Amrita Vishwa Vidyapeetham
School of Engineering
Department of Electronics and Communication Engineering

Branch: Electronics and Communication Engineering

Vision of the Department
To provide a value-based learning environment for producing engineers with a blend of technical skills, moral values and leadership qualities in the field of Electronics, Communication and Computing channelized towards technological advancement to cater to the needs of the industry and the society.

Mission of the Department

M1: Achieving excellence in teaching and learning with an emphasis on fundamental knowledge and hands-on exposure to match the state-of-the-art in technology.

M2: Providing an environment for core competency development and enhancing quality research in emerging areas.

M3: Facilitating professional growth to the students for higher education and career in industry and academia.

M4: Imbibing the essence of human values, ethics and professional skills to sustain socio-economic development.

Program Educational Objectives (PEOs)

PEO1: To integrate fundamental knowledge of basic science, mathematics and engineering to work on complex problems in the field of electronics and communication engineering.

PEO2: To promote independent research and continuous learning by providing hands-on exposure in electronics, signal processing and communication domains.

PEO3: To provide a platform to explore and pursue interests in diversified fields for a successful career.

PEO4: To nurture team spirit and leadership qualities with a sense of social responsibility and produce engineers with an ability to integrate engineering and society.

Program Objectives

To understand the

PO1: principles of Electronics & Electronic Devices

PO2: design, analysis & prototyping of Electronic Circuits & Systems

PO3: development of Large Scale Integrated Circuits

PO4: principles of Computing & Embedded Systems

PO5: principles and Techniques of Signal Processing

PO6: principles of Communication Engineering
PO7: principles, design & analysis of Modern Communication Systems

Program Specific Outcomes (PSO)

PSO1: To design, develop and prototype Electronic Systems

POS2: To design and develop VLSI & Embedded Systems

PSO3: To design and analyse the performance of Modern Communication Systems

Course Outcome (CO)

Statements that describe what students are expected to know, and are able to do at the end of each course. These relate to the skills, knowledge and behavior that students acquire in their progress through the course.

Program Outcomes (POs)

Program Outcomes are statements that describe what students are expected to know and be able to do upon graduating from the Program. These relate to the skills, knowledge, attitude and behavior that students acquire through the program. National Board for Accreditation (NBA) has defined the program outcomes for each discipline.

Program Outcomes for Engineering

1. Engineering knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.

2. Problem analysis: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

3. Design/development of solutions: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.

4. Conduct investigations of complex problems: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.

5. Modern tool usage: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.

6. The engineer and society: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.

7. Environment and sustainability: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.

8. Ethics: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.

9. Individual and team work: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.

10. Communication: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.

11. Project management and finance: Demonstrate knowledge and understanding of the engineering and management principles and apply these to one’s own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.

12. Life-long learning: Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.
ABBREVIATIONS USED IN THE CURRICULUM

Cat - Category
L - Lecture
T - Tutorial
P - Practical
Cr - Credits
AES - Aerospace Engineering
AIE - Computer Science and Engineering - Artificial Intelligence
BIO - Biology
CCE - Computer and Communication Engineering
CHE - Chemical Engineering
CHY - Chemistry
CSE - Computer Science and Engineering
CVL - Civil Engineering
CUL - Cultural Education
EAC - Electronics for Computer Engineering
ECE - Electronics and Communication Engineering
EEE - Electrical and Electronics Engineering
ELC - Electrical and Computer Engineering
ENGG - Engineering Sciences (including General, Core and Electives)
HUM - Humanities (including Languages and others)
IC - Integrated Circuit
MAT - Mathematics
MEE - Mechanical Engineering
MAOM - Mastery over Mind
MIMO - Multiple Input and Multiple Output
PHY - Physics
PRJ - Project Work (including Seminars)
SCI - Basic Sciences (including Mathematics)
VLSI - Very Large Scale Integration
# CURRICULUM

## Semester I

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**TOTAL CREDITS** 160

### PROFESSIONAL ELECTIVES

**Wireless Communication**

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**VLSI**

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- Continuous assessment can be quiz/assignment/mix of quiz and assignment totaling up to four (4)
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| SCI  | 23PHY241    | Electrical Engineering Materials                | 3 0 0 | 3      |
| SCI  | 23PHY242    | Physics of Lasers and Applications              | 3 0 0 | 3      |
| SCI  | 23PHY243    | Concepts of Nanophysics and Nanotechnology      | 3 0 0 | 3      |
| SCI  | 23PHY244    | Physics of Semiconductor Devices                | 3 0 0 | 3      |
| SCI  | 23PHY245    | Astrophysics                                    | 3 0 0 | 3      |

**Mathematics**

| SCI  | 23MAT240    | Statistical Inference                           | 3 0 0 | 3      |
| SCI  | 23MAT241    | Introduction to Game Theory                     | 3 0 0 | 3      |
| SCI  | 23MAT242    | Numerical Methods and Optimization              | 3 0 0 | 3      |
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Course Objectives

- To provide an understanding of nature from an engineering perspective
- To enable the study of engineering systems inspired by nature
- To motivate the development of technological ideas based on nature

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

CO1: understand the principles of systems in nature
CO2: understand engineering principles that are derived from nature
CO3: identify and ideate technological concepts inspired by nature
CO4: apply the concepts learnt to address simple engineering problems

CO-PO Mapping

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Syllabus

The course will consist of discussions of case studies, broadly classified into three groups of a minimum of 5 each:

Unit I
Introduction – Biological inspiration; Common characteristics of natural and engineered systems; Examples - Bullet train shape / Kingfisher’s beak (helping to reduce aerodynamic stress); Beehive structure (evaporative cooling and natural ventilation); Whale fin structure / Wind turbine blades (role of tubercules); Velcro tape / Hooks and loops (plants); Golden ratio in nature / Fibonacci numbers (ratio of dimensional properties)

Unit II
Biomimetics – Mimicking nature; Examples - Gene Therapy / Immunotherapy; Dam / Beavers (structural engineering); Aerodynamics / Flight / Birds (Wings, heavier-than-air flight, Humming Bird); Earthworm / Self-Cleaning by means of small electric currents; Lizards / locomotion (inter-atomic bonding); Lizards – change in direction of hair, with no stickiness / Scotch tape; Bones / Material shaping

Unit III
Bio-inspired Innovations - Control Theory / Feedback / Biomechanisms; Digital Electronics / Human logic; Echolocation / Dolphins / Bats (echolocation); Artificial Intelligence / Neural Networks;

Textbooks:

References:

Other resources:
2. https://tinyurl.com/Pawlyn-01
Course Objectives

- To strengthen the concepts of single variable calculus and linear ODEs
- To provide the fundamentals of matrix algebra
- To introduce the concepts and importance of Eigen values and Eigen vectors

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

- **CO1**: solve problems involving limits, derivatives and ODEs
- **CO2**: model and solve system of linear equations
- **CO3**: characterize systems using Eigen values and vectors
- **CO4**: apply the mathematical concepts learnt, to engineering problems

**CO-PO Mapping**

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Syllabus

**Unit I**
Calculus: Limit and Continuity: Limit of Functions, Continuous functions, Discontinuities, Monotonic Functions, Infinite Limits; Derivatives, Integration- Definite Integrals, Mean value theorem for definite integrals, Fundamental Theorem of Calculus, Integration Techniques. Examples of applications of the above in solving real engineering problems.

