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
ELECTRICAL 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	EEPC2001	Electrical Circuit Analysis	3-0-0	3	100	50
3	PC	EEPC2002	Electrical Machines - I	3-0-0	3	100	50
4	PC	EOPC2002	Analog and Digital Electronic Circuits	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	EEPC2201	Electrical Circuit Analysis Lab.	0-0-3	1.5	-	100
8	PC	EEPC2202	Electrical Machines - I Lab.	0-0-3	1.5	-	100
9	PC	EOPC2202	Analog and Digital Electronic Circuits 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.

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.

Module II **9Hours**

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

Module III **6 Hours**

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.

Module IV **8Hours**

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.

Module V **5Hours**

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.

EEPC2002 Electrical Machines-I (3-0-0)

Module I **6Hours**

Electromechanical Energy Conversion: Introduction to magnetic circuits,Magnetically induced EMF and MMF, Review of Faraday's Law and Lenz's Law, Hysteresis and Eddy-current losses.

Module II **8 Hours**

DC Generators: Principle of operation, Commutator action, Constructional features, Armature windings, Lapand wave windings, Simplex windings, E.M.F. Equation, Methods of excitation: separately excited and self-excited generators, Build-up of E.M.F., Critical field resistance and critical speed, Armature reaction: Cross magnetizing and demagnetizing AT/pole, Compensating winding, Commutation, Reactance voltage, Methods of improving commutation, Internal and External characteristics for self and separately excited DC generator,Load characteristics of shunt, series and compound generators, Parallel operation of DC generators.

Module III **8Hours**

DC Motors: Principle of operation, Back E.M.F., Torque equation, Characteristics and application of shunt, series and compound motors, Starting of DC motor, Necessity of a starter, Constant & Variable losses, Calculation of efficiency, Condition for maximum efficiency. Speed control of DC Motors: Armature voltage and field flux control methods, Ward Leonard method. Methods of Testing: Brake test, Swinburne's test.

Module IV **8Hours**

Single-phase Transformers: Single phase transformer, Constructional details, Principle of operation, EMF equation, Magnetizing current and core losses, Phasor diagrams at no-load and load conditions of an ideal transformer and practical transformer, Equivalent circuit, losses and efficiency, All day efficiency, Voltage regulation, Determination of parameters from tests (Polarity Test, Open Circuit Test and Short Circuit Test, Back to Backtest), Parallel operation of transformers and load sharing. Auto Transformer: Basic constructional features, VA conducted magnetically and electrically, Saving of copper, Applications.

Module V **10Hours**

Three phase Transformer: Constructional features of three phase transformers, As a single unit and as a bank of three single phase transformers, Three phase connection of transformers: Various phase displacements (0^0,180^0, $+30^0$and -30^0), Connection diagrams and Phasor diagrams of various vector groups (Yy0, Dd0, Dz0,Yy6, Dd6, Dz6, Yd1, Dy1, Yz1, Yd11, Dy11, and Yz11), Scott connection, Open delta connection, Parallel operation.

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

CO-1: Understand the concepts of Magnetic circuits.
CO-2: Understand the operation of DC Generators.
CO-3: Understand the operation and concepts of DC Motors.
CO-4: Understand the operation of single-phase transformers &auto transformer.
CO-5: Understand three phase transformers circuits.

Text Book(s):

1. I. J. Nagrath and D. P. Kothari, “Electric Machines”, McGraw Hill Education,2010.
2. P. S. Bimbhra, “Electrical Machinery”, Khanna Publishers,2011.

Reference Book(s):

1. Electric Machinery – Fitzgerald, Charles Kingsley Jr., S. D. Umans – Tata McGraw Hill.
2. Electric Machinery and Transformers – Guru & Hiziroglu – Oxford University Press, 2010.

Syllabus Preparation as per NEP

1. Each subject should have pre-requisites (if any), 5 Modules with minimum 30 contact hours.
2. Each subject COs, POs & PSOs are to be articulated as per Blooms Taxonomy.
3. In each subject, at least two Textbooks and relevant Reference books are to be mentioned.

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

EEPC2202 Electrical Machine-I Laboratory (0-0-3)

Sl. No	Name of the Experiment	Hrs.
1.	Load characteristics of DC shunt/compound generator.	**3**
2.	Load characteristics of DC series motor.	**3**
3.	Speed control of DC shunt motor by armature voltage control and flux control method.	**3**
4.	Determination of critical resistance and critical speed from no load test of a DC shunt generator.	**3**
5.	Back-to-Back testing of DC machines (Hopkinson's method)	**3**
6.	Determination of efficiency and voltage regulation by open circuit and short circuit test on single-phase transformer.	**3**
7.	Parallel operation of two single phase transformers.	**3**
8.	Study of Open delta and Scott connection of two single phase transformers.	**3**
9.	To connect and measure the line voltage & phase voltage of three single-phase transformer in (a) star-star (Y-Y) (b) star-delta (Y- Δ) (c) delta-delta (Δ-Δ) (d) delta-star (Δ-Y)	**3**
10.	Back-to Back test on two single phase transformers.	**3**

CO1: Understand load characteristics of DC shunt and compound generators and series motors.

CO2: Learn speed control methods for DC shunt motors, including armature voltage and flux control.

CO3: Analyse critical resistance and critical speed determination from DC shunt generator no-loadtests.

CO4: Explore back-to-back testing of DC machines using Hopkinson's method.

CO5: Determine efficiency and voltage regulation through open circuit and short circuit tests on single-phase transformers, and study parallel operation and different connection configurations of single-phase transformers.

EOPC2002 ANALOG AND DIGITAL ELECTRONICS CIRCUIT (3-0-0)

Course objectives: This course will enable students to

- Understand Bipolar Junction Transistors and Metal Oxide Semiconductors.
- Analysis of DC biasing of Semiconductor Circuits using BJT and MOSFET.
- Understand Input and Output characteristics of Single Stage Amplifier (both BJT and MOSFET).
- Apprehend characteristics of Feedback and Power amplifier.
- Introduce the concept of digital and binary systems
- inculcate concepts of K-MAP to simplify a Boolean expression
- Facilitate students in designing combinational and sequential logic circuits.

MODULE 1: **[8hrs]**

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

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: **[8 hrs]**

Biasing of FET and MOSFET: Fixed bias configuration, Self-bias configuration, Voltage divider bias and design.

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: **[4 hrs]**

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).

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

MODULE 4: **[5 hrs]**

Minimization of Boolean Functions: Canonical logic forms, sum of product & product of sums, Karnaugh maps (two, three and four variable), Don't-care Conditions, Quine-McCluskey technique.

Combinational Circuits: Binary multiplier, Magnitude Comparator, decoder, encoder, priority encoder, Multiplexers, De-multiplexers, Paritygenerators and Checkers, Code converters.

MODULE 5: **[5 hrs]**

Sequential circuits: Latches and Flip-flops (SR, D, JK, T), Master-salve flip-flop, flip-flop conversions, Design and analysis of synchronous binary counterand ripple counters.

Registers: Types of Registers, Serial In - Serial Out, Serial In - Parallel out, Parallel In - Serial Out, Parallel In - Parallel Out.

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

CO1: Understand the characteristics and configurations of single stage BJT and MOSFET amplifiers.

CO2: Design amplifier circuits using BJT, FET and study the low and high frequency response of BJT, FET amplifiers.

CO3: Analyse various power amplifiers and to gain knowledge on various oscillator circuits.

CO4: Understand various types of number systems and their conversions

CO5: Identify the importance of canonical forms in the minimization of Boolean functions in digital circuits.

CO6: Design and implement variety of logical devices using combinational circuits and Sequential circuits.

TEXT BOOKS

1. Microelectronic Circuits – Sedra& Smith, International Student Edition, 5th edition
2. Electronic Devices and Circuit Theory – Robert L.Boylestad and LowisNashelsky, Pearson education, New Delhi 10th edition
3. Digital Logic and Computer Design- M Morris Mano, 10th Edition, Pearson, 2008.

REFERENCE BOOKS

1. Millman's Integrated Electronics –Jacob Millman and Christos Halkias, Chetan D Parikh, Mcgraw Hill
2. Electronic Devices – Floyd, Pearson Education
3. Digital Fundamentals (8th Edition)-Floyd and Jain, Pearson Education Limited.

EOPC2002 ANALOG AND DIGITAL ELECTRONICS CIRCUIT (3-0-0)

Course objectives: This course will enable students to

- Understand Bipolar Junction Transistors and Metal Oxide Semiconductors.
- Analysis of DC biasing of Semiconductor Circuits using BJT and MOSFET.
- Understand Input and Output characteristics of Single Stage Amplifier (both BJT and MOSFET).
- Apprehend characteristics of Feedback and Power amplifier.
- Introduce the concept of digital and binary systems
- inculcate concepts of K-MAP to simplify a Boolean expression
- Facilitate students in designing combinational and sequential logic circuits.

MODULE 1: **[8hrs]**

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

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: **[8 hrs]**

Biasing of FET and MOSFET: Fixed bias configuration, Self-bias configuration, Voltage divider bias and design.

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: **[4 hrs]**

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).

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

MODULE 4: **[5 hrs]**

Minimization of Boolean Functions: Canonical logic forms, sum of product & product of sums, Karnaugh maps (two, three and four variable), Don't-care Conditions, Quine-McCluskey technique.

Combinational Circuits: Binary multiplier, Magnitude Comparator, decoder, encoder, priority encoder, Multiplexers, De-multiplexers, Paritygenerators and Checkers, Code converters.

MODULE 5: **[5 hrs]**

Sequential circuits: Latches and Flip-flops (SR, D, JK, T), Master-salve flip-flop, flip-flop conversions, Design and analysis of synchronous binary counterand ripple counters.

Registers: Types of Registers, Serial In - Serial Out, Serial In - Parallel out, Parallel In - Serial Out, Parallel In - Parallel Out.

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

CO1: Understand the characteristics and configurations of single stage BJT and MOSFET amplifiers.

CO2: Design amplifier circuits using BJT, FET and study the low and high frequency response of BJT, FET amplifiers.

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CO5: Identify the importance of canonical forms in the minimization of Boolean functions in digital circuits.

CO6: Design and implement variety of logical devices using combinational circuits and Sequential circuits.

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1. Microelectronic Circuits – Sedra& Smith, International Student Edition, 5th edition
2. Electronic Devices and Circuit Theory – Robert L.Boylestad and LowisNashelsky, Pearson education, New Delhi 10th edition
3. Digital Logic and Computer Design- M Morris Mano, 10th Edition, Pearson, 2008.

REFERENCE BOOKS

1. Millman's Integrated Electronics –Jacob Millman and Christos Halkias, Chetan D Parikh, Mcgraw Hill
2. Electronic Devices – Floyd, Pearson Education
3. Digital Fundamentals (8th Edition)-Floyd and Jain, Pearson Education Limited.

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.

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.

BACHELOR OF TECHNOLOGY
ELECTRICAL 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	EEPC2003	Electrical Machines – II	3-0-0	3	100	50
2	PC	EEPC2004	Electrical Measurement & Instrumentation	3-0-0	3	100	50
3	PC	EEPC2005	Power Electronics	3-0-0	3	100	50
4	PC	EOPC2003	Signals & 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	EEPC2203	Electrical Machines – II Lab.	0-0-3	1.5	–	100
8	PC	EEPC2204	Electrical Measurement & Instrumentation Lab.	0-0-3	1.5	–	100
9	PC	ECPC2202	Power Electronics Lab.	0-0-3	1.5	–	100
10	PC	EOPC2203	Signals & Systems 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.

