Course Description

1st Semester

Title: Mathematics-I **Code: 18B11MA111**

L-T-P scheme: 3-1-0 **Credits: 4**

Prerequisite: Students should have basic knowledge of Algebra and calculus.

Objective: This course is aimed:

1. To introduce the calculus of functions of two variables and applicability of derivatives and integrals of vector functions to Analytical geometry and physical problems.
2. To make students aware of the basic mathematical concepts and methods which will help them in learning courses in engineering and Technology.

Learning Outcomes:

Course Outcome	Description
CO1	Understand the rank, eigen values, eigen vectors, diagonalization of matrix; compute inverse of matrix by Caley-Hamilton theorem.
CO2	Recognize consistent and inconsistent systems of linear equations by the row echelon form of the augmented matrix, and solve it by Gauss elimination method.
CO3	Interpret derivatives and integrals of multivariable functions geometrically and physically; implement multivariable calculus tools in engineering, science, optimization, and understand the architecture of surfaces in plane and space etc.
CO4	Know about piecewise continuous functions, Laplace transforms and its properties; use of Laplace transform and inverse transform for solving initial value problems.
CO5	Realize importance of line, surface and volume integrals, Gauss and Stokes theorems and apply the concepts of vector calculus in real life problems.
CO6	Formulate mathematical models in the form of ordinary differential equations and learn various techniques of getting solutions of linear differential equations of second order.

Course Contents:

Unit 1: Algebra of matrices, Determinants, Rank, Gauss elimination method, Eigen values and vectors. Quadratic forms.

Unit 2: Partial differentiation. Taylor's series. Maxima and minima. Jacobians**,** Double integrals,

Unit 3: Differential Equations with constants coefficients.

Unit 4: Gradient, divergence and curl. Line and surface integrals, Normal and tangent to a surface. Gauss and Stokes theorems, Equations to a line, plane, curve and surfaces.

Unit 5: Laplace transforms.

Methodology:

The course will be covered through lectures supported by tutorials. There shall be 3 Lectures per week where the teacher will explain the theory, give some examples supporting the theory and its applications. About 12 Tutorial Sheets covering whole of the syllabus shall be given. Difficulties and doubts shall be cleared in tutorials. Apart from the discussions on the topics covered in the lectures, assignments/ quizzes in the form of questions will also be given.

Evaluation Scheme:

Exams	**Marks**	**Coverage**
Test-1	15 Marks	Syllabus covered upto Test-1
Test-2	25 Marks	Syllabus covered upto Test-2
Test-3	35 Marks	Full Syllabus
Assignment	10 Marks	
Tutorials	5 Marks	
Quiz	5 Marks	
Attendance	5 Marks	
Total	**100 Marks**	

Learning Resources:

Tutorials, lecture slides and books on mathematics-1 will be available on the JUET server.

Text Books:

1. Erwin Kreyszig: Advanced Engineering Mathematics, Wiley Publishers.
2. Lipshuts, S., Lipsom M.: Linear Algebra, 3rd Ed, Schaum series 2001.
3. B. V. Raman: Higher Engineering Mathematics, McGraw-Hill Publishers.
4. R.K. Jain, S.R.K. Iyenger: Advanced Engineering Mathematics, Narosa Publishing House, New Delhi.
5. Thomas, G.B., Finney, R.L.: Calculus and Analytical Geometry, 9th Ed., Addison Wesley,1996.
6. Grewal, B.S.: Higher Engineering Mathematics, Khanna Publishers Delhi.

Title: Physics-I **Code: 18B11PH111**

L-T-P Scheme: 3-1-0 **Credits: 4**

Objective:
Broadly, the study of Physics improves one's ability to think logically about the problems of science and technology and obtain their solutions. The present course is aimed to offer a broad aspect of those areas of Physics which are specifically required as an essential background to all engineering students for their studies in higher semesters. The course intends to impart sufficient scientific understanding of different phenomena associated with Special relativity, Modern Physics, Statistical physics, atomic physics, and lasers.

Course Outcomes:

Course Outcome	Description
CO1	Describe the limitations of Newton's laws and explain when special relativity become evant, Learn to Apply the principles of Special Relativity to an extended range of problems s olving particle kinematics
CO2	Demonstrate the ability to explain the concepts related to the consequences of Special Relativity, the nature of space-time and related dynamic observables
CO3	Acquired a profound understanding of inadequacy of classical mechanics regarding phenomena related to microscopic level, become well versed with the experimental developments, historical account and importance of probabilistic interpretation
CO4	Understand the basic quantum mechanical ideas and relevant mathematical framework, approach the solution of one-dimensional time independent Schrodinger equation
CO5	Appreciate the importance of applying statistical ideas to explore thermodynamic variables, developed ability to identify and apply appropriate statistical method for describing the assembly of microscopic particles, comprehend basic properties and working of Laser systems

Course Contents:
Unit-I (Theory of Special Relativity): Frames of reference, Galilean transformation, Michelson Morley Experiment, Postulates of special theory of relativity, time dilation and length contraction, twin paradox, Lorentz transformations, addition of velocities, Relativistic Doppler effect, Mass variation with velocity, Mass-energy relation.

Unit-II (Introduction to Modern Physics):
Quantization of Radiation, Black body radiation, Rayleigh-Jeans law, Planck's law of radiation Wien's law, Stefan's law, Photoelectric effect Compton scattering, Atomic spectra, Bohr model of hydrogen atom, Frank hertz experiment, Matter waves, de Broglie hypothesis, Davisson Germer experiment

Unit III Quantum Mechanics
Wave packets, phase and group velocity, Heisenberg's uncertainty principle, Schrödinger wave equation and its applications to the free particle in a box, potential barrier and Harmonic oscillator

Unit-IV (Statistical Mechanics): Maxwell-Boltzmann, Bose-Einstein and Fermi-Dirac distributions and their applications.

Unit- V Laser Physics & Applications

Fundamental ideas of stimulated and spontaneous emission, Einstein's coefficients, Principle and working of laser, Different types of lasers (He-Ne Laser, Ruby Laser, Semiconductor Laser), Applications of Lasers

Text Books and References:

1. A. Beiser, Perspectives of Modern Physics, Tata McGraw Hill.
2. J R Taylor, C D Zafiratos, M A Dubson, Modern Physics for Scientist &
1. Engineers, Pearson Education.
2. K Krane, Modern Physics, Wiley India
3. J Bernstein, P M Fishbane, S. Gasiorowicz, Modern Physics, Pearson
4. Education.
5. B. B. Laud, Laser and Non-Linear Optics, New Age International (P) Ltd.
6. R. Resnick, Relativity, New Age.

Title: English **Code: 18B11HS111**

L-T-P scheme: 2-0-1 **Credit: 3**

Prerequisite: None

Objective:

1. To enable understanding of basics of communication in Business environment.
2. To provide insight into structural aspect of communication in business.
3. To impart knowledge about communication theory and develop skills in oral and non-verbal communication.
4. To improve skills as critical readers, thinkers, listener and writer.

Learning Outcomes:

Course Outcome	Description
CO1	Outline the basic concept of verbal/ nonverbal skills to understand the role of effective communication in personal & professional success.
CO2	Describe drawbacks in listening patterns and apply listening techniques for specific needs.
CO3	Develop the understanding to analyze, interpret and effectively summarize a variety of textual content
CO4	Discuss a given technical/non-technical topic in a group setting and arrive at generalizations/consensus.
CO5	Create effective presentations
CO6	Create professional and technical documents that are clear and adhering to all the necessary convention.

Course Content:

Unit-1: Concept and Nature of Communication: Definition of Communication, Process & Stages of Communication, Barriers to Communication, Channels of Communication.

Unit-2: Listening Skills: The listening process**,** Importance of listening, Purpose and types of listening**,** Hearing and listening, listening with a purpose, Barriers to listening.

Unit-3: Speaking/Oral Skills: Importance of acquiring oral skills, Visual aids, Body Language, Delivery, Pronunciation, Use of connectives Organization of matter: Metadiscourse features, Textual organization, 7 C'S of effective communication, improving vocabulary by learning Root words in English, some foreign words, Reading comprehension, Some important synonyms and antonyms, commonly confused words, Etiquettes & grooming.

Unit-4: Reading Skills: Skimming and Scanning, Intensive and extensive reading, SQ3R Technique

Unit-5: Writing Skills: Business letters, Memo, Circulars, Notices, Report writing, resume writing, Agenda & Minutes writing, Tips on clear writing Translation- Hindi to English, Translation -English to Hindi.

Unit-6: Introduction to Modern Communication Media: Technology based communication tools, Committee types, Advantages, Conferences, Audio-video conferencing, Barriers and overcoming negative impact.

Unit-7: Public Speaking and Interviewing Strategies: Speech Preparation, Theory of group discussion, Participation in Group discussion, Oral presentation, Power point presentation, Tips for successful job interview, Do's and don'ts while appearing for interview, Mock interview, Some interview questions, Telephonic interview tips, Resume writing

Evaluation Scheme:

Exams	Marks	Coverage
Test-1	15 Marks	Based on Unit-1 & Unit-2
Test-2	25 Marks	Based on Unit-3, & Unit-4 and around 30% from coverage of Test-1
Test-3	35 Marks	Based on Unit-5 to Unit-7 and around 30% from coverage of Test-2
Assignment	10 Marks	
Tutorials	5 Marks	
Quiz	5 Marks	
Attendance	5 Marks	
Total	**100 Marks**	

Teaching Methodology:

The course will be taught with the aid of lectures, handouts, case studies, Task-based language learning, and comprehensive language learning through language lab.

Learning Resources:
Lecture slides and e-books on ENGLISH (will be added from time to time): Digital copy will be available on the JUET server.

Text Book:
1. K.K. Sinha- Business Communication (Galgotia Publications)

Reference Books:

1. R.C. Bhatia- Business Communication (Ane Books Pvt. Ltd.)
2. P.D. Chaturvedi – Business Communication (Pearson Education, 1st Edition 2006).
3. Lesikar RV & Pettit Jr. JD – Basic Business Communication: Theory & Application (Tata Mc Graw Hill, 10thEdition)
4. Wren & Martin, High School English Grammar & Composition – S. Chand & Co. Delhi.
5. Raman Meenakshi & Sharma Sangeeta, Technical Communication-Principles & Practice –O.U.P. New Delhi. 2007.
6. Mitra Barum K., Effective Technical Communication – O.U.P. New Delhi. 2006.
7. Better Your English- a Workbook for 1st year Students- Macmillan India, New Delhi.
8. Raymond Murphy,' Essential English Grammar', Cambridge University Press.

Title: Software Development Fundamentals **Code: 18B11CI111**

L-T-P scheme: 3-1-0 **Credit: 4**

Prerequisite: There is no prerequisite in this course; however, students having any prior experience of programming are desirable.

Objective:

1. To provide exposure to problem-solving through programming.
2. To provide students with understanding of code organization and functional hierarchical decomposition with using complex data types.

Learning Outcomes:

Course Outcome	Description
CO1	Makes students gain a broad perspective about the uses of computers in engineering industry.
CO2	Develops basic understanding of computers, the concept of algorithm and algorithmic thinking.
CO3	Develops the ability to analyze a problem, develop an algorithm to solve it.
CO4	Develops the use of the C programming language to implement various algorithms, and develops the basic concepts and terminology of programming in general.
CO5	Introduces the more advanced features of the C language

Course Content:

Unit-1: Introduction to Programming: Basic computer organization, operating system, editor, compiler, interpreter, loader, linker, program development. Variable naming, basic function naming, indentation, usage and significance of comments for readability and program maintainability. Types of errors, debugging, tracing/stepwise execution of program, watching variables values in memory. Constants, Variables and data Types Character Set, C tokens, Keywords and Identifiers, Constants, Variables, Data types, Declaration of Variables, assigning values to variables, typedef, and defining symbolic constants. printf & scanf function.

Unit-2: Operators and Expression: Introduction, Arithmetic Operators, Relational Operators, Logical Operators, Assignment Operators, Increment and Decrement Operators, Conditional Operators, Special Operators, Evaluation of expressions, Precedence of arithmetic operators, Type conversions in expressions, Operator precedence and associativity.
Management Input and Output Operators: Introduction, reading a character, writing a character, formatted input, formatted output.

Unit-3: Decision Making B**ranching:** Introduction, Decision making with IF statement, the IF-ELSE statement, nesting of IF-ELSE statement, ELSE-IF ladder, SWITCH statement, ternary operator, and the GOTO statement.

Looping: Introduction, the WHILE statement, the DO statement, The FOR statement, Break and Continue.

Unit-4: Array: Introduction, One-dimensional arrays, Two-dimensional arrays, arrays, Concept of Multidimensional arrays.
Handling of Character strings: Introduction, Declaring and initializing string variables, reading string from terminal, writing string to screen, String, Operations: String Copy, String Compare, String Concatenation and String Length (using predefined functions & without using them), Table of strings.

Unit-5: User-Defined Functions (UDF): Introduction, need for user-defined functions, the form of C function, elements of UDF, return values and their types, Calling a function, category of functions, Nesting of functions, Recursion, Functions with arrays, The scope and Lifetime of variables in functions, multi file program.
Structures and Unions: Introduction, Structure definition, declaring and initializing Structure variables, accessing Structure members, Copying & Comparison of structures, Arrays of structures, Arrays within structures, Structures within Structures, Structures and functions, Unions.

Unit-6: Pointers: Introduction, understanding pointers, Accessing the address of variable, Declaring and initializing pointers, accessing a variable through its pointer, Pointer expressions, Pointer increments and scale factor, Pointers and arrays, Pointers & character strings, Pointers & Functions, Function returning multiple values, Pointers and structures.
File Management in C and CONSOLE I/O: Introduction, Defining files and its Operations, Error handling during I/O operations, Random access files, Command line arguments. Types of files, File vs. Console, File structure, File attributes, Standard i/o, Formatted i/o, Sample programs.

Teaching Methodology:

This course is introduced to help students understand the discipline of programming. The programming language used to teach this course is C. Starting from the basic computer architecture, the student will slowly be exposed to program designing and later to programming fundamentals. The entire course is broken down into six separate units, from fundamentals of programming to some complex programming structures like pointers. This theory course is well complemented by a laboratory course under the name Software Development Fundamentals Lab in the same semester that helps a student learn with hand-on experience.

Evaluation Scheme:

Exams	Marks	Coverage
Test-1	15 Marks	Based on Unit-1 & Unit-2
Test-2	25 Marks	Based on Unit-3 & Unit-4 and around 20-30% from coverage till Test-1
Test-3	35 Marks	Based on Unit-5 to Unit-6 and around 30% from coverage till Test-2
Assignment	10 Marks	
Tutorials	5 Marks	
Quiz	5 Marks	

Attendance	5 Marks	
Total	**100 Marks**	

Learning Resources:

Tutorials and lecture slides on Software Development Fundamentals (will be added from time to time): Digital copy will be available on the JUET server.

Text Book:

[1] Programming in ANSI C by E. Balguruswamy, Tata Mc-Graw Hill.
[2] Programming With C, Schaum Series.

Reference Books/Material:

[1] The 'C' programming language by Kernighan and Ritchie, Prentice Hall
[2] Computer Programming in 'C' by V. Rajaraman, Prentice Hall
[3] Programming and Problem Solving by M. Sprankle, Pearson Education
[4] How to solve it by Computer by R.G. Dromey, Pearson Education

Web References:

[1] http://www2.its.strath.ac.uk/courses/c/
Notes on C programming by University of Strathclyde Computer Centre. This tutorial was awarded the NetGuide Gold Award during the 1990s.
[2] http://www.princeton.edu/~achaney/tmve/wiki100k/docs/C_%28programming_language%29.html
This site contains notes on C programming from Princeton University, USA.
These are very useful for students who are learning C as their first programming Language.
[3] http://www.stat.cmu.edu/~hseltman/Computer.html
Online reference material on Computers and Programming from Carnegie Mellon University, Pittsburgh, USA
[4] http://projecteuler.net/
Collection of mathematical problems which make you use your programming skills

Title: Physics Lab-I **Code: 18B17PH171**

L-T-P scheme: 0-0-2 **Credit: 1**

Learning Outcomes

Course Outcome	Description
CO1	Demonstrate ability to collect experimental data and understanding the working procedures within the precautionary limits
CO2	Acquired the ability to analyze the experimental data and related errors in a reflective, iterative and responsive way
CO3	Developed understanding of the basic concepts related to Modern Physics, Basic Solid-State Physics and Optics
CO4	Acquired a first hand and independent experience of verifying Kirchhoff's circuit laws and related concepts e.g. resistivity, measurement of resistance
CO5	Appreciate the importance of the laboratory work culture and ethics that is intended to impart features like regularity, continuity of self-evaluation and honesty of reporting the data

List of Experiments

1. To study the variation of magnetic field along the axis of Helmholtz Galvanometer and to determine its reduction factor.
2. To determine the resistance per unit length of a Carey Foster's bridge and to obtain the specific resistance of a given wire.
3. To determine the wavelengths of spectral lines Red, Green and Violet of mercury using plane transmission grating.
4. To determine the specific rotation of cane sugar solution using Bi-quartz polarimeter.
5. To observe Newton's rings and to determine the wavelength of sodium light.
6. To study the CRO and function generator by producing the following waveforms.
   i. 10kHz, 8Vp-p(sine wave, square wave, triangular wave)
   ii. 4kHz, 6Vp-p(sine wave, square wave, triangular wave)
   iii. 10kHz, 8Vpeak(sine wave, square wave, triangular wave)
   iv. 4kHz, $6V_{peak}$(sine wave, square wave, triangular wave)
7. To verify the Kirchhoff's current law.
8. To verify the Kirchhoff's voltage law.

Title: Software Development Lab **Code: 18B17CI171**

L-T-P scheme: 0-0-4 **Credit: 2**

Prerequisite: Experience in programming is desirable.

Objective:

1. To provide exposure to problem-solving through programming.
2. To provide students with understanding of code organization and functional hierarchical decomposition with using complex data types.
3. To give the student hands-on experience with the concepts.

Learning Outcomes:

Course Outcome	Description
CO1	Makes students gain a broad perspective about the uses of computers in engineering industry.
CO2	Develops basic understanding of computers, the concept of algorithm and algorithmic thinking.
CO3	Develops the ability to analyze a problem, develop an algorithm to solve it.
CO4	Develops the use of the C programming language to implement various algorithms, and develops the basic concepts and terminology of programming in general.
CO5	Introduces the more advanced features of the C language

Course Content:

The following assignments will be carried out in synchronization with the theory classes.

Unit-1: Introduction to programming Environment (Linux commands, editing tools such as vi editor, sample program entry, compilation and execution). Development of programs using multiple arithmetic and logical operators. Programs for Roots of quadratic equation, conversion of units etc.

Unit-II: Programs using simple control statements such as if else, while, do while etc. Making a program for a calculator for example. Extracting the digits of an integer, reversing digits, finding sum of digits etc.

Unit-III: Programs using For loop, switch statement etc. For example, Finding average of numbers, printing multiplication tables etc. Checking for primes, generation of Armstrong numbers. Generation of the Fibonacci sequence, Finding the square root of a number, calculation of factorials, printing various patterns using for loop. The greatest common divisor of two integers, Raising a number to large power.

Unit-IV: Programs using Arrays: declaring and initializing arrays. Program to do simple operations with arrays. Strings – inputting and outputting strings. Using string functions such as strcat, strlen etc. Writing simple programs for strings without using string functions. Finding the

maximum number in a set, Array order reversal, Finding maximum number from an array of numbers Removal of duplicates from an ordered array,

Unit-V: Selection/ Bubble/ Insertion sort, create a linked list, traverse a linked list, insert a node and delete a node form the list. Recursion and related examples such as Tower of Hanoi, computing factorial etc. Practice sessions and sessions for missed labs

Units to Lab Mapping:

Unit	Labs
I	1, 2, 3
II	4, 5
III	6, 7, 8
IV	9, 10, 11
V	12, 13, 14

Teaching Methodology:

This course is introduced to help students understand the discipline of programming. The programming language used to teach this course is C. Starting from the programming environment setup, the student will slowly be exposed to program designing and later to programming fundamentals. The entire course is broken down into six separate units, from fundamentals of programming to some complex programming structures like pointers. This theory course is well complemented by a laboratory course under the name Software Development Fundamentals Lab in the same semester that helps a student learn with hand-on experience.

Evaluation Scheme:

Exams		**Marks**	**Coverage**
P-1		15 Marks	Based on Lab Exercises: 1-6
P-2		15 Marks	Based on Lab Exercises: 7-13
Day-to-Day Work	Viva	20 Marks	70 Marks
	Demonstration	20 Marks	
	Lab Record	15 Marks	
	Attendance & Discipline	15 Marks	
Total		**100 Marks**	

Learning Resources:

Study material of Software Development Fundamentals Lab (will be added time to time): Digital copy will be available on the JUET server.

Text Book:

1. Programming in ANSI C by E. Balguruswamy, Tata Mc-Graw Hill.
2. Programming With C, Schaum Series.

Reference Books/Material:

1. The 'C' programming language by Kernighan and Ritchie, Prentice Hall
2. Computer Programming in 'C' by V. Rajaraman, Prentice Hall
3. Programming and Problem Solving by M. Sprankle, Pearson Education
4. How to solve it by Computer by R.G. Dromey, Pearson Education

Web References:

1. http://www2.its.strath.ac.uk/courses/c/
   a. Notes on C programming by University of Strathclyde Computer Centre. This tutorial was awarded the NetGuide Gold Award during the 1990s.

2. http://www.princeton.edu/~achaney/tmve/wiki100k/docs/C_%28programming_language%29.html
   a. This site contains notes on C programming from Princeton University, USA. These are very useful for students who are learning C as their first programming Language.

3. http://www.stat.cmu.edu/~hseltman/Computer.html
   a. Online reference material on Computers and Programming from Carnegie Mellon University, Pittsburgh, USA

4. http://projecteuler.net/
   a. Collection of mathematical problems which make you use your programming skills

Title: Workshop **Code: 18B17ME171**

L-T-P scheme: 0-0-3 **Credit: 1.5**

Prerequisite: Students must have the knowledge of fundamental principles of Physic and Chemistry upto class 12^{th} which helps them to understand the various process of Workshop Lab.

Objective:

1. To demonstrate students, the basic manufacturing processes of Workshop lab: Carpentry, Fitting, Welding, Machining and Casting Processes.
2. To develop effective skills in students to identify the manufacturing process with its applications
3. To be able to perform basic manufacturing processes safely.

Learning Outcomes:

Course Outcome	Description
CO1	Identify the various processes of manufacturing.
CO2	Capable to explain the use of various holding, measuring, marking and cutting tools
CO3	Prepare a useful job by performing the various processes in proper sequence safely
CO4	Apply Bernoulli's theorem to analyze the liquid metal velocity in casting process.
CO5	Develop the skills to join two metallic specimen using welding process
CO6	Work as a team on a project

Course Content:

Carpentry Shop

1. To study about various tools/equipments used in carpentry shop
2. To make Cross lap /T joint as per given specification
3. To make Cross lap /T joint as per given specification

Foundry Shop

1. To study about various tools used in foundry shop.
2. To prepare a green sand mould with the help of a given pattern.
3. To perform permeability test on moulding sand

Machine Shop

1. To study various machine tools such as lathe, milling, shaper, drilling, grinding, EDM drill and cutting tools used by them.
2. To perform turning, step turning and taper turning operations on lathe machine
3. To perform threading operation on the lathe machine

Fitting Shop

1. To study about various tools used in fitting shop.
2. To make a fitting job as per given drawing.

Welding Shop

1. To study various types of welding processes available in the workshop such as Electric arc welding, TIG and MIG welding, gas welding and spot resistance welding,
2. To prepare welding joint by using Electric arc welding/gas welding
3. To prepare welding joint by using Spot Resistance welding

Teaching Methodology:

This Lab course has been introduced to help a student to learn with hand-on experience on machines. The entire course is broken down into fourteen experiments. Experiments are performed different shop wise by taking the proper safety precautions. Workshop lab includes five shops namely: Carpentry, Foundry, Machining, Fitting and Welding. Basic principles of manufacturing processes are applied to prepare a job. Students learn here how to handle the real world problems by using technical skills. The way of experimentation here realizes the students that they are now moving on an Engineering path. This Lab course will enable a student to learn with hand-on experience.

Evaluation Scheme:

<table>
<tr><th colspan="2">Exams</th><th>Marks</th><th>Coverage</th></tr>
<tr><td colspan="2">P-1</td><td>15 Marks</td><td>Based on Lab Experiments: 1-7</td></tr>
<tr><td colspan="2">P-2</td><td>15 Marks</td><td>Based on Lab Experiments: 8-14</td></tr>
<tr><td rowspan="4">Day-to-Day Work</td><td>Viva</td><td>20 Marks</td><td rowspan="4">70 Marks</td></tr>
<tr><td>Demonstration</td><td>20 Marks</td></tr>
<tr><td>Lab Record</td><td>15 Marks</td></tr>
<tr><td>Attendance & Discipline</td><td>15 Marks</td></tr>
<tr><td colspan="2">Total</td><td colspan="2">100 Marks</td></tr>
</table>

Learning Resources:

Laboratory Manual available in Lab. Study material of Workshop Lab (will be added time to time): Digital copy will be available on the JUET server.

Text Books:

[1] "Workshop Technology Volume- I & II", B.S. Raghuvanshi, Dhanpat Rai & Co.
[2] "Workshop Technology Volume-I & II", Khanna Publisher.

Reference Books:

[1] "Workshop Technology Vol.- 1, 2, 3 & 4", Butterworth-Heinemann.
[2] "Material Science & Engineering", W. D. Callister, John Wiley

Web References:

[1] https://nptel.ac.in/courses/112/107/112107219/
[2] https://nptel.ac.in/courses/112/107/112107144/

2nd Semester

Title: Discrete Mathematics **Code: 18B11MA211**

L-T-P scheme: 3-1-0 **Credits: 4**

Objectives:

The aim of the course is to cover the basic principles sets relations functions partially ordered set, lattice, Boolean algebra and its applications. The main objective of the course is to develop in student, an intuitive understanding of graphs by emphasizing on the real world problems.

Course Outcomes:

At the end of the course, the student is able to:

Course Outcome	Description
CO1	Employ De Moivre's theorem in a number of applications to solve numerical problems.
CO2	Appreciate the definition and basics of graphs along with types and their examples.
CO3	Visualize the applications of graph theory to network flows. Understand the notion of planarity and coloring of a graph. Relate the graph theory to the real-world problems.
CO4	Understand the definition of a tree and learn its applications to fundamental circuits.
CO5	Solve real-life problems using finite-state and Turing machines
CO6	Learn about partially ordered sets, lattices and their types, Boolean algebra and Boolean functions, logic gates, switching circuits and their applications.

Course Contents:

Unit 1: Basics of set theory, Mathematical induction. Relations, Equivalence relation, partial- ordered relation algorithms and functions.

Unit 2: Big O notation, Proposition, Basic logical operators, Propositional functions and Quantifiers.

Unit 3: Graphs and related definitions, Eulerian and Hamiltonian graphs, Graph colorings. Trees, Algebraic expressions and Polish notation, shortest path.

Unit 4: Algebraic Systems. Lattice and Boolean Algebra.

Unit 5: Language, Finite State Automata and Machines. Grammars.

Teaching Methodology:

The course will be covered through lectures supported by tutorials. Apart from the discussions on the topics covered in the lecture's assignments/ quizzes in the form of questions will also be given.

Evaluation scheme:

Exams	Marks	Coverage
Test-1	15 Marks	Based on Unit-1

Test-2	25 Marks	Based on Unit-2 & Unit-3 and around 30% from coverage of Test-1
Test-3	35 Marks	Based on Unit-4 to Unit-5 and around 30% from coverage of Test-2
Assignment	10 Marks	
Tutorials	5 Marks	
Quiz	5 Marks	
Attendance	5 Marks	
Total	**100 Marks**	

References:

1. B. A, Davey & H. A. Priestley (2002). "Introduction to Lattices and Order" (2nd edition) Cambridge University, Press.
2. Edgar, G. Goodaire & Michael M. Parmenter (2018). "Discrete Mathematics with Graph Theory" (3rd edition). Pearson Education.
3. Rudolf Lidl & Günter Pilz (1998). "Applied Abstract Algebra" (2nd edition).Springer.
4. Kenneth H. Rosen (2012). "Discrete Mathematics and its Applications: With Combinatorics and Graph Theory" (7th edition), McGraw-Hill.
5. C. L. Liu (1985). "Elements of Discrete Mathematics" (2nd edition). McGraw- Hill.

Title: Physics-II **Code: 18B11PH211**

L-T Scheme: 3-1-0 **Credits: 4**

Objective:

Broadly, the study of Physics improves one's ability to think logically about the problems of science and technology and obtain their solutions. The present course is aimed to offer a broad aspect of those areas of Physics which are specifically required as an essential background to all engineering students for their studies in higher semesters. At the end of the course, the students will have sufficient scientific understanding of basic vector calculus, electrostatics, magnetostatics, electromagnetic fields and waves, basic understanding of physics of semiconducting materials

Course Outcomes:

Course Outcome	Description
CO1	Learn to apply the basic concepts of vector calculus and understanding of various Coordinate systems and related properties, demonstrate basic understanding of formulation and conduction of electric field produced by static charge distributions
CO2	Evaluate the electrostatic field due to symmetric charge distributions, Understand the utility of formulation of electric potential and solve related problems using special techniques and boundary conditions
CO3	Acquired understanding of electrostatic fields inside matter, Explain the magnetic field due to moving charge distribution, evaluate the magnetic field due to current distribution in space,
CO4	appreciate the importance of Maxwell's equations and understand the electromagnetic wave propagation in free space Categorization of materials on the basis of band structure
CO5	Developed understanding of quantum mechanical origin of band formation in solids, describing the energy state of electrons in crystalline materials, comprehend basic carrier properties

Course Content:

Unit I (Electrostatics)

Review of vector calculus, Cartesian, spherical polar and cylindrical co-ordinate systems, concept of gradient, divergence and curl, Coulomb's law, Gauss law and its applications, Boundary condition on electrostatic field, electric potential, Laplace equation, Poisson equation and related boundary value problems, capacitance, electrostatic fields in matter. [**10**]

Unit II (Magnetostatics)

Lorentz force, cyclotron formula, line, surface and volume currents, , Biot-Savart law and its applications, Ampere's law and its applications, equation of continuity, Faraday's law of electromagnetic induction, boundary conditions on magnetic field, Magnetic field in matter [**08]**

Unit III (Electromagnetic field)

Maxwell's equations in free space and matter, Maxwell correction to Ampere's law, Electromagnetic waves in free space and matter, Transverse nature of em waves and Polarization, Propagation of electromagnetic field in free space and Poynting vector, Poynting theorem , Normal incidence of em waves [**10]**

Unit IV (Elements of Solid State Physics)

Basic ideas of bonding in solids, Crystal structure, X-ray diffraction, Band theory of solids, Distinction between metals, semiconductors and insulators **[04]**

Unit V (Physics of Semiconductors)

Band theory of solids, Kronig Penney model, effective mass, Direct and indirect bandgap semiconductors, optical and thermal properties, Fermi-Dirac Distribution in semi-conductors, Equilibrium carrier concentrations in intrinsic and extrinsic semiconductors, Fermi energy variation with temperature and impurity concentration, Hall Effect in semiconductors, P-N junction characteristics **[10]**

Text/ Reference Books:

1. D.J. Griffiths, *Introduction to electrodynamics*, Prentice Hall of India Ltd.
2. B.G. Streetman, S. Banerjee, Solid State Electronic Devices
3. Semiconductor Physics and Devices, Donald A. Neamen
4. Boylstad and Nashelsky, *Electronic Devices and Circuits*, PHI, 6e, 2001.
5. J. Reitz, F. Milford and R. Christy, *Foundation of Electromagnetic Theory*, Narosa Publishing.
6. J. Millman and C.C. Halkias, Electronic Devices and Circuits, Millman, McGra-Hill

Title: Electrical Science **Code: 18B11EC211**

L-T-P Scheme: 3-1-0 **Credit: 4**

Prerequisite: Students must have studied the core concepts of "*Physics-1*".

Course Objectives:

1. This course is designed for developing the understanding about basics of electrical and electronics concepts.
2. In this course students will have an enough idea about the working of systems and enable them to analyze a circuit.

Learning Outcomes:

1. The students shall acquire the generic skills to study & analyze the electrical and electronic systems.
2. This course will enable them to think and design various applications of the electrical and electronics at basic level.

The student will be able to:

Course Outcome	Description
CO1	Understand the basic electrical and electronics component and their importance determine the current, voltage and power.
CO2	Apply networks laws and theorems to solve electric circuits and may understand circuit reduction techniques with their advantages.
CO3	Understand charging discharging Steady state and transient
CO4	Demonstrate the use of semiconductor diodes in various applications.
CO5	Discuss and explain the working of transistors Amplifiers, their configurations and applications.
CO6	Analysis concept and two port networks simplification technique.

Course Content:

Unit I: Basic Electrical Circuit: Electromotive Force (EMF), Terminal Voltage; Resistance (*R*), Inductance (*L*) and Capacitance (*C*) from (i) Circuit, (ii) Energy, and (iii) Geometrical Points of View; Voltage Divider, Current Divider; Star-Delta Transformation; Voltage Source and Current Source, Source Transformation, Combination of Sources; Controlled (Dependent) Sources.

Unit 2: Methods of Analysis: Kichhoff's Circuit Laws; Loop-Current Analysis, Mesh Analysis; Node-Voltage Analysis; Choices of Method of Analysis.

Unit 3: Network Theorems (DC Circuits): Superposition Theorem; Thevenin's Theorem; Norton's Theorem; Maximum Power Transfer Theorem.

Unit 4: DC Transients: Simple *RL* Circuit, Time Constant, Decay and Growth of Current; Simple *RC* Circuit, Discharging of a Capacitor, Charging of a Capacitor.

Unit 5: Two-Port Networks: Impedance, Admittance, Hybrid, Transmission Parameters; Equivalent Networks.

Unit 6: Diodes and its Applications: Unidirectional property, *PN*-junction with no bias, with forward bias and with reverse bias, *V-I* characteristics, Comparison of Si and Ge diodes, Temperature effects, Diode resistance (static and dynamic), Diode equation, Ideal diode, Circuit model of a diode. Half-wave and full-wave (centre tap and bridge) rectifiers, PIV rating of diode, Performance of half-wave and full-wave rectifiers, Shunt capacitor filter. Clippers: Series and Parallel, Limiters, Clampers. Zener diode, Analysis of Zener voltage regulator. LED, varactor diode.

Unit 7: Transistor: BJT Structure, Working of a transistor, Transistor current equation, Collector reverse saturation current, DC alpha of a transistor. The three configurations, CB and CE input and output characteristics.

Teaching Methodology:
Lectures would be interactive and it would cover the core concepts that are explained in the text and reference materials with adequate examples.

Evaluation Scheme:

Exams	Marks	Coverage
Test-1	15	Based on Unit-1 & Unit-2
Test-2	25	Based on Unit-3, Unit-4 & Unit-5 and around 30% from coverage of Test-1
Test-3	35	Based on Unit-6 to Unit-7 and around 30% from coverage of Test-2
Assignment	10	Based on Unit-1, Unit-2 & Unit-3
Tutorials	5	Based on Unit-4 & Unit-5
Quiz	5	Based on Unit-6 & Unit-7
Attendance	5	Based on attendance in the theory classes
Total	**100**	

Learning Resources:

Tutorials sheets, lecture slides and handwritten notes on Electrical circuit, Electrical Science and Basic Electronics (will be added from time to time): Digital copy will be available on the JUET server.

Text-Books:

1. D.C. Kulshreshtha, "Basic Electrical Engineering", McGraw Hill Education, 2009.
2. W.H. Hayt, J. E. Kemerlay & S.M. Durbin, "Engineering Circuit Analysis (Sixth Edition)", McGraw Hill, 2006.

3. R.C. Dorf & J.A. Svoboda, “Introduction to Electric Circuits”, John Wiley, 2004.
4. D.S. Chauhan & D.C. Kulshreshtha, ‘Electronics Engineering’, New Age, 2e, 2009.
5. D.C. Kulshreshtha, ‘Electronic Devices and Circuits’, New Age, 2e, 2006.

References:

1. Van Valkenburg, “Network Analysis”, Prentice-Hall India Ltd., 2001.
2. Abhijit Chakrabarti, Sudipta Nath, Chandan Kumar Chanda, “Basic Electrical Engineering”, Tata McGraw Hill Publishing Co, 2008.
3. Vincent Del Toro, “Principles of Electrical Engineering”, Prentice Hall of India.
4. Kumar and Jain, ‘Electronic Devices and Circuits’, PHI, 2007.
5. Boylstad and Nashelsky, ‘Electronic Devices and Circuits’, PHI, 6e, 2001.

Web References:

1. https://www.electrical4u.com/electrical-engineering-objective-questions-mcq/
2. https://www.pdfdrive.com/basic-electric-circuit-analysis-books.html
3. https://lecturenotes.in/subject/842

Journals References:

1. Circuits, Systems, and Signal Processing (CSSP), Springer
2. Journal of Electrical & Electronic Systems
3. International Journal of Circuit Theory and Applications, Wiley

Title: Object Oriented Programming **Code: 18B11CI211**

L-T-P Scheme: 3-1-0 **Credit: 4**

Prerequisites:
Students must have already registered for the course, "Software Development Fundamentals"

Objectives:
To strengthen their problem solving ability by applying the characteristics of an object-oriented approach and to introduce object oriented concepts in C++.

Learning Outcomes

Course Outcome	Description
CO1	List various principles of Object-Oriented Programming (OOP).
CO2	Describe the real world problems using object-oriented programming concepts.
CO3	Develop the programs using the fundamental concepts of OOP.
CO4	Identify and use various techniques used in OOP.
CO5	Apply techniques used in OOP to solve the software design problems on a given software project.
CO6	Demonstrate the learning on the course to solve the real-life programming problems.

Course Content

Unit-1: Review of Structured programming in C, Structured versus Object-Oriented Programming, Principles of Object-Oriented Programming, Beginning with C++, Control Structures, Functions in C++, Reference Variables, Default Parameters, Function Overloading, Inline Function, Const Variables.

Unit-2: Classes, Member Functions, Objects, Static Data Members, Static Member Functions, Friend Functions, Pointer to Members, Local classes, Constructors and Destructors of objects in C++,

Unit-3: Operator overloading and Type Conversions, Inheritance and its form, Multiple Inheritance in C++, Function Overriding, Virtual Inheritance, Virtual Base Class .

Unit-4: Pointers, Early binding, late binding, Type of polymorphism, Virtual Functions, Abstract Class, Virtual Destructor

Unit-5: Managing Console I/O Operations, File handling and Exception handling.

Unit-6: Templates, Function templates, Class templates, introduction to Standard Template Library (STL), Sequence, Containers, Iterators

Teaching Methodology

The course will use the mixed technique of interactive lectures, tutorials, guided case studies, literature survey, regular assignments and project work. Teaching in this course is designed to engage the students in active and experiential learning by taking a problem solving and design-oriented approach with special emphasis on real world applications. In the lectures the

fundamental theoretical concepts will be introduced and demonstrated through examples and case studies. Discussion in lecture will be done using design problems which will be implemented in laboratory individually in C++.

Evaluation Scheme

Evaluations	**Marks**	**Remarks**
T1	15 Marks (1 Hour)	
T2	25 Marks (1.5 Hours)	
T3	35 Marks(2 Hours)	
Assignments	10 Marks	2 or 3 Assignments to given
Quiz	5 Marks	2 or 3 quizzes
Tutorials	5 Marks	
Attendance	5 Marks	
Total	**100 Marks**	

Text books

1. Robert Lafore, Object oriented programming in C++, Waite Group.
2. E Balagurusamy, "Object-Oriented Programming with C++"

References

1. Deitel and Deitel,"C++ How to program", - Pearson Education.
2. Stroustrap B., the C++ Programming Language, Addison Wesley.
3. Lippman F. B., C++ Primer, Addison Wesley.
4. Prata S., C++ Primer Plus, Waite Group.
5. Parimala N., Object Orientation through C++, Macmillan India Ltd. 1999.
6. Pohl I., Object oriented Programming Using C++, Addison Wesley.
7. Grady Booch, James Rambaugh, Ivar Jacobson,"Unified Modelling Language user's guide" , Addison Wesley Limited

Title: Physics Lab-II **Code: 18B17PH271**

L-T-P Scheme: 0-0-2 **Credit: 1**

Learning Outcomes

Course Outcome	Description
CO1	Demonstrate ability to collect experimental data and understanding the working procedures within the precautionary limits
CO2	Acquired the ability to analyze the experimental data and related errors in a reflective, iterative and responsive way
CO3	Developed understanding of the basic concepts related to Modern Physics, Basic Solid State Physics, Optics,
CO4	Acquired a first hand and independent experience of verifying the working principle of solar cell
CO5	Appreciate the importance of the laboratory work culture and ethics that is intended to impart features like regularity, continuity of self-evaluation and honesty of reporting the data

Experiments List

1. To determine the magnetic susceptibility of a paramagnetic, $FeCl_3$ solution by Quinck's tube method.
2. To determine dispersive power of a prism using spectrometer.
3. To study the magnetostriction in metallic rod using Michelson-Interferometer.
4. To determine the Planck's constant using Photo electric effect.
5. To study the Hall effect in P type semi conductor and to determine
   (i) Hall voltage and Hall coefficient
   (ii) Number of charge carriers per unit volume
   (iii) Hall angle and mobility
6. To study the variation of resistivity of a semiconductor with temperature and to determine the band gap using Four-Probe method.
7. To study the presence of discrete energy levels in an atom by Franck Hertz experiment.
8. Using solar cell Trainer (a) study voltage and current of a solar cell (b) Voltage and current in series and parallel combinations (c) Draw power curve to find maximum power point (MPP) and to obtain efficiency of a solar cell

Title: Electrical Science Lab **Code: 18B17EC271**

L-T-P Scheme: 0-0-2 **Credit: 1**

Prerequisite: Student must have already registered for the course, "*Physics Lab-I*"

Objective:

1. The main aim of the lab is to familiarize with different types of electrical and electronic circuits
2. Identify their applications to the different electrical and electronic systems.

Learning Outcomes:

1. Completion of lab students will be able to understand the different techniques to simplify circuit
2. Two port networks and basic principles of different electronic devices and their characteristics.

Course Outcome	Description
CO1	Simplify complex network using Thevenin theorem and verify it. State Superposition Theorem and verify. Perform and verify Maximum Power Transfer Theorem.
CO2	To determine the Z parameters of the given two port network. Calculate the Y parameters for the given two port network.
CO3	V-I characteristic of p-n junction diode
CO4	Design Clipper and Clamper Circuit.
CO5	Rectifier circuits
CO6	Transistor and their v-I characteristics

Course Content:

1. Simplify complex network using Thevenin theorem and verify it.
2. State Superposition Theorem and verify.
3. Perform and verify Maximum Power Transfer Theorem.
4. To determine the Z parameters of the given two port network.
5. Calculate the Y parameters for the given two port network.
6. Perform Clipper Circuit.
7. Design Clamper Circuit.
8. Half wave rectifier with and without filter circuit.
9. Full wave rectifier with and without filter circuit.
10. Transistor as an Amplifier.
11. Common Emitter *v-i* characteristic of n-p-n transistor.
12. Common base *v-i* characteristic of n-p-n transistor.

Teaching Methodology:
In each experiment the practical is designed and analyzed on bread board with the help of physical devices by each student and further checked and validated by faculty and lab staff.

Evaluation Scheme:

Exams	**Marks**		**Coverage**
P-1	15 Marks		Based on Lab Exercises: 1-6
P-2	15 Marks		Based on Lab Exercises: 6-12
Day-to-Day Work	Viva	20 Marks	70 Marks
	Demonstration	20 Marks	
	Lab Record	15 Marks	
	Attendance & Discipline	15 Marks	
Total		**100 Marks**	

Learning Resources:

Tutorials sheets, lecture slides and handwritten notes on Electrical circuit, Electrical Science and Basic Electronics (will be added from time to time): Digital copy will be available on the JUET server.

Text-Books:

1. D.C. Kulshreshtha, "Basic Electrical Engineering", McGraw Hill Education, 2009.
2. W.H. Hayt, J. E. Kemerlay & S.M. Durbin, "Engineering Circuit Analysis (Sixth Edition)", McGraw Hill, 2006.
3. R.C. Dorf & J.A. Svoboda, "Introduction to Electric Circuits", John Wiley, 2004.
4. D.S. Chauhan & D.C. Kulshreshtha, 'Electronics Engineering', New Age, 2e, 2009.
5. D.C. Kulshreshtha, 'Electronic Devices and Circuits', New Age, 2e, 2006.

References:

1. Van Valkenburg, "Network Analysis", Prentice-Hall India Ltd., 2001.
2. Abhijit Chakrabarti, SudiptaNath, Chandan Kumar Chanda, "Basic Electrical Engineering", Tata McGraw Hill Publishing Co, 2008.
3. Vincent Del Toro, "Principles of Electrical Engineering", Prentice Hall of India.
4. Kumar and Jain, 'Electronic Devices and Circuits', PHI, 2007.
5. Boylstad and Nashelsky, 'Electronic Devices and Circuits', PHI, 6e, 2001.

Web References:
1. https://www.electrical4u.com/electrical-engineering-objective-questions-mcq/
2. https://www.pdfdrive.com/basic-electric-circuit-analysis-books.html
3. https://lecturenotes.in/subject/842

Journals References:
1. Circuits, Systems, and Signal Processing (CSSP), Springer
2. Journal of Electrical & Electronic Systems
3. International Journal of Circuit Theory and Applications, Wiley

Title: Object Oriented Programming Lab **Code: 18B17CI271**

L-T-P Scheme: 0-0-2 **Credit: 1**

Pre-requisites

Students must have already registered for the course, "Software Development Fundamentals Lab".

Objectives

To strengthen their problem-solving ability by applying the characteristics of an object- oriented approach and to introduce object oriented concepts in C++.

Learning Outcomes

CO1	Define basic concepts of Object-Oriented Programming (OOP).
CO2	Illustrate the key features available in OOP using C++.
CO3	Apply the concepts of OOP to solve different common problems.
CO4	Utilize the knowledge of OOP in solving programming problems.
CO5	Analyze the various concepts of OOP for their suitability on a given problem.
CO6	Design the systems, from concept to executable artefact, using object oriented techniques.

Course Content

Unit-1: Structured versus Object-Oriented Programming, Principles of Object-Oriented Programming, Beginning with C++, Control Structures, Functions in C++, Reference Variables, Default Parameters, Function Overloading, Inline Function, Const Variables.

Unit-2: Classes, Member Functions, Objects, Static Data Members, Static Member Functions, Friend Functions, Pointer to Members, Local classes, Constructors and Destructors of objects in C++,

Unit-3: Operator overloading and Type Conversions, Inheritance and its form, Multiple Inheritance in C++, Function Overriding, Virtual Inheritance, Virtual Base Class .

Unit-4: Pointers, Early binding, late binding, Type of polymorphism, Virtual Functions, Abstract Class, Virtual Destructor

Unit-5: Managing Console I/O Operations, File handling and Exception handling.

Unit-6: Templates, Function templates, Class templates, introduction to Standard Template Library (STL), Sequence, Containers, Iterators

Laboratory work and project

The students shall be given regular lab assignments, which will allow them to practically apply the concepts studied in the lecture Session. The lab assignments will be designed with focus on applying the concepts learnt in object-oriented programming, Data structures in an integrated manner.

Evaluation Scheme

Evaluations		**Marks**	**Remarks**
P-1		15 Marks	
P-2		15 Marks	
Continuous Evaluations	Viva	20 Marks	
	Demonstration	20 Marks	
	Lab Record	15 Marks	
	Discipline and Punctuality and Attendance	15 Marks	
Total		**100 Marks**	

Text book

1. Robert Lafore, Object oriented programming in C++, Waite Group
2. E Balagurusamy, "Object-Oriented Programming with C++"

References

1. Stroustrap B., the C++ Programming Language, Addison Wesley.
2. Lippman F. B., C++ Primer, Addison Wesley.
3. Prata S., C++ Primer Plus, Waite Group.
4. Parimala N., Object Orientation through C++, Macmillan India Ltd. 1999.
5. Pohl I., Object oriented Programming Using C++, Addison Wesley.
6. Grady Booch, James Rambaugh, Ivar Jacobson,"Unified Modelling Language user's guide" , Addison Wesley Limited

Title: Engineering Drawing & Design Lab **Code: 18B17ME272**

L-T-P scheme: 0-0-3 **Credits: 1.5**

Objective:

1. Enables students to learn the concepts of graphic communication, their role in sanitary construction.
2. Make familiar with different drawing equipment, technical standards and procedures for construction of geometric figures.
3. Equipped with the skill that enables them to convert pictorial to orthogonal representations.

Learning Outcomes:

Course Outcome	Description
CO1	Outline the objectives of scale and develop the imagination and mental visualization capabilities for correlating the geometrical details of objects.
CO2	To develop the constructional ability for a different curve.
CO3	To Describe BIS rules for orthogonal projection and understand the fundamental concept of orthogonal projection for point, line, plane and solids.
CO4	Understand and apply orthogonal projection for solids, section and intersection of solid objects/structures
CO5	To apply the skill of development of surfaces of three dimensional objects for evaluation of black size of the components.
CO6	Demonstrate computer aided drafting tools and techniques using CAD software's

Course Content:

Unit-1: Study and construction of lines, lettering, dimensioning, plane scales, diagonal scales, construction of different methods used for the construction of conic curves.

Unit-2: Study and construction of geometrical construction, cycloidal curves, involutes and helix etc.

Unit-3: Orthogonal projection of point in all possible positions, Study and construction of projection of line and its applications (inclined to both planes), and projection of planes (inclined to both planes).

Unit-4: Study and construction of projection of solids (right circular cone, prism, pyramid and cylinders), and true shape of sections,

Unit-5: Study and construction of oblique projection and development of surface, isometric view using orthogonal projection on isometric scales.

Unit-6: Introduction to basic and editing command of CAD software, 2-D drafting, surface modeling, and 3-D geometrical model.

Teaching Methodology:

This course is introduced to build the imagination and established the correlation between the real object and engineering drawing and CAD developed by the design engineers and the requirement of the production engineers of the different units.

Evaluation Scheme:

Exams		**Marks**	**Coverage**
P-1		15 Marks	Based on Lab Exercises: 1-7
P-2		15 Marks	Based on Lab Exercises: 8-14
Day-to-Day Work	Viva	20 Marks	70 Marks
	Demonstration	20 Marks	
	Lab Record	15 Marks	
	Attendance & Discipline	15 Marks	
Total		**100 Marks**	

Learning Resources:
The study material of engineering drawing & design lab (will be added time to time): Digital copy will be available on the JUET server.

Text Book:
1. Bhatt, N.D., Engineering Drawing,

Reference Books:
1. Gill, PS, A Text Book of Engineering Drawing (Geometrical Drawing)
2. Dhananjay A J, Engineering Drawing with an introduction to Auto CAD, Mc Graw Hill

3rd Semester:

Title: Techniques for Decision Making **Code**: **18B11HS312**

L-T-P scheme: 2-1-0 **Credit: 3**

Prerequisite: None

Objectives:

1. To use basic techniques of inferential data analysis, quality control, and regression modeling;
2. To analyze a set of data, to reach a conclusion based on these analyses, and to make and defend a recommended course of action;
3. To be well-equipped to take courses in Marketing, Investments, Accounting, Finance, and Operations Management that require proficiency in statistical methods.