**Unit II**
Differential Equations: Ordinary differential equations (ODE), Linear differential equations, Modelling problems: Electric circuits; Second order Differential Equations, Homogeneous Systems and Non-homogeneous with constant coefficients, System of ODEs, Basic concepts and theory; Examples of applications of the above in solving real engineering problem.

**Unit III**
Matrix Algebra: Review - System of linear Equations, linear independence; Properties of Matrices, Symmetric and Skew Symmetric Matrices, Hermitian and Skew Hermitian Matrices and Orthogonal matrices; Eigen values and Eigen vectors; Positive definite, negative definite and indefinite, Diagonalization and Orthogonal Diagonalization; Examples of applications of the above in solving real engineering problem.

Textbook(s)

Reference(s)
Course Objectives

- To provide insight into computational logic
- To introduce the fundamentals of computational thinking
- To introduce computational approach to problem solving

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

CO1: understand the concepts of computational logic
CO2: develop algorithmic thinking
CO3: identify algorithms and their suitability
CO4: apply algorithms to solve a problem

CO-PO Mapping

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Syllabus

Unit I
Introduction - Computational thinking, corner stones of computational thinking; characteristics of algorithms; problem solving strategies, computational logic, Boolean expressions and logic, data organization, variables, list, arrays and strings.

Unit II
Algorithmic thinking – name binding, sequence, selection, repetition and modularization; Modeling tools-state diagrams, pseudocodes and flowcharts – code tracing - problem solving with algorithms – merging, searching, sorting and recursions-brute force and greedy algorithms

Unit III
Introduction to analysis of algorithms - Algorithmic complexity, linear, logarithmic and exponential computational complexity – Introduction to Python programming.

Textbook(s)

Reference(s)

Lab Syllabus

Define a system which might cover most of the experiments. It is possible to define at most 2 systems for whole experiments of this course. In the beginning of the lab class, system level explanation must be given to the students.

Examination/evaluation for system level should have higher weightage of marks. They need to develop system (at least prototype) at the end, not on breadboard.

Example:
Develop logic/flow chart/algorithm for a multifunctional calculator.
Model different circuit topologies with dependent sources and analyze resulting voltage and current sources.
Experiment Contents:
1. Familiarization with flowgorithm
2. Visualization of logical flow in flowgorithm using addition and subtraction of two numbers.
3. Exposure to various formatting methods using problems on addition, subtraction, calculation of area of circle and identification of odd even numbers.
4. Arithmetic operations on vectors and matrices.
5. Solving Quadratic equations and generation of Fibonacci numbers
6. Modelling Simple resistive circuits
7. Use of arrays in solving problems.
8. Familiarization with strings.
9. Searching (linear and binary)
10. Sorting (bubble sort, insertion sort and selection sort)
11. Modelling circuits with dependent sources.

Textbook(s)

Reference(s)

Syllabus
Unit I

Unit II
AC and DC circuit Analysis – Ohm’s law, Kirchhoff’s voltage and Current law, Voltage divider and Current divider Rule, star delta transformation, Mesh and Nodal Analysis, Source transformation, Superposition Theorem, Thevenin & Norton’s Theorems, and Maximum power transfer theorem.

Unit III
Electrical Machines – Construction, Principle of operation and applications, DC generator and DC Motors. Significance of back EMF and EMF equation. Types of DC motors, Speed, Torque, Torque-Speed characteristics, Load characteristics, Construction and working principles of three phase induction motor and single phase transformer.

Textbook(s)

Reference(s)

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## 23ECE104 Physics of Semiconductors
(Pre-requisite: Nil)

### Course Objectives
- To provide an understanding of crystal structure
- To help appreciate the band gap nature of semiconductors
- To introduce the concepts of transport phenomena in semiconductors

### Course Outcomes: At the end of the course, the student should be able to
- CO1: understand the crystal structure of semiconductors
- CO2: understand semiconductors based on energy band gap
- CO3: understand current flow in semiconductors
- CO4: understand the behaviour of PN junctions & MOSFETs

### CO-PO Mapping

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### Syllabus

#### Unit I
Crystal structures - Crystal lattice, basis, unit cell and lattice parameters, crystal systems and Bravais lattices – Structure and packing fractions of SC, BCC, FCC, diamond cubic, NaCL; ZnS structures – crystal planes, directions and Miller indices, Imperfections in crystals.

#### Unit II

#### Unit III
Basic structure of PN junctions – Built-in-potential, Space Charge region, electric field across junction, Forward and reverse bias, band diagram, minority carrier distribution across junction in forward and reverse bias, boundary conditions; Basics of MOSFET – Structure of MOSFET, band diagram of MOS, Ideal MOS Capacitor, FET operation and their applications.

### Textbook(s)

Reference(s)

Course Objectives

- To provide understanding of basic programming in C
- To provide knowledge on programming constructs
- To enable development of modular programs

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

CO1: understand the syntax and semantics of programming
CO2: apply appropriate programming constructs
CO3: analyze programs and debug errors
CO4: develop programs to solve specific problems

CO-PO Mapping

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Syllabus

Unit I
Introduction- structure of C program: data types, storage classes, constants, enumeration constant, keywords, variables, operators, expressions, input/output statements, assignment statement conditional statements; number system: binary, decimal, hexadecimal, conversion between number system types; Introduction to tools – IDE, compilation, linking, debugging.

Unit II
Control flow statements - if-else, Looping – for, while, do-while, switch case, break and continue, goto and labels; Functions – function prototype, function definition, function call, built-in functions, recursion; Arrays – declaration, initialization, one-dimensional, matrix, multi-dimensional, array operations; string operations – length, compare, concatenate, copy. Recursion – recursive definition, recursive solution, designing recursive functions, limitations of recursion.

Unit III
Pointers – pointer operators, pointer arithmetic, array and pointers, array of pointers, parameters passing – pass by value, pass by reference; Structures – simple structure, nested structure, pointers and structure, array of structures, self-referential structures, dynamic memory allocation, typedef; Input-output – command line arguments; File operations – types, sequential access, random access.

Textbook(s)

Reference(s)
Course Objectives

- To provide hands-on experience of identifying electrical components and their specifications
- To help understand circuit theorems using practical circuits and measurements
- To demonstrate the principles of electrical machines

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

CO1: identify electrical components and their specifications
CO2: measure electrical quantities such as voltage and current
CO3: verify theorems for dc circuits
CO4: understand the operation of electrical machines

CO-PO Mapping

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Syllabus

Define a system which might cover most of the experiments. It is possible to define at most 2 systems for whole experiments of this course. In the beginning of the lab class, system level explanation must be given to the students.