EEPC2003 ELECTRICAL MACHINES-II (3-0-0)

Module I (08 Hours)
Three-phase synchronous generators:
Construction, Salient pole type and Cylindrical rotor structure, Armature windings, Winding factor, EMF equation, Armature reaction, Synchronous impedance, Alternator on load, Phasor diagrams, Open Circuit and Short Circuit tests, Short Circuit Ratio, Voltage regulation by EMF, MMF and ZPF methods, Two reactance concept of Salient pole Synchronous machines, Slip test, Power equations, Power angle characteristics.

Module II (06 Hours)
Parallel operation of alternators:
Requirements for parallel operation, synchronizing of alternators, three dark lamp method, synchroscope, synchronizing current, synchronizing power, synchronizing torque, effect of increasing the excitation, effect of increasing the driving torque and effect of change in speed of one of the alternators, load sharing between two alternators.

Module III (04 Hours)
Synchronous motors: Rotating magnetic field, operating principle of a synchronous motor, phasor diagrams, power equations, load angle, 'V' and inverted 'V' curves, synchronous condenser, starting methods, hunting.

Module IV (06 Hours)
Three-phase induction motors: Construction, principle of operation, types, squirrel cage rotor, slip ring induction motor, slip, torque equations, starting torque, full load torque, maximum torque, torque-slip and torque-speed characteristics, effect of rotor resistance, effect of change in supply voltage, effect of change in frequency, power losses and efficiency, synchronous watt, equivalent circuit of induction motor, phasor diagrams, power output, testing of induction motors, No-load test, Blocked rotor test, load test, measurement of slip, circle diagram.

Module V (06 Hours)
Starting and speed control of three-phase induction motors: DOL starting, stator resistance starting, auto transformer starting, star-delta starting, starting of sip ring induction motors, speed control by variation of supply voltage-supply frequency, rotor resistance control, crawling and cogging effects.
Single-phase induction motors: Construction, principle of operation, double field revolving theory, equivalent circuit, performance characteristics, starting methods, capacitor start-capacitor run single phase induction motors.

Course Outcomes (COs)

CO1: Explain the construction and working principles of synchronous generators, derive EMF equations, and analyze armature reaction and voltage regulation. (Knowledge, Understanding)

CO2: Demonstrate the requirements and procedures for the parallel operation of alternators and analyze the impact of synchronizing current, power, and torque on system stability and load sharing. (Application, Analysis)

CO3: Describe the construction, operating principles, and characteristics of synchronous motors, and analyze V and inverted V curves for performance assessment. (Knowledge, Understanding, Analysis)

CO4: Explain the structure, operation, and torque characteristics of three-phase induction motors, evaluate effects of rotor resistance and supply variations, and analyze equivalent circuits. (Understanding, Application, Analysis)

CO5: Analyze different starting and speed control methods for induction motors, assess performance of single-phase induction motors, and apply theories like double field revolving theory for performance analysis. (Analysis, Evaluation)

Textbooks:

1. "Theory & Performance of Electrical Machines" by J.B. Gupta, 15th edition, S. K. Kataria & Sons, reprint 2015.
2. Fitzgerald& Kingsley's "Electric Machinery", Stephen D. Umans, 7th edition, McGrawHill publishers, 2014.

Reference books:

1. "Electric Machinery" by P.S. Bimbhra, 2nd edition, Khanna Publishing House, 2022.
2. "Electric Machines" by D.P. Kothari and I.J. Nagrath, 5th edition, McGrawHill publishers, 2017.
3. "The Performance and Design of Alternating Current Machines", by M. G. Say, CBS Publishers & Distributors, 2005.

EEPC2004 ELECTRICAL MEASUREMENT AND INSTRUMENTATION (3-0-0)

Module I (8 Hours)

Measurement and Error:Definition, Accuracy and Precision, Significant Figures, Types of Errors. Standards of Measurement:Classification of Standards, Electrical Standards, IEEE Standards.

Measuring instruments: Absolute and secondary instrument, indicating and recording instrument.

Types Of Measuring Instrument: Ammeter and Voltmeter: Derivation for Deflecting Torque of; PMMC, MI (Attraction and Repulsion Types), Electro Dynamometer and Induction Type Ammeters and Voltmeters. Energy Meters and Wattmeter. Construction, Theory and Principle of Operation of Electro-Dynamometer and Induction Type Wattmeter, Compensation, Creep, Error, Testing, Single Phase and Polyphase Induction Type Watt-Hour Meters. Frequency Meters: Vibrating Reed Type, Electrical Resonance Type, Power Factor Meters.

Module II (8 Hours)

Measurement of Resistance, Inductance And Capacitance:

Resistance: Measurement of Low Resistance by Kelvin‟s Double Bridge, Measurement of Medium Resistance, Measurement of High Resistance, Portable Resistance Testing Set (Megohmmeter), Measurement of Resistance of Earth Connections.

Inductance: Measurement of Self Inductance by Ammeter And Voltmeter, and AC Bridges (Maxwell‟s, Hay‟s, & Anderson Bridge), Measurement of Mutual Inductance by Felici‟s Method, and as Self Inductance. Capacitance: Measurement of Capacitance by Ammeter and Voltmeter, and AC Bridges (Owen‟s, Schering &Wien‟s Bridge), Screening of Bridge Components and WagnorEarthing Device.

Transducer: Strain Gauges, Thermistors, Thermocouples, Linear Variable Differential Transformer

(LVDT), Capacitive Transducers, Peizo-Electric transducers, Optical Transducer, Hall Effect Transducer.

Module III (6 Hours)

Galvanometer: Construction, Theory and Principle of Operation of D‟arsonval, Vibration (Moving Magnet & Moving Coil Types), and Ballistic Galvanometer, Influence of Resistance on Damping, Logarithmic Decrement, Calibration of Galvanometers, Galvanometer Constants.

Potentiometer: Construction, Theory and Principle of Operation of DC Potentiometers (Crompton, Vernier, Constant Resistance, & Deflection Potentiometer), and AC Potentiometers (Drysdale-Tinsley & Gall-Tinsley Potentiometer).

Module IV (6 Hours)

Instrument Transformers:Potential and current transformers, ratio and phase angle errors, phasor diagram, methods of minimizing errors.

Electronic Instruments for Measuring Basic Parameters: Amplified DC Meters, AC Voltmeters Using Rectifiers, True RMS Voltmeter, Digital Multi-meter & Digital Frequency meter: (Block diagram, principle of operation)

Module V (2 Hours)
Oscilloscope: Block Diagrams, Delay Line, Multiple Trace, Oscilloscope Probes, Oscilloscope Techniques, Introduction to Analog and Digital Storage Oscilloscopes, Measurement of Frequency, Phase Angle, and Time Delay Using Oscilloscope.

Course Outcomes: On completion of this course, students are able to:
CO1: Explain the fundamentals of measurement, error analysis, and standards in electrical measurements.
CO2: Classify and evaluate various types of measuring instruments, including ammeters, voltmeters, energy meters, wattmeters, and frequency meters, understanding their principles and error sources.
CO3: Measure electrical quantities such as resistance, inductance, and capacitance using suitable methods and AC bridge techniques.
CO4: Illustrate the principles, construction, and operation of transducers like strain gauges, thermistors, thermocouples, and other sensing devices.
CO5: Apply the principles of operation and calibration of galvanometers and potentiometers for precise electrical measurement.
CO6: Evaluate instrument transformers, such as potential and current transformers, analyzing errors and correcting them.
CO7: Operate and interpret readings from electronic measuring instruments, such as digital multimeters and oscilloscopes, for frequency, phase, and time-delay measurements**.**

Text Book(s):
1. A Course in Electrical and Electronic Measurements and Instrumentation – A K Sawhney – Dhanpat Rai & Co.
2. Modern Electronic Instrumentation and Measurement Techniques – Helfrick& Cooper – Pearson Education.

Reference Book(s):
1. Electrical Measurements and Measuring Instruments – Golding &Widdis – 5th Edition, Reem Publication.
2. Electronic Instrumentation – H C Kalsi – 2nd Edition, Tata Mcgraw Hill
3. Electronic Measurement and Instrumentation – Oliver & Cage – Tata Mcgraw Hill

EEPC2005 POWER ELECTRONICS (3-0-0)

Module I (06 Hours)
Power Semiconductor Devices and Uncontrolled Rectifiers:
Introduction, working and characteristics of power diodes – power transistors – power MOSFETs – IGBTs.
Uncontrolled Single-phase Half-wave – Full-wave – Bridge rectifiers, Three-phase Half-wave and Bridge rectifiers, performance parameters, and waveform analysis for R and RLloads.
Thyristors, static I-V characteristics, turn-on methods, Gate characteristics, two transistor model of Thyristor, Ratings of Thyristors, Thyristor protection, Design of Snubber circuits, Series and Parallel operation of Thyristors, Thyristor commutation techniques: Natural and Forced commutation.

Module II (08 Hours)
Phase Controlled Rectifiers:
Principle of Phase control, Controlled Single-phase Half-wave rectifier, Full-wave converters, Full-wave Bridge converters, Semiconverter, Full converter, analysis with continuous and discontinuous current conduction, performance parameters, and waveform analysis for R – RL – RLE loads, operation with and without free-wheeling diodes.
Controlled Three-phase Half-wave converter – Full-wave converters, Full-wave Bridge converter, Semiconverter, Full converter, performance parameters and waveform analysis for R – RL – RLE loads, Dual converter, effect of source impedance on performance of converters.

Module III (04 Hours)
DC to DC Converters:
Principle of step-down and step-up operation, control strategies, generation of duty cycle, Buck, Boost, Buck-Boost, performance parameters, and waveform analysis.
Types of chopper circuits: first-quadrant, second-quadrant, two-quadrant, four-quadrant choppers, thyristor chopper circuits.

Module IV (06 Hours)
DC to AC Converters:
Principle of operation, Single-phase Voltage source Bridge inverter, Three-phase Bridge inverter, 180-degree conduction, 120-degree conduction, performance parameters, and waveform analysis, Introduction to Current Source Inverter.
Voltage control of single-phase inverter, pulse-width modulation, single pulse width modulation, sinusoidal pulse width modulation.
Voltage control of three-phase inverters, sinusoidal PWM.

Module V (06 Hours)
AC to AC converters and Drives:
AC voltage controllers: principle of phase control, principle of integral cycle control, singlephase full wave voltage controllers with R and RL loads, performance parameters and waveform analysis.
Cyclo converters: single phase Cyclo converters, performance parameters and waveform analysis.
Introduction of Power Electronics application in Electric Drives.

Course Outcomes (COs)

CO1: Explain the principles, characteristics, and applications of power semiconductor devices and uncontrolled rectifiers. (Understanding - Level 2)

CO2: Analyze and design single-phase and three-phase phase-controlled rectifiers with different load types (R, RL, RLE) and evaluate the performance under various conditions. (Analyzing - Level 4)

CO3: Describe the operating principles and control strategies of DC-DC converters and evaluate different chopper configurations and their applications. (Applying/Analyzing - Level 3/4)

CO4: Analyze the operational characteristics of DC-AC inverters and apply control techniques to single-phase and three-phase inverter circuits. (Applying - Level 3)

CO5: Explain AC-AC conversion techniques, including AC voltage controllers and cyclo-converters, and demonstrate their use in electric drives. (Understanding/Applying - Level 2/3)

Textbooks:

1. "Power Electronics" by P.S. Bimbhra, 7th edition, Khanna publishers,2022.
2. "Power Electronics-Devices, Circuits, and Applications" by Muhammad H. Rashid, 4th edition, Pearson publishers, 2014.

