following experiments are to be performed)

1. Familiarization with the architecture of a standard DSP kit.
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) Determine and plot the FFT of a given 1-D signal using DSP kit. Scattering parameters of Circulator /Isolators.
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. Convolution of long duration sequences using overlap add, overlap save using MATLAB.
11. Implementation of noise cancellation using adaptive filters on a DSP kit.

Course Outcomes:

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

CO1: Analyze different types of transformations.
CO2: Implement and modify of LTI systems.
CO3: Analyze the performance of DIT &DIF algorithms.
CO4: Implement IIR &FIR systems.
CO5: Demonstrate conclusions after computing PSD.

EOPC3203 ELECTRONICS MEASUREMENT & INSTRUMENTATION LABORATORY (0-0-3)

Course Objectives

- Comprehending the method of calibrating instruments
- Understanding about signal processing and data acquisition in measurement systems
- Understanding the working principles, characteristics and applications of transducers related to electrical engineering and interdisciplinary areas.
- Creating virtual instruments for measurement systems related to electrical engineering as well as interdisciplinary.

(Perform any 10 experiments from Hardware/Software)

Hardware

1. Study of static and dynamic characteristics of a Measuring Instrument.
2. Statistical analysis of errors in measurement (using standard dataset).
3. Measurement of Low Resistance using Kelvin's Double Bridge.
4. Calibration of capacitance sensor using Schering Bridge.
5. Measurement of frequency using Wien's Bridge.
6. Study of Lissajous pattern and measurement of unknown frequency.
7. Implement a basic sine wave and square wave oscillator and analyze its output.
8. Build and calibrate a basic frequency counter circuit.
9. Use a spectrum analyzer to study the frequency components of a signal.
10. Implement a phase detector and analyze its operation.
11. Measurement of Temperature using LM35 and Thermistor using microcontroller.
12. Measure displacement using an LVDT and analyze its output signal.
13. AC voltage measurement using PMMC meters using a diode bridge.
14. Data Acquisition using a Sound Card.

Software:

1. Familiarization of LabVIEW software and Data Acquisition Systems.
2. Measurement of resistance using Wheatstone bridge in the following applications using LabVIEW.
   a) Force measurement using strain gauges.
   b) Light detection using LDR.
3. Non-intrusive measurement of current using Hall effect sensors using LabVIEW.
4. Automatic water level controller using LabVIEW
5. Electrical Power Measurement using LabVIEW.
6. Measurement of displacement using LVDT with LabVIEW software.

Course Outcomes

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

CO1: Understand virtual instrumentation and program the data acquisition devices

CO2: Apply this knowledge to choose a proper transducer based on their characteristics for measurement of different parameters

CO3: Calibrate instruments related to electrical engineering as well as interdisciplinary and find their static characteristics

CO4: Create virtual instruments for measurement systems related to electrical engineering as well as interdisciplinary areas

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

EIGHTH SEMESTER(COMMON TO ALL BRANCHES OF B.Tech)							
Theory							
Sl No	**Category**	**Course Code**	**Course Title**	**L-T-P**	**Credit**	**University Marks**	**Internal Evaluation**
-	-	-	-		0		
				Total Credit (Theory)	**0**		
				Total Marks			
				Practical			
1	PSI	RMP8H201	Major Project / Internship	0-0-12	6		400
				Total Credit (Practical)	**6**		
				Total Semester Credit	**6**		
				Total Marks			**400**