Examination/evaluation for system level should have higher weightage of marks. They need to develop system (at least prototype) at the end, not on breadboard.

Example:
Design a circuit to validate most of the theorems listed in the experiment contents by changing the loads (appliances such as different power rating of lamp or others)

- Design Wheatstone bridge and modify one arm with one unknown resister (like sensor) and find the required load.

Experiment Contents:
1. Identification of electrical components and their specifications.
2. Familiarization of equipments like Multimeter, Function generator, DC Power supply and DSO, etc.
3. Verification of Kirchhoff’s laws.
4. Verification of Superposition theorem
5. Verification of Thevenin and Norton theorems
6. Speed control of a D.C motor.
7. Single phase transformers – turns ratio measurement, Step down/up
9. System Development (Mandatory)

Textbook(s)

Reference(s)
Course Objectives

- To provide hands-on exposure to programming in C
- To facilitate usage of Integrated Development Environment (IDE)
- To enable develop and debug programs

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

- CO1: write and execute simple programs
- CO2: employ IDE for compiling and debugging
- CO3: handle dynamic input-output operations
- CO4: develop programs for specific applications

CO-PO Mapping

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Syllabus

**Define a system which might cover most of the experiments. It is possible to define at most 2 systems for whole experiments of this course. In the beginning of the lab class, system level explanation must be given to the students.**

Examination/evaluation for system level should have higher weightage of marks. They need to develop system (at least prototype) at the end, not on breadboard.

Example:

Let them develop something which either dept. can use, admin can make use of, finance dept. can make use of or they themselves can make use of.

Experiment Contents:

1. Practice of Simple C Programs.
2. Control statements
3. Array concept
4. 1-D and multi-dimensional arrays operation
5. Strings and sorting of strings
6. Various types of functions and recursive functions
7. Pointers, Strings and pointers
8. Structures
9. File input/output and command line arguments
10. File handling and Dynamic memory allocation

Textbook(s)


Reference(s)


### Course Objectives

- To study fundamental concepts of Indian Heritage
- To discuss the cultural, philosophical, and historical facets of India
- To familiarize eternal and all-pervading nature of India’s cultural and spiritual ethos

### Course Outcomes:

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

**CO1:** understand true essence of India’s cultural and spiritual heritage  
**CO2:** understand the ethical and political strategic concepts to induce critical approach to various theories about India.  
**CO3:** get familiarized with the multidimension of man’s interaction with nature, fellow beings and society in general.  
**CO4:** appreciate the socio-political and strategic innovations based on Indian knowledge systems

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### Syllabus

**Unit I**

Introduction - Educational Heritage of Ancient India- Life and Happiness- Impact of Colonialism and Decolonization- A timeline of Early Indian Subcontinent

**Unit II**

Pinnacle of Selflessness and ultimate freedom- Indian approach towards life- Indian Mahatmas.

**Unit III**

Man’s association with Nature- Metaphors and Tropes- Indian approach towards strategic thinking- India: In the Views of Other Scholars and Travellers- Personality Development Through Yoga- Hallmark of Indian philosophical tradition- Conversations on Compassion with Amma

### Textbook(s)

Foundations of Indian Heritage, Amrita Vishwa Vidyapeetham (University publication)

### Reference(s)

2. Basham A. L., “The wonder that was India”, Sidwick and Jackson, 1954.
Course Objectives

- To enhance health and wellbeing of all faculty, staff, and students (UN SDG-3).
- To manage stressful emotions and anxiety, in turn facilitating inner peace and harmony.
- To enhance the understanding of experiential learning based on the University’s mission: “Education for Life along with Education for Living” and is aimed to allow learners to realize and rediscover the infinite potential of one’s true Being and the fulfillment of life’s goals.

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

CO1: describe what meditation is and to understand its health benefits.
CO2: understand the causes of stress and how meditation improves well-being.
CO3: understand the science of meditation.
CO4: learn and practice MA OM meditation in daily life.
CO5: understand the application of meditation to improve communication and relationships.
CO6: understand the power of meditation in compassion-driven action.

CO-PO Mapping

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Syllabus

The course syllabus will be covered in six units as described below

Unit 1: Describe Meditation and Understand its Benefits (CO1)

A: Importance of meditation. How does meditation help to overcome obstacles in life (Pre-recorded video with Swami Shubhamritananda Puri)

Reading 1: Why Meditate? (Swami Shubamritananda ji)


Additional Reading: Abhyasa Yoga: The Yoga of Practice. (Br. Achyutamrita Chaitanya)

B: Understand how meditation works. Understand how meditation helps in improving physical and mental health. Understand how meditation helps in the development of personality (Pre-recorded video with Dr. Ram Manohar)

Reading 1: Allen, Cynthia (2020) The Potential Health Benefits of Meditation

Additional Reading: Sharma, Hari (2022) Meditation: Process and Effects

Unit 2: Causes of Stress and How Meditation Improves Well-being (CO2)
A: Learn how to prepare for meditation. Understand the aids that can help in effectively practicing meditation. Understand the role of sleep, physical activity, and a balanced diet in supporting meditation. (Pre-recorded video with Dr. Ram Manohar)


Unit 3: The Science of Meditation (CO3)

A: A preliminary understanding of the Science of meditation. What can modern science tell us about this tradition-based method? (Pre-recorded video with Dr. Shyam Diwakar)

B: How meditation helps humanity according to what we know from scientific research (Pre-recorded video with Dr. Shyam Diwakar)

Reading 1: Does Meditation Aid Brain and Mental Health (Dr Shyam Diwakar)


Unit 4: Practicing MA OM Meditation in Daily Life (CO4)

Guided Meditation Sessions following scripts provided (Level One to Level Five)

Reading 1: MA OM and White Flower Meditation: A Brief Note (Swami AtmanandaPuri)


Unit 5: Improving Communication and Relationships (CO5)

How meditation and mindfulness influence interpersonal communication. The role of meditation in improving relationship quality in the family, at the university and in the workplace. (Pre-recorded video with Dr Shobhana Madhavan)


Unit 6 Meditation and Compassion-driven Action (CO6)

Understand how meditation can help to motivate compassion-driven action. (Pre-recorded video with Dr Shobhana Madhavan)


Text Books/Reference Books:

1. Meditation and Spiritual Life-Swami Yatiswarananda, Ramakrishna Math
3. Dhyana Yoga-Holy Gita Swami Chinmayanda
4. Voice of God, Chandrasekharendra Saraswati, 68th Acharya of Sri Kanchi Kamakoti Peetam,
5. Hindu Dharma-Chandrasekharendra Saraswati, 68th Acharya of Sri Kanchi Kamakoti Peetam,
6. Mind: It’s Mysteries and control-Swami Sivananda Saraswati
8. Books on Amma’s teachings like Awaken children, From Amma’s Heart etc.

