**Cluster –II: Common with B.Tech in (a) ComputerSci. & Engg. (b) Information Technology (c) Electronics & Communication Engg. (d) Electrical Engineering (e) Electrical & Electronics Engineering (f) Electronics Engg.**

**Bachelor of Technology inComputerSci. & Engg.(Credit Based)**

**KURUKSHETRA UNIVERSITY, KURUKSHETRA**

**Scheme of Studies/Examination**

**Semester I (w.e.f. session 2018-2019)**

| S.No. | CourseNo./ Code | Subject | L:T:P | Hours/ Week | Credits | ExaminationSchedule(Marks) | | | | Duration of exam(Hours) |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | Major Test | MinorTest | Practical | Total | |
| 1A | BS-115A | Semiconductor Physics | 3:1:0 | 4 | 4 | 75 | 25 | 0 | 100 | 3 |
| 1B | BS-101A | Chemistry | 3:1:0 | 4 | 4 | 75 | 25 | 0 | 100 | 3 |
| 2A | ES-105A | ProgrammingforProblemSolving | 3:0:0 | 3 | 3 | 75 | 25 | 0 | 100 | 3 |
| 2B | HM-101A | English | 2:0:0 | 2 | 2 | 75 | 25 | 0 | 100 | 3 |
| 3 | BS-133A | Calculus&LinearAlgebra | 3:1:0 | 4 | 4 | 75 | 25 | 0 | 100 | 3 |
| 4A | ES-109A | EngineeringGraphics&Design | 1:2:0 | 3 | 3 | 75 | 25 | 0 | 100 | 3 |
| 4B | ES-111LA | ManufacturingProcessesWorkshop | 0:0:3 | 3 | 1.5 | - | 40 | 60 | 100 | 3 |
| 5A | BS-141A | Biology | 2:1:0 | 3 | 3 | 75 | 25 | 0 | 100 | 3 |
| 5B | ES-101A | BasicElectricalEngineering | 4:1:0 | 5 | 5 | 75 | 25 | 0 | 100 | 3 |
| 6A | BS-117LA | Semiconductor Physics Lab | 0:0:3 | 3 | 1.5 | -- | 20 | 30 | 50 | 3 |
| 6B | BS-103LA | ChemistryLab | 0:0:3 | 3 | 1.5 | -- | 20 | 30 | 50 | 3 |
| 7A | ES-107LA | ProgrammingforProblemSolvingLab | 0:0:2 | 2 | 1 | -- | 20 | 30 | 50 | 3 |
| 7B | ES-103LA | BasicElectricalEngineeringLab | 0:0:2 | 2 | 1 | -- | 20 | 30 | 50 | 3 |
| 8A | ES-113LA | EngineeringGraphics&DesignPractice | 0:0:3 | 3 | 1.5 | -- | 20 | 30 | 50 | 3 |
| 8B | HM-103LA | LanguageLab | 0:0:2 | 2 | 1 | -- | 20 | 30 | 50 | 3 |
| | | Total | 12:5:8/ 12:3:10 | 25/25 | 21.0/ 20.0 | 375/ 300 | 185/ 200 | 90/ 150 | 650A/ 650B | |

**Note: A branch will study either the subjects corresponding to Sr. No. Marked A or corresponding to Sr. No. marked B in one particular semester.**
**Induction Program (Three weeks duration) is a part of scheme of first year in 1st semester for all branches.**

**Cluster –II: Common with B.Tech in (a) ComputerSci. & Engg. (b) Information Technology (c) Electronics & Communication Engg. (d) Electrical Engineering (e) Electrical & Electronics Engineering (f) Electronics Engg.**

## Bachelor of Technology in ComputerSci. &Engg.(Credit Based)
## KURUKSHETRA UNIVERSITY, KURUKSHETRA
## Scheme of Studies/Examination
## Semester II (w.e.f. session 2018-2019)

| S.No. | CourseNo./ Code | Subject | L:T:P | Hours/ Week | Credits | ExaminationSchedule(Marks) | | | | Duration of exam(Hours) |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | Major Test | MinorTest | Practical | Total | |
| 1A | BS-115A | Semiconductor Physics | 3:1:0 | 4 | 4 | 75 | 25 | 0 | 100 | 3 |
| 1B | BS-101A | Chemistry | 3:1:0 | 4 | 4 | 75 | 25 | 0 | 100 | 3 |
| 2A | ES-105A | ProgrammingforProblemSolving | 3:0:0 | 3 | 3 | 75 | 25 | 0 | 100 | 3 |
| 2B | HM-101A | English | 2:0:0 | 2 | 2 | 75 | 25 | 0 | 100 | 3 |
| 3 | BS-134A | Probablity& Statistics | 3:1:0 | 4 | 4 | 75 | 25 | 0 | 100 | 3 |
| 4A | ES-109A | EngineeringGraphics&Design | 1:2:0 | 3 | 3 | 75 | 25 | 0 | 100 | 3 |
| 4B | ES-111LA | ManufacturingProcessesWorkshop | 0:0:3 | 3 | 1.5 | - | 40 | 60 | 100 | 3 |
| 5A | BS-141A | Biology | 2:1:0 | 3 | 3 | 75 | 25 | 0 | 100 | 3 |
| 5B | ES-101A | BasicElectricalEngineering | 4:1:0 | 5 | 5 | 75 | 25 | 0 | 100 | 3 |
| 6A | BS-117LA | Semiconductor Physics Lab | 0:0:3 | 3 | 1.5 | -- | 20 | 30 | 50 | 3 |
| 6B | BS-103LA | ChemistryLab | 0:0:3 | 3 | 1.5 | -- | 20 | 30 | 50 | 3 |
| 7A | ES-107LA | ProgrammingforProblemSolvingLab | 0:0:2 | 2 | 1 | -- | 20 | 30 | 50 | 3 |
| 7B | ES-103LA | BasicElectricalEngineeringLab | 0:0:2 | 2 | 1 | -- | 20 | 30 | 50 | 3 |
| 8A | ES-113LA | EngineeringGraphics&DesignPractice | 0:0:3 | 3 | 1.5 | -- | 20 | 30 | 50 | 3 |
| 8B | HM-103LA | Language Lab | 0:0:2 | 2 | 1 | -- | 20 | 30 | 50 | 3 |
| | | Total | 12:5:8/ 12:3:10 | 25/ 25 | 21.0/ 20.0 | 375/ 300 | 185/200 | 90/150 | 650A/ 650B | |

**Note: A branch will study either the subjects corresponding to Sr. No. Marked A or corresponding to Sr. No. marked B in one particular semester.**

| BS-115 A | Semiconductor Physics | | | | | | |
|---|---|---|---|---|---|---|---|
| L | T | P | Credit | Major Test | Minor Test | Total | Time |
| 3 | 1 | - | 4 | 75 | 25 | 100 | 3h |

| Purpose | To introduce the fundamentals of solid state physics and its applications to the students. |
|---|---|
| | **Course Outcomes** |
| CO1 | To make the students aware of basic terminology of crystal structure. |
| CO 2 | Introduce the elementary quantum mechanics, which will be useful in understanding the concepts of solid state physics. |
| CO 3 | Discussion of classical free electron theory, quantum theory and Band theory of solids. |
| CO 4 | Basics and applications of semiconductors. |

**Unit - I**

**Crystal Structure:** Crystalline and Amorphous solids, Crystal Structure: lattice translation vector, symmetry operations, space lattice, basis; Unit cell and Primitive cell, Fundamental types of lattices: two-dimensional and three dimensional Bravais lattices; Characteristics of Unit cells: Simple Cubic (SC), Body Centred Cubic (BCC), Face Centred Cubic (FCC), Hexagonal Close Packed (HCP) structure; Simple crystal structures: Sodium Chloride, Cesium Chloride, Diamond, Cubic Zinc Sulfide; Miller Indices, Bonding in Solids, Point defects in crystals: Schottky and Frenkel defects.

**Unit – II**

**Quantum Theory:** Need and origin of Quantum concept, Wave-particle duality, Phase velocity and group velocity, Uncertainty Principle and Applications; Schrodinger's wave equation: time-dependent and time –independent; Physical Significance of wave function $\psi$.

**Unit – III**

**Free Electron Theory:** Classical free electron theory: electrical conductivity in metals, thermal conductivity in metals, Wiedemann-Franz law, success and drawbacks of free electron theory; Quantum free electron theory: wave function, eigen values; Fermi-Dirac distribution function, Density of states, Fermi energy and its importance, Thermionic Emission (qualitative).

**Band theory of Solids:** Bloch theorem, Kronig-Penney Model (qualitative), E versus k diagram, Brillouin Zones, Concept of effective mass of electron, Energy levels and energy bands, Distinction between metals, insulators and semiconductors, Hall effect and its Applications.

**Unit –IV**

**Semiconductors:** Conduction in Semiconductors, Intrinsic Semiconductors: Conductivity of charge carriers, Carrier concentration in intrinsic semiconductors; Extrinsic Semiconductors: n-type semiconductors, p-type semiconductors, charge carrier concentration in extrinsic semiconductors.

**Semiconductor Devices:** The p-n junction, Current-voltage characteristics of p-n junction; The Transistor: Bipolar Junction Transistor (BJT), Field Effect Transistor (FET), Metal-Semiconductor Junction (Ohmic and Schottky); Semiconductor Laser.

**Suggested Books:**


1. Applied Physics for Engineers, Wiley India Pvt. Ltd.
2. Introduction to Solid State Physics, John Wiley & Sons. .
3. Concepts of Modern Physics (5th edition), Tata McGraw-Hill Publishing Company Limited.
4. Solid State Physics, New Age International (P) Limited.
5. A Textbook of Quantum Mechanics, McGraw Hill Education (India) Private Limited.
   Introduction to Nanotechnology, John Wiley & Sons.


**Note: The paper setter will set the paper as per the question paper templates provided.**

| BS-117LA | Semiconductor Physics Lab | | | | | | |
|---|---|---|---|---|---|---|---|
| L | T | P | Credit | Practical | Minor Test | Total | Time |
| - | - | 3 | 1.5 | 30 | 20 | 50 | 3h |
| Purpose | To give the practical knowledge of handling the sophisticated instruments. | | | | | | |
| Course Outcomes | | | | | | | |
| CO | To make the students familiar with the experiments related with Semiconductor Physics. | | | | | | |

**Note: Student will be required to perform at least 10 experiments out of the following list.**

1. To study the V-I characteristics of a p-n diode.
2. To find the flashing and quenching potential of Argon and to find the capacitance of unknown capacitor.
3. To find the value of Planck's constant by using photoelectric cell.
4. To find the temperature coefficient of resistance by using Pt resistance thermometer by post office box.
5. To find the ionization potential of Argon/Mercury using a thyratron tube.
6. To study the variation of magnetic field with distance and to find the radius of coil by Stewart and Gee's apparatus.
7. To study the characteristics of (Cu-Fe, Cu-Constantan) thermocouple.
8. To find the value of Hall Coefficient of semiconductor.
9. To find the value of e/m for electrons by Helical method.
10. To find the band gap of intrinsic semiconductor using four probe method.
11. To calculate the hysteresis loss by tracing a B-H curve.
12. To find the frequency of ultrasonic waves by piezoelectric methods.
13. To verify Richerdson thermionic equation.

**Suggested Books:**


1. C.L.Arora, B. Sc. Practical Physics, S. Chand.
2. B.L. Worshnop and H, T, Flint, Advanced Practical Physics, KPH.
3. S.L. Gupta & V. Kumar, Practical Physics, PragatiPrakashan.

| BS-101A | Chemistry | | | | | | |
|---|---|---|---|---|---|---|---|
| L | T | P | Credit | Major Test | Minor Test | Total | Time |
| 3 | 1 | - | 4 | 75 | 25 | 100 | 3h |

| | |
|---|---|
| Purpose | To familiarize the students with basic and applied concept in chemistry |
| CO1 | An insight into the atomic and molecular structure |
| CO2 | Analytical techniques used in identification of molecules |
| CO3 | To understand Periodic properties |
| CO4 | To understand the spatial arrangement of molecules |

**UNIT - I**

**Atomic and molecular structure (10 lectures)**

Molecular orbitals of diatomic molecules ($N_2$, $O_2$, CO) Equations for atomic and molecular orbitals. Energy level diagrams of diatomics. Pi-molecular orbitals of butadiene and benzene and aromaticity. Crystal field theory and energy level diagrams of $[Co(NH_3)_6]$, $[Ni(CO)_4]$, $[PtCl_2(NH_3)_2]$ and magnetic properties of metal complexes. Band structure of solids and the role of doping on band structures.

**UNIT - II**

**Spectroscopic techniques and applications (8 lectures)**

Principles of spectroscopy and selection rules. Electronic spectroscopy(basic concept). Fluorescence and its applications in medicine.Vibrational and rotational spectroscopy of diatomic molecules.Applications.Basic concepts of Nuclear magnetic resonance and magnetic resonance imaging, Diffraction and scattering.

**UNIT - III**

**Use of free energy in chemical equilibria (4 lectures)**

Thermodynamic functions: energy, entropy and free energy. Estimations of entropy and free energies.Free energy and emf.Cell potentials, the Nernst equation and applications.

**Periodic properties (4 Lectures)**

Effective nuclear charge, penetration of orbitals, variations of s, p, d and f orbital energies of atoms in the periodic table, electronic configurations, atomic and ionic sizes, ionization energies, electron affinity and electronegativity, polarizability, oxidation states, coordination numbers and geometries, hard soft acids and bases, molecular geometries ($H_2O$, $NH_3$, $PCl_5$, $SF_6$, CCl4, $Pt(NH_3)_2Cl_2$

**UNIT - IV**

**Stereochemistry (6 lectures)**

Representations of 3 dimensional structures, structural isomers and stereoisomers, configurations and symmetry and chirality, enantiomers, diastereomers, optical activity, absolute configurations and conformational analysis.

**Organic reactions and synthesis of a drug molecule (4 lectures)**

Introduction to reactions involving substitution, addition, elimination, oxidation, reduction, cyclization and ring openings. Synthesis of a commonly used drug molecule(paracetamol and Aspirin)

**Suggested Books:**

1) University chemistry, by B. M. Mahan, Pearson Education
2) Chemistry: Principles and Applications, byM. J. SienkoandR. A. Plane
3) Fundamentals of Molecular Spectroscopy, by C. N. Banwell
4) Engineering Chemistry (NPTEL Web-book), by B. L. Tembe, Kamaluddin and M. S.Krishnan
5) Physical Chemistry, by P. W. Atkins
6)Organic Chemistry: Structure and Function by K. P. C. Volhardt and N. E. Schore,5th Edition http://bcs.whfreeman.com/vollhardtschore5e/default.asp

**Note: The paper setter will set the paper as per the question paper templates provided.**

| BS-103LA | Chemistry Lab | | | | | | |
|---|---|---|---|---|---|---|---|
| L | T | P | Credit | Practical | Minor Test | Total | Time |
| - | - | 3 | 1.5 | 30 | 20 | 50 | 3h |

**LIST OF EXPERIMENTS**

1. To Determine the surface tension of a given liquid
2. To determine the relative viscosity of a given liquid using Ostwald's viscometer
3. To identify the number of components present in a given organic mixture by thin layer chromatography
4. To determine the alkalinity of a given water sample
5. Determination of the strength of a given HCl solution by titrating it with standard NaOH solution using conductometer
6. Synthesis of a drug (paracetamol/Aspirin)
7. Determination of chloride content of a given water sample
8. To determine the calcium & magnesium or temporary & permanent hardness of a given water sample by EDTA method
9. To determine the total iron content present in a given iron ore solution by redox titration
10. Determination of the partition coefficient of a substance between two immiscible liquids
11. To find out the content of sodium, potassium in a given salt solution by Flame Photometer
12. To find out the λmax and concentration of unknown solution by a spectrophotometer
13. To find out the flash point and fire point of the given oil sample by Pensky Martin apparatus
14. To determine the amount of dissolved oxygen present in a given water sample
15. To find out the pour point and cloud point of a lubricating oil
16. Determination of the strength of a given HCl solution by titrating it with standard NaOH solution using pH meter
17. Using Redwood Viscometer find out the viscosity of an oil sample

**Note: Atleast 9 experiments to be performed from the list**.

| ES-105A | Programming for Problem Solving | | | | | | |
|---|---|---|---|---|---|---|---|
| L | T | P | Credit | Major Test | Minor Test | Total | Time |
| 3 | - | - | 3 | 75 | 25 | 100 | 3h |
| Purpose | To familiarize the students with the basics of Computer System and C Programming | | | | | | |
| Course Outcomes | | | | | | | |
| CO 1 | Describe the overview of Computer System and Levels of Programming Languages. | | | | | | |
| CO 2 | Learn to translate the algorithms to programs (in C language). | | | | | | |
| CO 3 | Learn description and applications of conditional branching, iteration and recursion. | | | | | | |
| CO 4 | To use arrays, pointers and structures to formulate algorithms and programs. | | | | | | |

**UNIT – I**

Overview of Computers: Block diagram and its description, Number systems, Arithmetic of number systems, Computer Hardware: Printers, Keyboard and Mouse, Storage Devices.

Introduction to programming language: Different levels of PL: High Level language, Assembly language, Machine language; Introduction to Compiler, Interpreter, Debugger, Linker, Loader, Assembler.

Problem Analysis: Problem solving techniques, Algorithms and Flowchart representation.

**UNIT – II**

Overview of C: Elements of C, Data types; Storage classes in C; Operators: Arithmetic, relational, logical, bitwise, unary, assignment and conditional operators, precedence & associativity of operators.

Input/output: Unformatted & formatted I/O function in C.

Control statements: if statement, switch statement; Repetition: for, while, and do-while loop; break, continue, goto statements.

**UNIT – III**

Arrays: Definition, types, initialization, processing an array, String handling.

Functions: Definition, prototype, parameters passing techniques, recursion, built-in functions, passing arrays to functions, returning arrays from functions.

**UNIT – IV**

Pointers: Declaration, operations on pointers, pointers and arrays, dynamic memory allocation, pointers and functions, pointers and strings.

Structure & Union: Definition, processing, passing structures to functions, use of union.

Data files: Opening and closing a file, I/O operations on files.

**Suggested Books:**


1. Brian W. Kernighan Dennis Ritchie, "C Programming Language" Pearson Education India.
2. SubrataSaha,Subhodip Mukherjee:Basic Computation & Programming with 'C'-Cambridge University Press.
3. Ajay Mittal, "Programming in C - A Practical Approach", Pearson.
4. E Balagurusamy :Programming in ANSI C,TMH Education.
5. PradipDey and ManasGhose, "Computer Fundamental and Programming in C", Oxford Pub.
6. ForouzanBehrouz, "Computer Science: A Structured Programming Approach Using C", Cengage Learning.
7. Ashok Kamthane, "Programming in C, 3e", Pearson Education India..
8. YashwantKanetker, "Let us C", BPB Publications.
9. A K Sharma, " Fundamentals of Computers & Programming" DhanpatRai Publications
10. Rajaraman V., "Computer Basic and C Programming", Prentice Hall of India Learning.


**Note: The paper setter will set the paper as per the question paper templates provided.**

| ES-107LA | Programming for Problem Solving Lab | | | | | | |
|---|---|---|---|---|---|---|---|
| L | T | P | Credit | Practical | Minor Test | Total | Time |
| - | - | 2 | 1 | 30 | 20 | 50 | 3h |
| Purpose | To Introduce students with problem solving using C Programming language | | | | | | |
| Course Outcomes | | | | | | | |
| CO 1 | To formulate the algorithms for simple problems | | | | | | |
| CO 2 | Implementation of arrays and functions. | | | | | | |
| CO 3 | Implementation of pointers and user defined data types. | | | | | | |
| CO 4 | Write individual and group reports: present objectives, describe test procedures and results. | | | | | | |

**LIST OF PROGRAMS**

1. Write a program to find the sum of individual digits of a positive integer.
2. Write a program to generate the first n terms of the Fibonacci sequence.
3. Write a program to generate all the prime numbers between 1 and n, where n is the input value given by the user.
4. Write a program to find the roots of a quadratic equation.
5. Write a function to generate Pascal's triangle.
6. Write a program for addition of Two Matrices
7. Write a program for calculating transpose of a matrix.
8. Write a program for Matrix multiplication by checking compatibility
9. Write programs to find the factorial of a given integer by using both recursive and non-recursive functions.
10. Write a function that uses functions to perform the count the lines, words and characters in a given text.
11. Write a program to explores the use of structures, union and other user defined variables
12. Write a program to print the element of array using pointers
13. Write a program to implement call by reference
14. Write a program to print the elements of a structure using pointers
15. Write a program to read a string and write it in reverse order
16. Write a program to concatenate two strings
17. Write a program to check that the input string is a palindrome or not.
18. Write a program which copies one file to another.
19. Write a program to reverse the first n characters in a file.

**Note: At least 10 programs are to be performed & executed from the above list.**

| HM-101 A | English | | | | | | |
|---|---|---|---|---|---|---|---|
| L | T | P | Credit | Major Test | Minor Test | Total | Time |
| 2 | - | - | 2 | 75 | 25 | 100 | 3h |

| Course Outcomes | |
|---|---|
| CO 1 | Building up the vocabulary |
| CO 2 | Students will acquire basic proficiency in English including writing skills |

**UNIT- 1**

**Vocabulary Building**

1.1 The concept of Word Formation
1.2 Root words from foreign languages and their use in English
1.3 Acquaintance with prefixes and suffixes from foreign languages in English to formderivatives.
1.4 Synonyms, antonyms, and standard abbreviations.

**UNIT- 2**

**Basic Writing Skills**

2.1 Sentence Structures
2.2 Use of phrases and clauses in sentences
2.3 Importance of proper punctuation
2.4 Creating coherence
2.5 Organizing principles of paragraphs in documents
2.6 Techniques for writing precisely

**UNIT- 3**

**Identifying Common Errors in Writing**

3.1 Subject-verb agreement
3.2 Noun-pronoun agreement
3.3 Misplaced modifiers
3.4 Articles
3.5 Prepositions
3.6 Redundancies
3.7 Clichés

**UNIT- 4**

**Nature and Style of sensible Writing**

4.1 Describing
4.2 Defining
4.3 Classifying
4.4 Providing examples or evidence
4.5 Writing introduction and conclusion
4.6 Comprehension
4.7 Précis Writing
4.8 Essay Writing

**Suggested Books:**

(i) Practical English Usage. Michael Swan. OUP. 1995.
(ii) Remedial English Grammar. F.T. Wood. Macmillan.2007
(iii)On Writing Well. William Zinsser. Harper Resource Book. 2001
(iv) Study Writing. Liz Hamp-Lyons and Ben Heasly.Cambridge University Press. 2006.
(v) Communication Skills. Sanjay Kumar and PushpLata.Oxford University Press. 2011.
(vi) Exercises in Spoken English. Parts.I-III. CIEFL, Hyderabad. Oxford University Press

**Note: The paper setter will set the paper as per the question paper templates provided.**

| HM-103LA | Language Lab | | | | | | |
|---|---|---|---|---|---|---|---|
| **L** | **T** | **P** | **Credit** | **Practical** | **Minor Test** | **Total** | **Time** |
| **-** | **-** | **2** | **1** | **30** | **20** | **50** | **3h** |

**OBJECTIVES**

1. Listening Comprehension
2. Pronunciation, Intonation, Stress and Rhythm
3. Common Everyday Situations: Conversations and Dialogues
4. Communication at Workplace
5. Interviews
6. Formal Presentations

| BS-133 A | Calculus and Linear Algebra | | | | | | |
|---|---|---|---|---|---|---|---|
| L | T | P | Credit | Major Test | Minor Test | Total | Time |
| 3 | 1 | - | 4 | 75 | 25 | 100 | 3 h |
| Purpose | To familiarize the prospective engineers with techniques in calculus, sequence & series, multivariable calculus, and linear algebra. | | | | | | |

| Course Outcomes | |
|---|---|
| CO1 | To introduce the idea of applying differential and integral calculus to notions of improper integrals. Apart from some applications it gives a basic introduction on Beta and Gamma functions. |
| CO 2 | To introduce the fallouts of Rolle's Theorem that is fundamental to application of analysis to Engineering problems. |
| CO 3 | To develop the essential tool of matrices and linear algebra in a comprehensive manner. |
| CO 4 | To familiarize the student with vector space as an essential tool in most branches of engineering. |

**UNIT-I** (12 hrs)

**Calculus**:

Evaluation of definite and improper integrals: Beta and Gamma functions and their properties; Applications of definite integrals to evaluate surface areas and volumes of revolutions.

Rolle's Theorem, Mean value theorems, Indeterminate forms and L'Hospital's rule.

**UNIT-II** (8 hrs)

**Matrices**

Matrices, vectors: addition and scalar multiplication, matrix multiplication; Linear systems of equations, linear Independence, rank of a matrix, determinants, Cramer's Rule, inverse of a matrix, Gauss elimination and Gauss-Jordan elimination.

**UNIT-III** (10 hrs)

**Vector spaces**

Vector Space, linear dependence of vectors, basis, dimension; Linear transformations (maps), range and kernel of a linear map, rank and nullity, Inverse of a linear transformation, rank nullity theorem, composition of linear maps.

**UNIT-IV** (10 hrs)

**Vector spaces**

Eigenvalues, eigenvectors, symmetric, skew-symmetric, and orthogonal Matrices, eigenbases. Diagonalization; Inner product spaces.

**Suggested Books:**


1.ErwinKreyszig, Advanced Engineering Mathematics, 9th Edition, John Wiley & Sons, 2006.

2. Erwin Kreyszig and SanjeevAhuja, Applied Mathematics- I, Wiley India Publication, Reprint 2015.

3. G.B. Thomas and R.L. Finney, Calculus and Analytic geometry, 9th Edition, Pearson, Reprint, 2002.

4. Veerarajan T., Engineering Mathematics for first year, Tata McGraw-Hill, New Delhi, 2008.

5. Ramana B.V., Higher Engineering Mathematics, Tata McGraw Hill New Delhi, 11th Reprint, 2010.

6. D. Poole, Linear Algebra: A Modern Introduction, 2nd Edition, Brooks/Cole, 2005.

7. N.P. Bali and Manish Goyal, A text book of Engineering Mathematics, Laxmi Publications, Reprint, 2008.

8. B.S. Grewal, Higher Engineering Mathematics, Khanna Publishers, 36th Edition, 2010.

9. V. Krishnamurthy, V.P. Mainra and J.L. Arora, An introduction to Linear Algebra, Affiliated East–West press, Reprint 2005.

10. S. Lipschutz and M. Lipson, Schaum's outline of Linear Algebra,, McGraw Hill Education; 3 edition (1 July 17).


**Note: The paper setter will set the paper as per the question paper templates provided.**

| BS-134 A | Probability & Statistics | | | | | | |
|---|---|---|---|---|---|---|---|
| L | T | P | Credit | Major Test | Minor Test | Total | Time |
| 4 | 1 | - | 4.5 | 75 | 25 | 100 | 3 h |
| Purpose | To familiarize the prospective students with techniques of probability and statistics. | | | | | | |
| Course Outcomes | | | | | | | |
| CO1 | Probability theory provides models of probability distributions( theoretical models of the observable reality involving chance effects) to be tested by statistical methods which has various engineering applications, for instance, in testing materials, control of production processes, robotics, and automatization in general, production planning and so on. | | | | | | |
| CO 2 | To develop the essential tool of statistics in a comprehensive manner. | | | | | | |
| CO 3 | To familiarize the student with the problem of discussing universe of which they in which complete enumeration is impractical, tests of significance plays a vital role in their hypothesis testing. | | | | | | |

**UNIT-I** (10 Hrs)

**Basic Probability:** Introduction, additive law of probability, Conditional Probability, Independent Events, Bayes' Theorem.

Random Variables: Discrete random variables, probability distribution, Probability mass function and distribution function, Expectation, Moments, Variance and standard deviation of discrete random variables.

**UNIT-II** (10 Hrs)

**Continuous Probability distribution:**

Continuous random variables, probability distribution, Probability density function and distribution function, Expectation, Moments, Variance and standard deviation of Continuous random variables.

Probability distributions: Binomial, Poisson and Normal - evaluation of statistical parameters for these three distributions.

**UNIT-III** (10 hrs)

**Basic Statistics:**

Measures of Central tendency: Mean, median, quartiles, mode, Geometric mean, Harmonic mean, Measures of dispersion: Range, Quartile deviation, mean deviation, standard deviation, coefficient of variation, Moments, Skewness and Kurtosis, Correlation, Coefficient of correlation, methods of calculations, Lines of regression, Rank correlation.

**UNIT-IV** (10 hrs)

**Applied Statistics:**

Curve fitting by the method of least squares: Introduction, Fitting of a straight line, fitting of second degree curve, fitting of a polynomial of degree m, fitting of a geometric or power curve of the form $y = ax^b$, fitting of an exponential curve of the form $y = ab^x$.

**Test of significance:** Basic terminology, Large sample test for single proportion, difference of proportions, single mean, difference of means, Small samples test for single mean, difference of means, Chi-square test for goodness of fit.

**Suggested Books:**


1. Erwin Kreyszig, Advanced Engineering Mathematics, 9th Edition, John Wiley & Sons,2006.
2. P. G. Hoel, S. C. Port and C. J. Stone, Introduction to Probability Theory, Universal Book Stall, 2003 (Reprint).
3. S. Ross, A First Course in Probability, 6th Ed., Pearson Education India, 2002.
4. W. Feller, An Introduction to Probability Theory and its Applications, Vol. 1, 3rd Ed.,Wiley, 1968.
5. N.P. Bali and and Manish Goyal, A text book of Engineering Mathematics, Laxmi Publications, Reprint, 2010.
6. Ramana B.V., Higher Engineering Mathematics, Tata McGraw Hill New Delhi, 11th Reprint, 2010.
7. B.S. Grewal, Higher Engineering Mathematics, Khanna Publishers, 36th Edition, 2010.
8. Veerarajan T., Engineering Mathematics (for semester III), Tata McGraw-Hill, New Delhi, 2010.


**Note: The paper setter will set the paper as per the question paper templates provided.**

| Course code | ES-109A | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Coursetitle | EngineeringGraphics&Design | | | | | | | |
| Scheme and Credits | L | T | P | Credits | Major Test | Minor Test | Total | Time |
| | 1 | 2 | 0 | 3 | 75 | 25 | 100 | 3h |

**Course Outcomes**

| Objective- To expose students to the basics of Engineering Drawing , graphics and Projections. | |
|---|---|
| CO-1 | To learn about construction of various types of curves and scales. |
| CO-2 | To learn about orthographic projections of points, lines and planes. |
| CO-3 | To Learn about the sectional views and development of Right regular solids |
| CO-4 | To Learn about the construction of Isometric Projections and conversion of Isometric views to Orthographic views and vice-versa. |

**UNIT - I**

**IntroductiontoEngineeringDrawing**:

Principles of Engineering Graphics and their significance, usage of Drawing instruments, lettering, Conic sections including the Rectangular Hyperbola (General method only); Cycloid, Epicycloid, Hypocycloid and Involute; Scales – Plain, Diagonal and Vernier Scales;

**UNIT - II**

**Orthographic Projections:**

PrinciplesofOrthographicProjections-Conventions-Projections ofPointsandlinesinclined tobothplanes;Projectionsofplanesinclined to one principalPlane.

**ProjectionsofRegular Solids:**

Solid with axis inclinedtobothePlanes;

**UNIT - III**

**Sections andSectionalViewsofRightRegular Solids**:

Sectional views of simple right regular soilds like prism, pyramid, Cylinder and Cone. Development ofsurfacesofRightRegularSolids-Prism,Pyramid,CylinderandCone;

**UNIT - IV**

**Isometric Projections:**

Principles of Isometric projection – Isometric Scale, Isometric Views, Conventions; Isometric Views of lines, Planes, Simple and compound Solids; Conversion of IsometricViews to Orthographic Views and Vice-versa, Conventions;

**Suggested Books:**


1. Engineering Graphics using AUTOCAD 2000: T. Jeyapoovan, Vikas Publishing House.
2. Engineering Drawing: Plane and Solid Geometry: N.D. Bhatt and V.M.Panchal, Charotar Publishing House.
3. Engineering Drawing: Amar Pathak, Dreamtech Press, New Delhi.
4. Thomas E.French, Charles J.Vierck, Robert J.Foster, "Engineering drawing and graphic technology", McGraw Hill International Editions.
5. Engineering Graphics and Drafting: P.S. Gill, Millennium Edition, S.K. Katariaand Sons.
6. A Primer on Computer aided Engineering Drawing-2006, published by VTU, Belgaum.
7. A.Yarwood, Introduction to AutoCAD 2017, Published by CRC Press.
8. O. Ostrowsky, Engineering Drawing with CAD applications, Butterworth Heinemann,1999.
9. BSI, Technical production documentation (TPD) – specification for defining, specifying and graphically reporting products, BS8888, 2002.
10. CorrespondingsetofCADSoftwareTheoryandUserManuals.