Reference books:

1. "Power Electronics, Converters, Applications, and Design", by Ned Mohan, T. M. Undeland, W. P. Robbins, 3rd Edition, Wiley publishers, 2022.
2. "Power Electronics", by Daniel W. Hart, Mc Graw Hill publishers, 2011.

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
    -

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.

ECPC2202 POWER ELECTRONICS LAB. (0-0-3)

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

PO1 Gain a thorough understanding of the characteristics and behavior of key power semiconductor devices, including SCR, IGBT, and MOSFET, through practical V-I characteristic analysis and theoretical studies.

PO2 Acquire the ability to design, analyze, and implement single-phase and three-phase rectifier circuits, both full-wave (mid-point and bridge type) and semi converters, for different types of loads (resistive and inductive).

PO3 Learn to design and test DC-DC converters, including buck and boost converters, to understand their operation, performance parameters, and applications in power management.

PO4 Develop the ability to accurately measure and analyze key parameters such as latching and holding currents in SCRs, ensuring proper device operation and enhancing understanding of their dynamic performance in various applications.

PO5 Evaluate single-phase and three-phase PWM voltage source inverters (VSI), focusing on their performance, efficiency, and control strategies, particularly using PWM control techniques

Sl.	Name of the Experiment	Hrs.
1.	Study of the V-I characteristics of SCR, IGBT and MOSFET.	3
2.	Study of the cosine controlled triggering circuit	3
3.	To measure the latching and holding current of a SCR	3
4.	Study of the single phase half wave controlled rectifier and semi converter circuit with R and R-L Load	3
5.	Study of single phase full wave controlled rectifier circuits (mid point and Bridge type) with R and R-L Load	3
6.	Study of three phase full wave controlled rectifier circuits (Full and Semi converter) with R and R-L Load	3
7.	Study of the Buck converter	3
8.	Study of the Boost converter	3
9.	Study of the single phase PWM voltage source inverter.	3
10.	Study the performance of three phase VSI with PWM control.	3

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 GPIO 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.

BACHELOR OF TECHNOLOGY
ELECTRICAL 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	EEPC3001	Control System	3-0-0	3	100	50
2	PC	EEPC3002	Power System – I	3-0-0	3	100	50
3	PC	ECPC3001	Microprocessor & Microcontroller	3-0-0	3	100	50
4	PE	ECPE3001	Electromagnetic Field Theory	3-0-0	3	100	50
		EEPE3002	CAD of Electrical Machines				
		EEPE3003	Energy Conservation & Auditing				
		EEPE3004	Special Electrical Machines				
		–	–				
		–	–				
		–	–				
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	EEPC3201	Control System Laboratory	0-0-3	1.5	–	100
8	PC	EEPC3202	Power System Simulation Laboratory	0-0-3	1.5	–	100
9	PC	EEPC3203	Microprocessor & Microcontroller Laboratory	0-0-3	1.5	–	100
10	PSI	EEPS3201	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.

ECPE3001 ELECTROMAGNETIC FIELD THEORY (3-0-0)

Course Objectives

This course introduces fundamental concepts of electromagnetic fields, covering coordinate systems, vector calculus, electrostatic and magnetostatic fields, Maxwell's equations, and wave propagation. Students will learn to analyze transmission lines, apply boundary conditions, and solve field-related problems using theoretical principles and mathematical formulations.

Module-I: (06 Hrs.)

Co-ordinate systems & Transformation: Cartesian co-ordinates, circular cylindrical co-ordinates, spherical co-ordinates.

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.

Module-II: (08 Hrs.)

Electrostatic Fields: Coulomb's Law, Electric Field Intensity, Electric Fields due to point, line, surface and volume charge, Electric Flux Density, Gauss's Law – Maxwell's Equation, Applications of Gauss's Law, Electric Potential, Relationship between Electric Potential (E) and Potential Gradient (V) –Maxwell's Equation an Electric Dipole & Flux Lines, Energy Density in Electrostatic Fields.

Electrostatic Boundary – Value Problems: Passion's & Laplace's Equations, Uniqueness theorem, General procedures for solving passions or Laplace's Equation.

Module-III: (08 Hrs.)

Magnetostatic Fields: Biot-Savart's Law, Magnetic Field intensity due to a finite and infinite wire carrying current; Magnetic field intensity on the axis of a circular and rectangular loop carrying current; Magnetic flux Density; Magnetic Vector Potential; Ampere's circuital law and simple applications; Inductance and mutual inductance. Boundary conditions for electric fields and magnetic fields. Conduction current and displacement current densities; Continuity equation for current; Maxwell's Equation in Differential and Integral form from Modified form of Ampere's circuital law, Faraday's Law and Gauss's Law.

Module-IV: (04 Hrs.)

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-V: (04 Hrs.)

Transmission line: Waves in transmission line, Line parameters, Transmission line equation & solutions, Propagation constants, Characteristic impedance, Wavelength, Velocity of propagation. Standing Wave Ratio (SWR), impedance matching. Solution of problems. Electromagnetic interference.

Course Outcomes:

On completion of this course, students are able to:

CO-1: Understand and apply coordinate systems and vector calculus for formulating electromagnetic field problems.

CO-2: Analyse electrostatic fields and apply Gauss's law, electric potential, and energy density in solving field-related problems.

CO-3: Apply magnetostatic laws and principles (Biot–Savart, Ampere's) to compute magnetic fields and understand inductance.

CO-4: Interpret Maxwell's equations for time-varying electromagnetic fields and understand electromagnetic wave propagation.
CO-5: Analyse transmission line behaviour, wave parameters, and use impedance matching techniques to reduce losses and interference.

Text Book(s):
1. Matthew N. O. Sadiku, Principles of Electromagnetics, Oxford University Press, 2015.
2. Hayt W. H. and J. A. Buck, Engineering Electromagnetics, McGraw-Hill, 2011.

Reference Book(s):
1. C. R. Paul, K. W. Whites, S. A. Nasor, Introduction to Electromagnetic Fields, McGraw-Hill Education, 1997.
2. Cheng D K,Fundamentals of Engineering Electromagnetics, Pearson, 1992.

EEPC3001 CONTROL SYSTEM (3-0-0)

Course Objectives :

This course provides fundamental knowledge of control systems, covering mathematical modeling, time and frequency domain analysis, stability criteria (Routh-Hurwitz, Nyquist), and controller design (P, PI, PID). Students will learn state-space representation, system simplification techniques, and apply performance indices to analyze and design effective control systems.

Module-I: (08 Hrs.)

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: (06 Hrs.)

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: (08 Hrs.)

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: (04 Hrs.)

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

Module-V: (04 Hrs.)

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.

Course Outcomes:

On completion of this course, students are able to:

CO-1: Develop the mathematical model of the physical systems and simplify the complicated system.

CO-2: Employ time domain analysis to predict and diagnose transient performance parameters of the system for standard input functions.

CO-3: Formulate different types of analysis in the frequency domain to explain the nature of the stability of the system

CO-4: Identify the needs of different types of controllers and compensators to ascertain the required dynamic response from the system.

CO-5: Model and Analyse state space representation of LTI system to check the controllability and observability

Text Book(s):

1. K. Ogata, Modern Control Engineering, Pearson Education India, 2015
2. I.J. Nagrath and M. Gopal, Control System Engineering, New age international Publishers, 2009.
3. Norman S. Nise, Control Systems Engineering, Willey India Pvt. Ltd, 2024

Reference Book(s):

1. R.C. Dorf and R.H.Bishop, Modern Control System, Pearson Education, 2017.
2. B.C. Kuo, Automatic Control System, Prentice Hall, 1990.
3. S. Hasan Saeed, Automatic Control Systems (with Matlab Programs), Katson Books, 2017.

EEPC2003 ELECTRICAL MACHINES-II (3-0-0)

Module I (08 Hours)
Three-phase synchronous generators:
Construction, Salient pole type and Cylindrical rotor structure, Armature windings, Winding factor, EMF equation, Armature reaction, Synchronous impedance, Alternator on load, Phasor diagrams, Open Circuit and Short Circuit tests, Short Circuit Ratio, Voltage regulation by EMF, MMF and ZPF methods, Two reactance concept of Salient pole Synchronous machines, Slip test, Power equations, Power angle characteristics.

Module II (06 Hours)
Parallel operation of alternators:
Requirements for parallel operation, synchronizing of alternators, three dark lamp method, synchroscope, synchronizing current, synchronizing power, synchronizing torque, effect of increasing the excitation, effect of increasing the driving torque and effect of change in speed of one of the alternators, load sharing between two alternators.

Module III (04 Hours)
Synchronous motors: Rotating magnetic field, operating principle of a synchronous motor, phasor diagrams, power equations, load angle, 'V' and inverted 'V' curves, synchronous condenser, starting methods, hunting.

Module IV (06 Hours)
Three-phase induction motors: Construction, principle of operation, types, squirrel cage rotor, slip ring induction motor, slip, torque equations, starting torque, full load torque, maximum torque, torque-slip and torque-speed characteristics, effect of rotor resistance, effect of change in supply voltage, effect of change in frequency, power losses and efficiency, synchronous watt, equivalent circuit of induction motor, phasor diagrams, power output, testing of induction motors, No-load test, Blocked rotor test, load test, measurement of slip, circle diagram.

Module V (06 Hours)
Starting and speed control of three-phase induction motors: DOL starting, stator resistance starting, auto transformer starting, star-delta starting, starting of sip ring induction motors, speed control by variation of supply voltage-supply frequency, rotor resistance control, crawling and cogging effects.
Single-phase induction motors: Construction, principle of operation, double field revolving theory, equivalent circuit, performance characteristics, starting methods, capacitor start-capacitor run single phase induction motors.

Course Outcomes (COs)

CO1: Explain the construction and working principles of synchronous generators, derive EMF equations, and analyze armature reaction and voltage regulation. (Knowledge, Understanding)

CO2: Demonstrate the requirements and procedures for the parallel operation of alternators and analyze the impact of synchronizing current, power, and torque on system stability and load sharing. (Application, Analysis)

CO3: Describe the construction, operating principles, and characteristics of synchronous motors, and analyze V and inverted V curves for performance assessment. (Knowledge, Understanding, Analysis)

CO4: Explain the structure, operation, and torque characteristics of three-phase induction motors, evaluate effects of rotor resistance and supply variations, and analyze equivalent circuits. (Understanding, Application, Analysis)

CO5: Analyze different starting and speed control methods for induction motors, assess performance of single-phase induction motors, and apply theories like double field revolving theory for performance analysis. (Analysis, Evaluation)

Textbooks:

1. "Theory & Performance of Electrical Machines" by J.B. Gupta, 15th edition, S. K. Kataria & Sons, reprint 2015.
2. Fitzgerald& Kingsley's "Electric Machinery", Stephen D. Umans, 7th edition, McGrawHill publishers, 2014.

Reference books:

1. "Electric Machinery" by P.S. Bimbhra, 2nd edition, Khanna Publishing House, 2022.
2. "Electric Machines" by D.P. Kothari and I.J. Nagrath, 5th edition, McGrawHill publishers, 2017.
3. "The Performance and Design of Alternating Current Machines", by M. G. Say, CBS Publishers & Distributors, 2005.