Learning Outcomes:

Course Outcome	Description
CO1	Outline various concepts of techniques for decision making with respect to the needs of modern business management.
CO2	Describe the real world problems using basic techniques of descriptive and inferential data analysis and business forecasting.
CO3	Identify and use various index numbers used in business decision making.
CO4	Apply decision making techniques to reach a conclusion based on the data analysis, and to make and defend a recommended course of action.
CO5	Deployment and proficiency in statistical methods.
CO6	Develop the understanding to analyze a set of data using correlation analysis and regression analysis.

Course Content:

Unit-1: Collection of data and Presentation of data: Classification of data, Secondary data, Primary data, designing of questionnaire, Unstructured and structured questionnaire, Tabulation of data, Charting of data.

Unit-2: Business Forecasting: Introduction, steps in forecasting, good forecasting, Time series forecasting, secular trend, seasonal variations, cyclical variations.

Unit-3: Index numbers: Uses, classification, problems, Methods of constructing index numbers, unweighted index numbers, Consumer Price index numbers.

Unit-4: Statistical Decision making : Decision making under certainity, Risk , uncertainty and conflict, Zero sum game, Prisoner's dilemma , Payoff Table, Maximin and minimax strategy.

Unit-5: Correlation Analysis and Regression analysis: Significance of the study of correlation, Correlation and causation, Karl Pearson's coefficient of correlation, Rank correlation, Method of least squares, Difference between correlation and regression, Regression lines and regression equation, Regression equation of Y on X and regression equation of X on Y.

Teaching Methodology:

The course "Techniques for Decision Making" is introduced to explain the basic concepts in statistics that have wide applicability in business decision making. As such, the focus will be more practical than theoretical. Because statistical analysis informs the judgment of the ultimate decision-maker—rather than replaces it—we will cover some key conceptual underpinnings of statistical analysis to insure that the students understand its proper usage. Statistics is about improved decision-making, which can be achieved through a thorough understanding of the data. We want to leave our pre-conceived notions at the door, and let the data tell us what is going on in a situation. The analytical techniques should provide valuable information to decision-makers. As such, it plays an important role in management decision processes. The course will be taught with the aid of lectures, tutorials, handouts, case studies, and problem-based learning.

Evaluation Scheme:

Exams	**Marks**	**Coverage**
Test-1	15 Marks	Based on Unit-1 & Unit-2
Test-2	25 Marks	Based on Unit-3 & Unit-4 and around 30% from coverage of Test-1
Test-3	35 Marks	Based on Unit-5 and around 30% from coverage of Test-2
Assignment	10 Marks	
Tutorials	5 Marks	
Quiz	5 Marks	
Attendance	5 Marks	
Total	**100 Marks**	

Learning Resources:

Lectures, tutorials and e-books on Techniques for Decision Making (will be added from time to time): Digital copy will be available on the JUET server.

Text Book:

1. "Business Statistics"; S.P. Gupta & M.P. Gupta, S. Chand Publishing, New Delhi, 2013.

Reference Books/Material:

1. "Statistics for Business & Economics"; Anderson, Thomson Learning, Bombay.
2. "Quantitative Methods in Business"; Anderson, Thomson Learning, Bombay.
3. "Business Statistics"; R.S. Bhardwaj, Excel Books.
4. "Statistics for Management"; Levin & Rubin, Prentice Hall of India, New Delhi.
5. "Two Person Game Theory"; A. Rapport & Anne Arbric, The University of Michigan Press, 1966.

Title: Probability and Random Processes **Code: 18B11MA511**

L-T-P scheme: 3-1-0 **Credit: 4**

Prerequisite: Students must have already studied course, "Mathematics-I" and should have the Knowledge of Differential & Integral Calculus.

Objective:

Objective of this course is to provide a foundation in the theory and applications of probability and stochastic processes and an understanding of the mathematical techniques relating to random processes in the areas of signal processing, detection, estimation, and communication. Topics include the axioms of probability, random variables, and distribution functions; functions and sequences of random variables; stochastic processes; and representations of random processes.

Learning Outcomes:

Course Outcome	Description
CO1	Construct sample spaces of random experiments; identify and specify events, and perform set operations on events; compute probabilities by counting; evaluate conditional probability, and apply Bayes' theorem to simple situations.
CO2	Express random variables by using CDFs, PMFs; calculate moments related to random variables; understand the concept of inequalities and probabilistic limits. Understand the axiomatic approach of probability theory and intrinsic need of (functions of) random variables for the analysis of random phenomena.
CO3	Compute probability distributions and correlation measures of bivariate random variables; obtain marginal and conditional distributions of random variables; find probabilities for outcomes of various events related to an uncertain phenomenon using appropriate probability distributions as models.
CO4	Conduct hypotheses tests concerning population parameters based on sample data; perform and interpret chi-square test of goodness-of-fit and test of independence; find the equation of regression line and second degree curve, and to predict the value of one variable based on the value of the other variable.
CO5	Identify and classify random processes and determine covariance and spectral density of stationary and ergodic random processes; demonstrate specific applications to Gaussian process.
CO6	Students are able to provide the theories associated with the random variable and random process. The course particularly provides the student with an ability to apply to real-world problems in the communication and physical systems.

Course Contents:

Unit-1: Random experiments, sample space and events. Three basic approaches to probability, conditional probability, total probability theorem, Bayes' theorem of Probability of causes, Bayes' theorem of future events, total independence, mutual independence and pair wise independence.

Unit-2: One dimensional random variables(discrete and continuous) and their distributions, bivariate distributions, joint, marginal and conditional distributions, characteristic function.

Unit-3: Covariance and correlation of random variables. Some special probability distributions: Binomial, Poisson, probability distributions. Negative Binomial,Geometric and Normal probability distributions. Fitting of probability distributions.

Unit-4: Concept of reliability: Reliability function, Hazard rate function, Mean time to failure, cumulative and average failure rate, Conditional reliability and failure rates, residual MTTF, some special failure rate distributions- exponential distribution and the Weibull distribution, reliability of systems- series configuration and some deductions, parallel- series configuration, series -parallel configuration.

Unit-5: Introduction and description of random processes, average values of random processes, stationary processes and computation of their averages, autocorrelation function and its properties, Cross correlation and its properties. Power spectral density function and its properties. Ergodicity of a random process, Poisson processes.

Teaching Methodology:

The course will be covered through lectures supported by tutorials. Apart from the discussions on the topics covered in the lectures assignments/ quizzes in the form of questions will also be given.

Evaluation Scheme:

Exams	**Marks**	**Coverage**
Test-1	15 Marks	Based on Unit-1
Test-2	25 Marks	Based on Unit-2 & Unit-3 and around 30% from coverage of Test-1
Test-3	35 Marks	Based on Unit-4 to Unit-5 and around 30% from coverage of Test-2
Assignment	10 Marks	
Tutorials	5 Marks	

Quiz	5 Marks	
Attendance	5 Marks	
Total	**100 Marks**	

Learning Resources:

Tutorials and lecture slides on Probability Theory and Random Processes (will be added from time to time): Digital copy will be available on the JUET server.

Text books:

1. T. Veerarajan ,Probability, Statistics and Random Processes, Tata McGraw Hill.
2. J.J. Aunon & V. Chandrasekhar, Introduction to Probability and Random Processes, Mc- Graw Hill International Ed.
3. A. Papoulis & S.U. Pillai, Probability, Random Varibles and Stochastic Processes, Mc-Graw Hill.
4. H. Stark, and J.M. Woods, Probability and Random Processes with Applications to Signal Processing, Pearson Education.

Title: Signals & Systems **Code: 18B11EC312**

L-T-P Scheme: 3-1-0 **Credits:4**

Prerequisite: Students must have already studied courses, "*Electrical Science*".

Objective:

1. To study the fundamentals of signals and systems.
2. To learn the concept of time domain and frequency domain analysis with the help of various signals transforms methods.

Learning outcomes:

Course Outcome	Description
CO1	Outline basics of signals and systems with respect to their needs in the digital and analog communication. Classification of signals and systems and examples of their applications.
CO2	Description of the LTI systems and their implementation using Matlab concepts.
CO3	Development of Fourier series and Fourier transform of continuous and discrete time signals using Matlab.
CO4	Identification and use of the Fourier transform, z-transform and Laplace transform, and their use in communication.
CO5	Application of various transforms methods on a given assignment.
CO6	Demonstration and deployment of questions based on transforms using Matlab.

Course Content:

Unit-1: Continuous-time and discrete-time signals, signal energy and power, periodic signals, even-odd signals, exponential and sinusoidal signals, Unit impulse and step functions, continuous and discrete time systems, System classifications.

Unit-2: Convolution integral and convolution sum, properties of LTI systems, LTI systems described by differential and difference equation, response of LTI systems.

Unit-3: Fourier series representation of continuous and discrete time signals, properties, Fourier Transform representation of continuous-time and discrete time signals, properties, system characterization by linear constant coefficient difference equation.

Unit-4: The Laplace Transform, ROC, properties of Laplace-transform, analysis and characterization of LTI systems using Laplace Transform, Stability and Causality using Laplace Transform.

Unit-5: The z-transform, ROC and pole-zero-plot, properties of z-transform, analysis and characterization of LTI systems using z-transform, Stability and Causality criterion.

Unit-6: Introduction to DSP, Random Variable and Random Processes, probability density function, mean, variance, correlation function, power spectral density.

Teaching Methodology:

This course is introduced to help students to understand the basics of signals and systems. Starting from frontend development, the student will slowly progress to learn other aspects of communication. Transforms that is helpful for a EC engineer. The entire course is based on: Fundamental and Designing, Matlab tools & Technologies and brief idea of the DSP. Each section includes multiple transforms to help a student gain basic knowledge of digital communication. This theory course is well complemented by a laboratory course under the name Signals & Systems Lab in the same semester that helps a student to learn with hand-on experience.

Evaluation Scheme:

Exams	Marks	Coverage
Test-1	15 Marks	Based on Unit-1
Test-2	25 Marks	Based on Unit-2, Unit-3 and around 30% from coverage of Test-1
Test-3	35 Marks	Based on Unit-4 to Unit-5 and around 30% from coverage of Test-2
Assignment	10 Marks	
Tutorials	5 Marks	
Quiz	5 Marks	
Attendance	5 Marks	
Total	**100 Marks**	

Learning Resources:
Tutorials and lecture notes/slides on Signals & Systems (will be added from time to time): Digital copy will be available on the JUET server.

Text Books:

[1] A.V. Oppenheim &A.S.Willsky & S.H. Nawab, Signals & Systems, Prentice Hall
[2] Hwei P. Hsu, Signals & Systems, Schaum's Outline, McGraw-Hill.
[3] B.P.Lathi, Signal Processing and Linear Systems, Cambridge Press, Carmichael, CA 1998

Reference Books:

[1] Symon Haykin, Signal & Systems, John Willey and Sons.

Web References:

[1] https://swayam.gov.in

Journals References:

[1] Journal of Signal Processing Systems - Springer
[2] Signal Processing - Journal - Elsevier

Title: Analogue Electronics **Code: 18B11EC313**

L-T-P Scheme: 3-1-0 **Credit: 4**

Prerequisite: Students must have already studied courses, "*Electrical Science*".

Objective:

1. Extend knowledge of the theory and applications of transistors and transistor amplifier, operational amplifier, integrated circuits.
2. The concepts and use of feedback and feedback (amplifier) design.
3. To provide sufficient knowledge and experience so that students will be able to the use of a variety of analog electronic components.

Learning Outcomes:

1. The students shall acquire the generic skills to design and implement of basic electronics circuits and op-amp based circuits. The student will be able to:

Course Outcome	Description
CO1	Demonstrate the use of various review of diode and transistor in various applications.
CO2	Discuss and explain the working of transistors and operational Amplifiers, their configurations and applications.
CO3	Determine operating point and various stability factors of transistor.
CO4	Analyze low and high frequency transistor model. Evaluate the performance parameters of various multistage and power amplifiers.
CO5	Analyze the concept of feedback amplifier and its characteristics. Design oscillator circuits and analyze its performance.
CO6	Design oscillator circuits and analyze its performance.

Course Content:

Unit-1: Introduction: Review of Diode and BJT, Working of a transistor, Transistor current equation, Collector reverse saturation current, DC alpha of a transistor. The three configurations, CB and CE input and output characteristics, DC load line, transistor as an amplifier.

Unit-2: Field-Effect Transistor (FET): Junction Field-Effect Transistor (JFET): Basic construction, Types of FET, Pinch-off voltage, Drain saturation current, Output and transfer characteristics, MOSFET, Types MOSFET, Threshold voltage, Depletion and Enhancement type MOSFET-Construction, Operation and their Characteristics.

Unit-3: Transistor Biasing: Need of biasing, Choice of operating region, Need for bias stabilization, Fixed bias circuit, Analysis of fixed bias circuit, Saturation point. Emitter-feedback bias circuit, its analysis and drawbacks, Emitter-bias circuit, its analysis, Collector to base bias and its analysis, Voltage divider bias circuit, approximate analysis, more accurate analysis, Analysis of fixed bias circuit, Saturation point. Biasing of FET, Bias stabilization of JFET, Biasing of MOSFETs.

Unit-4: Single stage and Multistage Amplifiers: Biasing for the BJT amplifier design, AC analysis of BJT Common Emitter, Common Base and Common Collector BJT amplifiers, Small signal equivalent and large signal models of BJT. Biasing for the FET amplifier design, AC analysis of FET Common source amplifier, Common Gate and Common Drain amplifiers, Miller Theorem, Small-signal high-

frequency hybrid-pi model of a BJT, Calculation of bandwidth of single and multistage Amplifiers.

Unit-5: Operational Amplifier: General configuration and basic stages of an operational amplifier (Op-amp). Analysis of simple BJT op-amp, Op-amp parameters: ideal and practical. Ideal characteristics of an operational Amplifier – Differential Amplifier. Linear and non-linear applications of op-amp..

Unit-6: Feedback Amplifiers: Advantages of negative feedback, Loop gain, feedback factor, Closed-loop gain. Basic feedback topologies: Series- Shunt, Series-Series, Shunt-Shunt and Shunt-Series configurations, oscillators.

Teaching Methodology:

Lectures would be interactive and it would cover the core concepts that are explained in the text and reference materials with adequate examples.

Evaluation Scheme:

Exams	**Marks**	**Coverage**
Test-1	15	Based on Unit-1, & Unit-2
Test-2	25	Based on Unit-1, Unit-2, Unit-3 & Unit-4 and around 30% from coverage of Test-1
Test-3	35	Based on Unit-1, Unit-2, Unit-3, Unit-4, Unit-6 and around 30% from coverage of Test-2
Assignment	10	Based on Unit-1, Unit-2, Unit-3, Unit-4 Unit-5, & Unit-6
Tutorials	5	Based on Unit-1, Unit-2, Unit-3, Unit-4 Unit-5, & Unit-6
Quiz	5	Based on Unit-1, Unit-2, Unit-3, Unit-4 Unit-5, & Unit-6
Attendance	5	Based on attendance in the theory classes
Total	**100**	

Learning Resources:

Tutorials sheets, lecture slides and handwritten notes on Analog Electronics (will be added from time to time): Digital copy will be available on the JUET server.

Text Books:

[1] J. Milliman and C.C.Halkias: Integrated Electronics, Mc Graw Hill
[2] Bolleystead, Electronic Devices and Circuits
[3] Ramakant A.Gayakwad: Op-Amps and Linear Integrated Circuits, P.H.I.
[4] D.S. Chauhan & D.C. Kulshreshtha, 'Electronics Engineering', New Age, 2e, 2009.
[5] D.C. Kulshreshtha, 'Electronic Devices and Circuits', New Age, 2e, 2006.

Reference Books:

[1] David A. Bell: Electronics Devices & Circuits, PHI
[2] J B Gupta: Electronics Devices & Circuits

[3] Kumar and Jain, 'Electronic Devices and Circuits', PHI, 2007.
[4] Boylstad and Nashelsky, 'Electronic Devices and Circuits', PHI, 6e, 2001.

Web References:

[1] https://ocw.mit.edu/courses/electrical-engineering-and-computer-science/6-101-introductory-analog-electronics-laboratory-spring-2007/study-materials/
[2] https://www.sanfoundry.com/1000-analog-circuits-questions-answers/
[3] https://www.examveda.com/electrical-engineering/practice-mcq-question-on-analog-electronics/

Journals References:

[1] Analog Integrated Circuits and Signal Processing International Journal, Springer
[2] Electrical, Electronics and Telecommunications Journals
[3] Springer journal of Electrical and Electronics

Title: Measurement & Instrumentation **Code: 18B11EC314**

L-T Scheme: 3-0-0 **Credits: 3**

Prerequisite: Nil

Objectives:

1. To introduce students to the automatic measurement process.
2. To understand students how different types of meters work and their construction.
3. To provide a student knowledge of the various types of sensors and their signal conditioning circuits.
4. To develop the ability to use modern tools necessary for hardware projects.

Learning Outcomes:

Course Outcome	Description
CO1	Outline the measurement process and instrument characteristics concerning their needs in the industry.
CO2	Describe the working principle and operation of various types of measuring instruments.
CO3	Develop a measurement setup to meet industry expectations.
CO4	Identify and use various electrical instruments used in the measurement process.
CO5	Apply error analysis on a given measurement setup.
CO6	Demonstrate the application of various measurement devices.

Course Contents

Unit 1: Fundamentals of Measurement: Measurement Methods, Generalized measurement System, Classification of Instruments, Static & Dynamic Characteristics, Errors & Uncertainty measurement of system, Linear & Non-linear Systems.

Unit 2: Transducers: Transducers – Classification of transducers, Temperature transducer, Pressure transducer, Displacement transducer, Strain gauge, LVDT, RTD, Thermistor, Thermocouple, Piezo-electric transducer.

Unit 3: Signal Conditioning Circuits: D.C. bridges and their application in measurement of resistance, Kelvin's double bridge, A.C. Bridges- general equation, Potentiometer- DC potentiometer, multi-range potentiometer, Q-meter and its applications. Amplifiers, Attenuators, Filters, Instrumentation Amplifier, Analog to digital converts.

Unit 4: Electrical Instruments: Moving coil, Moving iron, PMMC, Dynamometer and Induction type instruments, Measurement of Voltage, Current, Power, Power Factor, Energy, Instrument Transformer - current and potential transformer, Measurement of Phase & Frequency.

Unit 5: Signal Generators and Display Devices: Multivibrators: a stable, monostable and bistable types. Generation of square and triangular waveforms. IC 555 timer and its application in multivibrators. Construction & working of Basic CRO, its Components (Deflection plates, Screen, Aquadag, Time Base Generator, Oscilloscope Amplifiers), Measurements of phase and frequency (Lissajous Patterns), Types of CRO, Special types of CRO, Types of CRO Probes. Digital Voltmeter.

Teaching Methodology:

This course is introduced to familiarize the student with the devices and processes utilized in the automation industry. Starting from the basic concepts, the student will gradually develop an

understanding of practical setups used in the industry. The entire course is broken down into five units, such that each unit covers a particular aspect of the measurement process. This theory course is well complemented by a laboratory course under the name Measurement and Instrumentation Lab in the same semester that helps a student learn with hands-on experience.

Evaluation Scheme:

Exams	**Marks**	**Coverage**
Test-1	15 Marks	Based on Unit-1, Unit-2 (Selected topic)
Test-2	25 Marks	Based on Unit-2 & Unit-3 and around 30% from coverage of Test-1
Test-3	35 Marks	Based on Unit-4 to Unit-5 and around 30% from coverage of Test-2
Assignment	10 Marks	
Tutorials	5 Marks	
Quiz	5 Marks	
Attendance	5 Marks	
Total	**100 Marks**	

Learning Resources:
Tutorials and lecture slides on Measurement & Instrumentation (will be added from time to time): Digital copy will be available on the JUET server.

Text Books:

[1] A.K.Sawhney & Puneet Sawhney, A Course in Mechanical Measurements and Instrumentation, 12/e, Dhanpat Rai & Co. (P) Ltd.,2004
[2] Albert D.Helfrick & William D.Cooper, "Modern Electronic Instrumentation and Measurement Technique",Low Price Edition, Pearson Education, 2005
[3] Ernest O.Doebelin, "Measurement Systems Application and Design", 5/e, Tata McGraw –Hill Publishing Company Ltd., 2004

Reference Books/Materials:

[1] H.S.Kalsi, "Electronic Instrumentaion", Technical Education Series, Tata McGraw –Hill Publishing Company Ltd.,2001
[2] D.C. Kulshreshtha, "Principles of Electrical Engineering", Tata McGraw Hill Publishing Co

Web References:

[1] https://nptel.ac.in/courses/108105153/
[2] https://nptel.ac.in/courses/108/105/108105064/

Journals References:

[1] International Journal of Instrumentation Technology (Inderscience)
[2] IEEE Transactions on Instrumentation and Measurement

Title: Environmental Science **Code: 18B19GE399**

L-T-P Scheme: 2-0-0 **Credit: 2**

Prerequisite: The students must be aware of basic Environmental Science upto class 12^{th}. Basic knowledge of Environmental Science helps them to correlate in various division of Engineering during this course.

Objective:
The purpose behind this course is to make the students familiar with Environment (surrounding) and to understand the significance/importance of natural resource, biodiversity, environment pollution and impact of intervention of human being in the Ecosystem. This course is mandatory for all branches of the Engineering and Sciences.

Course Learning Outcomes:

Course Outcome	Description
CO1	The outline, outcomes and attributes provide students with learning experiences that help in learning the significance and importance of environment in their life.
CO2	Describe the real world problems, challenges with the suitable case study based on conservation (natural resource and biodiversity), ecosystem, socio-economic development and remedial measure of the various pollutions (air, water, soil, noise and radiation).
CO3	Develop in students the ability to apply the knowledge and skills they have acquired to the solution of specific theoretical and applied problems in their surrounding (the Environment).
CO4	Identify and use of various techniques for solving the Environmental Problems.
CO5	Apply filed visit and justification by using various analytical techniques.
CO6	Demonstrate students with the knowledge and skill base that would enable them to undertake further studies in the Environmental Science and related multidisciplinary areas that involve Environmental Science and help to develop a range of generic skills that are relevant to wage employment, self-employment and entrepreneurship.

Modules	Description	No. of lectures
Unit 1:	Introduction to Environmental Science: Multidisciplinary nature of environmental science; components of environment –atmosphere, hydrosphere, lithosphere and biosphere. Scope and importance; Concept of sustainability and sustainable development.	2
Unit 2:	Ecosystems: What is an ecosystem? Structure and function of ecosystem; Energy flow in an ecosystem: food chain, food web and ecological succession. Case studies of the following ecosystems: a) Forest ecosystem b) Grassland ecosystem c) Desert ecosystem d) Aquatic ecosystems (ponds, streams, lakes, rivers, oceans, estuaries)	4
Unit 3:	Natural Resources: Renewable and Non-renewable Resources • Land Resources and land use change; Land degradation, soil erosion and desertification. • Deforestation: Causes and impacts due to mining, dam building on environment, forests, biodiversity and tribal populations. • Water: Use and over-exploitation of surface and ground water, floods, droughts, conflicts over water (international & inter-state). • Heating of earth and circulation of air; air mass formation and precipitation. • Energy resources: Renewable and non-renewable energy sources, use of alternate energy sources, growing energy needs, case studies.	5
Unit 4:	Biodiversity and its conservation: Levels of biological diversity: genetic, species and ecosystem diversity; Biogeography zones of India; Biodiversity patterns and global biodiversity hot spots. • India as a mega-biodiversity nation; Endangered and endemic species of India. • Threats to biodiversity: habitat loss, poaching of wildlife, man-wildlife conflicts, biological invasions; Conservation of biodiversity: In-situ and Ex-situ Conservation of biodiversity. • Ecosystem and biodiversity services: Ecological, economic, social, ethical, aesthetic and Informational value.	4
Unit 5:	Environmental Pollution: Environmental pollution: types, causes, effects and controls; Air, water, soil, chemical and noise pollution. • Nuclear hazards and human health risks. • Solid waste management: Control measures of urban and industrial waste. • Pollution case studies.	5
Unit 6:	Environmental Policies & Practices: Climate change, global warming, ozone layer depletion, acid rain and impacts on human communities and agriculture.• Environment Laws : Environment Protection Act; Air (Prevention & Control of Pollution) Act; Water (Prevention and control of Pollution) Act; Wildlife Protection Act; Forest Conservation Act; International agreements; Montreal and Kyoto protocols and conservation on Biological Diversity (CBD). The Chemical Weapons Convention (CWC). • Nature reserves, tribal population and rights, and human, wildlife conflicts in Indian context.	4
Unit 7:	Human Communities and the Environment Human population and growth: Impacts on environment, human health and welfares.	4

	• Carbon foot-print. • Resettlement and rehabilitation of project affected persons; case studies. • Disaster management: floods, earthquakes, cyclones and landslides. • Environmental movements: Chipko, Silent valley, Bishnios of Rajasthan. • Environmental ethics: Role of Indian and other religions and cultures in environmental conservation. • Environmental communication and public awareness, case studies (e.g., CNG vehicles in Delhi).	
Unit 8:	Field Work: Visit to a local area to document assets-river / forest / grassland /hill / mountain. polluted sites(Urban, rural ,industrial, agriculture), plants, insects, bird, Ecosystem (pond, river, hill slopes etc)	4
	Total	**32**

Teaching Methodology:

The core module Syllabus for Environment Science includes class room teaching and Field Work. The syllabus is divided into eight units covering lectures. The first seven units will cover 28 lectures, which are class room based to enhance knowledge skills and attitude to environment. Unit eight is based on field activities which will be covered in 4 lecture hours and would provide student firsthand knowledge on various local environmental aspects. Field experience is one of the most effective learning tools for environmental concerns. This moves out of the scope of the text book mode of teaching into the realm of real learning in the field, where the teacher merely acts as a catalyst to interpret what the student observes or discovers in his/her own environment. Field studies are as essential as class work and form an irreplaceable synergistic tool in the entire learning process. Course material provided by UGC for class room teaching and field activities is utilized.

Evaluation Scheme:

Exams	Marks	Coverage
Test-1	15 Marks	Based on Unit-1 Unit 2 and Unit-3
Test-2	25 Marks	Based on Unit-4 & Unit-5 (70 %) and around 30% from coverage of Test-1
Test-3	35 Marks	Based on Unit-6 to Unit-7 and around 30% from coverage of Test-1 and Text-2
Assignment	10 Marks	
Tutorials	5 Marks	
Quiz	5 Marks	
Attendance	5 Marks	
Total	**100 Marks**	

Learning Resources:

Tutorials and lecture slides on Web Development (will be added from time to time): Digital copy will be available on the JUET server.

Text Book

1. Bharucha Erach, 2003. The Biodiversity of India, Mapin Publishing Pvt. Ltd, Ahmadabad – 380013, India.
2. De Anil Kumar, Environmental Chemistry, Wiley Eastern Ltd, 2007.
3. Agarwal KC, 2001. Environmental Biology, Nidhi Publishers Ltd. Bikaner.

Reference Book

1. Brunner RC, 1989, Hazardous Waste Incineration, McGraw Hill Inc. 480pgs.
2. Clark R B, Marine Pollution, Clanderson Press, Oxford (TB).2001.
3. Cunningham WP, Cooper TH, Gorhani E & Hepworth MT, 2001. Environmental Encyclopedia, Jaico Publishing House, Mumbai, 1196 pgs.
4. Gleick HP, 1993. Water in Crisis, Pacific Institute for Studies in Development, Environment and Security. Stockholm Environmental Institute, Oxford University Press, 473pgs.
5. Heywood VH, and Watson RT, 1995. Global Biodiversity Assessment. Cambridge University Press 1140pgs.
6. Jadhav H and Bhosale VM, 1995. Environmental Protection and Laws. Himalaya Publishing House, Delhi 284pgs.
7. Mckinney ML and Schoch RM, 1996. Environmental Science Systems and Solutions. Web enhanced edition, 639pgs.

Title: Signals & Systems Lab **Code: 18B17EC372**

L-T-P scheme: 0-0-2 **Credit: 1**

Prerequisite: Students must have already studied the courses, "*Electrical Science Lab*" and *"Physics-1 Lab".*

Objective:

1. To learn and be able to understand the characteristics of Signals by using the MATLAB.
2. To develop the abilities to design the applications of communication systems based on the signal processing.

Learning Outcomes:

Course Outcome	**Description**
CO1	Outline basics of signals and systems with respect to their needs in the digital and analog communication. Examples of MATLAB Programs.
CO2	Description of the LTI systems and their implementation using MATLAB concepts.
CO3	Development concept of Fourier series and Fourier transform of continuous and discrete time signals using MATLAB.
CO4	Identification and use of the Fourier transform, z-transform and Laplace transform, and their implementation in MATLAB.
CO5	Application of various transforms methods on a given assignment.
CO6	Demonstration and deployment of questions based on transforms using MATLAB.

Course Content:

Unit I: Lab exercise based on continuous-time and discrete-time signals, signal energy and power, periodic signals, even-odd signals, exponential and sinusoidal signals, Unit impulse and step functions, continuous and discrete time systems, System classifications.

Unit II: Lab exercise based on **c**onvolution integral and convolution sum, properties of LTI systems, LTI systems described by differential and difference equation.

Unit III: Lab exercise based on Fourier series representation of continuous and discrete time signals, Fourier Transform representation of continuous-time and discrete time signals.

Unit IV: Lab exercise based on **t**he Laplace Transform, ROC, properties of Laplace-transform.

Unit V: Lab exercise based on **t**he z-transform, ROC and pole-zero-plot, properties of z-transform, and analysis.

Unit VI: Lab exercise based on Random Variable and Random Processes function.

Teaching Methodology:

This course is based on: Fundamental and Designing, MATLAB tool. Brief idea of the DSP. Each section includes multiple transforms to help a student gain basic knowledge of digital communication system design. This laboratory course that helps a student learn with hand-on experience.

Evaluation Scheme:

Exams		**Marks**	**Coverage**
P-1		15 Marks	Based on Lab Exercises: 1-6
P-2		15 Marks	Based on Lab Exercises: 6-14
Day-to-Day Work	Viva	20 Marks	70 Marks
	Demonstration	20 Marks	
	Lab Record	15 Marks	
	Attendance & Discipline	15 Marks	
Total		**100 Marks**	

Learning Resources:

Lab Manual of Signals & Systems Lab. Digital copy will be available on the JUET server.

Text Book:

[1] Laboratory Manual available in Lab
[2] Study material available in related folder of Server
A.V. Oppenheim &A.S.Willsky & S.H. Nawab, Signals & Systems, Prentice Hall
[3] Hwei P. Hsu, Signals & Systems, Schaum's Outline, McGraw-Hill.
[4] B.P.Lathi, Signal Processing and Linear Systems, Cambridge Press, Carmichael, CA 1998

Reference Books:

1. Symon Haykin, Signal & Systems, John Willey and Sons.

Web References:

[1] https://swayam.gov.in

Journals References:

[1] Journal of Signal Processing Systems - Springer
[2] Signal Processing - Journal - Elsevier
[4] ACM Transactions on the Information Systems
[5] ACM Transactions on Graphics
[6] ACM Transactions on Internet Technology

Title: Analogue Electronics Lab **Code: 18B17EC373**

L-T-P Scheme: 0-0-2 **Credit: 1**

Prerequisite: Student must have already registered for the course, "Electrical science"

Objective:

1. Students will be capable to acquire the knowledge of bread board implementation of analogue circuits.
2. They will be able to understand the difference between expected output and actual output of any analogue circuits.

Learning Outcomes:

1. They will be able to understand the difference between expected output and actual output of any analogue circuits.
2. The students will be able to understand the reason due to that actual output differ from the expected output.

Course Outcome	Description
CO1	Design and analysis of op-amp amplifier
CO2	Performance of rectifier
CO3	Design and implement of filter Circuits Plot and plot its frequency response.
CO4	Design and implement Oscillators circuits.
CO5	Demonstrate square wave and triangular wave generator
CO6	Mathematical operation using Op-Amp

Course Content:

1. Design and analysis of Inverting amplifier, non-inverting amplifier and voltage follower.
2. To test the performance of Half-wave Precision Rectifier using Op-Amp (IC741).
3. Design and implement an Integrator using 741 Op-Amp IC.
4. Design and implement a first order low pass filter at a high cut off frequency of 1 KHz with a pass band gain of 2 or more. Plot its frequency response.
5. Design and implement a differentiator using 741 Op-Amp IC.
6. Design and implement a first order high pass filter at a high cut off frequency of 10 KHz with a pass band gain of 2 or more. Plot its frequency response.
7. Design and implement a Wein Bridge Oscillator to generate a sinusoidal wave of frequency f_o =1KHz.
8. Design and implement a Phase Shift Oscillator to generate a sinusoidal wave of frequency f_o =200 Hz.
9. Design and implement square wave generator using 741 Op-Amp IC.
10. Design and implement triangular wave generator using 741 Op-Amp IC.
11. Design and Implement a first order wide band pass filter with a cut off frequency 200Hz to 1 KHz and a pass-band gain of 4.Plot its frequency response and hence find out its Q.
12. To implement full wave precision rectifier using 741 Op-Amp IC.
13. Design Summing Amplifier using Op-Amp (741 IC).

Teaching Methodology:
In each experiment the practical is designed and analyzed on bread board with the help of physical devices by each student and further checked and validated by faculty and lab staff.

Evaluation Scheme:

Exams	**Marks**		**Coverage**
P-1	15 Marks		Based on Lab Exercises: 1-6
P-2	15 Marks		Based on Lab Exercises: 7-13
Day-to-Day Work	Viva	20 Marks	70 Marks
	Demonstration	20 Marks	
	Lab Record	15 Marks	
	Attendance & Discipline	15 Marks	
Total		**100 Marks**	

Learning Resources:
Tutorials sheets, lecture slides and handwritten notes on Analog Electronics lab and viva-voce related digital content is also ensured to available on the JUET server for registered students.

Text Books:

[1] J. Milliman and C.C.Halkias: Integrated Electronics, Mc Graw Hill
[2] Bolleystead, Electronic Devices and Circuits
[3] Ramakant A.Gayakwad: Op-Amps and Linear Integrated Circuits, P.H.I.
[4] D.S. Chauhan & D.C. Kulshreshtha, 'Electronics Engineering', New Age, 2e, 2009.
[5] D.C. Kulshreshtha, 'Electronic Devices and Circuits', New Age, 2e, 2006.

Reference Books:

[1] David A. Bell: Electronics Devices & Circuits, PHI
[2] J B Gupta: Electronics Devices & Circuits
[3] Kumar and Jain, 'Electronic Devices and Circuits', PHI, 2007.
[4] Boylstad and Nashelsky, 'Electronic Devices and Circuits', PHI, 6e, 2001.

Web References:

[1] https://ocw.mit.edu/courses/electrical-engineering-and-computer-science/6-101-introductory-analog-electronics-laboratory-spring-2007/study-materials/
[2] https://www.sanfoundry.com/1000-analog-circuits-questions-answers/
[3] https://www.examveda.com/electrical-engineering/practice-mcq-question-on-analog-electronics/

Journals References:

[1] Analog Integrated Circuits and Signal Processing International Journal, Springer
[2] Electrical, Electronics and Telecommunications Journals
[3] Springer journal of Electrical and Electronics

Title: Measurement & Instrumentation Lab **Code: 18B17EC374**

L-T-P scheme : 0-0-2 **Credit: 1**

Prerequisite: Nil

Objectives:

1. To introduce students to the automatic measurement process.
2. To understand students how different types of meters work and their construction.
3. To provide a student knowledge of the various types of sensors and their signal conditioning circuits.
4. To develop the ability to use modern tools necessary for hardware projects.

Learning Outcomes: In reference to Measurement & Instrumentation (18B11EC314), the students will be able to:

Course Outcome	Description
CO1	Outline the measurement process and instrument characteristics concerning their needs in the industry.
CO2	Describe the working principle and operation of various types of measuring instruments.
CO3	Develop a measurement setup to meet industry expectations.
CO4	Identify and use various electrical instruments used in the measurement process.
CO5	Apply error analysis on a given measurement setup.
CO6	Demonstrate the application of various measurement devices.

Course Content:

Unit 1: Lab exercise based on introduction to DC bridges and measurement of resistance
Unit 2: Lab exercise based on working of AC bridges and measurement of inductance and capacitance
Unit 3: Lab exercise based on operation of transducer for strain and displacement measurement
Unit 4: Lab exercise based on measurement of temperature using active and passive transducers
Unit 5: Lab exercise based on implementation of signal conditioning circuits such as amplifier, analog to digital converter etc.

Teaching Methodology:

This course is introduced to help the students to familiarize with the devices and methods used for automatic measurement. In this course, the mixed technique of interactive discussion, regular assignments will be used. In the discussion the fundamental theoretical concepts will be introduced and demonstrated through examples. Discussion will be implemented in laboratory by using the practical setups.

Evaluation Scheme:

Exams	Marks	Coverage
P-1	15 Marks	Based on Lab Exercises: 1-5

P-2		15 Marks	Based on Lab Exercises: 6-11
Day-to-Day Work	Viva	20 Marks	70 Marks
	Demonstration	20 Marks	
	Lab Record	15 Marks	
	Attendance & Discipline	15 Marks	
Total		**100 Marks**	

Learning Resources:

Study material of Measurement & Instrumentation Lab (will be added from time to time): Digital copy will be available on the JUET server.

Text Books:

[1] Laboratory Manual available in Lab
[2] A.K.Sawhney & Puneet Sawhney, A Course in Mechanical Measurements and Instrumentation, 12/e, Dhanpat Rai & Co. (P) Ltd.,2004
[3] B.C.Nakra & K.K.Chaudhary,Instrumentation Measurement And Analysis, Tata McGraw-Hill Publishing Company Ltd, New Delhi.,1996
[4] D.Patranabis, Principles of Industrial Instrumentation, 2/e, Tata McGraw-Hill Publishing Company Ltd, New Delhi.,1998

Reference Books/Materials:

[1] James W. Dally, William F. Riley & Kenneth G.McConnell, Instrumentation for Engineering Measurements,2/e,Wiley Student Edition, John Wiley & Sons,INC,2003.
[2] John P.Bentley, Principles of Measurement Systems, Low Price Edition, Pearson Education Asia,2000
[3] Dr.D.S.Kumar, Mechanical Measurements and Control, 3/e, Reprint-2004, Metropolitan Book Co. Private Ltd.,2004
[4] Liptak, B.G., "Instrumentation Engineers Handbook (Measurement)", CRC Press, 2005.

Web References:

[1] https://nptel.ac.in/courses/108/108/108108147/
[2] https://nptel.ac.in/content/storage2/nptel_data3/html/mhrd/ict/text/112104250/lec21.pdf
[3] https://www.electronics-tutorials.ws/io/io_1.html

Journals References:

[1] Sensors and Actuators A: Physical (Elsevier)
[2] Journal of Sensors (Hindawi)

Title: Programming in Python **Code: 21B19CI399**

L-T-P scheme: 0-0-2 **Credit: Audit**

Prerequisite: No explicit prerequisite course work is required, but students are expected to have a fundamental understanding of basic computer principles and previous experience using a personal computer.

Objective:
To emphasize object-oriented programming. Problem decomposition and principles of programming are stressed throughout the course. Advance aspects of programming may be taken care off through Python.

Learning Outcomes:

Course Outcome	Description
CO1	Installation and understanding features of Python.
CO2	Describe Python data types to handle programming problems
CO3	Develop understanding looping to handle new data types
CO4	Identify appropriate methods to solve challenging problems.
CO5	Apply programming knowledge to solve real world problems in the form of Project

Course Contents:

An Introduction to Python: Introductory Remarks about Python, Strengths and Weaknesses, A Brief History of Python, Python Versions, Installing Python, Environment Variables, Executing Python from the Command Line, IDLE, Editing Python Files, Getting Help, Dynamic Types, Python Reserved Words, Naming Conventions.

Basic Python Syntax: Introduction, Basic Syntax, Comments, String Values, String Operations, The format Method, String Slices, String Operators, Numeric Data Types, Conversions, Simple Input and Output, The print Function.

Language Components: Introduction, Control Flow and Syntax, Indenting, The if Statement, Relational Operators, Logical Operators, True or False, Bit Wise Operators, The while Loop, break and continue, The for Loop.

Collections: Introduction, Lists, Tuples, Sets, Dictionaries, Sorting Dictionaries, Copying Collections, Summary.

Functions: Introduction, Defining Your Own Functions, Parameters, Function Documentation, Keyword and Optional Parameters, Passing Collections to a Function, Variable Number of Arguments, Scope Functions- “First Class Citizens”, Passing Functions to a Function, Mapping Functions in a Dictionary, Lambda, Closures.

Text Book

1. Programming Python /Mark Lutz.

Reference Books

1. Think Python / Allen B Downey
2. Python 101 / Dave Kuhlman

Evaluation scheme:

Exams		**Marks**	**Coverage**
P-1		15 Marks	Based on Lab Exercises: 1-7
P-2		15 Marks	Based on Lab Exercises: 8-14
Day-to-Day Work	Viva	20 Marks	70 Marks
	Demonstration	20 Marks	
	Lab Record	15 Marks	
	Attendance & Discipline	15 Marks	
Total		**100 Marks**	

4th Semester

HSS Elective – 1

Title: Concept of Digital Marketing **Code: 18B14HS441**

L-T-P Scheme: 3-0-0 **Credit: 3**

Prerequisite: None

Objective:

1. Learn cutting-edge Digital Marketing techniques like Search Engine Optimization, Search Engine Marketing, Social Media Marketing, Mobile Marketing, Analytics and Digital Strategy.
2. Measure, Analyze and Optimize Social Media Marketing Campaigns

Learning Outcome
At the end of the course, the students should:

Course Outcome	Description
CO1	Develop successful written, visual, and digital communication skills essential for a career in digital marketing including social media marketing. Discuss the key elements of a digital marketing strategy.
CO2	Apply digital marketing methods to select the best digital & social media tools for the target audience to achieve optimum results.
CO3	Acquire and illustrate social media listening skills for effective evaluation of social media tools and marketing.
CO4	Understand the need to identify cultural, global and societal influences to digital marketing.
CO5	Identify the social trends that influence digital and social media tools and strategy.
CO6	Describe how changing technology impacts the Digital Marketing environment.

Course Description
Unit 1: Introduction to Digital Marketing, Strategies in Digital Marketing. Search Engine Optimization – (Understand the search engine as default entry point to internet. Learn how to get website listed among top search engine results) - Search Engine working, Crawlers, ranking algorithm and techniques.Types of search engines, white hat SEO, black hat and grey hat SEO, on page optimization and techniques.

Unit 2: Search Engine Marketing – Basics of marketing, Inbound and outbound marketing, Appreciate the role of pay per click in website listing. Learn how to effectively run ads on Search Engines. Email Marketing– Learn how to effectively build your users lists, deliver e-mails & generate relevant clicks.

Unit 3: Social Media Marketing– Learn how to build brand, generate leads & aggregate audience on social media. Inbound Marketing– Learn how to attract & convert customers by earning their trust through various techniques such as content marketing.

Unit 4: Web Analytics – Basic web analytics process, web analytics technologies, log file analysis, Best Web Analytics Tools: Clickstream Analysis Tools, Content and Blog Marketing– Increasing audience engagement through content marketing. Learn to use white paper, brochure, and case studies for unique interaction.

Unit 5: Mobile Marketing– Strategizing marketing through smart devices. Learn App-based marketing, QR codes, Location-based marketing, SMS marketing.

Teaching Methodology:
This course will be taught through the Powerpoint, case studies and discussions.

Evaluation Scheme:

Exams	**Marks**	**Coverage**
Test-1	15 Marks	Based on Unit-1
Test-2	25 Marks	Based on Unit-2 & Unit-3 and around 30% from coverage of Test-1
Test-3	35 Marks	Based on Unit-4 to Unit-5 and around 30% from coverage of Test-2
Assignment	10 Marks	
Tutorials	5 Marks	
Quiz	5 Marks	
Attendance	5 Marks	
Total	**100 Marks**	

Learning Resources:
Lecture slides and other study material on Digital Marketing (will be added from time to time): Digital copy will be available on the JUET server.

Text Books

1. ” Digital Marketing: Strategy, Implementation & Practice”; Dave Chaffey & Fiona Ellis-Chadwick, Pearson, 2019
2. “The Power of Visual Storytelling”; Ekaterina Walter, McGrawHill, 2014

Web References:
1. https://neilpatel.com › what-is-digital-marketing
2. https://www.digitalvidya.com › blog › learn-digital-marketing-guide

Title: Life Skills **Code: 18B11HS411**

L-T-P scheme: 2**-0-0** **Credit: 2**

Prerequisites*:* **None Objective:**

1. To employ positive behavior management techniques and to develop skills to manage their own behavior effectively
2. To develop one's personality by being aware of the self, connecting with others, reflecting on the abstract and the concrete.
3. To enhance the employability and maximize the potential of the students by introducing them to the principles that underlying personal and professional success, and help them acquire the skills needed to apply these principles in their lives and careers.

Learning Outcomes:

CO1	Outline different life skills required in personal and professional life.
CO2	Describe the application of different theoretical perspectives within the field of motivation and applying these motivation theories to everyday settings (e.g., business, social interactions, education)
CO3	Develop the understanding of personality and shaping behavior through personality
CO4	Identify the basic mechanics of perception by demonstrating these through presentations.
CO5	Apply well-defined techniques to cope with emotions and stress and develop an awareness of the self.
CO6	Understand the basics of leadership and Learning

Course Content:

Unit-1: Overview of Life Skills: Meaning and significance of life skills, Life skills identified by WHO: Self-awareness, Empathy, Critical thinking, Creative thinking, Decision making, problem solving, Effective communication, interpersonal relationship, coping with stress, coping with emotion.

Unit-2: Motivation: Morale and Morale Building, Need and Importance of motivation, Process and types of motivation, Theories of motivation, Essentials of Good Motivation system

Unit-3: Overview of Personality concept and types, Personality traits, Factors that help in shaping personality, Theories of personality, Measurement of personality

Unit-4: Perception: - Factors affecting perception, Perceptual mechanisms Perceptual errors and distortions, Behavioral applications of perceptions

Unit-5: Self Awareness, Coping with emotions: Identifying and managing emotions, harmful ways of dealing with emotions, Stress Management: Stress, reasons and effects, identifying stress, Managing Stress

Unit-6: Conflict Management –sources, process and resolution of conflict

Unit-7: Leadership: Need for Leadership, Models of leadership development, and Characteristics of a good leader.

Unit-8: Learning: Concepts and Theories, classical conditioning, operant conditioning, biological influences, Cognitive influences, social learning theory, Behavioral modification theory

Teaching Methodology:

Life skills are those competencies that provide the means for an individual to be resourceful and positive while taking on life's vicissitudes. This course will equip students with the social and interpersonal skills that enable them to cope with the demands of everyday life. There will be a particular focus on social-cognitive processes and how situational factors trigger various emotions and corresponding motives that can then drive behavior. The main objectives of this course is to build self-confidence, encourage critical thinking, foster independence and help students to communicate more effectively

Evaluation Scheme:

Exams	**Marks**	**Coverage**
Test-1	15 Marks	Based on Unit-1, Unit-2 & Unit-3
Test-2	25 Marks	Based on Unit-4 & Unit-5 and around 30% from coverage of Test-1
Test-3	35 Marks	Based on Unit-6, Unit-7 & Unit-8 and around 30% from coverage of Test-2
Assignment	10 Marks	
Tutorials	5 Marks	
Quiz	5 Marks	
Attendance	5 Marks	
Total	**100 Marks**	

Learning Resources:
Case studies, video lectures and lecture slides on Life Skills (will be added from time to time): Digital copy will be available on the JUET server.

Text Book:
1. “Effective Communication and Soft Skills”; Nitin Bhatnagar, Pearson Education

India,1e, 2011
2. “Personality Development and Soft Skills”; Barun Mitra, Oxford Higher Education,2016
3. “Sizzling Soft Skills for Spectacular Success”; P. Ameer Ali, Notion Press, 2017
4. “Organizational Behavior”; Stephen P. Robbins, Timothy A. Judge, Neharika Vohra, Pearson Education India, 16e, 2016
5. “Managing Organisations”; Rachna Chaturvedi, Vikas Publications, 2013

Reference Books/Material:

1. “The Power of Your Subconscious Mind”; Joseph Murphy, General press, 2015
2. “The Life-Changing Magic of Tidying Up: The Japanese Art of De cluttering and Organizing”; Marie Kondō, 1e,Ten speed Press, 2011
3. “The Power of Habit: Why We Do What We Do in Life and Business”; Charles Duhigg, Random House, 2012.

Title: Digital Circuit Design **Code: 18B11EC411**

L-T-P Scheme: 3-0-0 **Credit: 3**

Prerequisite: Students must have already studied courses, "*Analogue Electtronics*".

Objective:

1. The objective of this course is to analyze and design combinational circuits and sequential circuits
2. Introduce the concept of memories, programmable logic devices and digital ICs.

Learning outcomes:

1. At the end of the course the student will be able to analyze, design, and evaluate digital circuits, of medium complexity, that are based on SSIs, MSIs, and programmable logic devices.
2. Recognize and apply the number systems and Boolean algebra.
3. Reduce Boolean expressions and implement them with Logic Gates.
4. Analyze, design and implement combinational and sequential circuits.
5. Perform Logic Minimization for single/multiple output function(s) and evaluate the performance of a given Digital circuit/system.
6. Draw the timing diagrams for the identified signals in a digital circuit.

Course Outcome	**Description**
CO1	Recognize and apply the number systems and Boolean algebra.
CO2	Reduce Boolean expressions and implement them with Logic Gates.
CO3	Analyze, design and implement combinational and sequential circuits.
CO4	Perform Logic Minimization for single/multiple output function(s) and evaluate the performance of a given Digital circuit/system.
CO5	Draw the timing diagrams for the identified signals in a digital circuit. Design and implement various types of Counters and registers circuit
CO6	Assess the performance of a given digital circuit with Mealy and Moore configurations. Analyze and differentiate logic families, TTL and CMOS. Compare the performance of a given digital circuits/systems with respect to their speed, power consumption, number of ICs, and cost.

Course Contents:

Unit-1: Conversion of bases, Representation of negative numbers, 9's and 1's complement, 10's and 2's complement, Binary arithmetic, BCD code, Excess-3 code, Gray Code and Alphanumeric code. Logic gates and Boolean algebra, Standard and canonical representation and minimization of Boolean expressions using Karnaugh Map and Quine – McClausky methods.

Unit-2: Half & full adder and subtractor, Parallel adder, BCD adders, Lookahead carry generator. Decoders, Encoders, Multiplexers and De-multiplexers, Code convertor, Comparator, Parity generator and Checker. Binary multiplier.

Unit-3: Flip Flops: SR, JK, Master slave JK, T and D. Shift Registers and their Applications. Synchronous and Asynchronous counters, Design of counters using flip flops.

Unit -4: Moore and Melay machines, State tables, state diagrams and timing diagrams. ROM, PROM,

EPROM, EEPROM, PAL, and PLA.

Unit-5: Characteristics of logic families, RTL, DTL, TTL, ECL and CMOS logic family, Interfacing between TTL and CMOS and vice-versa.