**Note: The paper setter will set the paper as per the question paper templates provided.**

| Course code | ES-113LA | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Coursetitle | EngineeringGraphics&Design Practice | | | | | | | |
| Scheme and Credits | L | T | P | Credits | Practical | Minor Test | Total | Time |
| | - | - | 3 | 1.5 | 30 | 20 | 50 | 3h |
| Pre-requisites(if any) | - | | | | | | | |

| Aim: To make student practice on engineering graphics and designsoftwaresand provide exposuretothevisualaspectsofengineeringdesign. | |
|---|---|
| CO-1 | To give an overview of the user interface and toolboxes in a CAD software. |
| CO-2 | To understand to customize settings of CAD software and produce CAD drawing. |
| CO-3 | To practice performing various functions in CAD softwares. |
| CO-4 | To Learn about solid modelling and demonstration of a simple team design project. |

**Module 1:OverviewofComputerGraphics:**
Listingthecomputertechnologiesthatimpactongraphicalcommunication,Demonstrating Knowledgeofthetheory ofCADsoftware[suchas:TheMenuSystem,Toolbars(Standard, ObjectProperties,Draw,Modify andDimension),DrawingArea(Background,Crosshairs, CoordinateSystem),Dialogboxes andwindows,Shortcutmenus(Button Bars),The CommandLine(whereapplicable),TheStatusBar,Differentmethodsofzoom asusedin CAD,Selectanderaseobjects.; IsometricViewsoflines,Planes, Simpleandcompound Solids];
**Module2:Customization &CAD Drawing:**
Setupofthedrawingpageandtheprinter,includingscalesettings,Settingup ofunitsanddrawing limits;ISOand ANSIstandardsforcoordinatedimensioningandtolerancing; Orthographic constraints, Snap to objects manually and automatically; Producingdrawingsbyusingvariouscoordinateinputentrymethodstodrawstraightlines,Applyingvari ouswaysofdrawingcircles;
**Module3:Annotations,layering&other functions:**
Applyingdimensionstoobjects,applyingannotationstodrawings;Settingupanduseof Layers,layerstocreatedrawings,Create,editandusecustomizedlayers; Changingline lengthsthroughmodifyingexisting lines(extend/lengthen);Printingdocumentstopaper usingtheprintcommand;orthographicprojection techniques;Drawingsectionalviewsof compositerightregulargeometricsolids andprojectthetrueshapeof thesectionedsurface; Drawing annotation,Computer-aideddesign(CAD)softwaremodelingof partsand assemblies.Parametricandnon-parametricsolid,surface,and wireframemodels.Partediting andtwo-dimensionaldocumentationofmodels.Planarprojectiontheory,includingsketching of perspective,isometric,multi-view,auxiliary,andsectionviews.Spatialvisualization exercises.Dimensioning guidelines,tolerancingtechniques; dimensioningandscalemulti viewsofdwelling;
**Module4:Demonstration ofasimpleteamdesign project**:
Geometryandtopologyofengineeredcomponents:creation ofengineeringmodelsandtheir presentationinstandard2Dblueprintform andas3Dwire-frameandshadedsolids;meshed topologiesforengineeringanalysisandtool-path generationforcomponentmanufacture; geometricdimensioningandtolerancing;Useof solid-modelingsoftwareforcreating associativemodels atthecomponentand assemblylevels;floorplans thatinclude: windows,doors,andfixturessuchasWC,bath,sink,shower,etc.Applying colourcodingaccordingto buildingdrawingpractice;Drawingsectionalelevation showingfoundation toceiling; IntroductiontoBuildingInformationModeling (BIM).
**Suggested Books(ES-113L):**

1. Chris McMahon and Jimmie Browne, CAD/CAM – Principle Practice and Manufacturing Management, Addison Wesley England, Second Edition, 2000.
2. Chougule N.K.; CAD/CAM /CAE, Scitech Publications India Pvt. Ltd.
3. Vikram Sharma; Computer Aided Design and Manufacturing, S.K. Kataria and Sons.
4. Rogers, D.F. and Adams, A., Mathematical Elements for Computer Graphics, McGraw Hill Inc, NY, 1989
5. Ibrahim Zeid, CAD/CAM theory and Practice, Tata McGraw Hill Publishing Co. Ltd., New Delhi, 1992.
6. M.P. Groover, Automation, Productions systems and Computer-Integrated Manufacturing by Prentice – Hall.
7. A Primer on Computer aided Engineering Drawing-2006, published by VTU, Belgaum.
8. A.Yarwood, Introduction to AutoCAD 2017, Published by CRC Press.
9. O. Ostrowsky, Engineering Drawing with CAD applications, Butterworth Heinemann,1999.
10. BSI, Technical production documentation (TPD) – specification for defining, specifying and graphically reporting products, BS8888, 2002.
11. (Correspondingsetof)CADSoftwareTheoryandUserManuals
12. Ibrahim Zeid, Mastering CAD/CAM, Tata McGraw Hill Publishing Co. Ltd., New Delhi.
13. P. Radhakrishnan, S. Subramanayan and V.Raju, CAD/CAM/CIM, New Age International (P) Ltd., New Delhi.
14. Groover M.P. and Zimmers E. W., CAD/CAM: Computer Aided Design and Manufacturing, Prentice Hall International, New Delhi, 1992.
15. Dr. Sadhu Singh, Computer Aided Design and Manufacturing, Khanna Publishers, New Delhi, Second Edition, 2000.
16. Thomas E.French, Charles J.Vierck, Robert J.Foster, “Engineering drawing and graphic technology”, McGraw Hill International Editions.

| Course code | ES-111LA | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Coursetitle | ManufacturingProcessesWorkshop | | | | | | | |
| Scheme and Credits | L | T | P | Credits | Practical | Minor Test | Total | Time |
| | 0 | 0 | 3 | 1.5 | 60 | 40 | 100 | 3h |
| Pre-requisites (if any) | | | | | | | | |

| Aim: To make student gain a hands on work experience in a typical manufacturing industry environment. | |
|---|---|
| CO-1 | To familiarize with different manufacturing methods in industries and work on CNC machine. |
| CO-2 | To learn working in Fitting shop and Electrical and Electronics shops, |
| CO-3 | To practice working on Carpentry and Plastic moulding/glass cutting jobs. |
| CO-4 | To gain hands on practice experience on Metal casting and Welding jobs. |

**ManufacturingProcessesWorkshop**

**Contents**

1.ManufacturingMethods-casting,forming,machining,joining, advancedmanufacturing methods
2. CNCmachining, Additivemanufacturing
3. Fittingoperations&powertools
4. Electrical&Electronics
5. Carpentry
6. Plasticmoulding,glasscutting
7. Metalcasting
8. Welding(arc welding&gas welding), brazing

**Suggested Books:**


1. Kalpakjian S. And Steven S. Schmid, "Manufacturing Engineering and Technology" , 7th edition, Pearson Education India Edition.
2. HajraChoudhury S.K., HajraChoudhury A.K. and Nirjhar Roy S.K., " Elements of Workshop Technology" , Vol. I 2008 and Vol. II 2010, Media promoters and publishers private limited, Mumbai.
3. Gowri P. Hariharan and A. Suresh Babu," Manufacturing Technology – I" Pearson Education, 2008.
4. Roy A. Lindberg, " Processes and Materials of Manufacture" , 4th edition, Prentice Hall India, 1998
5. Rao P.N., "Manufacturing Technology" , Vol. I and Vol. II, Tata McGraw-Hill House, 2017.

| BS-141A | Biology | | | | | | |
|---|---|---|---|---|---|---|---|
| L | T | P | Credit | Major Test | Minor Test | Total | Time |
| 2 | 1 | - | 3 | 75 | 25 | 100 | 3h |
| Purpose | To familiarize the students with the basics of Biotechnology | | | | | | |
| Course Outcomes | | | | | | | |
| CO1 | Introduction to essentials of life and macromolecules essential for growth and Development | | | | | | |
| CO2 | Defining the basic concepts of cell division, genes and Immune system | | | | | | |
| CO3 | Introduction of basic Concept of ThermoGenetic Engg. & Biochemistry | | | | | | |
| CO4 | Introduction of basic Concept of Microbiology & Role of Biology in Different Fields | | | | | | |

**Unit – I**

**Introduction to living world:** Concept and definition of Biology; Importance of biology in major discoveries of life Characteristic features of living organisms; Cell ultra-structure and functions of cell organelles like nucleus, mitochondria,chloroplast, ribosomes and endoplasmic reticulum; Difference between prokaryotic and eukaryotic cell; Difference between animal and plant cell.

**Classification of organisms**: Classify the organisms on the basis of (a) Cellularity;- Unicellular and Multicellular organisms. (b) Energy and Carbon Utilization:- Autotrophs, Hetrotrophs and Lithotrops (c) Habitat (d) Ammonia excretion:- ammonotelic, 17ricotelic and ureotelic. (e) Habitat- acquatic or terrestrial (e) Molecular taxonomy- three major kingdoms of life

**Unit-II**

**Introduction to Biomolecules:** Definition, general classification and important functions of carbohydrates, lipids, proteins, nucleic acids (DNA& RNA: Structure and forms). Hierarch in protein structure: Primary secondary, tertiary and quaternary structure. Proteins as enzymes, transporters, receptors and structural elements.

**Enzymes as biocatalysts:** General characteristics, nomenclature and classification of Enzymes. Effect of temperature, Ph, enzyme and substrate concentrations on the activity of enzymes. Elementary concept of and coenzymes. Mechanism of enzyme action. Enzyme kinetics and kinetic parameters (Km and Vmax)

**Unit-III**

**Genetics:-**Mendel's laws of inheritance. Variation and speciation.Concepts of recessiveness and dominance. Genetic Disorders: Single gene disorders in human. **Human traits**: Genetics of blood groups, diabetes type I & II.

**Cell Division**:- Mitosis and its utility to living systems. Meiosis and its genetic significance.Evidence of nucleic acids as a genetic material. Central Dogma of molecular biology

**4. Role of immune system in health and disease**: Brief introduction to morphology and pathogenicity of bacteria, fungi, virus, protozoa beneficial and harmful for human beings.

**Unit-IV**

**Metabolism:-**Concept of Exothermic and endothermic reactions. Concept of standard free energy and Spontaneity in biological reactions. Catabolism (Glycolysis and Krebs cycle) and synthesis of glucose (Photosynthesis:- Light and Dark Reaction) of glucose. ATP as Energy Currency of the cell

**Microbiology:** Concept of species and strains, sterilization and media compositions, growth kinetics.

**Role of Biology :**Role of Biology in Agriculture, Medicine, Forensic science, Bioinformatics, Nanotechnology, Micro-electromechanical systems (Bio-MEMS) and Sensors (Biosensors).

**Text Book:**

1. Introduction to Biotechnology, By Deswal&Deswal, DhanpatRai Publications N.A

2.Campbell, J. B. Reece, L. Urry, M. L. Cain and S. A. Wasserman, "Biology: A global approach", Pearson Education Ltd, 2014.

3. E. E. Conn, P. K. Stumpf, G. Bruening and R. H. Doi, "Outlines of Biochemistry", John Wiley and Sons, 2009.
D. L. Nelson and M. M. Cox, "Principles of Biochemistry", W.H. Freeman and Company, 2012.

4.G. S. Stent and R. Calendar, "Molecular Genetics", Freeman and company, 1978.

**Note: The paper setter will set the paper as per the question paper templates provided**

**Suggested Books:**

1. Molecular Biology of cell, 4th ed. Alberts, Bruce et al. Garland Science Publishing, New York.

2. Microbiology. Pelczar Jr., M.J.; Chan, E.C.S. and Krieg, N.R. Tata McGraw Hill, New Delhi.

3. Lehninger: Principles of Biochemistry, 3rd edition, by David L. Nelson and M.M. Cox. Maxmillan/ Worth publishers.
4. Genetics by Snusted& Simmons.
5. Molecular Biotechnology: Principles Application of Recombinant DNA. Glick, B. R. and Pasternak, J. J. ASM press WashingtonDC.
6. Kuby's Immunology, Goldsby, R A,.Kindt, T.J, Osborne, B.A.(2003) W. H. Freeman and company, New York.
7. Recombinant DNA 2nd Edition. Watson, James D. and Gilman, M. (2001) W.H Freeman and Company, NewYork.
8. Essentials of Molecular Biology 4thed, Malacinski, G. M. (2003) Jones &Bartlet Publishers, Boston.

| ES-101A | BASIC ELECTRICAL ENGINEERING | | | | | | |
|---|---|---|---|---|---|---|---|
| L | T | P | Credit | Major Test | Minor Test | Total | Time(Hrs) |
| 4 | 1 | - | 5 | 75 | 25 | 100 | 3 |
| Purpose | To familiarize the students with the basics of Electrical Engineering | | | | | | |
| Course Outcomes | | | | | | | |
| CO1 | Deals with steady state circuit analysis subject to DC. | | | | | | |
| CO 2 | Deals with AC fundamentals & steady state circuit response subject to AC. | | | | | | |
| CO 3 | Deals with introductory Balanced Three Phase System analysis and Single Phase Transformer. | | | | | | |
| CO 4 | Explains the Basics of Electrical Machines & Electrical installations | | | | | | |

**Unit-I**

**D.C. circuits**: Ohm's Law, junction, node, circuit elements classification: Linear & nonlinear, active & passive, lumped & distributed, unilateral & bilateral with examples. KVL, KCL, Loop and node-voltage analysis of resistive circuit.Star-Delta transformation for resistors.

**Network Theorems:** Superposition, Thevenin's, Norton's and Maximum power transfer theorems in a resistive network.

**Unit-II**

**AC Fundamentals:** Mathematical representation of various wave functions. Sinusoidal periodicsignal, instantaneous and peak values, polar & rectangular form of representation of impedances and phasor quantities. Addition & subtraction of two or more phasor sinusoidal quantities using component resolution method.RMS and average values of various waveforms.

**A.C. Circuits**: Behavior of various components fed by A.C. source (steady state response of pureR, pure L, pure C, RL, RC, RLC series with waveforms of instantaneous voltage, current & power on simultaneous time axis scale and corresponding phasor diagrams), power factor, active, reactive & apparent power. Frequency response of Series & Parallel RLC ckts.including resonance, Q factor, cut-off frequency & bandwidth. Generation of alternating emf.

**Unit-III**

**Balanced Three Phase Systems:** Generation of alternating 3- phaseemf). 3-phase balanced circuits, voltage and current relations in star and delta connections. Measurement of 3-phase power by two wattmeter method for various types of star & delta connected balanced loads.

**Single Phase Transformer** (qualitative analysis only): Concept of magnetic circuits.Relation between MMF & Reluctance.Hysteresis & Eddy current phenomenon.Principle, construction &emf equationPhasor diagram at ideal, no load and on load conditions. Losses & Efficiency, regulation. OC & SC test, equivalent circuit, concept of auto transformer.

**Unit-IV**

**Electrical Machines** (qualitative analysis only)**:** Construction and working of dc machine with commutateor action, speed control of dc shunt motor. Generation of rotating magnetic fields, Construction and working of a three-phase induction motor, Significance of torque-slip characteristic. Basics of Single-phase induction motor, capacitor start capacitor run Single-phase induction motor working. Basic construction and working of synchronous generator and motor.

**Electrical Installations (LT Switchgear):** Switch Fuse Unit (SFU), MCB, ELCB, MCCB, Types of Wires and Cables, Earthing.

**Suggested Books:**


1. Basic Electrical Engg: A complete Solution by Vijay Kumar Garg, Wiley India Ltd.
2. Electrical Engg. Fundamentals by Rajendra Prasad, PHI Pub.
3. Basic Electrical Engg.by S.K. Sahdev, Pearson Education
4. Electrical Engg. Fundamentals:byBobrow, Oxford Univ.Press
5. Basic Electrical Engg. By Del Toro.
6. Saxena&Dasgupta: Fundamentals of Electrical Engg (Cambridge University Press).


**Note: The paper setter will set the paper as per the question paper templates provided.**

| ES-103LA | BASIC ELECTRICAL ENGINEERING LAB | | | | | | |
|---|---|---|---|---|---|---|---|
| L | T | Practical | Credit | Minor Test | (Practical) | Total | Time (Hrs) |
| - | - | 2 | 1 | 20 | 30 | 50 | 3 |

| Purpose | To familiarize the students with the Electrical Technology Practicals |
|---|---|

| Course Outcomes | |
|---|---|
| CO1 | Understand basic concepts of Network theorems |
| CO 2 | Deals with steady state frequency response of RLC circuit parameters solution techniques |
| CO 3 | Deals with introductory Single Phase Transformer practicals |
| CO 4 | Explains the constructional features and practicals of various types of Electrical Machines |

## LIST OF EXPERIMENTS

1. To verify KVL and KCL.
2. To verify Superposition theorem on a linear circuit with at least one voltage & one current source.
3. To verify Thevenin's Theorem on a linear circuit with at least one voltage & one current source.
4. To verify Norton's Theorem on a linear circuit with at least one voltage & one current source.
5. To study frequency response of a series R-L-C circuit on CRO and determine resonant frequency& Q- factor for various Values of R, L, and C.
6. To study frequency response of a parallel R-L-C circuit on CRO and determine resonant frequency& Q -Factor for various values of R, L, and C.
7. To perform O.C. and S.C. tests on a single phase transformer.
8. To perform direct load test on a single phase transformer and plot efficiency v/s load characteristic.
9. To perform speed control of DC shunt motor.
10. To perform starting & reversal of direction of a three phase induction motor.
11. Measurement of power in a 3 phase balanced system by two watt meter method.
12. Study of Cut sections of DC Machines, Induction Motor
13. To study components of various LT Switchgears

**Note: At least 9 out of the listed experiments to be performed during the semester.**

**Bachelor of Technology (Electronics & Communication Engineering) (Credit Based)**
**KURUKSHETRA UNIVERSITY KURUKSHETRA**
**Scheme of Studies/Examination(Modified)**
**Semester III (w.e.f. session 2019-2020)**

| Sr. No. | Course No. | Subject | L:T:P | Hours/Week | Credits | Examination Schedule (Marks) | | | | Duration of Exam (Hrs) |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | Major Test | Minor Test | Practical | Total | |
| 1 | BS-201A | Optics & Waves | 3:0:0 | 3 | 3 | 75 | 25 | 0 | 100 | 3 |
| 2 | EC-201A | Electronic Devices | 3:0:0 | 3 | 3 | 75 | 25 | 0 | 100 | 3 |
| 3 | EC-203LA | Electronic Devices Lab | 0:0:2 | 2 | 1 | - | 40 | 60 | 100 | 3 |
| 4 | EC-205A | Digital Electronics | 3:0:0 | 3 | 3 | 75 | 25 | 0 | 100 | 3 |
| 5 | EC-207LA | Digital Electronics Lab | 0:0:2 | 2 | 1 | - | 40 | 60 | 100 | 3 |
| 6 | EC-209A | Signals & Systems | 3:0:0 | 3 | 3 | 75 | 25 | 0 | 100 | 3 |
| 7 | EC-211LA | Signals & Systems Lab | 0:0:2 | 2 | 1 | - | 40 | 60 | 100 | 3 |
| 8 | EC-213A | Network Theory | 3:0:0 | 3 | 3 | 75 | 25 | 0 | 100 | 3 |
| 9 | ES-219A | Essentials of Information Technology | 3:0:0 | 3 | 3 | 75 | 25 | 0 | 100 | 3 |
| 10 | *EC-215A | Industrial Training-I | 2:0:0 | 2 | - | - | 100 | - | 100 | 3 |
| 11 | **MC-901A | Environmental Sciences | 3:0:0 | 3 | - | 75 | 25 | 0 | 100 | 3 |
| | | **Total** | | **26** | **21** | **450** | **270** | **180** | **900** | |

*EC-215A is a mandatory credit-less course in which the students will be evaluated for the industrial training undergone after 2nd semester and students will be required to get passing marks to qualify.
**MC-901A is a mandatory credit-less course in which the students will be required to get passing grade.

**Bachelor of Technology (Electronics & Communication Engineering) (Credit Based)**
**KURUKSHETRA UNIVERSITY KURUKSHETRA**
**Scheme of Studies/Examination(Modified)**
**Semester IV (w.e.f. session 2019-2020)**

| S. No. | Course No. | Subject | L:T:P | Hours/ Week | Credits | Examination Schedule (Marks) | | | | Duration of Exam (Hrs) |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | Major Test | Minor Test | Practical | Total | |
| 1 | BS-207A | Applied and Computational Mathematics | 3:0:0 | 3 | 3 | 75 | 25 | 0 | 100 | 3 |
| 2 | EC- 202A | Digital Communication | 3:0:0 | 3 | 3 | 75 | 25 | 0 | 100 | 3 |
| 3 | EC-204LA | Communication Lab | 0:0:2 | 2 | 1 | - | 40 | 60 | 100 | 3 |
| 4 | EC-206A | Analog Circuits | 3:0:0 | 3 | 3 | 75 | 25 | 0 | 100 | 3 |
| 5 | EC-208LA | Analog Circuits Lab | 0:0:2 | 2 | 1 | - | 40 | 60 | 100 | 3 |
| 6 | EC-210A | Microprocessors & Microcontrollers | 3:0:0 | 3 | 3 | 75 | 25 | 0 | 100 | 3 |
| 7 | EC-212LA | Microprocessors & Microcontrollers Lab | 0:0:2 | 2 | 1 | 0 | 40 | 60 | 100 | 3 |
| 8 | EC-214A | Electromagnetic Field Theory | 3:0:0 | 3 | 3 | 75 | 25 | 0 | 100 | 3 |
| 9 | ES-208A | Basics of Analog Communication | 3:0:0 | 3 | 3 | 75 | 25 | 0 | 100 | 3 |
| 10 | *MC-902A | Constitution of India | 3:0:0 | 3 | - | 75 | 25 | 0 | 100 | 3 |
| | | **Total** | | **27** | **21** | **450** | **270** | **180** | **900** | |



*MC-902A is a mandatory credit-less course in which the students will be required to get passing grade.

**Note: All the students have to undergo 4 to 6 weeks Industrial Training after 4th semester which will be evaluated in 5th semester**

| BS – 201A | Optics and Waves | | | | | | |
|---|---|---|---|---|---|---|---|
| L | T | P | Credit | Major Test | Minor Test | Total | Time |
| 3 | - | - | 3 | 75 | 25 | 100 | 3h |
| Purpose | To introduce the fundamentals of wave and optics for the applications in Engineering field. | | | | | | |
| Course Outcomes | | | | | | | |
| CO 1 | Familiarize with basic phenomenon used in propagation of waves. | | | | | | |
| CO 2 | Introduce the fundamentals of interference, diffraction, polarization and their applications. | | | | | | |
| CO 3 | To make the students aware to the importance of Laser in technology. | | | | | | |

**Unit - I**

**Waves:** Travelling waves, Characteristics of waves, Mathematical representation of travelling waves, General wave equation, Phase velocity, Light source emit wave packets, Wave packet and Bandwidth, Group velocity and real light waves.

**Propagation of light waves:** Maxwell's equations, Electromagnetic waves and constitutive relations, Wave equation for free-space, Uniform plane waves, Wave polarization, Energy density, the pointing vector and intensity, Radiation pressure and momentum, Light waves at boundaries, Wave incident normally on boundary, Wave incident obliquely on boundary: law of reflection, Snell's law and reflection coefficients.

**Unit - II**

**Interference:** Principle of Superposition, Conditions for Sustained interference, Young's double slit experiment, Division of wave-front: Fresnel's Biprism and its applications, Division of amplitude: Interference due to reflected and transmitted light, Wedge-shaped thin film, Newton's rings and its applications, Michelson Interferometer and its applications.

**Unit – III**

**Diffraction:** Types of diffraction, Fraunhofer diffraction at a single slit, Plane transmission diffraction grating: theory, secondary maxima and secondary minima, width of principal maxima, absent spectra, overlapping of spectral lines, determination of wavelength; Dispersive power and resolving power of diffraction grating.

**Polarization:** Polarization of transverse waves, Plane of polarization, Polarization by reflection, Double refraction, Nicol Prism, Quarter and half wave plate, Specific Rotation, Laurent 's half shade polarimeter, Biquartz polarimeter.

**Unit – IV**

**Laser:** Stimulated Absorption, Spontaneous and Stimulated Emission; Einstein's Coefficients and its derivation, Population Inversion, Direct and Indirect pumping, Pumping schemes, Main components of Laser, Gas lasers (He-Ne, $CO_2$), Solid state lasers (Ruby, Neodymium, semiconductor), Dye laser, Characteristics of Laser, Applications of Laser.

***Text/Reference Books:***


1. P.K. Diwan, Applied Physics for Engineers, *Wiley India Pvt. Ltd.*, *India*
2. N. Subrahmanyam, B. Lal, M.N. Avadhanulu, A Textbook of Optics, *S. Chand & Company Ltd*., *India.*
3. A. Ghatak, Optics, *McGraw Hill Education (India) Pvt. Ltd., India*.
4. E. Hecht, A.R. Ganesan, Optics, *Pearson India Education Services Pvt. Lt., India.*


**Note: The Examiner will be given the question paper template and will have to set the question paper according to the template provided along with the syllabus.**

| EC-201A | Electronic Devices | | | | | | |
|---|---|---|---|---|---|---|---|
| Lecture | Tutorial | Practical | Credit | Major Test | Minor Test | Total | Time |
| 3 | - | - | 3 | 75 | 25 | 100 | 3 Hrs. |
| Course Outcomes (CO) | | | | | | | |
| CO1 | To understand the concept of carrier transport phenomena in semiconductors and diodes such as p-n junction diode and tunnel diode. | | | | | | |
| CO2 | To understand the detailed operation of BJT and calculation of its parameters using transistor models. | | | | | | |
| CO3 | To understand the operation, characteristics & parameters of FET and MOSFET. | | | | | | |
| CO4 | To understand the concept of different types of regulated power supplies and Op-Amp based voltage regulators | | | | | | |

## UNIT-I

**Charge Carriers Transport** : Energy bands in intrinsic and extrinsic silicon; Carrier transport: diffusion current, drift current, mobility and resistivity; Generation and recombination of carriers; Continuity equation, PN Junction: Basic Structure, small signal equivalent circuit of p-n diode, derivation of barrier potential and diode current equation, Simple diode circuits: clipping, clamping and rectifiers, Zener diode and its application as voltage regulator.

### UNIT-II

**Bipolar Junction Transistor:** Basic principle of operation, Current gains : derivation of $\alpha, \beta, \Upsilon$ and their relationship. Various modes of operation of BJT, Base Width Modulation, Transistor hybrid model, h-parameter equivalent circuit of transistor, Analysis of transistor amplifier using h-parameters, calculation of input impedance, output impedance and voltage gain.

### UNIT-III

**Field Effect Devices**: JFET : basic Operation and characteristics, drain and transfer characteristics, pinch off voltage, parameters of JFET: Transconductance ($g_m$), ac drain resistance ($r_d$), amplification factor($\mu$) ,Small Signal Model & Frequency Limitations. MOSFET: basic operation, depletion and enhancement type, pinch-off voltage, Shockley equation and Small Signal Model of MOSFET, MOS capacitor.

### UNIT-IV

**Regulated Power Supplies**: Voltage Regulation, block diagram of DC regulated power supply, Zener diode voltage regulators: transistor series voltage regulator, Transistor shunt voltage regulator, Controlled Transistor Voltage Regulator, Op-Amp Series and shunt voltage regulator.

**Text Books:**

**1.** Millman & Halkias: Integrated Electronics, TMH.
**2.** Boylestad & Nashelsky: Electronic Devices & Circuit Theory, PHI.

**Reference Books:**

**1.** B.G. Streetman, Solid State Electronic Devices, Prentice Hall of India, New Delhi, 1995.
**2.** E S. Yang, Microelectronic Devices, McGraw Hill, Singapore, 1988.
**3.** A.S. Sedra and K.C. Smith, Microelectronic Circuits, Saunder's College Publishing, 1991.
**4.** S Salivahanan and N Naresh Kumar, Electronics devices and circuits, McGraw Hill,1998.

**Note:** Separate paper template will be provided to the paper setter for setting the question paper of end term semester examinations.

| EC-203LA | Electronic Devices Lab | | | | | | |
|---|---|---|---|---|---|---|---|
| **Lecture** | **Tutorial** | **Practical** | **Credit** | **Practical** | **Minor Test** | **Total** | **Time** |
| **-** | **-** | **2** | **1** | **60** | **40** | **100** | **3 Hrs.** |
| **Course Outcomes (CO)** | | | | | | | |
| **CO1** | **To teach the students how to experimentally plot the VI characteristics of various diodes such as p-n diode, zener diode etc. find the threshold voltage and zener breakdown voltage from the VI curve.** | | | | | | |
| **CO2** | **To teach the students how to experimentally find the values of various parameters of Transistor such as voltage gain, current gain etc.** | | | | | | |
| **CO3** | **To teach the students how to plot the input and output characteristics of FET and MOSFET by experimental method.** | | | | | | |
| **CO4** | **To experimentally teach the students the concept of different configurations of regulated power supplies using Zener diodes and Op-Amp.** | | | | | | |

**List of experiments:**

**1.** To study the VI characteristics of p-n diode in forward and reverse bias and find the threshold voltage from the VI curve.
**2.** To study the operation of Zener diode as a voltage regulator.
**3.** To study the operation of half-wave and full wave rectifiers and calculate their ripple factor values.
**4.** To study the operation of series and parallel Clippers using P-N junction diodes.
**5.** To study the operation of clampers using P-N junction diodes.
**6.** To experimentally plot the input and output characteristics of a given BJT transistor in CE configuration and calculate its various parameters.
**7.** To experimentally plot the input and output characteristics of a given BJT transistor in CB configuration and calculate its various parameters.
**8.** To study the transfer and drain characteristics of JFET and calculate its various parameters.
**9.** To study the transfer and drain characteristics of MOSFET and calculate its various parameters.
**10.** To study the different types of negative feedback in two stage amplifier and to observe its effects upon the amplifier parameters.
**11.** To study the Zener diode as a transistor series voltage regulator.
**12.** To study the Zener diode as a transistor shunt voltage regulator.

**Reference Books:**

**1.** Millman & Halkias: Integrated Electronics, TMH.
**2.** Boylestad & Nashelsky: Electronic Devices & Circuit Theory, PHI.

**Note:** Atleast ten (10) experiments from the above list are mandatory to perform for the students.

| EC-205A | Digital Electronics | | | | | | |
|---|---|---|---|---|---|---|---|
| Lecture | Tutorial | Practical | Credit | Major Test | Minor Test | Total | Time |
| 3 | - | - | 3 | 75 | 25 | 100 | 3 Hrs. |
| Course Outcomes (CO) | | | | | | | |
| CO1 | Students will be able to understand the basic logic gates and will be able to apply minimization techniques for reducing a function upto six variables. | | | | | | |
| CO2 | Students will be able to design combinational circuits and applications related to them. | | | | | | |
| CO3 | Students will be able to write the truth table, excitation table, characteristic equations of various flip flops and to design the sequential circuits using Flip flops. | | | | | | |
| CO4 | Students will be able to familiarize with varied memory types and various A/D, D/A Converters and their characteristics. | | | | | | |

**UNIT-I**

**Fundamentals of Digital Systems and Techniques**: Digital signals, AND, OR, NOT, NAND, NOR and Exclusive-OR operations, Boolean algebra, number systems: binary, signed binary, octal, hexadecimal number, binary arithmetic,one's and two's complements arithmetic, Codes:BCD codes, Excess-3, Gray codes, Error detecting and correcting codes: parity check codes and Hamming code

**Minimization Techniques:**Basic postulates and fundamental theorems of Boolean algebra: Standard representation of logic functions: SOP and POS forms, Simplification of switching functions using K-map and Quine-McCluskey tabular methods,Don't care conditions, Digital logic families: TTL, Schottky TTL and CMOS logic, interfacing CMOS and TTL, Tri-statelogic.

**UNIT-II**

**Combinational DigitalCircuits**:Design procedure: Half adder, Full Adder, Half subtractor, Full subtractor , Parallel binary adder, parallel binary Subtractor, Carry Look Ahead adder, Serial Adder/Subtractor, BCD adder, Binary Multiplier, Binary Divider, Multiplexer/ De-multiplexer, decoder, encoder, parity checker, parity generators, code converters, Magnitude Comparator.

**UNIT-III**

**Sequential circuits**: A 1-bit memory, the circuit properties of Bistable latch, the clocked SR flip flop, J- K, T and D types flip flops, applications of flip flops: shift registers, serial to parallel converter, parallel to serial converter, Synchronous and Asynchronous mod counter,FSM, sequence generator and detector.

**UNIT-IV**

**A/D and D/A Converters**: Digital to analog converters: weighted resistor/converter, R-2R Ladder D/Aconverter, specifications for D/A converters, analog to digital converters: quantization and encoding, parallel comparator A/Dconverter, successive approximation A/D converter, specifications for A/D converters

**Semiconductor Memories and Programmable Logic Devices**: Characteristics of memories, read only memory (ROM), read and write memory (RAM), Programmable logic array, Programmable array logic, Introduction to Field Programmable Gate Array (FPGA)

**Text Books:**

**1.** M. M. Mano, "Digital design", Pearson Education India, 2016.
**2.** Donald P. Leach and Albert Paul Malvino, Digital Principles and Applications, 8th Edition, TMH, 2003.
**3.** Taub Schilling, Digital Integrated Electronics, TMH

**Reference Books:**

**1.** A. Kumar, "Fundamentals of Digital Circuits", Prentice Hall India, 2016.
**2.** A.K. Maini, Digital Electronics, Wiley India
**3.** R P Jain, Modern digital electronics, TMH

**Note:** Separate paper template will be provided to the paper setter for setting the question paper of end term semester examinations.

| EC-207LA | Digital Electronics Lab | | | | | | |
|---|---|---|---|---|---|---|---|
| **Lecture** | **Tutorial** | **Practical** | **Credit** | **Practical** | **Minor Test** | **Total** | **Time** |
| **-** | **-** | **2** | **1** | **60** | **40** | **100** | **3 Hrs.** |
| **Course Outcomes (CO)** | | | | | | | |
| **CO1** | **Students will be able to verify truth tables of basic logic gates and design various gates using universal gates.** | | | | | | |
| **CO2** | **Students will be able to design various combinational circuits and verify their operation.** | | | | | | |
| **CO3** | **Students will be able to design different sequential circuits by using flip flops and verify their operation.** | | | | | | |
| **CO4** | **Students will be to study and design various encoders and decoders.** | | | | | | |

**List of experiments:**

**1.** Familiarization with Digital Trainer Kit and associated equipment.

**2.** Study of TTL gates AND, OR, NOT, NAND, NOR, EX-OR, EX-NOR.

**3.** Design and realize a given function using K-Maps and verify its performance.

**4.** To verify the operation of Multiplexer and De-multiplexer.

**5.** To verify the operation of Comparator.

**6.** To verify the truth table of S-R, J-K, T, D Flip-flops.

**7.** To verify the operation of Bi-directional shift register.

**8.** To design and verify the operation of 3-bit asynchronous counter.

**9.** To design and verify the operation of asynchronous Up/down counter.

**10.** To design and verify the operation of asynchronous Decade counter.

**11.** Study of Encoder and Decoder.

**12.** Study of BCD to 7 segment Decoder



**Text Books:**


1. M. M. Mano, "Digital design", Pearson Education India, 2016.
2. Donald P. Leach and Albert Paul Malvino, Digital Principles and Applications, 8th Edition, TMH, 2003.


**Note:** Atleast ten (10) experiments from the above list are mandatory to perform for the students.

| EC-209A | Signals and Systems | | | | | | |
|---|---|---|---|---|---|---|---|
| **Lecture** | **Tutorial** | **Practical** | **Credit** | **Major Test** | **Minor Test** | **Total** | **Time** |
| **3** | **-** | **-** | **3** | **75** | **25** | **100** | **3 Hrs.** |

**Course Outcomes (CO)**

**At the end of this course, students will demonstrate the ability to**

| | |
|---|---|
| **CO1** | **Analyze different types of signals.** |
| **CO2** | **Represent continuous and discrete systems in time and frequency domain using different transforms.** |
| **CO3** | **Understand sampling theorem and its implications.** |

**UNIT-I**

**Introduction to Signals:** Continuous and discrete time signals, deterministic and stochastic signals, periodic and a periodic signals, even and odd signals, energy and power signals, exponential and sinusoidal signals and singular functions. Signal representation in terms of singular functions, orthogonal functions and their use in signal representation

**Introduction to Systems:** Linear and non-linear systems, time invariant and time varying systems, lumped and distributed systems, deterministic and stochastic systems, casual and non-causal systems, analog and discrete/digital memory and memory less systems.

**UNIT-II**

**Random Variables:** Introduction to Random Variables, pdf, cdf, moments, distributions, correlation functions.

**Linear Time Invariant Systems**: Introduction to linear time invariant (LTI) systems, properties of LTI systems, convolution integral, convolution sum, causal LTI systems described by differential and difference equations, Concept of impulse response.

**UNIT-III**

**Discretization of Analog Signals:** Introduction to sampling, sampling theorem and its proof, effect of undersampling, reconstruction of a signal from sampled signal.

**Fourier Series** : Continuous time Fourier series (CTFS), Properties of CTFS, Convergence of Fourier series, Discrete time Fourier Series (DTFS), Properties of DTFS **,** Fourier series and LTI system, Filtering.

**UNIT-IV**

**Fourier Transform:** Continuous Time Fourier Transform (CTFT), Properties of CTFT, Systems characterized by linear constant- coefficient differential equations, Discrete time fourier transform (DTFT), Properties of DTFT, Duality, Systems characterized by Linear constant coefficient difference equations.

**Laplace Transform**: Introduction to Laplace transform, Region of convergence for laplace transform, Inverse laplace transform, Properties oflaplace transform, Analysis and characterization of LTI systems using laplace transform, System function algebra and block diagram representations,Unilateral laplace transform.

**Text Books:**

1. Alan V. Oppenheim, Alan S. Willsky, S. Hamid Nawab, Signals and Systems, Prentice Hall India, 2nd Edition, 2009

Reference Books:

1. Simon Haykins – "Signal & Systems", Wiley Eastern
2. Tarun Kumar Rawat , Signals and Systems , Oxford University Press.
3. H. P. Hsu, "Signals and systems", Schaum's series, McGraw Hill Education, 2010.
4. M. J. Robert "Fundamentals of Signals and Systems", McGraw Hill Education, 2007.
5. B. P. Lathi, "Linear Systems and Signals", Oxford University Press, 2009.

Note: Question paper template will be provided to the paper setter.

| ECE-211LA | Signals & Systems Lab | | | | | | |
|---|---|---|---|---|---|---|---|
| **Lecture** | **Tutorial** | **Practical** | **Credit** | **Practical** | **Minor Test** | **Total** | **Time** |
| **-** | **-** | **2** | **1** | **60** | **40** | **100** | **3 Hrs.** |
| **Course Outcomes (CO)** | | | | | | | |
| **CO1** | **To understand the basic concepts of software.** | | | | | | |
| **CO2** | **To explore properties of various types of signals and systems.** | | | | | | |
| **CO3** | **To explore different properties of signals and systems.** | | | | | | |
| **CO4** | **To understand the concept of sampling in time and frequency domain.** | | | | | | |

**List of experiments:**

1. Introduction of the MATLAB/SciLab/Octave software.
2. To demonstrate some simple signal.
3. To explore the effect of transformation of signal parameters (amplitude-scaling, time-scaling and time- shifting).
4. To visualize the complex exponential signal and real sinusoids.
5. To identify a given system as linear or non-linear.
6. To explore the time variance and time invariance property of a given system.
7. To explore causality and non-causality property of a system.
8. To determine Fourier transform of a signal.
9. To determine Laplace transform of a signal.
10. To demonstrate the time domain sampling of bandlimited signals (Nyquist theorem).
11. To demonstrate the sampling in frequency domain (Discrete Fourier Transform).
12. To demonstrate the convolution and correlation of two continuous-time signals.
13. To demonstrate the convolution and correlation of two discrete-time signals.