SEMESTER II

23MAT130  Engineering Mathematics –II  L-T-P-C: 3-1-0-4
(Pre-requisite – Engineering Mathematics-I)

Course Objectives

- To introduce the concepts of multivariable calculus
- To introduce the concepts of vector space and inner products
- To provide the foundations of matrix transformations and decompositions

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

CO1: solve problems involving vector differentiation and integration
CO2: understand the concepts of vector spaces and orthonormalisation
CO3: apply matrix transformations to linear system
CO4: apply concepts of vector calculus and linear algebra to engineering problems

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Syllabus

Unit I
Vector Spaces - Vector spaces, subspace, linear independence, basis, row, column and null spaces and dimension theorem. Inner product space, orthogonally, Gram-Schmidt orthogonalisation. Linear Transformation (matrix transformation) and inverse linear transformation; Matrix Decompositions: LU, QR, Jordan, EVD, and SVD decompositions. Examples of applications of the above in solving real engineering problems.

Unit II
Vector Differentiation- Vector and Scalar Functions, Derivatives, Curves, Tangents, Arc Length, Curves in Mechanics, Velocity and Acceleration, Gradient of a Scalar field, Directional derivative, Divergence of a Vector field, Curl of a Vector field. Examples of applications of the above in solving real engineering problems.

Unit III
Textbook(s)


Reference(s)


Course Objectives

- To enable the design of diode-based circuits
- To provide an understanding of the operation and analysis of MOSFET circuits
- To enable an understanding of BJTs & FinFETs

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

CO1: characterise semiconductor diodes
CO2: analyse diode-based circuits
CO3: design diode-based circuits for specific applications
CO4: understand the operation of transistors

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Syllabus

Unit I
Diode and its applications- PN Junction Diodes, Forward and Reverse Biasing, Reverse Saturation Current, Diode current components, Cut-in voltage; VI Characteristics, Diode Models; Zener diodes -Shunt voltage regulator, Regulator Design, Schottky diode, Tunnel diode, LED’s, Varactor diodes; Rectification – Half-wave, Full-wave and Bridge, Rectifier with and without Filters; Wave shaping circuits- Clipping & Clamping Circuits, voltage multiplier.

Unit II
MOSFET –Construction, structure, Enhancement and depletion mode, Regions of operation; MOSFET characteristics; MOSFET as a switch, MOSFET as an amplifier; DC Analysis and small signal model; FinFET- Construction- advantages and applications.

Unit III
Introduction to BJT – BJTs, NPN and PNP transistors, Transistor currents, VI characteristics, Region of operation, BJT as an amplifier, BJT as a switch; DC Analysis.

Textbook(s)

2. “FinFET and Other Multi-Gate Transistors”- by J.P Colinge

Reference(s)


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Course Objectives

- To provide foundations of signals and systems
- To introduce time and frequency domain representations
- To enable analysis of LTI systems

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

CO1: characterize signals and systems
CO2: conduct time domain analysis on LTI systems
CO3: obtain frequency domain representations of signals
CO4: analyze spectral properties of LTI systems

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Syllabus

Unit I
Introduction to Signals- Continuous time and discrete time signals - Classification of Signals: Periodic, Aperiodic, Even, Odd, Energy and Power signals, Deterministic and Random signals, Elementary signals: unit step, unit impulse, unit ramp, sinusoidal and complex exponential signals - Basic operations on signals: Multiplication by a scalar, signal addition, linear combination, signal multiplication, time shifting, time scaling, combination of time shifting and time scaling- Introduction to Systems- Classification of Systems: Continuous time, discrete time, Invertible, non-invertible, Causal, non-causal systems, time-invariant, time-variant systems, Linear and non-linear systems, BIBO stable and unstable systems - Interconnection of systems.

Unit II
Time Domain characterization of continuous time and discrete time LTI systems - Convolution Integral-Convolution Sum- Fourier series representation of continuous time periodic signals, properties of continuous time Fourier series - Fourier transform of continuous time aperiodic and sinusoidal signals - properties of continuous time Fourier transform.

Unit III

Textbook(s)

Reference(s)
Course Objectives

- To provide the concepts of transient analysis of circuits
- To introduce the concepts of frequency response and passive filters
- To introduce two-port networks and network parameters

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

CO1: analyse the transient behaviour of circuits
CO2: apply Laplace transforms for circuit analysis
CO3: understand the behaviour of passive filters
CO4: analyse two-port networks

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Syllabus

Unit I

Unit II
Transient Analysis - Time domain analysis of first and second order circuits – source free excitation- with DC Excitation.

Unit III

Textbook(s)

Reference(s)
**Course Outcomes:** At the end of the course, the student should be able to

**CO1:** generate, visualize signals and interpret their properties  
**CO2:** conduct operations on signals  
**CO3:** analyze Linear Time Invariant systems  
**CO4:** analyze and interpret the spectral properties using transforms

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### Syllabus

*Define a system which might cover most of the experiments. It is possible to define at most 2 systems for whole experiments of this course. In the beginning of the lab class, system level explanation must be given to the students.*

*Examination/evaluation for system level should have higher weightage of marks. They need to develop system (at least prototype) at the end, not on breadboard.*

### Example:

Integrate background music to vocal with different play rates and audio effects

1) System to vary the play rate of audio file
   - Read the audio file and implement time scaling operation to obtain a variable play rate.  
   - Analyse the properties of the given system in terms of linearity, stability, causality.  
   - Understand the effects of the aforementioned operation in the frequency domain.

2) System to create audio effects
   - Read audio file and implement audio effects such as echo and chorus.  
   - Analyse the effect of these effects in the frequency domain.

3) Guitar note generation
   - Create multiple Guitar notes by using CTFS approach.  
   - Analyse the effect of adding harmonics in the generated note.

### Experiment Contents:

2. Basic Operations on Signals-Operation on dependent variable  
3. Basic Operations on Signals-Operation on independent variable  
4. Types of signals-Periodicity, Even, Odd, Energy and Power  
5. Properties of Systems-Linearity, Time invariance, stability  
6. Continuous and Discrete-time Convolution  
7. Verification of system interconnections  
8. CTFS and Gibbs Phenomenon  
9. CTFT and its properties  
10. DTFS and its properties  
11. DTFT and its properties  
12. Z-transform

### Textbook(s)


### Reference(s)

Course Objectives

- To introduce hardware platforms for interfacing sensors and actuators
- To introduce mobile application development for IoT
- To help build and prototype IoT based systems

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

CO1: interface sensors and actuators to hardware platforms
CO2: transfer data and control remote devices
CO3: develop mobile application for IoT
CO4: build and demonstrate IoT based systems

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Syllabus

Define a system which might cover most of the experiments. It is possible to define at most 2 systems for whole experiments of this course. In the beginning of the lab class, system level explanation must be given to the students.

Examination/evaluation for system level should have higher weightage of marks. They need to develop system (at least prototype) at the end, not on breadboard.

Example:

Design an IoT based system to: (should use a technology with least cost possible)

a) count/occupancy (number of students present) of ECE classrooms at each hour of the dept. time table.

b) display this statistics in HoD/department office monitor. The display of counting should be updated every 10 minutes. The same display can also be available in the class room.

c) indicate the availability of teacher(s) in the class hour (this should also be updated every 10min)

d) switch off the display devices off all ECE classrooms from IoT lab (remote).