Teaching Methodology:

Lectures would be interactive and it would cover the core concepts that are explained in the text and reference materials with adequate examples.

Evaluation Scheme:

Exams	**Marks**	**Coverage**
Test-1	15	Based on Unit-1 & Unit-2
Test-2	25	Based on Unit-2, Unit-3 & Unit-4 and around 30% from coverage of Test-1
Test-3	35	Based on Unit-3, Unit-4 to Unit-5 and around 30% from coverage of Test-2
Assignment	10	Based on Unit-1, Unit-2, Unit-3, Unit-4 & Unit-5
Tutorials	5	Based on Unit-1, Unit-2, Unit-3, Unit-4 & Unit-5
Quiz	5	Based on Unit-1, Unit-2, Unit-3, Unit-4 & Unit-5
Attendance	5	Based on attendance in the theory classes
Total	**100**	

Learning Resources:

Tutorials sheets, lecture slides and handwritten notes on Digital Circuit Design (will be added from time to time): Digital copy will be available on the JUET server.

Text Books:

[1] M. Morris Mano, "Digital Design," Pearson Education, 3rd edition,

Reference Books:

[1] Morris Mano, Digital Logic and Computer Design, PHI
[2] 2. Taub and Schilling, Digital Integrated Electronics, McGraw Hill, Int. Ed.
[3] Zainalabdil Navabi, Analysis & Modeling of Digital System, TMH
[4] Charles H. Roth, Jr., Fundamental of Logic Design, Cengage Learning, 5th edition.

Web References:

[1] https://www.sanfoundry.com/digital-circuits-multiple-choice-questions-answers/
[2] https://www.examveda.com/electrical-engineering/practice-mcq-question-on-digital-electronics/

Journals References:

[1] Digital logic circuits, IEEE publisher

[2] Logic Circuits, ScienceDirect, Elsevier
[3] Digital Circuits, ScienceDirect, Elsevier

Title: Analog and Digital Communication **Code: 18B11EC412**

L-T-P scheme: 3-1-0 **Credit: 4**

Prerequisite: Students must have already studied courses, "*Signals and System*".

Objective:

1. To learn the principles and techniques of modern communication system.
2. To analyze the performance of communication system in presence of noise.

Learning Outcomes:

Course Outcome	Description
CO1	Understand basic elements of a communication system and signal analysis
CO2	Accomplish the behavior of analog communication in time and frequency domain
CO3	Express the conversion of analog to digital communication system
CO4	Explicit the performance of line codes and methods to mitigate inter symbol interference
CO5	Describe and analyze the various modern digital modulation techniques
CO6	Evaluate the performance of noise in analog communication and Bit error rate in digital communication

Course Content:

Unit-1: Introduction: Electronic communication system, Signal properties, Frequency Translation and spectrum. Baseband and carrier Communication.

Unit-2: Linear Modulation: Principles of Amplitude Modulation (AM), Double Side Band Modulation with suppressed carrier, Single Side Band, Quadrature Amplitude Modulation, Vestigial Side Band modulation, Generation and Demodulation, carrier Acquisition, Superhetrodyne AM receiver.

Unit-3:Exponential Modulation: Concept of Instantaneous Frequency, Bandwidth, Frequency Modulation (FM), Phase Modulation (PM), Armstrong and Indirect Generation, Demodulation, Pre-emphasis and De-emphasis, Stereophonic broadcasting system.

Unit-4:Pulse Modulation: Sampling Theorem, Natural and Flat-top sampling, Pulse Code Modulation (PCM), Quantization, Companding, Differential Pulse Code Modulation(DPCM), Delta Modulation (DM), Adaptive Delta Modulation(ADM), Pulse Amplitude Modulation(PAM), Pulse Width Modulation(PWM), Pulse Position Modulation(PPM).

Unit-5: Digital Modulation schemes: Digital communication system, Line coding, Pulse shaping, Digital Modulation schemes, Amplitude Shift Keying (ASK), Phase Shift Keying (PSK), Frequency Shift Keying (FSK), M-ary communication, Quadrature Amplitude Modulation(QAM), Minimum Shift Keying (MSK) etc, Generation and Reception, Power spectral density, Constellation.

Unit-6: Optimal Reception: Optimal reception of Digital signal, Maximum likelihood detection and

Bayes Receiver, Matched Filter, Equalization Techniques.

Unit-7: Multiplexing: Time Division Multiplexing (TDM), Frequency Division Multiplexing (FDM).

Unit-8: Noise Analysis: Mathematical representation, Gaussian and white noise characteristics, Noise in analog communication, Calculation of Signal-to-Noise Ratio (SNR) and Bit Error Rate (BER).

Teaching Methodology:
This course is introduced to help students for understanding the basic concept of communication systems. Initially an overview of communication systems along with signals and Fourier Transforms will be discussed briefly. In the first part, Analog communication techniques including AM and FM will be covered and followed by analog to digital conversion using sampling with pulse communication are explained in details. In the second part, digital communication is start from line coding and pulse shaping. Later, modulation techniques such as PSK and MSK etc. will be covered. At the end multiplexing techniques, noise performance on analog communication along with SNR and BER calculation has been evaluated.

Evaluation Scheme:

Exams	**Marks**	**Coverage**
Test-1	15	Based on Unit-1, Unit-2 & Unit-3
Test-2	25	Based on Unit-4 & Unit-5 and around 30% from coverage of Test-1
Test-3	35	Based on Unit-6 to Unit-8 and around 30% from coverage of Test-2
Assignment	10	
Tutorials	5	
Quiz	5	
Attendance	5	
Total	**100**	

Learning Resources:
Tutorials and lecture slides on theory course will be added from time to time and a digital copy of study material will be available on the JUET server.

Text Book:
[1] "Modern Digital and Analog Communications Systems", Lathi B. P., 3rd Edi. , Oxford university press, 2005.
[2] "Principles of Communication Systems", Taub H., Schilling D.L. and Saha G., 3rd Edi., Tata McGraw Hill, 2008.

Reference Books:
[1] "Communications Systems", Haykin S., 4th Edi. , John Wiley and Sons, 2004.
[2] "Digital Communications", Proakis J. G., 4th Edi. , Tata McGraw Hill, 2000.

Web References:

[1] https://www.wisdomjobs.com/e-university/analog-communication-tutorial-1677/
[2] https://www.tutorialspoint.com/principles_of_communication/

Journals References:
[1] International Journal of Communication Systems Wiley publication
[2] International Journal of Digital Communication and Analog Signals

Title: Electromagnetic Field Theory **Code: 21B11EC415**

L-T-P scheme: 3-1-0 **Credit: 4**

Prerequisite: Students must have already studied "Physics-*1 and 2*".

Objective:

1. To learn and be able to implement the front-end and back-end Electromagnetic Field Theory
2. To develop the abilities to call oneself full-stack Electromagnetic Field

Learning Outcomes:

Course Outcome	**Description**
CO1	Get familiar with processes of full stack Electromagnetic Field
CO2	Have a good grounding of Electromagnetic Field Terminologies, Maxwell Equation, Pointing Theorem
CO3	Possess demonstrative skills in using and applying different modes of wave propagation (TE, TM and TEM) and guided media
CO4	Investigate the characteristics of electromagnetic wave and its propagation in free space and transmission line.
CO5	Apply electromagnetic engineering approaches required to create radio wave applications
CO6	Learn to apply concept of EMT in practical application and in research.

Course content :

Unit-1 : Electromagnetic Wave Propagation: Propagation in Good Conductors, Skin Effect, Reflection of uniform Plane Waves at normal incidence, Plane Wave reflection, Wave propagation in dispersive media, concept of phase velocity and group velocity.

Unit-2: Transmission Lines: Typical Transmission lines- Co-axial, Two Wire, Microstrip, Coplanar and Slot Lines, Transmission Line Parameters, Transmission Line Equations, Wave propagation in Transmission lines, low loss, lossless line, Distortion less line, Input Impedance, Standing Wave Ratio ,Power. and lossy lines, Shorted Line, Open-Circuited Line, Matched Line.

Unit-3: Waveguides and Waveguide Devices: Wave propagation in waveguides, Parallel plate waveguides, TEM, TM and TE modes, Rectangular waveguides, circular waveguides, Power transmission and attenuation, Rectangular cavity resonators, directional couplers, isolator, circulator.

Unit-4: Radiation of electromagnetic waves: Concept of retarded potentials, Antenna Parameters: Radiation Mechanism, Current Distribution on a Thin Wire Antenna, Radiation Pattern, Radiation Power Density, Radiation Intensity.

Unit-5: Antenna Basics: Introduction, basic Antenna parameters, patterns, beam area, radiation intensity, beam efficiency, diversity and gain, antenna apertures, effective height, bandwidth, radiation, efficiency, antenna temperature and antenna filed zones.

Teaching Methodology:
This course is introduced to help students transition from a simple to introduce students with different coordinate systems and familiarize the students with the different concepts of electrostatic, magneto static and time varying electromagnetic systems.

Evaluation Scheme:

Exams	**Marks**	**Coverage**
Test-1	15 Marks	Based on Unit-1, Unit-2
Test-2	25 Marks	Based on Unit-3 & Unit-4 and around 30% from coverage of Test-1
Test-3	35 Marks	Based on Unit-5 and around 30% from coverage of Test-2
Assignment	10 Marks	
Tutorials	5 Marks	
Quiz	5 Marks	
Attendance	5 Marks	
Total	**100 Marks**	

Learning Resources:

Tutorials and lecture slides on Electromagnetic Field Theory (will be added from time to time): Digital copy will be available on the JUET server.

Text Books:

[1] W.Hayt," Engineering Electromagnetics"
[2] G. S. N. Raju, Antennas and Propagation, Pearson Education (2001)

Reference Books:

[1] J. D. Kraus and R.J.Marhefka,"Antennas for all applications" Tata McGraw-Hill
[2] Liao Samuel Y,"Microwave Devices and Circuits"

Web References:

[1] www.engineering.purdue.edu
[2] www.physics.bgu.ac.il

Journals References:

[1] International Journal of Electromagnetics and Applications
[2] Journal of Electromagnetic Analysis and Applications
[3] Journal of Electromagnetic Waves and Applications

Title: Control System **Code: 18B11EC414**

L-T-P Scheme: **3-1-0** **Credits: 4**

Prerequisite: Not Applicable

Objective:

1. To provide knowledge of the various physical system, their mathematical modeling.
2. To analyze the performance of a system using time-domain analysis techniques.
3. To familiarize the student with the basic concept of stability and apply stability analysis techniques.
4. To introduce concepts of controller and designing of convention control schemes.

Learning Outcomes:

Course Outcome	Description
CO1	Outline various control system models with respect to their needs in the industry.
CO2	Describe the working of industrial control systems using the control theory and concepts.
CO3	Develop a mathematical model to represent a physical system.
CO4	Identify the stability conditions of a control scheme.
CO5	Apply time-domain and frequency domain analysis to evaluate the performance of a control system.
CO6	Demonstration and deployment of basic PID controller.

Course Content:

Unit-1: Introduction to control systems: Concept of control system, Open-Loop and Closed-loop systems, Elements of feedback control system. Advantages and applications of close loop control system. Review of laplace transform, Initial final value theorem, Final value theorem.

Unit- 2: Mathematic modeling: Mathematical modeling of electrical systems, mechanical systems, thermal system, liquid level system. Electrical analogues of other dynamic systems. Control hardware and their models. Transfer function models of linear time-invariant systems. Block diagram reduction techniques. Signal Flow graph.

Unit-3: Time Domain Analysis: Standard test signals. Time response of first and second order systems for standard test inputs. Application of initial and final value theorem. Design specifications for second-order systems based on the time-response.

Concept of Stability. Routh-Hurwitz Criteria. Relative Stability analysis. Root-Locus technique. Construction of Root-loci.

Unit 3: Frequency Domain analysis and Design: Relationship between time and frequency response, Polar plots, Bode plots. Nyquist stability criterion. Relative stability using Nyquist criterion – gain and phase margin. Closed-loop frequency response.

Unit 4: Introduction to Controller Design: Stability, steady-state accuracy, transient accuracy, disturbance rejection, insensitivity and robustness of control systems. Root-loci method of feedback controller design. Design specifications in frequency-domain. Frequency-domain methods of design. Application of Proportional, Integral and Derivative Controllers, Lead and Lag compensation in designs.

Unit 5: State variable Analysis: Concepts of state variables. State variable representation. State space

model. Conversion from State Variable model to Transfer Function model, Equivalence between Transfer Function model and State Variable representation. Diagonalization of State Matrix. Solution of state equations. Eigenvalues and Stability Analysis. Concept of controllability and observability.

Teaching Methodology:
This course is introduced to develop the understanding of control systems in various areas of engineering. Starting from the basic concepts, the student will gradually develop an understanding of automatic systems used in the industry. The entire course is broken down into five units, such that each unit covers a particular aspect of the control and automation.

Evaluation Scheme:

Exams	**Marks**	**Coverage**
Test-1	15 Marks	Based on Unit-1, Unit-2 (Selected topics)
Test-2	25 Marks	Based on Unit-2 & Unit-3 and around 30% from coverage of Test-1
Test-3	35 Marks	Based on Unit-4 to Unit-5 and around 30% from coverage of Test-2
Assignment	10 Marks	
Tutorials	5 Marks	
Quiz	5 Marks	
Attendance	5 Marks	
Total	**100 Marks**	

Learning Resources:
Tutorials and lecture slides on Control Systems (will be added from time to time): Digital copy will be available on the JUET server.

Text Books:
[1] M. Gopal, “Control Systems: Principles and Design”, McGraw Hill Education, 1997.
[2] K. Ogata, “Modern Control Engineering”, Prentice Hall, 1991.

Reference Books/Material:
[1] B. C. Kuo, “Automatic Control System”, Prentice Hall, 1995.
[2] J. Nagrath and M. Gopal, “Control Systems Engineering”, New Age International, 2009

Web References:
[1] https://nptel.ac.in/courses/107106081/
[2] https://web.stanford.edu/class/archive/ee/ee392m/ee392m.1034/
[3] https://ocw.mit.edu/courses/aeronautics-and-astronautics/16-30-feedback-control-systems-fall-2010/lecture-notes/

Journals References:

[1] IEEE Control Systems
[2] IFAC Journal of Systems & Control, Elsevier
[3] International Journal of Control Systems and Robotics – IARAS

Title: Digital Circuit Design Lab **Code: 18B17EC471**

L-T-P Scheme: 0-0-2 **Credit: 1**

Prerequisite: Student must have already registered for the course, "*Analog Electronics Lab*"

Objective:

1. Students will be capable to acquire the knowledge of bread board implementation of digital circuits.
2. The objective of this course is to analyze and design combinational circuits and sequential circuits
3. Introduce the concept of memories, programmable logic devices and digital ICs.

Learning Outcomes:

1. At the end of the course the student will be able to analyze, design, and evaluate digital circuits.
2. Recognize and apply the number systems and Boolean algebra minimization and implement with Logic Gates.
3. Analyze, design and implement combinational and sequential circuits.

CO1	Implementation of Boolean algebra and verification of logic gates
CO2	Reduce Boolean expressions and implement them with Logic Gates and minimization techniques.
CO3	Analyze, design and implement combinational circuits like adder, subtractor and multiplier.
CO4	Analyze, design and implement sequential circuits like flip-flops.
CO5	Perform Logic Minimization for single/multiple output function(s) and evaluate the performance of a given Digital circuit/system.
CO6	Draw the timing diagrams for the identified signals in a digital circuit. Design and implement various types of Counters and registers circuit

Course Content:

Experiment No 1: Familiarization and Verification of logic functions of the TTL ICs.
Activity 1: Verification of AND gate using 7408 IC.
Activity 2: Verification of OR gate using 7432 IC.
Activity 3: Verification of NOT gate using 7404 IC.
Activity 4: Verification of NAND gate using 7400 IC.
Activity 5: Verification of NOR gate using 7402 IC.
Activity 6: Verification of XOR gate using 7486 IC.

Experiment No 2: Implementation of Combinational digital circuits using MSI Logic.
Activity 1: Combinational circuit-1
Activity 2: Combinational circuit-2

Experiment No 3: Implementation of Binary Adders and Subtractors.
Activity 1: Implementation of the Half-Adder.
Activity 2: Implementation of the Full-Adder using two Half-Adders.
Activity 3: Implementation of the Half-Subtractor.
Activity 4: Implementation of the Full-Subtractor using two Half-Subtractors.
Activity 5: Implementation of the 4-Bit Parallel Adder using ICs 7483.
Activity 6: Implementation of the 4-Bit Parallel Subtractor using IC 7483.

Experiment No 4: K-map and Boolean function simplification

Activity 1: Simplify the given digital circuit using K-map and Verify the simplified function by implementing the given circuit and its simplified one.

Activity 2: Simplify the given functions whose minterm canonical formula is given. Implement the two functions with identical inputs and only use NAND gate ICs. Verify your result from the truth table.

Activity 3: Simplify the given Boolean function using minterms and maxterms. Implement both the simplified functions and verify that the functions are complement to each other. Construct the truth table as per your input/output behavior of the circuit.

Experiment No 5: Implementation of code converters (Gray-to-Binary & Binary-to-Gray)

Activity 1: Design and Implement a Binary-to Gray code converter

Activity 2: Design and Implement a Gray-to-Binary code converter

Activity 3: Verify your code converter by converting a Binary-to-Gray and then Gray-to-Binary.

Experiment No 6: Implementation of Multiplexer

Activity 1: Implementation of 2-to-1 Multiplexer using gates.

Activity 2: Implementation of 2-to-1 Multiplexer with enable/disable control signal.

Activity 3: Implementation of 2-to-1 Multiplexer using IC 74157.

Activity 4: Implementation of 4-to-1 Multiplexer using IC 74153.

Activity 5: Implementation of 8-to-1 Multiplexer using 4-to-1 MUX (IC 74153)

Experiment No 7: Implementation of Demultiplexer.

Activity 1: Implementation of 1-to-2 Demultiplexer.

Activity 2: Implementation of 1-to-2 Demultiplexer with enable/disable control signal.

Activity 3: Implementation of 1-to-4 Demultiplexer using IC 74139.

Experiment No 8: Use of Flip-Flop TTL IC in digital system.

Activity 1: Design and Implement NAND gated SR Latch

Activity 2: Design and Implement clocked RS Flip-Flop

Activity 3: Design and Implement D Flip-Flop using IC 7474.

Activity 4: Design and Implement JK Flip-Flop using IC 7476.

Activity 5: Design and Implement Master-Slave JK Flip-Flop.

Experiment No 9: Implementation of 4-Bit Binary Counter.

Activity 1: Implementation of 4-Bit Binary counter using 7493 IC .The clock signal to be given through the pulsar and 1 Hz clock generator, and observe the output through LED.

Activity 2: Draw the waveform of the counter outputs Q_A, Q_B, Q_C and Q_D

Activity 3: Implementation of BCD counter using 7493 IC. Observe the output through seven-segment display.

Activity 4: Implementation of Mod-5 counter using 7493 IC.

Activity 5: Implementation of Mod-7 counter using 7493 IC.

Experiment No 10: Implementation of Shift Registers

Activity 1: Implementation of 4.bit Serial load parallel out (SIPO) shift register using 7474 IC.

Activity 2: Implementation of 4.bit parallel load serial out (PISO) shift register using 7474 IC.

Activity 3: Use of universal shift register IC 74194

Experiment No.11: Implementation of 2-bit Arithmetic Logic Unit (ALU).

Experiment No12: Implementation of BCD-to-Seven Segment Decoder/Driver

Activity 1: Design and Implement BCD-to-seven Segment Decoder

Activity 2: Implement BCD-to-Seven Segment Decoder using IC 7447
Activity 3: Generate the BCD code using binary counter (IC 7493) and display the code through a seven-segment display

Teaching Methodology:

In each experiment the practical is designed and analyzed on bread board with the help of physical devices by each student and further checked and validated by faculty and lab staff.

Evaluation Scheme:

Exams	**Marks**	**Coverage**	
P-1	15 Marks	Based on Lab Exercises: 1-5	
P-2	15 Marks	Based on Lab Exercises: 6-11	
Day-to-Day Work	Viva	20 Marks	70 Marks
	Demonstration	20 Marks	
	Lab Record	15 Marks	
	Attendance & Discipline	15 Marks	
Total	**100 Marks**		

Learning Resources:

Tutorials sheets, lecture slides and handwritten notes on Digital Circuit Design lab and viva-voce related digital content is also ensured to available on the JUET server for registered students

Text Books:

[1] Morris Mano, "Digital Design," Pearson Education, 3rd edition,

Reference Books:

[1] Morris Mano, Digital Logic and Computer Design, PHI
[2] 2. Taub and Schilling, Digital Integrated Electronics, McGraw Hill, Int. Ed.
[3] Zainalabdil Navabi, Analysis & Modeling of Digital System, TMH
[4] Charles H. Roth, Jr., Fundamental of Logic Design, Cengage Learning, 5th edition.

Web References:

[1] https://www.sanfoundry.com/digital-circuits-multiple-choice-questions-answers/
[2] https://www.examveda.com/electrical-engineering/practice-mcq-question-on-digital-electronics/

Journals References:

[1] Digital logic circuits, IEEE publisher
[2] Logic Circuits, Sciencedirect, Elsevier
[3] Digital Circuits, Sciencedirect, Elsevier

Title: Analog and Digital Communication lab **Code: 18B17EC472**

L-T-P scheme: 0-0-2 **Credit: 1**

Prerequisite: Students must have already studied courses, "*Signals and System Lab*".

Objective:

1. To learn the principles and techniques of analog communication system.
2. To analyze the performance of pulse and digital communication system.

Learning Outcomes: In reference to Analog & Digital Communication (18B11EC412), the students will be able to:

Course Outcome	**Description**
CO1	Understand basic communication system
CO2	Express the conversion of analog to digital communication system
CO3	Identify different types of pulse communication
CO4	Describe and analyze the various digital modulation techniques
CO5	Demonstrate the concept of multiplexing
CO6	Work as a team on a project.

Course Content:

Unit-1; Lab exercises based on amplitude modulation and frequency modulation
Unit-2; Lab exercises based on analog to digital conversion like as pulse code modulation and sigma delta modulation
Unit-3; Lab exercises based on various pulse modulations such as pulse width and pulse position
Unit-4; Lab exercises based on amplitude shift and frequency shift keying
Unit-5; Lab exercises based on framing and marking in time division multiplexing
Unit-6; Lab exercises based on pseudo noise generation

Teaching Methodology:
This lab course is introduced to help students for understanding the basic concept of communication systems. Initially an analog communication technique will be covered and followed by analog to digital conversion using sampling with pulse communication are explained in details. In the second part, digital modulation will be covered. At the end, framing and marking along in multiplexing and pn sequence generator has been discussed.

Evaluation Scheme:

Exams	**Marks**	**Coverage**	
P-1	15 Marks	Based on Lab Exercises: 1-7	
P-2	15 Marks	Based on Lab Exercises: 8-14	
Day-to-Day	Viva	20 Marks	70 Marks

Work	Demonstration	20 Marks	
	Lab Record	15 Marks	
	Attendance & Discipline	15 Marks	
Total		**100 Marks**	

Learning Resources:
Study material of Analog & Digital Communication Lab (will be added time to time): Digital copy will be available on the JUET server.

Text Book:

[1] "Modern Digital and Analog Communications Systems", Lathi B. P., 3rd Edi. , Oxford university press, 2005.
[2] "Principles of Communication Systems", Taub H., Schilling D.L. and Saha G., 3rd Edi., Tata McGraw Hill, 2008.

Reference Books:

[1] "Communications Systems", Haykin S., 4th Edi. , John Wiley and Sons, 2004.
[2] "Digital Communications", Proakis J. G., 4th Edi. , Tata McGraw Hill, 2000.

Web References:
1. https://www.wisdomjobs.com/e-university/analog-communication-tutorial-1677/
2. https://www.tutorialspoint.com/principles_of_communication/

Journals References:

[1] International Journal of Communication Systems Wiley publication
[2] International Journal of Digital Communication and Analog Signals

Title: Hardware Lab **Code: 18B17EC572**

L-T-P scheme: 0-0-2 **Credit: 1**

Prerequisite: Students must have already studied the courses, "*Electrical Science Lab*" and "*Digital Circuit Design Lab*".

Objective:

1. Students will be able to understand the identification of different electronic components, use of bread board for testing the circuit.
2. Development of Layout from software, Etching, drilling and soldering process along with fault diagnosis.

Learning Outcomes:

Course Outcome	Description
CO1	Outline various electronic components like diode, transistors, FET's with respect to their needs for the design of various projects
CO2	Description of different type of power supply which will be used to design any hardware circuit.
CO3	Development of the various OP-AMP based circuits to design different type of hardware circuits.
CO4	Identification and use of various logic gate-based circuits to develop control circuit in the hardware circuit.
CO5	Application of various components on a given assignment/ project.
CO6	Demonstration and deployment of basic combinational & sequential circuits.

Course content

Unit 1: Physical identification of different Electronic Components like Diode, transistors, FET's
Unit 2: Different type of Power supply
Unit 3: OP-AMP based Circuits
Unit 4: Logic gate based Circuits
Unit 5: Combinational & sequential Circuits

List of Projects

1. A-stable multivibrator (IC type)
2. Differential Amplifier
3. Regulated power supply (+/-12V -> +/-5V Power unit)
4. Simple amplifier
5. High pass/ low pass Butterworth filter
6. Digital Logic design (Multiplexer, Encoder etc.)
7. Binary weighted register 4 bit D/A Converter
8. Stair-case Signal Generator
9. Water Level Indicator
10. Electronic Heart
11. Note-Pad Lamp for telephone
12. Panic Alarm
13. Traffic Light Controller

14. Single-Supply Sinusoidal Flasher
15. Fastest Finger First

Teaching Methodology:

This course is introduced to help students the basic components and how to develop simple hardware projects with the help of these components.

Evaluation Scheme:

Exams		**Marks**	**Coverage**
P-1		15 Marks	Based on projects: 1-7
P-2		15 Marks	Based on projects: 8-14
Day-to-Day Work	Viva	20 Marks	70 Marks
	Demonstration	20 Marks	
	Lab Record	15 Marks	
	Attendance & Discipline	15 Marks	
Total		**100 Marks**	

Learning Resources:

Circuit diagram and component list will be given in the hardware Lab (will be added time to time): Digital copy will be available on the JUET server.

Text Books:

[1] Electronic project book, BPS publication.
[2] Electronics for you (Monthly Magazine).

Reference Books/Material:

[1] "Electronics project management and design", D. Joseph Stadtmiller, Pearson; 1 edition 2000.
[2] "50 Electronics Projects for Beginners", A.K.Maini, Pustak Mahal; First Edition 2007.

Web References:

[1] www.electronicshub.org
[2] https://nevonprojects.com

Journals References:

[1] Journal of Communications Technology and Electronics
[2] IEEE Transaction on communication

5th Semester

HSS Elective – 2

Title: Concept of Economics **Code: 21B14HS547**

L-T-P scheme: 2-1-0 **Credit: 3**

Prerequisite: None

Objectives:

1. The course is concerned with the application of economic principles and methodologies to key management decisions within organizations.
2. It provides principles to foster the goals of the organization, as well as a better understanding of the external business environment in which an organization operates.
3. It is fundamentally a unique way of thinking about problems, issues and decisions that managers face in each of the functional areas of the organization as well as the strategic ones faced by general managers.

Learning Outcomes:

Course Outcome	Description
CO1	Outline what economics is and how micro and macroeconomics differ from each other. Describe basic concepts of Demand and Supply & Elasticity's of demand
CO2	Develop an understanding of factors of production. And demand forecasting
CO3	Identify different types of cost and revenue. Deploy and be proficient in contribution and break-even analysis
CO4	Apply logic to understand different market structures viz Perfect Competition; Monopoly; Monopolistic Competition; and Oligopoly.
CO5	To understand the concept of national income, inflation, monetary policy and fiscal policy and business cycles
CO6	Develop an understanding Foreign Trade of India, Foreign Exchange and Balance of Payments

Course Content:

Unit-1: Introduction of Micro & Macro-economic Concepts: Scope, Micro and Macro economics, Fundamental concepts of Economics, Law of demand**,** Law of Supply Marginal Utility theory, Elasticity of demand – Price, Income, Cross, Advertising, Demand forecasting- Quantitative and Qualitative methods

Unit-2: Production and Cost Theory and Analysis: Production with one variable, optimal employment of a factor of production, Production with two variable inputs, Production Isoquants, Production Isocosts, **Cost Theory and Analysis :** Cost concepts – Opportunity, Explicit, Marginal, Incremental and Sunk, Relation between Production & Cost, Short run cost function, Long run cost function, Profit contribution analysis, Break Even analysis

Unit-3: Pricing under Different Market Structures: Perfect Competition - Determination of Price output relationship in short run, long run, Monopoly -Determination of Price output relationship in short run & long run , Price discrimination, Monopolistic Competition - Determination of Price output

relationship in short run & long run , Product Differentiation ,Oligopoly -Types ,Determination of Price output relationship , Price leadership model, Collusive and Non Collusive Oligopoly

Unit-4: National Income, -concepts, components, Methods and problems in measuring national income, Per capita income, Circular flow of income, Inflation, Monetary and fiscal policy, Business cycles

Unit-5: Foreign Trade of India, Foreign Exchange, Balance of Payments

Teaching Methodology:
Teaching methodology in this course involves classroom lectures as well tutorials. The tutorials allow a closer interaction between the students and the teacher as each student gets individual attention. In tutorials, the teacher will be keeping track of each student's progress and address her/his individual difficulties. Written assignments and projects submitted by students as part of the course will also discussed in tutorials.

Evaluation Scheme:

Exams	**Marks**	**Coverage**
Test-1	15 Marks	Based on Unit-1 & Unit-2
Test-2	25 Marks	Based on Unit-3 & Unit-4 and around 30% from coverage of Test-1
Test-3	35 Marks	Based on Unit-5 and around 30% from coverage of Test-2
Assignment	10 Marks	
Tutorials	5 Marks	
Quiz	5 Marks	
Attendance	5 Marks	
Total	**100 Marks**	

Reference Books/Material:

[1] Osborne, M. (2004), An introduction to game theory. Oxford University Press.
[2] Snyder, C., Nicholson, W. (2010), Fundamentals of microeconomics. Cengage Learning.
[3] Varian, H. (2010), Intermediate microeconomics: A modern approach, 8th ed. W. W. Norton.
[4] Bergstrom, T., Varian, H. (2014),Workouts in intermediate microeconomics. W. W. Norton
[5] Bernheim, B., Whinston, M. (2009). Microeconomics. Tata McGraw-Hill.
[6] Mankiw, N. (2007). Economics: Principles and applications, 4th ed. Cengage Learning.
[7] Snyder, C., Nicholson, W. (2010). Fundamentals of microeconomics. Cengage Learning.

Title: Data Structures and Algorithms **Code: 18B11CI512**

L- T-P Scheme: 3-0-0 **Credit: 3**

Prerequisite: Students must have already registered for the course, "Software Development Fundaments" (18B11CI111).

Objective:
This course develops:
1. problem solving ability using programming
2. ability to express solutions to problems clearly and precisely
3. ability to design and analyze algorithms
4. introduces with fundamental data structures
5. Strengthen ability to design and evaluate ADTs, nonlinear temporary and persistent data structures and related algorithms.

Learning outcomes:

Course Outcome	Description
CO1	List various types of data structures with respect to their requirements in different fields.
CO2	Describe the various methods to evaluate the algorithms.
CO3	Develop algorithms based on linear and non-linear data structures
CO4	Identify the suitability of the data structures and algorithms as per the requirements.
CO5	Apply data structures to develop efficient algorithms.
CO6	Demonstrate the learning of the course to solve the real life programming problems.

Course content:
This course is intended to provide a thorough introduction to the use of data structures in programming. This course will cover the necessary mathematical background, but will assume the required programming experience.

Unit I: UNIT 1: Introduction to Data Structures, Algorithm and Complexity
Data structure overview, need of data structure and how to select relevant data structure for given problem, basic C data types and ADT. Algorithm overview and its properties, problem analysis and construction of algorithm, difference among algorithm, program, and software, algorithm analysis and complexity, asymptotic notations to represent the time complexity.

UNIT II: Searching and Sorting
Overview, memory representation of 1D and 2D array, sparse matrix, operation supported by an array, Linear search, binary search (iterative), binary search (recursive), Sorting, Types of sorting algorithms, bubble sort, selection sort, insertion sort, quick sort, merge sort, heap sort, radix sorting, counting sorting, Bucket Sorting.

UNIT III: Linear data structures
Linked list, types of linked list, and operations on linked lists. Stack overview, stack implementation using array and linked list, basic operations on stack, applications of stack – evaluation of mathematical

expression, conversion of expression from one form to another (Polish Notation), Tower of Hanoi problem. Queue overview, basic operations on queue – enqueue, dequeue, implementation of queue using array and linked list, types of queue - linear queue, circular queue.

UNIT IV: Non-linear data structures
Tree definition and its terminology, representation of graph using array and linked list, tree traversals – preorder, inorder and postorder, binary search tree (BST) with insertion, deletion and searching operations, extended binary tree and its application in Huffman tree,
Introduction to graph, types of graph, traversal algorithms in graph – breadth first search, depth first search.

Unit V: Heap, Priority Queues, B-Tree, AVL, Splay Tree, Red-Black Tree, Threaded Tree. Elementary Graph algorithms: Minimum spanning trees, Kruskal's algorithm, Prim's algorithm. Single source shortest path, all pair shortest path.

Teaching Methodology:

Evaluation Scheme:

Exams	Marks	Coverage
Test-1	15 Marks	
Test-2	25 Marks	
Test-3	35 Marks	
Assignment	10 Marks	
Tutorials	5 Marks	
Quiz	5 Marks	
Attendance	5 Marks	
Total	**100 Marks**	

Learning Resources:
Tutorials and lecture notes/slides on Data Structures and Algorithm (will be added from time to time): Digital copy will be available on the JUET server.

Text Books:

1. Sartaj Sahni, "Fundamentals of Data Structures", Tata Mc Graw Hill, New York
2. Seymour Lipschutz., "Data Structures with C", Schaum's Outline Series
3. Narasimha Karumanchi, "Data Structures and Algorithms" Made Easy
4. Corman et al: "Introduction to Computer Algorithms", the Massachusetts institute of Technology, Cambridge, Massachusetts.

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Reference Books:

1. Langsam, Augestein, Tenenbaum: Data Structures using C and C++
2. Weiss: Data Structures and Algorithm Analysis in C/C++

3. Samir K. Bandyopadhyay," Data Structures using C"
4. Hopcraft, Ullman: Data Structures and Algorithms

Web References:

Journals References:

Discipline Elective: 1

Title: Network Synthesis **Code: 18B14EC542**

L-T-P Scheme: 3-0-0 **Credit: 3**

Prerequisite: Students must have already studied courses, "*Electrical Sciences*".

Objective:

1. To develop the knowledge of various network functions and their characteristics which will be useful to all engineers to learn the Time-domain response of the network and stability.
2. They will also understand the basic filter structures and their applications in the real world.

Learning Outcomes:

Course Outcome	Description
CO1	Outline various network functions with respect to their needs for the design of active and passive network and time domain response to define their stability.
CO2	Description of the characteristic parameters of symmetrical and asymmetrical networks
CO3	Development of the filter design to meet market expectations using LC circuit.
CO4	Identification and use of various positive real functions like LC, RC, RL and RLC for a various network design
CO5	Application of filter design techniques on a given assignment/ project.
CO6	Demonstration and deployment of basic transmission line and coaxial cables for the transmission of the signal.

Course Content:

Unit 1: Network Functions: Poles and zeros, restrictions on pole and zero locations for driving point functions and transfer functions. Time-domain response from pole and zero plot. Stability of active networks.

Unit 2: Characteristic Parameters of symmetrical and asymmetrical two port networks and their design: Image impedance, iterative impedance, characteristic impedance, propagation coefficient, image transfer coefficient, iterative transfer coefficient, Lattice and Bridged T networks, reactive matching networks, matching techniques, insertion loss, symmetrical and asymmetrical attenuators and their design.

Unit 3: Passive LC Filters: Analysis and design of Low pass, high pass, band pass and band elimination filters, m-derived filters, composite filters, Filter specifications, Butterworth approximation, Chebyshev approximation, elliptic function approximation, frequency transformation.

Unit 4: Positive real function: LC, RL, RC, and RLC network synthesis, Foster and Cauer network, minimum positive real function, Brune's method, Bott-Duffin method, Synthesis-Coefficient.

Unit 5: Transmission line fundamentals: Lumped parameter equivalent, voltage and current on a transmission line, infinite line, characteristic impedance and propagation constant

Unit 6: Effects on Transmission line: waveform distortion, attenuation and phase equalizers, distortion-less line, loading, liner reflection on a line, reflection coefficient, input and transfer impedances, open

circuit and short circuit line, reflection factors, reflection loss, insertion loss, T and π equivalents of a line, location of line fault, construction and design of two wire line and coaxial cable.

Teaching Methodology:
Lectures would be interactive and it would cover the core concepts that are explained in the text and reference materials with adequate examples.

Evaluation Scheme:

Exams	Marks	Coverage
Test-1	15 Marks	Based on Unit-1 and Unit-2
Test-2	25 Marks	Based on Unit-3 & Unit-4 and around 30% from coverage of Test-1
Test-3	35 Marks	Based on Unit-5 to Unit-6 and around 30% from coverage of Test-2
Assignment	10 Marks	
Tutorials	5 Marks	
Quiz	5 Marks	
Attendance	5 Marks	
Total	**100 Marks**	

Learning Resources:
Tutorials and lecture slides on network synthesis (will be added from time to time): Digital copy will be available on the JUET server.

Text Books:
[1] Ryder: Networks and Transmission Lines, PHI Learning.
[2] Valkenberg: Introduction to Modern Network synthesis, Wiley India.
[3] Suresh: Electric Circuits and Networks, Pearson Education.

Reference Books/Material:
[1] Raju: Electromagnetic field theory and Transmission Lines, Pearson Education.
[2] Ganesan: Transmission Lines and Waveguides, TMH.
[3] Rao: Electromagnetic Waves and Transmission Lines, PHI learning.

Web References:
[1] https://www.electrical4u.com
[2] https://www.awr.com

Journals References:

[1] IEEE transaction on circuit and Systems
[2] Springer circuit systems and signal processing

Title: Digital Hardware Design **Code: 18B14EC543**

L- T-P Scheme: 3-0-0 **Credit: 3**

Prerequisite: Students should be studied the courses: "Digital Circuit Design".

Objective:
The course shall provide the students with advanced knowledge in modern electronic design with the help of a hardware description language.

Learning outcomes:

Course Outcome	Description
CO1	Outline basics of digital electronics with respect to their needs in the digital system design. Classification of digital systems and examples of their applications.
CO2	Description of the RTL micro-operations and their symbolic notions.
CO3	Development of Arithmetic Logic Unit (ALU) for various operations to be performed.
CO4	Identification and use of the combinational and sequential logic circuits and their use in system implementation.
CO5	Application of various synchronous and asynchronous circuits on a given assignment.
CO6	Demonstration and deployment of designs based on RTL using VHDL.

After successful completion of the course the student shall be able to design and implement the digital hardware circuits. Also the students will verify, synthesize and implement a design written in VHDL.

Course content:

Unit I: Introduction
Digital Design Flow, Hardware Design Environment- Design and Verification, EDA Tools, Simulation and Synthesis process.

Unit II: Register transfer logic (RTL)
Inter register transfer, arithmetic, logic and shifter micro-operations, conditional control, ASM chart, data-path and control logic design.

Unit III: Processor logic design
Processor organization, arithmetic logic unit, design of ALU, overflow, arithmetic shift, design of multi-purpose accumulator.

Unit IV: Asynchronous Sequential Machine
Introduction to asynchronous sequential machine. Analysis of asynchronous circuits, flow table, race condition, primitive flow table, state reduction, state assignment and synthesis of asynchronous circuit. hazards.

Unit V: Arithmetic logic design
Ripple carry adder, carry look-ahead adder, carry select adder, carry save adder, parallel multiplier, sign multiplication, Baugh-Wooly multiplication algorithm, radix-4 Booth multiplication algorithm

Unit VI: RTL simulation
Package declaration for different data types, use of generate statement, VHDL coding of generic logic components for combinational logic circuits (multiplexer, decoder, parallel adder/ subtractor, ALU and multiplier) and sequential logic circuits (registers and accumulator).

Teaching Methodology:
This course is introduced to help students to understand the basics of Digital circuit and system design. Starting from frontend development, the student will slowly progress to become to other aspects of digital VLSI. Design skills that are helpful for an engineer. The entire course is based on: Fundamental and Designing, EDA tool & Technologies and brief idea of the digital hardware. Each section includes digital circuit designs to help a student to gain basic knowledge of digital systems.

Evaluation Scheme:

Exams	**Marks**	**Coverage**
Test-1	15 Marks	Based on Unit-1
Test-2	25 Marks	Based on Unit-2, Unit-3 and around 30% from coverage of Test-1
Test-3	35 Marks	Based on Unit-4 to Unit-5 and around 30% from coverage of Test-2
Assignment	10 Marks	
Tutorials	5 Marks	
Quiz	5 Marks	
Attendance	5 Marks	
Total	**100 Marks**	

Learning Resources:
Tutorials and lecture notes/slides on Digital Hardware Design (will be added from time to time): Digital copy will be available on the JUET server.

Text Books:
1. M.Morris Mano: Digital Logic and Computer Design, Prentice Hall of India.

Reference Books:
1. M.Morris Mano: Digital Design, Prentice Hall of India.
2. Charls Roth: Fundamental of Logic Design.

Web References:
[1] https://swayam.gov.in
Journals References:

[1] IET Computers & Digital Techniques - IET Digital Library
[2] IEEE Transactions on Computers

Science Elective

Title: Power Science **Code: 18B14FS541**

L-T-P scheme: 3-0-0 **Credit: 3**

Prerequisite: The student should know the basics of various electronic components, and its characteristics. Should know the applications of various electronic components like diode, transistor, etc. Student should have studied "*Electronic devices*" course.

Objective:

The student will be able to understand the various power devices, characteristics, structure, and its applications in various aspects. The student will be able to implement various projects based on various power devices.

Learning Outcomes:

Course Outcome	Description
CO1	Structure of various power devices and its characteristics.
CO2	Structure of most commonly power device i.e. thyristors.
CO3	Develop the various circuits of thyristors.
CO4	Identify the various circuits and working in practical aspect.
CO5	Relate and analyse the circuits and working which would be helpful in real applications.
CO6	Develop circuits and its working which would minimize the power loss in practical application.

Course Content:

Unit-1: Review of basics of electrical circuits like KVL, KCL. Review of basic electronic components like diode, transistor.

Power Semiconductor Devices: Diodes- performance parameter, Effects of forward and reverse recovery time, transistors- steady state and switching characteristics, Performance parameters. UJT- operation, characteristics, relaxation oscillators, Power MOSFET- Construction, Working, Switching Characteristics, IGBT, Construction, Working, Switching Characteristics, Applications, Diac, Construction, Working, Characteristics, Triac, Construction, Working, Characteristics.

Unit-2: Thyristors: V-I characteristics, switching characteristics, Gate characteristics, Two transistor model, turn-on, turn-off, di/dt & dv/dt protection, design of Snubber circuit, firing- resistance and resistance capacitance firing, commutation techniques- class A, B, C&D.

Unit-3: Rectifiers: Uncontrolled- single phase with (R, RL, and RLE) load. Controlled- single phase with (R, RL, and RLE) load.

Unit-4: Choppers: Principle of operation, control strategies, step up and step down chopper, type-A, B, C, & D chopper.

Unit-5: Inverters: Single phase inverters, Cyclo converters.

Teaching Methodology: This course is introduced so that students are able to understand various power devices and its applications in various fields. The student is able to understand how efficient power utilization can be done by deploying various power devices.

Evaluation Scheme:

Exams	**Marks**	**Coverage**
Test-1	15 Marks	Based on Unit-1, Unit-2
Test-2	25 Marks	Based on Unit-1, Unit-2 & Unit-3 and around 30% from coverage of Test-1
Test-3	35 Marks	Based on Unit-3, Unit-4 & Unit-5.
Assignment	10 Marks	
Tutorials	5 Marks	
Quiz	5 Marks	
Attendance	5 Marks	
Total	**100 Marks**	

Learning Resources:

Lecture slides on Power Science (will be added from time to time): Digital copy will be available on the JUET server.

Text Book:

[1] P. S. Bimbhra, Power Electronics, 3/e, Khanna Publishers
[2] Muhammad H. Rashid, Power Electronics, 3/e , Pearson Education, 2005

References Books

[1] P. C. Sen, Power Electronics, 24th reprint TMH, 2005
[2] Sugandhi, R.K., Sungadhi, P.K., *Thyristor theory and Applications*, Wiley Eastern Ltd, 2003.

Web References:

[1] www.tutorialspoint.com
[2] www.electronics-notes.com
[3] www.lecturenotes.in

Journals References:

[1] Journal of Power Electronics.
[2] IEEE Transaction on Power Electronics.

Title: Science of Semiconductors **Code: 18B14FS542**

L-T-P Scheme: 3-0-0 **Credit: 3**

Prerequisite: Students must have already studied courses: *"Physics-1" and "Physics-2".*

Objective:

1. To study the fundamentals of Semiconductor materials.
2. To study the concept of characteristics and conducting properties of semiconductor materials and devices.

Learning outcomes:

Course Outcome	Description
CO1	Outline basics of materials, Intrinsic semiconductors and conductivity of various semiconductors.
CO2	Description of the unidirectional property of *PN*-junction. Performance of half-wave and full-wave rectifiers and various diodes and applications.
CO3	Development of BJT Structure, models of BJT and working of a transistor.
CO4	Identification of equilibrium in semiconductors. Study of the metal semiconductor junctions and Ohmic contacts.
CO5	Application of Junction Field-Effect Transistor (JFET): Output and transfer characteristics.
CO6	Demonstration and deployment of MOS techniques and circuit design.

Course Content:

Unit I: Semiconductor Science

Materials, Intrinsic semiconductors, Covalent bonds, Electron-hole concepts, Random movement of carriers, Hole as a particle, Recombination of electrons and holes, Conductivity of semiconductors. Extrinsic Semiconductors, Donor and acceptor impurities.

Unit II: Semiconductor Diodes

Unidirectional property, *PN*-junction with no bias, with forward bias and with reverse bias, Transition and diffusion capacitances. *V-I* characteristics, Comparison of Si and Ge diodes, Temperature effects, Diode resistance (static and dynamic), Diode equation, Ideal diode, Circuit model of a diode. Half-wave and full-wave (centre tap and bridge) rectifiers, PIV rating of diode, Performance of half-wave and full-wave rectifiers, Shunt capacitor filter. Zener diode, Analysis of Zener voltage regulator. Tunnel diode, LED, varactor diode, schottkey diode

Unit III: Bipolar Junction Transistor (BJT)

BJT Structure, models of BJT, Working of a transistor, Transistor current equation, Collector reverse saturation current, DC alpha of a transistor. The three configurations, CB and CE input and output characteristics, DC load line.

Unit IV: Metal-Semiconductor Contacts: equilibrium, idealized metal semiconductor junctions, nonrectifying (ohmic) contacts, Schottky diodes, tunneling.

Unit V: Field-Effect Transistor (FET)

Junction Field-Effect Transistor (JFET): Basic construction, Pinch-off voltage, Drain saturation current,

Output and transfer characteristics.

Unit VI: MOS Field-Effect Transistor
Threshold voltage, Depletion and Enhancement type MOSFET---Construction, Operation and Characteristics. Derivation of current-voltage characteristics, dependence on device structure, State-of-the-Art MOS Technology: small-geometry effects, mobility degradation due to channel and oxide fields, velocity saturation, hot-electron effects, device wear out mechanisms.

Evaluation Scheme:

Exams	**Marks**	**Coverage**
Test-1	15 Marks	Based on Unit-1
Test-2	25 Marks	Based on Unit-2, Unit-3 and around 30% from coverage of Test-1
Test-3	35 Marks	Based on Unit-4 to Unit-6 and around 30% from coverage of Test-2
Assignment	10 Marks	
Tutorials	5 Marks	
Quiz	5 Marks	
Attendance	5 Marks	
Total	**100 Marks**	

Learning Resources:
Tutorials and lecture notes/slides on Signals & Systems (will be added from time to time): Digital copy will be available on the JUET server.

Text Books:
1. Boylstad and Nashelsky, 'Electronic Devices and Circuits', PHI, 6e, 2001.
2. Electronic Devices and Circuits, Millman, Jacob.

Reference Books:
1. C Kulshreshtha, 'Electronic Devices and Circuits', New Age, 2e, 2006.
2. Salivahanan and Arivazhagan, 'Digital Circuits and Design' Vikas Publishing, 2e, 2003.

Web References:
[1] https://www.udemy.com/
[2] https://swayam.gov.in/nd1_noc20_ee29/preview

Journals References:

[1] VLSI Design— An Open Access Journal - Hindawi
[2] IEEE Transactions on Very Large Scale Integration

Title: Nanoscience and Technology **Code: 18B14FS543**

L-T Scheme: 3-0 **Credits: 3**

Objectives: The course aims to provide students an understanding of materials and their properties at the atomic level. The course is focused at imparting the effect of scale and size of materials on the properties of engineering materials. The modern development in the area of nanoscience and nanotechnology emphasizing on the manufacturing and processes for the synthesis of nanostructured materials, which are prime objectives to be addressed in this course.

Learning Outcomes: At the end of this course, student would be able understand several analytical tools to characterize the nanostructured materials. Using the understanding of nanoscience and nanotechnology, they will able to perform classification of nanostructure materials, its large-scale manufacturing for various engineering applications.

Course Outcome

Course Outcome	Description
CO1	Introduction to concept of Nanoscience and classification of nanostructured materials
CO2	Basic concept of crystal structure and quantum mechanics
CO3	Size effect and its effect on structural properties of materials.
CO4	Introducing basic concepts of defects, crystal structures, band theory of solids in 1D, 2D and 3D.
CO5	Synthesis and characterization of nanostructured materials.

Course Content:

Introduction and Classification of nano-structured materials: Nanoscience and Nanotechnology, Brief History and future scope, Gleiter's classification of nano-structured materials, Classification of nanostructures by dimensionality. **(Lectures: 10)**

Basic Concepts: Concept of matter waves, Schrodinger wave equation, confinement, particle in a potential box, barrier penetration and tunneling effects, concept of density of states (0D,1D, 2D and 3D)**,** Band formation in solids and extension to semiconductors **(Lectures: 6)**

Size effects and properties of nano-structured materials: Concept of characteristic time and length scales of physical phenomena, Definition and types of size effects, extended internal surface, increasing surface energy and tension, Grain boundaries, classical and quantum size effects, size dependent thermal, mechanical, electrical, magnetic and optical properties of nano-structured materials e.g. Reduction of lattice parameter, decrease in melting point, decreasing thermal conductivity, diffusion enhancement, increasing plastic yield strength and hardness, blue shift, broadening of energy bands, phase transitions in ferromagnetic and ferroelectric materials. **(Lectures: 12)**

Techniques for synthesis of Nanostructures: Top-down and Bottom approaches, Vapor – phase synthesis, Liquid phase synthesis, Sol-gel technique, Solid – state phase synthesis, consolidation of nano-powders. **(Lectures: 6)**

Basic characterization and microscopy of Nanostructure materials: X-ray diffraction (XRD), UV-visible, FTIR, TGA, Scanning Electron microscopy (SEM), Transmission electron Microscopy (TEM), Scanning probe microscopy, Scanning tunneling Microscopy (STM) and Atomic Force microscopy (AFM). **(Lectures: 4)**

Nanotechnology Applications: Applications of Nanostructures for diversified fields of Engineering.