EEPC3002 POWER SYSTEM - I (3-0-0)

Course Objectives:
This course provides fundamental knowledge of power systems, covering transmission line parameters, performance analysis, corona effects, and mechanical design of overhead lines. Students will learn to calculate inductance, capacitance, and resistance, analyze distribution systems, and understand underground cables and earthing principles for efficient power system operation.

Module-I: (02 Hrs.)
Introduction to Power System and Generation of Electric Power: Evolution of Power Systems and Present-Day Scenario. Structure of power system. Conventional and non-conventional sources of Electrical Energy.

Module-II: (08 Hrs.)
Transmission Line Parameters: Types of Conductors, Resistance, Inductance of a Conductor due to Internal Flux, Flux Linkages between Two Points External to an Isolated Conductor, Inductance of a Single Phase Two Wire Line, Flux Linkages of one Conductor in a Group, Inductance of Composite-Conductors, Concept of GMD, Transposition of lines, Inductance of a Three Phase Line with symmetrical and Unsymmetrical Spacing, Inductance Calculations for Bundled Conductors, Skin effect and Proximity effect. Capacitance of a Two Wire Line, Capacitance of a Three Phase Line with symmetrical and Unsymmetrical Spacing, Effect of Earth on the Capacitance of a Three Phase Line, Capacitance Calculations for Bundled Conductors, Parallel- Circuit Three Phase Lines.

Module-III: (07 Hrs.)
Performance of Transmission Lines: Representation of Short, medium and long Transmission Line, Equivalent Circuit, Calculation and analysis of performance of transmission lines, Voltage Profile of transmission lines, Ferranti Effect, Power Flow Through Transmission Line, Power Flow capability and Surge Impedance Loading, Series and Shunt Compensation of Transmission Line.

Corona: Theory of corona formation, Electric Stress, Critical Disruptive Voltage, Visual Critical Voltage, Power Loss Due to Corona, Factor affecting corona loss, Methods for reducing corona loss, Advantages and Disadvantages of Corona.

Module-IV: (06 Hrs.)
Mechanical Design of Overhead Transmission Lines: Line Supports, the catenary curve, Sag and Tension Calculation, supports at different levels, stringing chart, Sag template, Conductor Spacing and Ground Clearance, Effects and Prevention of Vibrations (Vibrations and Dampers).
Overhead Line Insulators: Insulator Materials, Types of Insulators, Voltage distribution over a string of suspension insulators, String Efficiency, Methods of improving string efficiency, Testing of insulators.

Module-V: (07 Hrs.)
Distribution Systems: Classification of Distribution Systems, Primary and secondary distribution network, Voltage Drop in DC Distributors, Voltage Drop in AC Distributors, Kelvin's Law, Limitations of Kelvin's Law, Application of Capacitors to Distribution Systems.
Underground Cables: Type and construction, Classification of Cables, Parameters of Single Core Cables, Grading of Cables, Capacitance of Three Core Cable, Comparison of overhead lines with underground Cables.
Power System Earthing: Soil Resistivity, Earth Resistance, Tolerable Step and Touch Voltage, Actual Touch and Step Voltages. Design of Earthing Grid.

Course Outcomes:

On completion of this course, students are able to:

CO1. Understand the structure and evolution of power systems and distinguish between conventional and non-conventional energy sources.

CO2. Calculate the resistance, inductance, and capacitance of transmission lines using relevant formulas and techniques.

CO3. Analyze the performance of different transmission line types (short, medium, and long) and assess voltage regulation and power flow.

CO4. Evaluate the effects of corona in transmission lines and recommend methods to minimize power loss.

CO5. Perform mechanical design calculations for overhead transmission lines, including sag, tension, and vibration prevention.

Text Book(s):

1. C. L. Wadhwa, Electrical Power Systems, India: New Age International Publishers, 2010.
2. A. Hussain, Power System, New Delhi, India: CBS Publishers & Distributors, 1998.
3. S. Sivanagaraju, S. Satyanarayana, Electrical Power Transmission and Distribution, Pearson Education, 2009.

Reference Book(s):

1. O. I. Elgerd, Electric Energy Systems Theory. New York, NY, USA: McGraw-Hill Education, 1995.
2. D. P. Kothari and I. J. Nagrath, Modern Power System Analysis, 4th ed. New Delhi, India: McGraw-Hill Education, 2011.
3. R.K. Rajput, Power System Engineering, Laxmi Publications (P) Ltd, 2007.

EEPC3201 CONTROL SYSTEM LABORATORY (0-0-3)

Course Objectives:

This lab course provides hands-on experience in analyzing and designing control systems. Students will study DC and AC motor control, design compensators, implement PID controllers, validate transfer functions, and use MATLAB for stability analysis (root locus, Bode plots) to evaluate system performance.

1. Study of a dc motor driven position control system. (03 Hrs)
2. Study of speed torque characteristics of two-phase AC servomotor and determination of its transfer function. (03 Hrs)
3. Obtain the frequency response of a lag and lead compensator. (03 Hrs)
4. To observe the time response of a second order process with P, PI and PID control and apply PID control to servomotor. (03 Hrs)
5. To determine the transfer function of a system (network) using transfer function analyser. (03 Hrs)
6. To study and validate the controllers for a temperature control system. (03 Hrs)
7. To study the position control system using Synchroscope. (03 Hrs)
8. To Analyse the Time Domain specifications of Under damped second order system using MATLAB. (03 Hrs)
9. To analyse the stability of the system by using Root locus using MATLAB. (03 Hrs)
10. To analyse the stability of the given linear system using Bode plot using MATLAB. (03 Hrs)

Course Outcomes:

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.

EEPC3202 POWER SYSTEM SIMULATION LABORATORY (0-0-3)

Course Objectives

This lab course provides hands-on experience in power system simulation using MATLAB/SIMULINK. Students will analyze transmission line parameters, model short/medium/long lines, study Ferranti effect, calculate sag and string efficiency, improve voltage profiles, and compare distribution systems to develop practical skills in power system analysis and design.

1. Determination of transmission line parameters (inductance and capacitance) for a single-phase line using MATLAB Program / SIMULINK Model. (3Hrs)
2. Determination of transmission line parameters (inductance and capacitance) for a symmetrical & unsymmetrical three-phase transmission line using MATLAB Program / SIMULINK Model (3Hrs)
3. Determination of Power Angle Diagrams, Reluctance Power, Excitation, Emf and Regulation for Salient and Non-Salient Pole Synchronous Machines using MATLAB Program / SIMULINK Model (3Hrs)
4. Modelling and performance analysis of short & medium transmission line using MATLAB Program / SIMULINK Model (3Hrs)
5. Study of Surge Impedance Loading of a long transmission line using MATLAB Program / SIMULINK Model (3Hrs)
6. Verify the Ferranti effect in a transmission line using MATLAB Program / SIMULINK Model (3Hrs)
7. Evaluation of sag in overhead transmission lines with equal and unequal tower heights using MATLAB Program / SIMULINK Model (3Hrs)
8. Determination of string efficiency of suspension-type insulators using MATLAB Program / SIMULINK Model (3Hrs)
9. Improvement of voltage profile at a load bus using a shunt capacitor using MATLAB Program / SIMULINK Model (3Hrs)
10. Study and compare the performance of a ring and radial distributions systems using MATLAB Program / SIMULINK Model (3Hrs)

Course Outcomes:

CO1: Analyse and calculate the inductance and capacitance of single-phase and three-phase transmission lines (symmetrical and unsymmetrical configurations).

CO2: Develop models for short, medium, and long transmission lines and evaluate their performance parameters such as voltage regulation and efficiency.

CO3: Interpret and analyse the Ferranti effect in medium and long transmission lines using appropriate simulation or experimental techniques.

CO4: Compute the sag and tension in overhead transmission lines for both equal and unequal tower heights and string efficiency of suspension-type insulators.

CO5: Analyse the voltage profile at a load bus using a shunt capacitor and compare the performance of a ring and radial distributions systems .

EEPC3202 POWER SYSTEM SIMULATION LABORATORY (0-0-3)

Course Objectives

This lab course provides hands-on experience in power system simulation using MATLAB/SIMULINK. Students will analyze transmission line parameters, model short/medium/long lines, study Ferranti effect, calculate sag and string efficiency, improve voltage profiles, and compare distribution systems to develop practical skills in power system analysis and design.

1. Determination of transmission line parameters (inductance and capacitance) for a single-phase line using MATLAB Program / SIMULINK Model. (3Hrs)
2. Determination of transmission line parameters (inductance and capacitance) for a symmetrical & unsymmetrical three-phase transmission line using MATLAB Program / SIMULINK Model (3Hrs)
3. Determination of Power Angle Diagrams, Reluctance Power, Excitation, Emf and Regulation for Salient and Non-Salient Pole Synchronous Machines using MATLAB Program / SIMULINK Model (3Hrs)
4. Modelling and performance analysis of short & medium transmission line using MATLAB Program / SIMULINK Model (3Hrs)
5. Study of Surge Impedance Loading of a long transmission line using MATLAB Program / SIMULINK Model (3Hrs)
6. Verify the Ferranti effect in a transmission line using MATLAB Program / SIMULINK Model (3Hrs)
7. Evaluation of sag in overhead transmission lines with equal and unequal tower heights using MATLAB Program / SIMULINK Model (3Hrs)
8. Determination of string efficiency of suspension-type insulators using MATLAB Program / SIMULINK Model (3Hrs)
9. Improvement of voltage profile at a load bus using a shunt capacitor using MATLAB Program / SIMULINK Model (3Hrs)
10. Study and compare the performance of a ring and radial distributions systems using MATLAB Program / SIMULINK Model (3Hrs)

Course Outcomes:

CO1: Analyse and calculate the inductance and capacitance of single-phase and three-phase transmission lines (symmetrical and unsymmetrical configurations).

CO2: Develop models for short, medium, and long transmission lines and evaluate their performance parameters such as voltage regulation and efficiency.

CO3: Interpret and analyse the Ferranti effect in medium and long transmission lines using appropriate simulation or experimental techniques.

CO4: Compute the sag and tension in overhead transmission lines for both equal and unequal tower heights and string efficiency of suspension-type insulators.

CO5: Analyse the voltage profile at a load bus using a shunt capacitor and compare the performance of a ring and radial distributions systems .

EEPC3203 MICROPROCESSOR AND MICROCONTROLLER LABORATORY (0-0-3)

Course Objectives:

This laboratory course aims to develop practical skills in microprocessor (8086) and microcontroller (8051/Arduino) programming and interfacing. Students will implement arithmetic, sorting, and communication programs, interface peripherals (ADC/DAC, motors), and design embedded systems (sensors, IoT applications). Emphasis is placed on hardware-software integration, debugging, and using development tools for real-world 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.

EEPE3002 CAD OF ELECTRICAL MACHINES (3-0-0)

Course Structure:
This course introduces computer-aided design (CAD) techniques for electrical machines, covering transformers, DC machines, induction motors, and synchronous machines. Students will learn material selection, dimension calculation, performance analysis, and optimization methods to develop efficient machine designs using modern CAD tools and methodologies.