Experiment Contents:

1. GPIO and ADC Programming – LED – Switch – Relay - Proximity Sensor - Seven Segment
2. ADC Programming - Potentiometer - Temperature Sensor – Moisture Sensor - Gas Sensor
3. LCD and Keypad Interfacing
4. Serial Communication – Bluetooth - GPS.
5. SPI and I2C Programming – RFID - RTC
6. Speed and Direction Control of Motors – DC – Stepper/Servo
7. WebServer and IoT Cloud Communication – ESP8266, Thingspeak
8. Basic Mobile Application Development – MIT App Inventor 2

Textbook(s)

Course Objectives

- To enable the study and extraction of device parameters from datasheets
- To enable the use of simulation tools in analysing electronic circuits
- To provide experience in design and prototyping of diode-based circuits
- To enable the characterization of transistors

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

CO1: use datasheets effectively
CO2: simulate electronic circuits
CO3: prototype diode-based circuits
CO4: characterize transistors

CO-PO Mapping

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Syllabus

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Examination/evaluation for system level should have higher weightage of marks. They need to develop system (at least prototype) at the end, not on breadboard.

Example:
Design a power supply system to get the following output:
1) 4 DC output voltage (+5V, +9V, +12V and +24V) (Use bridge rectifier with step down transformer)
2) Get regulated +5V and +24V from the same circuit
3) Use 24Vpp from the secondary and clip (get) the voltage to 16V positive cycle and 24V negative cycle
4) The regulated output of 24V is switched at 1kHz frequency and supplied to a LED bulb (light) (use MOSFET for switching)

Experiment Contents:
1. Familiarization of electronic components
2. Characterization of PN junction diode
3. Realization of Clipper circuits
4. Realization of Clamper circuits
5. Realization of Rectifiers - Half wave and Full wave with filter
6. Zener diode characteristics and as a voltage regulator
7. MOSFET Input and Output Characteristics
8. MOSFET-DC analysis
9. BJT Input and Output Characteristics

Textbook(s)

References(s)

Course Objectives
- To develop techniques of scanning for specific information, comprehension and organization of ideas
- To introduce the fundamentals of mechanics of formal writing, documentation and presentation
- To introduce the art of critical thinking and analysis

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

CO1: apply the basic elements of language in formal correspondence by interpreting and analyzing information and to organize ideas in a logical and coherent manner
CO2: understand and summarize technical documents
CO3: understand the mechanics of writing and the elements of formal correspondence
CO4: compose project reports/documents, revise them for language accuracy and make technical presentations

CO-PO Mapping

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Syllabus

Unit I
Error Analysis, Mechanics of Writing: Grammar rules - articles, tenses, auxiliary verbs (primary & modal) prepositions, subject-verb agreement, pronoun-antecedent agreement, discourse markers and sentence linkers, impersonal passive, modifiers, phrasal verbs, General Reading and Listening comprehension - rearrangement & organization of sentences

Unit II
Different kinds of written documents: Definitions- Descriptions- Instructions-Recommendations- User manuals - Reports – Proposals; Formal Correspondence: Writing Formal Letters/Emails; Punctuation; Scientific Reading & Listening Comprehension
Unit III
Technical paper writing: Documentation style - Document editing – Proof reading - Organizing and Formatting; Tone and style; Graphical representation; Reading and listening comprehension of technical documents; Mini Technical project / Term paper (10 -12 pages); Technical presentations

Reference(s)

Course Objectives

<table>
<thead>
<tr>
<th>22ADM111</th>
<th>Glimpses of Glorious India</th>
<th>L-T-P-C: 2-0-1-2</th>
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- To introduce to the depths and richness of the Indian culture and knowledge traditions
- To enable obtain a synoptic view of the grandiose achievements of India in diverse fields
- To equip with a knowledge of own country and its eternal values

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

CO1: understand and analyze the legacy of ancient Indian cultures and a discussion on practical Vedânta
CO2: comprehend the teachings and principles of Kauṭilya, conceptual aspects of Gods, and contribution of the Bhagavadgītā.
CO3: discuss the Indian soft powers and a portrayal of how nature was preserved through the medium of faith
CO4: recognize the contribution that India has made to the world

CO-PO Mapping

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Syllabus

Unit I
Role of Women in India- Kaūṭilya- Conceptual aspects of gods

Unit II
Bhagavadgītā: From Soldier to Saṅsārin to Sādhaka - Lessons of Yoga from Bhagavad Gita- Indian Soft powers- Preserving Nature through Faith- Different facets of Ancient Indian Cultures

Unit III
Practical Vedanta- To the World from India: Art and architecture, music, dance, theatre, sports, Yoga- Indian Approach to Science: Chemistry, Physics, Metallurgy, Medical Sciences, Astronomy, Mathematics, Naval engineering.

Textbook

Glimpses of Glorious India, Amrita Vishwa Vidyapeetham (University publication)
Reference(s)


SEMESTER III

| 23ECE201 | Digital Electronics | L-T-P-C: 3-0-0-3 |

Course Objectives

- To provide an understanding of basic building blocks of digital circuits
- To enable the understanding of Boolean algebra and logic function optimization
- To enable design of combinational and sequential circuits

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

CO1: realise a given expression in terms of basic building blocks
CO2: minimise a given logic expression
CO3: design combinational circuits
CO4: design Sequential circuits

CO-PO Mapping

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Syllabus

Unit I

Unit II

Unit III

Textbook(s)

Reference(s)

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<td><strong>(Pre-requisite): Electronic Devices and Circuits</strong></td>
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Course Objectives
- To provide an understanding of biasing of transistors
- To enable design of single and multistage amplifiers
- To provide an understanding of feedback and its effects

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

CO1: analyze different configurations of amplifiers
CO2: analyze the impact of feedback on amplifier circuits
CO3: analyze effect of capacitance on frequency response
CO4: analyze the operation of multistage amplifiers

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Syllabus

Unit I
MOSFET Biasing and configurations – Review of MOSFETs, basic amplifier configurations, MOSFET at dc, biasing, Load line analysis; MOSFET amplifier- Small-signal analysis, Single-stage amplifier, Common Source, Common Gate, Source Follower.

Unit II
Multi-stage amplifiers- Cascode, Darlington pair; MOSFET Frequency response – Parasitic capacitances in transistors; Basic building blocks of ICs, current source as load, current source for biasing.

Unit III
Feedback concepts– types of feedback, Series and shunt configurations; Feedback network - effect on Gain, Bandwidth, input/output impedance; Analysis of single and multi-stage amplifiers with feedback with respect to Gain, Bandwidth, Impedance, etc.