(Lectures: 4)

Text Books:

1. Nano Structures & Nano Materials, Synthesis, Properties & Applications by Guozhong Cao, Imperial College Press.
2. Concept of modern Physics by Arthur Beiser, 6 th Edison, McGraw-Hill.

Reference Books:

1. Introduction to Solid State Physics by C.Kittel 7th ed. Wiley
2. Nanoscale Energy Transport and Conversion: A Parallel Treatment of Electrons, Molecules, Phonons, and Photons by Gang Chen, Oxford University Press
3. Nano/Micro scale heat transfer by Zhuomin M. Zhang, Mc Graw-Hill Nanoscience and Technology series
4. Nanoscale materials in chemistry, 2 nd edition, by Kenneth J. Klabunde and Ryan M. Richards, John Wiley & Sons.

Title: Material Science & Applications **Code: 18B14PH543**

L-T Scheme: 3-0 **Credits: 3**

Objectives: Materials are the building blocks for almost all the technologies associated with electronic gadgets, electrical components, communication systems, signal processing, storing of information, hardware components and their related accessories. Therefore, search for new materials and study of their properties, useful for electronics, electrical and computer technology has become an area of current interest to the scientists and technologists. The present course aims at giving the students a basic knowledge necessary for understanding electric, magnetic, semiconducting, polymeric, solar and superconducting materials used in engineering applications.

Course Outcomes:

Course Outcomes	Description
CO1	Provides basic ideas about the crystal structure, lattice planes and unit cells for the understanding of various physical, electrical and optical properties of solids. Also, to analyse the different crystal structure using the X-ray diffraction technique.
CO2	To understand different polarisation mechanism related with the dielectric materials, which is useful for understanding the mechanism of capacitors and their applications in devices.
CO3	Establishes ideas of magnetic hysteresis in different ferromagnetic materials for their application in magnetic memories, hard drives etc. The topics are significant to understand their soft and hard magnetic behaviour on basis of their magnetic structure and type of materials.
CO4	Provides basic knowledge about the components and working of the battery and other storage devices. Also, these topics explain the basics of solar cell to be used in solar panels and other device applications.
CO5	It gives understanding about the critical temperature and critical magnetic field of the superconductors. Provides explanation of superconductors and HTSC using the BCS theory. It explains how these materials are applicable in Maglev and Squid devices.

Course Contents:

Unit I (Elementary Crystallography): Introduction to crystallography, Lattice translation vectors, Basis and Crystal structure, Symmetry operations, Primitive Lattice cell, Two-dimensional lattice types, systems, Number of lattices, Point groups, Three-dimensional lattice types, Systems, Number of Lattices, Points groups and space groups. Indexing system for crystal planes, Miller indices, Simple crystal structures, NaCl, hcp, diamond structure.
X-Ray diffraction and Bragg's law; Determination of Crystal structure using Bragg's diffractometer. **[10]**

Unit II (Dielectric Materials): Polarisation mechanism & Dielectric Constant, Sources of polarizability, Behaviour of polarisation under alternating field, Applications of Dielectric Materials in capacitor, Different types of capacitor, Charging-discharging mechanism of capacitor, Energy stored in capacitor, Design of capacitor banks for specific requirements, Piezo motor and

transformer, ferro memory cell. **[10]**

Unit III (Magnetic Materials): Concept of magnetism, Classification – dia-, para-, ferro-, antiferro- and ferri-magnetic materials, Concepts of electromagnetic induction, application of magnetic materials for motors, transformers, generators and magnetic storage devices. **[10]**

Unit IV (Materials for Energy Storage & Conversion Devices): Different types of energy storage devices, concept of battery, choice of electrode and electrolyte material for rechargeable battery. Concepts of p-n junction, Solar cell, Applications of solar cells in making solar panels. [10]

Unit V (**Superconducting Materials:**): Meissner effect, Critical field, type-I and type-II superconductors; Field penetration and London equation; BCS Theory, High temperature Superconductors and their Applications. **[5]**

Text Books & References:

1. Introduction to Solid State Physics, Charles Kittel, 8th Ed., 2004, Wiley India Pvt. Ltd.
2. Elements of Solid-State Physics, J.P. Srivastava, 2nd Ed., 2006, Prentice-Hall of India
3. Solid State Physics, N.W. Ashcroft and N.D. Mermin, 1976, Cengage Learning
4. Solid State Physics by S. O. Pillai.

Title: Biochemistry **Code: 18B14CH541**

L-T-P Scheme: 3-0-0 **Credit: 3**

Prerequisite: The students must be aware of basic Chemistry and Biology up to the I. Sc. level. This knowledge helps them to correlate and adopt at Graduate Level (B. Tech. Electronic and Communication Engineering).

Objective:
The objective of the course is to introduce various techniques to students that are used in biological research as well as to provide them with an understanding of the underlying principles of these techniques. The emphasis is also on experimental skills in the form of practical exercises so that students can apply this knowledge to improve their understanding of the subject for better execution of these techniques.

Course Learning Outcomes:

Course Outcome	Description
CO1	The outline, outcomes, and attributes provide students with learning experiences that help in achieving deep interests in learning various analytical techniques for industry based on biochemistry.
CO2	Describe the real-world problems, challenges with the application of the electronics gadget. Students will acquire knowledge about the principles and applications of spectrophotometric and chromatography techniques used in a biochemistry lab.
CO3	Develop in students the ability to apply the knowledge and skills they have acquired to the solution of specific theoretical and applied problems in the application of electrophoresis, centrifugation techniques, cell culture and microscopic techniques.
CO4	It will also give them an opportunity to get hands on experience to develop their experimental skills expected from any biochemist working in a research lab
CO5	Apply experimental demonstration and validation by using various analytical techniques given in theorem, principles as explained in lectures.
CO6	Demonstrate students with the knowledge and skill base that would enable them to undertake further studies in Biochemistry. It helps to develop a range of generic skills that are relevant to wage employment, self-employment, and entrepreneurship.

Course Contents
Unit I: Spectroscopic Techniques No. of hours: 15 Electromagnetic radiation, interaction of radiation with biomolecules, principle of UV-visible absorption spectrophotometry, Lambert's Law, Beer's Law, working of a spectrophotometer. Applications of UV-visible absorption spectrophotometry in biochemistry. Fluorescence spectrophotometry: Phenomena of fluorescence, intrinsic and extrinsic fluorescence, applications of fluorescence in biochemistry.

Unit II: Chromatography No. of hours: 15 Preparation of sample, different methods of cell lysis, salting out, dialysis. Introduction to chromatography. Different modes of chromatography: paper, thin layer and column. Preparative and analytical applications. Principles and applications of: Paper Chromatography, Thin Layer Chromatography, Ion Exchange Chromatography, Molecular Sieve Chromatography, Affinity Chromatography.

Unit III: Electrophoresis No. of hours: 12 Basic Principle of electrophoresis, Paper electrophoresis, Gel

electrophoresis, discontinuous gel electrophoresis, PAGE, SDS-PAGE, Native gels, denaturing gels, agarose gel 105 electrophoresis, buffer systems in electrophoresis, electrophoresis of proteins and nucleic acids, protein and nucleic acid blotting, detection and identification (staining procedures), molecular weight determination, isoelectric focusing of proteins.

Unit IV: Centrifugation No. of hours: 8 Principle of centrifugation, basic rules of sedimentation, sedimentation coefficient. Various types of centrifuges, low speed centrifuge, high speed centrifuge and ultracentrifuge, types of rotors. Application of centrifugation, differential centrifugation, density gradient centrifugation- zonal and isopycnic.

Unit V: Microbiological/Cell culture techniques No. of hours: 5 Types of media, selective and enrichment media, sterilization methods, bacterial culturing, CFU determination, growth curves, Generation/doubling times, cell counting, viable and nonviable. Growth and maintenance of cultures, biosafety cabinets, CO2incubator. Staining procedures, plating and microtony.

Unit VI: Microscopy No. of hours: 5 Principle of light microscopy, phase contrast microscopy, fluorescence microscopy. Permanent and temporary slide preparation, histology and staining.

Teaching Methodology:
The entire syllabus has divided into six units. Each section includes multiple topics to help a student gain a deeper understanding of Physical Chemistry. This course is divided into 42 Lectures, 14 Tutorial, and 14 Experiments. The facility provided in LRC for both textbooks of ebook for getting a better understanding of students. The NPTEL lecture was also made available to students.

Evaluation Scheme:

Exams	Marks	Coverage
Test-1	15 Marks	Based on Unit-1 and Unit-2
Test-2	25 Marks	Based on Unit-2 & Unit-3 (80 %) and around 20% from coverage of Test-1
Test-3	35 Marks	Based on Unit-3 to Unit-4 (80%) and around 20% from coverage of Test-1 and Text-2
Assignment	10 Marks	
Tutorials	5 Marks	
Quiz	5 Marks	
Attendance	5 Marks	
Total	**100 Marks**	

Learning Resources:
Tutorials and lecture slide on Web Development (will be added from time to time): Digital copy will be available on the JUET server.

References

1. Boyer, R.F. (2012). Biochemistry Laboratory: Modern Theory and Techniques (6th ed.). Boston, Mass: Prentice Hall. ISBN-13: 9780136043027.
2. Plummer, D. T. (1998). An Introduction to Practical Biochemistry. (3rd ed.). Tata McGraw Hill Education Pvt. Ltd. (New Delhi). ISBN: 13: 9780070994874 / ISBN:10: 0070994870.
3. Wiley, J.M., Sherwood, L.M., Woolverton, C.J. (2017). Prescott's Microbiology. (10th ed.). McGraw Hill Higher Education. ISBN13: 9781259657573.

4. Wilson, K., Walker, J. (2010). Principles and Techniques of Biochemistry and Molecular Biology, (7th ed.). Cambridge University Press. ISBN 9780521516358.

Additional Resources:

1. Cooper, T. G., (2011). The Tools of Biochemistry (2nd ed.). Wiley-Interscience Publication (New Delhi). ISBN: 13:9788126530168. 106
2. Freifelder, D. (1982). Physical Biochemistry: Applications to Biochemistry and Molecular Biology (2nd ed.). W.H. Freeman and Company (New York), ISBN: 0716713152 / ISBN:0716714442.

Title: Microprocessor and Interfacing **Code: 18B11EC511**

L-T-P Scheme: 3-0-0 **Credit: 3**

Prerequisite: Students must have studied "*Digital circuits design*".

Objective:

1. To introduce 8085 architecture and programming in assembly language.
2. To introduce basic concepts of interfacing memory and peripheral devices to a microprocessor.
3. To introduce serial and parallel bus standards. To introduce various interfacing devices such as 8255, 8254 and 8257.

Learning Outcomes:

Course Outcome	Description
CO1	Outline various basic concepts of microprocessors, evolution, embedded system, and semiconductor memory. Understand Standard Architecture of Intel Microprocessors
CO2	Describe the architecture of 8085, registers, pin configuration, timing and control unit and timing diagram. Learn control components of a microprocessor-based system though the use of interrupts
CO3	Develop the programming skills in assembly language, subroutines, knowledge of addressing modes and instruction set.
CO4	Identify the concepts associated with interfacing a microprocessor to memory and to I/O devices and to learn the programming of peripheral I/O devices.
CO5	Applications of microprocessor Measurement, learn the control components of a microprocessor-based system through the use of interrupts.
CO6	Acquaint with the background knowledge for understanding next-generation CPUs.

Course contents:

Unit-1: Introduction of microprocessor: Evolution of microprocessor, word length, input & output device, single chip microcomputers, embedded microprocessor, semiconductor memory, RAM, ROM, EPROM, cache memory, memory hierarchy.

Unit-2: Microprocessor architecture (Intel 8085): ALU, timing and control unit, registers, data and address bus, pin configuration, Intel 8085 instructions, op-code and operands, instruction word size, Instruction cycle, fetch and execute operation, machine cycle and state, instruction and data flow, timing diagram, Interrupts.

Unit-3: Programming of Microprocessor: Machine, assembly and high level language, Instruction and data format, Addressing modes, status flags, Stacks, Subroutines, Assembly language programs.

Unit-4: Peripheral devices and their Interfacing: Address space partitioning, memory mapped and I/O mapped I/O schemes, Data transfer schemes, I/O ports, Programmable Peripheral interface (8255), Programmable Counter/Interval Timer (8254), Programmable DMA controller (8257), Programmable Interrupt controller (8259), 8251.

Unit-5: Microprocessor-Based data acquisition system: Analog to digital converter (ADC- 0800, 0808/0809), Digital to analog converter (DAC-0800), Delay subroutine, 7-segment display, Display of

alphanumeric characters.

Unit-6: Microprocessors Applications: Measurement, Microprocessor based speed control of Stepper motor, Water-level indicator, microprocessor based Traffic light control.

Teaching Methodology:
They can build a project based on the concepts of interfacing between processing machine and real-life application devices. Students will be able to write assembly language programs.

Evaluation Scheme:

Exams	**Marks**	**Coverage**
Test-1	15 Marks	Based on Unit-1&Unit-2
Test-2	25 Marks	Based on Unit-2 & Unit-3 and around 30% from coverage of Test-1
Test-3	35 Marks	Based on Unit-4 to Unit-6 and around 30% from coverage of Test-2
Assignment	10 Marks	
Tutorials	5 Marks	
Quiz	5 Marks	
Attendance	5 Marks	
Total	**100 Marks**	

Learning Resources:
Tutorials and lecture slides on Microprocessor and Interfacing (will be added from time to time): Digital copy will be available on the JUET server.

Text Books:

[1] Gaonkar, Ramesh, "Microprocessor Architecture Programmes and Applications 8085, 4th edition, Prentice Hall.
[2] D. V. Hall, "Microprocessors and Interfacing", Tata McGraw-Hill Education, 3rd Edition 2013.
[3] A.K Ray, K. M. Bhurchandani, "Advanced Microprocessors and Peripherals" Tata McGraw-Hill Education, 2nd Edition, 2006.

Reference Books:

[1] B. Ram, "Fundamentals of Microprocessors and Microcontrollers", 7th edition (2010), Dhanpat Rai Publication, India.

Web references:
[1] http://www.daenotes.com/electronics/digital-electronics/Intel-80858bitmicroprocessor#axzz2I9yUSe7I
[2] https://www.smartzworld.com/notes/microprocessors-and-microcontrollers-mpmc/
[3] http://www.iare.ac.in
[4] www.nptel.ac.in

Journals References:
[1] Elsevier Journal on Microprocessors and Microsystems
[2] IEEE Microprocessors and Controllers

Title: Digital Signal Processing **Code: 18B11EC413**

L-T-P Scheme: 3-0-0 **Credit: 3**

Prerequisite: Students must have already studied courses, "*Signals & Systems"*

Objective:

1. To enhance comprehension capabilities of students through understanding of designing procedure of digital filters both FIR and IIR using different approaches and their associated structures.
2. To study linear predictors for adaptive signal processing.
3. To learn different adaptive filtering algorithms and obtain results from multirate signal processing.

Learning Outcomes: The students will be able to:

Course Outcome	Description
CO1	Outline various discrete/digital signals and systems, their representation and processing
CO2	Describe concept of frequency domain analysis of discrete time signals
CO3	Develop the concept of basic filters and filtering process and their realization
CO4	Identify different approaches and their associated structures designed for both digital FIR and IIR filters.
CO5	Apply important algorithmic design paradigms and method of analysis.
CO6	Demonstrate the concept of multi-rate signal processing and sampling rate conversion & filtering algorithm for the real time application.

Course Content:

Unit 1: Discrete Signals: Review of Discrete time sequences and systems, Linearity, shift- invariance, causality and stability criterion. **Z-Transform:** Review of Z-transforms, Region of Convergence, Relationship between Z transform and Fourier Transform, Inverse Z-transform and its evaluation, System function and structures of a digital filter.

Unit 2: Discrete Fourier Transforms and FFT: Discrete Time Fourier Transform, Discrete Fourier Transform. Fast Fourier Transform (FFT) algorithms using Decimation in Time and Decimation in Frequency techniques, Chirp Z-transform.

Unit 3: IIR and FIR Filter Design: Basic Structures, Review of approximation of filter functions, Design of IIR filters based on Analog filter functions, Invariant & Modified Invariant Impulse Response techniques, Bilinear transformation method, Direct design approach, Linear phase description of FIR filters, Windowing and Frequency sampling techniques of design, Computer aided design techniques.

Unit 4: Some DSP Applications: Applications in speech processing and power spectrum estimation. Introduction to illustrate applications of DSP in image processing,

Unit 5: Adaptive and Multi-rate Systems: Introduction to Adaptive Filters, Design of Adaptive Filters using various techniques, Decimation & Interpolation, Filter design for Sampling Rate Conversation by a Rational Factor I/D.

Teaching Methodology:
This course is introduced to help the students to design various filters by using window functions. In this course, the mixed technique of interactive lectures, tutorials, and regular assignments will be used. In the lectures the fundamental theoretical concepts will be introduced and demonstrated through examples. Discussion in lecture will be done using design problems which will be implemented in laboratory individually in Matlab.

Evaluation Scheme:

Exams	Marks	Coverage
Test-1	15 Marks	Based on Unit-1, Unit-2
Test-2	25 Marks	Based on Unit-3 and around 30% from coverage of Test-1
Test-3	35 Marks	Based on Unit-4 and Unit-5 and around 30% from coverage of Test-2
Assignment	10 Marks	
Tutorials	5 Marks	
Quiz	5 Marks	
Attendance	5 Marks	
Total	**100 Marks**	

Learning Resources:
Lecture and tutorial slides on Digital Signal Processing (will be added from time to time): Digital copy will be available on the JUET server.

Text Books:
[1] Proakis & Manolakis, Digital *Signal Processing: Principles Algorithms and Applications*, PHI.

Reference Books/ Material:

[1] S.K. Mitra, Digital Signal Processing: A Computer Base Approach, TMH
[2] Andreas Antoniou, Digital Signal Processing: Signals, Systems and Filters, TMH
[3] Texas Instruments, Digital Signal Processing Applications with the TMS 320 Family, Prentice Hall

Web References
[1] www.dspguide.com
[2] www.byclb.com/totorials/dsp advanced

Journal References
[1] IET Signal Processing Journal
[2] Journal of Advanced Research in Signal Processing & Applications, ADR publications
[3] Signal & Image Processing : An International Journal(SIPIJ
[4] EURASIP Journal on Advances in Signal Processing
[5] International Journal of Wireless Personal Communications

Title: Data Structures and Algorithms Lab **Code: 18B17CI572**

L-T-P Scheme: 0-0-2 **Credit: 1**

Prerequisite:

Objective:
This course develop problem solving ability using programming, develop ability to express solutions to problems clearly and precisely, develop ability to design and analyze algorithms, introduce with fundamental data structures, develop ability to design and evaluate abstract data types and data structures.

Learning Outcomes: The students shall acquire the generic skills to design and implement data structures and related algorithms for a broad-based set of computing problems

Course Outcome	Description
CO1	Define basic operations on linear data structures
CO2	Illustrate the efficiency of a data structures in terms of time and space complexity.
CO3	Apply the data structures solve the searching and sorting problems.
CO4	Utilize the knowledge of non-linear data structures in solving programming problems.
CO5	Analyze and develop the algorithms using suitable data structures for a given problem.
CO6	Understand basic techniques for designing algorithms, including the techniques of Recursion, Divide-and-Conquer, Greedy Algorithms and Dynamic Programming.

Course Description:
This course is intended to provide a thorough introduction to the use of data structures in programming. This course will cover the necessary mathematical background, but will assume the required programming experience.

Course Contents:
1. Programming exercises based on recursion, array, pointer, string, structures.
2. Programming exercises based on sparse matrix, operations supported by array.
3. Programming exercises based on searching in array.
4. Programming exercises based on sorting algorithms.
5. Programming exercises based on traversing, insertion, deletion, searching and reverse in singly linked list and doubly linked list.
6. Programming exercises based on stack implementation using linked list and array.
7. Programming exercises based on evaluation of mathematical expression, conversion of expression from one form to another (Polish Notation), Tower of Hanoi problem.
8. Programming exercises based on operations on queue, circular queue
9. Programming exercises based on tree data structures, representation of graph using array and linked list, tree traversals – preorder, inorder and postorder, binary search tree (BST) with insertion, deletion and searching operations.
10. Programming exercises based on graph data structures, traversal algorithms in graph – breadth first search, depth first search
11. Programming exercises based on Heap, B-Tree, AVL, Splay Tree, Red-Black Tree, Threaded

Tree.

12. Programming exercises based on Elementary Graph algorithms: Minimum spanning trees, Kruskal's algorithm, Prim's algorithm. Single source shortest path, all pair shortest path.

.

Teaching Methodology:

Evaluation Scheme

Exams		**Marks**	**Coverage**
P-1		15 Marks	
P-2		15 Marks	
Day-to-Day Work	Viva	20 Marks	70 Marks
	Demonstration	20 Marks	
	Lab Record	15 Marks	
	Attendance & Discipline	15 Marks	
Total		**100 Marks**	

Learning Resources:

Text Books:

1. Sartaj Sahni, "Fundamentals of Data Structures", Tata Mc Graw Hill, New York
2. Seymour Lipschutz., "Data Structures with C", Schaum's Outline Series
3. Narasimha Karumanchi, "Data Structures and Algorithms" Made Easy
4. Corman et al: "Introduction to Computer Algorithms", the Massachusetts institute of Technology, Cambridge, Massachusetts.

Reference Books:

1. Langsam, Augestein, Tenenbaum: Data Structures using C and C++
2. Weiss: Data Structures and Algorithm Analysis in C/C++
3. Samir K. Bandyopadhyay," Data Structures using C"
4. Hopcraft, Ullman: Data Structures and Algorithms

Web references:

Journals References:

Title: Microprocessor and Interfacing Lab **Code: 18B11EC571**

L-T-P Scheme: 0-0-2 **Credit: 1**

Prerequisite: Students must have adequate basics of digital electronics.

Objective:

1. To introduce 8085 architecture and programming in assembly language.
2. To introduce basic concepts of interfacing memory and peripheral devices to a microprocessor.
3. To introduce serial and parallel bus standards. To introduce various interfacing devices such as 8255, 8254 and 8257.

Learning Outcomes:

Course Outcome	Description
CO1	Outline based on introduction to 8085 microprocessor kit and practice of commands.
CO2	Describe the architecture of 8085, registers and memory.
CO3	Develop the programming skills in assembly language, subroutines, knowledge of addressing modes and instruction set.
CO4	Identify the concepts associated with interfacing a microprocessor to memory and to I/O devices and to learn the programming of peripheral I/O devices.
CO5	Applications of microprocessor Measurement, learn the control components of a microprocessor-based system though the use of interrupts.
CO6	Acquaint with the background knowledge for understanding next-generation CPUs.

Course contents:

Unit-I: Lab exercise based on familiarization with 8085 microprocessor kit and practice of different commands for Assembly language programming of 8085.

Unit-2: Lab exercise based on transfer of data in different registers and memory locations.

Unit-3: Lab exercise based on addition, subtraction and complement of two 8-bit and 16-bit numbers placed at different memory locations.

Unit-4: Lab exercise based on finding smaller and larger number from two numbers and arranging list of numbers in increasing and decreasing order.

Unit-5: Lab exercise based on finding even and odd numbers and to find square of number from lookup table.

Unit-6: Lab exercise based on interfacing of 8255 PPI and 8253 Programmable timer with 8085.

Teaching Methodology:

They can build a project based on the concepts of interfacing between processing machine and real-life application devices. Students will be able to write assembly language programs.

Evaluation Scheme

Exams		Marks	Coverage
P-1		15 Marks	Based on Lab Exercises: 1-7
P-2		15 Marks	Based on Lab Exercises: 8-14
Day-to-Day Work	Viva	20 Marks	70 Marks
	Demonstration	20 Marks	
	Lab Record	15 Marks	
	Attendance & Discipline	15 Marks	
Total		**100 Marks**	

Learning Resources:

Lab manual on Microprocessor and Interfacing lab (will be added from time to time): Digital copy will be available on the JUET server.

Text Books:

[4] Gaonkar, Ramesh, "Microprocessor Architecture Programmes and Applications 8085, 4th edition, Prentice Hall.

[5] D. V. Hall, "Microprocessors and Interfacing", Tata McGraw-Hill Education, 3rd Edition 2013.

[6] A.K Ray, K. M. Bhurchandani, "Advanced Microprocessors and Peripherals" Tata McGraw-Hill Education, 2nd Edition, 2006.

Reference Books:

[1] B. Ram, "Fundamentals of Microprocessors and Microcontrollers", 7th edition (2010), Dhanpat Rai Publication, India.

Web references:

[1] http://www.daenotes.com/electronics/digital-electronics/Intel-80858bitmicroprocessor#axzz2I9yUSe7I

[2] https://www.smartzworld.com/notes/microprocessors-and-microcontrollers-mpmc/

[3] http://www.iare.ac.in

[4] www.nptel.ac.in

Journals References:

[1] Elsevier Journal on Microprocessors and Microsystems

[2] IEEE Microprocessors and Controllers

Title: Digital Signal Processing Lab **Code: 18B17EC473**

L-T-P Scheme: 0-0-2 **Credit: 1**

Prerequisite: Students must have already studied courses, "*Signals & Systems"*

Objective:

1. To enhance comprehension capabilities of students through understanding of various functions of MATLAB
2. To study various transforms for signal analysis.
3. To learn different windowing techniques for filter design

Learning Outcomes: In reference to Digital Signal Processing (18B11EC413), the students will be able to:

Course Outcome	Description
CO1	Outline based on introduction to MATLAB and operation of its various functions, Discrete/digital signals and systems along with their representation.
CO2	Describe concept of linear & circular convolution with MATLAB.
CO3	Develop the concept of various methods such as overlap add and overlap save used for convolution.
CO4	Identify different approaches for implementation of Z-transform, Region of convergence, Inverse Z-transform.
CO5	Apply important approach for time and frequency analysis signal by using Discrete Time Fourier Transform, Discrete Fourier Transform. Fast Fourier Transform (FFT) algorithms by using Decimation in Time and Decimation in Frequency techniques.
CO6	Demonstrate the concept of various windows for FIR and IIR filters design with MATLAB

Course Content:

Unit 1: Lab exercise based on introduction to MATLAB and generation of various signals.
Unit 2: Lab exercise based on implementation of linear & circular convolution with MATLAB
Unit 3: Lab exercise based on implementation of linear convolution using overlap adds and overlaps save methods with MATLAB
Unit 4: Lab exercise based on implementation of Z-transform, region of Convergence, Inverse Z-transform and its evaluation MATLAB
Unit 5: Lab exercise based on Discrete Time Fourier Transform, Discrete Fourier Transform. Fast Fourier Transform (FFT) algorithms using Decimation in Time and Decimation in Frequency techniques
Unit 6: Lab exercise based on implementation of various windows and FIR and IIR filters with MATLAB

Teaching Methodology:
This course is introduced to help the students to design various filters by using window functions. In this course, the mixed technique of interactive discussion, regular assignments will be used. In the discussion the fundamental theoretical concepts will be introduced and demonstrated through examples. Discussion will be implemented in laboratory by using Matlab.

Evaluation Scheme:

Exams	Marks		Coverage
P-1	15 Marks		Based on Lab Exercises: 1-7
P-2	15 Marks		Based on Lab Exercises: 8-14
Day-to-Day Work	Viva	20 Marks	70 Marks
	Demonstration	20 Marks	
	Lab Record	15 Marks	
	Attendance & Discipline	15 Marks	
Total	**100 Marks**		

Learning Resources:
Study material of Digital Signal Processing Lab (will be added time to time): Digital copy will be available on the JUET server.

Text Books:
[1] "Digital Signal Processing: Principles Algorithms and Applications", Proakis & Manolakis, PHI 4e, 2015.

Reference Books/ Material:

[1]. "Digital Signal Processing: A Computer Base Approach", S.K. Mitra, TMH, 2e, 2005.
[2]. "Digital Signal Processing: Signals, Systems and Filters", Andreas Antoniou, TMH, 4e, 2015.
[3]. "Texas Instruments, Digital Signal Processing Applications with the TMS 320 Family", Prentice Hall,2e,1987

Web References
[1] www.dspguide.com
[2] www.byclb.com/totorials/dsp advanced

Journal References
[1] IET Signal Processing Journal
[2] Journal of Advanced Research in Signal Processing & Applications, ADR publications
[3] Signal & Image Processing: An International Journal (SIPIJ)
[4] EURASIP Journal on Advances in Signal Processing
[5] International Journal of Wireless Personal Communications

Title: Minor Project-1 **Code: 18B19EC591**

L-T-P Scheme: 0-0-4 **Credit: 2**

Prerequisite: Students must have already studied the courses**,** "*Hardware Lab*" and "*Digital Circuit Design Lab*".

Objective:

1. Students will be able to understand the identification of different electronic components, use of bread board for testing the circuit.
2. Development of Layout from software, Etching, drilling and soldering process along with fault diagnosis.

Learning Outcomes:

Course Outcome	**Description**
CO1	Outline the project topics with respect to their needs for the society.
CO2	Description of usefulness of the work in the context of present application
CO3	Development of the literature survey in chronological order
CO4	Identification of the problem and the solution of that problem by project.
CO5	Application of the project in the society.
CO6	Demonstration and deployment of basic block diagram/algoritham steps of proposed method

Course Content:

Unit 1: Motivation about Project Topic
Unit 2: Usefulness of the work in the context of present application
Unit 3: Literature survey in chronological order.
Unit 4: Problem Formulation
Unit 5: Study /Analysis of different existing methods based on adequate performance parameters.
Unit 6: Mathematical formulation of proposed method.
Unit 7: Block Diagram/Algorithm Steps of proposed method.

Teaching Methodology:
This course is introduced to help students the basic components and how to develop real time hardware projects which will be helpful to the society.

Evaluation Scheme:

Exams		**Marks**	**Coverage**
Presentation-1		15 Marks	Unit 1-Unit 3
Presentation-2		15 Marks	Unit 4-Unit 5
Presentation-3		20 Marks	Unit 6-Unit 7
Day to Day Work	Attendance	10 Marks	50 Marks
	Sincerity	10 Marks	
	Project report	15 Marks	
	Performance	15 Marks	

Total	**100 Marks**

Learning Resources:
Students with concern to the faculty develop some new idea for preparing the project and related information they will acquire from the faculty and internet.

Text Books:

[1] Electronic project book, BPS publication.
[2] Electronics for you (Monthly Magazine).

Reference Books/Material:

[1] "Electronics project management and design", D. Joseph Stadtmiller, Pearson; 1 edition 2000.
[2] "50 Electronics Projects for Beginners", A.K.Maini, Pustak Mahal; First Edition 2007.

Web References:

[1] www.electronicshub.org
[2] https://nevonprojects.com

Journals References:

[1] Journal of Communications Technology and Electronics
[2] IEEE Transaction on communication

6th Semester

HSS Elective – 3

Title: Logical & Quantitative Technique **Code: 18B14HS650**

L-T-P scheme: 2-1-0 **Credit: 3**

Prerequisite: None

Objective:

1. To familiarize the students with the concept and pattern of aptitude tests.
2. To solve quantitative aptitude problems and questions applying logical reasoning, within a short time span given during the placement drives.
3. To acquaint them with types of questions asked in quantitative aptitude, logical reasoning and verbal ability.

Learning Outcomes:

Course Outcome	Description
CO1	Outline the basic concepts of quantitative ability, logical reasoning skills, and verbal aptitude.
CO2	Explain and pratice the concepts and questions related to data interpretation, data sufficiency and verbal ability.
CO3	Describe the quick ways to solve quantitative aptitude problems and questions applying logical reasoning, within a short time span.
CO4	Develop a thorough understanding of the concepts of quantitative ability and verbal reasoning, enabling students to manage the placement challenges more effectively.
CO5	Identify and work out the frequently asked patterns in quantitative aptitude and logical reasoning.
CO6	Deployment and solve previous campus placements aptitude papers facilitating the students to compete in various competitive exams like CAT, CMAT, GATE, GRE, GATE, UPSC, GPSC etc.

Course Content:

Unit-1: Numbers and Arithmetic: Number system, Percentages, Profit & Loss, Interest, Ratio, Proportion and Variation, Time and Work, Time, Speed and Distance. Trains, Boats and streams, Pipes and cisterns, Mixture and Allegations, Calendar.

Unit-2: Counting and Data Interpretation: Permutation & Combinations, Probability. Data Interpretation, Data Sufficiency, Set theory, Venn Diagrams.

Unit-3: Logical Reasoning: Important concept in logical reasoning, Logical reasoning based on arrangements, Logical reasoning based on rankings, Team formation, Quantitative reasoning, Puzzle test.

Unit-4: Verbal Reasoning: Syllogism, Logical deduction, Binary Logic, Critical Reasoning. Blood Relations.

Unit-5: Verbal Ability: Spotting Errors, Vocabulary and Reading Comprehension, Antonyms, Spellings, Ordering of Words, Sentence Improvement, Ordering of Sentences, Closet Test, One Word Substitutes,

Change of Voice, Verbal Analogies, Synonyms, Selecting Words, Sentence Formation, Sentence Correction, Completing Statements, Paragraph Formation, Comprehension, Idioms and Phrases, Change of Speech, Precis writing.

Teaching Methodology:
The course "Logical & Quantitative Technique" is introduced with an integral focus on campus placement. This course would train the students on a variety of question types used by the companies and improve their language skill. The course will train the students on the quick ways to solve quantitative aptitude problems and questions applying logical reasoning, within a short time span given during the placement drives. The course will also suit the need of the students and to acquaint them with frequently asked patterns in quantitative aptitude and logical reasoning. The course will be taught with the aid of lectures, handouts, case studies, task-based language learning, and comprehensive language learning through language lab.

Evaluation Scheme:

Exams	**Marks**	**Coverage**
Test-1	15 Marks	Based on Unit-1
Test-2	25 Marks	Based on Unit-2 & Unit-3 and around 30% from coverage of Test-1
Test-3	35 Marks	Based on Unit-4 & Unit-5 and around 30% from coverage of Test-2
Assignment	10 Marks	
Tutorials	5 Marks	
Quiz	5 Marks	
Attendance	5 Marks	
Total	**100 Marks**	

Learning Resources:
Lecture handouts and e-books on Logical & Quantitative Technique (will be added from time to time): Digital copy will be available on the JUET server.

Text Book:
[1] "Verbal and Non-Verbal Reasoning"; R.S. Agarwal, S. Chand Publishing, New Delhi, 2013.

Reference Books/Material:
[1] "Quantitative Aptitude"; R.S. Agarwal, S. Chand Publishing, New Delhi, 2013.
[2] "English Grammar & Composition"; Wren and Martin, S. Chand Publishing, New Delhi, 2012.
[3] "Business Communication"; K.K. Sinha, Taxmann Publications, New Delhi, 4e, 2012.

Title: Telecommunication Networks **Code: 18B11EC611**

L-T-P scheme: 3-0-0 **Credits: 3**

Prerequisite: None

Objective: This course is aimed:

1. To build basic concepts of Telecommunication and Computer network established for the communication.
2. This course also aims to provide the fundamental concepts in the design and implementation of networks, their protocols and applications.

Learning Outcomes:

Course Outcome	Description
CO1	Outline basic and some advanced concepts and techniques of telecommunications networks.
CO2	Describe problem solving approaches as applied in telecommunications networking areas.
CO3	Analyse performance of basic communication networks using both analytical and simulation techniques.
CO4	Develop the telecommunication network design techniques and practical implementation issues.
CO5	Understand the basic properties of internet and telecommunications traffic properties.
CO6	Use of cryptography and network security.

Course Contents:

Unit I: Introduction: Introduction to computer network, classification of networks WAN, MAN, LAN), distributed systems, digital signals and data rates, bit stream, symbols and band rate, transmission media, modems, structure of computer network, circuit, packet, message switching, Network topological, Network model, ISO-OSI model, TCP/IP model, primitives and services.

Unit II: Physical Layer: Physical Layer Design Issues (Service provided to data link Layer) Introduction Transmission media, RS-232-C and RS-449, Line coding.

Unit III: Data Link Layer: Data Link Layer Design Issues (Service Provided to N/w Layer), Framing, error control, flow control, Link Management, Error Detection and Error Correction Coding, Data Link Protocols (Elementary and sliding Window), local and metropolitan area networks. The Medium Access sub layer, Static and Dynamic Channel Allocation in LANs and MANs, ALOHA Protocols (Pure and Slotted), Different Protocols of LAN, IEEE Standard 802 for LAN (802.2, 802.4, 802.5).

Unit IV: Network Layer: Network Layer Design Issues (Service Provided to Transport Layer). Routing, Congestion, Internetworking. Routing Algorithms, Congestion Control Algorithm Internetworking, congestion control. Design issues, buffer management, synchronization. Session and presentation layer synchronization issues, formatting, data compression, data security.

Unit V: Transport Layer: Transport Layer Design Issue. Connection Management, Buffer Management, Quality of Service. Session Layer Design Issues Synchronization issues. Introduction to Presentation Layer. Encryption and decryption. RSA algorithm.

Methodology:

This course will help the students to facilitate interaction and information transfer over large distances. With internet, computer and telephone networks, businesses can allocate their resources efficiently. The students will be able to learn basic concepts of computer network, its working principle & operation of Internet and Intranet. They will also learn the working principle of operation of LAN, WAN, MAN, congestion in the network and network management.

Evaluation Scheme:

Exams	**Marks**	**Coverage**
Test-1	15 Marks	Based on Unit-1, Unit-2
Test-2	25 Marks	Based on Unit-2, 3 & Unit-4 and around 30% from coverage of Test-1
Test-3	35 Marks	Based on Unit-4 and Unit-5 and around 30% from coverage of Test-2
Assignment	10 Marks	
Tutorials	5 Marks	
Quiz	5 Marks	
Attendance	5 Marks	
Total	**100 Marks**	

Learning Resources:

Tutorials and lecture slides on Telecommunication networks (will be added from time to time).

Text Books

1. A.S. Tennenbaum, Computer Networks, PHI
2. W. Stallings, Data & Computer Communication, PHI
3. Forouzen, Behrouz A.Fegan, Sophia Chung Data Communications and Networking, TMH

Reference Books

1. Carne, E. Bryan Professional's Guide to Data Communication in a TCP/IP World Artech House, London, 2004
2. Young, Margret Levine Internet: The Complete Reference, Tata McGraw Hill, New Delhi, 2002

Web References:

1. www.britannica.com
2. www.vssut.ac.in

Journals References:

1. International Journal on Advances in Telecommunications
2. Journal of Network and Computer applications- Elsevier
3. IEEE transactions on networking
4. ACM Journals on networking

Title: VLSI Design **Code: 18B11EC612**

L-T Scheme: 3-0-0 **Credits: 3**

Prerequisite: Students should be studied the course, *"Digital Circuit Desgn".*

Objective:
1. To develop the concept of different types of MOSFET circuits.
2. To design the Digital Circuits by using the VHDL.

Course Outcomes:

Course Outcome	Description
CO1	Outline various VLSI circuit design techniques with respect to their needs of the digital Integrated Circuit (IC) fabrication and concepts of some circuit modelling.
CO2	Description of the digital circuit design issues using VHDL concepts.
CO3	Development of the design to meet market expectations using static dynamic CMOS logic.
CO4	Identification and use of various cost estimation techniques used in VLSI engineering.
CO5	Application of design techniques on a given assignment/ project.
CO6	Demonstration and deployment of basic VLSI circuits using VHDL.

Course Contents:
Unit I: Introduction to VHDL Basic Terminology, Entity Declaration, Architecture Declaration; Dataflow Modeling, Behavioral Modeling, Structural Modeling, Configuration Declaration, Package Declaration, Package Body, data objects and data types, Operators, Generics components, Function Declaration, Hardware simulation & synthesis in VHDL, VLSI Design Flow.

Unit II: Manufacturing process MOS process flow (Silicon wafer, photolithography, diffusion and ion implantation, deposition, etching, package materials, interconnect levels, thermal consideration in packaging etc), N-well, p-well and twin tub process, VLSI scaling-constant voltage, constant field scaling, limitation of scaling.

Unit III: MOS logic design MOS fundamentals, I-V characteristics, transfer characteristics, enhancement and depletion MOS, channel length modulation, body effect, biasing of MOSFETs, capacitances in MOS Design of MOS inverter with resistive load, static design of NMOS saturated load inverter, NMOS inverter with linear load, depletion mode load, Design of W/L, power dissipation, propagation delay, and noise margin analysis. CMOS inverter, static and dynamic characteristics of CMOS inverter, CMOS logic gates, Stick diagram, layout, λ-based design rule

Unit IV: Combinational and sequential circuits Combinational logic design (Logic gates), MOS Memory-RAM (static and dynamic), ROM, sense amplifier, address decoder, Reliability, Circuit simulation

Unit V: FPGA and ASIC FPGA basics, Different type of FPGA Architecture, logic design using FPGA, ASIC design, Logic design using ASIC's.

Methodology:

This course is introduced to help students to understand the basics of digital circuit design at transistor level. Starting from frontend development, the student will slowly progress to learn other aspects of design including static and dynamic CMOS logic. Circuit technologies that are helpful for a VLSI designer. The entire course is based on: Fundamental and Designing, brief idea of the Back End Tools & Technologies. Each section includes multiple circuit technologies to help a student gain design experience. This theory course is well complemented by a laboratory course under the name VLSI Design Lab in the same semester that helps a student to learn with hand-on experience.

Evaluation Scheme:

Exams	**Marks**	**Coverage**
Test-1	15 Marks	Based on Unit-1
Test-2	25 Marks	Based on Unit-2, Unit-3 and around 30% from coverage of Test-1
Test-3	35 Marks	Based on Unit-4 to Unit-5 and around 30% from coverage of Test-2
Assignment	10 Marks	
Tutorials	5 Marks	
Quiz	5 Marks	
Attendance	5 Marks	
Total	**100 Marks**	

Learning Resources:

Tutorials and lecture notes/slides on VLSI Design (will be added from time to time): Digital copy will be available on the JUET server.

Text Books:

1. S-M. Kang and Y. Leblebici, CMOS Digital Integrated Circuits: Analysis and Design, 3rd ed
2. Neil, H.E. Waste, Kamran Eshraghian, Principles of CMOS VLSI design, Pearson Education.
3. J. Bhasker, VHDL Primer, 3rd edition

Reference Books

1. J. Rabaey, A. Chandrakasan, and B. Nikolic, Digital Integrated Circuits: A Design Perspective, 2nd edition
2. R. C. Jaeger and T. N. Blalock, Microelectronic Circuit Design, 3rd edition
3. Peter. J. Ashenden, The student's guide to VHDL, 2nd edition

Web References:

[4] https://www.udemy.com/
[5] https://swayam.gov.in/nd1_noc20_ee29/preview

Journals References:

[1] VLSI Design— An Open Access Journal - Hindawi
[2] IEEE Transactions on Very Large Scale Integration

Discipline Elective: 2, 3

Title: Electronic Testing **Code: 18B14EC641**

L-T-P scheme: 3-0-0 **Credit: 3**

Prerequisite: Students must have already studied courses, **"***Electrical Science*" and *"VLSI Design"*.

Objective:

1. To develop the basic knowledge of various testing methods for analog and digital circuits.
2. To give the brief introduction of various testing equipment used in the testing of analog and digital circuits.

Learning Outcomes:

Course Outcome	Description
CO1	Outline various test process and automatic test equipment with respect to their needs for the design quality product and fit in test economics.
CO2	Description of testing parameters of digital testing and fault simulation to measure the testability.
CO3	Development of the standard testing models for scanning various faults.
CO4	Identification and use of various testable system design, core-based design and test wrapper design.
CO5	Application of testing techniques on a given assignment/ project.
CO6	Demonstration and deployment of basic analog, digital and mixed signal tests, optical and X-ray inspection procedures, functional block level design of in-circuit test equipment.

Course Content:

Unit-1 Introduction: Test process and automatic test equipment, test economics and product quality, fault modeling.

Unit-2 Digital Testing: Logic and fault simulation, testability measures, combinational and sequential circuit test generator.

Unit-3 Design for Testability: Built-in Self-test (BIST), scan chain design, Random logic BIST, Memory BIST.

Unit-4 Boundary scan test standard: Analog test bus, functional microprocessor test, Fault dictionary, Diagnostic tree, Testable system design, core-based design and test wrapper design, Test design for SOCs.

Unit-5 Loaded Board Testing: Unpowered short circuit tests, Unpowered analog tests, Powered in-circuit analog, digital and mixed signal tests.

Unit-6 Test Equipment: Optical and X-ray inspection procedures, functional block level design of in-circuit test equipment.

Teaching Methodology:

This course is introduced to help students transition from electronics circuits to testing of electronic circuits. Starting with the understanding of different testing strategies, the student will be able to understand digital testing. The entire course is broken down into six separate units: Discrete Representation of Continuous Systems, Discrete System Analysis, Stability of Discrete Time System, State Space Approach for discrete time systems, Design of Digital Control System and Discrete output feedback control. Each section includes multiple technologies to help a student gain more experience as a electronic control system designer.

Evaluation Scheme:

Exams	**Marks**	**Coverage**
Test-1	15 Marks	Based on Unit-1, Unit-2
Test-2	25 Marks	Based on Unit-3 & Unit-4 and around 30% from coverage of Test-1
Test-3	35 Marks	Based on Unit-5 to Unit-6 and around 30% from coverage of Test-2
Assignment	10 Marks	
Tutorials	5 Marks	
Quiz	5 Marks	
Attendance	5 Marks	
Total	**100 Marks**	

Learning Resources:

Lecture notes/slides on Electronic Testing (will be added from time to time): Digital copy will be available on the JUET server.

Text Book:

[1] Michael L. Bushnell and Vishwani D. Agrawal, "Essentials of Electronic Testing for Digital, Memory & Mixed-signal VLSI circuits", Springer, 2006.

[2] Principles of Testing Electronic Systems 1st Edition, Samiha Mourad , Yervant Zorian, Wiley-Inter science, 2000.

Reference Books/Material:

[1] Essentials of Electronic Testing for Digital, Memory and Mixed-Signal VLSI Circuits: Michael L. Bushnell Vishwani D. Agrawal, Springer

[2] Electronics Testing and Measurement William F. Waller Macmillan, 1972.

Web References:

[1] https://www.elprocus.com/

[2] https://www.sigmatest.org/

Journals References:

[1] VLSI the integration Elsevier

[2] Springer journal electronic testing

Title: Embedded System **Code: 18B14EC642**

L-T-P scheme: 3-0-0 **Credit: 3**

Prerequisite: Students must have already studied "*Microprocessor & Interfacing*".

Objective:

1. Develop an understanding of embedded system design life cycle and co-design concept.
2. Analyze and examine the real time and non -real time operating system systems and determine their role in applications design.
3. Deal with the internal architecture and design methodology of a micro-controller based embedded system.

Learning Outcomes:

Course	Description
CO1	Express the evolution of Embedded Systems and Study the Real time Operating system
CO2	Illustrate CISC and RISC instruction set architecture and processor architecture and its applications
CO3	Understand various types of memory used in embedded system
CO4	Embedded Systems on a Chip (SoC) and the use of VLSI designed circuits.
CO5	Identify the hardware and software components of an embedded system

Course Content:

Unit-1: Introduction to Embedded Computing Overview- Characteristics of Embedding Computing Applications, Concept of Real time Systems, Challenges in Embedded System Design. Design Process- Requirements, Specifications, Architecture Design, Designing of Components, System Integration

Unit-2: Embedded System Architecture CISC and RISC instruction set architecture, Basic Embedded Processor/Microcontroller Architecture-CISC (Motorola-68HC11 and 8051 processor), CISC (ARM), DSP Processors and Harvard Architecture (PIC). Memory System Architecture-Caches and Virtual Memory. I/o Sub-system - Busy-wait I/0, DMA and Interrupt driven I/0.

Unit-3: Designing Embedded Computing Platform Using CPU Bus- Bus Protocols and Bus Organization. Memory Devices and their Characteristics- RAM, ROM, UVROM, EEPROM, Flash Memory, DRAM. I/O Devices- Timers and Counters, Interrupt Controllers, DMA Controllers, A/D and D/A Converters, Displays, Keyboards and Infrared devices. Component Interfacing- Memory Interfacing and I/O Device Interfacing.

Unit-4: Design of Embedded Processors Application Specific Logic Design using Field Programmable Devices and ASICs, Introduction to Hardware Description Languages. Design Examples- Data Compressor and Alarm Clock

Unit-5: Software Development and Tools Embedded system evolution trends, round-robin, robin with interrupts, function – one scheduling architecture, algorithms, introduction to- assembler - compiler-cross compilers and integrated development environment (IDE). Object oriented interfacing, recursion, debugging strategies, simulators

Teaching Methodology:

This course is introduced to help students transition from a simple understand the scientific principles and concepts behind embedded systems and "big ideas" in embedded systems.

Evaluation Scheme:

Exams	Marks	Coverage
Test-1	15 Marks	Based on Unit-1, Unit-2
Test-2	25 Marks	Based on Unit-3 & Unit-4 and around 30% from coverage of Test-1
Test-3	35 Marks	Based on Unit-5 and around 30% from coverage of Test-2
Assignment	10 Marks	
Tutorials	5 Marks	
Quiz	5 Marks	
Attendance	5 Marks	
Total	**100 Marks**	

Learning Resources:

Tutorials and lecture slides on Embedded System (will be added from time to time): Digital copy will be available on the JUET server.

Text Book:

[1] David E Simon, An embedded software primer, Pearson education Asia, 2001.
[2] John B Peat man, Design with micro-controller, Pearson education Asia, 1998.
[3] Jonarthan W Valvano Brooks/code, Embedded microcomputer systems, Real time interfacing", Thomson learning 2001.

Reference Books/Material:

[1] Burns, Alan and Welling, Andy, real – time systems and programming languages, Second edition. Harlow: Addison-Wesley-Longman, 1997.
[2] Raymond J A Bhur and Donald L Bialey, An introduction to real time systems: Design to networking with C/C++, Pren

Web References:

[1] www.embedded.com
[2] www.esacademy.com

Journals References:

[1] International Journal of Embedded Systems
[2] Journal of Embedded Systems
[3] Journal of Advanced Research in Embedded System

Title: Antenna and Wave Propagation **Code: 18B14EC643**

L-T-P scheme: 3-0-0 **Credit: 3**

Prerequisite: Students must have already studied "*Electromagnetic field Theory*".

Objective:

3. To learn and be able to implement the front-end and back-end Antenna and Wave Propagation.
4. To develop the abilities to call oneself full-stack Antenna

Learning Outcomes:

Course Outcome	Description
CO1	Get familiar with processes of full stack basic antenna parameters.
CO2	Have a good grounding of antenna terminologies, Radiation Pattern, VSWR
CO3	Possess demonstrative skills in design and analyze of antenna
CO4	To identify characteristics of radio wave propagation.
CO5	Apply antenna engineering approaches required to create antenna application

Course Content:

Unit-1: Review of Antenna Basics: Introduction, basic Antenna parameters, patterns, radiation intensity, beam efficiency, diversity and gain, antenna apertures, effective height, bandwidth, radiation, efficiency, antenna temperature.