**Reference Books:**

**1.** B. P. Lathi, "Linear Systems and Signals", Oxford University Press, 2009.

**2.** Signals and Systems using Scilab, www.scilab.in.

**3.**Signals and Systems using Octave, www.octave.org

**Note:** Atleast ten (10) experiments from the above list are mandatory to perform for the students.

| EC-213A | Network Theory | | | | | | |
|---|---|---|---|---|---|---|---|
| Lecture | Tutorial | Practical | Credit | Major Test | Minor Test | Total | Time |
| 3 | - | - | 3 | 75 | 25 | 100 | 3 Hrs. |
| Course Outcomes (CO) | | | | | | | |
| CO1 | To understand the concept of network topologies and the network analysis in the time domain for solving simple and complex circuits. | | | | | | |
| CO2 | Describe the circuit element models, network analysis using Laplace transform and time domain behavior from the pole-zero plots. | | | | | | |
| CO3 | Describe the characteristics & parameters of two port networks. | | | | | | |
| CO4 | To understand the concept of filters and synthesis of one port networks. | | | | | | |

**UNIT I**

**INTRODUCTION: -** Principles of network topology, graph matrices, Network Analysis (Time-Domain): Singularity Functions, Source-Free RC, RL, Series RLC, Parallel RLC circuits, Initial & Final Conditions, Impulse & Step Response of RC, RL, Series RLC, Parallel RLC circuits.

**UNIT 2**

**NETWORK ANALYSIS (using Laplace Transform): -** Circuit Element Models, Transient Response of RC, RL, RLC Circuits to various excitation signals such as step, ramp, impulse and sinusoidal excitations using Laplace transform.

**NETWORK FUNCTIONS: -** Terminal pairs or Ports, Network functions for one-port and two-port networks, poles and zeros of Network functions, Restrictions on pole and zero Locations for driving point functions and transfer functions.

**UNIT 3**

**CHARACTERISTICS AND PARAMETERS OF TWO PORT NETWORKS: -** Relationship of two-port variables, short-circuit admittance parameters, open circuit impedance parameters, transmission parameters, hybrid parameters, relationships between parameter sets, Inter-connection of two port networks.

**UNIT 4**

**TYPES OF FILTERS AND THEIR CHARACTERISTICS: -** Filter fundamentals, constant-k and m-derived low-pass and high-pass filters.

**NETWORK SYNTHESIS: -** Causality & Stability, Hurwitz Polynomials, Positive real functions, Synthesis of one port networks with two kind of elements.

**TEXT BOOKS:**

1. Fundamentals of Electric Circuits: Charles K. Alexander, Matthew N. O. Sadiku, McGraw Hill Education
2. Network Analysis: M.E. Van Valkenburg, PHI

**REFERENCE BOOKS:**

1. Network Analysis & Synthesis: F. F. Kuo, John Wiley.
2. Circuits & Networks: Sukhija & Nagsarkar, Oxford Higher Education.
3. Basic Circuit Theory: DasoerKuh, McGraw Hill Education.
4. Circuit Analysis: G.K. Mithal, Khanna Publication.

**Note:** Separate paper template will be provided to the paper setter for setting the question paper of end term semester examinations.

| ES-219A | Essentials of Information Technology | | | | | | |
|---|---|---|---|---|---|---|---|
| **Lecture** | **Tutorial** | **Practical** | **Credit** | **Major Test** | **Minor Test** | **Total** | **Time** |
| **3** | **-** | **-** | **3** | **75** | **25** | **100** | **3 Hrs.** |
| **Course Outcomes (CO)** | | | | | | | |
| **CO1** | **Develop basic computational thinking. Learn how to reason with variables, state transitions, conditionals, and iteration** | | | | | | |
| **CO2** | **Understand the notion of data types, and higher order data structures such as lists, tuples, and dictionaries.** | | | | | | |
| **CO3** | **Develop a basic understanding of computer systems -architecture, OS, mobile and cloud computing.** | | | | | | |
| **CO4** | **Learn basic SQL programming** | | | | | | |

**UNIT-I**

**Python Programming**: Familiarization with the basics of Python programming, process of writing a program, running it, and print statements; simple data-types: integer, float, string. The notion of a variable, and methods to manipulate it, Knowledge of data types and operators: accepting input from the console, assignment statement, expressions, operators and their precedence. Conditional statements: if, if-else, if-elsif-else; Notion of iterative computation and control flow: for, while, flowcharts, decision trees and pseudo code

**UNIT-II**

**Idea of debugging**: errors and exceptions; debugging: pdb, break points. Sequence datatype: Lists, tuples and dictionary, Introduce the notion of accessing elements in a collection using numbers and names. Sorting algorithm: bubble and insertion sort; count the number of operations while sorting. Strings: Strings in Python : compare, concat, substring. **Data visualization using Pyplot:** line chart, pie chart, and bar chart.

**UNIT-III**

**Computer Systems and Organisation**: description of a computer system and mobile system, CPU, memory, hard disk, I/O, battery, power. Types of software:Types of Software – System Software, Utility Software and Application Software, how an operating system runs a program, operating system as a resource manager. **Cloud Computing**: Concept of cloud computers, cloud storage (public/private),and brief introduction to parallel computing.

**UNIT-IV**

**Relational databases**: idea of a database and the need for it, relations, keys, primary key, foreign key; use SQL commands to create a table, foreign keys; insert/delete an entry, delete a table. SQL commands: select, project, and join; indexes. Basics of NoSQL databases: Mongo DB

**Text Books:**

**1.** Python Programming: A modular approach by Sheetal Taneja and Naveen Kumar Pearson

**Reference Books:**

**1.** Python Programming - Using Problem Solving Approach by Reema Thareja Oxford Publication.
**2**. Database Management System a Practical Approach by Rajiv Chopra by S. Chand

**Note:** Separate paper template will be provided to the paper setter for setting the question paper of end term semester examinations.

| MC-901A | Environmental Sciences | | | | | | |
|---|---|---|---|---|---|---|---|
| **Lecture** | **Tutorial** | **Practical** | **Credit** | **Major Test** | **Minor Test** | **Total** | **Time** |
| **3** | **0** | **0** | **0** | **75** | **25** | **100** | **3 Hrs.** |
| **Purpose** | To learn the multidisciplinary nature, scope and importance of Environmental sciences. | | | | | | |
| **Course Outcomes (CO)** | | | | | | | |
| **CO1** | The students will be able to learn the importance of natural resources. | | | | | | |
| **CO2** | To learn the theoretical and practical aspects of eco system. | | | | | | |
| **CO3** | Will be able to learn the basic concepts of conservation of biodiversity. | | | | | | |
| **CO4** | The students will be able to understand the basic concept of sustainable development. | | | | | | |

**UNIT 1**

The multidisciplinary nature of environmental studies, Definition, Scope and Importance, Need for public awareness, Natural Resources: Renewable and Non-Renewable Resources: Natural resources and associated problems.

(a) Forest Resources: Use and over-exploitation, deforestation, case studies. Timber eztraction, mining, dams and their effects on forests and tribal people.
(b) Water Resources: Use & over-utilization of surface & ground water, floods, drought, conflicts over water, dams-benefits and problems.
(c) Mineral Resources: Use and exploitation, environmental effects of extracting and using mineral resources, case studies.
(d) Food Resources: World Food Problems, changes caused by agriculture and overgazing, effects of modern agriculture, fertilizer-pesticide problems, water logging, salinity, case studies.
(e) Energy Resources: Growing energy needs, renewable & non-renewable energy sources, use of alternate energy sources. Case studies.
(f) Land Resources: Land as a resource, land, degradation, man induced landslides, soil erosion and desertification.

Role of an individual in conservation of natural resources, Equitable use of resources for sustainable lifestyle.

**UNIT II**

**Ecosystem-Concept of an ecosystem**. Sturcture and function of an ecosystem, Producers, consumers and decomposers, Energy flow in the ecosystem, Ecological Succession, Food Chains, food webs and ecological pyramids. Introduction, types, characteristic features, structure and function of the following ecosystem: (a) Forest Ecosystem, (b) Grassland Ecosystem, (c) Desert Ecosystem and (d) Aquatic Ecosystems (ponds, streams, lakes, rivers, oceans, esturaries

Field Work: Visit to a local area to document Environment assets-river/forest/grassland/hill/mountain, Visit to a local polluted site-Urban /Rural Industrial/Agricultural, Study of common plants, insects and birds, Study of simple ecosystems-pond, river, hill, slopes etc. (Field work equal to 5 lecture hours).

**UNIT III**

**Biodiversity and its conservation:** Introduction, Definition: genetic, species and ecosystem diversity. Biogeographical classification of India. Value of biodiversity: consumptive use, productive use, social, ethical, aesthetic and option values. Biodiversityof global, National and local levels. India as a mega-diversity nation Hot spots of Biodiversity, Threats to biodiversity: Habitat loss, poaching of wild life, man-wildlife conflicts, Endangered and endemic species of India, Conservation of Biodiversity- In situ and Ex-Situ conservation of biodiversity.

**Environmental Pollution Definition:** Cause, effects and control measures of (a) Air Pollution (b) Water Pollution (c) Soil Pollution (d) Marine Pollution (e) Noise Pollution (f) Thermal Pollution (g) Nuclear Hazards

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

**UNIT IV**

**Social Issues and the Environment**. From unsustainable to sustainable development, Urban problems related to energy, Water conservation, rain water harvesting, watershed management. Resettlement and rehabilitation of people: Its problems and concerns, Case Studies: Environmental ethics-issues and possible solutions. Climate change, global warming, acid rain, ozone layer depletion, nuclear accidents and holocaust. Case studies: Wasteland Reclamation, Consumerism and waste products, Environment Protection Act, Air (Prevention and Control of Pollution) Act, Water (Prevention and Control of Pollution) Act, Wildlife Protection Act, Forest Conservation Act, Issues involved in enforcement of environmental legislation, Public Awareness, Human population and the Environment, Population growth, variation among nations, Population explosion-Family Welfare Programme, Environment and human health. Human rights, Value Education, HIV/AIDS, Women and Child Welfare, Role of Information Technology in Environment and Human Health, Case Studies, Drugs and their effects; Useful and harmful drugs, Use and abuse of drugs, Stimulant and depressan drugs, Concept of drug de-addiction, Legal position on drugs and laws related to drugs.

**Suggested Books**


- Environmental Studies- Deswal and Deswal. Dhanpat Rai and Co.
- Environmental Science and Engineering Anandan, P. and Kumaravelan, R. 2009. Scitech Publications (India) Pvt. Ltd., India.
- Environmental Studies. Daniels Ranjit R. J. and Krishnaswamy. 2013. Wiley India.
- Environmental Science- Botkin and Keller. 2012. Wiley , India


**Note: The Examiner will be given the question paper template to set the question paper.**

| BS-207A | APPLIED AND COMPUTATIONAL MATHEMATICS | | | | | | |
|---|---|---|---|---|---|---|---|
| LECTURE | TUTORIAL | PRACTICAL | CREDIT | MAJOR TEST | MINOR TEST | TOTAL | TIME |
| 3 | - | - | 3 | 75 | 25 | 100 | 3 H |
| Purpose | The objective of this course is to familiarize the prospective Engineers with ordinary and partial differential equations, Laplace Transform which allow deterministic mathematical formulations of phenomena in engineering processes and to study numerical methods for the approximation of their solution. More precisely, the objectives are as under: | | | | | | |

| Course Outcomes | |
|---|---|
| CO 1 | To introduce the Ordinary & Partial Differential Equations, its formation and solutions for multivariable differential equations originated from real world problems. |
| CO 2 | To study some extended topics in calculus essential for computations w.r.t. parameter variations ,vectors and field theory. |
| CO 3 | Introduction about the concept of Laplace transform and how it is useful in solving the definite integrals and initial value problems. |
| CO 4 | To introduce the tools of numerical methods in a comprehensive manner those are used in approximating the solutions of various engineering problems. |

**UNIT-1**

## ORDINARY & PARTIAL DIFFERENTIAL EQUATIONS

**ODE:** First order ordinary differential equations: Exact, linear and Bernoulli's equations, Euler's equations, Equations not of first degree: equations solvable for p, equations solvable for y, equations solvable for x and Clairaut's type.

Second order linear differential equations with constant coefficients.

**PDE:** Formation of Partial Differential Equations, Solutions of first order linear and non-linear PDEs, Charpit's method, Solution to homogenous linear partial differential equations (with constant coefficients) by complimentary function and particular integral method.

**UNIT-2**

## ADVANCE CALCULUS

Multivariable Calculus: Multiple Integration: Double integrals (Cartesian), change of order of integration in double integrals, Change of variables (Cartesian to polar and ) Triple integrals (Cartesian), orthogonal curvilinear coordinates, Simple applications involving cubes, sphere .

Vector Calculus: Gradient, divergence and Curl and their properties, Directional derivative. Line integrals, surface integrals, volume integrals, Theorems of Green, Gauss and Stokes (without proof).

**UNIT-3**

## LAPLACE TRANSFORM

Laplace Transform, Laplace Transform of Elementary Functions, Basic properties of Laplace Transform, Laplace transform of periodic functions, finding inverse Laplace transform by different methods, Convolution theorem, solving ODEs by Laplace Transform method.

**UNIT-4**

## NUMERICAL TECHNIQUES

Solution of polynomial and transcendental equations: Bisection method, Newton-Raphson method and Regula-Falsi method, Lagrange's formulae.

Numerical Differentiation using Newton's forward and backward difference formulae, Numerical integration: Trapezoidal rule and Simpson's 1/3rd rule, Taylor's series, Runge-Kutta method for solving first and second order equations.

**Textbooks/References:**


1. Erwin Kreyszig and Sanjeev Ahuja, Applied Mathematics-II, Wiley India Publication, Reprint, 2015.
2. W. E. Boyce and R. C. Di Prima, Elementary Differential Equations and Boundary Value Problems, 9th Edition, Wiley India,
3. S. L. Ross, Differential Equations, 3rd Ed., Wiley India, 1984.
4. E. A. Coddington, An Introduction to Ordinary Differential Equations, Prentice Hall India, 1995.
5. G.F. Simmons and S.G. Krantz, Differential Equations, Tata McGraw Hill, 2007.
6. R. Haberman, Elementary Applied Partial Differential equations with Fourier Series and Boundary Value Problem, 4th Ed., Prentice Hall.
7. Ian Sneddon, Elements of Partial Differential Equations, McGraw Hill, 1964.
8. Manish Goyal and N.P. Bali, Transforms and Partial Differential Equations, University Science Press, Second Edition, 2010.
9. N.P. Bali and Manish Goyal, A text book of Engineering Mathematics, Laxmi Publications, Reprint, 2010.
10. B.S. Grewal, Higher Engineering Mathematics, Khanna Publishers, 35th Edition, 2000.
11. Veerarajan T., Engineering Mathematics, Tata McGraw-Hill, New Delhi, 2008.
12. P. Kandasamy, K. Thilagavathy, K. Gunavathi, Numerical Methods, S. Chand & Company, 2nd Edition, Reprint 2012.
13. S.S. Sastry, Introductory methods of numerical analysis, PHI, 4th Edition, 2005.
14. Erwin Kreyszig, Advanced Engineering Mathematics, 9th Edition, John Wiley & Sons, 2006.


**Note: The Examiner will be given the question paper template to set the questions.**

| EC-202A | Digital Communication | | | | | | |
|---|---|---|---|---|---|---|---|
| **Lecture** | **Tutorial** | **Practical** | **Credit** | **Major Test** | **Minor Test** | **Total** | **Time** |
| **3** | **-** | **-** | **3** | **75** | **25** | **100** | **3 Hrs.** |

| Course Outcomes (CO) | |
|---|---|
| **CO1** | **To learn digitization of analog signal by pulse modulation system and analyze their system performance** |
| **CO2** | **To analyze different baseband transmission schemes and their performance.** |
| **CO3** | **To learn and understand different digital modulation schemes and compute the bit error performance** |
| **CO4** | **To analyze different modulation tradeoffs and different equalization techniques.** |

**UNIT-I**

Pulse modulation.Sampling process. Pulse Amplitude and Pulse code modulation (PCM),Differential pulse code modulation. Delta modulation, Noise considerations in PCM, Time Division multiplexing.Quantization noise in delta modulation, The O/P signal to quantization noise ratio in delta modulation, O/P signal to noise ratio in delta modulation, varients of DM.

**UNIT-II**

Base Band Pulse Transmission: Matched filter and its properties, average probability of symbol error in binary enclosed PCM receiver, Intersymbol interference, Nyquist criterion for distortionless base band binary transmission, ideal Nyquist channel raised cosine spectrum, correlative level coding Duo binary signalling, tapped delay line equalization, adaptive equalization, LMS algorithm, Eye pattern.

**UNIT-III**

Elements of Detection Theory, Optimum detection of signals in noise,Coherent communication with waveforms- Probability of Error evaluations.

Pass band Digital Modulation schemes- ASK, Phase Shift Keying, Frequency Shift Keying,Quadrature Amplitude Modulation, Continuous Phase Modulation and Minimum Shift Keying. Signal space diagram and spectra of the above systems, effect of intersymbol interference, bit symbol error probabilities, synchronization.

**UNIT-IV**

Digital Modulation tradeoffs.Optimum demodulation of digital signals over band-limited channels- Maximum likelihood sequence detection (Viterbi receiver).Equalization Techniques.Synchronization and Carrier Recovery for Digital modulation.

**Text Books:**

**1.**Haykin S., "Communications Systems", John Wiley and Sons, 2001.

**2.**Proakis J. G. and Salehi M., "Communication Systems Engineering", Pearson Education, 2002.

**3.** Taub H. and Schilling D.L., "Principles of Communication Systems", Tata McGraw Hill, 2001.

**Reference Books:**

**1.**Proakis J.G., ``Digital Communications", 4th Edition, McGraw Hill, 2000.

**2.**Lathi B.P., " Modern Digital and Analog Communication", 4th edition, Oxford university Press, 2010

| EC-204LA | COMMUNICATION LAB | | | | | | |
|---|---|---|---|---|---|---|---|
| Lecture | Tutorial | Practical | Credit | Practical | Minor Test | Total | Time |
| - | - | 2 | 1 | 60 | 40 | 100 | 3 Hrs. |
| Course Outcomes (CO)<br>Upon completion of the course, students will be able to | | | | | | | |
| CO1 | Generate and analyze Analog Modulated and demodulated Signals. | | | | | | |
| CO2 | Test & observe the outputs of different types of analog detectors. | | | | | | |
| CO3 | Generate and analyze digital Modulated and demodulated Signals. | | | | | | |
| CO4 | Test & observe the outputs of different types of digital detectors. | | | | | | |

**List of experiments:**

1: To study and Perform Amplitude Modulation & Demodulation.
2: To study and Perform Frequency Modulation and Demodulation.
3: To study and Perform Pulse Amplitude Modulation and Demodulation.
4: To study and Perform Pulse Width Modulation and Demodulation.
5: To study and Perform Pulse Position Modulation and Demodulation.
6: To study and Perform Pulse Code Modulation and Demodulation.
7: To study and Perform Time Division Multiplexing (TDM) system.
8: To study and Perform Amplitude Shift Keying (ASK) Modulation and De- Modulation.
9: To study and Perform Frequency Shift Keying (FSK) Modulation and De-Modulation.
10: To study and Perform Phase Shift Keying (PSK) Modulation and De-Modulation.
11: To study and Perform Quadrature Phase Shift Keying (QPSK) Modulation and De-Modulation.
12: To study and perform Adaptive Delta Modulation and demodulation.
13. To study Base Band Transmission and calculate bit error rate.

**Note: At least ten (10) experiments from the above list are mandatory to perform for the students.**



**Reference Books:**

1. Taub & Schilling, Principles of Communication Systems, McGraw Hill Publications, (1998) 2nd ed.
2. Simon Haykin, Communication Systems, John Wiley Publication, 3rd ed.
3. Sklar, Digital Communications, Prentice Hall-PTR, (2001) 2nd ed.
4. Lathi B. P., Modern Analog and Digital Communication, , Oxford University Press, (1998) 3rd

| EC-206A | Analog Circuits | | | | | | |
|---|---|---|---|---|---|---|---|
| Lecture | Tutorial | Practical | Credit | Major Test | Minor Test | Total | Time |
| 3 | - | - | 3 | 75 | 25 | 100 | 3 Hrs. |
| Course Outcomes (CO) | | | | | | | |
| CO1 | To make the students understand the analysis of various BJT and FET amplifiers using small signal models. | | | | | | |
| CO2 | To teach the students the concept of describe the frequency response of multistage amplifiers and the detailed concept of feedback topologies. | | | | | | |
| CO3 | To make the students learn various oscillator circuits using both Op-Amp and BJT. | | | | | | |
| CO4 | To teach the students the various application circuits of Op-Amp and designing for a given specification. | | | | | | |

**UNIT-I**

**Amplifier Models**: Amplifier types: Voltage amplifier, current amplifier, trans-conductance amplifier and trans-resistance amplifier, comparison based on input impedance and output impedance. Small signal analysis of BJT amplifiers: CE, CB and CC amplifiers using $r_e$ model, small signal analysis of the CS JFET amplifiers, estimation of voltage gain, input resistance, output resistance etc, design procedure for particular specifications of amplifiers.

**UNIT-II**

**Transistor Frequency Response:** Class A, class B, class C amplifiers: calculation of maximum efficiency. Frequency response of the amplifiers: low frequency, mid-frequency and high frequency region. Effect of cascading of amplifiers on the frequency response, cut-off frequencies, Bandwidth and voltage gain. Miller effect, Feedback in amplifiers: Voltage series, current series, voltage shunt, current shunt, effect of feedback on gain, bandwidth, input impedance, output impedance.

**UNIT-III**

**Oscillators:** Barkhausen criterion for oscillators, types of Oscillators: RC phase shift oscillator, Wien bridge oscillator, LC oscillators : Hartley oscillator, Collpit oscillator, derivation of frequency of oscillation for BJT and Op-amp configurations, 555 timer: operation as astable and monostable multivibrator.

**UNIT-IV**

**Op-Amp Applications**: Simple op-amp circuits: adder, subtractor, Schmitt trigger, Differential amplifier: calculation of differential gain, common mode gain, CMRR, OP-AMP design: design of differential amplifier for a given specification, design of gain stages and output stages.



**Text Books:**

**1.** Millman & Halkias: Integrated Electronics, TMH.
**2.** Boylestad & Nashelsky: Electronic Devices & Circuit Theory, PHI.

**Reference Books:**

**1.** B.G. Streetman, Solid State Electronic Devices, Prentice Hall of India, New Delhi, 1995.
**2.** E S. Yang, Microelectronic Devices, McGraw Hill, Singapore, 1988.
**3.** A.S. Sedra and K.C. Smith, Microelectronic Circuits, Saunder's College Publishing, 1991.
**4.** S Salivahanan and N Naresh Kumar, Electronics devices and circuits, McGraw Hill,1998.

**Note:** Separate paper template will be provided to the paper setter for setting the question paper of end term semester examinations.

| EC-208LA | Analog Circuits Lab | | | | | | |
|---|---|---|---|---|---|---|---|
| **Lecture** | **Tutorial** | **Practical** | **Credit** | **Practical** | **Minor Test** | **Total** | **Time** |
| **-** | **-** | **2** | **1** | **60** | **40** | **100** | **3 Hrs.** |
| **Course Outcomes (CO)** | | | | | | | |
| **CO1** | **To design and calculate the gain , frequency response etc. of the various configuration of transistor amplifier.** | | | | | | |
| **CO2** | **To make students Design various RC oscillators using Op-Amp 741 for a given frequency of oscillation.** | | | | | | |
| **CO3** | **To make students Design various RC oscillators using BJT for a given frequency of oscillation.** | | | | | | |
| **CO4** | **To teach the students the design of various Op-Amp circuits such as adder, subtractor etc.** | | | | | | |

**List of experiments:**

1. To design a simple common emitter (CE) amplifier circuit using BJT and find its gain and frequency response. To design a differential amplifier using BJT and calculate its gain and frequency response.
2. To design a BJT emitter follower and determine is gain, input and output impedances.
3. To design and test the performance of Phase shift Oscillator using Op-Amp 741.
4. To design and test the performance of Wien bridge oscillator using Op-Amp 741.
5. To design and test the performance of BJT - RC Phase shift Oscillator for f0 ≤ 10 KHz.
6. To design and test the performance of BJT – Hartley Oscillators for RF range f0 ≥100KHz.
7. To design and test the performance of BJT – Colpitt Oscillators for RF range f0 ≥100KHz.
8. To design an astable multivibrator using 555 timer.
9. To design a monostable multivibrator using 555 timer.
10. To design Schmitt trigger using Op-amp and verify its operational characteristics.
11. To design an adder circuit using Op-Amp to add three dc voltages.
12. To design a subtractor using Op-Amp to subtract DC voltages v1 and v2.

**Reference Books:**

**1**. Millman & Halkias: Integrated Electronics, TMH.
**2**. Boylestad & Nashelsky: Electronic Devices & Circuit Theory, PHI.
**3**. S Salivahanan and N Naresh Kumar, Electronics devices and circuits, McGraw Hill,1998.

**Note:** Atleast ten (10) experiments from the above list are mandatory to perform for the students.

| EC-210A | MICROPROCESSORS AND MICROCONTROLLER | | | | | | |
|---|---|---|---|---|---|---|---|
| **Lecture** | **Tutorial** | **Practical** | **Credit** | **Major Test** | **Minor Test** | **Total** | **Time** |
| **3** | **-** | **-** | **3** | **75** | **25** | **100** | **3 Hrs.** |
| **Course Outcomes (CO)** | | | | | | | |
| **CO1** | **Acquired knowledge about the architecture of Microprocessors and Microcontrollers.** | | | | | | |
| **CO2** | **Acquired knowledge about instruction set and programming concept of Microprocessors and Microcontrollers in assembly and C language.** | | | | | | |
| **CO3** | **To understand peripheral interfacing with Microprocessors and Microcontrollers.** | | | | | | |
| **CO4** | **To design the systems /models based on Microprocessors and Microcontrollers** | | | | | | |

**UNIT-I**

Evolution of Microprocessor, Introduction to 8-bit Microprocessor 8085 architecture, Pin Details 8085 Microprocessor, 8086 Architecture description of data registers, address registers; pointer and index registers, PSW, Queue, BIU and EU, 8086 Pin diagram descriptions. Generating 8086 CLK and reset signals using 8284. WAIT state generation. Microprocessor BUS types and buffering techniques, 8086 minimum mode and maximum mode CPU module, 8086 CPU Read/Write timing diagrams in minimum mode and maximum mode.

**UNIT-II**

8051 Architecture, On-chip memory organization – general purpose registers, SFR registers, Internal RAM and ROM, Oscillator and Clock circuits. Pin Diagram of 8051, I/O Pins, Port, Connecting external memory, Counters and Timers, Purpose of TCON & TMOD registers, Serial data transmission/reception and transmission modes, Purpose of SCON & PCON registers, Different Types of Interrupts, Purpose of Time Delays, 8051 addressing modes.

**UNIT-III**

8086 Instruction format, addressing modes, Data transfer instructions, string instructions, logical instructions, arithmetic instructions, transfer of control instructions; process control instructions. 8051 Data transfer instructions, arithmetic and logical instructions, Jump and Call instructions, I/O port, Timer and Counter programming, Serial port and Interrupt programming, Assembly language programs.

**UNIT-IV**

Memory devices, Address decoding techniques, Interfacing SRAMS; ROMS/PROMS, 8086 Interrupt mechanism; interrupt types and interrupt vector table. Intel's 8255 - description and interfacing with 8086, ADCs and DACs, - types operation and interfacing with 8086.

Interfacing of Matrix Keyboards, ADC, DAC, Temperature Sensor, Stepper Motor with 8051.

**Text Books:**


1. D.V. Hall, Microprocessors and Interfacing, McGraw Hill 2nd ed.
2. Kenneth Ayala," The 8051 Microcontroller" 3rd ed. CENGAGE Learning.
3. M.A. Mazidi, J.G. Mazidi, R. D. McKinlay," The 8051 Microcontroller and Embedded systems using assembly and C" -2nd Ed, Pearson Education.
4. Liu, Gibson, "Microcomputer Systems: The 8086/88 Family", 2nd Edition, PHI,2005.
5. Barry B. Brey, "The Intel Microprocessor8086/8088, 80186", Pearson Education, Eighth Edition, 2009.
6. Uffenback, "The 8086 Family Design" PHI, 2nd Edition.


**Reference Books:**


1. Mke Predko, "Programming and Customizing the 8051 Microcontroller", TMH.
2. Manish K Patel,"Microcontroller based embedded system", McGraw Hill Education.


**Note:** Separate paper template will be provided to the paper setter for setting the question paper of end term semester examinations.

| EC-212LA | MICROPROCESSORS AND MICROCONTROLLER LAB | | | | | | |
|---|---|---|---|---|---|---|---|
| **Lecture** | **Tutorial** | **Practical** | **Credit** | **Practical** | **Minor Test** | **Total** | **Time** |
| **-** | **-** | **2** | **1** | **60** | **40** | **100** | **3 Hrs.** |
| **Course Outcomes (CO)** | | | | | | | |
| **CO1** | **To familiarization with 8085, 8086 Microprocessors and 8051 Microcontrollers.** | | | | | | |
| **CO2** | **Ability to write an assembly language program for 8086 Microprocessors as well as C language program for 8051 Microcontroller.** | | | | | | |
| **CO3** | **Ability to interfacing the various Peripheral to 8086 Microprocessors and 8051 Microcontrollers.** | | | | | | |
| **CO4** | **Ability to design the systems based on 8051 Microcontrollers.** | | | | | | |

**List of experiments to be performed using 8086 and 8051 Microcontrollers**

**For 8086 Microprocessor write an Assembly Language Program to**

1 Add / Sub two 16 bit numbers.
2 Multiply two 16 bit unsigned/ signed numbers.
3 Divide two unsigned/ signed numbers (32/16 , 16/8, 16/16, 8/8 )
4 Find smallest/ largest number from array of n numbers.
5 Arrange numbers in array in ascending/ descending order.
6 Convert Hex to Decimal, Decimal to Hex.
7 Compare two strings using string instructions / without using string instructions.
8 Display string in reverse order, string length, Concatenation of two strings.
9 To find 1's and 2's complement of a number.
10 To find the Fibonacci Series.
11 To find Log of a given number using look up table.
12 To find Factorial of a number.
13 To write an ALP using 8051 Microcontrollers to perform addition, subtraction, multiplication and division of two eight bit numbers.
14 To write an ALP using 8051 Microcontrollers to perform logical operation i.e., AND, OR, XOR and Complement of two eight bit numbers.
15 To write an ALP using 8051 Microcontrollers to perform multi byte addition and subtraction of unsigned number.
16 To write an embedded C program using 8051 Microcontrollers for interfacing LCD to display message "LCD Display" on LCD screen.
17 To write an embedded C program using 8051 Microcontrollers for interfacing keypad to port P0 .Whenever a key is pressed; it should be displayed on LCD.
18 To write an embedded C program using 8051 Microcontrollers for interfacing a switch and a buzzer to two different pins of a Port such that the buzzer should sound as long as the switch is pressed.
19 To write an embedded C program using 8051 Microcontrollers for interfacing stepper motor to rotate clockwise and anticlockwise directions.
20 To write an embedded C program using 8051 Microcontrollers for interfacing relay and buzzer.

**Reference Books:**


1. Kenneth Ayala," The 8051 Microcontroller" 3rd ed. CENGAGE Learning.
2. M.A. Mazidi, J.G. Mazidi, R. D. McKinlay," The 8051 Microcontroller and Embedded systems using assembly and C" -2nd Ed, Pearson Education.


**Note:** Atleast ten (10) experiments from the above list are mandatory to perform for the students.

| EC-214A | ELECTROMAGNETIC FIELD THEORY | | | | | | |
|---|---|---|---|---|---|---|---|
| Lecture | Tutorial | Practical | Credit | Major Test | Minor Test | Total | Time |
| 3 | - | - | 3 | 75 | 25 | 100 | 3 Hrs. |

**UNIT I**

Review: vector analysis in all the three coordinate system, line, surface & volume integrals, gradient, divergence & curl of a vector & their physical significance, Gauss Divergence theorem, Stokes theorem. Gauss law in electrostatics & its applications, uniform line, surface & volume charge distributions, concepts of electric field & electric potentials, electric field & potential due to a linear dipole, method of images.

**UNIT II**

Biot Savart's law, Amperes circuital law & its applications. Boundary conditions for both the electric & magnetic fields at the interface of various types of media. Laplace, Poisson's equation & continuity equation. Faraday's & Lenz's laws, How Maxwell fixed Ampere's law, Maxwell's equations in differential & integral forms & their physical significance in circuit theory, retarded potentials.

**UNIT III**

Plane & uniform plane waves and their properties, waves equations in various media. . Polarisation & its types. Intrinsic impedance, propagation constant. Reflection & refraction of uniform plane waves at the interface of conductor- dielectric & dielectric - dielectric (both normal and oblique incidence). Relaxation time ,skin effect, skin depth & surface impedance, Poynting vector theorem & its physical significance.

**.UNIT IV**

Distributed parameters, circuit parameters, concepts of voltage & current flow on a transmission line, Transmission line equations, characteristic impedance. Reflection of transmission line, maxima & minima, standing wave ratio of a transmission line. Impedance matching, Smith's chart & its computational applications.

Concept of Wave Guide and TE, TM and TEM modes in rectangular and circular wave guide. Cut off and guide wave length.



References:

1. Fields and Waves by D.K. Cheng. (Pearson Education)
2. Electomagnetics by J.D. Krauss(TMGH)
3. Principles of Electomagnetics by Sadiku (Oxford Univ. Press)

| ES -208A | BASICS OF ANALOG COMMUNICATION | | | | | | |
|---|---|---|---|---|---|---|---|
| Lecture | Tutorial | Practical | Credit | Major Test | Minor Test | Total | Time |
| 3 | - | - | 3 | 75 | 25 | 100 | 3 Hrs. |
| Course Outcomes (CO):Upon completion of the course, students will be able to | | | | | | | |
| CO1 | Describe different types of noise and predict its effect on various analog communication systems. | | | | | | |
| CO2 | Understand and analyze various Amplitude modulation and demodulation methods. | | | | | | |
| CO3 | Understand and analyze Angle modulation and demodulation methods. | | | | | | |
| CO4 | Understand the concepts of Transmitters and Receivers and their circuits. | | | | | | |

**Unit-I**

**Communication system and Noise:** Constituents of communication system, Modulation, Bandwidth requirement, Noise, Classification of noise, Resistor noise, Multiple resistor noise sources, Noise Temperature, Noise bandwidth, Noise figure, its calculation and measurement, Bandpass noise representation, Noise calculation in Communication Systems: Noise in Amplitude Modulated System, Noise in angle modulated systems.

**Analog Modulation Techniques**: Theory of amplitude modulation, AM power calculations, AM modulation with a complex wave, Concepts of angle modulation, Theory of frequency modulation, Mathematical analysis of FM, Spectra of FM signals, Narrow band FM, Wide band FM, Phase modulation, Phase modulation obtained from frequency modulation, Comparison of AM, FM & PM.

**Unit-II**

**AM Transmission:** Generation of Amplitude Modulation, Low level and high level modulation, Basic principle of AM generation, Square law modulation, Vander bijl modulation, Suppressed carrier AM generation (Balanced Modulator) ring Modulator.

**AM Reception:** Tuned Ratio Frequency (TRF) Receiver, Super heterodyne Receiver, RF Amplifier, Image Frequency Rejection, Cascade RF Amplifier, Frequency Conversion and Mixers, Tracking & and Alignment, IF Amplifier, AM detectors, Distortion in diode detectors, AM receiver characteristics.

**Unit-III**

**FM Transmission:** FM allocation standards, Generation of FM by direct method, Varactor diode Modulator, Indirect generation of FM, The Armstrong method RC phase shift method, Frequency stabilized reactance FM transmitter, FM stereo transmitter, Noise triangle.

**FM Reception:** Direct methods of Frequency demodulation, Frequency discrimination (Balanced slope detector), Foster seelay of phase discriminator, Ratio detector, Indirect method of FM demodulation, FM detector using PLL, Pre-emphasis / de-emphasis, FM receiver, FM stereo receiver.