Textbook(s)

Reference(s)
Course Objectives

- To introduce discretization in time and frequency domain
- To provide knowledge of discrete frequency representation and efficient computation
- To introduce design and analysis of digital filters

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

CO1: understand concepts of sampling and aliasing
CO2: analyze signals using discrete Fourier transform
CO3: apply efficient methods for digital signal processing
CO4: design and analyze digital filters

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Syllabus

Unit I
Sampling- Effects of sampling in time and frequency domain - Aliasing and reconstruction in time and frequency domain - Discrete Fourier transform (DFT) – Definition - Inverse Discrete Fourier Transform - properties of DFT including periodicity, multiplication of two DFT and circular convolution – Fast Fourier Transform (FFT) - Decimation in Time FFT, Decimation in Frequency FFT, Inverse DFT using FFT - Linear filtering methods based on DFT- overlap add and overlap save methods.

Unit II

Unit III

Textbook(s)

Reference(s)
To introduce the concepts of electromagnetic fields
To provide foundations of plane waves and its application to communication
To provide exposure to wave propagation through waveguides

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

CO1: understand the concepts of electric and magnetic fields
CO2: understand the concept of time-varying electromagnetic field
CO3: understand the wave propagation model
CO4: understand wave propagation through waveguides

CO-PO Mapping

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Syllabus

Unit I
Electrostatics and Steady State Currents: Review of Vector Calculus - Electrostatics - Postulates - Coulomb’s law - Gauss law - Electric potential - Behavior of conductors and dielectric in static fields - Dielectric constant - Poisson’s and Laplace equation. Current density - Point form of Ohm’s law – Continuity equation

Unit II

Unit III

Textbook(s)

Reference(s)

Course Objectives
- To introduce the statistical concepts necessary for exploratory data analysis
- To provide the foundations of data pre-processing, interpretation & visualization
- To introduce the concepts of statistical testing
**Course Outcomes:** At the end of the course, the student should be able to

**CO1:** understand descriptive statistics and data distributions  
**CO2:** apply pre-processing techniques  
**CO3:** interpret and visualise data  
**CO4:** apply statistical tests

**CO-PO Mapping**

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**Syllabus**

**Unit I**  
Introduction - Data Science, Importance of probability for Data science, Axioms of probability, Conditional probability and Bayes theorem; Random variables: Discrete, Uniform and Binomial Distribution, Continuous, Normal Distribution, Exponential and Poisson Distribution; Types of Data, Central tendency measures, Dispersion measures, Skewness and Mean, Covariance and Correlation, Central limit theorem.

**Unit II**  
Data Processing- Collection Strategies, Data Pre-Processing Overview, Data Cleaning, Data Integration, Encoding techniques- Ordinal, One hot and Binary, Data Reduction-PCA, Data Transformation and Discretization, Exploratory data analysis: Visualization before analysis, visualizing a single variable, Examining multivariate Data- Heat map.

**Unit III**  
Statistical Testing -Introduction to Hypothesis Testing-Null and alternative hypothesis, Type of Errors, A/B testing, Parametric test: the T-test, Z-test, non-parametric tests- Chi-square tests, P-value, Confidence Intervals, Parametric confidence intervals, Bootstrap confidence intervals

**Textbook(s)**


**Reference(s)**


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**Course Objectives**

- To provide hands-on experience in realising simple logic expressions  
- To demonstrate the power of logic function optimization  
- To enable the implementation of combinational and sequential circuits

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

**CO1:** use datasheets & simulation tools effectively  
**CO2:** realise simple logic circuits  
**CO3:** design & implement combinational circuits  
**CO4:** design & implement sequential circuits

**CO-PO Mapping**
Syllabus

Define a system which might cover most of the experiments. It is possible to define at most 2 systems for whole experiments of this course. In the beginning of the lab class, system level explanation must be given to the students.

Examination/evaluation for system level should have higher weightage of marks. They need to develop system (at least prototype) at the end, not on breadboard.

Example:
Let them design a calculator or clock which have many functionalities.

Experiment Contents:

1. Verification of Basic Logic Gates.
3. Simplification and Realization of a given Boolean Expression
   i) Using basic gates
   ii) SOP Using NAND gates only
   iii) SOP Using NOR gates only
   iv) POS Using NAND gates only
   v) POS Using NOR gates only and
   vi) Compare and analyze the above implementations
4. Design and verification of Adders and Subtractors.
5. Design and verification of Parallel Adder / Subtractor.
6. Design and verification of Binary to Gray code converter and vice versa.
7. Design and verification of BCD to Excess-3 code converter and vice versa.
8. Design and verification of 2-bit Magnitude Comparator.
9. Design and verification of Multiplexers
10. Implementation and verification of Half adder, full adder, half subtractor and full subtractor using multiplexers.
11. Design and verification of Flip-flops (D, T and JK flipflop).
12. Design and verification of shift Registers.
13. Design and verification of Ring and Johnson Counters.
14. Design and verification of 4-bit asynchronous Up and Down Counters

Textbook(s)

Reference(s)

Course Objectives
- To provide hands-on experience in design, prototyping and characterizing of transistor amplifiers
- To enable the design and implementation of multi-stage amplifiers
• To enable the application of negative feedback and study its effect on amplifier performance

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

CO1: use datasheets effectively
CO2: simulate complex amplifier circuits
CO3: prototype & characterize transistor amplifiers
CO4: prototype & characterize negative feedback amplifiers

CO-PO Mapping

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Syllabus

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Examination/evaluation for system level should have higher weightage of marks. They need to develop system (at least prototype) at the end, not on breadboard.

Example:
Design a microphone amplifier to amplify your audio signal. Take this as input, design a driver amplifier using MOSFET to drive a speaker of 12W. You can quickly design a regulated power supply necessary for this circuit (12V-15V).

Design a multistage voltage amplifier (Low Noise Amplifier-LNA to be used in 2-3G base station) which will have a frequency response (600MHz to 3GHz) and a gain of 18dB.

Experiment Contents:

1. MOSFET Biasing Circuit – Voltage Divider Biasing with and without source resistance.
2. Common Source Stage Input & Output Characteristics.
3. Common Gate Stage Input & Output Characteristics
4. Source Follower Stage Input & Output Characteristics.
7. Multi-stage amplifier Characteristics
8. Voltage series Feedback amplifier
9. Current shunt Feedback amplifier

Textbook(s)


Reference(s)

Course Objectives

- To provide an understanding of discretization of signals
- To provide hands-on exposure to discrete Fourier analysis and efficient computation
- To enable design and analysis of digital filters

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

CO1: analyze the effects of sampling
CO2: apply discrete Fourier analysis on signals
CO3: perform efficient computation on digital signals
CO4: design and analyze digital filters

CO-PO Mapping

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Examination/evaluation for system level should have higher weightage of marks. They need to develop system (at least prototype) at the end, not on breadboard.