Unit-2: Point Sources and Arrays: Introduction, point sources, power patterns, power theorem, radiation intensity, filed patterns, phase patterns. Array of two isotropic point sources, non-isotropic but similar point sources, principles of pattern multiplication, broad side array, broad side versus end fire array, isotropic point sources of equal amplitude and spacing.

Unit-3: Electric Dipoles and Thin Linear Antennas
Introduction, short electric dipole, fields of a short dipole, radiation resistance of short dipole, radiation resistances of $\lambda/2$ Antenna, thin linear antenna, micro strip arrays, low side lobe arrays, long wire antenna, folded dipole antennas.

Unit-4: Antenna Types: Circular loop Antennas, horn antennas, rectangular horn antennas, Helical Antenna, Yagi-Uda array, corner reflectors, parabolic reflectors, log periodic antenna. Microstrip Antenna: Definition, advantages, disadvantages of microstrip antenna. Radiation mechanism and radiated fields of microstrip antenna.

Unit-5: Radio Wave Propagation: Introduction, Ground wave propagation, free space propagation, ground reflection, surface wave, diffraction. **Troposphere Wave Propagation:** Troposcopic scatter, Ionosphere propagation, electrical properties of the ionosphere, effects of earth's magnetic field.

Teaching Methodology:
Lectures would be interactive and it would cover the core concepts that are explained in the text and reference materials with adequate examples.

Evaluation Scheme:

Exams	Marks	Coverage
Test-1	15 Marks	Based on Unit-1 & Unit-2 Test-1
Test-2	25 Marks	Based on Unit-3 & Unit-4 and around 30% from coverage of Test-2
Test-3	35 Marks	Based on Unit-5 and around 30% from coverage of Test-3
Assignment	10 Marks	
Tutorials	5 Marks	
Quiz	5 Marks	
Attendance	5 Marks	
Total	**100 Marks**	

Learning Resources:

Tutorials and lecture slides on Antenna and Wave Propagation (will be added from time to time): Digital copy will be available on the JUET server.

Text Book:

[1] John D. Krauss, Antennas, III (SEI) edition, McGraw-Hill International edition, 2006.
[2] Harish and Sachidananda, Antennas and Wave Propagation, Oxford Press 2007.
[3] E. C. Jordan and Balmain, "Electro Magnetic Waves and Radiating Systems", PHI, 1968, Reprint 2003.

Reference Books/Material:

[1] C A Balanis, **Antenna Theory Analysis and Design ,**2nd ED, John Wiley, 1997
[2] Sineon R Saunders, **Antennas and Propagation for Wireless Communication Systems,** John Wiley, 2003.
[3] G S N Raju, **Antennas and wave propagation,** Pearson Education 2005.
[4] W.L Stutzman and G.A. Thiele, "Antenna analysis and design", John Wiley, 2000.
[5] Ramesh Garg , "Microstrip Antenna".

Web References:

[1] www.mtiwe.com
[2] www.radio-astronomy.org

Journals References:

[1] IEEE Transactions on Antennas and Propagation
[2] International Journal of Antennas and Propagation
[3] IET Microwaves, Antennas & Propagation

Title: Microwave and Radar System **Code: 18B14EC644**

L-T-P scheme: 3-0-0 **Credit: 3**

Prerequisite: The student should have basic knowledge of Electromagnetic Engineering and Communication Systems.

Objective:

1. Microwave Engineering introduces the student to Radar/microwave analysis methods and design techniques.
2. Scattering parameters are defined and used to characterize devices and system behavior. Passive and active devices commonly utilized in microwave subsystems are studied.

Learning Outcomes:

Course Outcome	Description
CO1	Identify with the microwave spectrum and their applications
CO2	Understand about different modes of wave propagation (TE, TM and TEM) and waveguide structure.
CO3	Study the performance of specialized microwave tubes such as klystron, reflex klystron, magnetron and Travelling wave tube
CO4	Understand the principles of Radar
CO5	Explain blocks involved in Radar system

Course Content:

Unit I: Introduction: Microwave Spectrum, Typical applications of Microwaves, Safety considerations.

Unit II: Microwave Waveguide and Waveguide Resonator: Rectangular Waveguide- Design consideration, TE & TM modes, TE_{10} mode analysis, cut-off frequency, propagation constant, phase and group velocity, power transmission, attenuation, waveguide excitation, wall current; Introduction of circular waveguide; resonant frequency, Q-factor,.

Unit III: Waveguide Passive Components and Their S-Matrix Representation: N-port networks-Properties of S matrix, Transmission matrix & their relationships; Microwave passive components and their S matrix representation: Attenuators, Phase shifter, Directional coupler, Bethe-hole coupler, Magic tee, hybrid ring, Circulators, Isolators; Design procedure of filter, low-pass prototype design, implementation.

Unit IV: Microwave Tubes: Electron beam & Field interaction for energy exchange in resonant (two cavity klystron, Reflex Klystron, Magnetron) and non-resonant (TWT &BWO) microwave active devices: Typical characteristics & applications (only physical explanation is required, no mathematical derivation required).

Unit V: An introduction to radar
Basic Radar, The simple form of the Radar equation, Radar block diagram, Radar frequencies, application of Radar, the origins of Radar.

Unit VI: MTI and pulse doppler radar
Introduction to Doppler and MTI Radar, delay line Cancellers, digital MTI processing, Moving target detector, pulse Doppler Radar.

Teaching Methodology:

This course is introduced to help students transition from a simple understand the Microwave circuit problems using time-varying sources and Design Microwave amplifiers, Microwave oscillators, Microwave detectors/mixers and Microwave control circuits.

Evaluation Scheme:

Exams	**Marks**	**Coverage**
Test-1	15 Marks	Based on Unit-1, Unit-2
Test-2	25 Marks	Based on Unit-3 & Unit-4 and around 30% from coverage of Test-1
Test-3	35 Marks	Based on Unit-5 & Unit-6 and around 30% from coverage of Test-2
Assignment	10 Marks	
Tutorials	5 Marks	
Quiz	5 Marks	
Attendance	5 Marks	
Total	**100 Marks**	

Learning Resources:

Tutorials and lecture slides on Microwave and Radar System (will be added from time to time): Digital copy will be available on the JUET server.

Text Book:

1. Microwave Engineering, 3Rd Ed David M. Pozar, Willey & Sons Inc.
2. Microwaves, K C Gupta, New Age Publishers.
3. Microwave Engineering, A Das & S Das, TMH.
4. Microwave Devices & Circuits, SY Liao, Pearson Education /PHI

Reference Books/Material:

1. Microwave Engineering-Passive Circuits, PA Rizzi , Pearson Education.
2. Foundation of Microwave Engineering, 2ed edition, Robert E Collin, McGraw Hill, Inc.
3. Microwave Devices & Circuit Design, GP Srivastava & VL Gupta.

Web References:

[1] www.slideshare.net
[2] www.hindawi.com

Journals References:

[1] Microwave and Wireless Communications
[2] International Journal of Microwave Science and Technology
[3] Role of radar in microwaves - IEEE Journals & Magazine

Title: Optical Communication **Code: 18B14EC645**

L-T-P Scheme: 3-0-0 **Credits: 3**

Prerequisite: Students must have already studied "Electromagnetic Field Theory" and "Analog & Digital communication".

Objective:

1. Offers a gradual approach to optical communications with emphasis on latest developments in coherent optical communications.
2. Broad introduction to transmitters and receivers, this course covers optical fibers and waveguides, lasers, detectors, optical amplifiers, channel impairments and their mitigation using signal processing algorithms.

Course Outcomes:

Course Outcome	Description
CO1	Outline the Fundamentals of optical fiber and laser communication
CO2	Develop the factors responsible for signal degradation in OFS.
CO3	Describe types and working of optical transmitters and receivers, and digital and analogue transmission systems.
CO4	Identify the different display devices and fluorescent materials.
CO5	Describe the working of optical amplifiers.
CO6	Application of optical communication in various fields

Course Content:

Unit-1: Introduction Optical Fibers and Laser communication: Light propagation in fibers and Graded Index fibers, Numerical Aperture and Attenuation, Overview of optical fiber communications, Optical transmitter components--lasers and optical modulators

Unit-2: Single and Multimode fibers and their propagation characteristics, Low loss fibers, Connectors, Splicing and Splice loss.

Unit-3: Couplers; Applications of Laser in various fields including Optical Communication using Optical Cables.

Unit-4: Display Devices. Fluorescent Materials.

Unit-5 : Optical receivers I:Photodetectors and its performance characteristics, noise in photodetection, common types of photodetectors

Unit-6: Optical receivers II: Direct detection, self-homodyne (differential) detection, and coherent detection, Sensitivity, Impact of noise

Unit-7: Optical Amplifiers: Semiconductor optical Amplifier, EDFA, Raman Amplifier, Wideband Optical Amplifiers.

Teaching Methodology:

This course is introduced to help students to understand optical fibers and how communication can be done using optical fibers. The course will make the basic understanding of properties of different Information Technology materials and hence build up a suitable foundation for the understanding of design and working of communication, processing and storage devices fabricated with these materials.

Evaluation Scheme:

Exams	**Marks**	**Coverage**
Test-1	15 Marks	Based on Unit-1, Unit-2
Test-2	25 Marks	Based on 3 & Unit-4 and around 30% from coverage of Test-1
Test-3	35 Marks	Based on Unit-5, Unit-6 and Unit-7 and around 30% from coverage of Test-2
Assignment	10 Marks	
Tutorials	5 Marks	
Quiz	5 Marks	
Attendance	5 Marks	
Total	**100 Marks**	

Learning Resources:

Lecture slides on Optical Communication (will be added from time to time): Digital copy will be available on the JUET server.

Text Books:

[1] S.O. Pillai, Solid State Physics, New Age International Publishers.
[2] W.D. Callister Jr., Material Science and Engineering: An Introduction, John Wiley.
[3] B. B. Laud, Laser and Non-linear Optics, John Wiley & Sons.

Reference Books/Material:

[1] Van Vlack, Elements of Material Science and Engineering, Pearson Education.
[2] Srivastava and Srinivasan, Material Science and Engineering

Web References:

[1] www.tutorialspoint.com
[2] www.electronics-notes.com

Journals References:

[1] Elsevier journal on optical communication
[2] IEEE journal of optical communication and networking
[3] Journal of Optical and Fiber Communications-Springer

Title: DSP Processors **Code: 18B14EC646**

L-T-P Scheme: 3-0-0 **Credits: 3**

Prerequisite: Students must have already studied courses, "*Signals & Systems"* and "*Digital Signal Processing*".

Objective:

1. To introduce various techniques of digital signal processing that are fundamental to various industrial applications.
2. To learn the basis of DSP systems, its theory and practical implementation of different kind of algorithms
3. To know third generation DSP architectures and interfacing of memory and I/O peripherals to the DSP processors.

Course Outcomes:

Course Outcome	Description
CO1	Outline the software model and pipelining for generalized DSP processor
CO2	Describe the programming concepts for TMS 320C3X, 5X and 67XX
CO3	Develop the detailed architectures and instruction sets of TMS 320C3X, 5X and 67XX
CO4	Apply special characteristics and features of generalized DSP processors
CO5	Identify the differentiate between generalised processor and DSP processor
CO6	Demonstrate the interfacing of memory and I/O peripherals with programmable devices

Course Contents:

Unit -1: Introduction to Digital Signal Processing: Introduction, A Digital signal-processing system, The sampling process, Discrete time sequences, Discrete Fourier Transform(DFT) and Fast Fourier Transform(FFT),Linear time-invariant systems, Digital filters, Decimation and interpolation, Analysis and Design tool for DSP Systems MATLAB,DSP using ATLAB. Computational Accuracy in DSP Implementations: Number formats for signals and coefficients in DSP systems, Dynamic Range and Precision, Sources of error in DSP implementations, A/D Conversion errors, DSP Computational errors, D/A Conversion Errors, Compensating filter.

Unit -2: Architectures for Programmable DSP Devices: Basic Architectural features, DSP computational Building Blocks, Bus Architecture and Memory, Data Addressing Capabilities, Address Generation Unit, Programmability and Program Execution, Speed issues Features for External interfacing. EXECUTION CONTROL AND PIPELINING: Hardware looping, Interrupts, Stacks, Relative Branch Support, Pipelining and performance, Pipeline Depth, Interlocking, Branching effects, interrupt effects, pipeline Programming models.

Unit -3: Programmable Digital Signal Processors: Commercial Digital signal-processing Devices, Data Addressing modes of TMS320C54XX DSPs, Data Addressing modes of TMS320C54XX Processors, Memory space of TMS320C54XX Processors, Program Control, TMS320C54XX instructions and Programming, On-Chip peripherals, Interrupts of TMS320C54XX processors, Pipeline Operation of TMS320C54XX Processors.

Unit -4: Implementation of Basic DSP Algorithms: The Q-notation, FIR Filters, IIR Filters, interpolation Filters, Decimation filters, PID Controller, Adaptive Filters, 2-D Signal Processing. Implementation of FFT Algorithms: An FFT Algorithm for DFT Computation, A Butterfly Computation,

Overflow and scaling, Bit reversed index generation, An 8-point FFT implementation on the TMS320C54XX, Computation of signal spectrum.

Unit -5: Interfacing Memory and I/O Peripherals to Programmable DSP Devices: Memory space organization, External bus interfacing signals, Memory interface, parallel I/O interface, Programmed I/O, Direct Memory access (DMA).A Multichannel buffered serial port (McBSP), McBSP Programming, a CODEC interface circuit, CODEC programming, A CODEC-DSP interface example.

Methodology:

The course will use the mixed technique of interactive lectures, tutorials, and regular assignments. In the lectures the fundamental programming concepts of TMS kit will be introduced. Discussion in lecture will be done regarding DSP processors by using DSP algorithms.

Evaluation Scheme:

Exams	**Marks**	**Coverage**
Test-1	15 Marks	Based on Unit-1, Unit-2
Test-2	25 Marks	Based on Unit-3 and around 30% from coverage of Test-1
Test-3	35 Marks	Based on Unit-4 and Unit-5 and around 30% from coverage of Test-2
Assignment	10 Marks	
Tutorials	5 Marks	
Quiz	5 Marks	
Attendance	5 Marks	
Total	**100 Marks**	

Learning Resources:

Lecture slides on DSP Processors (will be added from time to time): Digital copy will be available on the JUET server.

Text Books:

[1] S. Salivahanan, A. Vallavaraj. C. Gnanpriya, Digital signal processing -TMH-2nd, 2001.
[2] Lourens R Rebinarand Bernold, Theory, and applications of digital signal processing.
[3] Auntoniam, Digital filter analysis and design -TMH.

Reference Books

[1] Sanjit K. Mitra, Digital signal processing – TMH second edition
[2] Lan V. Opphenheim, Ronald W. Shafer, Discrete time signal processing -PHI 1996 1st edition.
[3] John G. Proakis, Digital signal processing principles – algorithms and applications -PHI-3rd edition 2002.

Web References:

[1] www. ece.cobb.wisc.edu/courses
[2] www.ti.com/processors/digtal-signal-processors

Journals References:

[1] Digital Signal Processing Science Direct
[2] Digital Signal Processing: A Review Journal Elsevier Journal
[3] Journal of Signal Processing Systems Springer

Title: Telecommunication Networks Lab **Code: 18B17EC671**

L-T-P Scheme: 0-0-2 **Credit: 1**

Objective:

The objective of this course is to build basic concepts of Telecommunication and Computer network established for the communication. This course also aims to provide the fundamental concepts in the design and implementation of networks, their protocols and applications.

Learning Outcomes:

Course Outcome	Description
CO1	Understand the hardware, software and different components of a network
CO2	Perform basic configurations on routers and Ethernet switches
CO3	Develop a basic knowledge of installing and configuring networking applications.
CO4	Analyze the telecommunication network design techniques and practical implementation issues.
CO5	Apply verification and validation techniques on a given software project.
CO6	Demonstrate deployment and basic maintenance skills.

Course Content:

Unit 1: Lab exercise based on the introduction to riverbed modeler and its working

Unit 2: Lab exercise on Ethernet and Switched LAN

Unit 3: Lab exercise on network model and token ring

Unit 4: Lab exercise on introduction to BOSON and routing protocols

Unit 5: Lab exercise on OSPF and RIP protocols.

Evaluation Scheme:

Exams	Marks	Coverage
P1	15 Marks	Based on Lab exercise 1-6
P2	15 Marks	Based on Lab exercise 7-12
Viva	20 Marks	
Demonstration	20 Marks	
Lab record	15 Marks	70 marks
Attendance $ Discipline	15 Marks	
Total	**100 Marks**	

Learning Resources:

Study material on Telecommunication networks Lab (will be added from time to time): Digital copy will be available on the JUET server

Text Books:

1. A.S. Tennenbaum, Computer Networks, PHI
2. W. Stallings, Data & Computer Communication, PHI
3. Forouzen, Behrouz A.Fegan, Sophia Chung Data Communications and Networking, TMH

Reference Books:

1. Carne, E. Bryan Professional's Guide to Data Communication in a TCP/IP World Artech House, London, 2004
2. Young, Margret Levine Internet: The Complete Reference, Tata McGraw Hill, New Delhi, 2002

Web References:

1. www.study.com
2. www.britanica.com

Journals References:

[1] IEEE transactions on Telecommunication networks

Title: VLSI Design Lab **Code: 18B17EC672**

L-T-P scheme: 0-0-2 **Credit: 1**

Prerequisite: Students must have already studied the courses, "*Digital Circuit Design Lab"*.

Objective:
1. To learn and be able to understand the basic operations of digital circuits by using the VHDL.
2. To develop the abilities to design the applications of digital systems based on the VLSI.

Learning Outcomes:

Course Outcome	**Description**
CO1	Outline various VLSI circuit design techniques with respect to their needs of the digital circuit designs and concepts of circuit modeling.
CO2	Described concept of Digital circuit design using VHDL.
CO3	Development of the design using sequential logic.
CO4	Identify various circuit simulations used in VLSI engineering.
CO5	Application of designs on a given assignment/ project.
CO6	Demonstration and deployment of basic VLSI circuits using VHDL.

Course Content:

Unit I: Lab exercise based on combinational circuit design using VHDL.

Unit II: Lab exercise based on Simulation to verify the input and output waveform and circuit delay.

Unit III: Lab exercise based on RCA and multiplier circuit design using VHDL.

Unit IV: Lab exercise based on sequentila circuit design using VHDL.

Unit V: Lab exercise based on logic design using FPGA, ASIC design, Logic design using ASIC's.

Teaching Methodology:
This course is introduced to help students to understand the basics of digital circuit design. Starting from frontend development, the student will slowly progress to become to other aspects of design. Circuit technologies that are helpful for a VLSI designer. The entire course is based on: Fundamental and Designing, Front End EDA tools. Each section includes multiple circuit technologies to help a student gain design experience. This laboratory course helps a student learn with hand-on experience.

Evaluation Scheme:

Exams	**Marks**	**Coverage**
P-1	15 Marks	Based on Lab Exercises: 1-6

P-2		15 Marks	Based on Lab Exercises: 6-14
Day-to-Day Work	Viva	20 Marks	70 Marks
	Demonstration	20 Marks	
	Lab Record	15 Marks	
	Attendance & Discipline	15 Marks	
Total		**100 Marks**	

Learning Resources:
Experiments on VLSI Design (will be added from time to time): Digital copy will be available on the JUET server.

Text Books:
1. S-M. Kang and Y. Leblebici, CMOS Digital Integrated Circuits: Analysis and Design, 3rd ed
2. Neil, H.E. Waste, Kamran Eshraghian, Principles of CMOS VLSI design, Pearson Education.
3. J. Bhasker, VHDL Primer, 3rd edition

Reference Books and Materials:
1. J. Rabaey, A. Chandrakasan, and B. Nikolic, Digital Integrated Circuits: A Design Perspective, 2nd edition
2. R. C. Jaeger and T. N. Blalock, Microelectronic Circuit Design, 3rd edition
3. Peter. J. Ashenden, The student's guide to VHDL, 2nd edition

Web References:
[1] https://www.udemy.com/
[2] https://swayam.gov.in/nd1_noc20_ee29/preview

Journals References:
[1] VLSI Design— An Open Access Journal - Hindawi
[2] IEEE Transactions on Very Large Scale Integration

Title: Advanced Communication Lab **Code: 18B17EC673**

L-T-P scheme: 0-0-2 **Credit: 1**

Prerequisite: Students must have already studied courses, "*Analog and Digital Communication*".

Objective:

1. To gain advance knowledge on various fields of communication systems
2. To implement various project based on matlab and simulink design

Learning Outcomes:

Course Outcome	Description
CO1	Accomplish the behavior of digital modulation techniques
CO2	Set up the communication link in optical communication
CO3	Establish the microwave link to measure various parameters
CO4	Realize the antenna and wave propagation in a particular communication
CO5	Observe the location of object using global positioning system
CO6	Design and implement the matlab and simulink model.

Course Content:

Unit-1; Lab exercises based on generation and detection of Quadrature Phase Shift Keying QPSK) and Quadrature Amplitude Modulation (QAM)
Unit-2; Lab exercises based on communication link in optical fiber and measure numerical aperture and different losses.
Unit-3; Lab exercises based on measurements of frequency, guided wavelength, power, Voltage Standing Wave Ratio (VSWR) and attenuation in a microwave test bench.
Unit-4; Lab exercises based on directivity and gain of a dipole, micro-strip patch and yagi uda antenna.
Unit-5; Lab exercises based on Global Positioning System
Unit-6; Lab exercises based on matlab and simulink design of various communication system

Teaching Methodology:
The lab course will cover the different communication fields such as digital communication, microwave, optical fiber etc. Initially a board-based practical will be conducted on advance modulation techniques. In the first part, optical fiber link can be accomplished in lab session. Afterward, microwave is being set up with the help of test bench and generators. In the second part, antenna characteristics can be calculated through a particular communication link. Moreover, a global positioning system is elaborated by identifying the location of object. At the end, matlab and simulink software will improve the hands on simulation of advance communication systems

Evaluation Scheme:

Exams		Marks	Coverage
P-1		15 Marks	Based on Lab Exercises: 1-7
P-2		15 Marks	Based on Lab Exercises: 8-14
Day-to-Day Work	Viva	20 Marks	70 Marks
	Demonstration	20 Marks	

	Lab Record	15 Marks	
	Attendance & Discipline	15 Marks	
Total		**100 Marks**	

Learning Resources:
Study material of Advance Communication Lab (will be added time to time): Digital copy will be available on the JUET server.

Text Book:

[1] "*Microwave Devices & Circuits*", S.Y. Liao, Pearson Education.
[2] "*Contemporary communication system using MATLAB and Simulink*", J. G Proakis., M. Salehi and G. Bauch, 1st ed., Cengage learning, 2004.

Reference Books:

[1] "*Digital Communications, Fundamental and Applications*", B. Skalar, Pearson Education
[2] *"Optical fiber communications"* G. Keiser, McGraw-Hill, 2000

Web References:
[1] http://www.msec.ac.in/files/ece/lab

Journals References:
[1] Wireless personal communication Springer

Title: Minor Project-2 **Code: 18B19EC691**

L-T-P Scheme: 0-0-4 **Credit: 2**

Prerequisite: Students must have already studied the courses, "*Hardware Lab*" and "*Minor project-1*".

Objective:

Students will be able to understand the identification of different electronic components, projects used by the society, development of software.

Learning Outcomes:

Course Outcome	Description
CO1	Outline the project topics with respect to their needs for the society.
CO2	Description of usefulness of the work in the context of present application
CO3	Development of the literature survey in chronological order
CO4	Identification of the problem and the solution of that problem by project.
CO5	Application of the project in the society.
CO6	Demonstration and deployment of basic block diagram/algorithm steps of proposed method

Course Content:

Unit 1: Identify parameters for performance evaluation.

Unit 2: Theoretical comparison of proposed and existing method.

Unit 3: It is expected that student will formulate a model for simulation of the system or design to validate the theoretical finding.

Unit 4: Student must explain the simulation model clearly through block diagram or flowchart.

Unit 5: Mention the chosen platform for simulation with reason (if any).

Unit 6: Mention the coding styles clearly.

Unit 7: Simulation of design module. It is expected that student will simulate their own design and the existing design which they included in the comparison list to validate the theoretical result.

Unit 8: Proper comparison of the simulation result to verify performance.

Unit 9: Based on the theoretical and simulation results the project findings are to be highlighted.

Teaching Methodology:

This course is introduced to help students the basic components and how to develop real time hardware projects which will be helpful to the society.

Evaluation Scheme:

Exams	Marks	Coverage
Presentation-1	15 Marks	Unit 1-Unit 3

Presentation-2		15 Marks	Unit 4-Unit 6
Presentation-3		20 Marks	Unit 7-Unit 9
Day to Day Work	Attendance	10 Marks	50 Marks
	Sincerity	10 Marks	
	Project report	15 Marks	
	Performance	15 Marks	
Total		**100 Marks**	

Learning Resources:

Students with concern to the faculty develop some new idea for preparing the project and related information they will acquire from the faculty and internet.

Text Books:

[1] Electronic project book, BPS publication.
[2] Electronics for you (Monthly Magazine).

Reference Books/Material:

[1] "Electronics project management and design", D. Joseph Stadtmiller, Pearson; 1 edition 2000.
[2] "50 Electronics Projects for Beginners", A.K.Maini, Pustak Mahal; First Edition 2007.

Web References:

[1] www.electronicshub.org
[2] https://nevonprojects.com

Journals References:

[1] Journal of Communications Technology and Electronics
[2] IEEE Transaction on communication

7th Semester

Open Elective - 1

Title: Sensors and Transducers **Code: 18B14EC761**

L-T-P scheme: 3-0-0 **Credit: 3**

Objectives: To develop the understanding on characteristics of Sensor & Transducers used in industry. Recent developments in the field of Sensor & Transducers. To understand the selection, installation of suitable sensing elements to design the appropriate signal conditioning circuit for their specific measurement applications.

Learning Outcomes:

Course Outcome	Description
CO1	Outline various types of sensors and transducers with respect to their application in the industry.
CO2	Describe the operating principle of various types of sensors.
CO3	Develop skills to select sensors& transducer for a specific measurement requirement.
CO4	Use of various transducers and signal conditioning circuits in the measurement process.
CO5	Analyze the performance of digital transducers.
CO6	Demonstrate the application of various transducers.

Learning Outcomes: After successful completion of this course, students should

1. Understand the fundamental principles of various types of sensors including thermal, mechanical, electrical, electromechanical and optical sensors.
2. Understand their general characteristics, terminologies, sensing and transduction principles;
3. Be familiar with criteria for sensors and transducers selection and choose appropriate measurement methods for engineering tasks and scientific researches.

COURSE CONTENTS

Unit 1: Fundamentals of Measurement

Measurement Methods, Classification, Generalized measurement System, Characteristics of measurement: Accuracy, Precision, Resolution, Sensitivity, Linearity; Errors & Uncertainty measurement of system, Linear & Non-linear Systems.

Unit 2: Transducers

Basic concept of sensors and transducer, their comparisons, Primary and secondary transducer, Active & passive transducers, Resistive, Inductive and Capacitive Sensors; Peizo-resistive, Peizo-electric, Thermal, Optical Transducers; Signal conditioning circuits.

Unit 3: Temperature Sensors

Sensors for Temperature Measurement- non- electrical and electrical method, Bimetallic Thermometer, Resistance temperature detector(RTD): working principle, construction, measurement setup, materials, Thermistor: operating principle, construction, Bridge circuit ,Thermocouple: construction, operation, lead and reference junction compensation, Radiation and Optical Pyrometer.

Unit 4: Pressure and Force Sensors

Strain Gauges- measurement technique, resistance strain gauge and its types, Dummy strain gauges, Quarter, half and full bridge configuration,
Transducers for Measurement of Pressure: - Manometers types (like Single column, inclined, U-tube), Mechanical Types (Bourdon, bellows and diaphragm), Elastic Types transducers, Low Pressure measurement gauges (Ionization, McLeod etc.).

Unit 5: Flow Sensors
Transducers for Measurement of Flow: - Types of flow meters, Theory of variable head constant area meter and its types, theory of constant head variable area meter and its types, theory of variable head variable area meter and its types, Special flow meters- Electromagnetic, Hot wire Anemometer, Turbine meter and Ultrasonic flow meter.

Unit 6: Miscellaneous Sensor
Level sensors, Ultrasonic, Capacitive and Gamma Ray level Gauges. Measurement of Humidity and Moisture- basic definitions, psychometric method, Smart sensors - Fibre optic sensors, MEMS – Nano sensors, proximity sensor.

Teaching Methodology:

This course is introduced to familiarize the student with the various transducers used in the automation industry. Starting from the basic concepts, the student will gradually develop an understanding of practical setups used in the industry. The entire course is broken down into six units, such that each unit covers the use of sensors for a particular application.

Evaluation Scheme:

Component & Nature	Duration	Marks / Weightage
T1	1 hr	15
T2	1hr 30 minutes	25
T3	2 hrs	35
Tutorials		05
Attendance		05
Quiz		05
Assignments		10
Total		**100**

Learning Resources:
Tutorials and lecture slides will be assigned to the student.: Digital copy will be available on the JUET server.

Text Books:

[1] A.K.Sawhney & Puneet Sawhney, A Course in Mechanical Measurements and Instrumentation, 12/e, , Dhanpat Rai & Co. (P) Ltd.,2004
[2] B.C.Nakra & K.K.Chaudhary,Instrumentation Measurement And Analysis, Tata McGraw-Hill Publishing Company Ltd, New Delhi.,1996
[3] D.Patranabis, Principles of Industrial Instrumentation, 2/e, Tata McGraw-Hill Publishing Company Ltd, New Delhi.,1998
[4] James W. Dally, William F. Riley & Kenneth G.McConnell, Instrumentation for Engineering Measurements,2/e,Wiley Student Edition, John Wiley & Sons,INC,2003.
[5] John P.Bentley, Principles of Measurement Systems, Low Price Edition, Pearson Education

Asia,2000
[6] Dr.D.S.Kumar, Mechanical Measurements and Control, 3/e, Reprint-2004, Metropolitan Book Co. Private Ltd.,2004
[7] Liptak, B.G., “Instrumentation Engineers Handbook (Measurement)”, CRC Press, 2005.

Refernce Books:

1. James W. Dally, William F. Riley & Kenneth G.McConnell, Instrumentation for Engineering Measurements,2/e,Wiley Student Edition, John Wiley & Sons,INC,2003.
2. John P.Bentley, Principles of Measurement Systems, Low Price Edition, Pearson Education Asia,2000
3. Dr.D.S.Kumar, Mechanical Measurements and Control, 3/e, Reprint-2004, Metropolitan Book Co. Private Ltd.,2004
4. Liptak, B.G., “Instrumentation Engineers Handbook (Measurement)”, CRC Press, 2005.

Web References:

[1] https://nptel.ac.in/courses/108/108/108108147/
[2] https://nptel.ac.in/content/storage2/nptel_data3/html/mhrd/ict/text/112104250/lec21.pdf
[3] https://www.electronics-tutorials.ws/io/io_1.html

Journals References:

[1] Sensors and Actuators A: Physical (Elsevier)
[2] Journal of Sensors (Hindawi)

Title: Introduction to Microprocessors and Microcontrollers **Code:18B14EC762**

L-T-P Scheme: 3-0-0 **Credits:3**

Prerequisite: Students must have already studied "*Digital Electronics*" course.

Course Objective:

1. Students should learn a microprocessor's programming model at a level that enables them to write assembly language programs for the processor that meets given specifications, learn concepts associated with interfacing a microprocessor to memory
2. Learn how to control components of a microprocessor-based system through the use of interrupts.
3. Students understand the basic operation of a microcontroller system and who have learned fundamental programming skills in assembly language.

Learning Outcomes:

Course Outcome	Description
CO1	Outline various microprocessor and microcontroller with respect to their needs for the development of digital systems
CO2	Description of the characteristic parameters of 8085 microprocessor.
CO3	Development of the input output interfacing circuits.
CO4	Identification and use of various microcontrollers and their hardware description.
CO5	Application of microprocessor and microcontroller on a given assignment/ project.
CO6	Demonstration and deployment of basic design of microprocessor and microcontroller-based computer systems.

Course Content:

Unit I: Introduction to Microprocessor: Review of digital electronics , historical background, Microprocessor and microcontroller based computer systems.

Unit-2: 8085 Microprocessor: Introduction, 8085: pin-outs and the pin function, instruction set, bus timings, addressing mode, programming in 8085, programming example, counter and delay, stack and subroutine, basic Interrupt processing, hardware interrupts.

Unit-3: I/O Interfacing: Memory organization & Interfacing, I/O interfacing.

Unit-4: 8086 microprocessor: Pin-outs and the pin function, clock generators, bus buffering & latching, ready and wait states, minimum mode versus maximum mode, memory segmentation. Programming in 8086, programming example.

Unit-5: Introduction of microcontrollers: A microcontroller's survey, Development system for microcontrollers and case studies. 8051: microcontrollers Hardware, Input/output pins, ports & circuits, External memory, counters & timers, Serial Data input/output, interrupts. 8051 addressing mode: Programming the 8051.

Teaching Methodology:

This course is introduced to help student to understand basics of microprocessor and microcontroller. He will be able to understand and perform various programming of microprocessor and its interfacing.

Lectures would be interactive and it would cover the core concepts that are explained in the text and reference materials with adequate examples.

Evaluation Scheme:

Exams	**Marks**	**Coverage**
Test-1	15 Marks	Based on Unit-1 and Unit-2
Test-2	25 Marks	Based on Unit-3 & Unit-4 and around 30% from coverage of Test-1
Test-3	35 Marks	Based on Unit-5 to Unit-6 and around 30% from coverage of Test-2
Assignment	10 Marks	
Tutorials	5 Marks	
Quiz	5 Marks	
Attendance	5 Marks	
Total	**100 Marks**	

Learning Resources:
Lecture slides on Microprocessor and microcontroller (will be added from time to time): Digital copy will be available on the JUET server.

Text Books :
[1] Fundamentals of Microprocessors and Microcontrollers, 7th edition, Dhanpat Rai Publication, India, 2010 by B. Ram.
[2] Introduction to Microprocessors, Wiley Eastern (Latest Edition) R.S. Gaonkar.

References
[1] Advanced microprocessors and peripherals by AK Ray.
[2] The 8051 microcontrollers Architecture, Programming & application ,2nd edition by Kenneth.J. Ayala

Web References:

[1] https://www.tutorialspoint.com/
[2] https://www.lecturenotes.in

Journals References:

[1] Microprocessors and Microsystems journal Elsevier.
[2] Microprocessors and Microsystems journal Science direct.
[3] Journal of Microcontroller engineering and applications.

Discipline Elective: 4, 5, 6

Title: Internet Based Automation **Code: 18B14EC741**

L-T-P Scheme: 3-0-0 **Credit: 3**

Prerequisites:
The student should have knowledge of basic Internet technology, multimedia and computer networking.

Objectives:
1. The student will be able to understand the vision of IoT from a global context.
2. Will be able to understand the application of IoT, Determine the Market perspective of IoT, use of Devices, Gateways and Data Management in IoT.
3. After learning this, the student can be able to build state of the art architecture in IoT. Similarly, he will come up with the application of IoT in Industrial and Commercial Building Automation and Real-World Design Constraints.

Learning Outcomes

Course Outcome	Description
CO1	Understand the vision of IoT from a global context for technical industries fulfilling the user requirement.
CO2	To understand and able to realize the revolution of IoT.
CO3	Determine the Market perspective of IoT.
CO4	Use of Devices, Gateways and Data Management in IoT. Able to understand building blocks of Internet of Things and characteristics.
CO5	Building state of the art architecture in IoT.
CO6	Illustrate the application of IoT in Industrial Automation and identify Real World Design Constraints.

Course Content

Unit-1: IoT and Web Technology: The Internet of Things Today, Time for Convergence, Towards the IoT Universe, Internet of Things Vision, IoT Strategic Research and Innovation Directions, IoT Applications, Future Internet Technologies, Infrastructure, Networks and Communication, Processes.

Unit-2: M2M to IoT: A Basic Perspective– Introduction, Some Definitions, M2M Value Chains, IoT Value Chains, An emerging industrial structure for IoT, The international driven global value chain and global information monopolies. An Architectural Overview– Building an architecture, Main design principles and needed capabilities, An IoT architecture outline, standards considerations.

Unit-3: IoT Architecture: Introduction, State of the art, Architecture Reference Model- Introduction, Reference Model and architecture, IoT reference Model, IoT. Reference Architecture- Introduction, Functional View, Information View, Deployment and Operational View, Other Relevant architectural views.

Unit-4: IoT Applications in Automation: Introduction, IoT applications for industry: Future Factory Concepts, Brownfield IoT, Smart Objects, Smart Applications, Four Aspects in your Business to Master IoT, Value Creation from Big Data and Serialization, IoT for Retailing Industry, IoT For Oil and Gas Industry, Opinions on IoT Application and Value for Industry, Home Management, eHealth.

Unit-5: Privacy, Security and Governance: Introduction, Overview of Governance, Privacy and Security Issues, Contribution from FP7 Projects, Security, Privacy and Trust in IoT-Data-Platforms for Smart Cities, First Steps Towards a Secure Platform, Smartie Approach.

Teaching Methodology

This course is introduced to help students to amalgamate hardware and software for different industrial requirements. Starting from the basics of IoT from web technology moving towards the basic architecture and models will make the students to implement the in different application like industrial automation, object automation, etc. At last, the student will learn to implement the security and governance of the IoT based communication systems.

Evaluation Scheme

Exams	**Marks**	**Coverage**
Test-1	15 Marks	Based on Unit-1, Unit-2 (30%)
Test-2	25 Marks	Based on Unit-2 (70%) & Unit-3 and around 30% from coverage of Test-1
Test-3	35 Marks	Based on Unit-4 to Unit-5 and around 30% from coverage of Test-2
Assignment	10 Marks	
Tutorials	5 Marks	
Quiz	5 Marks	
Attendance	5 Marks	
Total	**100 Marks**	

Learning Resources:

Tutorials and lecture slides on Web Development (will be added from time to time): Digital copy will be available on the JUET server.

Text books

[1] Vijay Madisetti and Arshdeep Bahga, "Internet of Things (A Hands-on-Approach)", 1 st Edition, VPT, 2014.

References

[1] Francis daCosta, "Rethinking the Internet of Things: A Scalable Approach to Connecting Everything", 1 st Edition, Apress Publications, 2013
[2] Cuno Pfister, Getting Started with the Internet of Things, O"Reilly Media, 2011, ISBN: 978-1-4493-9357-1.

Web References:

[1] https://nptel.ac.in/courses/106105166/
[2] http://ocw.cs.pub.ro/courses/iot/courses/01

[3] https://freevideolectures.com/blog/guide-to-learn-internet-of-things-iot/
[4] https://web.stanford.edu/class/ee392b/
[5] https://www.springeropen.com/p/engineering/internet-of-things

Journals References:

[1] IEEE Internet of Things (*IoT*) *Journal*
[2] Internet of Things by Elsevier.
[3] International Journal of Internet of Things and Web Services

Title: Linear VLSI IC Design **Code: 18B14EC742**

L-T-P: Scheme: 3-0-0 **Credit: 3**

Prerequisite: Students should be studied the courses, "Digital Circuit Design" and VLSI Design.

Course Objectives:

1. To develop the concept of different types of analog MOSFET circuits.
2. To design the Analog Circuits by using the circuit simulations.

Learning Outcomes:

1. The students shall acquire the generic skills to study & analyze the electrical and electronic systems.
2. This course will enable them to think and design various applications of the electrical and electronics at basic level.

Course Outcomes:

Course Outcome	Description
CO1	Outline various MOS circuit design techniques with respect to their needs of the linear Integrated Circuit (IC) design and concepts of some circuit modelling.
CO2	Description of the digital circuit design issues using simulations.
CO3	Development of the design to meet market expectations using CMOS logic.
CO4	Identification and use of various cost estimation techniques used in IC design.
CO5	Application of design techniques on a given assignment/ project.
CO6	Demonstration and deployment of MOS analog circuits.

Course Content:

Unit I:

MOSFET Modelling: Energy band diagram of MOSFET, Threshold Voltage, Work function difference, Flat band voltage, Depletion layer thickness, Charge distribution, C-V characteristics.

Unit II:

Non-ideal Effects in MOSFET: Short Channel and Narrow Width Effect, Sub-threshold Conduction, VT roll-off, Dain Induced Barrier Lowering, Gate Induced Drain Leakage, Gate Tunnelling, Punch through.

UNIT III:

MOS amplifiers: Review of MOS Transistor operation models and equivalent circuits for low and high frequency. Single-Stage Amplifiers, Differential Amplifiers.

Current Mirrors: MOS Passive and Active Current Mirrors: Cascode Current mirror, Wilson Current mirror and their applications.

Unit IV:

MOS Operational Amplifier: Theory and design of MOS Operational Amplifier, Complete CMOS operational amplifier including frequency compensation. Comparators and Voltage Reference Sources.

Unit V:

MOS Linear Circuit Design: A/D (analogue-to-digital) converters, averaging amplifiers, differentiators, DC (direct-current) amplifiers, integrators, multi-vibrators, Sinusoidal Oscillators, Non-Sinusoidal Oscillators, Active Filters, Switched-Capacitor Filters and Voltage Regulators.

Teaching Methodology:

This course is introduced to help students to understand the basics of analog MOS circuit design at transistor level. Starting from frontend development, the student will slowly progress to learn other aspects of design including CMOS logic. Circuit technologies that are helpful for linear IC designer. The entire course is based on: Fundamental and Designing, and brief idea of the Back End Tools & Technologies. Each section includes multiple circuit technologies to help a student to gain design experience.

Evaluation Scheme:

Exams	Marks	Coverage
Test-1	15	Based on Unit-1
Test-2	25	Based on Unit-2, Unit-3 and around 30% from coverage of Test-1
Test-3	35	Based on Unit-4 to Unit-5 and around 30% from coverage of Test-2
Assignment	10	Based on Unit-1
Tutorials	5	Based on Unit-2, Unit-3 and around 30% from coverage of Test-1
Quiz	5	Based on Unit-4 to Unit-5 and around 30% from coverage of Test-2
Attendance	5	Based on Unit-1
Total	**100**	

Learning Resources:

Tutorials and lecture notes/slides on analog IC Design (will be added from time to time): Digital copy will be available on the JUET server.

Text-Books:

1. B. Razavi, *Design of Analog CMOS Integrated Circuits*, McGraw Hill, 2001.
2. P. E. Allen and D. R. Holberg, *CMOS Analog Circuit Design*, 2nd Edition, Oxford University Press, 1997.

References:

1. Donald A. Neamen, “Semiconductor Physics and Devices, 3rd Edition, McGraw Hill, 2007.
2. Ben G. Streetman, Sanjay Banerjee, “Solid State Electronic Devices”, Pearson Education, 7th Edition, 2014.
3. Boylstad and Nashelsky, ‘Electronic Devices and Circuits’, PHI, 6e, 2001.

Web References:

[1] https://www.udemy.com/
[2] https://swayam.gov.in/nd1_noc20_ee29/preview

Journals References:

[1] VLSI Design— An Open Access Journal - Hindawi
[2] IEEE Transactions on Very Large Scale Integration

Title: Multi-rate Signal Processing and Filter Banks **Code: 18B14EC743**

L-T-P Scheme: 3-0-0 **Credits:3**

Prerequisite: Students must have already studied courses, "*Digital Signal Processing"*.

Course Objective:

The course will enable the students to:

1. To study about the interpolator and decimator
2. To learn about IIR & FIR filter design for multirate signal processing.
3. To enhance knowledge about different filters for communication system.

Learning Outcomes: The students will be able to:

Course Outcome	Description
CO1	Outline the fundamentals of multirate signal processing
CO2	Describe concept of up sampler and down-sampler
CO3	Describe concept of up sampler and down-sampler
CO4	Identify different approaches for designing of half-band filters, Hilbert transform band-pass filter, Interpolating with low pass half-band filters
CO5	Develop the concept of poly-phase representation of signals and filters and its multi-stage implementation
CO6	Demonstrate the concept of timing recovery in a digital demodulator digitally controlled sampled data delay and FM receiver.

Course Content:

Unit I: Review of digital filters

Digital FIR filter design, Filter specifications, ideal filters; Equi-ripple filters; Windowing and the Gibbs phenomenon; The Remez Algorithm, Digital IIR filter design, Bilinear transformation.

Unit II: Fundamentals of Multi-rate Systems

Down sampling, Up sampling, commutativity of up sampling and down sampling, noble identities, inter-connection of building blocks, poly-phase representation of signals and filters, multi-stage implementation, applications of multi-rate systems.

Unit III: Useful classes of filters such as Nyquist Filter and square-root Nyquist filter

Systems using re-sampling filters, Re-sampling filters: Interpolators, Interpolator architecture, band-pass interpolator, rational ratio sampling, arbitrary re-sampling ratio, Farrow filter.

Unit IV: Half-band filters

Half-band low pass and high pass filters, window design of half-band filter, Remez Algorithm design of half-band filters, Hilbert transform band-pass filter, Interpolating with low pass half-band filters. Dyadic half-band filters. Recursive poly-phase filters: All pass recursive filters, two-path and M-path recursive all-pass filters.

Unit V: Cascade and multiple stages filter structures

Communication systems applications: timing recovery in a digital demodulator digitally controlled sampled data delay, FM receiver and demodulator.

Teaching Methodology:
This course is introduced to help the students to design up-sampler and down-sampler. In this course, the mixed technique of interactive lectures and regular assignments will be used. In the lectures the fundamental theoretical concepts will be introduced and demonstrated through examples.

Evaluation Scheme:

Exams	**Marks**	**Coverage**
Test-1	15 Marks	Based on Unit-1, Unit-2
Test-2	25 Marks	Based on Unit-3 and around 30% from coverage of Test-1
Test-3	35 Marks	Based on Unit-4 and Unit-5 and around 30% from coverage of Test-2
Assignment	10 Marks	
Tutorials	5 Marks	
Quiz	5 Marks	
Attendance	5 Marks	
Total	**100 Marks**	

Learning Resources:

Tutorials and lecture slides on Multi-rate Signal Processing and Filter Banks (will be added from time to time): Digital copy will be available on the JUET server.

Text Books :
1. **"**Multirate Systems and Filter Banks", P. P. Vaidyanathan, Pearson Education, 1e, 2004.
2. "Digital Signal Processing, A Computer Approach", S K Mitra, TMH, 3e, 2006.
3. Fredric J Harris, "Multirate Signal Processing for Communication Systems", Pearson Education, 1e, 2007.

References
1. "Digital Signal Processing: A practical Approach", Emmanuel C. Ifeachor and Barrie W. Jervis, Pearson Education, 2e, 2002.
2. "Multirate Digital Signal Processing", N. J. Fliege, John Wiley & Sons, 1e, 1997**.**

Web References:

1. www.dspguide.com
2. www.ece.iastate.edu

Journals References:
[1] IEEE Transitions on Signal Processing
[2] IEEE Signal Processing Letters
[3] Elsevier Signal Processing: Image Communication
[4] EURASIP Journal on Advances in Signal Processing
[5] International Journal of Wireless Personal Communication

Title: Information Theory and Coding **Code: 18B14EC744**

L-T-P Scheme: 3-0-0 **Credit: 3**

Prerequisite: Students must have already studied "Probability and Random Processes".

Objective:

This course covers the fundamental concepts of information theory and error control coding.
At the conclusion of the course, several objectives will be achieved:

1. Students will be introduced to the basic notions of information and channel capacity.
2. Students will be introduced to convolutional and block codes, decoding techniques, and automatic repeat request (ARQ) schemes.
3. Students will understand how error control coding techniques are applied in communication systems.

Learning Outcomes:

Course Outcome	Description
CO1	Review the basic probability theory, random variables, distributions and densities
CO2	Design the optimal codes using entropy coding.
CO3	Describe the channel performance using Information theory.
CO4	Comprehend various error control code properties.
CO5	Apply linear block codes for error detection and correction
CO6	Apply convolution codes for performance analysis & cyclic codes for error detection and correction.

Course Content

Unit-1: Review of Basic Probability

Probability spaces, Random variables, Distributions and densities, Functions of random variables, Statistical Averages, Inequalities of Markov and Chebyshev, Weak law of large numbers.

Unit II: Information Measure: Discrete entropy, Joint and conditional entropies, Entropy in the continuous case, Maximization of continuous entropy, Entropy of a band limited white Gaussian process.

Data Compression: Uniquely decipherable and instantaneous codes, Kraft- McMillan inequality, Noiseless coding theorem, Construction of optimal codes.

Unit III: Data Transmission: Discrete memory less channel, Mutual information and channel capacity, Shannon's fundamental theorem and its weak converse, Capacity of a band limited AWGN channel, Limits to communication – Shannon limit.

Error Control Coding: Coding for reliable digital transmission and storage, Types of codes, Modulation and coding, ML decoding, Performance measures.

Unit IV: Linear Block Codes: Algebra Background, Groups, Fields, Binary field arithmetic, Vector Spaces over GF Generator and parity check matrices, Syndrome and error detection, Standard array and syndrome decoding, Hamming codes.

Cyclic Codes: Polynomial representation, Systematic encoding, Cyclic encoding, Syndrome decoding.

Unit V: Convolutional Codes: Generator Sequences, Structural properties, Convolutional encoders, Optimal decoding of Convolutional codes- the Viterbi algorithm.

Turbo Codes: Introduction, Distance properties, Performance analysis, Design of the turbo codes, Iterative decoding of turbo codes.

Teaching Methodology

The Students will be able to learn basic concepts of information theory, memoryless channels and shannon's capacity. They will also learn different types of codes like block codes, cyclic codes and convolutional codes.

Evaluation Scheme

Exams	**Marks**	**Coverage**
Test-1	15 Marks	Based on Unit-1, Unit-2
Test-2	25 Marks	Based on Unit-2, 3 & Unit-4 and around 30% from coverage of Test-1
Test-3	35 Marks	Based on Unit-4 and Unit-5 and around 30% from coverage of Test-2
Assignment	10 Marks	
Tutorials	5 Marks	
Quiz	5 Marks	
Attendance	5 Marks	
Total	**100 Marks**	

Learning Resources:

Tutorials and lecture slides on Information Theory and coding technique(will be added from time to time): Digital copy will be available on the JUET server

Text books

[1] R.B. ASH: Information Theory, Dover, 1990
[2] R.W. YEUNG: Information Theory and Network Coding, Springer, 2008.

References

[1] SHU LIN & D.J. COSTELLO: Error Control Coding, 2nd Edn, Pearson, 2004.
[2] T.K. MOON: Error Correction Coding, Wiley, 2006.

Web References:

1. www.nptel.ac.in
2. www.tutorialspoint.com
3. www.smartzworld.com

Journals References:

1. IEEE transactions on Information Theory
2. International Journal of Information and Coding theory

Title: Advance Control System **Code: 18B14EC745**

L-T-P Scheme: 3-0-0 **Credit: 3**

Prerequisites: Students must have already studied "*Control System*" course.

Objectives:

1. To familiarize the student with the fundamentals of state-space representation of a system.
2. To develop an ability to design the control system with given requirements.

Learning Outcomes

Course Outcome	Description
CO1	Outline various types of physical systems used in the industry.
CO2	Describe the working of automatic control systems using the control theory and concepts.
CO3	Develop a state-space model to represent a physical system.
CO4	Identify the design requirements of a particular system.
CO5	Apply the analysis techniques to evaluate the performance and stability of a control system.
CO6	Implement the basic optimal controller.