Module-I: (08 Hrs.)
Fundamental Aspects of Electrical Machine Design: Design of machines- design factors-limitation in design-modern trends in electrical machine design-types of magnetic, electric and insulating materials- modes of heat dissipation-cooling of rotating machines-methods of cooling.
Computer Aided Design (CAD) of Electrical Machines
Limitation and assumptions in traditional designs, need of CAD, analysis, synthesis and hybrid methods, design optimisation methods, variables, constraints and objective function, problem formulation

Module-II: (06 Hrs.)
Design of Transformers: Transformer Windings-output equation-design of main dimensions-design of core-choice of flux density-determination of number of turns and length of the mean turn-resistance and leakage reactance-no load current calculation-cooling of transformers –calculation of number of tubes.

Module-III: (08 Hrs.)
Design of DC Machines: Output equation-selection of specific magnetic and electric loadings-separation of D and L- estimation of number of conductors, armature slots and conduct dimensions-choice of number of poles and calculation of length of airgap-design of field systems, interpoles and brushes.

Module-IV: (04 Hrs.)
Design of Induction Motors: Output equation- main dimensions- choice of average flux density and ampere conduction for meter-design of stator slots and rotor slots-design of rotor bars end rings-design of wound rotor-design of no load current.

Module-V: (04 Hrs.)
Design of Synchronous Machines: Types of construction-output equation-main dimensions-short circuit ratio and its effects on the performance-design of rotor-design of field winding-Design of turbo alternators-Rotor design temperature rise and its effects.

Course Outcomes:
On completion of this course, students are able to:
CO-1: Classify the materials used for construction of electrical machines.
CO-2: Assess the overall dimensions of a transformer.
CO-3: Examine the design, performance of DC machines.
CO-4: Develop the overall dimensions of rotating machines.
CO-5: Analyse the design and performance of rotating machines.

Text Book(s):
1. K. M. Vishnu Murthy, Computer Aided Design of Electrical Machine Machines, B.S. Publications, 2008.
2. A.K. Sawhney, A Course in electrical Machine Design, Dhanpat Rai & Co. (P) Limited, 2016.

Reference Book(s):
1. A.E Clayton and NN Hancock, The Performance and Design of Direct Current Machines, CBS Publishers, 2004.
2. M. G. Say, Performance and Design of A.C. Machines, ELBS and Pitman & Sons, 2008.
3. S. K. Sen, Principles of Electrical Machine Design with Computer Programmes, Oxford and IBH Company Pvt. Ltd., 2006

EEPE3003 ENERGY CONSERVATION & AUDITING (3-0-0)

Course Objectives:
This course provides comprehensive knowledge of energy conservation and auditing techniques, covering energy management principles, industrial audits, electrical system efficiency (motors, HVAC, lighting), power factor improvement, and economic analysis methods (payback, NPV). Students will learn to identify energy-saving opportunities and evaluate conservation projects using practical tools and methodologies.

Module-I: (06 Hrs.)
Basic principles of Energy audit: Energy audit-definitions, concept, types of audit, energy index, cost index, pie charts, Sankey diagrams, load profiles, Energy conservation schemes-Energy audit of industries-energy saving potential, energy audit of process industry, thermal power station, building energy audit

Module-II: (04 Hrs.)
Energy management: Principles of energy management, organizing energy management program, initiating, planning, controlling, promoting, monitoring, reporting.

Module-III: (08 Hrs.)
EB billing: HT and LT supply, transformers, electric motors- motor efficiency computation, energy efficient motors, pumps, fans, blowers, compressed air systems, refrigeration and air conditioning systems, cooling towers, electric heaters (space and liquid), DG-sets, illuminating devices, power factor improvement, and harmonics.

Module-IV: (06 Hrs.)
Power factor improvement, Lighting: Power factor-methods of improvement, location of capacitors, pf with nonlinear loads, effect of harmonics on p.f., p.f. motor controllers-good lighting system design and practice, lighting control, lighting energy audit

Module-V: (04 Hrs.)
Economic aspects and analysis: Economic analysis- Depreciation methods, time value of money, rate of return, present worth method, replacement analysis, life cycle costing analysis-Energy efficient motors
Computation of Economic aspects: Calculation of simple payback method, net present worth method-Power factor correction, lighting-Applications of life cycle costing analysis, return on investment.

Course Outcomes:
On completion of this course, students are able to:
CO1: Understand and explain the basic principles, concepts, and methodologies used in energy audits and identify opportunities for energy conservation.
CO2: Apply energy management principles to plan and organize an effective energy management program in an industrial or commercial setup.
CO3: Analyze energy consumption patterns in electrical systems such as motors, pumps, fans, and HVAC systems and suggest efficiency improvements.
CO4: Evaluate power factor correction and lighting systems, and perform energy audits to enhance energy efficiency and quality.
CO5: Perform economic analysis of energy conservation projects using techniques such as payback period, NPV, and life cycle cost analysis.

Text Book(s):

1. Paul o' Callaghan, Energy management, Mcgraw Hill Book company,1998
2. W.R.Murphy and G.McKay, Energy Management, Butterworth Heinemann,1978
3. John C. Andreas, Energy efficient electric motors, Marcel Dekker Inc Ltd,1995
4. S.C.Tripathy, Electric Energy Utilization & Conservation, Tata Mcgraw Hill,1991

Reference Book(s):

1. W.C.Turner, Energy Management Handbook, Fairmont Press,1993
2. Albert Thumann, William J. Younger, Handbook of Energy Audits, Terry Niehus, 2009

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

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.

BIJU PATNAIK UNIVERSITY OF TECHNOLOGY, ODISHA

ROURKELA

Curriculum and Syllabus

B. Tech (*Electrical Engineering)* from the Admission Batch 2018-19

Semester (6^{th})

Sixth Semester							
Theory							
Sl No	**Category**	**Course Code**	**Course Title**	**L-T-P**	**Credit**	**University Marks**	**Internal Evaluation**
1	PC	REL6C001	Power System operation and Control	3-0-0	3	100	50
2	PC		Microprocessor and Micro controllers	3-0-0	3	100	50
3	BS		Optimization in Engineering	3-0-0	3	100	50
4	PE	REL6D001	Electric Power System Protection	3-0-0	3	100	50
		REL6D002	Electric and Hybrid Vehicles				
			Biomedical Instrumentation				
5	OE		Artificial Intelligence and Machine Learning	3-0-0	3	100	50
			Communication Engineering				
			Computer Organisation and Architecture				
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		Power System Operation and Control Lab	0-0-3	2		100
2	PC		Microprocessor and Micro controllers 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 INTERNSHIP 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	REL6C001	Power System operation and Control	L-T-P 3-0-0	3 Credits

Module I: **(10 hours)**

Review of the structure of a Power System and its components. Per unit calculations. Analysis of Power Flows: Formation of Bus Admittance Matrix. Real and reactive power balance equations at a node. Load and Generator Specifications. Application of numerical methods for solution of nonlinear algebraic equations – Gauss Seidel, Coupled and Decoupled Newton-Raphson methods for the solution of the power flow equations. Regulating Transformers.

Module II: **(8 hours)**

Economic Operation and Management of Power System: Basic Pricing Principles: Generator Cost Curves, Utility Functions, Economic Operation with and without Transmission losses, Transmission loss coefficient, Economic Dispatch, Unit Commitment, Function of Load Dispatch Centres. Demand side-management.

Module III: **(10 hours)**

Control of Frequency and Voltage: Turbines and Speed-Governors, Frequency dependence of loads, Droop Control and Power Sharing. Automatic Generation Control. Generation and absorption of reactive power by various components of a Power System. Excitation System Control in synchronous generators, Automatic Voltage Regulators, ALFC of Single and Two Area Systems.

Module IV: **(12 hours)**

Power System Stability: The Stability Problem, Rotor Dynamics and the Swing Equation, The Power-Angle Equation, Synchronizing Power Coefficients, Equal- Area Criterion for Stability, Multi-machine Stability Studies: Classical Representation, Step-By-Step Solution of the Swing Curve, Factors Affecting Transient Stability.

Books:

[1] J. Grainger and W. D. Stevenson, "Power System Analysis", McGraw Hill Education, 1994.
[2] O. I. Elgerd, "Electric Energy Systems Theory", McGraw Hill Education, 1995.
[3] D. P. Kothari and I. J. Nagrath, "Modern Power System Analysis", McGraw Hill Education, 4th Edition, 2011.
[4] Power System Analysis- By Hadi Saadat, TMH, 2002 Edition, Eighth Reprint.
[5] C.L. Wadhwa, "Electrical Power Systems", New Age International Publishers, 6th Edition.
[6] A. R. Bergen and V. Vittal, "Power System Analysis", Pearson Education Inc, 1999.

Digital Learning Resources:

Course Name: Power System Analysis
Course Link: https://nptel.ac.in/courses/108/105/108105067/
Course Instructor: Prof. A K Sinha, IIT Kharagpur

Course Name: Power System Analysis
Course Link: https://nptel.ac.in/courses/117/105/117105140/
Course Instructor: Prof. D Das, IIT Kharagpur

Course Name:	Power System Analysis
Course Link:	https://nptel.ac.in/courses/108/104/108104051/
Course Instructor:	Prof. Arindam Ghosh, IIT Kanpur

Course Name:	Computer Aided Power System Analysis
Course Link:	https://nptel.ac.in/courses/108/107/108107028/
Course Instructor:	Dr. Vinay Pant and Dr. B. Das, IIT Roorkee

6^{th} Semester	REE6C002	Microprocessor and Micro controllers	L-T-P 3-0-0	3 Credits

Module I: **(10 hours)**

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

Module II: **(8 hours)**
16-bit microprocessor instruction set and assembly language programming:
Programmer's model of 8086; operand types, operand addressing; assembler directives, instruction Set-Data transfer group, Arithmetic group, Logical group.

Module III: **(8 hours)**
Microprocessor peripheral interfacing:
Introduction; Generation of I/O ports; Programmable Peripheral Interface (PPI) - Intel 8255; Sample-and-Hold Circuit and Multiplexer; Keyboard and Display Interface; Keyboard and Display Controller (8279).

Module IV: **(12 hours)**
8-bit microcontroller- H/W architecture instruction set and programming:
Introduction to 8051 Micro-Controllers, Architecture; Memory Organization; Special Function register; Port Operation; Memory Interfacing, I/O Interfacing; Programming 8051 resources, interrupts; Programmer's model of 8051; Operand types, Operand addressing; Data transfer instructions, Arithmetic instructions, Logic instructions, Control transfer instructions; Programming.

Module V: **(10 hours)**
Maximum mode system configuration, Direct memory access, Interfacing of D- to-A converter, A-to-D converter, CRT Terminal Interface, Printer Interface, Programming of 8051 timers, 8051 serial interface. Introduction to 80386 and 80486 Microprocessor family.

Books:
[1] Microprocessor Architecture, Programming and application with 8085, R.S. Gaonkar, PRI Penram International publishing PVT. Ltd., 5th Edition .
[2] Microprocessors and Interfacing, Programming and Hardware, Douglas V Hall, TMH Publication, 2006.
[3] Microprocessors and Interfacing, N. Senthil Kumar, M. Saravanan, S. Jeevananthan
[4] The 8051 Microcontroller and Embedded Systems, Muhammad Ali Mazidi, Janice Gillispie Mazidi, Rolin D.M C Kinlay, Pearson Education, Second Edition, 2008.
[5] Microcontrollers: Principles and Application, Ajit Pal, PHI Publication.
[6] Microprocessors and Microcontrollers Architecture, programming and system design using 8085, 8086, 8051 and 8096, Krishna Kant, PHI Publication, 2007.
[7] Advanced Microprocessors and Peripherals, A.K. Ray, K M Bhurchandi, TMH Publication, 2007.
[8] Textbook of Microprocessor and Microcontroller, Thyagarajan, Scitech Publication.