**Unit-IV**

**SSB Transmission:** Introduction, Advantages of SSB Transmission, Generation of SSB, The Filter method The Phase Shift Method, The Third Method, Pilot Carrier SSB, Vestigial Side-band Modulation (VSB), VSB-SC, Application of AM and FM in TV transmission.

**SSB Reception:** SSB Product Demodulator, Balanced Modulator as SSB Demodulator, Pilot Carrier SSB Receiver, Modern Communication Receiver.

**Analog Pulse Modulation:** Introduction, Pulse amplitude modulation (PAM), PAM Modulator Circuit, Demodulation of PAM Signals, Pulse Time Modulation (PTM): Pulse Width Modulation (PWM), Pulse Position Modulation (PPM), PWM and PPM Demodulator,

**Text Books**

1. Kennedy, G., Electronic Communication Systems, McGraw-Hill (2008) 4th ed.
2. Lathi.B.P.,Modern Digital and Analog Communications Systems 3rd ed.

**Reference Books:**

1.Taub, H., Principles of Communication Systems, McGraw-Hill (2008) 3rd ed.
2. Haykin, S., Communication Systems, John Willey (2009) 4th ed.
3. Proakis, J. G. and Salehi, M., Fundamentals of Communication Systems, Dorling Kindersley (2008) 2nd ed.
4. Mithal G K, Radio Engineering, Khanna Pub.
5. Singh & Sapre—Communication Systems: 2/e, TMH

**Note:** Separate paper template will be provided to the paper setter for setting the question paper of end term semester examinations.

| MC-902A | Constitution of India | | | | | |
|---|---|---|---|---|---|---|
| **Lecture** | **Tutorial** | **Practical** | **Major Test** | **Minor Test** | **Total** | **Time** |
| **3** | **-** | **-** | **75** | **25** | **100** | **3 Hrs.** |
| **Purpose** | **To know the basic features of Constitution of India** | | | | | |
| **Course Outcomes** | | | | | | |
| **CO1** | **The students will be able to know about salient features of the Constitution of India.** | | | | | |
| **CO2** | **To know about fundamental duties and federal structure of Constitution of India.** | | | | | |
| **CO3** | **To know about emergency provisions in Constitution of India.** | | | | | |
| **CO4** | **To know about fundamental rights under constitution of India.** | | | | | |

**UNIT-I**

1. Meaning of the constitution law and constitutionalism, Historical perspective of the Constitution of India. Salient features and characteristics of the Constitution of India.
2. Scheme of the fundamental rights

**UNIT - II**

3. The scheme of the Fundamental Duties and its legal status. The Directive Principles of State Policy – Its importance and implementation. Federal structure and distribution of legislative and financial powers between the Union and the States.
4. Parliamentary Form of Government in India – The constitution powers and status of the President of India

**UNIT - III**

5. Amendment of the Constitutional Powers and Procedure. The historical perspectives of the constitutional amendments in India.
6. Emergency Provisions: National Emergency, President Rule, Financial Emergency. Local Self Government – Constitutional Scheme in India.

**UNIT-IV**

7. Scheme of the Fundamental Right to Equality. Scheme of the Fundamental Right to certain Freedom under Article 19.

8. Scope of the Right to Life and Personal Liberty under Article 21.



**Text Books**

**1.** Constitution of India. Prof.Narender Kumar (2008) 8th edition. Allahabad Law Agency**.**

**Reference Books:**

**1.** The constitution of India. P.M. Bakshi (2016) 15th edition. Universal law Publishing.

**Bachelor of Technology (Electronics & Communication Engineering) (Credit Based)**
**KURUKSHETRA UNIVERSITY KURUKSHETRA**
**Scheme of Studies/Examination**

**Semester V (w.e.f. session 2020-2021)**

| S.No. | Course No. | Subject | L:T:P | Hours/ Week | Credits | Examination Schedule (Marks) | | | | Duration of Exam (Hrs.) |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | Major Test | Minor Test | Practical | Total | |
| 1 | HM-903A | Soft Skill & Interpersonal Communication | 3:0:0 | 3 | 3 | 75 | 25 | 0 | 100 | 3 |
| 2 | EC-303LA | Electromagnetic Waves Lab | 0:0:2 | 2 | 1 | - | 40 | 60 | 100 | 3 |
| 3 | EC-305A | Computer Organization & Architecture | 3:0:0 | 3 | 3 | 75 | 25 | 0 | 100 | 3 |
| 4 | EC-307A | Information Theory and Coding | 3:0:0 | 3 | 3 | 75 | 25 | 0 | 100 | 3 |
| 5 | EC-309A | Digital Signal Processing | 3:0:0 | 3 | 3 | 75 | 25 | 0 | 100 | 3 |
| 6 | EC-311LA | Digital Signal Processing Lab | 0:0:2 | 2 | 1 | 0 | 40 | 60 | 100 | 3 |
| 7 | ECP* | Program Elective-I | 3:0:0 | 3 | 3 | 75 | 25 | 0 | 100 | 3 |
| 8 | ECO* | Open Elective-I | 3:0:0 | 3 | 3 | 75 | 25 | 0 | 100 | 3 |
| 9 | **EC-313A | Industrial Training-II | 2:0:0 | 2 | - | - | *100 | - | *100 | 3 |
| 10 | ***MC-903A | Essence of Indian Traditional Knowledge | 3:0:0 | 3 | - | 100 | - | 0 | 100 | 3 |
| | | **Total** | | **27** | **20** | **550** | **230** | **120** | **900** | |

*** The course of both Program Elective and Open Elective will be offered at 1/3rd strength or 20 students (whichever is smaller) of the section.**

**EC-313A is a mandatory credit-less course in which the students will be evaluated for the industrial training undergone after 4th semester and students will be required to get passing marks to qualify.

***MC-903A is a mandatory credit-less course in which the students will be required to get passing marks in the major test.

**Bachelor of Technology ( Electronics & Communication Engineering) (Credit Based)**
**KURUKSHETRA UNIVERSITY KURUKSHETRA**
**Scheme of Studies/Examination**

| LIST OF OPEN ELECTIVES (B.TECH. ECE) | | |
|---|---|---|
| **SEM** | **CODE** | **SUBJECT** |
| **V** | ECO-1A | Computer Networks |
| | ECO-2A | Mechatronics |
| | ECO-3A | Electronic Measurement and Instruments |
| | ECO-4A | Renewable Energy Resources |
| MOOC1 | | |

| LIST OF PROGRAM ELECTIVES (B.TECH. ECE) | | |
|---|---|---|
| **SEM** | **CODE** | **SUBJECT** |
| **V** | ECP-1A | Probability Theory & Stochastic Processes |
| | ECP-2A | Speech and Audio Processing |
| | ECP-3A | Introduction to MEMS |
| | ECP-4A | Power Electronics |
| | ECP-5A | VLSI Technology |

| HM-903A | Soft Skills & Interpersonal Communication | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Lecture | Tutorial | Practical | Credit | Major Test | Minor Test | Practical | Total | Time |
| 3 | 0 | 0 | 3 | 75 | 25 | - | 100 | 3 Hrs. |

**Course Outcomes**

At the end of this course students will demonstrate the ability to

| | |
|---|---|
| CO1 | Develop basic understanding of Communication |
| CO2 | Understand the process of communication and speaking |
| CO3 | Develop the Personality concepts and its implementation |
| CO4 | Develop the basic of Group Discussion and interviews |

**Unit-I**

Communication: Introduction Verbal, Non-Verbal, kinesics, proxemics, chronemics, Types of communication, extra personal communication, intrapersonal communication, intrapersonal communication, mass communication, Creativity in communication, Role of communication, flow of Communication and its need, Persuasive communication and negotiation; Time management in Persuasive communication, Importance of Persuasive Communication

**Unit-II**

Barriers in the way of communication, noise, intrapersonal barriers, interpersonal barriers, organizational barriers, Extra personal barriers, Basics of communication: importance of communication, process of communication, objectives and characteristics of communication, Communication skills: Accent, Intonation, Phonetics, Speaking skills, Confidence, clarity, Fluency, Quality, pronunciation

**Unit-III**

Personality Development; what is personality? Role of personality, Heredity, Environment, situation, Basics of personality, Soft skills; Needs and training, Activity in soft skills, Organizational skill; introduction and its need ,basics principles for Organization skills, Stress management; Introduction, Stress at home and office, Stress prevention, analyze the model of stress.

**Unit-IV**

Group discussion, form of Group discussion, strategy for Group discussion, discussing problems and solution, Oral presentation, introduction, planning, Occasion, Purpose, Modes of delivery, Resume making; Purpose of Resume, Resume design and structure, contents in Resume, types of resume, Job interview, introduction, objective of Interview, types of interview, stages of interview, Face to face interview and campus interview

**Text Books:**

1.Technical Communication Principles and Practice by Meenakshi Raman and Sangeeta Sharma by Oxford Publication

**Reference Books:**

1.Personality Development and soft skills by Barun K. Mitra, Oxford Publication
2.Communication Skills For Engineers by C.Muralikrishna and Sunita Mishra, Pearson Pub.

| EC-305A | Computer Organization and Architecture | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Lecture (Hrs.) | Tutorial (Hrs.) | Practical (Hrs.) | Credit | Major Test | Minor Test | Practical | Total | Time |
| 3 | - | - | 3 | 75 | 25 | - | 100 | 3 Hrs. |
| **Course Outcomes**<br>At the end of this course students will demonstrate the ability to | | | | | | | | |
| **CO1** | *To understand the concept of basics of computer hardware & software* | | | | | | | |
| **CO2** | *To understand the concept of control design & processor design* | | | | | | | |
| **CO3** | *To familiarize with the concept of various memory systems.* | | | | | | | |
| **CO4** | *To familiarize with the concept of system organisation.* | | | | | | | |

**UNIT-I**

Basic Structure of Computer Hardware and Software: Introduction to basic computer architecture, register transfer, bus and memory transfers, arithmetic, logic and shift micro operations. Central Processing Unit: Introduction, general register organization, stack organization, instruction formats, addressing modes, data transfer and manipulation, program control, RISC, Macros and Subroutines.

**UNIT-II**

**Control Design:** Micro programmed control, control memory, address sequencing, micro program example, design of control unit, Hardwired Control: design methods, Multiplier Control Unit, CPU Control unit.

**Processor Design:** Decimal arithmetic unit –BCD adder, BCD subtraction, decimal arithmetic operations, Forms of Parallel processing classification of Parallel structures, Array Processors, Structure of general purpose Multiprocessors.

**UNIT-III**

**Memory Organization:**

Memory hierarchy, device characteristics, auxillary memory, associative memory, cache memory, virtual memory, memory management, hardware multiprocessor architectures and their characteristics, interconnection structures, Random access memories: semiconductor RAMS, Serial-access Memories – Memory organization, Main Memory Allocation.

**UNIT-IV**

**System Organization:**

Pipeline and Vector Processing: Parallel processing, pipelining, arithmetic pipeline, instruction pipeline, RISC pipeline, vector processing, array processors, Input-output Organization: Peripheral devices, input-output interface, asynchronous data transfer, modes of transfer, priority interrupt, DMA,

**Text Books:**

1. Morris Mano, “Computer System Architecture”, PHI.
2. J.F. Heys, “Computer Organization and Architecture”, TMH.

**Reference Books:**

1. J. Hennessy and D. Patterson, Computer Architecture A Quantitative Approach, 3rd Ed, Morgan Kaufmann, 2002.

| EC-307A | INFORMATION THEORY AND CODING | | | | | |
|---|---|---|---|---|---|---|
| Lecture (Hrs.) | Tutorial (Hrs.) | Practical (Hrs.) | Major Test | Minor Test | Total | Time |
| 3 | 0 | 0 | 75 | 25 | 100 | 3 Hr. |
| Course Outcomes | | | | | | |
| CO1 | Acquire knowledge to understand the concept of information and entropy | | | | | |
| CO2 | Ability to analyze and understand Shannon's theorem for coding | | | | | |
| CO3 | Foster ability to identify basic errors Calculation of channel capacity | | | | | |
| CO4 | To develop skills to apply coding techniques | | | | | |

**UNIT – I**

Probability, random variables, Probability distribution functions and probability density functions, Expectation, moments, Random Processes, mean and Auto Correlation, Stationary and ergodicity, Information theory : the definition of information, the zero-memory information source, entropy for discrete ensembles; properties of entropy, Shannon's noiseless coding theorem; Encoding of discrete sources,

**UNIT-II**

Properties of codes: Introduction, types of codes: uniquely decodable codes, instantaneous codes, construction of an instantaneous code, Kraft inequality: statement and discussion and Proof, Markov sources; Shannon's noisy coding theorem and converse for discrete channels; Calculation of channel capacity and bounds for discrete channels; Application to continuous channels.

**UNIT – III**

Coding information sources: The average length of a code, Shannon's First Theorem, Finding binary compact codes- Huffman codes, Code efficiency and redundancy; Channels and mutual information: Information channels, Binary symmetric channels, Probability relations in a channel, A priori and A posteriori entropies, Mutual information, properties of mutual information, types of channels: Noiseless, deterministic, Cascaded channels, Channel capacity.

**UNIT – IV**

Channel Coding: Shannon second theorem for Noisy channels, Introduction to error control coding, Types of codes, Maximum Likelihood decoding, Linear block codes, Error detecting and correcting capabilities of a block code, Hamming code, cyclic code, convolutional arithmetic codes.

**Text/Reference Books:**


1. N. Abramson, Information and Coding, McGraw Hill, 1963.
2. M. Mansurpur, Introduction to Information Theory, McGraw Hill, 1987.
3. R.B. Ash, Information Theory, Prentice Hall, 1970.
4. Shu Lin and D.J. Costello Jr., Error Control Coding, Prentice Hall, 1983.

| EC-309A | | Digital Signal Processing | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Lecture (Hrs.) | Tutorial (Hrs.) | Practical (Hrs.) | Credit | Major Test | Minor Test | Practical | Total | Time |
| 3 | - | - | 3 | 75 | 25 | - | 100 | 3 |
| **Course Outcomes**<br>At the end of this course students will demonstrate the ability to | | | | | | | | |
| **CO1** | Obtain Z-transformation of discrete time signals | | | | | | | |
| **CO2** | Obtain DFT and FFT of discrete time signals | | | | | | | |
| **CO3** | Implement structures for different discrete time systems | | | | | | | |
| **CO4** | Design of FIR and IIR digital filters for various applications | | | | | | | |

**Unit-I**

**Discrete Transforms**: Z- transform and its properties, Inversion of Z-transform, One sided Z- transform and solution of differential equations. Analysis of LTI systems in Z-domain, causality, stability, schur-cohn stability test, relationship between Z-transform and Fourier transform.

**Frequency Selective Filters**: All pass filters, minimum-phase, maximum-phase and mixed- phase systems, Goertzel algorithm, Chirp Z-transform, applications of Z-Transform.

**Unit-II**

**Frequency Domain Sampling and DFT**: DTFT, DFT, properties, Linear filtering using DFT, Frequency analysis of signals using DFT, radix 2 and radix-4 FFT, computation of DFT of real sequences.

**Implementation Structures of Discrete Time Systems**: Direct form, cascade form, frequency sampling and lattice structures for FIR systems. Direct forms, transposed form, cascade form parallel form. Lattice and lattice ladder structures for IIR systems.

**Unit-III**

**Design of FIR Filters**: Characteristics of practical frequency selective filters, types of FIR filters, filter design specifications such as peak pass band ripple, minimum stop band attenuation etc., alternation theorem. Design of FIR filters using windowing method, frequency sampling method and Park-McClellan's method. Design of optimum equiripple FIR filters. Comparison of design methods for FIR filters. Effect of finite register length in FIR filter design.

**Unit-IV**

**Design of IIR Filters**: Design of IIR filters from analog filters, Design by approximation of derivatives, Impulse Invariance Method, Bilinear Transformation Method, Least Square Methods. Characteristics of Butterworth, Chebyshev and Elliptical analog filters, Frequency transformations, design of IIR filters in frequency domain.

**Text/Reference Books:**


1. J. G. Proakis and D.G. Manolakis, “Digital Signal Processing: Principles, Algorithms And Applications”, 4th ed. Prentice Hall.
2. A.V. Oppenheim and R. W. Schafer, “Discrete Time Signal Processing”, Prentice Hall, 1989.
3. S. K. Mitra, “Digital Signal Processing: A computer based approach”, McGraw Hill, 2011.
4. L. R. Rabiner and B. Gold, “Theory and Application of Digital Signal Processing”, Prentice Hall, 1992.
5. J. R. Johnson, “Introduction to Digital Signal Processing”, Prentice Hall, 1992.
6. D. J. DeFatta, J. G. Lucas and W. S. Hodgkiss, “Digital Signal Processing”, John Wiley & Sons, 1988.

| ECP-1A | Probability Theory &Stochastic Processes | | | | | | |
|---|---|---|---|---|---|---|---|
| **Lecture** | **Tutorial** | **Practical** | **Credit** | **Major Test** | **Minor Test** | **Total** | **Time** |
| **3** | **-** | **-** | **3** | **75** | **25** | **100** | **3Hr** |
| **Purpose** | **To familiarize the students with the basics of Probability Theory &Stochastic Processes** | | | | | | |
| **Course Outcomes** | | | | | | | |
| **CO1** | **Develop an understanding to the basic concepts of Sets, Probabilities &Random Variables.** | | | | | | |
| **CO 2** | **To understand various distribution functions &bounds.** | | | | | | |
| **CO 3** | **To analyze and appreciate various Random Sequences and theorems.** | | | | | | |
| **CO 4** | **To apply various Random Processes &Power Spectral Density to real life problems.** | | | | | | |

**Unit-I**

Sets and set operations; Probability space; Conditional probability and Bayes theorem; Combinatorial probability and sampling models. Discrete random variables, probability mass function, probability distribution function,example random variables and distributions; Continuous random variables, probability density function, probability distribution function, example distributions

**Unit-II**

Joint distributions, functions of one and two random variables, moments of random variables; Conditional distribution, densities and moments; Characteristic functions of a random variable; Markov, Chebyshev and Chernoff bounds

**Unit-III**

Random sequences and modes of convergence (everywhere, almost everywhere, probability, distribution and mean square); Limit theorems; Strong and weak laws of large numbers, central limit theorem.

**Unit-IV**

Random process. Stationary processes. Mean and covariance functions. Ergodicity, Transmission of random process through LTI. Power spectral density.

**Text Books:**

1. H. Stark and J. Woods, ``Probability and Random Processes with Applications to Signal Processing," ThirdEdition, Pearson Education

2. A. Papoulis and S. Unnikrishnan Pillai, ``Probability, Random Variables and Stochastic Processes," Fourth Edition, McGraw Hill.

**Reference Books:**

1. K. L. Chung, Introduction to Probability Theory with Stochastic Processes, Springer International,
2. P. G. Hoel, S. C. Port and C. J. Stone, Introduction to Stochastic Processes, UBS Publishers
3. S. Ross, Introduction to Stochastic Models, Harcourt Asia, Academic Press.

| ECP-2A | SPEECH and AUDIO PROCESSING | | | | | | |
|---|---|---|---|---|---|---|---|
| **Lecture (Hrs.)** | **Tutorial (Hrs.)** | **Practical (Hrs.)** | **Credit** | **Major Test** | **Minor Test** | **Total** | **Time(Hrs)** |
| **3** | **-** | **-** | **3** | **75** | **25** | **100** | **3** |
| **Course Objectives** | To enlighten the students about the fundamentals of speech and audio processing. | | | | | | |
| **Course Outcomes**<br>At the end of this course the student should be able to | | | | | | | |
| **CO1** | Mathematically model the speech signal | | | | | | |
| **CO2** | Analyze the quality and properties of speech signal. | | | | | | |
| **CO3** | Modify and enhance the speech and audio signals. | | | | | | |
| **CO4** | To understand various speed coding standards. | | | | | | |

**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.

Speech Signal Processing- Pitch-period estimation, all-pole and all-zero filters,convolution; Power spectral density, periodogram, autoregressive model, autocorrelation estimation.

**Unit-II**

Linear Prediction of Speech- Basic concepts of linear prediction; LinearPrediction Analysis of non-stationary signals –prediction gain, examples; Levinson-Durbin algorithm; Long term and short-term linear prediction models; Moving average prediction.

Speech Quantization- Scalar quantization–uniform quantizer, optimum quantizer,logarithmic quantizer, adaptive quantizer, differential quantizers; Vector quantization – distortion measures, codebook design, codebook types.

**Unit-III**

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.

Linear Prediction Coding- LPC model of speech production; Structures of LPCencoders and decoders; Voicing detection; Limitations of the LPC model.

**Unit-IV**

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.

**Text/Reference 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.

| ECP-3A | Introduction to MEMS | | | | | | |
|---|---|---|---|---|---|---|---|
| **Lecture (Hrs.)** | **Tutorial (Hrs.)** | **Practical (Hrs.)** | **Major Test** | **Minor Test** | **Total** | **Time** | **Credit** |
| **3** | **0** | **0** | **75** | **25** | **100** | **3 Hr.** | **3** |
| **Course Outcomes** | | | | | | | |
| **CO1** | **Students will be using knowledge of mathematics, science, and engineering to understand various MEMS devices.** | | | | | | |
| **CO2** | **Students be able to Appreciate the underlying working principles of MEMS and NEMS devices.** | | | | | | |
| **CO3** | **Understanding basic principles of bulk micromachining and clean rooms practices** | | | | | | |
| **CO4** | **Understand Design and model of MEM devices.** | | | | | | |

UNIT-I

Introduction: MEMS definition, classification of MEMS, Historical Background, Established applications of MEMS, modern MEMS applications, Miniaturization issues, Micro/Nano Sensors, Actuators and Systems overview, Multidisciplinary nature of MEMS – principles and examples of Micro sensors and micro actuators.

UNIT-II

Scaling laws in miniaturization - scaling advantages and issues, influence of scaling on material properties, scaling in mechanical systems, scaling in fluidic systems, scaling chemical and biological systems, scaling in heat conducting and heat convection.

UNIT-III

Basic MEMS fabrication methods: MEMS Fabrication Methods, Oxidation, Deposition Techniques, Photolithography, Materials for Micromachining, Substrates, additive Films and Materials, Bulk Micromachining, Wet Etching Dry Etching, Surface Micromachining, Fusion Bonding, High-Aspect-Ratio-Micromachining, LIGA, Laser Micromachining, Computer Aided Design, Assembly and System Integration, Multi-Chip Modules, Passivation and Encapsulation,

UNIT-IV

Mechanics of solids in MEMS/NEMS: Stresses, Strain, Hookes's law, Poisson effect, Linear Thermal Expansion, Bending; Energy methods, Overview of Finite Element Method, Modeling of Coupled Electromechanical Systems.

**Text/Reference Book:**

1. G. K. Ananthasuresh, K. J. Vinoy, S. Gopalkrishnan K. N. Bhat, V. K. Aatre, Micro and Smart Systems, Wiley India, 2012.
2. S. E.Lyshevski, Nano-and Micro-Electromechanical systems: Fundamentals of Nano-and Microengineering (Vol. 8). CRC press, (2005).
3. S. D. Senturia, Microsystem Design, Kluwer Academic Publishers, 2001.
4. M. Madou, Fundamentals of Microfabrication, CRC Press, 1997.

| ECP-4A | POWER ELECTRONICS | | | | | | |
|---|---|---|---|---|---|---|---|
| **Lecture (Hrs.)** | **Tutorial (Hrs.)** | **Practical (Hrs.)** | **Major Test** | **Minor Test** | **Total** | **Time** | **Credit** |
| **3** | **0** | **0** | **75** | **25** | **100** | **3 Hr.** | **3** |
| **Course Outcomes** | | | | | | | |
| **CO1** | **Acquire knowledge about Build and test circuits using power devices such as SCR** | | | | | | |
| **CO2** | **Ability to analyze Analyze and design controlled rectifier, DC to DC converters, DC to AC inverters** | | | | | | |
| **CO3** | **Foster ability to Learn how to analyze these inverters and some basic applications** | | | | | | |
| **CO4** | **To develop skills to build, and Design SMPS.** | | | | | | |

**UNIT-I**

Characteristics of Semiconductor Power Devices: Thyristor, power MOSFET and IGBT : structure, Characteristics, operation, Brief introduction to power devices: TRIAC, MOS controlled thyristor (MCT), Thyristor Triggering circuit, Thyristor commutation circuit, Uses and design of snubber circuits for thyristor, power MOSFETs and IGBT. Fast recovery diodes and schottky diodes.

**UNIT-II**

Rectifiers types: Controlled and Uncontrolled Rectifiers: Single phase: Study of semi and full bridge converters for R, RL, RLE loads. Analysis of load voltage, load current and derivation of load form factor and ripple factor, Effect of source impedance on the performance of the controlled rectifiers, Analysis of three phase half wave controlled rectifiers with R load, Analysis of three phase half wave controlled rectifiers with R load.

**UNIT-III**

Choppers: Quadrant operations of Type A, Type B, Type C, Type D and type E choppers, Control strategies for choppers, Detailed analysis of Type A chopper. Step up chopper. Inverters: Types of inverters, operating principle, Single phase half bridge inverter, Single phase full bridge inverter.

**UNIT-IV**

AC Voltage Controllers: Types of AC voltage controllers: symmetrical and asymmetrical controllers, Principle of phase control, ON-OFF control, Single phase ac voltage controller with R load. Cycloconverters: Principle of cycloconverter operation, step up and step down cycloconverters, Output voltage equation for a cycloconverter, Applications: Switching Power Supplies, SMPS, UPS.

Text /Reference Books:

1. Muhammad H. Rashid, “Power electronics” Prentice Hall of India.
2. Ned Mohan, Robbins, “Power electronics”, edition III, John Wiley and sons.
3. P.C. Sen., “Modern Power Electronics”, edition II, Chand& Co.
4. V.R.Moorthi, “Power Electronics”, Oxford University Press.
5. Cyril W., Lander,” Power Electronics”, edition III, McGraw Hill.

| ECP-5A | VLSI Technology | | | | | | |
|---|---|---|---|---|---|---|---|
| **Lecture (Hrs.)** | **Tutorial (Hrs.)** | **Practical (Hrs.)** | **Major Test** | **Minor Test** | **Total** | **Time** | **Credit** |
| **3** | **0** | **0** | **75** | **25** | **100** | **3 Hr.** | **3** |
| **Course Outcomes** | | | | | | | |
| **CO1** | **Students will be able estimate oxide thickness, growth rate, etch rate, deposition rate, and perform pattern etching etc. using knowledge of mathematics, science, engineering and practices.** | | | | | | |
| **CO2** | **Students can design and conduct experiments such as oxidation, metallization and analyze growth / deposition rate, thickness etc.** | | | | | | |
| **CO3** | **Shall be able to understand system, design such as CVD reactor, PVD chamber etc.** | | | | | | |
| **CO4** | **Understanding of fabrication sequence of CMOS and NMOS , PMOS Integrated circuits.** | | | | | | |

**UNIT-I**

Crystal growth: monolithic and hybrid ICs, crystal growth, Czochralski technique of crystal growth, wafer preparation and specifications, defects, measurements of parameters of crystals, Fabrication steps, Oxidation: Theory of growth of Silicon dioxide layer, oxidation kinetics, Dry, wet and high pressure oxidation, plasma oxidation, properties of oxidation, defects induced due to oxidation.

**UNIT -II**

Epitaxial process: Epitaxy and its concept, Growth kinetics of epitaxial growth, Low temperature epitaxy, growth chemistry of Si epitaxial layer, apparatus for epitaxial layer, MBE system Diffusion process: Diffusion models of solid, Fick's theory of diffusion, Solution of Fick`s law, diffusion parameters measurements, Ion implantation: Scattering phenomenon, range theory, channeling, implantation damage, ion implantation systems, Annealing.

**UNIT-III**

Lithography: Optical and non-optical lithography, electron, X-ray and ion-beam lithography, contact/proximity and projection printers, alignment. Photoresist and Etching: Types of photoresists, polymer and materials, Etching- Dry & Wet etching, basic regimes of plasma etching, reactive ion etching and its damages, lift-off, and sputter etching.

**UNIT-IV**

Metallization: Applications and choices, physical vapor deposition, patterning, VLSI process fabrication steps: PMOS, NMOS and CMOS IC technology, Packaging : Package types, packaging design consideration, VLSI assembly technologies. Yield and reliability in VLSI.

SUGGESTED BOOKS:

1. S.M. SZE, VLSI Technology , McGraw Hill. 2009, 2nd Edition
2. S. K. Gandhi, VLSI Fabrication Principles, Wiley, 2nd edition
3. S.A. Campbell, The Science and Engineering of Microelectronic Fabrication ,Oxford 2008,2nd edition
4. Sedra & Smith, Microelectronic Circuits 2004, Oxford, 5th edition
5. J.D. Plummer, Silicon VLSI Technology: Fundamentals, Practice, and Modeling, Pearson.

| ECO-1A | | Computer Networks | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Lecture (Hrs.) | Tutorial (Hrs.) | Practical (Hrs.) | Credit | Major Test | Minor Test | Practical | Total | Time |
| 3 | - | - | 3 | 75 | 25 | - | 100 | 3 Hrs |
| Purpose | To familiarize the students with the concepts of basic computer networks used in communication. Also familiarize the students with the various layers of OSI and TCP/IP model. | | | | | | | |
| | Course Outcomes | | | | | | | |
| CO1 | To understand the concept of basics of computer networks and physical layer& media. | | | | | | | |
| CO2 | To understand the concept and processes of data link layer and medium access sublayer. | | | | | | | |
| CO3 | To familiarize with the concept and design issues of network, transport & session layer and presentation layer. | | | | | | | |
| CO4 | To familiarize with the concept and protocols of application layer. | | | | | | | |

**Unit – I**

**Introduction:** Introduction to Computer Networks, Protocols and standards, Network Models: The OSI Model, TCP/IP protocol suite, Introduction to addressing.

**Physical Layer and Media:** Guided &Unguided media,Circuit Switching and Packet Switching, The TelephoneSystem, ATM.

**Unit -II**

**The Data Link Layer:** Data Link Layer Design issues,Data link control: Framing, Flow & Error control, Noiseless channels, Noisy channels, HDLC, Point to Point protocols.

**The Medium Access Sublayer:** Aloha Protocols, LAN Protocols: wired LAN's, Wireless LAN.

**Unit -III**

**Network Layer:** Forwarding, Flow Control, Error Control, Multicast routing, IPv4 addresses, IPv6 addresses, internetworking, SNMP, ARP

**Transport & Session Layer, Presentation Layer:** Flow Control and Congestion Control at the Transport Layer,Transmission Control Protocol – Basic Features, TCP Congestion Control, cryptography

**Unit-IV**

**Application Layer:** Design issues, file transfer, access and management, electronic mail, WWW & HTTP .

**Text Books:**

1. Forouzan B.A, Data Communications and Networking, Tata-Mc-Graw Hill.
2. Tanenbaum A.S, Computer Networks, PHI.

**Reference Books:**

1. Stallings W, Data and Computer Communications, PHI.
2. Leon –Garcia, Computer Networks, Mc Graw Hill

| ECO-2A | MECHATRONICS | | | | | | |
|---|---|---|---|---|---|---|---|
| Lecture (Hrs.) | Tutorial (Hrs.) | Practical (Hrs.) | Credit | Major Test | Minor Test | Total | Time(Hrs) |
| 3 | - | - | 3 | 75 | 25 | 100 | 3 |

**Course Outcomes**

The Objective of this course is to make the students aware about Mechanical and Electronic Instruments together for different applications. This course will help students to build the fundamental concepts of inter disciplinary problems. **At the end of this course the student should be able**

| | |
|---|---|
| **CO1** | To understand Mechatronics System and its applications. |
| **CO2** | To understand the operations of different Sensors and Transducers and their applications. |
| **CO3** | To understand the Electrical and Mechanical Actuation Systems operations and their uses. |
| **CO4** | To understand the basic structure of PLC and its applications and designing examples of Mechatronics Systems. |

**UNIT-I**

**INTRODUCTION TO MECHATRONICS**: Definition, Evolution, Scope, Mechatronics Design Elements, Examples, and Applications; Measurement Systems; Control Systems: Open and Close Loop Systems, Block Diagram of Feedback Control System.

**UNIT-II**

**TRANSDUCERS AND SENSORS:** Transduction Principle, Classification of Transducers, Selection Parameters, Resistive, Inductive, Capacitive, Piezoelectric, Photoelectric, Measurement of Flow and Level; Sensors: LVDT, LMDT, Proximity, Force, Pressure, Pneumatic, Light, Touch and Tactile, Ultrasonic and Voice Recognition etc.

**UNIT-III**

**ACTUATORS**: Actuator Types and Application Areas, Electromechanical Actuators, Electrical Actuators : Servo and Stepper Motors; Pneumatic and Hydraulic Actuators, Piezoelectric Actuators, Magnetostrictive actuators, Memory-metal Actuators, Ion-exchange Polymer-metal Composite; Mechanical Actuators: Mechanism, Kinematics Chains, Bearings, Belt Drives, Chains and Chain Drives, Pulleys, Cams and Gears.

**UNIT-IV**

**PLC AND MECHATRONIC SYSTEM DESIGN:** Microprocessors, Microcontrollers; PLC**:** Introduction, Basic Structure, Input/Output Processing, Programming, Mnemonics, Timers, Internal Relays and Counters, Data Handling, Analog Input/Output, Selection of a PLC, Advantages and Uses; Design of Mechatronic Systems: Mechatronics design elements, Embedded system, MEMS, Robotics; Description of Designing a Mechatronic System: Automatic Camera, Washing Machine and List of some other Mechatronic Systems.

***Text Books:***


1. *R. K. Rajput, "A Textbook of Mechatronics", S. Chand & Company Pvt. Ltd, 2015.*
2. *Nitaigour Premchand Mahalik, "Mechatronics Principles, Concepts and Applications", Tata McGraw-Hill publishing company Ltd, 2003.*
3. *M.D.Singh & J.G. Joshi, " Mechatronics" , PHI Learning Private Limited, 2015.*


***Reference Books:***


1 *Devdas Shetty & Richard A.Kolk, "Mechatronics System Design", PWS Publishing Company (Thomson Learning Inc.).*

2 *William Bolton, "Mechatronics Electronics Control systems in Mechanical andElectrical Engineering", Prentice Hall.*

| ECO- 3A | Electronic Measurement and Instruments | | | | | | |
|---|---|---|---|---|---|---|---|
| **Lecture** | **Tutorial** | **Practical** | **Credit** | **Major Test** | **Minor Test** | **Total** | **Time** |
| **3** | **0** | **0** | **3** | **75** | **25** | **100** | **3 Hr.** |
| **Purpose** | **To familiarize the students with the concepts of Electronics Measurements like measurement of voltage, current & resistance etc.** | | | | | | |
| **Course Outcomes** | | | | | | | |
| **CO1** | **Students will learn the techniques of measurement of resistance using different bridges** | | | | | | |
| **CO2** | **AC Bridges & Voltage Indicating & Recording Devices will be introduced to the students** | | | | | | |
| **CO3** | **Students will be able to recognize the functioning of different Analog & Digital Instruments** | | | | | | |
| **CO4** | **Transducers & Data Acquisition Systems will be introduced to the students** | | | | | | |

**Unit-I**

**Measurement and Error:** Functional elements and generalized configuration of a measuring Instrument, Characteristics of instruments, errors in measurements and their statistical analysis.

**Measurement of Resistance:** Wheat stone bridge, Carey-Foster Bridge, Kelvin double bridge, Measurement of Insulation resistance.

**Unit-II**

**Bridges:** Maxwell Inductance bridge. Maxwell Inductance Capacitance Bridge, Anderson's Bridge, Hay's Bridge, De-Sauty's Bridge, Schering's bridge and Wein's bridge.

**Voltage Indicating and Recording Devices:** Analog voltmeters and Potentiometers, Self balancing potentiometer and X-Y recorders, Galvanometers - Oscillographs, Cathode - Ray Oscilloscopes, Magnetic Tape Recorders.

**Unit-III**

**Electronic Instruments:** Wave analyzer, Distortion meter: Q-meter. Measurement of Op-Amp parameters.

**Digital Instruments:** Digital Indicating Instruments, Comparison with analog type, digital display methods, digital methods of time and frequency measurements, digital voltmeters.

**Unit-IV**

**Transducers:** Classification of Transducers, Strain Gauge, Displacement Transducers - Capacitive Transducers, LVDT, Piezo-electric Transducers, Temperature Transducers – resistance thermometer, Thermocouples and Thermistors, Liquid level measurement Low pressure (vacuum) measurement.