Course Content

Unit-1: Mathematical modelling of systems: Electrical System, Mechanical System, Thermal System, Liquid Level system, Hydraulic System, Pneumatic System, Linearization of nonlinear system, DC Motor speed and position control, Control of Thermal Process, Liquid Level Control Process.

Unit-2: Control System Design: Preliminary design consideration, System requirement in time and frequency domain, Lead Compensation, Lag Compensation, Lag-Lead Compensation, Control System design by Root Locus method, Control System design by Frequency Response Techniques.

Unit-3: Pole-placement design: Stability improvement by state feedback, Preconditions for pole placement, State Regulator Design, Design of State Observers, Lyapunov Stability Analysis. Linear Quadratic Optimal Control, Optimal Control Problem, Parameter optimization, Quadratic Performance Index.

Unit-4: Introduction to Optimal Control and Nonlinear Control: Performance Indices. Regulator problem, Tracking Problem. Nonlinear system–Basic concepts and analysis.

Unit V: Digital Control: Discrete-time systems. Difference Equations. State-space models of linear discrete-time systems. Stability of linear discrete-time systems. Digital implementation of controllers.

Teaching Methodology

This course is introduced to develop an understanding of optimal control design techniques. Starting from the basic concepts of optimal control theory, the student will gradually develop an understanding of the design procedure of a control system. The entire course is broken down into five units, such that each unit covers a particular aspect of the analysis and design process.

Evaluation Scheme

Exams	Marks	Coverage
Test-1	15 Marks	Based on Unit-1, Unit-2 (Selected topics)
Test-2	25 Marks	Based on Unit-2 & Unit-3 and around 30% from coverage of Test-1
Test-3	35 Marks	Based on Unit-4 to Unit-5 and around 30% from coverage of Test-2
Assignment	10 Marks	
Tutorials	5 Marks	
Quiz	5 Marks	
Attendance	5 Marks	
Total	**100 Marks**	

Learning Resources:
Tutorials and lecture slides on Control Systems (will be added from time to time): Digital copy will be available on the JUET server.

Text books

[1] K. Ogata, "Modern Control Engineering," Prentice-Hall India, 4rd Ed
[2] M.Gopal, "Control System: Principle and Design", 4rd Ed

References

[1] M.Gopal, "Digital Control and State Variable Methods", Tata Mcgraw Hill, 3rd Ed
[2] T.J. Ross, "Fuzzy Logic with Engineering Applications", Wiley India, 3rd Ed

Web References:

[1] https://nptel.ac.in/courses/101/108/101108057/
[2] https://online.stanford.edu/courses/aa203-optimal-and-learning-based-control

Journals References:
[1] Optimal Control Applications and Methods
[2] Optimal Control, Elsevier

Title: Neural Network **Code: 18B14EC746**

L-T-P Scheme: 3-0-0 **Credit: 3**

Prerequisite: Students must have knowledge on "Linear Algebra".

Objective:

To provide the knowledge of different methodologies used to design a neural network that can handle the raw data and get trained according to the input output mapping.

Learning Outcomes:

The students should get the idea about the problems that can be effectively solved by neural network like pattern classification, character recognition, image processing, medical diagnostic etc. and shall acquire the generic skills to design and implement neural structures and related algorithms.

Course Outcome	Description
CO1	Understand the differences between ANN and BNN
CO2	understand the differences between networks for supervised and unsupervised learning;
CO3	design single and multi-layer feed-forward neural networks;
CO4	Analyze the performance of neural networks.
CO5	Design the neural network based on back propagation algorithm
CO6	Design and analyze the unsupervised learning-based networks

Course Content

Unit-1: Biological Neuron: Introduction, soft computing, history, human brain, biological neuron, artificial neuron, comparison, McCulloch-Pitts model.

Unit II: Artificial neuron: Neuron model, transfer function, network architectures, learning strategy: supervised, unsupervised, and reinforcement, vector spaces, inner product, norm, orthogonality, reciprocal basis vectors, Eigen value and Eigen vectors.

Unit III: Single-layer feed forward networks: Perceptron architecture, pattern classification, single and multiple inputs, learning rule, unified learning rule, hebb & pseudo inverse rule, widrow-hoff, adaptive linear neuron (ADALINE) network, least mean square algorithm adaptive filtering.

Unit IV: Performance Surfaces & Optimization: Taylor series, directional derivatives minima, necessary conditions, Eigen system of the hessian, steepest descent, stable learning Rates, minimizing along a Line, Newton's method, conjugate gradient.

Unit V: Multi-layer feed forward networks: Multilayer perceptron, back propagation algorithm, chain rule, sensitivities, batch, incremental training, advantages and drawbacks.

Unit VI: Associative learning, competitive learning, self-organizing feature maps, radial basis networks, adaptive resonance theory, hopfield network.

Teaching Methodology

The students will be able to learn basic concepts of neural network, its working principle & operation of single layer and multilayer neural networks. They will also learn the performance learning and optimization for training of neural networks.

Evaluation Scheme

Exams	**Marks**	**Coverage**
Test-1	15 Marks	Based on Unit-1, Unit-2
Test-2	25 Marks	Based on Unit-2, 3 & Unit-4 and around 30% from coverage of Test-1
Test-3	35 Marks	Based on Unit-4 and Unit-5 and around 30% from coverage of Test-2
Assignment	10 Marks	
Tutorials	5 Marks	
Quiz	5 Marks	
Attendance	5 Marks	
Total	**100 Marks**	

Learning Resources:

Tutorials and lecture slides on Neural networks (will be added from time to time): Digital copy will be available on the JUET server

Text books

[1] Hagan M. T., Demuth H. B., Beale M. and Jesús O. D. "*Neural network design*", 4th ed., Cengage learning.

[2] Simon Haykin, "*Neural Networks: A comprehensive Foundation*", 2nd ed., Pearson education 1999.

References

[1] Kumar S., "*Neural network: a classroom approach*", 1st ed., Tata McGraw hill, 2004.

[2] Sivanandam S. N., Sumathi S. and Deepa S. N. , "*Introduction to Neural Networks using Matlab 6.0*", 1st ed., Tata McGraw hill, 2006.

Web References:

[1] www.tutorialspoint.com

[2] www.towarsdatascience.com

Journals References:

[1] IEEE Transactions on Neural Networks

[2] IEEE Transactions on Neural Networks and Learning systems

Title: Mobile Communication **Code: 18B14EC747**

L-T-P Scheme: 3-0-0 **Credits: 3**

Prerequisite: Students must have already registered for the courses, "Analog Communication & Digital Communication".

Objectives:

1. This is an elective course for B.Tech, VIIth semester (ECE & CSE) students. To introduce the student to the most recent techniques in the broad field of Wireless Communications. To equip the students with basic skills required to design such systems.
2. To learn the basics of multi-user detection theory, history of spread spectrum and apply optimization techniques to wireless communication problems. Student teams design and analyze a new spread-spectrum communication receiver for realistic channel environment.

Learning Outcome:

Having successfully completed the module, students will be able to demonstrate knowledge and understanding of:

1. The fundamentals of mobile radio channels, and the limitations imposed by tetherless systems.
2. The basic modulation, transmission techniques and practical channel coding schemes.
3. The architectures of mobile communication systems, and some standard mobile radio systems, such as the Pan-European system known as GSM.

Course Outcome	Description
CO1	Evolution of mobile communicaton and system evaluation
CO2	Explain cellular design concepts and various multiple access systems.
CO3	Describe multipath propagation and 3G Wireless networks.
CO4	Familiarity with GSM and CDMA mobile standards
CO5	Describe WLL, WAP, WML, WiMAX and Mobile IP
CO6	Understand emerging technologies required for future wireless systems.

Course Contents:

UNIT 1: Introduction to mobile communication, scope and application Mobile communication system evaluation, Basic concepts, 1G, 2G,& 3G, IMT2000, LMDS.

Unit II: Multiple access technologies, FDMA, TDMA, CDMA, Frequency Reuse factor, WCDMA.

Unit III: Propagation model, Spread Aloha multiple access, System capacity & Soft capacity, Channel Assignment Strategies, Sectoring, Handoff Strategies , Networking in WLL, CDMA cellular standards, Co-channel Interference, CDMA security aspects, Trunking and GOS, Key features of CDMA, CDMA cellular standards, DECT, Personal area Network.

Unit IV: Propagation Models, Fading, Impulse Response, Small Scale Multipath Measurements, CDMA security aspects, Key features of CDMA, Diversity techniques, Soft handoff, Power control, Mobile data communication, Switching Techniques, Circuit switched data services, IS-95 Forward, Reverse Channel Model, Packet switch data services, Wireless local area networks.

Unit V: Wireless ATM (WATM),Wireless application protocol (WAP),UMTS, Bluetooth, Wi-max, User

Scenarios in Bluetooth, LAN, Bluetooth Architecture, Mobile IP, Physical layer, Link Manager Protocol, Mobile network layer.

Unit VI: GSM standards, GSM Architecture, Protocols, Typical call flow sequences in GSM, GSM radio aspects, Radio interface, Localization and Calling, Hand over.

Teaching Methodology

The students will be able to learn basic concepts of mobile network, its working principle & operation of cellular system. They will also learn the different multiple access techniques, fading channels and various mobile standards

Evaluation Scheme

Exams	**Marks**	**Coverage**
Test-1	15 Marks	Based on Unit-1, Unit-2
Test-2	25 Marks	Based on Unit-2, 3 & Unit-4 and around 30% from coverage of Test-1
Test-3	35 Marks	Based on Unit-4 and Unit-5 and around 30% from coverage of Test-2
Assignment	10 Marks	
Tutorials	5 Marks	
Quiz	5 Marks	
Attendance	5 Marks	
Total	**100 Marks**	

Learning Resources:

Tutorials and lecture slides on mobile communication (will be added from time to time): Digital copy will be available on the JUET server

Text books

[1] Theodore Rappaport S, Wireless Communications: Principles and Practice, PHI Publication.
[2] William C Lee, Mobile Communications Engineering Theory and Applications Marcel Dekker.
[3] Geier, J.: Wireless LANs (2nd edition).

References

[1] Schiller, J.:Mobile Communications (2nd edition), Addison-Wesley 2003.
[2] Viterbi, Principles of Spread-Spectrum (Addison Wesley).
[3] Vijay K. Grag and Joseph E. Wilkes, Wireless and Personal Communications Systems.

Web References:

1. www.javapoint.com
2. www.electronicsforu.com
3. www.tutorialspoint.com

Journals References:

[1] IEEE transactions on Mobile Computing
[2] IEEE Transaction on wireless communication

Title: Statistical Signal Processing **Code: 18B14EC748**

L-T-P Scheme: 3-0-0 **Credit: 3**

Prerequisite: Student should have studied basic course on "*Probability*"**.**

Objective:

1. The Statistical Signal Processing course considers representing real-world signals by stochastic or random processes.
2. The tools for analyzing these random signals are developed in the Probability, Random Variables, and Estimation Theory course, and this course extends them to deal with time series.
3. This course also investigates the affect of systems and transformations on time-series, and how they can be used to help design powerful signal processing algorithms to achieve a particular task.

Learning Outcomes:

Course Outcome	**Description**
CO1	Introduction to stochastic processes and overview of statistical signal processing.
CO2	Explanation of Estimation theory.
CO3	Methods of parameter estimation.
CO4	Description of different types of filters.
CO5	White noise and its effect.
CO6	Linear models of random signals.

Course Content

Unit-1: Introduction: Stationary processes: Strict sense and wide sense stationary; Correlation and spectral analysis of discrete-time wide sense stationary processes, white noise, response of linear systems to wide-sense stationary inputs, spectral factorization

Unit-2: Parameter estimation: Properties of estimators, Minimum Variance Unbiased Estimator (MVUE Cramer Rao bound, MVUE through Sufficient Statistics, Maximum likelihood estimation- properties. Bayseaen estimation- Minimum Mean-square error(MMSE) and Maximum a Posteriori(MAP) estimation

Unit-3: Signal estimation in white Gaussian noise– MMSE, conditional expectation; Linear minimum mean-square error (LMMSE) estimation, orthogonality principle and Wiener Hoff equation

Unit-4: FIR Wiener filter, linear prediction-forward and backward predictions, Levinson-Durbin Algorithm, application –linear prediction of speech

Unit-5: Non-causal IIR wiener filter, Causal IIR Wiener filtering

Unit-6: Iterative and adaptive implementation of FIR Wiener filter: Steepest descent algorithm, LMS adaptive filters, convergence analysis, least-squares(LS) method, Recursive LS (RLS) adaptive filter, complexity analysis, application- neural network

Unit-7: Kalman filters: Gauss -Markov state variable models; innovation and Kalman recursion, steady-state behaviour of Kalman filters

Teaching Methodology

Many practical signals are random in nature or modeled as random processes. Student will be able to understand statistical signal processing which forms the backbone of modern communication and signal processing systems. The student will be able to understand the three broad components of statistical signal processing: random signal modeling, estimation theory and detection theory.

Evaluation Scheme

Exams	**Marks**	**Coverage**
Test-1	15 Marks	Based on Unit-1, Unit-2
Test-2	25 Marks	Based on Unit-3 & Unit-4 and around 30% from coverage of Test-1
Test-3	35 Marks	Based on Unit-5 to Unit-7 and around 30% from coverage of Test-2
Assignment	10 Marks	
Tutorials	5 Marks	
Quiz	5 Marks	
Attendance	5 Marks	
Total	**100 Marks**	

Learning Resources:

Lecture slides on Statistical Signal Processing (will be added from time to time): Digital copy will be available on the JUET server.

Text books

[1] M. Hays, *Statistical Digital Signal Processing and Modelling,* John Willey and Sons, 1996.

References

[1] M.D. Srinath, P.K. Rajasekaran and R. Viswanathan, S*tatistical Signal Processing with Applications,* PHI, 1996.
[2] Simon Haykin, *Adaptive Filter Theory,* Prentice Hall, 1996
[3] D.G. Manolakis, V.K. Ingle and S.M. Kogon, *Statistical and Adaptive Signal Processing*, McGraw Hill, 2000
[4] S. M. Kay, *Modern Spectral Estimation,* Prentice Hall, 1987
[5] S. J. Orfanidis, *Optimum Signal Processing*, Second Edition, MacMillan Publishing, 1989.
[6] H. Stark and J.W. Woods, *Probability and Random Processes with Applications to Signal Processing*, Prentice Hall 2002.
[7] A. Papoulis and S.U. Pillai, *Probability, Random Variables and Stochastic Processes*, 4th Edition, McGraw-Hill, 2002.

Web References:

[1] www.nptel.ac.in.
[2] http://www.astro.rug.nl/~saleem/courses/SSP/SSPLectureNotes.pdf.

Journals References:
[1] An introduction to statistical signal processing with applications.
[2] EURASIP Journal on Advances in Signal Processing.

Title: Image and Video Processing **Code: 18B14EC749**

L-T-P Scheme: 3-0-0 **Credit: 3**

Prerequisite: Students must have already studied "*Digital signal processing*" course.

Objective:

1. The student will be able to understand basics of image and video.
2. Student will be able to understand various processing techniques which could be applied on various types of images and videos.
3. The techniques could be further used in various specific purpose applications

Learning Outcomes:

Course Outcome	Description
CO1	Outline of general terminology of digital image processing and fundamentals of video.
CO2	Describe various types of image processing techniques in spatial and frequency domain and basic video processing techniques.
CO3	Develop various types of image processing techniques.
CO4	Identify the problems and evaluate the methodologies for image and video processing.
CO5	Apply various types of image and video processing techniques and analyse them.
CO6	Analyse different types of image and video processing techniques in real world.

Course Content

Unit-1: Digital Image Fundamentals-Elements of visual perception, image sensing andacquisition, image sampling and quantization, basic relationships between pixels – neighborhood, adjacency, connectivity, distance measures.

Unit-2: Image Enhancements and Filtering-Gray level transformations, histogramequalization and specifications, pixel-domain smoothing filters – linear and order-statistics, pixel-domain sharpening filters – first and second derivative, two-dimensional DFT and its inverse, frequency domain filters – low-pass and high-pass.

Unit-3: Color Image Processing-Color models–RGB, YUV, HSI; Color transformations–formulation, color complements, color slicing, tone and color corrections; Color image smoothing and sharpening; Color Segmentation.

Unit-4: Image Segmentation- Detection of discontinuities, edge linking and boundary detection, thresholding – global and adaptive, region-based segmentation.

Unit-5: Wavelets and Multi-resolution image processing- Uncertainty principles of Fourier Transform, Time-frequency localization, continuous wavelet transforms, wavelet bases and multi-resolution analysis, wavelets and Subband filter banks, wavelet packets.

Unit-6: Image Compression-Redundancy–inter-pixel and psycho-visual; Losslesscompression – predictive, entropy; Lossy compression- predictive and transform coding; Discrete Cosine

Transform; Still image compression standards – JPEG and JPEG-2000.

Unit-7: Fundamentals of Video Coding- Inter-frame redundancy, motion estimation techniques – fullsearch, fast search strategies, forward and backward motion prediction, frame classification – I, P and B; Video sequence hierarchy – Group of pictures, frames, slices, macro-blocks and blocks; Elements of a video encoder and decoder; Video coding standards – MPEG and H.26X.

Unit-8: Video Segmentation- Temporal segmentation–shot boundary detection, hard-cuts and soft-cuts; spatial segmentation – motion-based; Video object detection and tracking.

Teaching Methodology

This course is introduced to understand basics of image and video. The student will understand the basics of image and video. He will able to apply various processing techniques on image as well as video.

Evaluation Scheme

Exams	**Marks**	**Coverage**
Test-1	15 Marks	Based on Unit-1, Unit-2
Test-2	25 Marks	Based on Unit-3 & Unit-4 and around 30% from coverage of Test-1
Test-3	35 Marks	Based on Unit-5 to Unit-8 and around 30% from coverage of Test-2
Assignment	10 Marks	
Tutorials	5 Marks	
Quiz	5 Marks	
Attendance	5 Marks	
Total	**100 Marks**	

Learning Resources:

Lecture slides on Image and video processing (will be added from time to time): Digital copy will be available on the JUET server.

Text books

[1] R.C. Gonzalez and R.E. Woods, Digital Image Processing, Second Edition, Pearson Education 3rd edition 2008

[2] Anil Kumar Jain, Fundamentals of Digital Image Processing, Prentice Hall of India.2nd edition 2004.

[3] Murat Tekalp , Digital Video Processing" Prentice Hall, 2nd edition 2015.

References

[4] Digital Image Processing by S.Jayaraman, Tata Mc-Graw HillEducation,2009.

[2] Digital Video processing by A. Murat Tekalp, by Prentice Hall

Web References:

[1] https://www.coursera.org/learn/digital
[2] https://lecturenotes.in/download/material/30278-digital-image-video-processing

Journals References:

[1] EURASIP Journal on Image and Video Processing
[2] IEEE Transactions on Pattern Analysis and Machine Intelligence

Title: Major Project Part-I **Code: 18B19EC791**

L-T-P scheme: 0-0-8 **Credit: 4**

Prerequisite: Students must have basic knowledge of project topic.

Objective:

1. To learn and be able to implement either hardware or software project based on the topic.
2. To develop the abilities to complete the project in time and have the practical knowledge.

Learning Outcomes:

Course Outcome	Description
CO1	Outline of the problem related to various electronics and communication field.
CO2	Identify the problem in real world or related to previous work.
CO3	Develop the system or algorithm related to the problem either software or hardware based.
CO4	Describe the various cost-effective solutions or techniques to the problem.
CO5	Analyze the different algorithms and report writing.

Teaching Methodology:

This course is introduced to develop the ability to complete the project in time. Student will be able to learn the practical application of the project topic. Will have the basic knowledge of the various components and benefits in the real life and learn to do coding in case the project is hardware based. If the project is software based then student will be able to develop its programming skills and its implications and benefits in practical life.

Evaluation Scheme:

Exams		Marks	Coverage
P-1		15 Marks	Based on Guidelines provided for Project
P-2		15 Marks	Based on Guidelines provided for Project
P-3		20 Marks	Based on Guidelines provided for Project
Day-to-Day Work	Attendance	10 Marks	70 Marks
	Sincerity	10 Marks	

	Project Report	15 Marks	
	Performance	15 Marks	
Total		**100 Marks**	

Learning Resources:
Students with concern to the faculty develop some new idea for preparing the project and related information they will acquire from the faculty and internet.

Text Books:

[1] Electronic project book, BPS publication.
[2] Electronics for you (Monthly Magazine).

Reference Books/Material:
[1] "Electronics project management and design", D. Joseph Stadtmiller, Pearson; 1 edition 2000.
[2] "50 Electronics Projects for Beginners", A.K.Maini, Pustak Mahal; First Edition 2007.

Web References:
[1] www.electronicshub.org
[2] https://nevonprojects.com

Journals References:
[1] Journal of Communications Technology and Electronics
[2] IEEE Transaction on communication

Title: Summer Training **Code: 18B19EC792**

Duration: 4-6 Weeks **Credits: 0**

Course Objective:
It is important that students should be motivated about the summer training and know what is expected from it. They are also required to get familiar with the work environment, modern tools and systems, participating in teamwork, preferably as part of a multi-disciplinary team. The student should be able to about the project development cycle: requirement analysis, design, development, and test. They are required to apply the knowledge and skills gained in engineering curriculum to real-life issues and problems, contemporary issues. They are supposed to understand the professional and ethical responsibilities of an engineer and also to make contacts for future employment with the industries where they have been allotted.

Learning Outcomes:

Course Outcome	Description
CO1	Able to learn that clearly define what student intend to learn during the summer training. Able to Express what student plan to achieve throughout the internship and how it will be accomplished.
CO2	Able to conclude the experience of the industry whether it is academic or core.
CO3	Able to focus on selected areas that student will be exposed to throughout the training.
CO4	Able to involve new learning, expanded growth, or improvement on the job based on his curriculum studies.
CO5	Able to effectively relating academic learning to the internship experience.
CO6	Able to complete the tasks provided by the industry within stipulated time duration.

Criteria for selecting a place for summer training
Students should consider the following when selecting the company (or an institution) for summer training.

Required:
The company must work on Electronics/computer engineering applications and/or systems such as hardware/software design, development or testing.

Strongly Recommended:
The company should use contemporary tools and techniques. The company should follow engineering standards and methods. The company should work on projects that have local or global impact. The student should be given opportunity to work on real-world problems. The student should be able to observe the organization of the company. The student should work in a team, and if possible a multidisciplinary team.

Recommendations to students

Listed below are some recommendations for students who will do summer training.

Before Training:

1. Verify that the company will satisfy all the Required Criteria from Section stated above, and as many as possible of the Strongly Recommended Criteria.
2. If needed, do not hesitate to contact your Summer Training Coordinator.

During Training:

1. Be active, enthusiastic, motivated, and energetic.
2. Work hard. • Be pro-active. Do not wait for somebody to tell you what to do.
3. Try to plan your time and what you expect from summer training week by week.
4. Keep a daily/weekly record of the progress of your training.

Evaluation Scheme:

Exams	**Marks**
Training Report	35 Marks
Training Diary	35 Marks
Presentation	20 Marks
Viva	10 Marks
Total	**100 Marks**

Grading Scheme:

Students scoring 60% (and above) marks may be awarded Satisfactory Grade and performance below 60% will have to repeat the summer training in next year.

8th Semester

Open Elective – 2

Title: Introduction to Neural Network **Code: 18B14EC861**

L-T-P: 3-0-0 **Credits: 3**

Prerequisite: Students must have knowledge on "Linear Algebra".

Objectives: To provide the knowledge of different methodologies used to design a neural network that can handle the raw data and get trained according to the input output mapping.

Learning Outcomes: The students should get the idea about the problems that can be effectively solved by neural network like pattern classification, character recognition, image processing, medical diagnostic etc. and shall acquire the generic skills to design and implement neural structures and related algorithms.

Course Outcome	Description
CO1	Understand the differences between ANN and BNN
CO2	understand the differences between networks for supervised and unsupervised learning;
CO3	design single and multi-layer feed-forward neural networks;
CO4	Analyse the performance of neural networks.
CO5	Design the neural network based on back propagation algorithm
CO6	Design and analyze the unsupervised learning based networks

Course Content:

Unit-1: Biological Neuron: Introduction, soft computing, history, human brain, biological neuron, artificial neuron, comparison, McCulloch-Pitts model.

Unit-2: Artificial neuron: Neuron model, transfer function, network architectures, learning strategy: supervised, unsupervised, and reinforcement, vector spaces, inner product, norm, orthogonality, reciprocal basis vectors, Eigen value and Eigen vectors.

Unit-3: Single-layer feed forward networks: Perceptron architecture, pattern classification, single and multiple inputs, learning rule, unified learning rule, hebb & pseudo inverse rule, widrow-hoff, adaptive linear neuron (ADALINE) network, least mean square algorithm adaptive filtering.

Unit-4: Performance Surfaces & Optimization: Taylor series, directional derivatives minima, necessary conditions, Eigen system of the hessian, steepest descent, stable learning Rates, minimizing along a Line, Newton's method, conjugate gradient.

Unit-5: Multi-layer feed forward networks: Multilayer perceptron, back propagation algorithm, chain rule, sensitivities, batch, incremental training, advantages and drawbacks.

Unit-6: Associative learning, competitive learning, self-organizing feature maps, radial basis networks, adaptive resonance theory, hopfield network.

Teaching Methodology: The students will be able to learn basic concepts of neural network, its working

principle & operation of single layer and multilayer neural networks. They will also learn the performance learning and optimization for training of neural networks.

Evaluation Scheme:

Exams	Marks	Coverage
Test-1	15 Marks	Based on Unit-1, Unit-2
Test-2	25 Marks	Based on Unit-2, 3 & Unit-4 and around 30% from coverage of Test-1
Test-3	35 Marks	Based on Unit-4 and Unit-5 and around 30% from coverage of Test-2
Assignment	10 Marks	
Tutorials	5 Marks	
Quiz	5 Marks	
Attendance	5 Marks	
Total	**100 Marks**	

Learning Resources: Tutorials and lecture slides on Neural networks (will be added from time to time): Digital copy will be available on the JUET server

Text Books:

1 Hagan M. T., Demuth H. B., Beale M. and Jesús O. D. "Neural network design", 4th ed., Cengage learning.
2 Simon Haykin, "Neural Networks: A comprehensive Foundation", 2nd ed.,

Reference Books:

1 Kumar S., "Neural network: a classroom approach", 1st ed., Tata McGraw hill, 2004.
2 Sivanandam S. N., Sumathi S. and Deepa S. N. , "Introduction to Neural Networks using Matlab 6.0", 1st ed., Tata McGraw hill, 2006.

Web References:

1 www.tutorialspoint.com
2 www.towarsdatascience.com

Journal References:

1 IEEE Transactions on Neural Networks
2 IEEE Transactions on Neural Networks and Learning systems

Discipline Elective: 7, 8

Title: Spread Spectrum Communication **Code: 18B14EC841**

L-T-P Scheme: 3-0-0 **Credits:3**

Prerequisite: Students must have the knowledge of digital communication.

Course Objective:
The course will enable the students to:
Student will be capable to acquire the knowledge of advance communication system Spread spectrum modulation for secure communication, its antijam characteristics & different wireless standards GSM and CDMA Standards (1G to 4G).

Learning Outcomes: The students will be able to:

Course Outcome	Description
CO1	Outline various models of time-invariant and time-variant multipath fading channels
CO2	Describe different multiple assess communication strategies to enhance system capacity
CO3	Develop equalization and coding schemes to control bit error rate
CO4	Apply various wireless diversity and reception techniques to improve signal to noise ratio
CO5	Design high data-rate indoor and outdoor wireless communication systems
CO6	Identify different codes used in communication system

Course Content:

Unit I: Spread Spectrum Systems

Direct sequence spread spectrum methods employing BPSK, QPSK and MSK - Frequency Hop spread spectrum methods - Coherent slow frequency Hop technique - Non coherent slow and fast frequency Hop spread spectrum techniques - Hybrid DS/FH spread spectrum - Complex envelope representation of spread spectrum systems.
Communication in the presence of pulse noise jamming - Low probability detection scheme - Direct Sequence Spread Spectrum (DSSS) and Frequency Hop Spread Spectrum Systems and examples of Spread Spectrum Systems.

Unit 2: Binary Shift Register Sequences for Spread Spectrum Systems

Definition - PN sequence generator fundamentals - Maximal length sequences - Properties, Power spectrum and Polynomial tables for maximal length sequences - Gold codes - Rapid Acquisition systems - Non-linear code generators.

Unit 3: Synchronization of Spread Spectrum Systems

Optimal tracking of wideband signals - Early-late tracking loops - Code tracking loops for FHSS-Optimum synchronization techniques - Multiple dwell and sequential detectors - Synchronization using a matched filter - Synchronization by estimating the received spreading code.

Unit 4: Performance of Spread Spectrum System

SS Systems communications models - Performance without coding under AWGN and different jamming environments - spread spectrum systems performances with forward error correction - Block coding - Convolutional coding and specific error correcting codes - Inter leaving - Random coding bounds.

Unit 5:
Orthogonal Walsh Codes CDMA Standards, CDMA One (IS-95A, IS-95B), CDMA 2000 (IX, DillV), W-CDMA CDMA for mobile communications – issues, GSM standards, GSM Architecture, Protocols Radio resource management Interfacing between BTS and MSC Restoration technique.

Teaching Methodology:
This course is introduced to help the students to familiar with various keying techniques and spread spectrum systems. In this course, the mixed technique of interactive lectures, tutorials, and regular assignments will be used. In the lectures the fundamental theoretical concepts regarding performance of spread spectrum system and different CDMA standards will be introduced. Discussion in lecture will be done based on GSM.

Evaluation Scheme:

Exams	**Marks**	**Coverage**
Test-1	15 Marks	Based on Unit-1, Unit-2
Test-2	25 Marks	Based on Unit-3 and around 30% from coverage of Test-1
Test-3	35 Marks	Based on Unit-4 and Unit-5 and around 30% from coverage of Test-2
Assignment	10 Marks	
Tutorials	5 Marks	
Quiz	5 Marks	
Attendance	5 Marks	
Total	**100 Marks**	

Learning Resources:

Tutorials and lecture slides on Spread Spectrum Communication (will be added from time to time): Digital copy will be available on the JUET server.

Text Books :

[1] R. L. Peterson, R. Ziemer and D. Broth, "Introduction to Spread Spectrum Communications", Prentice Hall, 1995.
[2] V. K. Garg, "Principles and Applications of GSM", Pearson Education.

References

[1] R. E. Ziemer and R. L. Peterson, "Digital Communications & Spread Spectrum Systems," MacMillan, 1985.
[2] J. G. Proakis, "Digital Communications," McGraw Hill, 4th ed.
[3] V. K. Garg, K. Smolik and J. Wilkes, “Applications of CDMA in Wireless / Personal Communications,” Prentice Hall, 1997.
[4] Walke, "Mobile Radio Network Protocols and Traffic Performance", John Wiley.

Web References:

[1] www.tutorialspoint.com/digital communication
[2] www.wirelesscommunication.nl/cdma
[3] www.accesscience.com/content/spread-spectrum

Journals References:

[1] International Journal of Communication, Elsevier
[2] International Journal of Vehicular Communications, Elsevier
[3] International Journal of Communication Systems, John Wiley
[4] Journal of International Communication, Springer
[5] International Journal of Communication Networks and Information Security
[6] AEÜ - International Journal of Electronics and Communications, Elsevier

Title: Speech Signal Processing **Code: 18B14EC842**

L-T-P Scheme: 3-0-0 **Credit: 3**

Prerequisite: The student should know the basics of various signals, and its properties. Should have studied "*Signal and system*" and should know the knowledge of various transforms like z-transform, DFT, FFT, etc.

Course Objective:

1. The student will be able to understand the human voice signal and its generation.
2. Various speech signal and its processing. Signal transformation into digital type and its processing.

Learning Outcomes:

Course Outcome	Description
CO1	Outline of speech signal processing and various signals and human vocal system.
CO2	Describe the real voice signal created by human and description of various speech signals.
CO3	Develop the various quantization and coding techniques.
CO4	Identify the various models and coding scheme used in practical aspect.
CO5	Relate and analyse the coding techniques and quantization methods which would be helpful in real applications.
CO6	Develop different quantization and coding methods which would minimise the error of speech signal in practical application.

Course Content:

Unit I: Introduction- Speech production and modeling - Human Auditory System;General structure of speech coders; Classification of speech coding techniques – parametric, waveform and hybrid ; Requirements of speech codecs –quality, coding delays, robustness.

Unit-2: Speech Signal Processing- Pitch-period estimation, all-pole and all-zero filters,convolution; Power spectral density, periodogram, autoregressive model, autocorrelation estimation.

Unit-3: Linear Prediction of Speech- Basic concepts of linear prediction; Linear Prediction Analysis of non-stationary signals –prediction gain, examples; Levinson-Durbin algorithm; Long term and short-term linear prediction models; Moving average prediction.

Unit-4: Speech Quantization- Scalar quantization–uniform quantizer, optimum quantizer, logarithmic quantizer, adaptive quantizer, differential quantizers; Vector quantization – distortion measures, codebook design, codebook types.

Unit-5: Scalar Quantization of LPC- Spectral distortion measures, Quantization based onreflection coefficient and log area ratio, bit allocation; Line spectral frequency – LPC to LSF conversions, quantization based on LSF.

Unit-6: Linear Prediction Coding- LPC model of speech production; Structures of LPC encoders and decoders; Voicing detection; Limitations of the LPC model.

Unit-7: Code Excited Linear Prediction-CELP speech production model; Analysis-by-synthesis;

Generic CELP encoders and decoders; Excitation codebook search – state-save method, zero-input zerostate method; CELP based on adaptive codebook, Adaptive Codebook search; Low Delay CELP and algebraic CELP.
Speech Coding Standards-An overview of ITU-T G.726, G.728 and G.729standards

Teaching Methodology:
This course is introduced so that student will be able to understand the basics of speech signal. Student will be able to understand the speech production and perception in human being. The student would be able to design the speech production system.

Evaluation Scheme:

Exams	**Marks**	**Coverage**
Test-1	15 Marks	Based on Unit-1, Unit-2
Test-2	25 Marks	Based on Unit-3 & Unit-4 and around 30% from coverage of Test-1
Test-3	35 Marks	Based on Unit-5 to Unit-7 and around 30% from coverage of Test-2
Assignment	10 Marks	
Tutorials	5 Marks	
Quiz	5 Marks	
Attendance	5 Marks	
Total	**100 Marks**	

Learning Resources:

Tutorials and lecture slides on Speech Signal Processing (will be added from time to time): Digital copy will be available on the JUET server.

Text Books :
[1] "Digital Speech" by A.M.Kondoz, Second Edition (Wiley Students_ Edition), 2004.
[2] "Speech Coding Algorithms: Foundation and Evolution of Standardized Coders", W.C. Chu, WileyInter science, 2003.

References
[1] Speech and Audio signal processing by B.Gold, John Willey and sons.
[2] Speech and Audio Signal Processing by A.R.Jayan, PHI Learning

Web References:

[1] http://isle.illinois.edu/~hasegawa/notes/
[2] https://sites.google.com/site/samahghanem/lecture-notes-in-speech-signal- processing

Journals References:

[1] EURASIP Journal on Audio, Speech, and Music Processing
[2] IEEE Transactions on Audio, Speech, and Language Processing

Title: Wireless Sensor Network **Code: 18B14EC843**

L-T-P Scheme: 3-0-0 **Credit: 3**

Prerequisite: Students must have knowledge of Wired and Wireless computer network.

Course Objective:

1. Introduce student's various aspects on sensor networks, and expose them to the fundamental issues in designing and analyzing.
2. Students will study related technologies and standards ranging from networking, algorithms and other support

Learning Outcomes:

Course Outcome	Description
CO1	Outline the basics of wireless sensor and ad-hoc network.
CO2	Describe the communication protocols employed in wireless sensor and ad hoc network.
CO3	Develop the appropriate technology to implement a WSN.
CO4	Identify to assess different communication protocols and their usefulness in different applications Usage
CO5	Applications of naming, addressing, time synchronization and routing protocols.
CO6	Demonstrate deployment and basic maintenance skills.

Course Content:

Unit I: Introduction: History, Wireless Network, Classification, Application examples, Wireless sensor network (WSN), Challenges, Characteristic requirements, Required mechanisms Mobile Ad Hoc Networks (MANETs), fieldbuses, MANET v/s WSN.

Unit-2: Node architectures: Single-node architecture, Hardware components, communication device, sensors and actuator, Energy consumption, Radio Transceivers, Case study: Tiny Os and nesC, Mica mote, EYES, BT nodes, scatter web.

Unit-3: Network architecture: Sensor network scenarios, single–hop sources and sinks, Optimization goals and figures of merit, Design principles for WSNs, Adaptive fidelity and accuracy, Physical layer, Frequency allocation, Packet transmission and synchronization, transceiver design, Mediation device, Dynamic modulation scheme.

Unit-4: Link-layer protocol: Fundamentals, Error control, ARQ & FEC techniques, Hybrid Framing Adaptive schemes, Intermediate checksum schemes, combining packet-size optimization, Link management.

Unit-5: Media Access Protocols: Various assignment protocols, Wireless MAC protocols, Sparse topology and energy managenment, Wakeup radio concepts.

Unit-6: Naming & Addressing: Address management tasks, uniqueness of addresses, Address allocation and assignment, Addressing overhead, Address and name management in wireless sensor networks, Assignment of MAC addresses, Distributed assignment of locally unique addresses.

Unit-7: Time synchronization and Routing protocol: Node clocks and the problem of accuracy,

properties and structure of time synchronization algorithm.Gossiping and agent-based unicast forwarding, Energy-efficiency, unicast protocols, multipath unicast routing, Source, core & Mesh based tree protocols geographic routing, geocasting, mobile nodes Mobile sinks Mobile data collectors mobile regions, publish/subscribe interaction paradigm, Data-centric routing, Data-centric storage.

Teaching Methodology:
This course will help students to identify the major issues associated with sensor networks. Students will explore current sensor technologies by researching key areas such as algorithms, protocols, hardware, and applications. Examples will be discussed in the class.

Evaluation Scheme:

Exams	**Marks**	**Coverage**
Test-1	15 Marks	Based on Unit-1 & Unit-2
Test-2	25 Marks	Based on Unit-2 & Unit-4 and around 30% from coverage of Test-1
Test-3	35 Marks	Based on Unit-5 to Unit-7 and around 30% from coverage of Test-2
Assignment	10 Marks	
Tutorials	5 Marks	
Quiz	5 Marks	
Attendance	5 Marks	
Total	**100 Marks**	

Learning Resources:

Tutorials and lecture slides on Wireless Sensor Networks (will be added from time to time): Digital copy will be available on the JUET server.

Text Books :

[1] Xiangyang Li , "Wireless Ad-hoc and Sensor Network–Theory and applications", Cambridge University Press,2006
[2] Holger Karl and Andreas Willig "Protocols and Architectures for Wireless Sensor Networks" WILEY 2005.

References

[1] C.S. Raghavendra, Krishna M. Sivalingam and Taieb Znati, "Wireless Sensor Networks", Springer, 2005.
[2] Feng Zhao and Leonidas Guibas," Wireless Sensor Networks", Elsevier, 2004.

Web References:

[1] IEEE 802.15.4 Standardization Committee
[2] Secure Data Aggregation in Wireless Sensor Networks: A *Survey
[3] A list of secure aggregation proposals for WSN

Journals References:

[1] European Conference on Wireless Sensor Networks (EWSN)
[2] International Conference on Information Processing in Sensor Networks (IPSN)
[3] Conference on Embedded Networked Sensor Systems (SenSys)

Title: **Satellite Communication** **Code: 18B14EC844**

L-T-P: Scheme: **3-0-0** **Credit**: **3**

Prerequisites:
Students must have already studied course, "*Analog and Digital Communication*".

Objectives:
1. To learn and be able to implement the downlink and uplink design technologies.
2. To develop the abilities to detect and correct error using various codes.

Learning Outcomes:

Course Outcome	Description
CO1	Outline basic knowledge of satellite communication principles.
CO2	Describe the orbital mechanics and launches for the satellite communication.
CO3	Develop the basic knowledge of link design of a satellite system.
CO4	Identify to provide better understanding of multiple access systems and earth station technology.
CO5	Applications to prepare students with knowledge in satellite navigation and GPS and satellite packet communications.
CO6	Demonstrate deployment and basic maintenance skills.

Course Content:
Unit-1: Introduction: Brief History, Overview, Satellite Orbits: Orbital mechanics, Look Angle determination, Launch Vehicles: Placing satellite in geostationary orbit, geostationary transfer orbit, Orbital effects in communications, Types of Orbits, Coverage and frequency consideration.

Unit-2: Satellite Link: Basic transmission theory: EIRP, free-space transmission, System Noise: Noise figure, noise temperature, C/N ratio of earth station. Downlink design, uplink design, combined uplink- down link *CIN.*

Unit-3: Modulation and Multiplexing: FM links, SCPC, FDM/FM, Digital Transmission, Digital modulation & demodulation, Time division multiplexing, Multiple Access: FDMA, TDMA, DAMA, SPADE, CDMA.

Unit-4: Error Control Coding: Error detection and correction, Channel capacity, Error control coding: Linear and cyclic block codes, Convolution codes, Implementation of error detection on satellite links. Propagation effects and their impact on Satellite -Earth links: Quantifying attenuation and depolarization, Propagation effects that are not associated with Hydrometeors, Rain and Ice effects, Prediction of Rain attenuation, Prediction of XPD.

Unit -5: Satellite Navigation and GPS: Radio and Satellite Navigation, GPS Principles, GPS receiver and codes, GPS Navigation message, GPS signal levels, timing accuracy, GPS receiver operation

Teaching Methodology:

This course is introduced to help students learn about satellite communication, orbital mechanisms, uplink and downlink designing. Examples and numerical problems will be discussed.

Evaluation Scheme (Theory):

Exams	**Marks**	**Coverage**
Test-1	15 Marks	Based on Unit-1 & Unit-2.
Test-2	25 Marks	Based on Unit-3 & Unit-4 and around 30% from coverage of Test-1
Test-3	35 Marks	Based on Unit-4 to Unit-5 and around 30% from coverage of Test-2
Assignment	10 Marks	
Tutorials	5 Marks	
Quiz	5 Marks	
Attendance	5 Marks	
Total	**100 Marks**	

Learning Resources:
Tutorials and lecture slides on Satellite Communication (will be added from time to time): Digital copy will be available on the JUET server.

Text books

[1] T. Pratt, C. Bostian, J. Allnutt, "Satellite Communications", 2nd Edition, Wiley

Reference Books:

[1] D.Roddy, "Satellite Communications", 3rd Edition, Tata McGraw-Hill.

Web References:

[1] Satellite Communication, http://www.cse.wustl.edu/~jain/cis788-97/satellite_nets/index.htm
[2] Satellite Data Networks, http://www.cse.wustl.edu/~jain/cis788-97/satellite_data/index.htm
[3] www.nptel.ac.in

Journals References:

[1] IEEE Transactions on Satellite communication
[2] Elsevier Journal on Satellite communication

Title: Biomedical Signal Processing **Code: 18B14EC845**

L-T-P Scheme: 3-0-0 **Credit: 3**

Prerequisite: Student must have already registered for the course, "*Electromagnetic Field Theory*", "*Digital Signal Processing*" and "*Wireless Communication*".

Course Objective:

1. To provide an introduction to multiple antennas based wireless communications.
2. The course covers fundamentals of multiple-input multiple-output (MIMO) communication system.
3. The basic quantities like diversity, coding gain, array gain are introduced.
4. The error rate of the MIMO systems is analyzed in detail.
5. The MIMO information theory is also covered.
6. The concept of transmit and receive diversity, beamforming and combining, and space-time block code are also thoroughly explained.
7. The precoder design and multiuser MIMO is also covered.
8. Developing wireless communication systems needs to meet higher capacity demands driven by Internet and multimedia applications.
9. To achieve higher rates of transmission in a highly restricted radio spectrum, new transmission techniques, which offer significant improvements in spectral efficiencies and transmission reliability, must be developed.
10. Multiple-input multiple-output (MIMO) wireless channels and Space-Time Coding (STC) are techniques, which simultaneously offer coding gains, spectral efficiency and diversity improvement.
11. The objective of this course is to present the key theoretical concepts of MIMO wireless channels and STC with applications to future generations of wireless networks.

Learning Outcomes:

Course Outcome	Description
CO1	Introduction of Multiple Input Multiple Output (MIMO) and BLAST Communication Systems.
CO2	Compare MIMO Systems with Single Input Single Output (SISO) Systems.
CO3	Analyse the Information Theoretic advantages of MIMO Systems. To be able to design and evaluate receiver and transmitter diversity techniques.
CO4	Analyse the spatial multiplexing properties of MIMO.
CO5	Understanding and ability to analyse space time codes.
CO6	Understand the concepts of additional techniques for capacity and flexibility enhancement related to the MIMO communication systems and to be able to calculate capacity of MIMO systems.

Course Content:

Unit I: Basic of Digital Communication System for MIMO: Overview of cellular service progression, Gaussian random variable, BER performance of communication systems in an AWGN channel, BER and SER for BPSK, QPSK in AWGN, M-ary PAM, M-QAM, M-ary PSK.

Unit-2: Introduction of MIMO : Introduction to MIMO wireless Communications, MIMO system model, Fundamental properties and models of MIMO systems, Multiple Antennas in wireless systems, Principle of Diversity, Multiplexing Capability, SIMO, MISO, MIMO systems, Multiple antenna Techniques in commercial wireless systems. Electromagnetic Waves propagation through MIMO channels, Orthogonality of signals.

Unit-3: MIMO Receivers:MIMO zero forcing receiver, properties of the zero forcing receiver matrix, principle of orthogonality interpretation of ZF receiver, MIMO MMSE receiver, robustness of MMSE to noise amplification, Low and High SNR properties of the MMSE receiver.

Unit-4: MIMO Channel process: Singular Value Decomposition (SVD) of the MIMO channel, SVD and MIMO capacity, Alamouti and Spacetime codes, OSTBC, Nonlinear receiver: VBLAST.Double directional propagation to MIMO channels, statistical propertied of the channel matrix, discrete channel modeling. Empirical models, Standardized models.

Unit-5: MIMO Implementations: Space time Encoder, Design methodology, Spatial Multiplexing/V-BLAST, ML decoding, Sphere decoding, D-BLAST, OSTBC, QOSTBC, Linear dispersion codes. Space time Trellis codes.

Teaching Methodology:

1. The students must be able to describe the problem that confronts the designer when the technologies are passing on to future technologies in the Wireless Communication area, be able to describe how to enhance the capacity of the complex wireless communication system with less requirement of Bandwidth.
2. Lectures would require more attention in the class due to the advance and new methodology and it would cover the core concepts that are explained in the text and reference materials with adequate examples.

Evaluation Scheme:

Exams	**Marks**	**Coverage**
Test-1	15 Marks	Based on Unit-1, Unit-2(30%)
Test-2	25 Marks	Based on Unit-2 (70%)& Unit-3 and around 30% from coverage of Test-1
Test-3	35 Marks	Based on Unit-4 to Unit-5 and around 30% from coverage of Test-2
Assignment	10 Marks	
Tutorials	5 Marks	
Quiz	5 Marks	
Attendance	5 Marks	
Total	**100 Marks**	

Learning Resources:

Tutorials and lecture slides on Web Development (will be added from time to time): Digital copy will be available on the JUET server.

Text Books :

[1] Smart Antenna Engineering – By Ahmed El Zooghby
[2] Space-Time Processing for MIMO Communications – By A.B.Gershman and N.D.Sidiropoulos

[3] Fundamental of Wireless Communication – by David Tse and Pramod Vishwanath, Cambridge press.

Web References:

[1] https://ieeexplore.ieee.org/document/1266912
[2] https://www.edgefx.in/multiple-input-and-multiple-output-mimo-wireless-communications/
[3] https://www.southwestantennas.com/articles/general-product-information/introduction-basics-mimo-communication-technology
[4] https://www.mathworks.com/help/phased/mimo-communication.html
[5] https://swayam.gov.in/nd1_noc20_ee33
[6] https://ece.nitk.ac.in/course/ce829-mimo-communication-systems

Journals References:

[1] IEEE Antenna and Wave Propagation letters
[2] IEEE Vehicular Techonology
[3] Wireless Personal Communication
[4] AEU International Journal of Electronics

Title: MIMO Systems **Code: 18B14EC846**

L-T-P Scheme: 3-0-0 **Credit: 3**

Objective:
Students must have already registered for the course, "*Electromagnetic Field Theory*", "*Digital Signal Processing*" and "*Wireless Communication*".

Learning Outcomes:

Course Outcome	Description
CO1	Outline basics to advanced concepts and techniques of Computer networks.
CO2	Describe problem solving approaches as applied in Data communication networking areas.
CO3	Analyse performance of basic communication networks using both analytical and simulation techniques.
CO4	Develop the Computer network design techniques and practical implementation issues.
CO5	Understand the basic properties of internet and data traffic properties.
CO6	Apply verification and validation techniques on a given software project.
CO7	Demonstrate deployment and basic maintenance skills.

Course Content:

Unit I: Introduction: Introduction to computer network, classification of networks WAN, MAN, LAN), distributed systems, digital signals and data rates, bit stream, symbols and band rate, transmission media, modems, structure of computer network, circuit, packet, message switching, Network topological, Network model, ISO-OSI model, TCP/IP model, primitives and services.

Unit II: Physical Layer: Physical Layer Design Issues (Service provided to data link Layer) Introduction Transmission media, RS-232-C and RS-449, Line coding, Switching Techniques.

Unit III: Data Link Layer: Data Link Layer Design Issues (Service Provided to N/w Layer), Framing, error control, flow control, Link Management, Error Detection and Error Correction Coding, Data Link Protocols (Elementary and sliding Window), local and metropolitan area networks. The Medium Access sub layer, Static and Dynamic Channel Allocation in LANs and MANs, ALOHA Protocols (Pure and Slotted), Different Protocols of LAN, IEEE Standard 802 for LAN (802.2, 802.4, 802.5).

Unit IV: Network Layer: Network Layer Design Issues (Service Provided to Transport Layer). Routing, Congestion, Internetworking. Routing Algorithms, Congestion Control Algorithm Internetworking, congestion control. Design issues, buffer management, synchronization. Session and presentation layer synchronization issues, formatting, data compression, data security.

Unit V: Transport Layer: Transport Layer Design Issue. Connection Management, Buffer Management, Quality of Service. Session Layer Design Issues Synchronization issues. Introduction to Presentation Layer. Encryption and decryption. RSA algorithm.

Teaching Methodology

This course will help the students to facilitate interaction and information transfer over large distances. With internet, computer and telephone networks, buisenesses can allocate their resources efficiently. The students will be able to learn basic concepts of computer network, its working principle & operation of Internet and Intranet. They will also learn the working principle of operation of LAN, WAN, MAN, congestion in the network and network management.

Evaluation Scheme:

Exams	**Marks**	**Coverage**
Test-1	15 Marks	Based on Unit-1, Unit-2
Test-2	25 Marks	Based on Unit-2, 3 & Unit-4 and around 30% from coverage of Test-1
Test-3	35 Marks	Based on Unit-4 and Unit-5 and around 30% from coverage of Test-2
Assignment	10 Marks	
Tutorials	5 Marks	
Quiz	5 Marks	
Attendance	5 Marks	
Total	**100 Marks**	

Learning Resources:

Tutorials and lecture slides on Telecommunication networks (will be added from time to time).