6th Semester		**Optimization in Engineering**	**L-T-P 3-0-0**	**3 Credits**

Digital Learning Resources:

Course Name: Microcontrollers and Applications
Course Link: https://nptel.ac.in/courses/117/104/117104072/
Course Instructor: Prof. S. P Das, IIT Kanpur

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.

6^{th} Semester	REL6D001	Electric Power System Protection	L-T-P 3-0-0	3 Credits

Digital Learning Resources:

Course Name: Foundations of Optimization
Course Link: https://nptel.ac.in/courses/111/104/111104071/
Course Instructor: Dr. Joydeep Dutta, IIT Kanpur

Module-I: **(10 hours)**

Introduction: Principle and need for protective schemes, Nature and causes of faults, Zones of protection, Primary and back-up protection, Basic principle of operation of protective system, Components of Protection System. Sequence Components and Fault Analysis: sequence impedance, fault calculations, Single line to ground fault, Line to ground fault with Z_f, Faults in Power systems, Concept of short circuit capacity of a Bus.

Module-II: **(10 hours)**

Operating Principles and Relay Construction: Relay design and construction, Relay classification, Types of Electromagnetic relays, Theory of Induction relay torque, General Equations of Comparators and Electromagnetic Relays, Over Current relays, Directional relays, Distance relays, Differential relays. Feeder Protection: Over current, Distance and Pilot Protection. Static Relays: (Comparators and different relays) Amplitude comparator, Phase Comparator, Coincidence type phase comparator, Basic elements of a static relay, Over Current Relays, Differential Protection, Static distance Protection.

Module-III: **(10 hours)**

Apparatus Protection: Transformer Protection, Generator Protection, Motor Protection,
Bus bar protection schemes. Numerical relays: Block Diagram of Numerical Relay, Signal Sampling & Processing, Numerical Over-current protection, Numerical Transformer differential Protection, Numerical distance Protection of Transmission Line.

Module-IV: **(12 hours)**

Switchgears: Auto reclosing, Theory of Circuit interruption, Circuit constants in relation to Circuit breaking, Re-striking voltage transient, characteristics of Re-striking Voltage,
Interaction between breaker and circuit, Current chopping. Circuit Breakers: Types of circuit breakers (air blast, air break, oil, vacuum, SF6 , DC circuit breaker), advantages and testing of circuit breaker.

Books:

[1] Power System Protection and Switchgear – B.Ravindranath & M.Chander–New Age International Publishers (Second Edition).
[2] Bhavesh Bhalja, R P Maheshwari, Nilesh G.Chothani, Oxford University Press
[3] Fundamentals of Power System Protection – Y.G.Paithankar and S.R.Bhide, PHI Publication.(Second Edition)
[4] Electrical Power System - C.L.Wadhwa New Age International Publishers. (Sixth Edition).

[5] Power System Engineering - M.L.Soni, P.V.Gupta, U.S.Bhatnagar, A.Chakrabarti, Dhanpat Rai & Co. (P) Ltd.
[6] Protection and Switchgear - B.Bhalja, R.P.Maheshwari, N.G. Chothani, OXFORD University Press.
[7] Power System Protection and Switchgear - Badri Ram, Vishwakarma, Tata McGraw hill.
[8] Switchgear and Protection – Sunil S Rao , Khanna Publishers, New Delhi.
[9] Power System relaying by Horwitz, Phadke, Research Press.

Digital Learning Resources:

Course Name:	Power System Protection
Course Link:	https://nptel.ac.in/courses/108/105/108105167/
Course Instructor:	Prof. Ashok Kumar Pradhan, IIT Kharagpur

Course Name:	NOC:Power System Protection and Switchgear
Course Link:	https://nptel.ac.in/courses/108/107/108107167/
Course Instructor:	Prof. Bhaveshkumar R. Bhalja, IIT Roorkee

Course Name:	Power System Protection
Course Link:	https://nptel.ac.in/courses/108/101/108101039/
Course Instructor:	Prof. S.A. Soman, IIT Bombay

6^{th} Semester	REL6D002	Electric and Hybrid Vehicles	L-T-P 3-0-0	3 Credits

Module I: **(10 Hours)**

Introduction to Hybrid Electric Vehicles: History of hybrid and electric vehicles, social and environmental importance of hybrid and electric vehicles, impact of modern drive-trains on energy supplies. Conventional Vehicles: Basics of vehicle performance, vehicle power source characterization, transmission characteristics, and mathematical models to describe vehicle performance.

Module II: **(10 Hours)**

Hybrid Electric Drive-trains: Basic concept of hybrid traction, introduction to various hybrid drive-train topologies, power flow control in hybrid drive-train topologies, fuel efficiency analysis. Electric Drive-trains: Basic concept of electric traction, introduction to various electric drive-train topologies, power flow control in electric drive-train topologies, fuel efficiency analysis.

Module III: **(10 Hours)**

Electric Propulsion unit: Introduction to electric components used in hybrid and electric vehicles, Configuration and control of DC Motor drives, Configuration and control of Induction Motor drives. Energy Storage: Introduction to Energy Storage Requirements in Hybrid and Electric Vehicles, Battery based energy storage and its analysis, Fuel Cell based energy storage and its analysis, Hybridization of different energy storage devices.

Module IV: **(10 Hours)**

Sizing the drive system: Matching the electric machine and the internal combustion engine (ICE), Sizing the propulsion motor, sizing the power electronics, selecting the energy storage technology. Battery Management System(BMS)/Energy Management System (EMS): Need of BMS, Rule based control and optimization based control, Software- based high level supervisory control, Mode of power transfer, Behaviour of drive motor. Electric Vehicles charging station: Type of Charging station, Selection and Sizing of charging station.

Books:

[1] Iqbal Hussein, Electric and Hybrid Vehicles: Design Fundamentals, CRC Press, 2003
[2] James Larminie, John Lowry, Electric Vehicle Technology Explained, Wi- ley, 2003.
[3] Mehrdad Ehsani, Yimi Gao, Sebastian E. Gay, Ali Emadi, Modern Electric, Hybrid Electric and Fuel Cell Vehicles: Fundamentals, Theory and Design, CRC Press, 2004.

Digital Learning Resources:

6^{th} Semester	REL5D003	Biomedical Instrumentation	L-T-P 3-0-0	3 Credits

Course Name: Introduction to Hybrid and Electric Vehicles
Course Link: https://nptel.ac.in/courses/108/103/108103009/
Course Instructor: Dr. Praveen Kumar and Prof. S. Majhi, IIT Guwahati

Course Name: Electric Vehicles - Part 1
Course Link: https://nptel.ac.in/courses/108/102/108102121/
Course Instructor: Prof. Amit Jain, IIT Delhi

Course Name: Fundamentals of Electric vehicles: Technology & Economics
Course Link: https://nptel.ac.in/courses/108/106/108106170/
Course Instructor: Prof. Ashok Jhunjhunwala et al, IIT Madras

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

6th Semester		Artificial Intelligence and Machine Learning	L-T-P 3-0-0	3 Credits

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.ByJOSEPH.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

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
Course Name:	Fundamentals of Artificial Intelligence
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		**Communication Engineering**	**L-T-P 3-0-0**	**3 Credits**

Module I: **(10 Hours)**

Introduction: Elements of an Electrical Communication System, Communication Channels and their Characteristics, Mathematical Models for Communication Channels Frequency domain analysis of signals and systems: Fourier series, Fourier Transforms, Power and Energy, Sampling and Band limited signals, Band pass signals.

Module II: **(10 Hours)**

Analog signal transmission and reception: Introduction to modulation, Amplitude Modulation (AM), Angle Modulation, Radio and Television broadcasting.

Module III: **(10 Hours)**

Pulse modulation systems: Pulse amplitude modulation, Pulse Time Modulation

Pulse code modulation: PCM system, Intersymbol interference, Eye patterns, Equalization, Companding, Time Division Multiplexing of PCM signals, Line codes, Bandwidth of PCM system, Noise in PCM systems.

Module IV: **(10 Hours)**

Delta Modulation (DM), Limitations of DM, Adaptive Delta Modulation, Noise in Delta Modulation, Comparison between PCM and DM, Delta or Differential PCM (DPCM), S-Ary System.

Books:

6th Semester		**Computer Organisation and Architecture**	**L-T-P 3-0-0**	**3 Credits**

[1] John G.Proakis,M. Salehi, Communication Systems Engineering, 2nd ed. New Delhi, India. PHI Learning Private Limited, 2009.
[2] R.P Singh and S.D Sapre, Communication Systems Analog & Digital, 2nd ed. New Delhi, India. Tata McGraw Hill Education Private Limited, 2009.

Digital Learning Resources:

Course Name: Analog Communication
Course Link: https://nptel.ac.in/courses/117/105/117105143/
Course Instructor: Prof. Goutam Das, IIT Kharagpur

MODULE-I **(08 Hours)**

Functional blocks of a computer: CPU, memory, input-output subsystems, control unit. Instruction set architecture of a CPU–registers, instruction execution cycle, RTL interpretation of instructions, addressing modes, instruction set. Case study – instruction sets of some common CPUs.

MODULE-II **(08 Hours)**

Data representation: signed number representation, fixed and floating point representations, character representation. Computer arithmetic – integer addition and subtraction, ripple carry adder, carry look- ahead adder, etc. multiplication – shift and add, Booth multiplier, carry save multiplier, etc. Division restoring and non restoring techniques, floating point arithmetic.

MODULE–III **(08 Hours)**

Introduction to x86 architecture. CPU control unit design: hardwired and micro-programmed design approaches, Case study – design of a simple hypothetical CPU. Memory system design: semiconductor memory technologies, memory organization. Peripheral devices and their characteristics: Input-output subsystems, I/O device interface, I/O transfers–program controlled, interrupt driven and DMA, privileged and non-privileged instructions, software interrupts and exceptions. Programs and processes–role of interrupts in process state transitions, I/O device interfaces – SCII, USB

MODULE –IV **(08 Hours)**

Memory organization: Memory interleaving, concept of hierarchical memory organization, cache memory, cache size vs. block size, mapping functions, replacement algorithms, write policies.

Books:

[1] "Computer Organization and Design: The Hardware/Software Interface", 5th Edition by David A. Patterson and John L. Hennessy, Elsevier.

[2] "Computer Organization and Embedded Systems", 6th Edition by CarlHamacher, McGraw Hill Higher Education

[3] "Computer Architecture and Organization", 3rd Edition by John P. Hayes, WCB/McGraw-Hill

[4] "Computer Organization and Architecture: Designing for Performance", 10th Edition by William Stallings, Pearson Education.

[5] "Computer System Design and Architecture", 2nd Edition by Vincent P. Heuring and Harry F. Jordan, Pearson Education.