Experiment Contents:
1. Sampling of analog signals and study of aliasing
2. Computation of DFT using direct/linear transformation method
3. Properties of DFT
4. DIT and DIF FFT implementation
5. Spectrum estimation with FFT
6. Application of DFT- Computation of 2N point DFT of a real sequence by using an N point DFT. Efficient computation of 2 sequences of length N using a single N point DFT.
7. Linear filtering using Overlap add/save method
8. Design of FIR filter using different windowing techniques
9. Design of IIR filters- Butterworth and Chebyshev
10. Applications of filtering in signal processing

Textbook(s)

References(s)
Course Objectives

To provide a deeper understanding of the ethical grandeur of Indian culture, and be inspired to follow the ideals of the characters depicted in Ramayana.

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

CO1: Appreciate the significance of Rāmāyaṇa as an itihāsa, and important aspects of Bālakāṇḍa.
CO2: Understand the family values and ideal human relationships portrayed in the Ayodhyakāṇḍa and Aranyakāṇḍa of Rāmāyaṇa.
CO3: Understand dharma and its nuances, emphasizing its applicability in an individual’s life through Kishkindhakāṇḍa and Sundarakāṇḍa of Ramayana.
CO4: Appreciate the triumph of dharma over adharma through Yuddhakāṇḍa of Rāmāyaṇa.
CO5: Appreciate the spiritual values from Rāmāyaṇa in resolving personal and social conflicts through varied effective presentations of important episodes of the Rāmāyaṇa.

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Syllabus

Unit I


Unit II

Kishkindha-Kāṇḍa: The Empire of Holy Monkeys. Sundara-Kāṇḍa: Heart of the Ramayana; Yuddha-Kāṇḍa: The most popular part of the Ramayana; Uttara-Kāṇḍa: An attempt to explain the untold stories.

Unit III

Ramayana and Modern-day learning, Ecological Awareness in the Ramayana; Different Ramayana: Epic that connects the world.

Textbooks/References

1. Leadership Lessons from the Ramayana, ASCSS
2. Rajagopalachari, C, The Ramayana
Course Objective

- To impart knowledge on the concepts of chemistry involved in the application of engineering materials that are used in the industry/day-to-day life.

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

CO1: characterize the solids using X-ray diffraction technique and analyse the materials using computational tools.

CO2: apply the fundamental principles of electrochemistry to illustrate the functioning of electrochemical energy systems.

CO3: understand the application of polymers in fabricating integrated electronic devices

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Syllabus

Unit I

Solid state- Fundamentals of crystalline structures – unit cell, lattice parameters, Bravais lattices and types of crystals; X-ray diffraction - Bragg’s equation and experimental methods (powder method and rotating crystal technique); Elements of symmetry in crystal systems, defects in crystals – stoichiometric, non-stoichiometric, extrinsic and intrinsic defects. Vesta – for visualization of crystal structures. Solar energy - introduction, utilization and conversion, photovoltaic cells - design, construction and working, panels and arrays. Advantages and disadvantages of PV cells. DSSC (elementary treatment).

Unit II

Electrochemical energy system - Faraday’s laws, origin of potential, electrochemical series, reference electrodes, Nernst equation, introduction to batteries - classification - primary, secondary and reserve (thermal) batteries. Kinetics of electrochemical reaction – Tafel equations. Characteristics - cell potential, current, capacity and storage density, energy efficiency. Construction, working and application of Leclanche cell-Duracell, lead acid batteries. Ni-Cd battery, Lithium ion batteries. Fuel cell - construction and working of PEMFC and biofuel cell.

Unit III


Textbooks and References:

Course Objectives

- To study the nature and facts about environment.
- To appreciate the importance of environment by assessing its impact on the human world.
- To study the integrated themes and biodiversity, pollution control and waste management.

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

CO1: understand aspects of nature and environment
CO2: analyze impact of environment on human world
CO3: to comprehend pollution control and waste management

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Unit I
Introduction- Overview of the global environment crisis; Biogeochemical cycles; Climate change and related international conventions & treaties and regulations. Ozone hole and related International conventions & treaties and regulations; Over population; Energy crisis; Water crisis; Ground water hydrogeology; Surface water resource development.

Unit II
Ecology, biodiversity loss and related international conventions – treaties and regulations. Deforestation and land degradation; Food crisis; Water pollution and related International and local conventions – treaties and regulations. Sewage - domestic and industrial; Effluent treatment; Air pollution and related international and local conventions, treaties and regulations. Other pollution (land, thermal, noise).

Unit III

Textbook(s)

Reference(s)

**Pre-requisite(s):** An open mind and the urge for self-development, basic English language skills, knowledge of high school level mathematics.

**Course Objectives**

- Assist students in inculcating Soft Skills and developing a strong personality
- Help them improve their presentation skills
- Support them in developing their problem solving and reasoning skills
- Facilitate the enhancement of their communication skills

**Course Outcomes**

**CO1:** Soft Skills: To develop greater morale and positive attitude to face, analyse, and manage emotions in real life situations, like placement process.

**CO2:** Soft Skills: To empower students to create a better impact on a target audience through content creation, effective delivery, appropriate body language and overcoming nervousness, in situations like presentations, Group Discussions and interviews.

**CO3:** Aptitude: To analyze, understand and employ the most suitable methods to solve questions on arithmetic and algebra.

**CO4:** Aptitude: To investigate and apply suitable techniques to solve questions on logical reasoning and data analysis.

**CO5:** Verbal: To infer the meaning of words and use them in the right context. To have a better understanding of the basics of English grammar and apply them effectively.

**CO6:** Verbal: To identify the relationship between words using reasoning skills. To develop the capacity to communicate ideas effectively.

**CO-PO Mapping**

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**Syllabus**
**Soft Skills**

**Soft Skills and its importance**: Pleasure and pains of transition from an academic environment to work-environment. New-age challenges and distractions. Learning to benefit from constructive criticisms and feedback, Need for change in mindset and up-skilling to keep oneself competent in the professional world.

Managing Self: Knowing oneself, Self-perception, Importance of positive attitude, Building and displaying confidence, Avoiding being overconfident, Managing emotions, stress, fear. Developing Resilience and handling failures. Self-motivation, Self-learning, and continuous knowledge up-gradation / Life-long learning. Personal productivity - Goal setting and its importance in career planning, Self-discipline, Importance of values, ethics and integrity, Universal Human Values.

**Aptitude**

**Problem Solving I**

**Numbers**: Types, Power Cycles, Divisibility, Prime, Factors & Multiples, HCF & LCM, Surds, Indices, Square roots, Cube Roots and Simplification.


Data Interpretation: Tables, Bar Diagrams, Venn Diagrams, Line Graphs, Pie Charts, Caselets, Mixed Varieties, Network Diagrams and other forms of data representation.

**Verbal**

**Vocabulary**: Familiarize students with the etymology of words, help them realize the relevance of wordanalysis and enable them to answer synonym and antonym questions. Create an awareness about the frequently misused words, commonly confused words and wrong form of words in English.

**Grammar (Basic)**: Help students learn the usage of structural words and facilitate students to identify errors and correct them.

**Reasoning**: Stress the importance of understanding the relationship between words through analogy questions.

**Speaking Skills**: Make students conscious of the relevance of effective communication in today’s world through various individual speaking activities.