Text Books:

1. A.S. Tennenbaum, Computer Networks, PHI
2. W. Stallings, Data & Computer Communication, PHI
3. Forouzen, Behrouz A.Fegan, Sophia Chung Data Communications and Networking, TMH.

Reference Books:

1. Carne, E. Bryan Professional's Guide to Data Communication in a TCP/IP World Artech House, London, 2004
2. Young, Margret Levine Internet: The Complete Reference, Tata McGraw Hill, New Delhi, 2002

Web References:

1. www.britannica.com
2. www.vssut.ac.in

Journals References:

1. International Journal on Advances in Telecommunications
2. Journal of Network and Computer applications- Elsevier
3. IEEE transactions on networking
4. ACM Journals on networking

Title: Instrumentation Engineering for Smart Cities **Code: 21B14EC848**

L-T Scheme: 3-0-0 **Credits: 3**

Prerequisite: Students must have already studied courses the concept of Instrumentation Engineering.

Objective:

1. The vital aim of instrumentation engineering is to ensure that control machinery and processes are working to achieve maximum productivity in an optimally efficient, safe and reliable manner.
2. The objective of smart cities is to promote cities that provide core infrastructure and give a decent quality of life to its citizens, a clean and sustainable environment and application of 'Smart' Solutions.

Learning Outcomes:

Course Outcome	Description
CO1	Get familiar with process of instrumentation engineering and smart cities.
CO2	Have a good grounding and concepts of instrumentation and control engineering.
CO3	Possess demonstrative skills in design and to develop smart cities.
CO4	To identify challenges to develop smart cities.
CO5	Apply instrumentation engineering approaches required to develop smart cities.

Course Content:

Unit-1 Introduction to smart cities, Services Different perceptions about Smart Cities, Aims of smart city, Smart City project, Initiatives for smart cities, Challenges to develop smart cities, Smart health,

Unit-2 Intelligently leveraging telemetry concepts of instrumentation and control, Communication engineering in form of smart network infrastructure. Smart leadership and strategy.

Unit-3 Application of automated metering infrastructure (AMI), monitoring and automation of substations, power network monitoring, Home automation network (HAN), Demand Response (DR), and Integration of solar PV (**Photovoltaic**)

Unit-4 Role of instrumentation in designing quality infrastructure and formulating solutions for basic amenities such as water, sanitation, solid waste management, and Smart transportation

Unit-5 Smart city planning & performance, Open data & analytics, Cyber security and privacy, Healthcare and wellness, Social media & Digital inclusion, Smart buildings, Smart energy innovation.

Teaching Methodology:

Lectures would be interactive and it would cover the core concepts that are explained in the text and reference materials with adequate examples.

Evaluation Scheme:

Exams	Marks	Coverage
Test-1	15 Marks	Based on Unit-1 & Unit-2 Test-1
Test-2	25 Marks	Based on Unit-3 & Unit-4 and around 30% from

		coverage of Test-2
Test-3	35 Marks	Based on Unit-5 and around 30% from coverage of Test-3
Assignment	10 Marks	
Tutorials	5 Marks	
Quiz	5 Marks	
Attendance	5 Marks	
Total	**100 Marks**	

Learning Resources:
Tutorials and lecture slides on Instrumentation Engineering for Smart Cities (will be added from time to time): Digital copy will be available on the JUET server.

Text Books:

1. Transforming City Governments for Successful Smart Cities, Editor: Manuel Pedro Rodriguez-Bolivar,ISBN: 978-3-319-03166-8

2. Smart Cities: Big Data and the Quest for a New Utopia, Anthony M. Townsend, ISBN: 978-0-393-08287-6
3. Beyond Smart Cities: How Cities Network, Learn and Innovate, Tim Campbell ISBN: 978-1-84971-426-6
4. Building Smart Cities: Analytics, ICT and Design Thinking, Carol L. Stimmel, ISBN: 978-1-4987-0276-8

Reference Books:

1. NextGen Smart CitiesThe Emergence Of A New CivilizationPhillip Andrews, Tom Allen, Debi Stack, Glenn Robertson
2. Smart Cities of Today and TomorrowBetter Technology, Infrastructure and Security Joseph N. Pelton, Indu B. Singh
3. Smart Cities Technologies, Challenges and Future Prospects Alfredo Barton, Raymond Manning

Web References:

1. https://www.solarimpulse.com/smart-cities/solutions
2. https://smartcities.gov.in
3. https://www.twi- global.com

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Journals References:

1. International Journal of Instrumentation and Measurement
2. Journal of Instrumentation
3. International Journal of Instrumentation Technology

Title: Major Project Part-II **Code: 18B19EC891**

L-T-P scheme: 0-0-16 **Credit: 8**

Prerequisite: Students must have basic knowledge of project topic.

Objective:

1. To learn and be able to implement either hardware or software project based on the topic.
2. To develop the abilities to complete the project in time and have the practical knowledge.

Learning Outcomes:

Course Outcome	**Description**
CO1	Test the given problem with different algorithms.
CO2	Simulation and comparison of existing techniques for a chosen problem
CO3	Develop the modified or new algorithm or solution of the problem
CO4	Comparison of the developed algorithm with the existing ones.
CO5	Demonstrate the final work and report writing.

Teaching Methodology:

This course is introduced to develop the ability to complete the project in time. Student will be able to learn the practical application of the project topic. Will have the basic knowledge of the various components and benefits in the real life and learn to do coding in case the project is hardware based. If the project is software based then student will be able to develop its programming skills and its implications and benefits in practical life.

Evaluation Scheme:

Exams		**Marks**	**Coverage**
P-1		15 Marks	Based on Guidelines provided for Project
P-2		15 Marks	Based on Guidelines provided for Project
P-3		20 Marks	Based on Guidelines provided for Project
Day-to-Day Work	Attendance	10 Marks	70 Marks
	Sincerity	10 Marks	
	Project Report	15 Marks	
	Performance	15 Marks	
Total		**100 Marks**	

Learning Resources: Students with concern to the faculty develop some new idea for preparing the project and related information they will acquire from the faculty and internet.

Text Books:

[1] Electronic project book, BPS publication.

[2] Electronics for you (Monthly Magazine).

Reference Books/Material:

[1] "Electronics project management and design", D. Joseph Stadtmiller, Pearson; 1 edition 2000.
[2] "50 Electronics Projects for Beginners", A.K.Maini, Pustak Mahal; First Edition 2007.

Web References:

[1] www.electronicshub.org
[2] https://nevonprojects.com

Journals References:

[1] Journal of Communications Technology and Electronics
[2] IEEE Transaction on communication

Minor Specializations

Sr. No.	Minor Specialization Offered by ECE dept.	Credits
1	Embedded System	20
2	Internet of Robotics Things	20

Minor Specialization-1: Embedded System

Sr. No.	Course Code	Dept.	Title of Course	Contact Hours				Credits	Sem.
				L	T	P	Total		
1.	18B11EC920	ECE	Electronic Circuit Design	3	-	-	3	3	III
2.	18B11EC914	ECE	Transducer Engineering	3		-	3	3	IV
3.	18B17EC974	ECE	Transducer Engineering Lab	-	-	2	2	1	IV
4.	18B11EC919	ECE	Digital Control System	3	-	-	3	3	V
5.	18B11EC915	ECE	Microcontroller and Embedded System	3	-	-	3	3	VI
6.	18B17EC976	ECE	Microcontroller and Embedded System lab	-	-	2	2	1	VI
7.	18B11EC916	ECE	Embedded Control System	3	-	-	3	3	VII/VIII
8.	18B11EC918	ECE	Real Time Embedded System Design	3	-	-	3	3	VII/VIII
			Total				**22**	**20**	

Minor Specialization-2 offered by ECE dept. with CSE dept.: Internet of Robotics Things for ECE and CSE students)

S. No.	Course Code	Dept.	Title of Course	Contact Hours				Credits	Sem.
				L	T	P	Total		
1.	18B11EC314 18B11EC919	ECE	Measurement & Instrumentation (for CSE)/ Digital Control System (for ECE)	3	0	0	3	3	V
2.	18B11EC911	ECE	Sensors, Actuators & Signal Processing	3		0	3	3	IV
3.	18B11CI916	CSE	Statistical Methods and Data Analysis	3	0	0	3	3	III
4.	18B17CI976	CSE	Statistical Methods and Data Analysis Lab	0	0	2	2	1	III
5.	18B11EC913	ECE/ CSE	Robotics & Machine Vision	3	0	0	3	3	VII/VIII
6.	18B17EC973	ECE	Robotics Programming Lab	0		2	2	1	VII/VIII

7.	18B17CI997	CSE	Internet of Things Lab	0	0	2	2	1	VII/VIII
8.	18B11CI937	CSE	Internet of Things Technology and Applications	2	0	0	2	2	VII/VIII
9.	18B11CI918	CSE	Machine Learning	3	0	0	3	3	VI
			Total				**23**	**20**	

***Students of ECE will be registered in course of 'Introduction to Artificial Intelligence' as prerequisite of 'Artificial Intelligence and Applications.**

Minor Specialization offered by Mechanical Engg. dept. with ECE dept. (for ECE and MEC students):

Industrial Automation

S. No.	Course Code	Dept.	Title of Course	Contact Hours				Credits	Sem.
				L	T	P	Total		
1	18B11EC914	ECE	Transducers Engineering	3		-	3	3	IV
2	18B17EC974	ECE	Transducers Engineering Lab	-	-	2	2	1	IV
3	18B11ME911	MEC	Robotics	3	-	-	3	3	V
4	18B11EC919/ XXXXXX	ECE	Digital Control System (for ECE students) /Microprocessors based Control System (For MEC students)	3	-	-	3	3	V
5	18B17ME971	MEC	Robotics/CIM Lab	-	-	2	2	1	V
6	18B11ME913	MEC	Industrial Automation	3	-	-	3	3	VI
7	18B11ME914	MEC	Control of Industrial Automation	3	-	-	3	3	VI
8	18B11ME912	MEC	Special Purpose Vehicle	3	-	-	3	3	VII
			Total	**18**	**-**	**4**	**22**	**20**	

Minor Specialization offered by Mechanical Engg. dept. with ECE dept. (for ECE and MEC students):

Mechatronics

S. No.	Course Code	Dept.	Title of Course	Contact Hours				Credits	Sem.
				L	**T**	**P**	**Total**		
1	18B11EC914	ECE	Transducers Engineering	3		-	3	3	IV
2	18B17EC974	ECE	Transducers Engineering Lab	-	-	2	2	1	IV
3	18B11ME917	MEC	Vehicle Dynamics	3	-	-	3	3	V
4	18B11ME915	MEC	Computer Integrated Manufacturing	3	-	-	3	3	V
5	18B17ME975	MEC	CIM Lab	-	-	2	2	1	V
6	18B11ME918	MEC	Control of Mechanical System	3	-	-	3	3	VI
7	18B11EC915	ECE	Micro-controller and Embedded System	3	-	-	3	3	VI
8	18B11ME916	MEC	Automated Guided Vehicles	3	-	-	3	3	VII
			Total	**18**	**-**	**4**	**22**	**20**	

Embedded System

Title: Electronic Circuit Design **Code: 18B11EC920**

L-T-P scheme: 3-0-0 **Credit: 3**

Course content
The course is organized around the phase of larger innovations in the design process of any electronic equipment. The students will get acquainted with a collaborating partner with a real-world problem. They will gain basic experience with relevant technology in order to design a system that meets the problem requirements.

Objective:
1. To organize the phase of larger innovations in the design process of any electronic equipment.
2. The students will get acquainted with a collaborating partner with a real-world problem.
3. Students will gain basic experience with relevant technology in order to design a system that meets the problem requirements.

Learning outcome:

Course Outcome	Description
CO1	Understand the D.C. power supply system
CO2	Design of SMPS and different power amplifier circuits
CO3	Analysis and evaluation of the sinusoidal oscillators for various frequencies
CO4	Design and analysis of various filters and their use in electronics and communication circuits.
CO5	Evaluate the frequency response to understand behaviour of electronic circuits

UNIT-1: Design of Power supply system: Unregulated D.C.. power supply system with rectifiers and filters. Design of emitter follower regulator, series regulators, overload protection circuits for regulators. Design of SMPS: Step up and step down.

UNIT-2: Design of class A small signal amplifiers: Emitter follower, Darlington pair amplifiers with and without Bootstrapping, Two stage direct coupled amplifier. Design of class A, Class AB audio power amplifier with drivers.

UNIT -3: Design of sinusoidal oscillators: OPAMP based Wein bridge and Phase Shift oscillators with AGC circuits, Transistor based Hartley, Colpits and Crystal oscillators, Evaluation of figure of merit for all above oscillator circuits.

UNIT-4: Design of constant current sources, Design of function generators, Design of tuned amplifiers. Design of Butterworth, Chebyshev filters upto sixth order with VCVS and IGMF configuration.

UNIT -5: ADC and DACs: Characteristics, interfacing, selecting an ADC. PCB Design guidelines for reduced EMI.

Teaching Methodology:
The students will be able to learn the electronic components, their operations and applications in communication circuits. They will also learn the designing of different electronic circuits.

Evaluation Scheme:

Exams	Marks	Coverage
Test-1	15 Marks	Based on Unit-1, Unit-2
Test-2	25 Marks	Based on Unit-2, 3 & Unit-4 and around 30% from coverage of Test-1
Test-3	35 Marks	Based on Unit-4 and Unit-5 and around 30% from coverage of Test-2
Assignment	10 Marks	
Tutorials	5 Marks	
Quiz	5 Marks	
Attendance	5 Marks	
Total	**100 Marks**	

Learning Resources:

Tutorials and lecture slides on Electronic circuit design (will be added from time to time): Digital copy will be available on the JUET server

TEXT BOOKS:

1. Operational amplifiers and linear integrated circuits, 3rd edition, Robert F.Coughlin, Prentice Hall International, Inc.
2. Ramakant A.Gayakwad: Op-Amps and Linear Integrated Circuits, Prentice Hall International, Inc.

REFRENCE BOOKS:

1. Regulated Power supply Handbook. Texas Instruments.
2. Monograph on Electronic circuit Design : Goyal & Khetan.
3. Intuitive analog circuit design : Mark.T Thompson; published by Elsevier.
4. PCB design guidelines for reduced EMI; Application notes, http://www.ti.com.

Web References:

[1] www.elprocus.com
[2] www.tutorialspoint.com

Journal References:

[1] IEEE transactions on circuits and systems
[2] IEEE transactions on electron devices

Title: Transducer Engineering **Code: 18B11EC914**

L-T Scheme: 3-0-0 **Credits: 3**

Prerequisite: Not Applicable

Objectives:

1. To understand the principle of operation and the important characteristics of transducerscommonly used in industry.
2. To familiarize with the selection criterion and installation process of transducers.
3. To design the appropriate signal conditioning circuit for specific measurement requirement.

Learning Outcomes:

Course Outcome	Description
CO1	Outline various types of transducers concerning their application in the industry.
CO2	Describe the operating principle of various types of the transducer.
CO3	Develop skills to select a transducer for a specific measurement requirement.
CO4	Identify and use various transducers and signal conditioning circuits used in the measurement process.
CO5	Analyze the performance of the transducer.
CO6	Demonstrate the application of various transducers.

Course Content:

Unit 1: Transducer Fundamentals: Basic concept of Sensors and transducer, their comparisons, Classification of Transducer, Working of transducers used for measurement of Displacement- resistive, inductive and capacitive method, Linear and Angular Velocity moving coil and moving magnet method, various tachometers and stroboscope, Acceleration- seismic and peizo electric accelerometer, Working principle of Capacitive Transducer, Piezo-Electric Transducer, and LVDT.

Unit 2: Strain and Temperature Measurement: Measurement Strain Gauges- strain measurement technique, resistance strain gauge and its types, Signal conditioning of strain gauges, Transducers for Temperature Measurement- non- electrical and electrical method, Bimetallic Thermometer, Resistance Thermometer like RTD, Thermistor and Thermocouple, Radiation and Optical Pyrometer.

Unit 3: Pressure Measurement: Transducers for Measurement of Pressure: - Manometers types (like Single column, inclined, U-tube), Mechanical Types (Bourdon, bellows and diaphragm), Elastic Types transducers, Low Pressure measurement gauges (Ionization, McLeod etc.).

Unit 4: Flow Measurement: Transducers for Measurement of Flow: - Types of flow meters, Theory of variable head constant area meter and its types, theory of constant head variable area

meter and its types, theory of variable head variable area meter and its types, Special flow meters- Electromagnetic, Hot wire Anemometer, Turbine meter and Ultrasonic flow meter.

Unit 5: Miscellaneous Measurement and Smart Sensor: Transducer for Level Measurement: - direct and indirect method, resistive method, Ultrasonic, Capacitive and Gamma Ray level Gauges. Measurement of Humidity and Moisture- basic definitions, psychometric method, Smart sensors - Fibre optic sensors, MEMS – Nano sensors, proximity sensor.

Teaching Methodology:
This course is introduced to familiarize the student with the various transducers used in the automation industry. Starting from the basic concepts, the student will gradually develop an understanding of practical setups used in the industry. The entire course is broken down into five units, such that each unit covers the use of transducer for a particular application. This theory course is well complemented by a laboratory course under the name Transducer Engineering Lab in the same semester that helps a student learn with hands-on experience.

Evaluation Scheme:

Exams	**Marks**	**Coverage**
Test-1	15 Marks	Based on Unit-1
Test-2	25 Marks	Based on Unit-2 & Unit-3 and around 30%from coverage of Test-1
Test-3	35 Marks	Based on Unit-4 to Unit-5 and around 30%from coverage of Test-2
Assignment	10 Marks	
Tutorials	5 Marks	
Quiz	5 Marks	
Attendance	5 Marks	
Total	**100 Marks**	

Learning Resources:
Tutorials and lecture slides on transducers (will be added from time to time): Digital copy will be available on the JUET server.

Text Books:

[1] A.K.Sawhney & Puneet Sawhney, A Course in Mechanical Measurements and Instrumentation, 12/e, Dhanpat Rai & Co. (P) Ltd.,2004
[2] B.C.Nakra & K.K.Chaudhary,Instrumentation Measurement And Analysis, Tata McGraw-Hill Publishing Company Ltd, New Delhi.,1996
[3] D.Patranabis, Principles of Industrial Instrumentation, 2/e, Tata McGraw-Hill Publishing Company Ltd, New Delhi.,1998

Reference Books/Materials:

[1] James W. Dally, William F. Riley & Kenneth G.McConnell, Instrumentation for Engineering Measurements,2/e,Wiley Student Edition, John Wiley & Sons,INC,2003.

[2] John P.Bentley, Principles of Measurement Systems, Low Price Edition, Pearson Education Asia,2000
[3] Dr.D.S.Kumar, Mechanical Measurements and Control, 3/e, Reprint-2004, Metropolitan Book Co. Private Ltd.,2004
[4] Liptak, B.G., "Instrumentation Engineers Handbook (Measurement)", CRC Press, 2005.

Web References:

[1] https://nptel.ac.in/courses/108/108/108108147/
[2] https://nptel.ac.in/content/storage2/nptel_data3/html/mhrd/ict/text/112104250/lec21.pdf
[3] https://www.electronics-tutorials.ws/io/io_1.html

Journals References:

[1] Sensors and Actuators A: Physical (Elsevier)
[2] Journal of Sensors (Hindawi)

Title: Transducer Engineering Lab **Code: 18B17EC974**

L-T-P scheme: 0-0-2 **Credit: 1**

Objectives:

1. To understand the principle of operation and the important characteristics of transducerscommonly used in industry.
2. To familiarize with the selection criterion and installation process of transducers.
3. To design the appropriate signal conditioning circuit for specific measurement requirement.

Learning Outcomes: In reference to Transducer Engineering (18B11EC914), the students willbe able to:

Course Outcome	Description
CO1	Outline various types of transducers used in the automation industry.
CO2	Describe the constructional details and working of various types of the transducer.
CO3	Develop a signal conditioning circuit to interface the transducer to the digital systems.
CO4	Identify and select a transducer for a specific measurement requirement.
CO5	Apply the analytical techniques to evaluate the performance of the transducer.
CO6	Demonstrate the application of various transducers.

Course Content:

Unit 1: Lab exercise based on introduction to sensors and transducers
Unit 2: Lab exercise based on working of various transducers
Unit 3: Lab exercise based on implementation of interfacing circuits to convert non-electrical signals to electrical signals.
Unit 4: Lab exercise based on measurement of physical parameters such as temperature, force, flow-rate etc.
Unit 5: Lab exercise based on the determination of electrical properties such as resistance, inductance, capacitance

Teaching Methodology:

This course is introduced to help the students to familiarize with the devices and methods used for automatic measurement. In this course, the mixed technique of interactive discussion, regular assignments will be used. In the discussion the fundamental theoretical concepts will be introduced and demonstrated through examples. Discussion will be implemented in laboratory by using the practical setups.

Evaluation Scheme:

Exams		Marks	Coverage
P-1		15 Marks	Based on Lab Exercises: 1-5
P-2		15 Marks	Based on Lab Exercises: 6-11
Day-to-Day Work	Viva	20 Marks	70 Marks
	Demonstration	20 Marks	
	Lab Record	15 Marks	
	Attendance & Discipline	15 Marks	
Total		**100 Marks**	

Learning Resources:

Study material of Measurement & Instrumentation Lab (will be added from time to time): Digitalcopy will be available on the JUET server.

Text Books:

[1] A.K.Sawhney & Puneet Sawhney, A Course in Mechanical Measurements andInstrumentation, 12/e, Dhanpat Rai & Co. (P) Ltd.,2004
[2] B.C.Nakra & K.K.Chaudhary,Instrumentation Measurement And Analysis, TataMcGraw-Hill Publishing Company Ltd, New Delhi.,1996
[3] D.Patranabis, Principles of Industrial Instrumentation, 2/e, Tata McGraw-Hill PublishingCompany Ltd, New Delhi.,1998

Reference Books/Materials:

[1] James W. Dally, William F. Riley & Kenneth G.McConnell, Instrumentation for Engineering Measurements,2/e,Wiley Student Edition, John Wiley & Sons,INC,2003.
[2] John P.Bentley, Principles of Measurement Systems, Low Price Edition, PearsonEducation Asia,2000
[3] Dr.D.S.Kumar, Mechanical Measurements and Control, 3/e, Reprint-2004, MetropolitanBook Co. Private Ltd.,2004
[4] Liptak, B.G., "Instrumentation Engineers Handbook (Measurement)", CRC Press, 2005.

Web References:

[1] https://nptel.ac.in/courses/108/108/108108147/
[2] https://nptel.ac.in/content/storage2/nptel_data3/html/mhrd/ict/text/112104250/lec21.pdf
[3] https://www.electronics-tutorials.ws/io/io_1.html

Journals References:

[1] Sensors and Actuators A: Physical (Elsevier)
[2] Journal of Sensors (Hindawi)

Title: Digital Control System **Code: 18B11EC919**

L-T-P Scheme: 3-0-0 **Credit: 3**

Prerequisite: Students must have already studied courses, "*Control Systems*".

Objective:

1. To familiarize the student with the working of automation systems.
2. To develop an ability to design a computer-aided control system with given requirements.

Learning Outcomes:

Course Outcome	Description
CO1	Outline various digital control systems and their application.
CO2	Describe the element and operation of a digital control system.
CO3	Develop the architecture of an automation system based on the specified requirements.
CO4	Identify the hardware and software components of a computer-aided control system.
CO5	Application of digital control systems on a given assignment/ project.
CO6	Demonstration and deployment of basic software modules of a digital control system.

Course Content:

Unit 1: Introduction to Digital Control: Review of conventional control system. Manual and automatic control schemes. Model-based and model-less control. Need of automatic control, Advantages, Limitations, Applications.

Unit 2: Programmable Logic Controller: History of programmable logic controller (PLC). Architecture of PLC. Elements of PLC, CPU, IO Modules, Power supply and Communication Modules, Input Output Devices, Interfacing of Field Devices.

Unit 3: Distributed Control Systems: Basics of Distributed Control Systems (DCS). Architecture and Working. Components of DCS, Field Instruments and Interfacing Circuits, Communication Protocols. Control of Field Instruments using Relay Devices.

Unit 4: Supervisory Control and Data Acquisition (SCADA): Introduction to SCADA. Fundamental Principle of Modern SCADA Systems. SCADA Hardware and Software. Remote Terminal Units (RTU). Master Station. Interfacing between SCADA and PLC.

Unit 5: Design of Industrial Automation Setup: Requirement gathering, System layout, Identification of Modules, Hardware Implementation, Software design. Case Study of Industrial Automation in Food Processing and Manufacturing Industry.

Teaching Methodology:

This course is introduced to help students transition from a simple electrical and electronics engineering concepts to applications of digital control system. Starting with the understanding ofcontinuous systems, the student will be able to understand computer-aided control and other aspects of system analysis. The entire course is broken down into five separate units to develop an understanding of various aspects of automation. Each section includes multiple technologies to help a student gain more experience as an electronic control system designer.

Evaluation Scheme:

Exams	Marks	Coverage
Test-1	15 Marks	Based on Unit-1, Unit-2
Test-2	25 Marks	Based on Unit-3 & Unit-4 and around 30%from coverage of Test-1
Test-3	35 Marks	Based on Unit-5 to Unit-6 and around 30%from coverage of Test-2
Assignment	10 Marks	
Tutorials	5 Marks	
Quiz	5 Marks	
Attendance	5 Marks	
Total	**100 Marks**	

Learning Resources:

Lecture notes/slides on Digital Control System (will be added from time to time): Digital copywill be available on the JUET server.

Text Books:

[1] K.S. Manoj, Industrial Automation with SCADA: Concepts, Communications and Security,Notion Press, 1/e, Indian Edition, 2019.
[2] T.R. Kurfess, Robotics and Automation Handbook, CRC Press, 2/e, Indian Edition, 2004.

Reference Books/Material:

[1] G. F. Franklin, J. D.Powell and M. L. Workman, Digital Control of Dynamic Systems,Addison Wesley, 1998,Pearson Education,Asia, 3/e, 2000.
[2] K. J.Astroms and B. Wittenmark, Computer Controlled Systems - Theory and Design,Prentice Hall, 3/e, 1997.

Web References:

[1] https://nptel.ac.in/courses/108/105/108105088/
[2] https://www.eolss.net/

Journals References:

[1] Science direct journal of digital control system
[2] IRE Transactions on Industrial Electronics

Title: Microcontroller and Embedded System **Code: 18B11EC915**

L-T-P scheme: 3-0-0 **Credit: 3**

Prerequisite: Students must have already studied courses, "*Microprocessor & Interfacing*".

Objective:

1. To understand the basic principles of microcontroller and embedded systems
2. To implement various project based on different interfacing with microcontroller

Learning Outcomes:

Course Outcome	Description
CO1	Realize of the fundamentals of a microprocessor
CO2	Understand the architecture of microcontroller 8051
CO3	Be trained in the instruction set and microcontroller programming
CO4	Express the memory and input/output interfacing with controllers
CO5	Foster ability to understand the role of embedded systems in industry
CO6	Design and analyze real time embedded systems using the concepts of processor

Course Content:

Unit-1: Fundamentals of Microprocessors: Fundamentals of microprocessor architecture. 8-bit microprocessor and microcontroller, architecture, comparison of 8-bit microcontrollers, 16-bit and 32-bit microcontrollers. Embedded system and its characteristics, Role of microcontrollers in embedded Systems. Overview of the 8051 family.

Unit-2: 8051 Architecture: Internal Block Diagram, CPU, ALU, address, data and control bus, working registers, special function register, Clock and Reset circuits, Stack and Stack Pointer, Program Counter, I/O ports, Memory Structures, Data and Program Memory, Timing diagrams and Execution Cycles.

Unit-3: Instruction Set and Programming: Addressing modes: Introduction, Instruction syntax, Data types, Subroutines Immediate addressing, Register addressing, Direct addressing, Indirect addressing, Relative addressing, Indexed addressing, Bit inherent addressing, bit direct addressing. 8051 Instruction set, Instruction timings. Data transfer instructions, Arithmetic instructions, Logical instructions, Branch instructions, Subroutine instructions, Bit manipulation instruction. Assembly language programs, C language programs. Assemblers and compilers. Programming and debugging tools.

Unit-4: Memory and I/O Interfacing: Memory and I/O expansion buses, control signals, memory wait states. Interfacing of peripheral devices such as General Purpose I/O, ADC, DAC, timers, counters and memory devices.
Unit-5: External Communication Interface: Synchronous and Asynchronous Communication. RS232, SPI, I2C. Introduction and interfacing to protocols like Blue-tooth and Zig-bee.

Unit-6: Applications: LED, LCD and keyboard interfacing. Stepper motor interfacing, DC Motor interfaces and sensor interfacing.

Unit-7: Embedded System: concept of embedded systems design, embedded microcontroller cores and

memories, examples, technological aspects of embedded systems: interfacing between analog and digital blocks, signal conditioning, digital signal processing. Subsystem interfacing, interfacing with external systems, user interfacing, design tradeoffs due to process compatibility, thermal considerations, etc., software aspects of embedded systems: real time programming languages and operating systems for embedded systems.

List of experiments:

Teaching Methodology:
This course is introduced to help students for understanding the basic concept of microcontroller. Initially an overview of microprocessor is discussed briefly. In the first part, 8051 microcontroller is elaborated with the help of architecture followed by assembly language programming. In the second part, various types of interfacing such as memory, Input output and external interface etc is implemented with 8051 microcontrollers. Afterward, application of microcontroller is explained by suitable examples. At the end, embedded system is described in details. Moreover, hardware and software aspects of embedded system has been elaborated with appropriate model and example,

Evaluation Scheme:

Theory course:

Exams	Marks	Coverage
Test-1	15	Based on Unit-1, Unit-2 & Unit-3
Test-2	25	Based on Unit-4 & Unit-5 and around 30% from coverage of Test-1
Test-3	35	Based on Unit-6 to Unit-7 and around 30% from coverage of Test-2
Assignment	10	Based on Unit-1, Unit-4 & Unit-6
Tutorials	5	Based on Unit-2 & Unit-5
Quiz	5	Based on Unit-3 & Unit-7
Attendance	5	Based on attendance in the theory classes
Total	**100**	

Lab course:

Exams	Marks	Coverage
P-1	15	Based on experiments: 1-6
P-2	15	Based on experiments: 7-12
Day to day work	40	Based on each practical observation
Lab record	15	Based on practical file
Attendance & discipline	15	Based on attendance in the practical and discipline in each lab session
Total	**100**	

Learning Resources:
Tutorials and lecture slides on theory course will be added from time to time while, lab manual will be

provided to students in each practical session and a digital copy of study material will be available on the JUET server.

Text Book:

[1] "The 8051 microcontroller" K. J. Ayala, Cengage Learning, 2005
[2] "8051 Microcontroller and embedded systems using assembly and C", M. A. Mazidi, J. G. Mazidi and R. D. Mckinlay, 2nd edi.,

Reference Books:

[1] "*Embedded system*", R. Kamal., 2nd edi., Tata McGraw Hill, 2008.
[2] *"Embedded micro computer systems*: *Real time interfacing*", Thomson learning 2001.

Web References:

[1] https://www.tutorialspoint.com/microprocessor/microcontrollers_8051_architecture
[2] https://www.codrey.com/embedded-systems/

Journals References:

[1] International Journal of Embedded Systems inder science publication
[2] Journal of Microcontroller Engineering and Applications

Title: Microcontroller and Embedded System Lab **Code: 18B17EC976**

L-T-P scheme: 0-0-2 **Credit: 1**

Prerequisite: Students must have already studied courses, "*Microcontroller & Embedded System*".

Objective:
1. To understand the basic principles of microcontroller and embedded systems.
2. To implement various project based on different interfacing with microcontroller.

Learning Outcomes: In reference to Microcontroller & Embedded System (18B11EC413), the students will be able to:

Course Outcome	Description
CO1	Realize of the fundamentals of a microprocessor
CO2	Understand the architecture of microcontroller 8051
CO3	Express the memory and input/output interfacing with controllers
CO4	Develop an interfacing with stepper motor and light emitting diode
CO5	Design and analyze real time embedded systems using the concepts of processor
CO6	Work as a team on a project

Course Content:

Unit-1; Lab exercises based on microprocessor and microcontroller
Unit-2; Lab exercises based on memory interfacing with microprocessor and microcontroller.
Unit-3; Lab exercises based on RS 232 and zigbee with microcontrollers
Unit-4; Lab exercises based on light emitting diode and stepper motor
Unit-5; Lab exercises based on embedded system design
Unit-6; Lab exercises based on various embedded project

Teaching Methodology:
This lab course is introduced to help students for understanding the basic concept of microcontroller. In the first part, 8051 microcontroller is elaborated with the help of architecture followed by assembly language programming. In the second part, various types of interfacing such as memory, Input output and external interface etc is implemented with 8051 microcontrollers. Afterward, application of microcontroller is explained by suitable examples. At the end, embedded system is described in details. Moreover, hardware and software aspects of embedded system has been elaborated with appropriate model and example.

Evaluation Scheme:

Exams	Marks	Coverage	
P-1	15 Marks	Based on Lab Exercises: 1-7	
P-2	15 Marks	Based on Lab Exercises: 8-14	
Day-to-Day Work	Viva	20 Marks	70 Marks
	Demonstration	20 Marks	

	Lab Record	15 Marks	
	Attendance & Discipline	15 Marks	
Total		**100 Marks**	

Learning Resources:
Study material of Microcontroller & Embedded System Lab (will be added time to time): Digital copy will be available on the JUET server.

Text Book:

[1] "The 8051 microcontroller" K. J. Ayala, Cengage Learning, 2005
[2] "8051 Microcontroller and embedded systems using assembly and C", M. A. Mazidi, J. G. Mazidi and R. D. Mckinlay, 2nd edi.,

Reference Books:

[1] "*Embedded system*", R. Kamal., 2nd edi., Tata McGraw Hill, 2008.
[2] *"Embedded microcomputer systems*: *Real time interfacing*", Thomson learning 2001.

Web References:
[1] https://www.tutorialspoint.com/microprocessor/microcontrollers_8051_architecture
[2] https://www.codrey.com/embedded-systems/

Journals References:
[1] International Journal of Embedded Systems inder science publication
[2] Journal of Microcontroller Engineering and Applications

Title: Embedded Control System **Code: 18B11EC916**

L-T-P scheme: 3-0-0 **Credit: 3**

Prerequisite: Students must have previous knowledge of introduction to microprocessor and controllers and embedded control system.

Objective:

1. To explain the various concepts used in embedded control systems.

Learning Outcomes:

Course Outcome	Description
CO1	Express the introduction of embedded systems and microcontroller
CO2	Identify with the concept of analog-to-digital conversion system
CO3	Understand the concept Input /Output Interfacing of embedded system
CO4	Develop programming and tools using hardware and software
CO5	Analyze the need of Real time Operating System (RTOS) in embedded systems

Course Content:
Unit-1: Introduction: Introduction to Embedded Systems, Its Architecture and system Model, Introduction to the HCS12/S12Xseries Microcontrollers, Embedded Hardware Building Block.

Unit-2: HCS12 System Description and Programming: The HCS12 Hardware System ,Modes of Operation, The B32 Memory System , The HCS12 DP256 Memory System, Exception Processing– Resets and Interrupts, Clock Functions, TIM, RTI,Serial Communications, SPI-Serial Peripheral Interface, I2C, HCS12 Analog-to-Digital Conversion System.

Unit-3:Basic Input /Output Interfacing Concepts: Input Devices, Output Devices and their Programming, Switch Debouncing, Interfacing to Motor, LCDs, Transducer, The RS-232 Interface and their Examples.

Unit-4:Development tools and Programming: Hardware and Software development tools, C language programming, Codewarior tools- Project IDE, Compiler, Assembler and Debugger, JTAG and Hardware Debuggers, Interfacing Real Time Clock and Temperature Sensors with I2C and SPI bus.

Unit-5:Real-time Operating Systems (RTOS): Basic concepts of RTOS and its types, Concurrency, Reentrancy, Intertask communication, Implementation of RTOS with some case studies.

Teaching Methodology:
This course is introduced to help students transition from a simple the concept of embedded Systems and its architecture and real-time operating systems.

Evaluation Scheme:

Exams	Marks	Coverage
Test-1	15 Marks	Based on Unit-1, Unit-2
Test-2	25 Marks	Based on Unit-3 & Unit-4 and around 30% from coverage of Test-1
Test-3	35 Marks	Based on Unit-5 and around 30% from coverage of Test-2
Assignment	10 Marks	
Tutorials	5 Marks	
Quiz	5 Marks	
Attendance	5 Marks	
Total	**100 Marks**	

Learning Resources:
Tutorials and lecture slides on Embedded Control System (will be added from time to time): Digital copy will be available on the JUET server.

Text Books:
[1] Barrett, S.F. and Pack, J.D., Embedded Systems, Pearson Education (2008).
[2] Haung, H.W., The HCS12 / 9S12: An Introduction to Software and Hardware Interfacing, Delmar Learning (2007).

Reference Books:
[1] Fredrick, M.C., Assembly and C programming for HCS12 Microcontrollers, Oxford University Press (2005).
[2] Ray, A.K., Advance Microprocessors and Peripherals-Architecture, Programming and Interfacing, Tata McGraw-Hill (2007).

Web References:
[1] www.embedded.com
[2] web.eecs.umich.edu

Journals References:

[1] Journal of Advanced Research in Embedded System
[2] American Journal of Embedded Systems and Applications
[3] Embedded Control System for Smart Walking Assistance

Title: Real Time Embedded Systems Design **Code: 18B11EC918**

L-T-P scheme: 3- 0 -0 **Credit: 3**

Prerequisite: Students must have the concept of "*Digital Electronics"* and "*Microprocessor Interfacing*".

Objective:
The objective of this course is to familiarize students with the issues and technologies involved in designing real-time and hardware-resource constrained systems. Design engineers are often called upon to make decisions about general purpose computing solutions vs. specialized hardware solutions.

Learning Outcomes:

Course Outcome	Description
CO1	Understand the vision and design of embedded systems with respect to the requirements of today's scenario used in technical industries fulfilling the user requirement.
CO2	Understanding the subject knowledge of basics on Embedded systems, Real time systems, Embedded system design and model, Standards and Networking.
CO3	Able to understand the design of embedded processors and types, parallelism, Memory Architecture, Hierarchy, Models, Input and Output hardware, The analog and digital interface.
CO4	Able to design real-time system with its multitasking and scheduling nature.
CO5	Able to analyze the Reachability and checking various models.
CO6	Able to have the knowledge of different analysis method and Fault tolerance techniques in real time systems.

Course Content:

Unit -1: Introduction: Definition of embedded system, Real Time Systems, Hardware Architecture, Embedded system design and model, Standards and Networking.

Unit-2: Design of Embedded Systems: Embedded processors and types, parallelism, Memory Architecture, Hierarchy, Models, Input and Output hardware, The analog and digital interface.

Unit-3: Real time multitasking and scheduling: Imperative Programs, Threads, process and message passing, Scheduling, Rate monotonic scheduling, Earliest deadline first, Scheduling and mutual exclusion, Multiprocessor scheduling.

Unit-4: Analysis and Verification: Invariant and temporal logics, Linear temporal logic, models as specification, Type equivalence and refinement, language equivalence and containment.

Unit-5: Reachability Analysis and Model checking: Open and Closed Systems, Reachability Analysis, Abstraction in Model Checking, Model Checking Liveness Properties.

Unit-6: Quantitative Analysis: Extreme-Case Analysis, Threshold Analysis, Average-Case Analysis, Basics of Execution Time Analysis, Optimization Formulation, Logical Flow Constraints, Bounds for Basic Blocks.

Teaching Methodology:
This course will give students the tools to intelligently make the necessary tradeoffs and understand the business consequences of their choices after the successful completion of this course. Lectures would be more theoretical and it would cover the core concepts that are explained in the text and reference materials with adequate examples.

Evaluation Scheme:

Exams	Marks	Coverage
Test-1	15 Marks	Based on Unit-1and Unit-2
Test-2	25 Marks	Based on Unit-3 & Unit-4 and around 30% from coverage of Test-1
Test-3	35 Marks	Based on Unit-5 to Unit-6 and around 30% from coverage of Test-2
Assignment	10 Marks	
Tutorials	5 Marks	
Quiz	5 Marks	
Attendance	5 Marks	
Total	**100 Marks**	

Learning Resources:

Tutorials and lecture slides on Web Development (will be added from time to time): Digital copy will be available on the JUET server.

Text Books:

[1] Tammy Norgaard, "Embedded Systems Architecture," Newes, 2005, ISBN 0-7506-7792-9.
[2] Edward A. Lee and Sanjit A. Seshia, "Introduction to Embedded Systems, A Cyber-Physical Systems Approach", http://LeeSeshia.org, ISBN 978-0-557-70857-4, 2011.

Reference Books:

[1] Giorgio C. Buttazzo, Hard Real-Time Computing Systems, Springer, 2004.

Web References:

[1] https://nptel.ac.in/courses/108/105/108105057/
[2] https://nptel.ac.in/courses/106105036/
[3] https://nptel.ac.in/courses/108102045/
[4] https://www.allaboutcircuits.com/technical-articles/introduction-to-real-time-embedded-systems/

Journals References:

[1] EURASIP Journal on Embedded Systems
[2] Embedded System and Intelligent Control by Hindawi
[3] IEEE Embedded system security

Internet of Robotics Things

Title: Measurement and Instrumentation **Code: 18B11EC314**

L-T Scheme: 3-0-0 **Credits: 3**

Prerequisite: Nil

Objectives:

1. To introduce students to the automatic measurement process.
2. To understand students how different types of meters work and their construction.
3. To provide a student knowledge of the various types of sensors and their signal conditioning circuits.
4. To develop the ability to use modern tools necessary for hardware projects.

Learning Outcomes:

Course Outcome	Description
CO1	Outline the measurement process and instrument characteristics concerning their needs in the industry.
CO2	Describe the working principle and operation of various types of measuring instruments.
CO3	Develop a measurement setup to meet industry expectations.
CO4	Identify and use various electrical instruments used in the measurement process.
CO5	Apply error analysis on a given measurement setup.
CO6	Demonstrate the application of various measurement devices.

Course Contents

Unit 1: Fundamentals of Measurement: Measurement Methods, Generalized measurement System, Classification of Instruments, Static & Dynamic Characteristics, Errors & Uncertainty measurement of system, Linear & Non-linear Systems.

Unit 2: Transducers: Transducers – Classification of transducers, Temperature transducer, Pressure transducer, Displacement transducer, Strain gauge, LVDT, RTD, Thermistor, Thermocouple, Piezo-electric transducer.

Unit 3: Signal Conditioning Circuits: D.C. bridges and their application in measurement of resistance, Kelvin's double bridge, A.C. Bridges- general equation, Potentiometer- DC potentiometer, Multi-range potentiometer, Q-meter and its applications. Amplifiers, Attenuators, Filters, Instrumentation Amplifier, Analog to digital converts.

Unit 4: Electrical Instruments: Moving coil, Moving iron, PMMC, Dynamometer and Induction type instruments, Measurement of Voltage, Current, Power, Power Factor, Energy, Instrument Transformer - current and potential transformer, Measurement of Phase & Frequency.

Unit 5: Signal Generators and Display Devices: Multivibrators: astable, monostable and bistable types. Generation of square and triangular waveforms. IC 555 timer and its application in multivibrators. Construction & working of Basic CRO, its Components (Deflection plates, Screen, Aquadag, Time Base Generator, Oscilloscope Amplifiers), Measurements of phase and frequency (Lissajous Patterns), Types of CRO, Special types of CRO, Types of CRO Probes. Digital Voltmeter.

Teaching Methodology:
This course is introduced to familiarize the student with the devices and processes utilized in the automation industry. Starting from the basic concepts, the student will gradually develop an understanding of practical setups used in the industry. The entire course is broken down into five units, such that each unit covers a particular aspect of the measurement process. This theory course is well complemented by a laboratory course under the name Measurement and Instrumentation Lab in the same semester that helps a student learn with hands-on experience.

Evaluation Scheme:

Exams	**Marks**	**Coverage**
Test-1	15 Marks	Based on Unit-1, Unit-2 (Selected topic)
Test-2	25 Marks	Based on Unit-2 & Unit-3 and around 30% from coverage of Test-1
Test-3	35 Marks	Based on Unit-4 to Unit-5 and around 30% from coverage of Test-2
Assignment	10 Marks	
Tutorials	5 Marks	
Quiz	5 Marks	
Attendance	5 Marks	
Total	**100 Marks**	

Learning Resources:
Tutorials and lecture slides on Measurement & Instrumentation (will be added from time to time): Digital copy will be available on the JUET server.

Text Books:

[1]. A.K.Sawhney & Puneet Sawhney, A Course in Mechanical Measurements and Instrumentation, 12/e, Dhanpat Rai & Co. (P) Ltd.,2004
[2]. Albert D.Helfrick & William D.Cooper, "Modern Electronic Instrumentation and Measurement Technique",Low Price Edition, Pearson Education, 2005
[3]. Ernest O.Doebelin, "Measurement Systems Application and Design", 5/e, Tata McGraw –Hill Publishing Company Ltd., 2004

Reference Books/Materials:

[1] H.S.Kalsi, "Electronic Instrumentaion", Technical Education Series, Tata McGraw –Hill Publishing Company Ltd.,2001
[2] D.C. Kulshreshtha, "Principles of Electrical Engineering", Tata McGraw Hill Publishing Co

Web References:

[1] https://nptel.ac.in/courses/108105153/
[2] https://nptel.ac.in/courses/108/105/108105064/

Journals References:

[1]. International Journal of Instrumentation Technology (Inderscience)
[2]. IEEE Transactions on Instrumentation and Measurement

Title: Sensors, Actuators & Signal Processing **Code: 18B11EC911**

L-T-P Scheme: 3-0-0 **Credit: 3**

Prerequisite: Students must have already studied course, "*Instrumentation and control*".

Objective:
The aim is to provide knowledge of sensor technology, features and characteristics of sensors, measuring devices and sensor and actuators applications in industry.

Learning Outcomes:

Course Outcome	Description
CO1	Outline the basics of sensors, Principles, Classification, Parameters, Basic requirements of sensors.
CO2	Describe the types of electrical and electronic sensors.
CO3	Develop the appropriate technology to implement digital sensors.
CO4	Identify Concepts of Actuators, Types of actuators, Actuator performance criteria and selection.
CO5	Applications of naming, addressing, time synchronization and routing protocols.
CO6	Demonstrate deployment and basic maintenance skills.

Course Content:
Unit-1: Fundamentals of sensors :Introduction to sensors , Principles, Classification, Parameters, Basic requirements of a sensors- Classification of sensors- Static and dynamic characteristics of sensors..

Unit-2: Electrical and Electronic sensors: Overview of analog mechanical, pneumatic and hydraulic, optical and opto-electronic sensors, electric and electronic sensors, Capacitive and Inductive type displacement sensor- position sensors, Resistive sensors, strain sensors, photoelectric sensors, fiber optic sensors and piezoelectric sensors.

Unit-3: Digital Sensors: Digital sensors, incremental sensors, position converters. Sensors to detect the position - Hall sensors, Sensors for measuring humidity and analyze the gases and the environment. Reflective optical and ultrasonic rangefinders. Sensors to measure speed and acceleration.

Unit-4: Actuators: Basic Concepts of Actuators, Types of actuators, Actuator performance criteria and selection, Fluidic actuators, Solenoids and voice coil motors, Stepper motors, DC motors, Piezo-electric actuators, Shape memory alloy actuators.

Unit-5: Signal Processing :Introduction, Fourier series and Fourier Transform representation of continuous and discrete time signals, Amplification, Filters, Converters, Compensation.

Teaching Methodology:
This course is introduced to help students to learns about various sensors, actuators and their functions. At the end of the course the student will be able to analyze, design, and evaluate digital circuits, of medium complexity, that are based on SSIs, MSIs, and programmable logic devices.

Evaluation Scheme:

Exams	Marks	Coverage
Test-1	15 Marks	Based on Unit-1 & Unit-2.
Test-2	25 Marks	Based on Unit-2 & Unit-3 and around 30% from coverage of Test-1
Test-3	35 Marks	Based on Unit-4 to Unit-5 and around 30% from coverage of Test-2
Assignment	10 Marks	
Tutorials	5 Marks	
Quiz	5 Marks	
Attendance	5 Marks	
Total	**100 Marks**	

Learning Resources:

Tutorials and lecture slides on Sensors, Actuators and Signal Processing (will be added from time to time): Digital copy will be available on the JUET server.

Text Books:

[1] D. Patranabis, "Sensors and Transducers", PHI Learning Private Limited.
[2] Patranabis, "Sensors and Actuators", 2nd Edition, PHI, 2013.

Reference Books:

[1] Julian W.Gardner and Vijay K Varadhan, "Microsensors, MEMS and Smart Devices", John Wiley & sons, 2001.

Web References:

[1] Tiny Battery May Power Next-Gen Gadgets. Arthur Tham. News Digest. 24-Feb-2003.http://www.extremetech.com/article2/0,3973,901021,00.asp
[2] "Carbon-MEMS Architectures for 3D Micro-batteries" PowerPoint Presentation. Marc Madou. Department of Mechanical and Aerospace Engineering. UCI, October 14, 2003.
[3] "MEMS for Environmental and Bioterrorism Applications". Southwestern Center for Microsystem Education and BioLink, 2009.

Journal References:

[1] IEEE Journal on Sensors
[2] IEEE Transactions on Vehicular Technology

Title: Statistical Methods and Data Analysis **Code: 18B11CI916**

L-T-P scheme: 3-0-0 **Credit: 3**

Prerequisite: None

Objective:
The objective of course is to equip the students with the mathematical & statistical techniques & their application to business problems. The emphasis will be on the concepts & application rather than derivations. The intention of the course is to make students able to use statistics as a helpful tool for solving complex business research problems under uncertainty and understand methods that quantify issues and give business managers a better basis for making decisions.

Learning Outcomes:

Course Outcome	Description
CO1	To familiarize the concept of data and data categorization and introduce the field of statistics & data analysis.
CO2	To understand and compute various measures of descriptive statistics such as mean, median, standard deviation, skewness, and kurtosis.
CO3	To describe basic concepts of probability and probability distributions and its applications in solving various business problems.
CO4	To learn and apply various statistical techniques such as sampling distribution, interval estimation and hypothesis testing for inferential data analysis using real world examples.
CO5	To develop the understanding to analyze a set of data / real world situations using correlation, regression analysis and ANOVA.
CO6	To build up decision making skills pertinent to the practice of statistics, including the students' abilities to formulate problems, to think creatively, and to synthesize information.

Course Content:
Unit-1: Introduction to Statistics, Types, Scope; Data sources, Data presentation, tabulation, charting, graphs; Measures of central tendency – Mean, Median, Mode; Measures of variations – range, interquartile range, standard deviation; Skewness, moments & kurtosis; Covariance and correlation.

Unit-2: Introduction to probability, basic laws & concepts, conditional probability; Probability distributions, random variable, probability function, expected value and variance, Discrete probability distribution, Binomial Distribution, Poisson Distribution, Continuous Probability Distribution, Normal Distribution, Exponential Distribution.