Digital Learning Resources:

Course Name:	Computer Architecture and Organisation
Course Link:	https://nptel.ac.in/courses/106/105/106105163/
Course Instructor:	Prof. Indranil Sengupta and Prof. Kamalika Datta, IIT Kharagpur

Course Name:	Computer Organisation and Architecture
Course Link:	https://nptel.ac.in/courses/106/106/106106166
Course Instructor:	Prof. V. Kamakoti, IIT Madras

Course Name:	Computer Organisation
Course Link:	https://nptel.ac.in/courses/106/106/106106092
Course Instructor:	Prof. S. Raman, IIT Madras

Course Name:	Computer Organisation and Architecture
Course Link:	https://nptel.ac.in/courses/106/104/106104073
Course Instructor:	Prof. B. Raman, IIT Kanpur

Course Name:	Computer Organisation and Architecture
Course Link:	https://nptel.ac.in/courses/106/103/106103068
Course Instructor:	Prof. J.K Deka, IIT Guwahati

Course Name:	Computer Organisation and Architecture- A Pedagogical Aspect
Course Link:	https://nptel.ac.in/courses/106/103/106103180
Course Instructor:	Prof. J.K Deka, Dr. S. Biswas and Prof. A. Sarkar, IIT Guwahati

6^{th} Semester	RIK6F001	Essence of Indian Knowledge Tradition - I	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

6^{th} Semester	REL5C201	Power System Operation and Control Laboratory	L-T-P 0-0-3	2 Credits

List of Experiments

(Perform any 05 Experiments from Group-A and any 03 Experiments from Group-B)

Group-A (Hardware Based)

1. To determine negative and zero sequence synchronous reactance of an alternator.
2. To determine sub-transient direct axis and sub-transient quadrature axis synchronous reactance of a 3-ph salient pole alternator.
3. To determine fault current for L-G, L-L, L-L-G and L-L-L faults at the terminals of an alternator at very low excitation.
4. To study the IDMT over-current relay and with different plug setting and time setting multipliers and plot its time – current characteristics.
5. To determine the operating characteristics of biased different relay with different % of biasing
6. To study the MHO and reactance type distance relays.
7. To determine location of fault in a cable using cable fault locator.

Group-B (Simulation Based)

1. To obtain steady-state, transient and sub-transient short-circuit currents in an Alternator.
2. To formulate the Y-Bus matrix and perform load flow analysis.
3. To compute voltage, current, power factor, regulation and efficiency at the receiving end of a three phase Transmission line when the voltage and power at the sending end are given. Use Π model.
4. To perform symmetrical fault analysis in a power system.
5. To perform unsymmetrical fault analysis in a power system.
6. Write a program in 'C' language to solve economic dispatch problem of a power system with only thermal units. Take production cost function as quadratic and neglect transmission loss.

Digital Learning Resources:

Virtual Lab Link: https://vp-dei.vlabs.ac.in/Dreamweaver/

6^{th} Semester	REEL6C202	Microprocessors and Microcontrollers Laboratory	L-T-P 0-0-3	2 Credits

List of Experiments

(Perform any 10 Experiments)

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

Digital Learning Resources:

Virtual Lab Link: http://vlabs.iitb.ac.in/vlabs-dev/labs_local/microprocessor/labs/explist.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 important. In this topic, students learn how to*	Same as above

		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 (*Electrical 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	REL7D001	Advanced Control Systems	3-0-0	3	100	50
		REL7D002	High Voltage Systems and DC Transmission				
		REC7D006	Advanced Digital Signal Processing				
3	PE	REL7D003	Smart Grid	3-0-0	3	100	50
		REL7D004	Flexible AC Transmission Systems				
		REL7D005	Power Station Engineering				
4	OE	RIT7D001	Internet of Things	3-0-0	3	100	50
		REC5D006	Digital VLSI Design				
		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
		RCS7D007	Soft Computing				
		REC7D002	Embedded System				
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.**

7^{th} 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

7^{th} Semester	REL7D001	Advanced Control Systems	L-T-P 3-0-0	3 Credits

Module I: **(12 hours)**

Discrete - Time Control Systems:
Introduction: Discrete Time Control Systems and Continuous Time Control Systems, SamplingProcess. Digital Control Systems: Sample and Hold, Analog to digital conversion, Digital to analogconversion. The Z-transform: Discrete-Time Signals, The Z-transform, Z-transform of Elementaryfunctions, Important properties and Theorems of the Z-transform. The inverse Z-transform, Z-Transform method for solving Difference Equations. Z-Plane Analysis of Discrete Time Control Systems: Impulse sampling & Data Hold, Reconstruction of Original signals from sampled signals: Sampling theorem, folding, aliasing. Pulse Transfer function: Starred Laplace Transform of the signal involving Both ordinary and starred Laplace Transforms; General procedures for obtaining pulse Transfer functions, Pulse Transfer function of open loop and closed loop systems. Mapping between the s-plane and the z-plane, Stability analysis of closed loop systems in the z-plane: Stability analysis by use of the Bilinear Transformation and Routh stability criterion, Jury's stability Test

Module II: **(12 hours)**

State Variable Analysis & Design:
Introduction: Concepts of State, State Variables and State Model (of continuous time systems): StateModel of Linear Systems, State Model for Single-Input-Single-Output Linear Systems, Linearizationof the State Equation. State Models for Linear Continuous – Time Systems: State-SpaceRepresentation Using Physical Variables, State – space Representation Using Phase Variables, Phasevariable formulations for transfer function with poles and zeros, State – space Representation usingCanonical Variables, Derivation of Transfer Function for State Model. Diagonalization: Eigenvaluesand Eigenvectors, Generalized Eigenvectors.Solution of State Equations: Properties of the State Transition Matrix, Computation of StateTransition Matrix, Computation by Techniques Based on the Cayley-Hamilton Theorem, Sylvester'sExpansion theorem. Concepts of Controllability and Observability: Controllability, Observability,Effect of Pole-zero Cancellation in Transfer Function. Pole Placement by State Feedback, ObserverSystems. State Variables and Linear Discrete – Time Systems: State Models from Linear DifferenceEquations/z-transfer Functions, Solution of State Equations (Discrete Case), An Efficient Method ofDiscretization and Solution, Linear Transformation of State Vector (Discrete-Time Case), Derivationof z-Transfer Function from Discrete-Time State Model.

Module III: **(12 hours)**

Nonlinear Systems:
Introduction: Behaviour of Nonlinear Systems, Investigation of nonlinear systems. CommonPhysical Non Linearities: Saturation, Friction, Backlash, Relay, MultivariableNonlinearity. The PhasePlane Method: Basic Concepts, Singular Points: Nodal Point, Saddle Point, Focus Point, Centre orVortex Point, Stability of Non-Linear Systems: Limit Cycles,

Construction of Phase Trajectories:Construction by Analytical Method, Construction by Graphical Methods. The Describing FunctionMethod: Basic Concepts: Derivation of Describing Functions: Dead-zone and Saturation, Relay withDead-zone and Hysteresis, Backlash. Stability Analysis by Describing Function Method: Relay withDead Zone, Relay with Hysteresis, Stability Analysis by Gain-phase Plots. Jump Resonance.Liapunov's Stability Analysis: Introduction, Liapunov's Stability Critrion: Basic Stability Theorems,Liapunov Functions, Instability. Direct Method of Liapunov & the Linear System: Methods ofconstructing Liapunov functions for Nonlinear Systems.

Books:

[1] *Discrete-Time Control System, by K.Ogata, 2nd edition (2009), PHI.*
[2] *Control Systems Engineering, by I.J. Nagrath and M.Gopal., 5th Edition (2007 / 2009), New Age International (P) Ltd. Publishers.*
[3] *Control Systems (Principles & Design) by M.Gopal, 3rd Edition (2008), Tata Mc.Graw Hill Publishing Company Ltd.*
[4] *Design of Feedback Control Systems by Stefani, Shahian, Savant, Hostetter, Fourth Edition (2009), Oxford University Press.*
[5] *Modern Control Systems by K.Ogata, 5th Edition (2010), PHI.*
[6] *Modern Control Systems by Richard C. Dorf. And Robert, H.Bishop, 11th Edition (2008), Pearson Education Inc. Publication.*
[7] *Design of Feedback Control Systems by Stefani, Shahian, Savant, Hostetter, Fourth Edition (2009), Oxford University Press.*

Digital Learning Resources:

Course Name:	Advanced Linear Continuous Control Systems: Applications with MATLAB Programming and Simulink
Course Link:	https://nptel.ac.in/courses/108/107/108107115/
Course Instructor:	Prof. Yogesh Vijay Hote, IIT Roorkee

7^{th} Semester	REL7D002	High Voltage Systems and DC Transmission	L-T-P 3-0-0	3 Credits

Module I: **(10 Hours)**

Introduction: Design, planning and layout of H.V. laboratories Conduction and breakdown in Gaseous Dielectrics: Townsend's current growth equation, current growth in the presence of secondary processes, and streamer theory of breakdown in gases. Breakdown in non-uniform fields and corona. Conduction and Breakdown in Liquid dielectrics: Pure liquids and commercial liquids, conduction and breakdown in commercial liquids. Breakdown and pre-breakdown phenomena in solid Dielectrics: Intrinsic breakdown, electromechanical breakdown, thermal breakdown.

Module II: **(10 Hours)**

Generation of High voltages: Generation of high D.C. voltage, high A.C. voltage, impulse voltage, impulse current, tripping and control of impulse generators. Measurement of high voltages and current: Measurement of high D.C., A.C. and impulse. Measurement of D.C. resistivity, dielectric constant and loss factor, partial discharge and Condition monitoring. H.V. Testing of Electrical Apparatus: Testing of insulators, bushings, isolators, circuit breakers, cables, transformers, and surge diverters.

Module III: **(12 Hours)**

HVDC Transmission System: DC Power Transmission Technology: Introduction, Comparison of AC and DC Transmission, Application. Analysis of HVDC Converters: Choice of converter configuration, Graetz circuit, Convertor bridge characteristics, Characteristics of a twelve pulse converters, Converter and HVDC system Control: Principles of DC Link control, Converter control characteristics, System control hierarchy Firing angle control, current and extinction angle control, Starting and stopping of DC link, Power Control.

Module IV: **(6 Hours)**

Smoothing Reactor and DC Line: Smoothing reactors, DC Line, transient over voltages in DC Line, Protection of DC line, DC breakers, Monopolar operation, Effects of proximity of AC and DC Transmission lines. Reactive Power Control: Reactive power requirements in steady state, Sources

of reactive power, Static var systems, Reactive power control during transients. Harmonics and Filters: Generation of Harmonics, Design of AC Filters, DC Filters, Carrier frequency and RI noise. Multiterminal DC systems: Potential applications of MTDC systems, Types of MTDC systems, control and protection of MTDC systems, Control and protection of MTDC Systems study of MTDC systems.

Course Name: High Voltage Engineering
Course Link: https://nptel.ac.in/courses/108/104/108104048/
Course Instructor: Prof. Ravindra Arora, IIT Kanpur

Books:

Course Name: High Voltage DC Transmission
Course Link: https://nptel.ac.in/courses/108/104/108104013/
Course Instructor: Dr. S.N. Singh, IIT Kanpur

[1] M. S. Naidu and V. Kamaraju, *High Voltage Engineering*, Tata McGraw Hill, 1995
[2] E.W. Kimbark, *Direct Current Transmission-vol.1*, Wiley Inter science, New York , 1971
[3] J. Kuffel and W. S. Zaengl, *High Voltage Engineering: Fundamentals*, Newnes, 2000
[4] J. Arrillaga, *HVDC Transmission*, IET, Peter Pereginver Ltd., London, U.K, 1998

Digital Learning Resources:

7^{th} Semester	**REC7D006**	**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.