**Data Acquisition Systems:** A to D and D to A converters, Analog and Digital Data Acquisition Systems, Multiplexing, Spatial Encoders, Telemetry.

**Text Book:**

1. A Course in Electrical and Electronics Measurements and Instrumentation: A.K. Sawhney; Dhanpat Rai & Sons.

**Reference Books:**

1. Electronics Instrumentation and Measurement Techniques: Cooper W.D & Helfrick A.D.; PHI Doeblin E.O., Measurement Systems: Application & Design, Mc Graw Hill.

| ECO-4A | Renewable Energy Resources | | | | | | |
|---|---|---|---|---|---|---|---|
| **Lecture** | **Tutorial** | **Practical** | **Credit** | **Major Test** | **Minor Test** | **Total** | **Time** |
| **3** | **-** | **-** | **3** | **75** | **25** | **100** | **3 Hour** |
| **Course Outcomes** | | | | | | | |
| **CO 1** | **To understand the energy demand of world, nation and available resources to fulfill the demand** | | | | | | |
| **CO 2** | **To know about the conventional energy resources and their effective utilization** | | | | | | |
| **CO 3** | **To acquire the knowledge of modern energy conversion technologies** | | | | | | |
| **CO 4** | **To be able to understand and perform the various characterization techniques of fuels** | | | | | | |
| **CO5** | **To be able to identify available nonconventional (renewable) energy resources and techniques to utilize them effectively.** | | | | | | |

## Unit-I

**Introduction:** Energy demand of world and country and gap analysis, Fossil fuel based systems, Impact of fossil fuel based systems, Non conventional energy – seasonal variations and availability, Renewable energy– sources and features, Hybrid energy systems. Distributed energy systems and dispersed generation (DG).

## Unit-II

**Solar thermal systems:** Solar radiation spectrum, Radiation measurement , Technologies, Applications, Heating, Cooling, Drying, Distillation, Power generation; Costing : Life cycle costing (LCC),Solar thermal system

Solar Photovoltaic systems ,Operating principle, Photovoltaic cell concepts ,Cell, module, array, Series and parallel connections, Maximum power point tracking, Applications ,Battery charging, Pumping , Lighting,Peltier cooling , Costing: Life cycle costing ,Solar PV system

## Unit-III

**Microhydel**: Operating principle, Components of a microhydel power plant, Types and characteristics of turbines, Selection and modification, Load balancing, Costing: Life cycle costing –Microhydel Wind ; Wind patterns and wind data, Site selection, Types of wind mills , Characteristics of wind generators, Load matching, Life cycle costing - Wind system LCC.

## Unit-IV

**Biomass**: Learning objectives, Operating principle, Combustion and fermentation, Anaerobic digester, Wood gassifier, Pyrolysis, Applications, Bio gas, Wood stoves, Bio diesel, Combustion engine, Life cycle costing - Biomass system LCC

Hybrid Systems, Need for Hybrid Systems, Range and type of Hybrid systems, Case studies of Diesel-PV, Wind-PV, Microhydel-PV, Biomass-Diesel systems, electric and hybrid electric vehicles

**Suggested Books**:


1. Ashok V Desai, Non-Conventional Energy, Wiley Eastern Ltd, New Delhi, 2003
2. Mittal K M, Non-Conventional Energy Systems, Wheeler Publishing Co. Ltd, New Delhi,2003
3. Ramesh R & Kumar K U, Renewable Energy Technologies, Narosa Publishing House, New Delhi, 2004
4. Wakil MM, Power Plant Technology, Mc Graw Hill Book Co, New Delhi, 2004.

| **EC-303LA** | **Electromagnetic Waves Lab** | | | | | | |
|---|---|---|---|---|---|---|---|
| Lecture | Tutorial | Practical | Credit | Major Test | Minor Test | Total | Time |
| | | 3 | 1.5 | 40 | 60 | 100 | 3 Hour |
| Purpose | To give the students an idea about the study and analysis of components used in Microwave Engineering | | | | | | |
| Course Outcomes | | | | | | | |
| *CO1* | *Students will learn the steps to analyze electric field behavior.* | | | | | | |
| CO2 | *Students will be able to characterize standing wave ration and reflection Coefficient.* | | | | | | |
| CO3 | *Students will learn the steps to analyze types of waveguide.* | | | | | | |
| CO4 | *Students will be able to find the unknown impedances in a transmission line.* | | | | | | |

**List of Experiments:**

1. Measurement of Electric Field between Parallel Conductors.
2. To Determine Electric Field Pattern between Two Circular Electrodes.
3. Experimentally determine the standing wave ration and reflection Coefficient in a transmission line.
4. Measurement of Dielectric Constant.
5. Design & Characterization of Rectangular Waveguide for dominant mode using HFSS.
6. Experimentally determine the frequency & Wavelength in a rectangular waveguide working in $TE_{10}$ mode using microwave bench.
7. Design & Characterization of Circular Waveguide using HFSS.
8. Design & Characterization of Microstrip Line using HFSS.
9. To measure unknown impedance with Smith Chart.
10. Desgin & Characterization of Microstrip line using simulation software.

| EC-311LA | Digital Signal Processing Lab | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Lecture (Hrs.) | Tutorial (Hrs.) | Practical (Hrs.) | Credit | Major Test | Minor Test | Practical | Total | Time |
| - | - | 2 | 1 | - | 40 | 60 | 100 | 3 |
| **Course Outcomes**<br>At the end of this course students will demonstrate the ability to | | | | | | | | |
| **CO1** | Plot different discrete time signals | | | | | | | |
| **CO2** | Verify the aliasing effects | | | | | | | |
| **CO3** | Design digital FIR filters for various applications | | | | | | | |
| **CO4** | Design digital IIR filters for various applications | | | | | | | |

**List of Experiments**

1. Write a program to plot the following functions: a) impulse function b) unit step c) unit ramp d) exponential and e) sinusoidal
2. Write a program to plot real part, imaginary part, magnitude and phase spectra of an exponential function.
3. Study the aliasing effect by using a sinusoidal signal. Show the plots of' continuous time signal, sampled signal and reconstructed signals by using subplot.
4. Write a program to compute and plot the convolution of two signals.
5. Define a function to compute the Z-transform of a finite length signal.
6. Verify the properties of Discrete Fourier Transform (DFT).
7. Study of different window functions available for design of FIR filters.
8. Design of FIR filters by using windowing method.
9. Design of equiripple FIR filter.
10. Study of magnitude and phase response of Butterworth, Chebyshev and Elliptic filters.
11. Design of IIR filters by using different analog filter approximation method.

| MC-903A | ESSENCE OF INDIAN TRADITIONAL KNOWLEDGE | | | | | | |
|---|---|---|---|---|---|---|---|
| Lecture | Tutorial | Practical | Credit | Major Test | Minor Test | Total | Time |
| 3 | 0 | 0 | 0 | 100 | - | 100 | 3 Hrs. |
| Purpose | To understand the values of Indian tradition. | | | | | | |
| Course Outcomes | | | | | | | |
| CO1 | Students will be able to understand the concept of Traditional knowledge and its importance | | | | | | |
| CO2 | Students will be able to know the need and importance of protecting traditional knowledge. | | | | | | |
| CO3 | Students will be able to know the various enactments related to the protection of traditional knowledge. | | | | | | |
| CO4 | Students will be able to understand the concepts of Intellectual property to protect the traditional knowledge. | | | | | | |

**UNIT-I**

**INTRODUCTION TO TRADITIONAL KNOWLEDGE** Define traditional knowledge, nature and characteristics, scope and importance, kinds of traditional knowledge, the physical and social contexts in which traditional knowledge develop, the historical impact of social change on traditional knowledge systems. Indigenous Knowledge (IK), characteristics, traditional knowledge vis-à-vis indigenous knowledge, traditional knowledge Vs western knowledge traditional knowledge vis-à-vis formal knowledge.

**UNIT-II**

**PROTECTION OF TRADITIONAL KNOWLEDGE**

Protection of traditional knowledge: The need for protecting traditional knowledge Significance of TK Protection, value of TK in global economy, Role of Government to harness TK.

**LEGAL FRAMEWORK AND TK**

A: The Scheduled Tribes and Other Traditional Forest Dwellers (Recognition of Forest Rights) Act, 2006, Plant Varieties Protection and Farmer's Rights Act, 2001 (PPVFR Act); B: The Biological Diversity Act 2002 and Rules 2004, the protection of traditional knowledge bill, 2016. Geographical indicators act 2003

**UNIT-III**

**TRADITIONAL KNOWLEDGE AND INTELLECTUAL PROPERTY**

Systems of traditional knowledge protection, Legal concepts for the protection of traditional knowledge, Certain non IPR mechanisms of traditional knowledge protection, Patents and traditional knowledge, Strategies to increase protection of traditional knowledge, global legal FORA for increasing protection of Indian Traditional Knowledge.

**UNIT-IV**

**TRADITIONAL KNOWLEDGE IN DIFFERENT SECTORS:**

Traditional knowledge and engineering, Traditional medicine system, TK and biotechnology, TK in agriculture, Traditional societies depend on it for their food and healthcare needs, Importance of conservation and sustainable development of environment, Management of biodiversity, Food security of the country and protection of TK. 139

**Text Books:**


1. Environmental Studies- Deswal and Deswal. Dhanpat Rai and Co.
2. Environmental Science and Engineering Anandan, P. and Kumaravelan, R. 2009. Scitech Publications (India) Pvt. Ltd., India.
3. Environmental Studies. Daniels Ranjit R. J. and Krishnaswamy. 2013. Wiley India.
4. Environmental Science- Botkin and Keller. 2012. Wiley, India


**Reference Books:**


1. Traditional Knowledge System in India by Amit Jha Atlantic publishers, 2002.
2. "Knowledge Traditions and Practices of India" Kapil Kapoor1, Michel Danino

**Bachelor of Technology (Electronics & Communication Engineering) (Credit Based)**
**KURUKSHETRA UNIVERSITY KURUKSHETRA**
**Scheme of Studies/Examination**
**Semester VI (w.e.f. session 2020-2021 )**

| S. No. | Course No. | Subject | L:T:P | Hours/ Week | Credits | Examination Schedule (Marks) | | | | Duration of Exam (Hrs.) |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | Major Test | Minor Test | Practical | Total | |
| 1 | HM-901A | Organizational Behavior | 3:0:0 | 3 | 3 | 75 | 25 | 0 | 100 | 3 |
| 2 | EC-302A | Control System Engineering | 3:0:0 | 3 | 3 | 75 | 25 | 0 | 100 | 3 |
| 3 | EC-304LA | Control System Engineering Lab | 0:0:3 | 3 | 1.5 | - | 40 | 60 | 100 | 3 |
| 4 | EC-306A | Verilog HDL | 3:0:0 | 3 | 3 | 75 | 25 | 0 | 100 | 3 |
| 5 | EC-308LA | Verilog HDL Lab | 0:0:3 | 3 | 1.5 | - | 40 | 60 | 100 | 3 |
| 6 | EC-310LA | Mini Project/Electronic Design Workshop | 0:0:4 | 4 | 2 | - | 40 | 60 | 100 | 3 |
| 7 | ECP* | Program Elective-II | 3:0:0 | 3 | 3 | 75 | 25 | 0 | 100 | 3 |
| 8 | ECO* | Open Elective-II | 3:0:0 | 3 | 3 | 75 | 25 | 0 | 100 | 3 |
| | | **Total** | | **25** | **20** | **375** | **245** | **180** | **800** | |

*** The course of both Program Elective and Open Elective will be offered at 1/3rd strength or 20 students (whichever is smaller) of the section. Note: All the students have to undergo 4 to 6 weeks Industrial Training after 6th semester which will be evaluated in 7th semester.**

**Bachelor of Technology ( Electronics & Communication Engineering) (Credit Based)**
**KURUKSHETRA UNIVERSITY KURUKSHETRA**
**Scheme of Studies/Examination**

| LIST OF OPEN ELECTIVES (B.TECH. ECE) | | |
|---|---|---|
| **SEM** | **CODE** | **SUBJECT** |
| **VI** | ECO-5A | Data Structures |
| | ECO-6A | Multimedia Communication |
| | ECO-7A | Consumer Electronics |
| | ECO-8A | Transducers and Their Applications |
| | | MOOC2 |

| LIST OF PROGRAM ELECTIVES (B.TECH. ECE) | | |
|---|---|---|
| **SEM** | **CODE** | **SUBJECT** |
| **VI** | ECP-6A | Antennas and Propagation |
| | ECP-7A | CMOS Design |
| | ECP-8A | Bio-Medical Electronics |
| | ECP-9A | Scientific Computing |

| HM-901A | ORGANIZATIONAL BEHAVIOUR (VI Semester) | | | | | | |
|---|---|---|---|---|---|---|---|
| Lecture | Tutorial | Practical | Credits | Major Test | Minor Test | Total | Time (Hrs.) |
| 3 | 0 | 0 | 3 | 75 | 25 | 100 | 3 |
| Purpose: | To make the students conversant with the basic concepts of organizational culture and behavior for nurturing their managerial skills. | | | | | | |
| Course Outcomes | | | | | | | |
| CO 1 | An overview about organizational behavior as a discipline and understanding the concept of individual behavior. | | | | | | |
| CO 2 | Understand the concept and importance of personality, emotions and its importance in decision making and effective leadership. | | | | | | |
| CO 3 | Enabling the students to know about the importance of effective motivation and its contribution in group dynamics and resolving conflicts. | | | | | | |
| CO 4 | Understand how to overcome organizational stress by maintaining proper organizational culture and effective communication. | | | | | | |

**UNIT-I**

**Introduction to Organizational Behavior*:*** Concept and importance of Organizational Behavior, Role of Managers in OB, Foundations or Approaches to Organizational Behavior, Challenges and Opportunities for OB.

**Foundation of individual behavior**: Biographical characteristics, concept of Abilities and Learning , Learning and Learning Cycle, Components of Learning, concept of values and attitude, types of attitude, attitude and workforce diversity

**UNIT-II**

**Introduction to Personality and Emotions**: Definition and Meaning of Personality, Determinants of Personality, Personality Traits Influencing OB, Nature and Meaning of Emotions, Emotions dimensions, concept of Emotional intelligence

**Perception and individual decision making***:* Meaning of perception, factors influencing perception, Rationaldecision- making process, concept of bounded rationality. Leadership- Trait approaches, Behavioral approaches, Situational approaches, and emerging approaches to leadership.

**UNIT-III**

**Motivation**: concept and theories of Motivation, theories of motivation-Maslow, Two Factor theory, Theory X and Y, ERG Theory, McClelland's Theory of needs, goal setting theory, Application of theories in Organizational Scenario, linkage between MBO and goal setting theory, employee recognition and involvement program.

**Foundations of Group Behavior and conflict management: Defining** and classifying of Groups, stages of group development, Informal and Formal Groups – Group Dynamics, Managing Conflict and Negotiation, a contemporary perspective of intergroup conflict, causes of group conflicts, Managing intergroup conflict through Resolution.

**UNIT-IV**

**Introduction to Organizational Communication**: Meaning and Importance of Communication process, importance of Organizational Communication, Effective Communication, Organizational Stress: Definition and Meaning, Sources and Types of Stress, Impact of Stress on Organizations, Stress

Management Techniques.

**Introduction to Organization Culture**- Meaning and Nature of Organization Culture, Types of Culture, Managing Cultural Diversity, Managing Change and Innovation – Change at work, Resistance to change, A model for managing organizational change.

**Text Books:**

1. Colquitt, Jason A., Jeffery A. LePine, and Michael Wesson. Organizational Behavior: Improving Performance and Commitment in the Workplace. 5th ed. New York: McGraw-Hill Education, 2017.

2. Hitt, Michael A., C. Chet Miller, and Adrienne Colella. Organizational Behavior. 4th ed. Hoboken, NJ: John Wiley

**Reference Books:**

1. Robbins, Stephen P., and Timothy Judge. Organizational Behavior. 17th ed. Harlow, UK: Pearson Education

2. Stephen P. Robins, Organisational Behavior, PHI Learning / Pearson Education, 11th edition, 2008.

| EC-302A | Control System Engineering (6th Semester) | | | | | | |
|---|---|---|---|---|---|---|---|
| **Lecture** | **Tutorial** | **Practical** | **Credit** | **Major Test** | **Minor Test** | **Total** | **Time** |
| **3** | **0** | **0** | **3** | **75** | **25** | **100** | **3 Hours** |
| **Purpose** | The purpose of this course is to create awareness about the various types of control systems with the techniques to analyze them so that the learner is able to mathematically design and evaluate the conditions for which a control system can provide stable output with improved performance. | | | | | | |
| | | | | | | | |
| **CO1** | Learner will be able to design and simplify the mathematical and graphical models of a control system through block diagram and signal flow graph method. | | | | | | |
| **CO2** | Learner can evaluate the conditions for which a system can work under stable conditions in time domain. | | | | | | |
| **CO3** | Learner will know about easier graphically methods to evaluate the conditions of stability in frequency domain. | | | | | | |
| **CO4** | Learner will able to apply the compensation technique using state variable approach to covert an unstable system into a stable system under certain conditions. | | | | | | |

## UNIT-I

**Introduction:** The Control system-Open loop & Closed loop, servomechanism, Stepper motor. Mathematical Models of Physical Systems: Differential equation of physical systems, Transfer Function, Block Diagram Algebra, Signal Flow-Graphs, Mason's Formula & its application. Feedback Characteristics of Control Systems: Feedback and Non-Feedback systems, Effects of Feedback on sensitivity (to parameter variations), Stability, Overall gain etc.

## UNIT-II

**Time Response Analysis:** Standard test signals, Time response of first order and second order systems, Steady-State Errors and Error Constants, Design Specification of second-order- systems. Stability: The concept of stability, necessary conditions for stability, Hurwitz Stability Criterion, Routh Stability Criterion, Relative Stability Analysis. The Root Locus Technique: The Root Locus Concept, Construction /development of Root loci for various systems, Stability considerations. Proportional, Integral and Derivative Controllers.

## UNIT-III

**Frequency Response & Stability Analysis:** Correlation between Time and Frequency response, Polar Plots, Nyquist plots, Bode Plots, Nyquist Stability criterion, Gain margin & Phase margin, relative stability using Nyquist Criterion, frequency response specifications.

## UNIT-IV

**Compensation of Control Systems**: Necessity of Compensation, Phase Lag compensation, Phase Lead Compensation, Phase Lag Lead Compensation, Feedback Compensation. State Variable Analysis: Concept of State, State Variable and State Model, State Models for Linear Continuous Time Systems, Diagonalization, Solution of state equations, Concept of Controllability and Observability.

**Text Book**: *Control System Engg.: I. J. Nagrath & M.Gopal; New Age India.*

**Reference Books:**

1.Automatic Control Systems: B.C. Kuo; PHI.
2.Modern Control Engg: K. Ogata; PHI.
3.Control Systems: Principles & Designing : Madan Gopal; TMH.

| EC-306A | Verilog HDL | | | | | | |
|---|---|---|---|---|---|---|---|
| **Lecture (Hrs.)** | **Tutorial (Hrs.)** | **Practical (Hrs.)** | **Credit** | **Major Test** | **Minor Test** | **Total** | **Time(Hrs)** |
| **3** | **-** | **-** | **3** | **75** | **25** | **100** | **3** |
| **Course Objectives** | To familiarize the students with the conventions of the Verilog HDL programming, algorithmic levels of abstraction for modelling digital hardware systems, the concept of test-benches to create testing behavioral environments for simulation based verification. | | | | | | |
| **Course Outcomes**<br>At the end of this course the student should be able to | | | | | | | |
| **CO1** | To understand the constructs and conventions of the Verilog HDL programming. | | | | | | |
| **CO2** | To understand the structural, register-transfer level (RTL), and algorithmic levels of abstraction for modelling digital hardware systems. | | | | | | |
| **CO3** | To design and modelling of combinational and sequential digital systems | | | | | | |
| **CO4** | To apply the concept of test-benches to create testing behavioral environments for simulation based verification. | | | | | | |

## Unit- I

**Introduction:** Introduction, conventional approach to digital design, VLSI design, ASIC design flow, Role of HDL, Conventional Data flow, ASIC data flow, Verilog as HDL, Levels of Design Description, Concurrency, Simulation and Synthesis, Functional Verification, System Tasks, Programming Language Interface (PLI), Module, Simulation and Synthesis Tools, Test Benches.
**Language constructs and conventions:** Introduction, Keywords, Identifiers, White Space Characters,
Comments, Numbers, Strings, Logic Values, Strengths, Data Types, Scalars and Vectors, Parameters, Memory, Operators, System Tasks.

## Unit-II

**Gate level modelling:** Introduction, AND Gate Primitive, Module Structure, Other Gate Primitives, Illustrative Examples, Tri-State Gates, Array of Instances of Primitives, Additional Examples, Design of Flip-flops with Gate Primitives, Delays, Strengths and Contention Resolution, Net Types, Design of Basic Circuits.
**Behavioralmodelling:** Introduction, Operations and Assignments, Functional Bifurcation, Initial Construct, Always Construct, Examples, Assignments with Delays, Wait construct, Multiple Always Blocks, Designs at Behavioral Level, Blocking and Non-blocking Assignments, The case statement, Simulation Flow, if and ifelse constructs, assign-deassign construct, repeat construct, for loop, the disable construct, while loop, forever loop, parallel blocks, force-release construct, Event.

## Unit-III

**Modelling at data flow level**: Introduction, Continuous Assignment Structures, Delays and Continuous Assignments, Assignment to Vectors, Operators, Additional Examples.

**Switch level modelling:** Introduction, Basic Transistor Switches, CMOS Switch, Bi-directional Gates, Time Delays with Switch Primitives, Instantiations with Strengths and Delays, Strength Contention with Trireg Nets.

## Unit-IV

**Functions, tasks, and user defined primitives:** Introduction, Function, Tasks, User- Defined Primitives (UDP), FSM Design (Moore and Mealy Machines).
**System tasks, functions, and compiler directives**: Introduction, Parameters, Path Delays, Module Parameters, System Tasks and Functions, File-Based Tasks and Functions, Compiler Directives, Hierarchical Access, General Observations.

**Text Books:**

1. T. R. Padmanabhan, B. Bala Tripura Sundari (2004), Design through Verilog HDL, Wiley & SonsEducation, IEEE Press, USA.
2. J. Bhaskar (2003), A Verilog Primier, 2nd edition, BS Publications, India.

**Reference Books:**

1. Samir Palnitkar (2013), Verilog HDL, Pearson India.
2. Stephen. Brown, ZvonkoVranesic (2005), Fundamentals of Logic Design with Verilog, Tata McGraw
Hill, India.
3. Charles H. Roth (2004), Digital Systems Design using VHDL, Jr. Thomson Publications, India.

| EC-308LA | Verilog HDL Lab | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| **Lecture** | **Tutorial** | **Practical** | **Credit** | **Major Test** | **Minor Test** | **Practical** | **Total** | **Time** |
| **0** | **0** | **3** | **1.5** | **0** | **40** | **60** | **100** | **3 Hour** |
| **CO1** | To describe, design, simulate, and synthesize circuits using the Verilog hardware | | | | | | | |
| **CO2** | To design and modelling of combinational and sequential digital system. | | | | | | | |
| **CO3** | To develop program codes for synthesis-friendly combinational and sequential logic. | | | | | | | |
| **CO4** | To understand the advanced features of Verilog HDL and be able to write optimized codes for complex systems. | | | | | | | |

List of Experiments:

1. Write a Program to implement logic gates.
2. Write a Program to implement half-adder.
3. Write a Program to implement Full-adder.
4. Write a Program to implement 4 bit addition/subtraction.
5. Write a Program to implement a 3:8 decoder.
6. Write a Program to implement an 8:1 mulltiplexer.
7. Write a Program to implement an 1:8 demultiplexer.
8. Write a Program to implement 4 bit comparator.
9. Write a Program to implement Mod-10 up counter.
10. Write a Program to perform serial to parallel transfer of 4 bit binary number.
11. Write a program to perform parallel to serial transfer of 4 bit binary number
12. Write a program to implements 8 bit ALU containing 4 arithmetic & 4 logic operation.

| EC-304LA | Control System Engineering Lab | | | | | | |
|---|---|---|---|---|---|---|---|
| Lecture | Tutorial | Practical | Credit | Major Test | Minor Test | Total | Time |
| | | 3 | 1.5 | 40 | 60 | 100 | 3 Hour |
| Purpose | To make students capable to design solutions for Control System engineering problems and design system components or processes that meet the specified needs of modern automated engineering industries. | | | | | | |
| Course Outcomes | | | | | | | |
| CO1 | Students will be able to execute time response analysis of a second order control system using MATLAB | | | | | | |
| CO2 | Students will be able to design Lag, Lead, Lead-Lag compensators and verify experimental results using MATLAB. | | | | | | |
| CO3 | Analyze toque- speed characteristics of DC and AC servomotors. | | | | | | |
| CO4 | Analyze and interpret stability of the system through Root Locus, Bode plot and Nyquist plot. | | | | | | |

**List of Experiments:**

1. Using MATLAB obtain time response of a second order system in case of under damped, over damped and critically damped systems.

2. To design a passive RC lead compensating network for the given specifications and to obtain its frequency response.

3. To design a passive RC lag compensating network for the given specifications and to obtain its frequency response.

4. To obtain torque speed characteristics of AC servo motor.

5. To obtain torque speed characteristics of DC servo motor.

6. To determine frequency response of a second order system and evaluation of Frequency domain specifications.

7. To simulate a DC position control system and hence to find the step response using MATLAB.

8. Obtain the phase margin and gain margin for a given transfer function by drawing bode plots and verify the same using MATLAB.

9. To obtain Root locus of a given T. F. and hence finding breakaway point, intersection point on imaginary axis and to draw the Nyquist plot for the given transfer function using MATLAB.

10. To digitally simulate the time response characteristics of Linear SISO systems using state variable formulation.

11. Experiment to draw the frequency response of a given lead-lag compensating network.

| ECP-6A | Antennas & Propagation | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| **Lecture** | **Tutorial** | **Practical** | **Credit** | **Major Test** | **Minor Test** | | **Total** | **Time** |
| **3** | **0** | **0** | **3** | **75** | **25** | | **100** | **3 Hrs.** |
| **Purpose** | *To familiarize the students with: Antennas used for various applications, performance parameters of antenna, methods of analysis of antenna, and different ways of propagating the signal.* | | | | | | | |
| CO1 | *To Understand the structure and properties of various antennas.* | | | | | | | |
| CO2 | *To understand the performance parameters of antenna.* | | | | | | | |
| CO3 | *To design antenna of required specifications.* | | | | | | | |
| CO4 | *To understand the different ways of signal propagation.* | | | | | | | |

**Unit-I**

**Fundamental concept:** Physical concept of radiation, Retarded potential, Radiation pattern, near- and far-field regions. **Antenna Parameters:** Radiation Resistance, Gain, Directive Gain, Power Gain, Directivity, Efficiency, Beam width, Effective Height, Effective Aperture, Bandwidth and Antenna Temperature. **Radiation from Wires:** Radiation from Hertzian Dipole, Short Dipole, Monopole Antenna, Folded Dipole Antenna and Half Wave Dipole.

**Unit-II**

**Antenna Arrays**: Uniform Linear Arrays - Broadside Arrays, Endfire Arrays. Analysis of arrays of 2 Isotropic Sources - Different Cases, Analysis of arrays of N Isotropic Sources - Different Cases, Principle of Pattern Multiplication, Binomial Array, Chebyshev Array. **TV Transmission & Reception Antennas:** Turnstile Antennas, Yagi-Uda antennas. **Standard Antennas:** Loop Antenna (Rectangular & Circular), Helical Antenna, Biconical Antenna.

**Unit-III**

**Aperture & Slot Antennas:** Radiation from Rectangular Apertures, Uniform and Tapered Aperture, Horn antenna, Reflector Antenna , Cassegrain and Gregorian Feeding Structures, Rectangular Slot Antenna.

**Broadband Antennas**: Huygens' Principle, The frequency independent concept: Rumsey's principle, Frequency Independent Planar Log Spiral Antenna, Frequency independent conical spiral antenna, Log periodic antenna, Lens Antenna.

**Microstrip/Patch Antennas:** Basic configurations of patch antennas: Rectangular, Circular. Different Feeding Techniques. Method to Analyze Patch antenna: Transmission Line Model.

**Unit-IV**

**Propagation of Radio Waves:** Introduction, Ground Wave Propagation, Space Wave Propagation and Sky Wave Propagation: Virtual Height, Critical Frequency, Maximum Usable Frequency (MUF) – Skip Distance, Fading, Multi Hop Propagation, Duct Propagation, Troposcatter Propagation, Flat Earth and Curved Earth Concept,.

**REFERENCES:**


1. J. D. Kraus, Antennas, McGraw Hill, 1988.
2. C.A. Balanis, Antenna Theory - Analysis and Design, John Wiley, 1982.
3. Antenna & Wave Propagation- K.D. Prasad, Satya Parkashan.
3. R.E. Collin, Antennas and Radio Wave Propagation, McGraw Hill, 1985.
4. I.J. Bahl and P. Bhartia, Micro Strip Antennas, Artech House, 1980.
6. A.R.Harish, M.Sachidananda, Antenna and Wave Propagation, Oxford University Press.

| ECP-7A | CMOS Design | | | | | |
|---|---|---|---|---|---|---|
| | | | | | | |
| **Lecture** | **Tutorial** | **Practical** | **Major Test** | **Minor Test** | **Total** | **Time** |
| **3** | **0** | **0** | **75** | **25** | **100** | **3 Hr.** |
| | | **Course Outcomes** | | | | |
| **CO1** | Student will be able to analyze MOS transistor characteristics | | | | | |
| **CO2** | Student will be able to design CMOS invertor of specific characteristics | | | | | |
| **CO3** | Student will be able to design combinational CMOS circuit of given boolean equation | | | | | |
| **CO4** | Student will be able to design sequential CMOS circuit of given specification | | | | | |

**Unit- I**

**Introduction:**Overview of VLSI Design Methodologies, VLSI Design flow, Design hierarchy, VLSI Design styles.
**MOS Transistor:** MOS structure, MOS system under external bias, structure and operation of MOSFET, C-V characteristics.

**Unit- II**

**MOS Invertors:** Introduction, resistive load invertor, invertor with n-type MOSFET load, CMOS invertor: circuit operation, noise margin, design of invertor, power and area consideration. .

**Unit -III**

**Combinational MOS Logic:** nMOS logic circuits with depletion nMOS load, CMOS logic circuits, complex logic circuits, CMOS pass gates

**Unit-IV**

**Sequential MOS Logic circuits:** Behaviour of bistable elemens, SR latch circuit, clocked latch and flip flop, CMOS D Latch and edge triggered flip flop

**Text Books:**
1. S. M. Kang and Y. Leblebici, CMOS Digital Integrated Circuits : Analysis and Design, Third Edition, MH, 2002.

**Reference Books:**
1. N. Weste, K. Eshraghian and M. J. S. Smith, Principles of CMOS VLSI Design : A Systems Perspective, Second Edition (Expanded), AW/Pearson, 2001.
2.J. P. Uyemura, CMOS Logic Circuit Design, Kluwer, 1999.

| ECP-8A | | Biomedical Electronics | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Lecture (Hrs.) | Tutorial (Hrs.) | Practical (Hrs.) | Credit | Major Test | Minor Test | Practical | Total | Time |
| 3 | - | - | 3 | 75 | 25 | - | 100 | 3 |
| **Course Outcomes** At the end of this course students will demonstrate the ability to | | | | | | | | |
| **CO1** | Understand and explain the concept of biomedical signals, electrodes and Instrumentation | | | | | | | |
| **CO2** | Understand and explain the physiological transducers and recording systems | | | | | | | |
| **CO3** | Understand and explain biomedical recorders and patient monitoring systems | | | | | | | |
| **CO4** | Understand and explain cardiac pacemakers, defibrillator and patient safety | | | | | | | |

**UNIT-I**

**Introduction:** Role of technology in medicine, physiological systems of the body, sources of biomedical signals, basic medical instrumentation and their performance requirements, intelligent medical instrumentation systems, consumer and portable medical equipment, implantable medical devices, role of engineers in healthcare facilities.

**Bioelectric Signals and Electrodes:** Origin of bioelectric signals, recording electrodes, silver- silver chloride electrodes, electrodes for ECG, electrodes for EMG, electrical conductivity of electrode jellies and creams, microelectrodes.

**UNIT-II**

**Physiological Transducers:** Definition, classification and performance characteristics of transducers, displacement, position and motion transducers, pressure transducers, transducers for body temperature measurement, photoelectric transducers, optical fiber sensors, biosensors, smart sensors.

**Recording System:** Basic recording system, general considerations for signal conditioners, preamplifiers, sources of noise in low level measurements, biomedical signal analysis and processing techniques, the main amplifier and driver stage, writing systems.

**UNIT-III**

**Biomedical Recorders:** Electrocardiograph, vectorcardiograph (Vcg), phonocardiograph (Pcg), digital stethoscope, electroencephalograph (Eeg), electromyograph.

**Patient Monitoring Systems:** System concepts, cardiac monitor, bedside patient monitoring systems, central monitors, measurement of heart rate, measurement of temperature, measurement of respiration rate, catheterization laboratory instrumentation, ambulatory monitoring instruments.

**UNIT-IV**

**Cardiac Pacemakers and Defibrillators:** Need for cardiac pacemaker and defibrillator, external pacemakers, implantable pacemakers, pacing system analyzer, DC defibrillator, implantable defibrillators, types of defibrillators, defibrillator analyzer.

**Patient Safety:** Electric shock hazards, leakage currents, safety codes for electromedical equipment, electrical safety analyzer.

**Text/Reference Books:**


1. R S Khandpur: Handbook of biomedical instrumentation, 3rd ed., McGraw Hill Education.
2. Joseph D. Bronzino: The biomedical engineering handbook, 2nd ed., CRC Press.

| ECP-9A | | Scientific Computing | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Lecture (Hrs.) | Tutorial (Hrs.) | Practical (Hrs.) | Credit | Major Test | Minor Test | Practical | Total | Time |
| 3 | - | - | 3 | 75 | 25 | - | 100 | 3 |
| **Course Outcomes**<br>At the end of this course students will demonstrate the ability to | | | | | | | | |
| **CO1** | To understand the concept of computational linear algebra and apply the matrix decompositions techniques to solve the problems of linear algebra | | | | | | | |
| **CO2** | To understand the concept of Scientific computing and will be able to find the solution of linear and non linear equations | | | | | | | |
| **CO3** | To learn the concept of Vector functions, partial derivatives, gradient and tangent planes | | | | | | | |
| **CO4** | To understand the various numerical techniques for solving differential equations and use MATLAB to visualize the solutions practically. | | | | | | | |

**Unit -I**

**Introduction to Computational Linear Algebra**

Fundamental algorithms in computational linear algebra with relevance to all science concentrators. Basic linear algebra and matrix decompositions (Cholesky, LU, QR, etc.), round-off errors and numerical analysis of errors and convergence. Iterative methods and conjugate gradient techniques. Computation of eigenvalues and eigenvectors, and an introduction to least squares methods

**Unit –II**

**Introduction to Scientific Computing**

Numerical computations; Includes instruction for programming in MATLAB. Applications solution of linear equations (with vectors and matrices) and nonlinear equations (by bisection, iteration, and Newton's method),interpolation, and curve-fitting, difference equations, iterated maps, numerical differentiation and integration, and differential equations.

**Unit –III**

**Vector Functions;** Derivatives,tangent vector velocity,acceleration,arc length of space curve,curvature and normal vectors,functions of two or more variables,limits and continuity,partial derivatives,directional derivatives,gradient and tangent planes,second derivative ,maxima,minima,sable point

**Unit -IV**

**Introduction to Numerical Solution of Differential Equations**Fundamental numerical techniques for solving ordinary and partial differential equations. Overview of techniques for approximation and integration of functions Differential equations,First Order differential equations,variables separable form,solution of first order linear equation,second and higher order equations,solution of constant coefficient second order equation, Solution of two-point boundary value problems, introduction to methods for solving linear partial differential equations.