Unit-3: Sampling – introduction, purpose, random sampling methods, non-random sampling methods; Sampling distributions, Sampling Distribution of the Mean, Central Limit Theorem, Sampling Distribution of the Proportion.

Unit-4: Statistical estimation – Introduction, Properties of a good estimator, Point Estimation, Interval Estimation for sample mean, Interval Estimation for sample proportion, Sample size determination, Hypothesis testing – basic concepts, Null and the Alternative Hypothesis, Tests of Hypotheses about Population Means, Tests of Hypotheses about Population Proportions.

Unit-5: Regression analysis, linear regression, regression lines, regression coefficients, coefficient of determination, Analysis of Variance – introduction, assumptions, computation; One-way classification – variance between samples, variance within samples, F-ratio calculation, Two-way classification.

Teaching Methodology:
The course is a mix of classroom teaching (power point slides) which includes case studies, quiz, problem solving, and numerical questions.

Evaluation Scheme:

Exams	**Marks**	**Coverage**
Test-1	15 Marks	Based on Unit-1 & Unit-2
Test-2	25 Marks	Based on Unit-3 & Unit-4 and around 30% from coverage of Test-1
Test-3	35 Marks	Based on Unit-5 and around 30% from coverage of Test-2
Assignment	10 Marks	
Tutorials	5 Marks	
Quiz	5 Marks	
Attendance	5 Marks	
Total	**100 Marks**	

Learning Resources:
Lectures, tutorials and e-books on Statistical Methods and Data Analysis (are added from time to time): Digital copy will be available on the JUET server.

Text Book:
[2] Anderson, Statistics for Business & Economics, Thomson Learning, Bombay.

Reference Books/Material:
[1] Gupta S.P. & Gupta M.P., Business Statistics, Sultan Chand & Sons, Delhi.
[2] Levin & Rubin, Statistics for Management, Prentice Hall of India, New Delhi.
[3] Mann P., Introductory Statistics, Wiley.
[4] Schumuller J., Statistical Analysis with Excel for Dummies, John Wiley & Sons, NJ.
[5] Berk & Karey, Data Analysis with Microsoft Excel, Cengage Learning, Boston.

Title: Statistical Methods and Data Analysis Lab **Code: 18B17CI976**

L-T-P scheme: 0-0-2 **Credit: 1**

Prerequisite: None

Objective:
The objective of course is to equip the students with the mathematical & statistical techniques & their application to business problems. The intention of the course is to make students able to apply statistics using Microsoft Excel as a tool for solving complex business research problems under uncertainty and understand methods that quantify issues and give business managers a better basis for making decisions.

Learning Outcomes:

Course Outcome	Description
CO1	To familiarize the concept of data and data categorization and introduce the field of statistics & data analysis.
CO2	To understand and compute various measures of descriptive statistics such as mean, median, standard deviation, skewness, and kurtosis.
CO3	To apply basic concepts of probability and probability distributions and its applications in solving various business problems.
CO4	To learn and apply various statistical techniques such as sampling distribution, interval estimation and hypothesis testing for inferential data analysis using real world examples.
CO5	To develop the understanding to analyze a set of data / real world situations using correlation, regression analysis and ANOVA.
CO6	To build up decision making skills pertinent to the practice of statistics, including the students' abilities to formulate problems, to think creatively, and to synthesize information.

Course Content:
Unit-1: Introduction to Statistics, Types, Scope; Data sources, Data presentation, tabulation, charting, graphs; Measures of central tendency – Mean, Median, Mode; Measures of variations – range, interquartile range, standard deviation; Skewness, moments & kurtosis; Covariance and correlation.

Unit-2: Introduction to probability, basic laws & concepts, conditional probability; Probability distributions, random variable, probability function, expected value and variance, Discrete probability distribution, Binomial Distribution, Poisson Distribution, Continuous Probability Distribution, Normal Distribution, Exponential Distribution.

Unit-3: Sampling – introduction, purpose, random sampling methods, non-random sampling methods; Sampling distributions, Sampling Distribution of the Mean, Central Limit Theorem, Sampling Distribution of the Proportion.

Unit-4: Statistical estimation – Introduction, Properties of a good estimator, Point Estimation, Interval Estimation for sample mean, Interval Estimation for sample proportion, Sample size determination, Hypothesis testing – basic concepts, Null and the Alternative Hypothesis, Tests of Hypotheses about Population Means, Tests of Hypotheses about Population Proportions.

Unit-5: Regression analysis, linear regression, regression lines, regression coefficients, coefficient of

determination, Analysis of Variance – introduction, assumptions, computation; One-way classification – variance between samples, variance within samples.

Teaching Methodology:
The course is taught through 2-hour lab exercises conducted using Microsoft Excel. The main emphasis is on problem solving and application of statistical concepts for business problems.

Evaluation Scheme:

Exams	**Marks**
Lab work	40 Marks
Lab record	15 Marks
Mid sem P1 Test	15 Marks
End sem P2 Test	15 Marks
Attendance and discipline	15 Marks
Total	**100 Marks**

Text Book:

1. Anderson, Essentials of Modern Business Statistics with Microsoft Excel, Cengage.

Title: Internet of Things Lab **Code: 18B17CI997**

L-T-P Scheme: 0-0-2 **Credit: 1**

Prerequisite:
Students are expected to have a good understanding of computer networks, familiarity with network programming, and object oriented programming.

Objective:
The course is designed to give the students a solid grounding of the key technologies involvedand how they are integrated to form complete Internet of Things (IoT) systems.

Learning Outcomes
1. Understand how Arduino and raspberry work as IoT devices
2. Review the various network protocols & communication technology used in IoT.
3. Be familiar with data analytic with IoT

Course Outcomes:

Course Outcome	Description
CO1	Familiarization with different physical Device related to IoT
CO2	Understand the Arduino Programming
CO3	Work on LED and LCD
CO4	Understand various motor behavior
CO5	Illustrate the work function of various sensors

Course Content
Lab Exercise Arduino UNO, LED, LCD, Motion Sensor, Pressure sensor, Moisture sensoretc., Motors like as steeper, DC etc. Wi Bluetooth, Camera.

Books

1. Srinivasa K G ,Siddesh G. M. & Hanumantha Raju R., Internet of Things ,2nd Edition,Cenegae Education, 2019.
2. Shriram K Vasudevan, Abhishek S Nagarajan & RMD Sundram, Internet of Things ,1st Edition,John Wiley & Sons,2019.

Title: Internet of Things Technology & Applications **Code: 18B11CI937**

L-T-P Scheme: 2-0-0 **Credit: 2**

Prerequisite:
Students are expected to have a good understanding of computer networks, familiarity with network programming, and object-oriented programming.

Objective:
The course is designed to give the students a solid grounding of the key technologies involvedand how they are integrated to form complete Internet of Things(IoT) systems.

Learning Outcomes
On completion of this course, students should be able to:
1. Understand how Arduino and raspberry work as IoT devices
2. Review the various network protocols & communication technology used in IoT.
3. Be familiar with data analytic with IoT

Course Outcomes:

CO1	Familiarization with different physical Device related to IoT
CO2	Understand the IoT Architectures with devices
CO3	Demonstrate the various tools required in IoT
CO4	Review of various IoT protocols & communication technologies
CO5	Data analytic with IoT

Course Content:
Unit 1-IoT Physical Device & Endpoints: Arduino UNO, Raspberry Pi,Operating system, interfaces, Intel edison & Intel Galileo board, pcDuino,Beagle Black and Cubieboard

Unit 2- IoT Architectures: Architectures for IoT, Elements of an IoT Architecture, Architectural design considerations

Unit 3- IoT Application & Tools: Smart Perishable Tracking, lavatory Maintenance, Smart Warehouse,IoT possibility in retail sector,Smart driver assistance system etc., MangoDB, Chef,Setting up Chef, Puupet, Key concepts of Chef and Puppet.

Unit 4-IoT Protocols & Commyunciation technologies : Bluetooth Low Energy(BLE), Light Fidelity (Li-Fi) Network layer: IPv4,Ipv6, Uniform Resource identi er(URI), Bluetooth,Zigbe

Unit 5-Data analytic for IoT: Apache Hadoop,Map Reduce model, Hadoop YARN.Apache Oozie,Apache Spark.

Books

1. Srinivasa K G ,Siddesh G. M. & Hanumantha Raju R., Internet of Things ,2nd Edition,Cenegae Education, 2019.
2. Shriram K Vasudevan, Abhishek S Nagarajan & RMD Sundram, Internet of Things ,1st Edition,John Wiley & Sons,2019.
3. Arshdeep Bahga & Vijay Madisetti, Internet of Things-A Hands-on-Approach ,1st Edi-tion, VPT, 2014.

Title: Machine Learning **Code: 18B11CI918**

L-T-P scheme: 3-0-0 **Credit: 3**

Prerequisite: The mathematical tools needed for the course will be covered in some classes in the first week of the course.

Objective:

1. To learn and be able to implement the basic statistical techniques in the areas of interests.
2. To develop the abilities to apply the basic Machine Learning algorithms and interpret their results.

Learning Outcomes:

At the end of the course, students:

1. Get familiar with the fundamental methods at the core of modern machine learning.
2. Have a good grounding of the essential algorithms for supervised and unsupervised learning
3. Possess demonstrative skills in using and applying Machine Learning.
4. Work as a team on a project.

Course Outcome	Description
CO1	List various approaches of Machine Learning.
CO2	Describe machine learning algorithms to solve the real world problems
CO3	Develop Hypothesis and machine learning models
CO4	Identify appropriate models for solving machine learning problems.
CO5	Apply learning techniques to solve real world machine learning problems
CO6	Evaluate and interpret the results of the algorithms.

Course Content:

Unit-I: Introduction to machine learning, supervised and unsupervised machine learning, Applications of AI and machine learning, Linear Algebra, Matrices, Multi-Variable Calculus and Vectors, Mean, Median, mode, Dispersion.

Unit-II: Probability, Probability Distributions, and Central Limit Theorem.
Hypothesis Testing: The what, why and how of Hypothesis Testing are covered in this module. P-Value, different types of tests and implementation in Python.
Exploratory Data Analysis: EDA brings out the information from the Data. This module covers Data Cleaning, Univariate/ Bivariate analysis.

Unit-III: Linear Regression: Simple and Multiple, Issues in Regression like Collinearity. Project on Linear Regression. Logistic Regression Univariate and Multivariate Logistic Regression for classification in ML, Implementation in R/Python, Naive Bayes Classification. Bias-Variance Tradeoff, Evaluation metrics: Confusion Matrix, F1 Score, Root Mean Squared Error.

Unit-IV: Decision Tree, Random Forest, SVM, Validation Techniques: Leave one out cross-validation, K-fold cross-validation, Stratified k-fold cross-validation.

Unit-V: K-Means clustering, Introduction to Neural Networks, Convolutional Neural Network.

Teaching Methodology:

This course is introduced to help students understand the discipline of Machine Learning. The

programming tool used to teach this course are R and Python. Starting from the basic mathematical tools, the student will slowly be exposed to inferential statistics, and later to Machine Learning Algorithms. This theory course is well complemented by a laboratory course under the name Machine Learning Lab in the same semester that helps a student learn with hand-on experience.

Evaluation Scheme:

Exams	**Marks**	**Coverage**
Test-1	15 Marks	Based on Unit-1 & Unit-2
Test-2	25 Marks	Based on Unit-3 & Unit-4 and around 20-30% from coverage till Test-1
Test-3	35 Marks	Based on Unit-5 to Unit-6 and around 30% from coverage till Test-2
Assignment	10 Marks	
Tutorials	5 Marks	
Quiz	5 Marks	
Attendance	5 Marks	
Total	**100 Marks**	

Learning Resources:
Tutorials and lecture slides on Machine Learning (will be added from time to time): Digital copy will be available on the JUET server.

Text Book:

1. Hastie, Tibshirani and Friedman. Elements of statistical learning.

Reference Material:

[1] L. Rosasco. Introductory Machine Learning Notes.
[2] Larry Wasserman. Clustering chapter

Industrial Automation

Title: Robotics **Code: 18B11ME911**

L-T-P Scheme: 3-0-0 **Credit: 3**

Prerequisite: Students must have already studied courses, "*Engineering Mechanics, Engineering Drawing and Design and Theory of Machines*".

Objective:

1. To learn and know about the anatomy of robots and how to perform robots.
2. To develop the abilities to write a program for a typical application of robot.

Learning Outcomes:

Course Outcome	Description
CO1	Outline the terminology, components and subsystems of robots.
CO2	Describe the working principles of drive system, end effectors, sensor, andmachine vision systems of robots.
CO3	Develop an idea to modify the motions or working of different joints and links in any robotic system.
CO4	Identify the most influencing parameters to fabricate the robotic system.
CO5	Apply appropriate technique to analyze the robot kinematics.
CO6	Demonstrate and deployment the skills to write the program for real world applications of robot.

COURSE CONTENT:

Unit-1: Introduction: Past, Present & Future, Robot anatomy, Work volume, Applications, Components and Subsystems, Classification of robot.

Unit-2: Robot technology: robot and its peripherals- Basic control system concepts and model,controllers, End effectors, Different types of grippers and design concepts.

Unit-3: Robot Drives, Actuators and Control Drive systems: Hydraulic, Pneumatic and Electrical. DC motor, Stepper motor, Robot motion, and Path control, Controller.

Unit-4: Robot Kinematics, Object location: Homogenous, Transformations.

Unit-5: Direct and Inverse kinematics, Dynamics of robots, Manipulator motion.

Unit-6: Sensors and Perception- Types of sensors, Vision system, Computer Interfaces, Robot Programming.

Teaching Methodology:

This course is introduced for helping students how to tasks are performed by mechanical

manipulators (Robots) in the industries. The entire course is broken down into six separate units: Robot terminology, Applications, Components and Subsystems, classification, grippers, actuators, controllers, Sensors, Kinematics and dynamics of robots, and robot programming.

Evaluation Scheme:

Exams	Marks	Coverage
Test-1	15 Marks	Based on Unit-1 and Unit-2
Test-2	25 Marks	Based on Unit-3 & Unit-4 and around 30%from coverage of Test-1
Test-3	35 Marks	Based on Unit-5 and Unit-6 and around 30%from coverage of Test-2
Assignment	10 Marks	
Tutorials	5 Marks	
Quiz	5 Marks	
Attendance	5 Marks	
Total	**100 Marks**	

Learning Resources:

Tutorials and lecture slides on Robotics Engineering (will be added from time to time):
Digitalcopy will be available on the JUET server.

Text Book:

[1] "Robotics Technology and Flexible Automation", S. R. Deb, S. Tata McGraw Hill Education Pvt. Ltd, 2010.
[2] "Introduction to Robotics", John J. Craig, Pearson, 2009.
[3] "Industrial Robots - Technology, Programming and Applications", M. P. Groover,
[4] M. Weiss, R. N. Nagal, N.G. Odrey, A. Dutta, McGraw Hill, New York, 2008.

Reference Books/Material:

[1] "Robotics Engineering – An Integrated Approach", Richard D Klafter, Thomas A Chmielewski, Michael Negin, Eastern Economy Edition, Prentice Hall of India Pvt. Ltd., 2006.
[2] "Robotics : Control, Sensing, Vision and Intelligence", Fu K S, Gonzalez R C, Lee C.S.G, McGraw Hill, 198

Web References:

[1] https://nptel.ac.in/courses/112/105/112105249/

Title: Microprocessor Based Control System **Code: 21B11EC921**

L-T-P Scheme: 3-0-0 **Credit: 3**

Prerequisite: Nil

Objective:

1. To familiarize the student with the working of automation systems.
2. To develop an understanding of a computer-aided control system and its design requirements.

Learning Outcomes:

Course Outcome	Description
CO1	Outline various digital systems used for control applications.
CO2	Describe the element and operation of a microprocessor.
CO3	Develop the architecture of an automation system based on the specified requirements.
CO4	Identify the hardware and software components of a computer-aided control system.
CO5	Application of industrial control systems on a given assignment/ project.

Course Content:

Unit 1: Introduction to Digital Systems: Review of number system: Binary, Octal, Hexadecimal. Logic gates: AND, OR, NOT, Universal Gates. Digital signals and Circuits, Digital to Analog Converters, Analog to Digital Converters.

Unit 2: Fundamentals of Microprocessors: Evolution of microprocessor, Word length, Hardware, Software, Input-Output Device, Single chip microcomputers. Semiconductor memory, RAM, ROM, EPROM. Architecture of Intel 8085 microprocessor: ALU, timing and control unit, registers, data and address bus, pin configuration. Instructions: op-code and operands. Interfacing with Memory and Input/Output Devices.

Unit 3: Conventional Control System: Control system: working, applications. Open-Loop and Closed-Loop control. On/Off and Continuous Control, Manual and automatic control schemes. Model-based and model-less control. Need of automatic control, Advantages, Limitations, Applications.

Unit 4: Programmable Logic Controller: History of programmable logic controller (PLC). Architecture of PLC. Elements of PLC, CPU, IO Modules, Power supply and Communication Modules, Input Output Devices, Interfacing of Field Devices.

Unit 5: Distributed Control Systems: Basics of Distributed Control Systems (DCS). Architecture and working. Components of DCS, Field Instruments and Interfacing Circuits, Communication Protocols. Control of Field Instruments using Relay Devices.

Unit 6: Supervisory Control and Data Acquisition (SCADA): Introduction to SCADA. Fundamental Principle of Modern SCADA Systems. SCADA Hardware and Software. Remote Terminal Units (RTU). Master Station.

Teaching Methodology:

This course is introduced to help students to understand concepts of industrial control system. Starting

with the understanding of continuous systems, the student will be able to understand computer-aided control and other aspects of system analysis. The entire course is broken down into six separate units to develop an understanding of various aspects of automation. Each section includes multiple technologies to help a student gain more experience as an electronic control system designer.

Evaluation Scheme:

Exams	**Marks**	**Coverage**
Test-1	15 Marks	Based on Unit-1, Unit-2
Test-2	25 Marks	Based on Unit-3 & Unit-4 and around 30% from coverage of Test-1
Test-3	35 Marks	Based on Unit-5 to Unit-6 and around 30% from coverage of Test-2
Assignment	10 Marks	2 marks assignment from each unit
Tutorials	5 Marks	Based on response of students in class
Quiz	5 Marks	Three quizzes before each test
Attendance	5 Marks	80-82%=1, 83-85% = 2, 85-88% = 2, 89% = 4, 90%>= 5 Marks
Total	**100 Marks**	

Learning Resources:
Lecture notes/slides on the course will be added from time to time. Digital copy will be available on the JUET server.

Text Books:

1. K.S. Manoj, Industrial Automation with SCADA: Concepts, Communications and Security, Notion Press, 1/e, Indian Edition, 2019.
2. T.R. Kurfess, Robotics and Automation Handbook, CRC Press, 2/e, Indian Edition, 2004.

Reference Books/Material:

1. G. F. Franklin, J. D.Powell and M. L. Workman, Digital Control of Dynamic Systems, Addison Wesley, 1998,Pearson Education,Asia, 3/e, 2000.
2. K. J.Astroms and B. Wittenmark, Computer Controlled Systems - Theory and Design, Prentice Hall, 3/e, 1997.

Web References:

[1] https://nptel.ac.in/courses/108/105/108105088/
[2] https://www.eolss.net/

Journals References:

[1] Science direct journal of digital control system
[2] IRE Transactions on Industrial Electronics

Title: Robotics/CIM Lab **Code: 18B17ME971**

L-T-P Scheme: 0-0-2 **Credit: 1**

Objectives

1. This course is designed to provide practical experience to students with an opportunity of hands-on training onCIM system including CNC machine tools and robots.
2. The topics covered in this course include the basics of automation, NC programming (Manual and APT),concepts of group technology, Flexible Manufacturing system, CIM and robotics etc.
3. The objective of this course is to expose the students to practical aspects of automation and the state-of-the-arttechnological developments in the area of modern manufacturing.

Learning Outcome

After completion of this course, the students will have:

1. Knowledge and operational experience of CNC lathe and milling part programming.
2. Knowledge and operational experience of programming for robots and CMM
3. Capability to comprehend the functioning of various components of the automation and CIM.

Learning Outcome:

Course Outcome	Description
CO1	Outline the components and subsystems of robots and basic concepts related to CIM like types of production, automation and FMS.
CO2	Describe the functioning of drive system, end effectors, sensor, and machine vision systems of robots and computer aided process planning (CAPP) and Automated inspection.
CO3	Develop ability to write CNC part programs, formation of part families, pick and place programs for robot and automated inspection through CMM.
CO4	Identify the sequence of operation, generate process plan and simulate the FMS operation in off-line mode.
CO5	Apply acquired knowledge to perform machining, inspection and assembly operations on Flexible manufacturing system available in Robotics/CIM lab of the department.
CO6	Demonstrate ability to work in a flexible manufacturing system in an organization.

Course Content

5-axis and 6-axis Robot

1. Introduction to 5 and 6 axis robot and basic operations. Write a simple program for pick and placeoperation for 5-axis robot.
2. Write program for pick and place operation for repetitive cycle for 5-axis robot.
3. Write a program for continuous welding operation for 6-axis robot.
4. Write and practice programming on 6-axis robot.

XL Turn Machine

1. Write a manual part program for Linear and Circular Contour (G01, G02, and G03) operation for the component. Write a manual part program for Box Facing (G94)

operation for the component.

2. Write a manual part program for Multiple Facing (G72) operation for the component. Write a manual part program for Multiple Turning operation with G71 Cycle for the component.
3. Write a manual part program for Peck Drilling operation with G74 Cycle for the component.
4. Write a manual part program for Turning and Parting OFF operation through subroutines for thecomponent.

XL Mill Machine

1. Write a manual part program for Contouring (G01, G02, and G03) operation (Linear & Circular Interpolation) for the component. Write a manual part program for Contouring (G40, G41) operation with Left cutter diameter compensation for the component.
2. Write a manual part program for Contouring (M98, M99) operation through subprogram for the component. Write a manual part program for Mirroring (M70, M71, M80, and M81) operation for the component.
3. Write a manual part program for Drilling (G73, G83, G98, and G99) operation for the component.
4. Write a manual part program for Pocketing (G170, G171) operation for the component.

Coordinate Measuring machine (CMM)

1. Write a program for automatic measurement of various dimensions such as OD, ID, thickness etc. of a part.

Complete CIM System

1. Demonstration and study of CIM system Off-line and on-line mode.

TEXT BOOK:

1. Robot programming Manual by MTAB, Chennai
2. CNC XLTURN Manual by MTAB, Chennai
3. CNC XLMILL Manual by MTAB, Chennai
4. Groover M. P., Automation, Production Systems And Computer-integrated Manufacturing, PHI.
5. Miller R. K., FMS/CIM Systems Integrated Handbook, Prentice Hall

Title: Industrial Automation **Code: 18B11ME913**

L-T-P: 3-0-0 **Credits: 3**

Prerequisite: Basic of electrical and electronics engineering, fluid mechanics, kinematics, thermodynamics.

Objective:

1. This course is a combination of mechanics, electronics and pneumatic/hydraulic.
2. To impart interdisciplinary knowledge to study conveyors, overhead cranes, robots,pneumatic/hydraulic controls, motors and PLC etc.
3. The aim of the course is to make a bridge among various engineering disciplines such as Mechanical, Electronics, Instrumentation, Computer and Control to understand automationin industries.

Learning Outcomes:

CO1	Outline of Automated systems to understand the requirement of automation
CO2	Describe various sensors, signal processing, motors, conveyors, robots, PLC,pneumatic and hydraulic systems
CO3	Develop the knowledge of automation to improve the performance of manufacturing, maintenance and assembly units
CO4	Identify the type of sensors, signal conditioning methods and actuators required for specific problem of automation
CO5	Apply the knowledge to develop and maintain various automation systems
CO6	Demonstrate the skill in the field of requirement

Course Content:

UNIT - I

Automation: Advantages, disadvantages, factory and manufacturing environment. (2)

Sensors: Performance terminology, displacement, velocity, acceleration, force, temperature,pressure, flow, light, position and proximity sensors. Signal conditioning and data acquisition. (8)

UNIT - II

Controllers: Open loop control, close loop control, proportional, derivative, integral, PID and adaptive control. (2)

Motors and Conveyors: DC motors, AC motors, stepper motors and servo motors. Belt conveyors, roller conveyors, chain and mat conveyors, indexing and synchronous machines, overhead cranes and industrial robots. (12)

UNIT - III

Pneumatics and Hydraulics: Flow control, pressure control, none-return, direction and logic control valves. Timers, pressure sequence, counter valves and limit switches. Pneumatic and hydraulic actuators. Multi-actuator circuits, cascade and shift register methods. Solenoid valves, relays, switches, logic control, memory functions, electrical timers and counters, pressure switches. (12)

UNIT - IV

Programmable Logic Controllers (PLC): Basic structure, input output processing, ladder programming, instruction list, latching, internal relays, sequencing, timers, counters, shift registers,

master and jump controls and data handling. (4)
Industrial Safety: Hazard analysis, emergency stops, physical guarding, lockout/ tagout, design mitigation, guard devices, software and intrinsic safety. (2)

Teaching Methodology:

The course will start from the architect of Automated systems such as inputs and outputs of any physical system. It includes different variety of sensors and the processing of the signals. Also, different variety of actuators used in Automated systems in the industry to get the required process. It is also required to know the basics of electrical motors and their controls, various modes of controls, conveyors and industrial robots.

In the field of automation pneumatics and hydraulics have their importance. Hence, in this subject different compressor, oil pump's introduction will be given. Different varieties of direction control valves are to be talked to achieve the required action by the actuators. It also includes different architect of the circuits to achieve the required job done. To further enhance the performance of the automation electro-pneumatics will come in action. Further it can be doneto the electro-pneumatics system by incorporating programmable logic controller. It is also deal with various aspects of industrial safety.

Evaluation Scheme:

Exams	**Marks**	**Coverage**
Test-1	15 Marks	Based on Unit I and II
Test-2	25 Marks	Based on Unit II, III and syllabus of T1 (20%)
Test-3	35 Marks	Based on Unit III, IV, syllabus of T1 (15%) and syllabus of T2 (15%)
Assignment	10 Marks	
Tutorials	5 Marks	
Quiz	5 Marks	
Attendance	5 Marks	
Total	**100 Marks**	

Learning Resources:

Lecture notes on Mechatronics and Automation (will be added from time to time): Digital copy will be available on the JUET server.

Text Book:

1. HMT Ltd, Mechatronics, Tata McGraw Hill.
2. Industrial Automation, McGraw Hill Education

References Books/Materials:

1. Isermann R., Mechatronics Systems: Fundamentals, Springer.

2. Bradley, D. A., Dawson, D., Buru, N. C. and Loader, A. J., Mechatronics, Chapman andHall.
3. Bolton W., Mechatronics, Pearson Education.

Web References:

1. www.youtube.com/user/nptelhrd

Journals References:

1. International Journal of Mechatronics and Automation

Title: **Control of Industrial Automation** **Code: 18B11ME914**

L-T-P scheme: **3-0-0** **Credit: 3**

Objectives

1. The objective of this course is to impart knowledge about automation in production systems.
2. To make students learn the important theoretical concepts, and the state-of-the-art technological developments in the area of automated manufacturing.
3. Various topics to be covered are basics of automation, NC and CNC technologies, conceptsof group technology, Flexible Manufacturing system, CIM and robotics, CAPP, CMM, 3D scanners, automated assembly, Reverse engineering and fundamentals of 3D printing.

Learning Outcome

Course Outcome	Description
CO1	Outline and fundamentals of Industrial automation and importance of automation in Industry 4.0.
CO2	Describe concepts of various types of automation in industries. NC and CNC technologies.
CO3	Develop concept of group Technology, FMS and its components.
CO4	Identify the scope of application of automated assembly, Computer aided process planning and other inspection techniques by studying fundamentals of the same.
CO5	Apply the line balancing algoriths to balance the automated assembly lines. Basic fundamentals of 3D printing and its classification, file formats etc.
CO6	Demonstrate skill to apply reverse engineering in association with 3D printing to create customized parts. 3D printing applications.

Course Description

Introduction to Automation: Introduction to Production Systems; Automation in Manufacturing and Production Systems: Fixed, Flexible and Programmable Automation, Automation strategies, levels of Automation; Product Development Process and Automation.

Flexible Manufacturing System: Fundamentals of NC and CNC Technology; Concept of Group Technology and Cellular Manufacturing; Flexible Manufacturing Systems and its Components: Workstations, AS/RS, Automated Transport System; Fundamentals of Robotic Systems and Applications.

Computer Aided Process Planning (CAPP): Introduction to process planning, CAPP,generative and retrieval type CAPP.

Automated assembly systems: Design for Automated Assembly, Assembly Line Balancing and examples.

Reverse Engineering: Definition, Scanning and Processing of Raw Data, Creation of CADModels; Introduction to Contact and Non-Contact Type Scanners, Types of 3D Optical Scanners andCoordinate Measuring Machine (CMM).

Introduction to 3D Printing: Definition, Processing Steps, Classification, Applications and File Formats for 3D Printing Technology.

Teaching Methodology:

This course is introduced to help students learn and understand various automation techniques being used in Industries. Students will be taught fundamentals of automation and its types, basics of NC and CNC technologies, Group technology, FMS, CAPP, automated assembly, and design for excellence, contact and non-contact types inspections techniques, CMM, 3D scanners, reverse engineering, fundamental of 3D printing technology, its classification, material and applications. Although, the course is not complemented by any lab course; students will be taken occasionally to lab for hands on experience.

Evaluation Scheme:

Exams	**Marks**
Test-1	15 Marks
Test-2	25 Marks
Test-3	35 Marks
Assignment	10 Marks
Tutorials	5 Marks
Quiz	5 Marks
Attendance	5 Marks
Total	**100 Marks**

Text Books:

1. Groover M. P., Automation, Production Systems And Computer-integrated Manufacturing,PHI.
2. Chua, C K, Leong, K F and Lim CS, *Rapid Prototyping: Principles and Applications inManufacturing*, World Scientific, 2003.
3. Gibson, I., Rosen, D.W. and Stucker, B., *Additive Manufacturing Technologies: RapidPrototyping to Direct Digital Manufacturing*, Springer, New York, 2010.
4. Raja, V. and Fernandes K.J., *Reverse Engineering – An Industrial Perspective*, Springer-Verlag London Ltd, 2008.

Title: Special Purpose Vehicle **Code: 18B11ME912**

L-T-P Scheme: 3-0-0 **Credits: 3**

Prerequisite: Student must have already studied courses, "Engineering Thermodynamics, Manufacturing process, Kinematic of Machine, Dynamics of machine, Internal combustion engines and automobile engineering".

Objective:

1. To make aware of the basics of automobile history & its development and Bharat stagerequirement in India.
2. To make aware of the role of the SPV in different industrial applications.
3. To learn the different types of special purpose vehicles for commercial and noncommercialapplications.
4. To make able to do the analysis of the different common auxiliaries utilized in the SPVs.
5. To develop an understanding of environmental aspect associated with the utilization ofinternal combustion engine based SPVs.

Learning Outcome

Course Outcome	Description
CO1	Outline basis for the categorization of SPVs
CO2	Demonstrate working principals of the auxiliaries associated with the SPVs
CO3	Describe working principals of the Skidder, skipper, loader
CO4	Demonstrate and understand different auxiliary associated with the cooling and lubrication systems
CO5	Develop skill for the performance analysis of CI and SI Engines
CO6	Describe power assisted mechanisms used in SPVs

COURSE CONTENT

Unit-01: Classification of Special Purpose Vehicles: based on applications, wheel types & truck type. Study of working principles & design considerations: of different systems involved like power system, transmission, final drive, lubrication, electrical, braking, steering, pneumatic & hydraulic control circuits.

Unit-02: Constructional & working features: of different types of earth moving machinery such as Tippers, shovels, loaders, Excavators, Dumpers, Dozers, Fork Lift truck, Road rollers. Study of instrumentation applied to special purpose vehicles/machines.

Unit-03: Farm Tractor: Layout, Load distribution, Engine, Transmission & Drive line, Steering, Braking system, Wheels & Tyres, Hydraulic system, Auxiliary Systems, Draw bar, PTO Shaft. Different types of Implements, accessories and attachments. Tractor trolley.

Unit-04: Mobile Cranes: Basic characteristics of truck cranes, stability & design features, control systems & safety devices.

Unit-05: Tracked Vehicles, Articulated Vehicles, Multi-axle Vehicles, fifth wheel mechanism. Semi trailer & Prime mover brakes & electrical systems. Dead Axles. Special Purpose Electric Vehicles, Solar Vehicles and Hybrid Vehicles. Types, architecture and parameters of design considerations

Teaching Methodology:

This is introduced to make the student capable of utilizing skills developed as an outcome from their above-mentioned pre-requisite subjects, various constructional parameters of the child parts and their requirement. Course contain deals within this Special purpose vehicle subject is categorized in five different. Different adequate laboratories viz. Automobile Engineering, Internal combustion Engine, fluid machinery will helps student to examine the performance of different auxiliaries of the SPVs.

Evaluation Scheme:

Exams	**Marks**	**Coverage**
Test-1	15 Marks	Based on Unit-1, & Unit-2
Test-2	25 Marks	Based on Unit-3 & Unit-4 and around 30% from coverage of Test-1
Test-3	35 Marks	Based on Unit-5 around 30% from coverage of Test-2
Assignment	10 Marks	
Tutorials	5 Marks	
Quiz	5 Marks	
Attendance	5 Marks	
Total	**100 Marks**	

Learning Resources:
Tutorials and lecture slides of the special purpose vehicle subject (will be added from time to time): Digital copy will be available on the JUET server.

REFERENCE BOOKS:

1. Obert E.F., Internal Combustion Engines & Air pollution, Hopper & Row Pub., NewYork.
2. Heywood J. B., Internal Combustion Engines Fundamentals, McGraw Hill, New York

Web References:
1. https://www.saeindia.org
2. http://www.oica.net
3. https://uia.org

Journals References:
1. https://www.sciencedirect.com/journal/transportation-research-part-a-policy-and-practice
2. https://www.sciencedirect.com/journal/journal-of-cleaner-production
3. https://www.sciencedirect.com/journal/advances-in-engineering-software

Title: Vehicle Dynamics **Code: 18B11ME917**

L-T-P scheme:3-0-0 **Credit: 3**

Prerequisite: Students must have already studied course, "*Automobile engineering*".

Objective:
To provide the knowledge of vehicle interactions, longitudinal dynamics: Steady state functions, Functions over longer event, Functions over shorter events, Lateral dynamics: Low speed maneuverability, Steady state cornering at high speed, vertical dynamics.

Learning Outcomes:

Course Outcome	Description
CO1	Outline basic principles of accelerating or braking a car and influence of driving resistances on vehicle dynamics.
CO2	Describe the discrepancy between demands and limits of power train.
CO3	Develop correlation between braking, wheel load and recovery of energy.
CO4	Identify the necessity of gears, clutches, different kinds of suspensions, springs and dampers.
CO5	Understand the single track model, slip angle and cornering forces
CO6	Demonstrate the conflict between driving safety and comfort.

Course Content:
Unit-1: Longitudinal dynamic aspects of vehicles. Clear and brief: acceleration and braking. Driving resistances and slip.

Unit-2: Demand of power and limits of a car, Elements involved when a car drives on a bumpy or rough street.

Unit-3: Survey of suspensions, springs and dampers. Simple single-track model, describe the slip angle of a wheel, cornering forces, lateral dynamics.

Unit-4: Dependency between longitudinal and lateral forces using Kamm's circle, Krempel's diagram, steady state cornering of the car.

Unit-5: Conflict between driving safety and comfort**.**

Teaching Methodology:
The development of vehicle dynamics has moved toward modeling, analysis, and optimization of multi-body dynamics supported by some compliant members. Therefore, merging dynamics with optimization theory was an expected development. The fast-growing capability of accurate positioning, sensing, and calculations, along with intelligent computer programming are the other important developments in vehicle dynamics.

Evaluation Scheme:

Exams	Marks	Coverage
Test-1	15 Marks	Based on Unit-1& Unit-2

Test-2	25 Marks	Based on Unit-3& Unit-4 and around 30% from coverage of Test-1
Test-3	35 Marks	Based on Unit-5 and around 30% from coverage of Test-1 & Test-2.
Assignment	10 Marks	
Tutorials	5 Marks	
Quiz	5 Marks	
Attendance	5 Marks	
Total	**100 Marks**	

Learning Resources:
Course-related resources will be provided on JUET server. This can include eBook, lecture material, supplementary course notes.

Text Book:
[1] Fundamentals of Vehicle Dynamics by T. Gillespie
[2] Vehicle Dynamics and Control by Rajesh Rajamani

Reference Books/Material:
[1] Tyre and Vehicle Dynamics by Hans B Pacejka
[2] Vehicle Dynamics, Theory and Applications by Reza N Jazar

Web References:
[1] https://docs.google.com/file/d/0B8Gz6W5GXwyoYzQ0ZjVlNTktYWQyYi00NThiLWJlM2YtNTcxYmI2OTQ0ODAz/edit
[2] https://www.dropbox.com/sh/es39r0uylix1ryo/AADHGK5_IVLIY7QSYIQviyQ6a/Automotive%20related%20books?dl=0&subfolder_nav_tracking=1

Journals References:
[1] Journal of Automobile Engineering: SAGE

Title: Computer Integrated Manufacturing (CIM) **Code: 18B11ME915**

L-T-P scheme: 3-0-0 **Credits: 3**

Objectives:

1. This course introduces students with computer assisted modern manufacturing technologies.
2. The topics covered in this course include basics of automation, NC programming (manual and APT), concepts of group technology, Flexible Manufacturing system, CIM and robotics.
3. The objective of this course is to make students learn the important theoretical concepts, and the state-of-the-art technological developments in the area of modern manufacturing.

Learning Outcome:

Course Outcome	Description
CO1	Outline basic concepts related to CIM like types of production, plant layout, sequencing and scheduling, group technology, types of automation and FMS.
CO2	Describe NC, CNC and DNC, types and components of FMS, part classification and coding schemes, computer aided process planning (CAPP) and Automated inspection.
CO3	Develop ability to write CNC part programs, formation of part families, pick and place programs for robot and automated inspection through CMM.
CO4	Identify the sequence of operation, generate process plan and simulate the FMS operation in off-line mode.
CO5	Apply acquired knowledge to perform machining, inspection and assembly operations on Flexible manufacturing system available in CIM lab of the department.
CO6	Demonstrate ability to work in a flexible manufacturing system in an organization.

COURSE CONTENT

Introduction: Automation, Need for Automation, Types of automation systems, Automation strategies, levels of automation, Introduction to NC, CNC and DNC and Computer integrated manufacturing, CIM wheel, components of CIM.

Part programming: Introduction, NC coordinate system, fixed and floating zero machines, NC motion control systems, part programming methods, Manual part programming for milling and lathe using G and M codes, various canned cycles.

Group Technology: part families, part classification and coding, production flow analysis, composite part concept, benefits of GT.

Flexible Manufacturing System: Definition of FMS, components of FMS, types of flexibilities, classification of FMS, primary and secondary material handling systems, FMS layout configurations, computer control system, FMS applications and benefits.

Automated Material Handling and AS/RS: Introduction, types of material handling equipment,

automated guided vehicle system (AGVs), applications, vehicle guidance and routing, traffic control and safety system management, Basic components of AS/RS, types of AS/RS, AS/RS controls, special features.

Robotics: Definition, robot anatomy and related attributes, robot configuration, work volume, types of control systems, end effectors, industrial applications of robot, introduction to robot programming.

Automated Inspection & Testing: Automated inspection principles, off-line and on-line inspection, contact and noncontact inspection techniques, Co-ordinate measuring machine (CMM): Introduction and types of CMM.

Manufacturing Support System: Product design and CAD, concurrent engineering and Computer aided process planning (CAPP).

Teaching Methodology:
This course is introduced to help students learn and understand the computer assisted manufacturing processes. Then they will be taught about CNC machines and their part programming. Finally, they will be made aware about FMS and CIM systems. This theory course is well complemented by a laboratory course under the name CIM Lab that helps students learn with hand-on experience.

Evaluation Scheme:

Exams	**Marks**	**Coverage**
Test-1	15 Marks	Based on Unit-1, Unit-2 and Unit-3
Test-2	25 Marks	Based on Unit-3, Unit-4, Unit-5 and around 30% from coverage of Test-1
Test-3	35 Marks	Based on Unit-6, Unit-7, Unit-8 and and around 30% from coverage of Test-2
Assignment	10 Marks	
Tutorials	5 Marks	
Quiz	5 Marks	
Attendance	5 Marks	
Total	**100 Marks**	

Text Book:

1. Groover M. P., Automation, Production Systems And Computer-integrated Manufacturing, PHI.
2. Miller R. K., FMS/CIM Systems Integrated Handbook, Prentice Hall

REFERENCES:

1. Parrish D. J, "Flexible manufacturing", Butterworth – Heinemann Ltd, 1990
2. Rao, P.N., CAD / CAM Principles and Applications, McGraw Hill Publishers, New Delhi
3. Jha, N. K., Handbook of Flexible Manufacturing Systems, Academic Press Inc.

Title: CIM Lab **Code : 18B17ME975**

L-T-P scheme: 0-0-2 **Credit: 1**

Scope and Objectives

1. This course is designed to provide practical experience to the students with an opportunity of hands-on training on modern CNC machines and CIM system.
2. The topics covered in this course include the basics of automation, NC programming (Manual and APT), concepts of group technology, Flexible Manufacturing system, CIM and robotics etc.
3. The objective of this course is to expose the students to practical aspects of automation and the state-of-the-art technological developments in the area of modern manufacturing.

LEARNING OUTCOME:

Course Outcome	Description
CO1	Outline basic concepts related to CIM like types of production, plant layout, sequencing and scheduling, group technology, types of automation and FMS.
CO2	Describe NC, CNC and DNC, types and components of FMS, part classification and coding schemes, computer aided process planning (CAPP) and Automated inspection.
CO3	Develop ability to write CNC part programs, formation of part families, pick and place programs for robot and automated inspection through CMM.
CO4	Identify the sequence of operation, generate process plan and simulate the FMS operation in off-line mode.
CO5	Apply acquired knowledge to perform machining, inspection and assembly operations on Flexible manufacturing system available in CIM lab of the department.
CO6	Demonstrate ability to work in a flexible manufacturing system in an organization.

Course Content

XL Turn Machine

1. Write a manual part program for Linear and Circular Contour (G01, G02, and G03) operation for the component.
2. Write a manual part program for Box Facing (G94) operation for the component.
3. Write a manual part program for Multiple Facing (G72) operation for the component.
4. Write a manual part program for Multiple Turning operation with G71 Cycle for the component.
5. Write a manual part program for Peck Drilling operation with G74 Cycle for the component.
6. Write a manual part program for Turning and Parting OFF operation through subroutines for the component.

XL Mill Machine

7. Write a manual part program for Contouring (G01, G02, and G03) operation (Linear & Circular Interpolation) for the component.
8. Write a manual part program for Contouring (G40, G41) operation with Left cutter diameter compensation for the component.
9. Write a manual part program for Contouring (M98, M99) operation through subprogram for the component.

10. Write a manual part program for Mirroring (M70, M71, M80, and M81) operation for the component.
11. Write a manual part program for Drilling (G73, G83, G98, and G99) operation for the component.
12. Write a manual part program for Pocketing (G170, G171) operation for the component.

5-axis and 6-axis Robot

13. Write a program for pick and place operation for 5-axis robot
14. Write a program for continuous welding operation for 6-axis robot

Coordinate Measuring machine (CMM)

15. Write a program for automatic measurement of various dimensions such as OD, ID, thickness etc. of a part.

Complete CIM System

16. Demonstration and study of CIM system Off-line manual mode.
17. Demonstration and study of CIM system on-line automatic mode

Teaching Methodology:

This course is introduced to help students learn and understand the fundamentals and hands on knowledge of computer integrated manufacturing. Students will make and simulate part programs for CNC Lathe and Milling machines and perform machining on these machines. They will also do Robot programming. Finally, they will be performing automatic operations on FMS and CIM systems. This lab course is well complemented by a theory course under the name Computer Integrated Manufacturing (CIM) that helps students learn with hand-on experience.

Evaluation Scheme:

Exams	Marks	Coverage
P-1	15 Marks	Based on Lab Exercises: 1-7
P-2	15 Marks	Based on Lab Exercises: 8-14
Day-to-Day Work	Viva	70 Marks
	Demonstration	
	Lab Record	
	Attendance & Discipline	
Total	**100 Marks**	

Text Book:

1. Groover M. P., Automation, Production Systems And Computer-integrated Manufacturing, PHI.
3. CNC XLTURN Manual by MTAB, Chennai
4. CNC XLMILL Manual by MTAB, Chennai
5. Miller R. K., FMS/CIM Systems Integrated Handbook, Prentice Hall

References:

1. Parrish D. J, "Flexible manufacturing", Butterworth – Heinemann Ltd, 1990
2. Rao, P.N., CAD / CAM Principles and Applications, McGraw Hill Publishers, New Delhi
3. Jha, N. K., Handbook of Flexible Manufacturing Systems, Academic Press Inc.

Title: Control of Mechanical System **Code: 18B11ME918**

L-T-P scheme:3-0-0 **Credit: 3**

Prerequisite: Students must have already studied courses, "*Engineering Mechanics and Theory of Machine*".

Objective:
1. To understand different controls of mechanical systems.
2. To design mechanical control systems as per the requirements.

Learning Outcomes:

Course Outcome	Description
CO1	Outline various mechanical systems, control of mechanical systems and control modes
CO2	Describe various mechanical systems and control systems
CO3	Develop the knowledge of modelling, analyzing and designing various control for mechanical systems
CO4	Identify and use the proper mechanical system and their control required to be implemented
CO5	Apply the knowledge of control of mechanical systems to implement in the required field
CO6	Demonstrate the practical exposure of various mechanical systems are their control

Course Content:
Unit 1: Introduction: Human-machine interaction and the need for control of mechanical systems, different mechanical systems

Unit 2: Mathematical modelling of physical systems: Mechanical, electrical, fluid, and thermal building blocks, rotational-translational, electro-mechanical and hydraulic-mechanical system models, modelling of dynamic systems: first and second order systems, system transfer functions.

Unit 3: Control system components, stability and algebraic criteria, transient response analysis, stability, and damping

Unit 4: Frequency domain techniques for analysis and design of dynamic systems: root locus and frequency response analysis

Unit 5: PID controls, analysis and design of control systems, advanced control topics

Teaching Methodology:
The fundamentals of mechanical systems are to be briefly discussed with their requirements. Mathematical modelling of all the mechanical systemsare to be completed. The modelling of dynamic modelsare to be completed for first and second-order system models and to find the transfer functions of the system models. After that, the introduction to the control system is to be discussed along with the components of the control system. The stability of the control systems are to be analysed. The transient analysis of the control systems are to be discussed, along with the concepts of damping the system. Then

the mechanical control systems are to be analysed and designed using root locus and frequency response analysis. At last, the various modes of control are to be discussed along with examples, including PID controls.

Evaluation Scheme:

Exams	Marks	Coverage
Test-1	15 Marks	Based on Unit-1, and Unit-2
Test-2	25 Marks	Based on Unit-2, Unit-3& Unit-4 and around 20% from coverage of Test-1
Test-3	35 Marks	Based on Unit-4and Unit-5 and around 14.3% from coverage of Test-1 and Test-2
Assignment	10 Marks	
Tutorials	5 Marks	
Quiz	5 Marks	
Attendance	5 Marks	
Total	**100 Marks**	

Learning Resources:

Tutorials and assignments on Control of mechanical system(will be added from time to time): Digital copy will be available on the JUET server.

Textbook:

1. Mechatronics by W. Bolton
2. Control systems engineering by Norman S. Nise

Reference Books/Material:

1. Theory and design for mechanical measurements by Richard S. Figliola and Donald E. Beasley

Web References:

1. https://onlinecourses.nptel.ac.in/noc22_me96/preview

Journals References:

1. Transaction On Control and Mechanical Systems
2. Proceedings of the Institution of Mechanical Engineers, Part I: Journal of Systems and Control Engineering

Title: Automated Guided Vehicles **Code : 18B11ME916**

L-T-P Scheme: 3-0-0 **Credits: 3**

Prerequisite: Student must have already studied courses, "Engineering Thermodynamics, Manufacturing process, Kinamatic of Machnie, Dynamics of machine , Internal combustion engines, hybrid Engines and automobile engineering, microprocessor and control system, Image processing, radar technology in brief".

Objective:

1. To make aware of the basics of future of the automobile industry.
2. To make aware of the role of the Automated guided vehicles (AGV) for different applications.
3. To learn the different types of special purpose AGVs for commercial and noncommercial applications .
4. To make able to do the analysis of the different common auxiliaries utilized in the AGVs.
5. To develop an understanding of environmental aspect associated with the utilization of internal combustion engine based AGVs.

Learning Outcomes :

Course Outcome	Description
CO1	Outline basis for the categorization of AGVs
CO2	Demonstrate working principals of the auxiliaries associated with the AGVs
CO3	Describe working principals of the Skidder, skipper, loader and SP-AGVs
CO4	Demonstrate and understand different auxiliary associated AGVs
CO5	Develop skill for the performance analysis of AGVs
CO6	Describe power assisted mechanisms used in AGVs

Course Content

Unit 1: Basic components of Automated guided vehicle (AGV), electric, pneumatic/ hydraulic systems for control.

Unit 2: Automated guided vehicle (AGV) systems design. System performance analysis, system stability assessment.

Unit 3: Analogue and digital control systems and their applications. Design principle of guidance path system.

Unit 4: Introduction and principle of floor control and traffic management system. Industrial Applications of Automated guided vehicle (AGV).

Teaching Methodology:

This is introduced to make the student capable of utilizing skills developed as an outcome from their above-mentioned pre-requisite subjects, various constructional parameters of the child parts and their requirement. Course contain deals within this Automated guided vehicle subject is categorized in four different. Different adequate laboratories viz. Automobile Engineering, Internal combustion Engine, fluid machinery and COEs/RC will helps student to examine the performance of different auxiliaries of the AGVs.

Evaluation Scheme:

Exams	Marks	Coverage
Test-1	15 Marks	Based on Unit-1, & Unit-2

Test-2	25 Marks	Based on Unit-3 & Unit-4 and around 30% from coverage of Test-1
Test-3	35 Marks	Based on Unit-5 around 30% from coverage of Test-2
Assignment	10 Marks	
Tutorials	5 Marks	
Quiz	5 Marks	
Attendance	5 Marks	
Total	**100 Marks**	

Learning Resources:
Tutorials and lecture slides of the special purpose vehicle subject (will be added from time to time): Digital copy will be available on the JUET server.

Reference Books:

1. Robot Operating System for Absolute Beginners: Robotics Programming Made Easyby Lentin Joseph
2. Robot Operating System (ROS): The Complete Reference (Volume 1) by Anis Koubaa
3. Robot Operating System (ROS): The Complete Reference (Volume 2) by Anis Koubaa
4. Robot Operating System (ROS): The Complete Reference (Volume 3) by Anis Koubaa
5. Robotics, Vision and Control: Fundamental Algorithms In MATLAB® Second, Completely by Peter Corke

Web References:
1. https://www.saeindia.org
2. http://www.oica.net
3. https://uia.org

Journals References:
1. https://www.sciencedirect.com/journal/advances-in-engineering-software