7^{th} Semester	REL7D003	Smart Grid	L-T-P 3-0-0	3 Credits

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

Module-I: **(10 hours)**

Evolution of Electric Power Grid, introduction to smart Grid, Concept, definitions, architecture and functions of Smart Grid. Need of Smart Grid. Difference between conventional & smart grid. Opportunities & Challenges of Smart Grid, Introduction to Smart Meters, Real Time Pricing, Smart Appliances. Automatic Meter Reading (AMR). Outage Management System (OMS). Home & Building Automation, Substation Automation, Feeder Automation, Smart Sensors, Geographic Information System (GIS). Intelligent Electronic Devices (IED) & their application for Monitoring & Protection.

Module-II: **(10 hours)**

Phasor Measurement Units (PMU), Wide Area Measurement System (WAMS), Wide-Area based Protection and Control Micro-grid concepts, need and application, Issues of Interconnection. Protection & control systems for micro-grid. Storage systems including Battery, SMES, Pumped Hydro. Compressed Air Energy Storage.

Module-III: **(10 hours)**

7^{th} Semester	REL7D004	Flexible AC Transmission Systems	L-T-P 3-0-0	3 Credits

Variable speed wind generators, fuel-cells, micro-turbines. Integration of renewables and issues involved, Advantages and disadvantages of Distributed Generation. Power Quality & EMC in smart Grid. Power Quality issues of Grid connected Renewable Energy Sources. Power Quality Conditioners for micro-grid. Web based Power Quality monitoring, Power Quality Audit.

Books:

[1] Ali Keyhani, "Design of Smart power grid renewable energy systems", Wiley IEEE,2011
[2] Clark W. Gellings, "The Smart Grid: Enabling Energy Efficiency and Demand Response", CRCPress, 2009.
[3] Stuart Borlase, "Smart Grid: Infrastructure,Technology and solutions " CRC Press
[4] Janaka Ekanayake, Nick Jenkins, KithsiriLiyanage, Jianzhong Wu, Akihiko Yokoyama, "Smart Grid: Technology and Applications", Wiley.
[5] Andres Carvallo, John Cooper, "The Advanced Smart Grid: Edge Power Driving Sustainability: 1", Artech House Publishers July 2011
[6] Mladen Kezunovic, Mark G. Adamiak, Alexander P. Apostolov, Jeffrey George Gilbert "Substation Automation (Power Electronics and Power Systems)", Springer

Digital Learning Resources:

Course Name:	Introduction to Smart Grid
Course Link:	https://nptel.ac.in/courses/108/107/108107113/
Course Instructor:	Prof. N.P. Padhy and Prof. Premalata Jena, IIT Roorkee

Module-I: **(14 hours)**

FACTS concept and General System Considerations: Transmission Interconnections, Flowof Power in an AC System, what limits the Loading Capability, Power Flow and DynamicStability Considerations of a Transmission Interconnection, Relative Importance ofControllable Parameters, Basic Types of FACTS Controllers, Basic Description andDefinitions of FACTS Controllers.Static Shunt Compensation: Objectives of Shunt Compensation, Methods of ControllableVAR Generation, Static VAR Compensators, SVC and STATCOM

Module-II: **(14 hours)**

Static Series Compensators: Objective of Series Compensation (GCSC, TSSC, TCSC), VariableImpedance Type Series Compensators, Switching Converter Type Series Compensators(SSSC) Static Voltage and Phase Angle Regulators: Objectives of Voltage and Phase AngleRegulators, Approaches to Thyristor-Controlled Voltage and Phase Angle Regulators(TCVRs and TCPARs).

7^{th} Semester	REL7D005	Power Station Engineering	L-T-P 3-0-0	3 Credits

Module-III: **(8 hours)**

Combined Compensators: Introduction, Unified Power Flow Controller (UPFC), TheInterline Power Flow Controller (IPFC), Generalized and Multifunctional FACTSControllers.

Books:

[1] "Understanding FACTS: Concepts & Technology of Flexible AC Transmission Systems" By N.G.Hingorani & L.Gyugyi, IEEE Press, Standard Publishers Distributors, Delhi.
[2] Facts Controllers in Power Transmission & Distribution by K.R.Padiyar, New Age International
[3] Modelling & Simulation in Power Networks, Enrique Acha, Clandio Esquival & H.A.Perez,CA Camcho, John Wiley & Sons.

Digital Learning Resources:

Course Name: Facts Devices
Course Link: https://nptel.ac.in/courses/108/107/108107114/
Course Instructor: Prof. Avik Bhattacharya, IIT Roorkee

Module-I: **(10hours)**

Introduction to different sources of energy and general discussion on their application togeneration, Indian Energy Scenario. Prediction of Load: Connected Load, Maximum Load, Demand Factor, Average load, Load Factor, Load duration curves, Diversity Factor, Choice of Type of Generation, Capacity Factor, Reserve Factor, Plant Use Factor, Base Load, Intermediate Load and Peak Load Plants. Economics of power generation: Cost of Electrical Energy, Construction costs, Fixed cost, Costs for Energy, Depreciation of Plant, Fuel cost, Economic scheduling principle, Annual Operating Costs, Effect of Load Factor on cost per kWh, Tariff or Charge to Consumer.

Module-II: **(8 hours)**

Nuclear power station: Introduction to fission & fusion, Principle of Nuclear Energy, Reactor Construction, Controlled Chain Reaction, Brief study of various Types of Power Reactor, Operational Control of Reactors, Location and layout of nuclear power plant,Economics of Nuclear Power Station.

Module-III: **(10hours)**

7th Semester	RIT7D001	Internet of Things	L-T-P 3-0-0	3 Credits

Hydro Electric power station: Selection of site for hydro-electric power plant. Hydrology: Hydrological cycle, precipitation, run-off and its measurement, hydrograph,flow duration and mass curves, Estimation of amount stored by a dam across theriver,Storage and Pondage, Elementary idea about Earthen and Concrete Dam.Types of Turbines: Operational principle of Kaplan and Francis Turbine and Pelton wheel, Speed and PressureRegulation, Work done and Arrangement and location of Hydroelectric Station: Catchment area, Reservoir, Dam, Head Gate, Spillways, Pen stock, Surge Tanks, Scroll case, Draft tubes and Tail Race, Power House, Classification of Hydroelectric Power Plants.Governors, Plant auxiliaries.

Module-IV: **(10hours)**

Thermal power station: Selection of site for thermal power plantMain Parts and Working of a Steam Station:Overall Block Diagram indicating the air circuit, coal and ash circuit, water and steamcircuit, various types of steam turbines, ash and coal handling system, High Pressure andHigh-capacity water tube boilers, Economizer, Superheaters, De-Superheater, Re-heater,Air Pre-heater. Draft System: Natural, Induced Forced and Balance Draft, PA fan, FD fan, ID fan, Chimney. Condensers, Feed water heaters, Evaporators, Make-up water, bleeding of steam, coolingwater system. Electrostatic Precipitator: Basic working Principle and constructional details Governors, Plant auxiliaries.

Books:

[1] P. K. Nag, “Power Plant Engineering”, 3rd Edition, Tata McGraw Hill Publication.
[2] M. V. Deshpande, “Elements of Electrical Power Station Design”, PHI.
[3] Bernhardt G. A. Skrotzki, William A. Vopat, “Power Station Engineering and Economy”, 2nd Edition, Tata McGraw Hill Publication.
[4] Arora &Domkundwar, “A Course in Power Plant Engineering”, Dhanpat Rai and sons.
[5] R. K. Rajput, “A Text Book of Power Plant Engineering”, 3rd Edition, Laxmi Publishing

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-3

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 Arshdeep Bahga & Vijay audisetti, University Press.
2. The Internet of Things, by Michael Millen, Pearson

7^{th} Semester	REC5D006	Digital VLSI Design	L-T-P 3-0-0	3 Credits

MODULE-I **(08Hours)**

Introduction: Historical Perspective, VLSI Design Methodologies, VLSI Design Flow, Design Hierarchy, Concept of Regularity, Modularity and Locality, VLSI Design Styles, Computer-Aided Design Technology.

Fabrication of MOSFETs: Introduction, Fabrication Processes Flow – Basic Concepts, The CMOS n-Well Process, Layout Design Rules, Stick Diagrams, Full Customs Mask Layout Design.

MOS Transistor: The Metal Oxide Semiconductor (MOS) Structure, The MOS System under External Bias, Structure and Operation of MOS Transistor (MOSFET), MOSFET Current-Voltage Characteristics, MOSFET Scaling and Small-Geometry Effects, MOSFET Capacitance.

MODULE-II

MOS Inverters – Static Characteristics: Introduction, Resistive-Load Inverters, Inverters with n-Type MOSFET Load, CMOS Inverter.

MOS Inverters – Switching Characteristics and Interconnect Effects: Introduction, Delay-Time Definitions, Calculation of Delay-Times, Inverter Design with Delay Constraints, Estimation of Interconnect Parasitics, Calculation of Interconnect Delay, Switching Power Dissipation of CMOSInverters.

Combinational MOS Logic Circuits: Introduction, MOS Logic Circuits with Depletion NMOS Loads, CMOS Logic Circuits, Complex Logic Circuits, CMOS Transmission Gates (Pass Gates).

MODULE-III

Sequential MOS Logic Circuits: Introduction, Behaviour of Bistable Elements, SR Latch Circuits, Clocked Latch and Flip-Flop Circuits, CMOS D-Latch and Edge Triggered Flip Flop.

Dynamic Logic Circuits: Introduction, Basic Principles of Pass Transistor Circuits, Voltage Bootstrapping, Synchronous Dynamic Circuit Techniques, Dynamic CMOS Circuit Techniques, High Performance Dynamic CMOS Circuits.

MODULE-IV

Design for Testability: Introduction, Fault Types and Models, Ad Hoc Testable Design Techniques, Scan-Based Techniques, Built-In Self-Test (BIST) Techniques, Current Monitoring IDDQ Test.

MODULE-V

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

Books:

[1] *CMOS Digital Integrated Circuits: Analysis and Design*, Sung-Mo Kang and Yusuf Leblebici, Tata McGraw-Hill Publishing Company Limited, 3rdEdn, 2003.

[2] Principles of CMOS VLSI Design – a Systems Perspective, K. Eshraghian and N.H.E. Weste, Addison Wesley,2nd Edition, 1993.

[3] Digital Integrated Circuits– *A Design Perspective***,** Jan M. Rabaey,Anantha Chandrakasan, Borivoje Nikolic, PHI, 2nd Edn.

[4] Modern VLSI Design System – *on – Chip Design*, Wayne Wolf, PHI, 3rd Edn.

[5] VLSI Design, Debaprasad Das, Oxford University Press, New Delhi, 2010

[6] CMOS Logic Circuit Design, John P. Uyemura, Springer, 2001.

[7] Digital Integrated Circuit Design, Ken Martin, Oxford University Press, 2000.

[8] VLSI Design Technique forAnalog and Digital Circuits, R L Geiger, TMH.

Digital Learning Resources:

Course Name: VLSI Design
Course Link: https://nptel.ac.in/courses/117/101/117101058/

Course Instructor: Prof. A.N. Chandorkar, IIT Bombay

Course Name: Digital VLSI Testing
Course Link: https://nptel.ac.in/courses/117/105/117105137/
Course Instructor: Prof. S, Chattopadhyay, IIT Kharagpur

Course Name: VLSI Technology
Course Link: https://nptel.ac.in/courses/117/106/117106093/
Course Instructor: Dr. Nandita Dasgupta, IIT Madras

7^{th} 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

7^{th} 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] Ajit Parulekar 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

7^{th} 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	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	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	RIK7F001	Essence of Indian Knowledge Tradition - II	L-T-P 3-0-0	0 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**