Text/Reference Books:


1. Calculus and Analytical Geometry (9th Edition) Thomas and Finney Pearson Education
2. Calculus (5th Edition) James Stewart
3. Advanced Engineering Mathematics (8th Edition) Erwin Kreyszig John Willey and Sons
4. Linear Algebra (2nd edition) Hoffman and Kunz Prentice Hall International
5. Linear Algebra Peter D.Lax
6. Differentials Equations with applications and Historical notes. Simmons G.F

| ECO-5A | Data Structures | | | | | | |
|---|---|---|---|---|---|---|---|
| | | | | | | | |
| **Lecture (Hrs.)** | **Tutorial (Hrs.)** | **Practical (Hrs.)** | **Major Test** | **Minor Test** | **Total** | **Time** | **Credit** |
| **3** | **-** | **-** | **75** | **25** | **100** | **3 Hr.** | **3** |
| | | **Course Outcomes** | | | | | |
| **CO1** | Student will be able to determine the time complexity of various operations on arrays | | | | | | |
| **CO2** | Student will be able to select appropriate data structure for given application | | | | | | |
| **CO3** | Student will be able to create link list and apply various operations. | | | | | | |
| **CO4** | Student will be able to evaluate the traversal of binary trees and represent graphs | | | | | | |

## Unit- I

**Introduction:** Concept of Data Structures, Design of suitable algorithm, algorithm analysis.
**Arrays:** 1-D arrays: Traversal, Selection, Searching, Insertion, Deletion and Sorting. Multi-D arrays, representation of arrays in physical memory, application of arrays

## Unit- II

**Stacks and Queues:** Stacks: Stack operations, Application of Stacks, Queues: operations, circular queue, priority queue, deque
**Pointers:** Introduction, pointer variable, pointers and arrays, array of pointers, pointers and structures

## Unit -III

**Linked Lists:** Introduction, Operations: Creation, Traversal, Searching, Insertion and Deletion. Circular and Doubly linked list, linked stacks and queues.

## Unit-IV

**Trees:** Basic terminology, binary trees, representation of binary trees: linear and linked, traversal of binary trees
**Graphs:** graph terminology, representation of graphs: array based, linked list based, set based.

**Text Books:**
1. Data Structures using C by A. K. Sharma , Pearson Publication
2. Theory & Problems of Data Structures by Jr. Symour Lipschetz, Schaum's outline by TMH.
**Reference Books:**
1. Data Structures using C by A. M. Tenenbaum, Langsam, Moshe J. Augentem, PHI Pub
2. Data Structures and program design in C by Robert Kruse, PHI Expert Data Structures with C by R.B. Patel

| ECO-6A | Multimedia Communication | | | | | | |
|---|---|---|---|---|---|---|---|
| **Lecture (Hrs.)** | **Tutorial (Hrs.)** | **Practical (Hrs.)** | **Credit** | **Major Test** | **Minor Test** | **Total** | **Time** |
| **3** | **-** | **-** | **3** | **75** | **25** | **100** | **3 Hrs.** |
| **PO** | To familiarize the students with the concepts of basic multimedia communication systems and various compression algorithms of text, audio, image and video. | | | | | | |
| **Course Outcomes (CO)** | | | | | | | |
| **CO1** | Students will understand the concept of multimedia communication system along with its applications and networks in detail. | | | | | | |
| **CO2** | Students will be able to learn the concept of compression in detail. They will understand the techniques of text and image compression. | | | | | | |
| **CO3** | In this outcome students will be well prepared of audio and video compression. | | | | | | |
| **CO4** | Students will understand the concept internet, its applications and CBIR systems | | | | | | |

**UNIT-I**

**Multimedia Communication:** Introduction, Multimedia networks: Telephone networks, Data networks, Television Networks, ISDN, B-ISDN. Multimedia Applications: Interactive applications over the internet and Entertainment applications.

Digitization Principles, Representation of Text, Images, Audio and Video.

**UNIT-II**

**Text Compression**: Compression principles, Text Compression techniques: Static Huffman Coding, Dynamic Huffman Coding, Arithmetic Coding, Lempel Ziv and Lempel Ziv welsh coding.

**Image Compression**: Graphics interchange format, Tagged image file format, Joint Photographic Experts Group (JPEG).

.

**UNIT-III**

**Audio Compression**: Differential Pulse Code Modulation, Adaptive Differential PCM, Adaptive Predictive coding, linear predictive coding and MPEG audio coders,

**Video Compression**: Video Compression principles, Frame types, Motion estimation and compensation, Implementation Schematics of I, P and B frames, H.261, H.263.

**UNIT-IV**

**Multimedia Synchronization:** Basic definitions and requirements Time stamping and Pack architecture.

**Internet Applications:** Domain name System, Electronic Mail, Internet Telephony, Content Based Image Retrieval Systems

Text Books:

1. Multimedia communications: Fred Halsall; Pearson Education Asia.

Reference Books:

1. Multimedia Systems" by Ralf Steinmetz and Klara Nahrstedt
2. Multimedia Systems, Standards, and Networks" by A. Puri and T. Chen

| ECO-7A | Consumer Electronics | | | | | | |
|---|---|---|---|---|---|---|---|
| **Lecture** | **Tutorial** | **Practical** | **Credit** | **Major Test** | **Minor Test** | **Total** | **Time** |
| **3** | **0** | **0** | **3** | **75** | **25** | **100** | **3** |
| **Course Outcomes** | | | | | | | |
| **CO1** | To understand fundamentals of Monochrome and Colour TV systems. | | | | | | |
| **CO2** | To understand television receivers and digital TV systems. | | | | | | |
| **CO3** | To understand audio fundamentals and systems. | | | | | | |
| **CO4** | To maintain various electronic home appliances. | | | | | | |

**UNIT-I**

Monochrome TV Systems and Colour TV Systems: Monochrome picture signal transmission and reception, scanning process, aspect ratio, persistence of vision and flicker, interlace scanning, picture resolution, Composite video signal, vestigial sideband transmission. Colour theory, Grassman's Law, hue, brightness, saturation, luminance and chrominance, Different types of TV camera tube, channel bandwidth.

**UNIT-II**

Television Receivers: Monochrome and colour picture tube, receiver controls, remote control, Television standards: PAL, SECAM, NTSC.

Digital TVs: working principle of HDTV, Principle and working of LCD and LED TV, Block diagram and working principle of OLED.

**UNIT-III**

Audio Fundamentals: Basic characteristics of sound signal: level and loudness, pitch, frequency response, fidelity and linearity, Reverberation, Microphone: working principle, characteristics, Types: carbon, condenser, crystal, electrostatic. Loudspeakers: working principle, Types: electrostatic, dynamic, permanent magnet.

**UNIT-IV**

FAX, Microwave Oven: types, single chip controllers, Washing Machine: wiring diagram, electronic controller for washing machine, types of washing machine, Air conditioner and Refrigerators: Components features, types and applications, Digital camera, ATM.

TEXT BOOKs:


- R.R. Gulati "Modern Television practices", New Age International Publication (P) Ltd. New Delhi Year 2011, latest edition.
- S.P. Bali., "Consumer Electronics", Pearson Education, 2010, latest edition.

REFERENCES:


- R Bali and S.P. Bali “Audio video systems : principle practices & troubleshooting”, Khanna Book Publishing Co. (P) Ltd., 2010Delhi , India, latest edition.
- R.G. Gupta “Audio video systems”, Tata Mc graw Hill, New Delhi, India 2010, latest edition.
- Jerry Whitaker & Blair Benson “Mastering Digital Television”, McGraw-Hill Professional, 2010 , latest edition.

| ECO-8A | Transducers & Its Applications | | | | | | |
|---|---|---|---|---|---|---|---|
| Lecture | Tutorial | Practical | Credit | Major Test | Minor Test | Total | Time |
| 3 | | - | 3 | 75 | 25 | 100 | 3 |
| Purpose | Understanding the structural and functional principles of sensors and transducers used for various physical and nonelectric quantities and how to use them to measure these quantities. | | | | | | |
| Course Outcomes | | | | | | | |
| CO 1 | Explain the principles of operation of the sensor parameters and generators | | | | | | |
| CO 2 | Interpretation of the measurement results by using transducers. | | | | | | |
| CO 3 | Development of measurement schemes for different non electrical quantities | | | | | | |
| CO 4 | Assimilating knowledge about the implementation of sensors and transducers. | | | | | | |

**Unit-I**

Definition of transducer. Advantages of an electrical signal as out-put. Basic requirements of transducers, Primary and Secondary Transducer, Analog or digital types of transducers. Resistive, inductive, capacitive, piezoelectric, photoelectric and Hall Effect tranducers.

**Unit-II**

**Measurement of Pressure** – Manometers, Force summing devices and electrical transducers **Measurement of Temperature** – Metallic resistance thermometers, semi conductor resistance sensors (Thermistors), thermo-electric sensors, pyrometers.

**Unit-III**

**Measurement of Displacement** – Potentiometric resistance type transducers, inductive type transducers, differential transformer (L.V.D.T), capacitive transducers, Hall effect devices, strain gage transducers. **Measurement of Velocity** – variable reluctance pick up, electromagnetic tachometers, photoelectric tachometer, toothed rotor tachometer generator.

**Unit-IV**

**Measurement of Force** – Strain-gage load cells, pneumatic load cell, LVDT type force transducer. **Measurement of Torque** – Torque meter, torsion meter, absorption dynamometers, inductive torque transducer, digital methods.

**Suggested Books**:


1. B.C. Nakra, K.K. Chaudhry, "Instrumentation Measurement and Analysis," Tata McGraw-Hill Publishing Company Limited, New Delhi.
2. Thomas G. Beckwith etc. all, "Mechanical Measurements (International Student Edition), Addison-Wesley Longman, Inc. England.
3. A.K. Sawhney, " A Course in Electrical and Electronic Measurements and Instrumentation," Dhanpat Rai & Sons, Delhi-6

**Bachelor of Technology (Electronics & Communication Engineering) (Credit Based) KURUKSHETRA UNIVERSITY KURUKSHETRA**
**Scheme of Studies/Examination**
**Semester VII (w.e.f. session 2021-2022)**

| S. No. | Course No. | Subject | L:T:P | Hours/ Week | Credits | Examination Schedule (Marks) | | | | Duration of Exam (Hrs) |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | Major Test | Minor Test | Practical | Total | |
| 1 | HM-904A | Intellectual Property Rights for Technology Development & Management | 3:0:0 | 3 | 3 | 75 | 25 | 0 | 100 | 3 |
| 2 | ECP* | Program Elective-III | 3:0:0 | 3 | 3 | 75 | 25 | 0 | 100 | 3 |
| 3 | ECP* | Program Elective-IV | 3:0:0 | 3 | 3 | 75 | 25 | 0 | 100 | 3 |
| 4 | ECP* | Program Elective Labs-V | 0:0:4 | 4 | 2 | - | 40 | 60 | 100 | 3 |
| 5 | ECO* | Open Elective-III | 3:0:0 | 3 | 3 | 75 | 25 | 0 | 100 | 3 |
| 6 | EC-401LA | Project Stage-I | 0:0:8 | 8 | 4 | - | 40 | 60 | 100 | 3 |
| 7 | **EC-403A | Industrial Training-III | 2:0:0 | 2 | - | - | *100 | - | *100 | 3 |
| | | **Total** | | **26** | **18** | **300** | **180** | **120** | **600** | |

*** The course of both Program Elective and Open Elective will be offered at 1/3rd strength or 20 students (whichever is smaller) of the section.**

**EC-403A is a mandatory credit-less course in which the students will be evaluated for the industrial training undergone after 6th semester and students will be required to get passing marks to qualify.

**Bachelor of Technology ( Electronics & Communication Engineering) (Credit Based) KURUKSHETRA UNIVERSITY KURUKSHETRA**
**Scheme of Studies/Examination**
**Semester VIII (w.e.f. session 2021-2022 )**

| S. No. | Course No. | Subject | L:T:P | Hours/ Week | Credits | Examination Schedule (Marks) | | | | Duration Of Exam. (Hrs.) |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | Major Test | Minor Test | Practical | Total | |
| 1 | ECP* | Program Elective-VI | 3:0:0 | 3 | 3 | 75 | 25 | 0 | 100 | 3 |
| 2 | ECP* | Program Elective-VII | 3:0:0 | 3 | 3 | 75 | 25 | 0 | 100 | 3 |
| 3 | ECO* | Open Elective-IV | 3:0:0 | 3 | 3 | 75 | 25 | 0 | 100 | 3 |
| 4 | ECO* | Open Elective-V | 3:0:0 | 3 | 3 | 75 | 25 | 0 | 100 | 3 |
| 5 | EC-402LA | Project Stage-II | 0:0:10 | 10 | 5 | - | 40 | 60 | 100 | 3 |
| 6 | ECP* | Program Elective Labs-VIII | 0:0:4 | 4 | 2 | | 40 | 60 | 100 | 3 |
| | | Total | | 26 | 19 | 300 | 180 | 120 | 600 | |

***The course of both Program Elective and Open Elective will be offered at 1/3rd strength or 20 students (whichever is smaller) of the section.**

**Bachelor of Technology ( Electronics & Communication Engineering) (Credit Based) KURUKSHETRA UNIVERSITY KURUKSHETRA**
**Scheme of Studies/Examination**

| LIST OF OPEN ELECTIVES (B.TECH. ECE) | | |
|---|---|---|
| **SEM** | **CODE** | **SUBJECT** |
| **VII** | **Open Elective-III** | |
| | ECO-9A | Bio-informatics |
| | ECO-10A | Electromechanical Energy Conversion |
| | ECO-11A | Operating Systems |
| **VIII** | **Open Elective-IV** | |
| | ECO-12A | Wavelets |
| | ECO-13A | Soft Computing |
| | ECO-14A | Neural Networks and Fuzzy Logic |
| | **Open Elective-V** | |
| | ECO-15A | Statistics and Operational Research |
| | ECO-16A | Mixed Signal Design |
| | ECO-17A | Blockchain Technology |

| LIST OF PROGRAM ELECTIVES (B.TECH. ECE) | | |
|---|---|---|
| **SEM** | **CODE** | **SUBJECT** |
| **VII** | **Program Elective-III** | |
| | ECP-10A | Fiber Optic Communications |
| | ECP-11A | Mobile Communication and Networks |
| | ECP-12A | Adaptive Signal Processing |
| | ECP-13A | Nano electronics |
| | **Program Elective-IV** | |
| | ECP-14A | Microwave Theory and Techniques |
| | ECP-15A | Embedded systems |
| | ECP-16A | Robotics |
| | ECP-17A | Digital Image Processing |
| | **Program Elective Labs-V** | |
| | ECP-14LA | Microwave Communication Lab |
| | ECP-15LA | Embedded System Lab |
| | ECP-16LA | Robotics Lab |
| | ECP-17LA | Digital Image Processing Lab |
| **VIII** | **Program Elective –VI** | |
| | ECP-18A | Wireless Communication |
| | ECP-19A | Biomedical Signal Processing |
| | ECP-20A | Machine Learning |
| | ECP-21A | Artificial Intelligence |
| | ECP-22A | Internet of Things |
| | **Program Elective –VII** | |
| | ECP-23A | Error correcting codes |
| | ECP-24A | Satellite Communication |
| | ECP-25A | High Speed Electronics |
| | ECP-26A | Software Defined Radio |
| **VIII** | **Program Elective Labs-VIII** | |
| | ECP-18LA | Wireless Communication Lab |
| | ECP-19LA | Biomedical Lab |
| | ECP-20LA | Machine Learning Lab |
| | ECP-21LA | Artificial Intelligence Lab |
| | ECP-22LA | Internet of Things Lab |
| | ECP-23LA | Augmented Reality/Virtual Reality Lab |

| HM-904A | Intellectual Property Rights for Technology Development & Management | | | | | | |
|---|---|---|---|---|---|---|---|
| **Lecture** | **Tutorial** | **Practical** | **Credit** | **Major Test** | **Minor Test** | **Total** | **Time** |
| **3** | **0** | **0** | **3** | **75** | **25** | **100** | **3 Hr.** |
| **Course Outcomes** | | | | | | | |
| **CO1** | Understanding that when IPR would take such important place in growth of individuals & nation, it is needless to emphasis the need of information about Intellectual Property Right to be promoted among students in general & engineering in particular. | | | | | | |
| **CO2** | Understand that IPR protection provides an incentive to inventors for further research work and investment in R & D, which leads to creation of new and better products, and in turn brings about, economic growth and social benefits. | | | | | | |
| **CO3** | To understand different laws related to the Intellectual Property ,copyright act,trademarks,patent act,duration of patents law and policy considerations | | | | | | |
| **CO4** | Underastand New Developments in IPR ,administration of patent system,IPR of biological systems etc. | | | | | | |

**Unit-I**

Nature of Intellectual Property: Patents, Designs, Trade and Copyright. Process of Patenting and Development: technological research, innovation, patenting, development. International Scenario: International cooperation on Intellectual Property. Procedure for grants of patents, Patenting under PCT.

**Unit-II**

Patent Rights: Scope of Patent Rights. Licensing and transfer of technology. Patent information and databases. Geographical Indications.

**Unit-III**

Law relating to Intellectual property: Introduction – meaning of intellectual property, main forms of IP, Copyright, Trademarks, Patents and Designs, Secrets; Law relating to Copyright in India including Historical evolution of Copy Rights Act, 1957, Meaning of copyright – computer programs, Ownership of copyrights and assignment, Criteria of infringement, Piracy in Internet –Remedies and procedures in India; Law relating to Patents under Patents Act, 1970 including Concept and historical perspective of patents law in India, Patentable inventions with special reference to biotechnology products, Patent protection for computer programs, Process of obtaining patent – application, examination, opposition and sealing of patents, Patent cooperation treaty and grounds for opposition, Rights and obligations of patentee, Duration of patents – law and policy considerations, Infringement and related remedies;

**Unit-IV**

New Developments in IPR: Administration of Patent System. New developments in IPR; IPR of Biological Systems, Computer Software etc. Traditional knowledge Case Studies, IPR and IITs.

**Text Books/Reference Books:-**


- T. Ramappa (2010), Intellectual Property Rights Law in India, Asia Law House
- Wadhera (2004), Intellectual Property Rights, Universal Law Publishing Co
- Bare text (2005), Right to Information Act
- O.P. Malhotra, Law of Industrial Disputes, N.M. Tripathi Publishers
- Rustamji R.F., Introduction to the Law of Industrial Disputes, Asia Publishing House

Ethics in Engineering- M.W.Martin& R.Schinzinger, McGraw-Hill

| ECO-9A | BIOINFORMATICS | | | | | | |
|---|---|---|---|---|---|---|---|
| **Lecture** | **Tutorial** | **Practical** | **Credit** | **Major Test** | **Minor Test** | **Total** | **Time** |
| **3** | **-** | **-** | **3** | **75** | **25** | **100** | **3 Hrs.** |
| **Purpose** | **The Purpose of this course to provide focus on the key concepts of Bioinformatics like biological databases, Sequence Alignment, Phylogenetic Analysis, Plasmid Mapping And Primer Design and Predictive Methods using nucleotide sequences and protein sequences** | | | | | | |
| **Course Outcomes** | | | | | | | |
| CO1 | Students will be able to illustrate with the basic principles of various types of databases | | | | | | |
| CO2 | Students will be able to perform various tools related to sequence alignment and statistical significance of alignment | | | | | | |
| CO3 | Student will develop the knowledge of various software tools for sequence analysis and primer designing | | | | | | |
| CO4 | Students will be able to differentiate between predictive methods for nucleotides and protein sequence analysis | | | | | | |

## UNIT I

### Databases

**a.** Sequence Databases: introduction of Databases, primary and secondary databases, nucleotide and protein sequence databases: Genbank, EMBL, DDBJ, Swissprot, pfam, PIR

**b.** Structure Databases: Introduction to structures. PDB (Protein Data bank) Molecular Modeling database at NCBI. , visualizing structural information.

**c.** Sequence and Structure File Formats.

**The Entrez system**: Integrated information axis, Information retrieval from biological database, sequence database beyond NCBI. Medical databases.

## UNIT II

### Sequence Alignment AND Database Searches

Introduction, the evolutionary basis of sequence alignment, Type of Aligmnents, Pair-wise Alignment, Multiple Alignment, The modular nature of proteins, Optimal alignment methods, substitution scores and gap penalties, statistical significance of alignment. FASTA, BLAST, low-complexity regions, repetitive elements, Tool of multiple sequence alignment: CLUSTAL W/X, progressive alignment method.

### Phylogenetic Analysis:

Elements of phylogenetic models, phylogenetic data analysis: alignment, substitution model building, tree building and tree evaluation, building the data model (alignment), determining the substitution model, tree-building methods, searching for trees, rooting trees, evaluation trees and data, phylogenic software (PHYLIP). phylogenetics online tool.

## UNIT III

**Sequence Analysis Using Software Resources :**

Introduction. The Wisconsin package, the Seq Lab environment, analyzing sequences with operations and Wisconsin package programmes, viewing output, monitoring programme progress and troubleshooting problems, annotating sequences and graphically displaying annotations in the Seqlab Editor, saving sequences in the Seq Lab Editor, Example of analysis that can be undertaken in Seqlab,

## UNIT IV

**Plasmid Mapping And Primer Design**

Restriction mapping, Mac Vector and OMIGA. primer design for PCR Sequencing, primer design programs and software.

**Predictive Methods using nucleotide sequences and protein sequences:** Predictive methods using nucleotide sequences: Introduction, Gene prediction methods, Computational gene prediction in eukaryotes , identity based on composition, physical properties based on sequence, prediction of protein secondary and tertiary structures. Related software.

**Text Books-**


1. Bioinformatics by Andreas D.Boxevanis. Wiley Interscience, 4th edition 2020.

2. Essential bioinformatics by Jin Xiong. Cambridge Uni Press 2020

3. Biocomputing Informatics and The Genome Projects by Smith D.W., Academic Press, 2014.

4. Bioinformatics: A Biologists Guide to Computing and the Internet. by Stuart M. Brown, NKU Medical Center, NY USA, 2000.


**Note: The Examiner will be given the question paper template and will have to set the question paper according to the template provided along with the syllabus.**

| ECO-10A | Electro-Mechanical Energy Conversion | | | | | | |
|---|---|---|---|---|---|---|---|
| **Lecture** | **Tutorial** | **Practical** | **Credit** | **Major Test** | **Minor Test** | **Total** | **Time** |
| **3** | **-** | **-** | **3** | **75** | **25** | **100** | **3** |
| **Purpose** | **To provide the constructional and working knowledge of various EMEC Devices.** | | | | | | |
| **Course Outcomes** | | | | | | | |
| **CO 1** | **To study various fundamental concepts of EMEC& DC machines.** | | | | | | |
| **CO 2** | **To study fundamental concepts and characteristics of Induction Machines.** | | | | | | |
| **CO 3** | **To study the basics of S**ynchronous Machines | | | | | | |
| **CO 4** | **To study working idea of some special electric motors with applications.** | | | | | | |

**UNIT-I(Qualitative analysis only)**

Introduction: Basic principles, conservation of energy, physical phenomenon involved in conversion, energy balance, energy stored in magnetic field, principles of Generating and motoring, prime movers, necessity of starters in motoring.

**DC MACHINES:**

DC generator: Basic construction, theory and working, commutation,generated EMF equation,Demagnetizing and cross magnetizing ampere turns, armature reaction,voltage build-up,brief idea of load characteristics of shunt, series and compound generator.

DC motor: Basic construction, theoryand working, concept of back EMF, torque and power equations, brief idea of load characteristics of shunt, series and compound motor, armature and field control methods of speed control of a DC shunt motor,3 point starter.

**UNIT-II(Qualitative analysis only)**

**INDUCTION MACHINES**:

3-phase induction motors:Rotating magnetic field, Basic construction, theory and working ofsquirrel cage and phase wound rotor types of3-phase I.M., slip, Torque- slip and load characteristics. Blocked rotor tests power and BHP developed at shaft. Star delta starting.

Single phase Induction Motor: Basic construction of, double revolving field theory, working of a capacitor start capacitor run Single phase Induction motor.

**UNIT-III (Qualitative analysis only)**

**SYNCHRONOUS MACHINES:**

Synchronous generator (alternator): Basic construction, theory and working, types of rotors&excitation systems.

Synchronous motor:Basic construction, theory and working of, locking operation, speed torque characteristics, V- Curves. Hunting -causes and remedies.

**UNIT-IV(Qualitative analysis only)**

**SPECIAL ELECTRICAL MACHINES:**

Basic concept and workingideas of:Stepper motor, permanent magnet brushless DC motor, permanent magnet synchronous motor, hysteresis motor, synchronous reluctance motor, repulsion motor.

Industrial and domestic applications and comparison of various types of motors.

**Text/Reference Books**


1. D.P Kothari and I.J Nagrath, “Electric Machines”, Tata McGraw Hill Publishers
2. P.S Bhimbra, “Electric Machines”, Khanna Publisher
3. AshfaqHussain, “Electric Machines”, DhanpatRai and Company
4. Fitzgerald &Kingsley, Electrical Machines, MGH publications.

| ECO-11A | Operating Systems | | | | | | |
|---|---|---|---|---|---|---|---|
| | | | | | | | |
| Lecture | Tutorial | Practical | Credits | Major Test | Minor Test | Total | Time |
| 3 | 0 | 0 | 3 | 75 | 25 | 100 | 3 Hr. |
| Course Outcomes | | | | | | | |
| CO1 | | Student will be able to understand structure and function of OS. | | | | | |
| CO2 | | Student will be able to understand the concept of OS | | | | | |
| CO3 | | Student will be able to understand the concurrent processing | | | | | |
| CO4 | | Student will be able to understand scheduling and deadlock in OS. | | | | | |

**Unit- I**

**Introduction:**OS functions: as user/computer interface, interaction with OS, commands, efficient resource manager, security and protection, evolution of OS, OS structure and future trends.

**Unit- II**

**OS Prerequisites:** Important software resources, interaction with OS in mainframe systems: PSW,controlling i/o, interrupt, interrupt priority, interrupt cycle. Fundamental concept related to IPC.

**Unit -III**

**Concurrent Processing :** Introduction, process concept, process control block, exec sys, concurrent program, process state transitions, hierarchy of processes.

**Unit-IV**

**Scheduling:** CPU scheduling algorithms: allocation of different resources, scheduling queues, different scheduling algorithms.
**Deadlock:** Introduction, deadlock and starvation, resource allocation graph, way to solve dedlock.

**Text Books:**
1. P. P Choudhary, Operating Systems by PHI Learning Pvt Ltd.

**Reference Books:**
1. Operating Systems : Internals and Design Principles, William Stallings, Pearson
2.Operating System Concepts", Abraham Silberschatz, Peter Baer Galvin, and Greg Gagne, Wiley

**Note: Question paper template will be provided to the paper setter.**

| ECO-12A | Wavelets | | | | | | |
|---|---|---|---|---|---|---|---|
| **Lecture** | **Tutorial** | **Practical** | **Credit** | **Major Test** | **Minor Test** | **Total** | **Time** |
| **3** | **-** | **-** | **3** | **75** | **25** | **100** | **3** |
| **Purpose** | **To understand the concept of wavelet theory and applications.** | | | | | | |
| **Course Outcomes**<br>**At the end of this course, student will be able to** | | | | | | | |
| **CO 1** | Interpret stationary and non-stationary signals | | | | | | |
| **CO 2** | Construct continuous wavelet transform | | | | | | |
| **CO 3** | Develop discrete wavelet transform | | | | | | |
| **CO 4** | Apply wavelets in different applications | | | | | | |

**Unit-I**

**Introduction** Stationary and non-stationary signals, Signal representation using basis and frames, Brief introduction to Fourier transform and Short time Fourier transform, Time- frequency analysis, Bases of time frequency: orthogonal, Filter banks, Multi resolution formulation: Wavelets from filters, Classes of wavelets: Haar, Daubechies, bi-orthogonal.

**Unit-II**

**Continuous Wavelet Transform** Continuous wavelet transform (CWT), Time and frequency resolution of the continuous wavelet transform, Construction of continuous wavelets: Spline, orthonormal, bi-orthonormal, Inverse continuous wavelet transform, Redundancy of CWT, Zoom property of the continuous wavelet transform, Filtering in continuous wavelet transform domain.

**Unit-III**

**Discrete Wavelet Transform And Filter banks** Orthogonal and bi- orthogonal two-channel filter banks, Design of two-channel filter banks, Tree-structured filter banks, Discrete wavelet transform, Non-linear approximation in the Wavelet domain, multi resolution analysis, Construction and Computation of the discrete wavelet transform, the redundant discrete wavelet transform.

**Unit-IV**

**Multi Resolution Analysis** Multirate discrete time systems, Parameterization of discrete wavelets, Bi-orthogonal wavelet bases, Two dimensional, wavelet transforms and Extensions to higher dimensions, wave packets, Application of wavelets in signal de-noising.

**TEXT BOOKS:**


1. A Wavelet Tour of Signal Processing, 2nd edition, S. Mallat, Academic Press, 1999.
2. Wavelets and Sub band Coding, M. Vetterli and J. Kovacevic, Prentice Hall, 1995.
3. Wavelet transforms: Introduction, Theory and applications, Raghuveer rao and Ajit S.Bopardikar, Pearson Education Asia, 2000.


**REFERENCES:**


1. Fundamentals of Wavelets: Theory, Algorithms, and Applications, J.C. Goswami and A.K. Chan, 2nd ed., Wiley, 2011.
2. Wavelets and their Applications, Michel Misiti, Yves Misiti, Georges Oppenheim, Jean- Michel Poggi, John Wiley & Sons, 2010 .
3. A premier on Wavelets and their scientific applications, J S Walker, CRC press, 2002.
4. Wavelets and signal processing: An application based introduction, Stark, Springer, 2005.
5. A friendly guide to Wavelets, Gerald keiser, Springer, 2011.
6. Multirate Systems and Filter Banks, P. P. Vaidyanathan, Pearson Education, 2004. Wavelets : from math too practice, Desanka.P.Radunovik, springer, 2009.
7. Insight into wavelets from theory to practice, K P Soman and KL Ramachandran, PHI, 2008.

| ECO-13A | Soft Computing | | | | | | |
|---|---|---|---|---|---|---|---|
| Lecture (Hrs.) | Tutorial (Hrs.) | Practical (Hrs.) | Credit | Major Test | Minor Test | Total | Time |
| 3 | - | - | 3 | 75 | 25 | 100 | 3Hr |
| Purpose | To familiarize the students with the basics of Soft Computing | | | | | | |
| **Course Outcomes** | | | | | | | |
| **CO1** | Motivation and historical background of Soft Computing. | | | | | | |
| **CO 2** | Application of Fuzzy logic. | | | | | | |
| **CO 3** | Biologically inspired algorithm such as neural networks, genetic algorithms, ant colony optimization, and bee colony optimization. | | | | | | |
| **CO 4** | Hybrid systems of neural network, genetic algorithms and fuzzy systems. | | | | | | |

**Unit-I**

**Soft Computing and Artificial Intelligence**: Introduction of Soft Computing, Soft Computing vs. Hard Computing, Various Types of Soft Computing Techniques, Applications of Soft Computing, AI Search Algorithm, Predicate Calculus, Rules of Interference, Semantic Networks, Frames, Objects, Hybrid Models

**Unit-II**

**Artificial Neural Networks and Paradigms**: Introduction to Neuron Model, Neural Network Architecture, Learning Rules, Perceptrons, Single Layer Perceptrons, Multilayer Perceptrons, Back propagation Networks, Kohnen'sself-organizing networks, Hopfield network, Applications of NN.

**Unit-III**

**Fuzzy Logic**: Introduction, Fuzzy sets and Fuzzy reasoning, Basic functions on fuzzy sets, relations, rule-based models and linguistic variables, fuzzy controls, Fuzzy decision making, applications of fuzzy logic.

**Unit-IV**

**Genetic Algorithms and Swarm Optimizations**: Introduction, Genetic Algorithm, Fitness Computations, Cross Over, Mutation, Evolutionary Programming, Classifier Systems, Genetic Programming Parse Trees, Variants of GA, Applications, Ant Colony Optimization, Particle Swarm Optimization, Artificial Bee Colony Optimization.

**Text Books:**

1. Simon S. Haykin, Neural Networks, Prentice Hall, 2nd edition.
2. Timothy J. Ross, "Fuzzy Logic with Engineering Applications", McGraw Hill.
**3.** D.E. Goldberg, "Genetic Algorithms: Search, Optimization and Machine Learning", Addison Wesley, N.Y.

**Reference Books:**

1. Zimmermann, “Fuzzy Set Theory and its Application”, 3rd Edition.
2. B. Yegnanrayana , “Artificial Neural Networks” , PHI.
3. Jacek M. Zurada, Introduction to Artificial Neural Systems, Jaico Publishing House.
4. Jang J.S.R., Sun C.T. and Mizutani E, "Neuro-Fuzzy and Soft computing", Prentice Hall.

| ECO-14A | Neural Networks and Fuzzy Logic | | | | | | |
|---|---|---|---|---|---|---|---|
| **Lecture** | **Tutorial** | **Practical** | **Credit** | **Major Test** | **Minor Test** | **Total** | **Time** |
| **3** | **0** | **0** | **3** | **75** | **25** | **100** | **3 Hr.** |
| **Course Outcomes** | | | | | | | |
| **CO1** | Understand the concept of Artificial Intelligence, search techniques and knowledge representation issues | | | | | | |
| **CO2** | Understanding reasoning and fuzzy logic for artificial intelligence | | | | | | |
| **CO3** | Students will be able to learn defuzzification and fuzzy measures | | | | | | |
| **CO4** | Students will be able to learn the applications of fuzzy logic and hybrid soft computing techniques | | | | | | |

**UNIT I – INTRODUCTION**

Artificial neural network: Introduction, characteristics- learning methods – taxonomy – Evolution of neural networks- basic models - important technologies - applications. Fuzzy logic: Introduction - crisp sets- fuzzy sets - crisp relations and fuzzy relations: cartesian product of relation - classical relation, fuzzy relations, tolerance and equivalence relations, non-iterative fuzzy sets. Genetic algorithm- Introduction - biological background - traditional optimization and search techniques - Genetic basic concepts.

**UNIT II - NEURAL NETWORKS**

McCulloch-Pitts neuron - linear separability - hebb network - supervised learning network: perceptron networks – adaptive linear neuron, multiple adaptive linear neuron, BPN, RBF, TDNN- associative memory network: auto- associative memory network, hetero-associative memory network, BAM, hop field networks, iterative auto associative memory network & iterative associative memory network – unsupervised learning networks: Kohonen self organizing feature maps, LVQ – CP networks, ART network.

**UNIT III - FUZZY LOGIC**

Membership functions: features, fuzzification, methods of membership value assignments- Defuzzification: lambda cuts - methods - fuzzy arithmetic and fuzzy measures: fuzzy arithmetic - extension principle - fuzzy measures - measures of fuzziness -fuzzy integrals - fuzzy rule base and approximate reasoning : truth values and tables, fuzzy propositions, formation of rules-decomposition of rules, aggregation of fuzzy rules, fuzzy reasoning-fuzzy inference systems-overview of fuzzy expert system-fuzzy decision making.

**UNIT IV - HYBRID SOFT COMPUTING TECHNIQUES & APPLICATIONS**

Neuro-fuzzy hybrid systems - genetic neuro hybrid systems - genetic fuzzy hybrid and fuzzy genetic hybrid systems – simplified fuzzy ARTMAP - Applications: A fusion approach of multispectral images with SAR, optimization of traveling salesman problem using genetic algorithm approach, soft computing based hybrid fuzzy controllers.

**References:**


・Elaine Rich and Kevin Knight “Artificial Intelligence”, 2nd Edition, Tata Mcgraw-Hill, 2005.

・Stuart Russel and Peter Norvig, “Artificial Intelligence: A Modern Approach”, 3rd Edition, Prentice Hall, 2009.


Text book(s) and/or required material

1. T1. Kliryvan- Fuzzy System & Fuzzy logic Prentice Hall of India, First Edition.
2. Lawrence Fussett- fundamental of Neural network Prentice Hall , First Edition. Reference Books: 1. Bart Kosko, ―Neural network and Fuzzy System‖ - Prentice Hall-1994.
2. J.Klin and T.A.Folger, ―Fuzzy sets‖ University and information- Prentice Hall -1996.
3. J.M.Zurada, ―Introduction to artificial neural systems‖-Jaico Publication house,Delhi 1994.
4. VallusuRao and HayagvnaRao , ―C++ Neural network and fuzzy logic‖-BPB and Publication, New Delhi,1996.
5. Intelligent Systems and Control-http://nptel.ac.in/courses/108104049/16

| ECO-15A | Statistics and Operational Research | | | | | | |
|---|---|---|---|---|---|---|---|
| **Lecture** | **Tutorial** | **Practical** | **Credit** | **Major Test** | **Minor Test** | **Total** | **Time** |
| **3** | **0** | **0** | **3** | **75** | **25** | **100** | **3 Hr.** |
| **Course Outcomes** | | | | | | | |
| **CO1** | The Objective of the paper is to introduce the basic concepts of Operational Research and linear programming to the students | | | | | | |
| **CO2** | Student will be able to learn and apply different methods to solve Linear Programming Problem. | | | | | | |
| **CO3** | Student will be able to learn moments, standard deviation ,correlation ,regression | | | | | | |
| **CO4** | Students will be able large sample test for single proportion ,difference of means, difference of proportions | | | | | | |

**UNIT-I**

**Basics of Operational Research**: Origin & Development of Operational Research, Definition and Meaning of Operational Research, Different Phases of an Operational Research Study, Scope and Limitations of Operational Research, Mathematical Modeling of Real Life Problems.

**UNIT-II**

**Linear Programming Problem**: Formulation, solution by Graphical Method, Theory of Simplex Method, Simplex Algorithm, Two phase Method, Charnes-M Method, Degeneracy,

**UNIT-III**

**Basic Statistics:** Measures of Central tendency: Mean, median, quartiles, mode, Geometric mean, Harmonic mean, Measures of dispersion: Range, Quartile deviation, mean deviation, standard deviation, coefficient of variation, Moments, Skewness and Kurtosis, Correlation, Coefficient of correlation, methods of calculations, Lines of regression, Rank correlation.

**UNIT-IV**

**Test of significance:** Basic terminology, large sample test for single proportion, difference of proportions, single mean, difference of means, Small samples test for single mean, difference of means, Chi-square test for goodness of fit

**References /Suggested Readings:**


1. G. Hadley: Linear Programming. Narosa, Reprint, 2002.
2. G. Hadley: Linear Algebra, Narosa, Reprint, 2002.
3. N.P. Bali and Manish Goyal, A text book of Engineering Mathematics, Laxmi Publications.
4. B.S. Grewal, Higher Engineering Mathematics, Khanna Publishers.
5. Hamdy A. Taha: Operations Research-An Introduction, Prentice Hall, 9th Edition,2010.
6. Ravindran, D. T. Phillips and James J. Solberg: Operations Research- Principles and Practice, John Wiley & Sons, 2005.

F.S. Hillier. G.J. Lieberman: Introduction to Operations Research- Concepts and Cases, 9th Edition, Tata Mc-Graw Hill, 2010.

| ECO-16A | Mixed Signal Design | | | | | | |
|---|---|---|---|---|---|---|---|
| **Lecture** | **Tutorial** | **Practical** | **Credit** | **Major Test** | **Minor Test** | **Total** | **Time** |
| **3** | **0** | **0** | **3** | **75** | **25** | **100** | **3 Hr.** |
| **Purpose** | This course teaches how in real life applications both analog and digital circuits can be implemented for various system design. | | | | | | |
| **Course Outcomes** | | | | | | | |
| **CO1** | To know basics and working of various Switched-Capacitor Circuits. | | | | | | |
| **CO2** | To understand various PLL circuits. | | | | | | |
| **CO3** | To gain knowledge on various D/A and A/D converters. | | | | | | |
| **CO4** | To apply knowledge of different architectures in mixed signal circuits for real life problems. | | | | | | |

**Unit-I**

**Switched-Capacitor Circuits**

Introduction to Sampling Switches: MOSFETS as switches, speed considerations, precision considerations, charge injection cancellations. Switched-Capacitor Amplifiers: Unity Gain Sampler-Buffer, Noninverting Amplifier, Precision Multiply-by-Two Circuit. Switched-Capacitor Integrator, Switched-Capacitor Common-Mode Feedback.

**Unit- II**

**Phase Locked Loop**

Characterization of a comparator, basic CMOS comparator design, analog multiplier design, PLL-simple PLL, charge-pump PLL, Applications of PLL

**Unit- III**

**D/A Converter**

Sample-and-Hold Characteristics, DAC Specifications, DAC Architectures: Digital input Code, Resister Steering, R-2R Ladder Networks, Current Steering, Charge-Scaling DACs, Cyclic DACs, Pipeline DACs.

**Unit- IV**

**A/D Converter**

ADC Specifications, ADC Architectures: Flash, The Two-Step Flash ADC, The Pipeline ADC, Integrating ADCs, The Successive Approximation ADC, The Oversampling ADC. Applications of DACs and ADCs.

**TEXT BOOKS:**


1. Jacob Baker, "CMOS circuit design, layout and simulation", John Wiley India.
2. Razavi, "Design of analog CMOS integrated circuits", McGraw Hill, Edition 2002.


**REFERENCE BOOKS:**


1. CMOS Analog Circuit Design –Philip E. Allen and Douglas R. Holberg, Oxford University Press, International Second Edition/Indian Edition.
2. Gregorian, Temes, "Analog MOS Integrated Circuit for signal processing", John Wiley & Sons, 1986.
3. Analog Integrated Circuit Design- David A. Johns,Ken Martin, Wiley Student Edition

| ECO-17A | Blockchain Technology | | | | | | |
|---|---|---|---|---|---|---|---|
| Lecture (Hrs.) | Tutorial (Hrs.) | Practical (Hrs.) | Credit | Major Test | Minor Test | Total | Time |
| 3 | - | - | 3 | 75 | 25 | 100 | 3Hr |
| **Course Outcomes** | | | | | | | |
| **CO1** | Understand how blockchain systems (mainly Bitcoin and Ethereum) work | | | | | | |
| **CO 2** | To securely interact with them | | | | | | |
| **CO 3** | Design, build, and deploy smart contracts and distributed applications | | | | | | |
| **CO 4** | Integrate ideas from blockchain technology into their own projects. | | | | | | |

**Unit I**

Basics: Distributed Database, Two General Problem, Byzantine General problem and Fault Tolerance, Hadoop Distributed File System, Distributed Hash Table, ASIC resistance, Turing Complete. • Cryptography: Hash function, Digital Signature - ECDSA, Memory Hard Algorithm, Zero Knowledge Proof.

**Unit II**

Blockchain: Introduction, Advantage over conventional distributed database, Blockchain Network, Mining Mechanism, Distributed Consensus, Merkle Patricia Tree, Gas Limit, Transactions and Fee, Anonymity, Reward, Chain Policy, Life of Blockchain application, Soft & Hard Fork, Private and Public blockchain.

**Unit III**

Distributed Consensus: Nakamoto consensus, Proof of Work, Proof of Stake, Proof of Burn, Difficulty Level, Sybil Attack, Energy utilization and alternate.

**Unit IV**

Cryptocurrency: History, Distributed Ledger, Bitcoin protocols - Mining strategy and rewards, Ethereum - Construction, DAO, Smart Contract, GHOST, Vulnerability, Attacks, Sidechain, Namecoin

**Text Book**

1. Arvind Narayanan, Joseph Bonneau, Edward Felten, Andrew Miller and Steven Goldfeder, Bitcoin and Cryptocurrency Technologies: A Comprehensive Introduction, Princeton University Press (July 19, 2016).

**2. Reference Books**

1. Antonopoulos, Mastering Bitcoin: Unlocking Digital Cryptocurrencies
2. Satoshi Nakamoto, Bitcoin: A Peer-to-Peer Electronic Cash System
3. DR. Gavin Wood, "ETHEREUM: A Secure Decentralized Transaction Ledger,"Yellow paper.2014.
4. Nicola Atzei, Massimo Bartoletti, and Tiziana Cimoli, A survey of attacks on Ethereum smart contracts

| ECP-10A | Fiber Optic Communications | | | | | | |
|---|---|---|---|---|---|---|---|
| **Lecture** | **Tutorial** | **Practical** | **Credit** | **Major Test** | **Minor Test** | **Total** | **Time** |
| **3** | **0** | **0** | **3** | **75** | **25** | **100** | **3 Hr.** |
| **Course Outcomes** | | | | | | | |
| **CO1** | **Students will be able to understand the structure of fiber and the mechanism of light travelling in the fiber.** | | | | | | |
| **CO2** | **Students will be able to analyze various losses associated with fibers.** | | | | | | |
| **CO3** | **Students will learn about the optical sources and optical detecters.** | | | | | | |
| **CO4** | **Students will be able to understand the various components and devices required in making optical networks** | | | | | | |

**UNIT – I**

**INTRODUCTION** : Optical Fibers: Structure, Propagation within the fiber, Numerical aperture of fiber, acceptance angle, step index and graded index fiber, Modes of propagation in the fiber, Single mode and multi mode fibers. Splices and connectors. Optical Power Launching and Coupling. Fiber-to-fiber joints.

**UNIT –II**

**LOSSES IN OPTICAL FIBER** : Attenuation, Absorption Losses, Scattering Losses, Leaky modes, Mode coupling losses, Bending Losses, Combined Losses in the fiber.

**DISPERSION EFFECT** : Effect of dispersion on the pulse transmission Intermodal dispersion, Material dispersion, Wave guide dispersion, Polarization Mode Dispersion, Total dispersion, Transmission rate. Dispersion Shifted Fibers, Dispersion Compensating Fibers.

**UNIT – III**

**LIGHT SOURCES** : LEDS, Laser Action in semiconductor Lasers, Semiconductor Lasers for optical communication – Laser modes, Spectral Characteristics, Power Voltage Characteristics, Frequency response.

**DETECTORS** : P-I-N Photodiode, APD, Noise Analysis in detectors, Coherent and non-coherent detection, Infrared sensors. Bit error rate.

**UNIT – IV**

**The fiber-optic Communication System:** Design considerations of fiber optic systems: Analog and digital modulation. Optical Devices: Optical coupler, space switches, linear divider-combiners, WDM: strategy, wavelength division multiplexer and demultiplexer, optical amplifier

**OPTICAL NETWORKS**: Elements and Architecture of Fiber-Optic Network, Optical link network-single hop, multihop, hybrid and photonic networks.

**Suggested Books:**

John Power, An Introduction to Fiber optic systems, McGraw Hill International.
John Gowar , Optical communication Systems.
R. Ramaswamy, Optical Networks, Narosa Publication
John M. Senior,Optical Fiber Communication
Gerd Keiser, Optical Fiber Communication

| ECP-11A | Mobile Communication and Networks | | | | | | |
|---|---|---|---|---|---|---|---|
| **Lecture (Hrs.)** | **Tutorial (Hrs.)** | **Practical (Hrs.)** | **Credit** | **Major Test** | **Minor Test** | **Total** | **Time** |
| 3 | - | - | 3 | 75 | 25 | 100 | 3 Hrs. |
| **Course Outcomes (CO)**<br>To expose the students to the most recent technological developments in Mobile communication systems.. | | | | | | | |
| **CO1** | To familiarize the students with the fundamental concepts of wireless, cellular technology<br>And signal propagation in mobiles | | | | | | |
| **CO2** | Students will able to learn the detail knowledge of GSM and GPRS. | | | | | | |
| **CO3** | After this unit students will understand the wireless access techniques and standards | | | | | | |
| **CO4** | Students will understand the concept of mobile receivers. | | | | | | |

**UNIT-I**

**Cellular concepts**: Cell structure, frequency reuse, cell splitting, channel assignment, handoff, interference, capacity, power control; Wireless Standards: Overview of 2G and 3G cellular standards.

**Signal propagation**: Propagation mechanism- reflection, refraction, diffraction and scattering, large scale signal propagation and lognormal shadowing. Fading channels-Multipath and small scale fading- Doppler shift, statistical multipath channel models, narrowband and wideband fading models

**UNIT-II**

**Mobile System and Network Architectures GSM Services and Features** – GSM system Architecture, GSM radio subsystem, Frame structure for GSM, Signal processing in GSM, GPRS Network architecture, GPRS services and features, 3G UMTS network architecture, UMTS services and features.

.

**UNIT-III**

**Wireless Standards Multiple access techniques:** FDMA, TDMA and CDMA, Wireless networking, Design issues in personal wireless systems, Cordless systems and Wireless Local Loop (WLL), IEEE 802.16 Fixed Broadband Wireless Access standard, Mobile IP and Wireless Application protocol**.**

**UNIT-IV**

**Receiver structure**: Diversity receivers- selection and MRC receivers, RAKE receiver, equalization: linear-ZFE and adaptive, DFE. Transmit diversity-Altamonte scheme.

**Text Books**

1. Rappaport, T.S., "Wireless Communications", Principles and Practice, Prentice Hall, NJ, 1996.
2.William Stallings, "Wireless Communication and Networking", Pearson Education, 2002.

| ECP – 12A | Adaptive Signal Processing | | | | | | |
|---|---|---|---|---|---|---|---|
| **Lecture** | **Tutorial** | **Practical** | **Credit** | **MajorTest** | **MinorTest** | **Total** | **Time** |
| **3** | **0** | **0** | **3** | **75** | **25** | **100** | **3 Hr.** |
| **CourseOutcomes** | | | | | | | |
| CO1 | To understand various stochastic processes and models in adaptive signal processing. | | | | | | |
| CO2 | To understand the analysis of wiener filters, the concept of the linear prediction and steepest descent algorithms. | | | | | | |
| CO3 | To use Least-Mean-Square (LMS) & Recursive Least-Squares (RLS) algorithms for specific engineering problems. | | | | | | |
| CO4 | To apply the concept robustness and analysis the Finite-Precision effects on LMS and RLS algorithms. | | | | | | |

**Unit -I**

**Stochastic Processes and Models:** Partial Characterization of a Discrete-Time Stochastic Process, Mean Ergodic Theorem, Correlation Matrix, Correlation Matrix of Sine Wave Plus Noise, Stochastic Models, Wold Decomposition, Asymptotic Stationarity of an Autoregressive Process, Yule—Walker Equations.
**Wiener Filters**: Linear Optimum Filtering: Statement of the Problem, Principle of Orthogonality, Minimum Mean-Square Error, Wiener-Hopf Equations, Error-Performance Surface, Multiple Linear Regression Model.

**Unit -II**

**Linear Prediction:** Forward Linear Prediction, Backward Linear Prediction, Levinson-Durbin Algorithm, Properties of Prediction-Error Filters, Schur-Cohn Test.
**Method of Steepest Descent**: Basic Idea of the Steepest-Descent Algorithm, The Steepest-Descent Algorithm Applied to the Wiener Filter, Stability of the Steepest-Descent Algorithm, Example, The Steepest-Descent Algorithm as a Deterministic Search Method, Virtue and Limitation of the Steepest- Descent Algorithm.

**Unit -III**

**The Least-Mean-Square (LMS) Algorithm:** Signal-Flow Graph, Optimality Considerations, Applications, Statistical Learning Theory, Transient Behavior and Convergence Considerations, Efficiency.
**The Recursive Least-Squares (RLS) Algorithm:** Some Preliminaries, The Matrix Inversion Lemma, The Exponentially Weighted RLS Algorithm, Selection of the Regularization Parameter, Update Recursion for the Sum of Weighted Error Squares, Example: Single-Weight Adaptive Noise Canceller.

**Unit -IV**

**Robustness:** Robustness, Adaptation, and Disturbances, Robustness: Preliminary Considerations Rooted in H∞ Optimization, Robustness of the LMS Algorithm, Robustness of the RLS Algorithm, Comparative Evaluations of the LMS and RLS Algorithms from the Perspective of Robustness.

**Finite-Precision Effects:** Quantization Errors, Least-Mean-Square (LMS) Algorithm, Recursive Least- Squares (RLS) Algorithm, Summary and Discussion.

**TEXT BOOKS:**

1. S. Haykin, Adaptive filter theory,Pearson

**REFERENCE BOOKS:**

1. T. Adali and S. Haykin, Adaptive Signal Processing, WileyIndia
2. B. Widrow and S.D. Stearns, Adaptive signal processing, PrenticeHall.

| Course No. | Course Title | Teaching Schedule | | | Allotment of Marks | | | Duration of Exam (Hrs.) |
|---|---|---|---|---|---|---|---|---|
| | | L | T | P | Major Test | Minor Test | Total | |
| ECP-13A | Nano electronics | 3 | 0 | 0 | 75 | 25 | 100 | 3 |
| **Course Outcomes** | | | | | | | | |
| **CO 1** | Students will Understand the basic physics behind the nanoelectronics devices | | | | | | | |
| **CO 2** | Students be able learn various classification of the nano-materials. | | | | | | | |
| **CO 3** | To Understand various fabrication methods of nonmaterials. | | | | | | | |
| **CO 4** | Students will learn to characterize various nanomaterials using various characterization tools. | | | | | | | |

**UNIT-I**

Introduction to nanotechnology, Impacts, Limitations of conventional microelectronics, Trends in microelectronics and optoelectronics, Mesoscopic physics, trends in microelectronics and optoelectronics, characteristic lengths in mesoscopic systems, Quantum mechanical coherence

**UNIT- II**

Classification of Nano structures, Low dimensional structures Quantum wells, wires and dots, Density of states and dimensionality, Basic properties of two dimensional semiconductor nanostructures, square quantum wells of finite depth, parabolic and triangular quantum wells.

**UNIT-III**

Introduction to methods of fabrication of nanomaterials, different approaches, physical vapour deposition, chemical vapour deposition, Molecular Beam Epitaxy, Ion Implantation, Formation of Silicon Dioxide-dry and wet oxidation methods.

**UNIT-IV**

Introduction to characterization of nanostructures, tools used for of nano materials characterization: Principle of operation of Scanning Tunnelling Microscope, Atomic Force Microscope, Scanning Electron microscope, Transmission Electron Microscope.

Text Books:

1. J.M. Martinez-Duart, R.J. Martin Palma, F. Agulle Rueda Nanotechnology for Microelectronics and optoelectronics, Elsevier, 2006
2. W.R. Fahrner, Nanotechnology and Nanoelctronics, Springer, 2005

References:

1. Chattopadhyay, Banerjee, Introduction to Nanoscience & Technology, PHI, 2012
2. George W. Hanson, Fundamentals of Nanoelectronics, Pearson Education, 2009.
3. K. Goser, P. Glosekotter, J. Dienstuhl, Nanoelectronics and nanosystems, Springer 2004.
4. Murty, Shankar, Text book of Nanoscience and Nanotechnology, Universities Press, 2012.
5. Poole, Introduction to Nanotechnology, John Wiley, 2006.
6. Supriyo Dutta, Quantum Transport- Atom to transistor, Cambridge, 2013.

| ECP-14A | Microwave Theory and Techniques | | | | | | |
|---|---|---|---|---|---|---|---|
| **Lecture** | **Tutorial** | **Practical** | **Credit** | **Major Test** | **Minor Test** | **Total** | **Time** |
| **3** | **0** | **0** | **3** | **75** | **25** | **100** | **3 Hr.** |
| **Course Outcomes** | | | | | | | |
| **CO1** | Learner will be able to mathematically design basic resonator cavities and will be able to measure microwave parameters such as impedance, frequency and VSWR etc | | | | | | |
| **CO2** | Learner will learn the conventional methods to generate the microwaves. | | | | | | |
| **CO3** | Learner will know about the importance of scattering parameters along with its applications in the analysis of basic microwave components. | | | | | | |
| **CO4** | Learner will learn about transferred electron and avalanche transit time devices in detail. | | | | | | |

**UNIT-I**

**Introduction to Microwaves**-History of Microwaves, Microwave Frequency bands, Applications of Microwaves: Civil and Military, Medical, EMI/ EMC, Effect of Microwaves on Human Body.
Mathematical Model of Microwave Transmission-Concept of Mode, Features of TEM, TE and TM Modes, Losses associated with microwave transmission, Concept of Impedance in Microwave Transmission.
Review of waveguides in brief, Coaxial Transmission Line, Strip line, Microstrip line.
Microwave Resonators: Cavity Resonators: Rectangular, Cylindrical, and Coaxial, Excitation and Coupling of cavities, Q factor.

**UNIT-II**

**Microwave Measurements**: Measurement of frequency, impedance (using slotted section) Attenuation, power, dielectric constant, measurement of V.S. W. R., Insertion loss and Permeability.
Microwave Generators: Construction, characteristics, operating principle and typical applications of Klystron(two cavity, multicavity), Reflex Klystron, Magnetron(Cylindrical magnetron and description of Πmode applications) and Traveling Wave Tube(TWT).

**UNIT-III**

**Matrix Description of Microwave Circuits**: Scattering Matrix: properties, measurement of scattering coefficients, scattering matrices for common microwave systems.
Passive and Active Microwave Devices- Microwave passive components: Directional Coupler, Power Divider, E Plane and H-Plane Tee, Magic Tee, Attenuator, Isolators, Circulator and Phase Shifter.
Microwave Active Components: Diodes, Transistors, Design Considerations of Filters, Amplifiers, Oscillators and Mixers (in Brief).

**UNIT-IV**

**Solid State Microwave Devices**: Transferred Electron Devices-Gunn Diode: Negative Differential Resistance Phenomenon, High Field Domain Formation. Avalanche Transit Time Devices: IMPATT, TRAPATT, BARITT diodes, Tunnel Diode, PIN Diode, Parametric amplifiers

Text Book: David M. Pozar, Microwave Engineering, John Wiley and sons Inc.

Reference Books:

1. Samuel Y. Liao, Microwave Devices and Circuits, Prentice-Hall of India.
2. Das. Annapurna & Sisir K. Das, Microwave Engineering, Tata McGraw-Hill.
3. R.E. Collins, Microwave Circuits, McGraw Hill.

| ECP-15A | EMBEDDED SYSTEMS | | | | | | |
|---|---|---|---|---|---|---|---|
| **Lecture** | **Tutorial** | **Practical** | **Credit** | **Major Test** | **Minor Test** | **Total** | **Time(Hrs)** |
| **3** | **0** | **0** | **3** | **75** | **25** | **100** | **3** |
| **Course Outcomes** | | | | | | | |
| **At the end of the course students will be able to** | | | | | | | |
| CO1 | Acquire knowledge about different types of Microcontrollers and various Embedded System design examples of real- life problems. | | | | | | |
| CO2 | Understand the PIC, AVR, ARM and SHARC architectures. | | | | | | |
| CO3 | Understand different types of I/O devices, Timer Devices and Communication Interfaces. | | | | | | |
| CO4 | Acquire knowledge about the design of RTOS and various operating systems. | | | | | | |

**UNIT I**

**INTRODUTION**: Different types of Microcontrollers, 4-bit, 8-bit, 16-bit, and 32-bit Microcontrollers, Processor Architectures: Harvard & Princeton, CISC & RISC, Microcontrollers Memory Types, Microcontrollers Features, Criteria for Choosing a Microcontroller, Applications of Microcontrollers, Embedded System**:** Definition, Embedded Processors; Hardware Units, Devices and Software Tools in a System, Embedded System on Chip, Complex Systems Design and Processors, Design Challenges, Design Process and Design Examples.

**UNIT II**

**PIC MICROCONTROLLER**: Introduction to PIC16 Microcontroller Family, Features of PIC16C74, Architecture and Pin diagram of PIC16C74, Pipelining, Program Memory Considerations, Register File Structure, Addressing Modes, Instruction Sets; Advanced Architectures**:** Only Brief General Architecture of AVR, ARM and SHARC.

**UNIT III**

**COMMUNICATION INTERFACES:** I/O Devices Types and Examples, Serial Communication Devices, Parallel Device Ports, Wireless Devices, Timer and Counting Devices, Distributed Networked Embedded System Architecture, Serial Bus Communication Protocols-$I^2C$, CAN, USB, FireWire and Advanced Buses; Parallel Bus Device Protocols- ISA, PCI, ARM and Advanced Buses; Network Protocols-HTTP, TCP, UDP, IP and Ethernet; Wireless and Mobile System Protocols- IrDA, Bluetooth, 802.11 and Zigbee; Device Drivers.

**UNIT IV**

**RTOS**: Architecture of Kernel, Processes, Threads, Task and Thread States, Task and Data, Distinction Between Function, ISR, IST and Task; Semaphores, Mutex, Event Registers, Pipes, Signal, Timers, Memory Management, Priority Inversion Problem, Disabling and Enabling Function, Queues and Mailboxes, Pipe and Sockets Functions;

Basic Design using a RTOS, RTOS Task-Scheduling Model, OS Standards: POSIX, Off- the-Shelf Operating System, Embedded Operating Systems, Real –Time Operating Systems, Handhold Operating Systems.

**Text Books:**


1. Raj Kamal, "Embedded systems architecture, programming and design", 3rd Ed., McGraw-Hill Companies.
2. John. B. Peatman, "Design with PIC Microcontroller", Pearson Education, 2003.
3. Dr. K.V.K.K. Prasad, "Embedded/Real-Time Systems: Concepts, design and programming", DreamTech Press.

**References Books:**


1. Myke Predko, "Programming and Customizing the 8051 Microcontroller", TMH.
2. M.A. Mazidi, R. D. McKinlay,Causey," The PIC microcontroller and Embedded Systems using assembly and C for PIC18", 2nd Ed., Pearson.
3. D.P. Kothari, Shriram K. Vasudevan, Sundaram R. M. D., Murali N., "Embedded System", New Age International (P) Limited, Publishers.
4. Shibu K V, "introduction to Embedded Systems", 2nd Ed., McGraw Hill Education(India) private Limited.


**Note: Separate question paper template will be provided to the paper setter for setting the question paper of end term semester examinations.**

| ECP-16A | ROBOTICS | | | | | | |
|---|---|---|---|---|---|---|---|
| **Lecture** | **Tutorial** | **Practical** | **Credit** | **Major Test** | **Minor Test** | **Total** | **Time(Hrs)** |
| **3** | **0** | **0** | **3** | **75** | **25** | **100** | **3** |
| **Course Prerequisites** | Transducers and Microprocessors. | | | | | | |
| **Course Objectives** | To enlighten the students about the fundamentals of robotic systems. | | | | | | |
| **Course Outcomes** | | | | | | | |
| **At the end of this course the student should be able to understand** | | | | | | | |
| **CO1** | The basic concepts related to the Robot, parts of Robots, End Effectors and to make familiar with the various Drive systems for Robot. | | | | | | |
| **CO2** | The operation of various Sensors and their Applications in Robots. | | | | | | |
| **CO3** | The Machine Vision and its Applications, and various Control Systems used in Robots. | | | | | | |
| **CO4** | The Robot Programming, Artificial Intelligence, Fuzzy Logic, Safety Standards of Robots and Industrial and Non-Industrial applications of Robots. | | | | | | |

## UNIT I

**FUNDAMENTALS OF ROBOT:** Definition, History and Development in Robot Technology, Robot Technology: Characteristics, Basic Components, Robot Anatomy, Robot Generations, Robot Selection, Present and Future Applications.

**ROBOTS DRIVE SYSTEMS AND END EFFECTORS**: Robot Classification: Arm Geometry, Degrees of Freedom, Power Sources, Types of Motion, Path Control; Robot End Effectors: Mechanical Grippers, Vacuum, Magnetic, Adhesive; Special Purpose Grippers, Process Tooling, Compliance, Robot Drive Systems: Hydraulic, Pneumatic and Electric System.

## UNIT II

**SENSORS :** Requirements of a Sensor, Sensor Classification; **Principle, Advantages, Disadvantages and Applications of the following Sensors**: Position Sensors - Potentiometer, Encoder, LVDT, Resolvers, LMDT and Hall–Effect Sensors; Velocity Sensors: Encoder, Tachometer and Differentiation of position signal; Acceleration Sensors, Force, Pressure Sensors: Piezoelectric, Force Sensing Resistor, Strain Gauge and Antistatic Foam; Torque Sensors, Micro Switches, Visible Light and Infrared Sensors, Touch and Tactile Sensors, Proximity Sensors: Magnetic, Optical, Ultrasonic, Inductive, Capacitive and Eddy Current; Range Finder: Ultrasonic, Light-base and GPS; Sniff Sensors, Taste Sensors, Vision Sensors, Voice Recognition Devices, Voice Synthesizers, RCC.

## UNIT III

**MACHINE VISION AND CONTROL SYSTEM:** Visual Sensing, Architecture of Robotics Vision System, Machine Vision: Image Acquisition - Vidicon Tube and CCD; Digitization, Image Processing: Spatial Domain Operations, Noise Reduction and Edge Detection etc.; Image Analysis: Object Recognition by Features-Template Matching, Discrete Fourier Descriptors and Computed Tomography; Depth Measurement with Vision System, Image Interpretation, Segmentation by Region Growing and Region Splitting, Image Data Compression, Machine Vision Application, Other Optical Methods; Control Systems: Basic Robot Control System, PLC, PID, CNC, MPU, and URC.

## UNIT IV

**ROBOT PROGRAMMING, ARTIFICIAL INTELLIGENCE AND ROBOTS APPLICATIONS:** Robot Programming: Programming Methods and Languages, Levels of Robot Programming, Space Position Programming, and Program Statements; Elements of Artificial Intelligence, System Architecture; Fuzzy Logic Control, Application of Fuzzy Logic in Robotics; Robot Safety, Safety Standards; Industrial Applications:

Automation in Manufacturing, Robot Applications: Material Handling, Processing Application, Assembly Application and Inspection Application; Evaluating the Potential of a Robot Application, Future Applications, Challenge, Innovations; Non-Industrial Application.

**Text Books:**


1. James G. Keramas, "Robot technology fundamentals", Delmar Publishers.
2. Saeed B. Niku, "Introduction to robotics analysis, control and applications", 2nd ed., Wiley India.
3. R. K. Mittal, I. J. Nagrath, "Robotics and Control", TMH Education Pvt.


**Note: Separate question paper template will be provided to the paper setter for setting the question paper of end term semester examinations.**

| ECP-17A | Digital Image Processing | | | | | |
|---|---|---|---|---|---|---|
| | | | | | | |
| **Lecture** | **Tutorial** | **Practical** | **Major Test** | **Minor Test** | **Total** | **Time** |
| **3** | **0** | **0** | **75** | **25** | **100** | **3 Hr.** |
| **Course Outcomes** | | | | | | |
| **CO1** | Student will be able to explain basic concepts of image processing | | | | | |
| **CO2** | Student will be able to design evaluate image enhancement techniques | | | | | |
| **CO3** | Student will be able to analyze various compression and morphological operations | | | | | |
| **CO4** | Student will be able to describe various video processing systems | | | | | |

**Unit – I**

**Digital image processing fundamentals:** Introduction, Image processing applications, Fundamental Steps in Digital Image Processing, Image Sampling and Quantization, Relationships between pixels, Color Fundamentals, color models.

**Unit - II**

**Image Enhancement:** Basics of intensity Transformations, Histogram processing, Spatial Domain filtering – Basics of Spatial Filtering, Smoothing and Sharpening Spatial Filtering.

Frequency Domain Filtering- Sampling and Fourier Transform of sampled functions, 2-D Sampling, Smoothing and Sharpening frequency domain filters – Ideal, Butterworth and Gaussian filters.

**Unit - III**

**Image Compression:** Fundamentals, Image Compression models, Error Free Compression – Huffman Coding, Arithmetic Coding, LZW Coding, Lossy Compression – Block transform coding.

**Morphological Image Processing:** Introduction, Erosion and Dilation, Opening and Closing, Hit or Miss Transformations, Boundary Extraction. Image Segmentation: Fundamentals of image segmentation, Point, Line, and Edge Detection.

**Unit - IV**

**Video Processing:** video formation, Video Frame classifications- I, P and B frames, Application of motion estimation in video coding, Patterns and Pattern classes - Recognition based on matching.

**Text Books:**

1. Rafael C. Gonzales, Richard E. Woods, "Digital Image Processing", Third Edition, Pearson Education, 2018.

**Reference Books:**

1.Rafael C. Gonzalez, Richard E. Woods, Steven L. Eddins, "Digital Image Processing Using MATLAB", Third Edition Tata Mc Graw Hill Pvt. Ltd., 2011

2. Anil Jain K. "Fundamentals of Digital Image Processing", PHI Learning Pvt. Ltd., 2011.

3. M. Tekalp, Digital Video Processing. Signal Processing Series, Prentice Hall, 1995.

4. Malay K. Pakhira, "Digital Image Processing and Pattern Recognition", First Edition, PHI Learning Pvt. Ltd., 2011.

**Note: Question paper template will be provided to the paper setter.**

| ECP-14LA | Microwave Communication Lab | | | | | | |
|---|---|---|---|---|---|---|---|
| Lecture (Hrs.) | Tutorial (Hrs.) | Practical (Hrs.) | Credit | Practical | Minor Test | Total | Time |
| - | - | 4 | 2 | 60 | 40 | 100 | 3 Hrs. |

**Course Outcomes (CO)**

To give the students an idea about the study and analysis of components used in Microwave Engg.

| | |
|---|---|
| **CO1** | Students will learn the steps to analyze microwave components. |
| **CO2** | Students will be able to find the characteristics of microwave components. |
| **CO3** | Students will learn the steps to analyze various antennas. |
| **CO4** | Students will be able to find the characteristics of various antennas. |

**List of Experiments:**

1. To study microwave components.
2. To study the characteristics of the reflex Klystron tube and to determine its electronic tuning range.
3. To determine the frequency and wavelength in a rectangular waveguide working in TE 10 mode.
4. To determine the standing wave ratio and reflection coefficient.
5. To study the I-V characteristics of gunn diode.
6. To study the magic Tee.
7. To study the isolator and attenuator.
8. To measure the coupling coefficient and directivity of a waveguide directional coupler.
9. To measure the polar pattern and the gain of a waveguide horn antenna.
10. To measure the insertion loss and attenuation.

| ECP-15LA | Embedded Systems Lab | | | | | | |
|---|---|---|---|---|---|---|---|
| **Lecture (Hrs.)** | **Tutorial (Hrs.)** | **Practical (Hrs.)** | **Credit** | **Practical** | **Minor Test** | **Total** | **Time** |
| **-** | **-** | **4** | **2** | **60** | **40** | **100** | **3 Hrs.** |
| **Course Outcomes (CO)**<br>**To give the students an idea about the 8051/PIC/AVR/ARM microcontrollers** | | | | | | | |
| **CO1** | To familiarization with 8051, PIC, AVR and ARM Microcontrollers. | | | | | | |
| **CO2** | Ability to write an embedded C language and assembly language program for 8051, PIC and AVR Microcontrollers. | | | | | | |
| **CO3** | Ability to interfacing the various Peripheral to 8051, PIC and AVR Microcontrollers. | | | | | | |
| **CO4** | Ability to design the embedded systems based on 8051, PIC and AVR Microcontrollers. | | | | | | |

**List of Experiments**

1. Write an embedded C program using 8051/PIC/AVR Microcontroller for interfacing DC motor to rotate clockwise and anticlockwise directions.
2. Write an embedded C program using 8051/PIC/AVR Microcontroller for interfacing stepper motor to rotate clockwise and anticlockwise directions.
3. Write an embedded C program using 8051/PIC/AVR Microcontroller for interfacing LCD to display message "WELCOME" on LCD screen.
4. Write an embedded C program using 8051/PIC/AVR Microcontroller for interfacing a switch and a buzzer at two different pins of a Port such that the buzzer should sound as long as the switch is pressed.
5. Write an embedded C program using 8051/PIC/AVR Microcontroller for interfacing keypad to port P0.Whenever a key is pressed; it should be displayed on LCD screen.
6. Write an embedded C program using 8051/PIC/AVR Microcontroller for interfacing LEDs to glow them in different pattern.
7. Write an embedded C program for 8051/PIC/AVR Microcontroller to display 0 to 9 on 7 segment display.
8. Write an embedded C program using 8051/PIC/AVR Microcontroller for interfacing RTC module to display current date and time on LCD screen
9. Write an embedded C program using 8051/PIC microcontroller for interfacing temperature sensor LM35 to display the current temperature on LCD screen.
10. Design an embedded system for traffic light controller using 8051/PIC Microcontroller

.

| ECP-16LA | Robotics lab | | | | | | |
|---|---|---|---|---|---|---|---|
| **Lecture (Hrs.)** | **Tutorial (Hrs.)** | **Practical (Hrs.)** | **Credit** | **Practical** | **Minor Test** | **Total** | **Time** |
| **-** | **-** | **4** | **2** | **60** | **40** | **100** | **3 Hrs.** |
| **Course Outcomes (CO):**<br>**To expose the students to the most recent technological developments in industrial Robot.** | | | | | | | |
| **CO1** | **To familiarization with FIRE BIRD Robot.** | | | | | | |
| **CO2** | **Abilities to interfacing various peripherals.** | | | | | | |
| **CO3** | **Student will be able to write embedded C language programming..** | | | | | | |
| **CO4** | **Ability to design the automatic system for robotics based application.** | | | | | | |

**List of Experiments**:

1. To get familiar with the AVR Studio 4.17 IDE and Fire Bird Robot.
2. Write a program for I/O interfacing to sense the pressing of push button Switch.
3. Write a program to alternately blink the set of LED
4. Write a program to display two digit numbers on LCD.
5. Write a program for obstacle detection of Robot
6. Write a program for controlling the speed of Fire Bird Robot.
7. Write a program for PWM based speed control of motor.
8. Write a program to design white line Follower Robot
9. To implement and design social distancing indicator and alarming system.
10. To Study implement the temperature based Fan speed controller.

| ECP-17LA | Digital Image Processing Lab | | | | | | |
|---|---|---|---|---|---|---|---|
| **Lecture (Hrs.)** | **Tutorial (Hrs.)** | **Practical (Hrs.)** | **Credit** | **Practical** | **Minor Test** | **Total** | **Time** |
| **-** | **-** | **4** | **2** | **60** | **40** | **100** | **3 Hrs.** |

**Course Outcomes (CO)**
**To give the students an idea about the study and analysis of digital image processing**

| | |
|---|---|
| **CO1** | Students will be able to explain the basics of Digital Image processing |
| **CO2** | Student will be able to explain sampling and quantization of digital image. |
| **CO3** | Student will be able to analyze the image enhancement operations on digital image. |
| **CO4** | Students will be able to analyze various image analysis and computer vision algorithm |

List of Experiments

1. Study of Image processing toolbox of MATLAB.
2. WAP to read and show various images of at least five different formats.
3. WAP to extract R, G, B component of Color Image.
4. WAP to convert a color image into gray scale and save it in new format.
5. WAP to invert a gray scale image.
6. WAP to implement Morphological operations on an image.
7. WAP to implement Histogram equalization.
8. WAP to implement various edge detection algorithms.
9. WAP to implement image segmentation.
10. WAP to implement boundary extraction of basic structure.

| ECP-18A | Wireless & Mobile Communication | | | | | | |
|---|---|---|---|---|---|---|---|
| **Lecture** | **Tutorial** | **Practical** | **Credit** | **Major Test** | **Minor Test** | **Total** | **Time** |
| **3** | 0 | **0** | **3** | **75** | **25** | **100** | **3 Hr.** |
| **Purpose** | To introduce the concepts of wireless / mobile communication using cellular environment. To make the students to know about the various modulation techniques, propagation methods, and multi access techniques used in the mobile communication. | | | | | | |
| **Course Outcomes** | | | | | | | |
| **CO 1** | It deals with the fundamental cellular radio concepts and generations of modern wireless communication. | | | | | | |
| **CO 2** | This also demonstrates the principle of trunking efficiency and how trunking and interference issues between mobile and base stations combine to affect the overall capacity of cellular systems. | | | | | | |
| **CO 3** | It provides idea about Multiple access techniques used in wireless communication. | | | | | | |
| **CO 4** | It presents different ways to Wireless Standards and mobility management. | | | | | | |

**Unit–I**

**Introduction to Wireless Communication Systems:** Evolution of mobile radio communications, examples of wireless comm. systems, paging systems, Cordless telephone systems, comparison of various wireless systems.

**Modern Wireless Communication Systems: Second generation cellular networks, third generation wireless networks, wireless in local loop, wireless local area networks, Blue tooth and Personal Area networks.**

**Unit–II**

**Introduction to Cellular Mobile Systems**: Spectrum Allocation, basic Cellular Systems, performance Criteria, Operation of cellular systems, analog cellular systems, digital Cellular Systems.

**Cellular System Design Fundamentals: Frequency Reuse, channel assignment strategies, handoff Strategies, Interference and system capacity, tracking and grade off service, improving coverage and capacity.**

**Unit– III**

**Multiple Access Techniques for Wireless Communication**: Introduction to Multiple Access, FDMA, TDMA, Spread Spectrum multiple Access, space division multiple access, packet ratio, capacity of a cellular systems.

**Unit-IV**

Wireless Standards-GSM, IS-95, UMTS-IMT-2000, Signaling, Call Control, Mobility Management and location Tracing.

## Suggested Books:


1. Theodore S.Reppeport, Wireless Communications Principles and Practice, IEEEPress, Prentice Hall.

2. William C.Y.Lec, Mobile Cellular Telecommunications, Analog and Digital Systems, Mc-Graw Hill Inc.

3 Kamilo Feher, Wireless Digital Communications, Modernization & Spread SpectrumApplications, Prentice Hall of India, New Delhi.

4 Kaveh Pahlavan and Allen H. Levesque " Wireless Information Networks", WileySeries, John Wiley and Sons Inc.

| ECP-19A | Bio-Medical Signal Processing | | | | | | |
|---|---|---|---|---|---|---|---|
| **Lecture** | **Tutorial** | **Practical** | **Credit** | **Major Test** | **Minor Test** | **Total** | **Time** |
| **3** | **-** | **-** | **3** | **75** | **25** | **100** | **3** |
| **Purpose** | **To understand the concept of Bio-Medical Signal Processing.** | | | | | | |
| **Course Outcomes**<br>**At the end of this course, student will be able to** | | | | | | | |
| **CO 1** | Interpret signals and systems | | | | | | |
| **CO 2** | Acquire Biomedical Signals such as ECG | | | | | | |
| **CO 3** | Apply adaptive filtering algorithms in biomedical applications | | | | | | |
| **CO 4** | Analyze different kinds of events and waveforms of biomedical origin | | | | | | |

**Unit – I**

**Signals and Information**: Definitions and properties of Laplace transform, Basic of DFT and FFT, z-transform, Sampling theorem.
**Linear Time-Invariant (LTI) Systems**: definitions and properties; causality, stability, impulse response, convolution, poles and zeros, frequency response, group delay, phase delay, Applications of Digital Signal Processing.

**Unit – II**

**Introduction to Biomedical Signal**: General measurement and diagnostic system, classification of signals, introduction to biomedical signals, Biomedical signal acquisition and processing.
**ECG**: ECG signal origin, ECG parameters-QRS detection different techniques, ST segment analysis, Arrhythmia, Arrhythmia analysis, Arrhythmia monitoring system.

**Unit – III**

**Adaptive Filtering**: Introduction, General structure of adaptive filters, LMS adaptive filter, adaptive noise cancellation, cancellation of ECG from EMG signal, Cancellation of maternal ECG in fetal ECG.
**EEG**: EEG signal characteristics, Sleep EEG classification and epilepsy.

**Unit – IV**

**Event Detection and waveform analysis:** Need for event detection, Detection of events & waves, Correlation analysis of EEG signals, Identification of heart sounds, Morphological analysis of ECG waves.
**Frequency Domain Analysis:** Introduction, Spectral analysis, linear filtering, Removal of high frequency noise (power line interference), motion artifacts (low frequency) and power line interference in ECG.

**Text Book:**

1. Biomedical Signal Analysis" A case study approach, Rangaraj M Rangayyan, John Wiley publications.

**Reference Books:**

1. "Biomedical Signal Processing Time and Frequency Domains Analysis (Volume I)", Arnon Cohen, CRC press.
2. "Biomedical Signal Processing Principles and Techniques" D.C.Reddy, Tata Mc Graw-Hill
3. "Biomedical Digital Signal Processing", Willis J. Tompkins, PHI

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| ECP-20A | Machine Learning | | | | | |
|---|---|---|---|---|---|---|
| | | | | | | |
| **Lecture** | **Tutorial** | **Practical** | **Major Test** | **Minor Test** | **Total** | **Time** |
| **3** | **0** | **0** | **75** | **25** | **100** | **3 Hr.** |
| **Course Outcomes** | | | | | | |
| **CO1** | Recite and understand the knowledge of classification and associated algorithms | | | | | |
| **CO2** | Explain and apply algorithms of statistical pattern recognition and supervised Learning | | | | | |
| **CO3** | Explain, implement and apply algorithms of non-parametric learning, feature extraction and selection | | | | | |
| **CO4** | Understand, explain and apply un-supervised learning, estimation and comparison of different classifiers | | | | | |

## UNIT-I

**Classification:** The Classification Process, Features, Training and Learning, Supervised Learning and Algorithm Selection, Approaches to Classification, Examples.
**Nonmetric Methods:** Introduction, Decision Tree Classifier, Information, Entropy, Impurity, Information Gain, Decision Tree Issues, Strengths and Weaknesses, Rule-Based Classifier, Other Methods.

## UNIT-II

**Statistical Pattern Recognition:** Measured Data and Measurement Errors, Probability Theory, Simple Probability Theory, Conditional Probability and Bayes' Rule, Naive Bayes Classifier, Continuous Random Variables, The Multivariate Gaussian, The Covariance Matrix, The Mahalanobis Distance.
**Supervised Learning:** Parametric and Non-parametric Learning, Parametric Learning, Bayesian Decision Theory, Discriminant Functions and Decision Boundaries, MAP (Maximum A Posteriori) Estimator.

## UNIT-III

**Nonparametric Learning:** Histogram Estimator and Parzen Windows, k-Nearest Neighbor (k-NN) Classification, Artificial Neural Networks, Kernel Machines.
**Feature Extraction and Selection:** Reducing Dimensionality, Preprocessing, Feature Selection, Inter/Intraclass Distance, Subset Selection, Feature Extraction, Principal Component Analysis, Linear Discriminant Analysis.

## UNIT-IV

**Unsupervised Learning:** Clustering, k-Means Clustering, Fuzzy c-Means Clustering, (Agglomerative) Hierarchical Clustering.
**Estimating and Comparing Classifiers:** Comparing Classifiers and the No Free Lunch Theorem , Bias and Variance, Cross-Validation and Resampling Methods: The Holdout Method , k-Fold Cross-Validation, Bootstrap, Measuring Classifier Performance, Comparing Classifiers, ROC Curves, McNemar's Test, Other Statistical Tests, The Classification Toolbox, Combining Classifiers.

**Text/References Books:**

**1.** Geoff Dougherty: Pattern Recognition and Classification An Introduction, 2013, Springer.
2. Christopher M. Bishop: Pattern Recognition and Machine Learning, Springer.

| ECP-21A | Artificial Intelligence | | | | | | |
|---|---|---|---|---|---|---|---|
| **Lecture** | **Tutorial** | **Practical** | **Credit** | **Major Test** | **Minor Test** | **Total** | **Time** |
| **3** | **0** | **0** | **3** | **75** | **25** | **100** | **3 Hr.** |
| **Course Outcomes** | | | | | | | |
| **CO1** | To familiarize the students with the fundamental concepts of Artificial Intelligance. | | | | | | |
| **CO2** | Students will able to learn the detail knowledge of Supervised and Unsupervised Learning. | | | | | | |
| **CO3** | After this unit students will be able to understand the concepts of Genetic Algorithm and Object Detection and Tracking | | | | | | |
| **CO4** | Students will be able to understand the concept of Artificial Neural Networks and reinforcement learning. | | | | | | |

UNIT-I

Introduction to Artificial Intelligence, need of AI, Applications of AI, Branches of AI, Defining intelligence using Turing Test, Classification, Preprocessing data, Label encoding, Logistic Regression classifier, Naïve Bayes classifier, Support Vector Machines.

UNIT-II

Regression, Building a single variable regressor, Building a multivariable regressor, Supervised and Unsupervised Learning, Detecting Patterns with Unsupervised Learning, Clustering data with K-Means algorithm, Estimating the number of clusters with Mean Shift algorithm,

UNIT-III

Genetic Algorithms, Fundamental concepts in genetic algorithms, Generating a bit pattern with predefined parameters Object Detection and Tracking: Frame differencing, Tracking objects using colorspaces, Object tracking using background subtraction, Face detection and tracking, Eye detection and tracking.

UNIT-IV

Artificial Neural Networks, Building a Perceptron based classifier, Constructing a single layer neural network, Constructing a multilayer neural network, Reinforcement Learning, Reinforcement learning versus supervised learning, Building blocks of reinforcement learning.

Text Book:

1. Introduction to Artificial Intelligence by Philip C. Jackson · 1974

Reference Book:

2. Artificial Intelligence by Chris Neil · 2020
3. Artificial Intelligence with Python by Prateek Joshi.

| ECP -22A | Internet of Things | | | | | | |
|---|---|---|---|---|---|---|---|
| **Lecture** | **Tutorial** | **Practical** | **Credit** | **Major Test** | **Minor Test** | **Total** | **Time** |
| **3** | **0** | **0** | **3** | **75** | **25** | **100** | **3 Hr.** |

| **Course Outcomes** | |
|---|---|
| **CO1** | Understand what IoT technologies are used for today, and what is required in certain scenarios. |
| **CO2** | Understand the types of technologies that are available and in use today and can be utilized to implement IoT solutions. |
| **CO3** | Understand the type of protocols and challenges for designing IoT systems. |
| **CO4** | Apply these technologies to tackle scenarios in teams of using an experimental platform for implementing prototypes and testing them as running applications. Understand operating system requirements of IOT. |

**Unit 1**

**Introduction to IoT:** Defining IoT, Characteristics of IoT, Functional blocks of IoT, Physical and logical design of IoT, Smart cities and IoT revolution, ,Difference between IoT and M2M, M2M and peer networking concepts Ipv4 and IPV6, Software Defined Networks SDN,

**Unit 2**

**Developing IoTs:** IoT design methodology, case study on IoT system for weather monitoring. IoT system Management,

Developing IoT applications through embedded system platform: Introduction to sensors, IoT physical devices and endpoints, Raspberry pi, Raspberry pi interfaces, Arduino, arduino interfaces.

**Unit 3**

**Protocols for IoT-** messaging protocols, transport protocols, Ipv4, Ipv6, URI, Cloud for IoT: IoT with cloud, challenges, introduction to fog computing, cloud computing,

Challenges in IoT: Design challenges, development challenges, security and legal considerations.

**Unit 4**

**Logic design using Python:** Introduction to python, data types, data structures, control flow, functions, modules, file handling and classes., implementing IotT concepts with python,

Applications of IoT, Connected cars IoT Transportation, Smart Grid and Healthcare sectors using IoT,

**References:**


1) A Bahaga, V. Madisetti, “Internet of Things- Hands on approach”, University press, 2014.
2) S.K.Vasudevan, A.S.Nagarajan, “Internet of Things”, Wiley, 2019.
3) CunoPfister, “Getting started with Internet of Things”, Maker Media, 1st edition, 2011. Samuel Greenguard, “Internet of things”, MIT Press, 2015.


**Web resources:**

1) http://www.datamation.com/open-source/35-open-source-tools-for-the-internet-of-things-1.html
2) https://developer.mbed.org/handbook/AnalogIn
3) http://www.libelium.com/50_sensor_applications
4) M2MLabs Mainspring http://www.m2mlabs.com/framework Node-RED http://nodered.org/

| ECP-23A | Error Correcting Codes | | | | | |
|---|---|---|---|---|---|---|
| | | | | | | |
| **Lecture** | **Tutorial** | **Practical** | **Major Test** | **Minor Test** | **Total** | **Time** |
| **3** | **0** | **0** | **75** | **25** | **100** | **3 Hr.** |
| **Course Outcomes** | | | | | | |
| **CO1** | Student will be able to evaluate linear codes | | | | | |
| **CO2** | Student will be able to evaluate cyclic codes | | | | | |
| **CO3** | Student will be able to evaluate BSH and RS codes | | | | | |
| **CO4** | Student will be able to evaluate convolution codes | | | | | |

**Unit- I**

**Basic concepts of linear codes:** Three fields, linear codes , generator and parity matrix, dual codes, weights and distances, puncturing codes, extending c odes, shortening codes, direct sums,permutation equivalent codes, Golay codes, RM Codes

**Unit- II**

**Cyclic Codes**: polynomials and euclidean algorithm, primitive elements, finite fields, subfields, field automorphism. clotomic cosets and minimal polynomials, factoring $x^n$ -1, zeros of cyclic code, minimum distance of cyclic codes.

**Unit -III**

**BCH and RS codes:** BCH codes, RS Codes, generalized RS codes, decoding BCH codes,burst error, concatenated and interleaving codes.

**Unit-IV**

**Convolution codes:** generator matrices and encoding, veterbi decoding: state diagram, trellis, diagram and viterbi algorithm, canonical generator matrices, free distance.
**Soft decision and iterative decoding: A**WGN, soft decision viterbi decoding, general viterbi algorithm, two way app decoding.

**Text Books:**
1.W. Cary Huffman, Fundamentals of Error-Correcting Codes by Cambridge University Press

**Reference Books:**
1. Ranjan Bose, Information Theory and Coding, McGraw Hill
2. W. Wesley Peterson and E. J. Weldon, *Error-Correcting Codes, The MIT Press*

**Note: Question paper template will be provided to the paper setter.**

| ECP-24A | Satellite Communication | | | | | | |
|---|---|---|---|---|---|---|---|
| **Lecture** | **Tutorial** | **Practical** | **Credit** | **Major Test** | **Minor Test** | **Total** | **Time** |
| **3** | **0** | **0** | **3** | **75** | **25** | **100** | **3 Hr.** |
| **Purpose** | **To familiarize the students with the concepts of Satellite communication and various terms, laws and multiple access schemes used in its working.** | | | | | | |
| **Course Outcomes** | | | | | | | |
| **CO1** | **To understand the concept of basics of satellite communication and various basic laws and terms of satellite communication.** | | | | | | |
| **CO2** | **To understand the concept and processes of various communication satellites used in satellite communication.** | | | | | | |
| **CO3** | **To familiarize with the concept and design issues of satellite link design and satellite access.** | | | | | | |
| **CO4** | **To familiarize with the concepts of Multiple access schemes used in satellite communication.** | | | | | | |

**Unit -I**

**SATELLITE ORBITS:** Orbital Mechanics- Kepler's laws ,locating the satellite in the Orbit, locating the satellite with respect to the earth, Orbital elements, look angle determination, Sub satellite point, Azimuth and elevation angle calculation, Orbital perturbations, Longitudinal and Inclination changes; Launches and launch vehicles-ELV's, Placing the satellite into geostationary orbit, Doppler shift, range variations, solar eclipse, sun transit outage.

**Unit -II**

**COMMUNICATION SATELLITES:** Satellite Subsystems, Attitude and Orbit Control system(AOCS), Telemetry, Tracking, Command and Monitoring (TTC&M), Power System, Communication Subsystems-description, Transponders, satellite antennas-basic antenna types, basic antennas in practice.

**Unit -III**

**Satellite link design and Satellite access:** Basic transmission theory**,** system noise temperature and G/T ratio; Downlink design-link budget; Uplink design; design for specified C/N, uplink and downlink attenuation in rain, communication link design procedure; system design examples.

**Unit –IV**

**Multiple access schemes:** FDMA, TDMA, CDMA, DAMA; VSAT systems-basic techniques, VSAT earth station engineering, system design; DBS systems-C-band and Ku band home TV, digital DBS; satellite mobile systems; GPS

**Text Books:**

1. Timothy Pratt, Satellite Communications, Wiley India edition

**Reference Books:**

2. Anil K Maini, Satellite Communication, Wiley India edition.
3. Siegmund M. Redl, Mathias K. Weber, Malcolm W. Oliphant, "An Introduction to GSM", Artech House Publishers, 1995.
4. Kraus, J.D., "Antennas", II Edition, John Wiley and Sons, NY, 1977. 5. Collin, R.E. and Zucker, F., - "Antenna theory: Part I", Tata McGraw Hill, NY, 1969.

| ECP-25A | High Speed Electronics | | | | | | |
|---|---|---|---|---|---|---|---|
| **Lecture** | **Tutorial** | **Practical** | **Credit** | **Major Test** | **Minor Test** | **Total** | **Time** |
| **3** | **-** | **-** | **3** | **75** | **25** | **100** | **3 Hour** |
| **Course Outcomes** | | | | | | | |
| **CO 1** | **Understand significance and the areas of application of high-speed electronics circuits.** | | | | | | |
| **CO 2** | **Understand the properties of various components used in high speed electronics** | | | | | | |
| **CO 3** | **Design High-speed electronic system using appropriate components.** | | | | | | |
| **CO 4** | **To be able to understand the effect of scaling on high speed VLSI circuits.** | | | | | | |

**UNIT-I**

Transit time of charge carriers, junction capacitances, ON-resistances and their dependence on the device geometry and size, carrier mobility, doping concentration and temperature. Contact resistance and interconnection/interlayer capacitances in the Integrated Electronics Circuits.

**UNIT-II**

Introduction to high-speed digital design: Frequency, time and distance - Capacitance and inductance effects - High seed properties of logic gates - Speed and power - Modelling of wires -Geometry and electrical properties of wires - Electrical models of wires - transmission lines - lossless LC transmission lines - lossy LRC transmission lines

**UNIT-III**

Devices: Passive and active, Lumped passive devices, Active : low frequency and high frequency models RF Amplifier Design, Stability, Low Noise Amplifiers, Broadband Amplifiers and Power Amplifiers, Class A, B, AB and C, D, E .

**UNIT-IV**

Impact of scaling on High Speed VLSI Circuit, Inter-Die Variation, Intra-Die Variation, Fail Causes Optimization Techniques for High Speed VLSI: Mathematic Optimization, Circuit optimization, CAD tool for optimization

Books:


1. Stephen H. Hall, Garrett W. Hall, James A. McCall "High-Speed Digital System Design: A Handbook of Interconnect Theory and Design Practices", August 2000, Wiley-IEEE Press
2. . Kerry Bernstein & et. al., High Speed CMOS Design Styles, Kluwer, 1999
3. William S. Dally & John W. Poulton; Digital Systems Engineering, Cambridge University Press, 1998
4. Howard Johnson & Martin Graham; High Speed Digital Design: A Handbook of Black Magic, Prentice Hall PTR, 1993
5. Masakazu Shoji; High Speed Digital Circuits, Addison Wesley Publishing Company, 1996
6. William S. Dally & John W. Poulton; Digital Systems Engineering, Cambridge University Press, 1998
7. Howard Johnson & Martin Graham; High Speed Digital Design: A Handbook of Black Magic, Prentice Hall PTR, 1993
8. Thomas H. Lee, "The Design of CMOS Radio-Frequency Integrated Circuits", CambridgeUniversity Press, 2004, ISBN 0521835399.
9. Behzad Razavi, "RF Microelectronics", Prentice-Hall 1998, ISBN 0-13-887571-5.
10. Guillermo Gonzalez, "Microwave Transistor Amplifiers", 2nd Edition, Prentice Hall.

11. Kai Chang, “RF and Microwave Wireless systems”, Wiley.
12. R.G. Kaduskar and V.B.Baru, Electronic Product design, Wiley India, 2011 Course Outcomes:

| ECP-26A | Software Defined Radio | | | | | | |
|---|---|---|---|---|---|---|---|
| **Lecture** | **Tutorial** | **Practical** | **Credit** | **Major Test** | **Minor Test** | **Total** | **Time** |
| **3** | **-** | **-** | **3** | **75** | **25** | **100** | **3 Hrs.** |
| **Purpose** | **To understand the underlying principles of Software Defined Radios and Cognitive Radio Networks.** | | | | | | |
| **Course Outcomes** | | | | | | | |
| CO1 | Understand the principles behind the Software Defined Radios over the conventional Cognitive Radios | | | | | | |
| CO2 | Ability to analyze Software Defined Networking protocols and cognitive radio techniques | | | | | | |
| CO3 | Understand the data traversal over SDN | | | | | | |
| CO4 | Design algorithms for Software Defined Radio and cognitive radio environments | | | | | | |
| CO5 | Understand the various types of key routing and switching techniques used in adaptive networks. | | | | | | |

**UNIT I**

**SOFTWARE DEFINED RADIO CONCEPTS**

Need for Software Radios - Characteristics and Benefits of a Software Radio - Design Principles of a Software Radio - RF Receiver Front-End Topologies - Importance of the Components to Overall Performance - Transmitter Architectures and Their Issues - Noise and Distortion in the RF Chain ADC and DAC Distortion - Flexible RF Systems

**UNIT II**

**SDR AS A PLATFORM FOR COGNITIVE RADIO**

Hardware Architecture: Baseband Processors - Hardware Architecture: Multi-Core Systems - Software Architecture: Design Philosophies - GNU Radio - Software Communications Architecture - Application Software - Component Development - Waveform Development - Cognitive Waveform Development

**UNIT III**

**COGNITIVE RADIO: TECHNOLOGIES REQUIRED**

Software Capable Radios - Software Programmable Radios - SDR Examples - Aware Adaptive and CRs - Radio Capabilities and Properties Comparison - Spectrum Awareness and Frequency Occupancy - Software Technology - Funding and Researches in CRs - Directions and Standards

**UNIT IV**

**OBJECT ORIENTED REPRESENTATION OF RADIOS**

Introduction to Network Resources - Network Resources - Object Oriented Programming - Object Request Broker Architecture - Object Brokers and Software Radios - Mobile Application Environments - Security in Software Radios - Joint Tactical Radio Systems - SCA Architectures.

REFERENCES

1. Software Radio: A Modern Approach to Radio Engineering By Jeffrey H. Reed Pearson Education Low Price Edition

2. “Cognitive Radio Technology”, Bruce A Fette, Academic Press, 2009

3. Cognitive Radio Networks by Wyglinski, Alexander M. Nekovee, Maziar, Hou, Y. Thomas, 2010 Elsevier.

4. “Cognitive Radio, Software Defined Radio and Adaptive wireless system, Huseyin Arslan , Springer, 1 edition ,September 24, 2007

| ECP-18LA | Wireless Communication Lab | | | | | | |
|---|---|---|---|---|---|---|---|
| **Lecture (Hrs.)** | **Tutorial (Hrs.)** | **Practical (Hrs.)** | **Credit** | **Practical** | **Minor Test** | **Total** | **Time** |
| **-** | **-** | **4** | **2** | **60** | **40** | **100** | **3 Hrs.** |

**Course Outcomes (CO)**

To give the students an idea about the Wireless communication theory and technology using the NI-Labview software and RF communication module.

| | |
|---|---|
| **CO1** | To study the wireless communication using NI-Labview |
| **CO2** | To learn about the functioning of Universal Software Radio Peripheral (USRP) |
| **CO3** | To learn the implementation of different analog modulation schemes using the USRP |
| **CO4** | To learn the implementation of different digital modulation schemes using the USRP. |

**List of Experiments:**

1. Introduction to NI-LabVIEW and familiarization with its basic functions.
2. Study of modulation toolkit and its usage in Wireless Communication.
3. Study the interfacing of hardware (USRP module) with the PC and configuring the same.
4. Implementation of AM using Software Defined Radio (SDR).
5. Implementation of FM using SDR with application such as transfer of files
6. Implementation of M-PSK transmitter using SDR concept.
7. Implementation of M-PSK receiver using SDR
8. Implementation of M-QAM transmitter using SDR.
9. Demonstrates the use of the Bluetooth functions to set up data transfer via Bluetooth between a server VI and a client VI.
10. Design two-dimensional convolution to perform image edge detection.
11. Implementation of M-QAM receiver using SDR.
12. Implementation of PSK Modulation system with Convolutional Coding.
13. Implementation of FSK Modulation system with BCH Coding.
14. Implementation of QAM Modulation system with Golay Coding

| ECP-19LA | Biomedical lab | | | | | | |
|---|---|---|---|---|---|---|---|
| **Lecture (Hrs.)** | **Tutorial (Hrs.)** | **Practical (Hrs.)** | **Credit** | **Practical** | **Minor Test** | **Total** | **Time** |
| **-** | **-** | **4** | **2** | **60** | **40** | **100** | **3 Hrs.** |
| **Course Outcomes (CO)**<br>**At the end of the course, student will be able to** | | | | | | | |
| **CO1** | **Elaborate various biomedical signals** | | | | | | |
| **CO2** | **Acquire and simulate ECG ,EMG and EEG biomedical signals** | | | | | | |
| **CO3** | **Simulate ECG Pulse missing detector** | | | | | | |
| **CO4** | **Demonstrate the functions of defibrillator and pacemaker** | | | | | | |

**List of Experiments:**

1. Familiarization of various biomedical signals.
2. To simulate Electrocardiogram Waveform
3. To simulate Electroencephalogram Signal
4. To simulate Electromyogram Signal
5. To Simulate Defibrillator
6. To simulate Pacemaker
7. To simulate Haemodialysis Machine
8. To simulate Biopotential Amplifier
9. To simulate ECG Pulse missing detector.
10. To simulate 12 Lead ECG Signals.

| ECP-20LA | Machine Learning Lab | | | | | | |
|---|---|---|---|---|---|---|---|
| **Lecture (Hrs.)** | **Tutorial (Hrs.)** | **Practical (Hrs.)** | **Credit** | **Practical** | **Minor Test** | **Total** | **Time** |
| **-** | **-** | **4** | **2** | **60** | **40** | **100** | **3 Hrs.** |
| **Course Outcomes (CO)**<br>**At the end of the course, student will be able to** | | | | | | | |
| **CO1** | Elaborate machine learning fundamentals | | | | | | |
| **CO2** | Implement different classification/regression algorithms | | | | | | |
| **CO3** | Design and develop artificial neural networks for different applications | | | | | | |
| **CO4** | Develop clustering algorithms | | | | | | |

List of Experiments:

1. To get familiarize with machine learning.
2. Implement and demonstratethe FIND-Salgorithm for finding the most specific hypothesis based on a given set of training data samples. Read the training data from a .CSV file
3. For a given set of training data examples stored in a .CSV file, implement and demonstrate the Candidate-Elimination algorithmto output a description of the set of all hypotheses consistent with the training examples.
4. Write a program to demonstrate the working of the decision tree based ID3 algorithm. Use an appropriate data set for building the decision tree and apply this knowledge to classify a new sample.
5. Build an Artificial Neural Network by implementing the Backpropagation algorithm and test the same using appropriate data sets.
6. Write a program to implement the naïve Bayesian classifier for a sample training data set stored as a .CSV file. Compute the accuracy of the classifier, considering few test data sets.
7. Assuming a set of documents that need to be classified, use the naïve Bayesian Classifier model to perform this task. Built-in MATLAB/Python/Java classes/API can be used to write the program. Calculate the accuracy, precision, and recall for your data set
8. Apply EM algorithm to cluster a set of data stored in a .CSV file. Use the same data set for clustering using k-Means algorithm. Compare the results of these two algorithms and comment on the quality of clustering. You can add MATLAB/Java/Python ML library classes/API in the program.

9. Write a program to implement k-Nearest Neighbour algorithm to classify the iris data set. Print both correct and wrong predictions. MATLAB/Java/Python ML library classes can be used for this problem
10. Implement the non-parametric Locally Weighted Regression algorithm in order to fit data points. Select appropriate data set for your experiment and draw graphs.

| ECP-21LA | Artificial Intelligence Lab | | | | | | |
|---|---|---|---|---|---|---|---|
| **Lecture** | **Tutorial** | **Practical** | **Credit** | **Practical** | **Minor test** | **Total** | **Time** |
| **0** | **0** | **4** | **2** | **60** | **40** | **100** | **3 Hr.** |
| **Course Outcomes**<br>**At the end of the course student will be able to** | | | | | | | |
| **CO1** | Implement AND/OR&NOT gate using single layer perception | | | | | | |
| **CO2** | Implement XOR gate using multilayer perception | | | | | | |
| **CO3** | Demonstrate the function of fuzzification/defuzzification processes | | | | | | |
| **CO4** | Demonstrate different case studies in the domain | | | | | | |

List of Experiments:

1. Implementation of AND/OR/NOT Gate using Single Layer Perceptron
2. Implementation of XOR Gate Using Multi-Layer Perceptron/ Error Back Propagation
3. Implementation of XOR Gate Using Radial Basis Function Network
4. Understanding the concepts of Perceptron Learning Rule
5. Understanding the concepts of Hebbiann Learning Rule
6. Understanding the concepts of Correlation Learning Rule
7. Understanding the working of Kohonen's Self Organising Maps
8. Understanding the functioning of Fuzzification process
9. Implementation of different method of Defuzzification process
10. Case study explaining function of Fuzzy Inference System
11. Case study explaining function of Optical Character Recognition

| ECP-22LA | Internet of Things Lab | | | | | | |
|---|---|---|---|---|---|---|---|
| **Lecture** | **Tutorial** | **Practical** | **Credit** | **Practical** | **Minor test** | **Total** | **Time** |
| **-** | **0** | **4** | **2** | **60** | **40** | **100** | **3 Hr.** |
| **Course Outcome: Students will be able to get the idea of Internet of Things technology.** | | | | | | | |
| **CO1** | **Student will be able to get familiarize with Arduino and Raspberry Pi** | | | | | | |
| **CO2** | **Student will be able to implement interfacing different sensorss with Arduino and Raspberry Pi** | | | | | | |
| **CO3** | **Student will be able to understand the concept of cloud** | | | | | | |
| **CO4** | **Student will be able to design module based on Internet of Things application** | | | | | | |

**List of Experiments**

1. Familiarization with concept of IoT, Arduino/Raspberry Pi and perform necessary software installation.
2. To interface LED/ Buzzer using relay with Arduino/Raspberry Pi and write a program to turn ON/OFF LED/Buzzer.
3. To interface Push button/Digital sensor (IR/LDR) with Arduino/Raspberry Pi and write a program to turn ON LED when push button is pressed.
4. To interface Analog sensors( Temperature/Humidity/ Ultrasonic) with Arduino/Raspberry Pi and write a program to display sensors data on the computer screen.
5. To interface OLED with Arduino/Raspberry Pi and write a program to print sensor data on it.
6. To interface sensor with Arduino/Raspberry Pi and write a program to turn ON/OFF Relay when sensor data is detected.
7. To interface motor using relay with Arduino/Raspberry Pi and write a program to turn ON/OFF motor when push button is pressed.
8. To interface Bluetooth with Arduino/Raspberry Pi and write a program to send sensor data on smart phone using Bluetooth.
9. To interface Bluetooth with Arduino/Raspberry Pi and write a program to turn LED ON/OFF when a 1/0 is received from smartphone using Bluetooth.
10. Write a program to upload sensor data on cloud.
11. Write a program to retrieve sensor data from cloud.

Components required-

1. Arduino with cable
2. Raspberry Pi with cable and memory card
3. Node MCU
4. Sensors-IR, LDR, DHT11 sensor, Push button, Pressure senser, Temperature sensor, Vibration, Rotation, Location, Torque, Sound, Weight etc.
5. Actuators-LED, Buzzer, Relay Switch, Motors, Motor Drivers, OLED, Display, Linear Actuator,
6. Bluetooth Module, Wi-fi Module, Ethernet Module
7. Smart Phone
8. Computer
9. Power Supply-5V, 12V, 3.3V
10. Internet facility

| ECP-23LA | Augmented Reality/Virtual Reality Lab | | | | | | |
|---|---|---|---|---|---|---|---|
| **Lecture (Hrs.)** | **Tutorial (Hrs.)** | **Practical (Hrs.)** | **Credit** | **Practical** | **Minor Test** | **Total** | **Time** |
| **-** | **-** | **4** | **2** | **60** | **40** | **100** | **3 Hrs.** |
| **Course Outcomes (CO)**<br>**To expose the students to the most recent technology i.e. Augmented Reality and Virtual Reality.** | | | | | | | |
| **CO1** | **Student will be able to familiarization of basics of Augmented Reality and Virtual Reality** | | | | | | |
| **CO2** | **Student will be able to Design 3D Objects** | | | | | | |
| **CO3** | **Student will be able to get an idea about the Vuforia .** | | | | | | |
| **CO4** | **Student will be able to design Game in Unity 3D Project.** | | | | | | |

List of Experiments

1. To get familiarization with the basics of AR/VR
2. Introduction to Unity 3D, and its game objects, materials, cameras, standard assets, asset store, adjusting size, position and rotation of game objects .
3. Program to Design 3D Modelling, Importing 3D models in Unity 3D, and to add buttons.
4. Program to Design of animating 3D models, adding material to 3d models
5. Program to Design User Interface using Unity 3D and customizing the colour, size, background, text etc. of the UI elements
6. To learn about Scripting, Adding scripts to game objects, controlling objects with scripts, button functionality with scripting.
7. Program to design Prefabs/Physics Elements, Creating prefabs, adding physics to game objects.
8. To learn about Vuforia SDK, Vuforia integration with Unity 3D, selecting a perfect image for AR development.
9. To design 2D game on Unity 3D
10. To learn about Scene Management in Augmented Reality Applications, MultiScene Arrangement in Augmented Reality Applications

Note: the above mentioned experiments are not limited. Teacher may introduce new experiments