**Reference(s)**:

5. The hard truth about Soft Skills, by Amazon Publication.
6. Verbal Skills Activity Book, CIR, AVVP
7. English Grammar & Composition, Wren & Martin
8. Nova’s GRE Prep Course, Jeff Kolby, Scott Thornburg & Kathleen Pierce
9. Cracking the New GRE 2012
10. Kaplan’s – GRE Comprehensive Programme
14. How to Prepare for Data Interpretation for the CAT, Arun Sharma.

**Evaluation Pattern**: 50:50

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<tr>
<th>Assessment</th>
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*CA - Can be presentations, speaking activities and tests.

**SEMESTER IV**

**Course Objectives**

- To provide understanding of Microcontrollers and its Applications
- To enable the understanding of Microcontroller Peripherals and their configuration
- To provide insight on the design of a simple Embedded System for specific Applications

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

- **CO1**: understand the fundamentals of Microcontroller and its Peripherals
- **CO2**: configure the Internal Peripherals of a Microcontroller
- **CO3**: interface External Peripherals with an Embedded Platform
- **CO4**: design a Microcontroller based System for real world applications

**CO-PO Mapping**

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**Syllabus**

**Unit I**
Introduction to Embedded Systems - Introduction to ARM Architecture - ARM Programmer's Model - ARM Processor Modes and States - Addressing Modes - ARM Instruction Set - Types - Data Processing Instructions - Assembly Language Programming - Binary Encoding of Data Processing Instructions - Data Transfer Instructions - Binary Encoding of Data Transfer Instructions

**Unit II**
Pipeline in Processor - Pipeline Hazards - ARM 3 Stage Pipeline - LPC2148 Microcontroller Architecture – GPIO - PLL - Introduction to serial communication - Serial Transmission and Reception using UART
Unit III

Textbook(s)

Reference(s)

Course Objectives
- To provide an understanding of operational amplifiers and their parameters
- To enable design of linear circuits using opamps
- To enable design of non-linear circuits using opamps

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

CO1: understand the operation of differential amplifiers
CO2: understand the specifications and parameters of opamps
CO3: design linear circuits based on opamps
CO4: design non-linear circuits based on opamps

CO-PO Mapping

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Syllabus

Unit I
MOS Differential pair - DC analysis, small-signal analysis, Common mode and Differential mode operations, common-mode rejection, mismatches in Rd and gm; Transistor current sources- Current mirrors, Cascoding, Wilson Current Mirror.

Unit II

Unit III

Textbook(s)

Reference(s)

**Course Objectives**

- To introduce the concepts of analog communication
- To provide the knowledge of time and frequency domain representation of analog modulation techniques
- To introduce the concepts of random processes and noise in analog communication systems

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

**CO1:** understand the principles of analog modulation and demodulation techniques

**CO2:** analyze the performance of different analog modulation techniques

**CO3:** understand the concepts of random processes

**CO4:** analyze the effect of noise in analog communication systems

**CO-PO Mapping**

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**Syllabus**

**Unit I**

Introduction: Communication, importance, Requirements-major components/blocks and their functions in brief; Channel - Types, Wired vs Wireless, communication through wired and wireless channels, requirements of communication for wireless channel; Types of communication systems (standards like analog, digital, mobile, etc). Frequency usage for analog types. Modulation - necessity, effect, types-linear and non-linear; Amplitude Modulation (AM): types of AM- DSB-SC AM-Conventional AM-SB modulation, Comparison of different types in terms of bandwidth, power, complexity, etc.; AM modulators; Demodulation and detection: Coherent and non-coherent detection, Demodulation of amplitude modulated signal- envelop detection, Demodulators; Vestigial sideband modulation - Signal Multiplexing – Example of AM communication systems. Super heterodyne receiver.

**Unit II**

Angle Modulation: Introduction and representation; kind of angle modulation- FM, PM; Generation of FM and PM, Implementation of modulators and demodulators for PM and FM; Spectral characteristics of angle modulation; Narrow band and wide band FM, bandwidth and power of FM/PM; Example of FM radio system; comparison between AM and FM radio systems.

**Unit III**

Noise effect: Introduction – channel noise, Guassian noise; Probability and random variables and process – basic concepts, random process in frequency domain, complex low pass representation of narrow band signals, narrow band noise and filtering; Effect of noise on linear/nonlinear modulation systems, derivation of signal to noise ratio (SNR) for analog and FM, Performance comparison.

**Textbook(s)**


**Reference(s)**
Course Objectives

- To provide knowledge of the modeling of physical systems
- To enable performance analysis of physical systems
- To enable the use of control theory for the performance enhancement of physical systems

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

CO1: develop mathematical models of physical systems
CO2: analyze the time domain response performance of systems
CO3: analyze the frequency domain response performance of systems
CO4: design a control system for a given specification

CO-PO Mapping

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* To be assessed through Term Project

Syllabus**

Unit I
Introduction - Need for control systems, Objectives of analysis and design, Design process. Laplace transforms review, Transfer functions of Electrical, mechanical and electro-mechanical systems (DC motor). Linearization concept. Block diagram reduction, signal flow graphs, Mason’s gain formula.

Unit II

Unit III

** all the concepts to be illustrated through MATLAB/SIMULNK/Hardware demonstrations

Textbook(s)

Reference(s)
Course Objectives

- To provide the foundations of machine learning
- To introduce supervised and unsupervised learning techniques
- To enable the appreciation of machine learning techniques

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

CO1: understand the mathematical foundations of machine learning
CO2: understand supervised and unsupervised learning techniques
CO3: apply machine learning techniques to standard datasets
CO4: analyze the performance of machine learning models

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Syllabus

Unit I

Unit II
Linear Models – linear regression, stochastic gradient descent, minibatch, regularization, early stopping, logistic regression; Support Vector Machines (SVM); Classification – K-Nearest Neighbor (KNN); Naïve Bayes; Decision Trees, Bagging, Random Forest, Boosting; Clustering – linkage algorithms, K-Means, DBSCAN.

Unit III
Neural Networks – artificial neural networks (ANN), multi-layer perceptron, neural network structures, fully connected, convolutional and recurrent neural networks, automatic differentiation, backpropagation, Optimizers – momentum, RMSProp, ADAM; Dropout; Applications of ANN to regression and classification.

Textbook(s)

Reference(s)
Course Objectives

- To provide hands-on experience of a Microcontroller and its Peripherals
- To provide experience in the interfacing of External Peripherals with a Microcontroller
- To enable the design and implementation of simple Embedded Systems

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

CO1: program in Assembly Language and Embedded C
CO2: configure the Internal Peripherals of a Microcontroller
CO3: interface External Peripherals with a Microcontroller
CO4: prototype a Microcontroller based System

CO-PO Mapping

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Syllabus

Define a system which might cover most of the experiments. It is possible to define at most 2 systems for whole experiments of this course. In the beginning of the lab class, system level explanation must be given to the students.

Examination/evaluation for system level should have higher weightage of marks. They need to develop system (at least prototype) at the end, not on breadboard.

Example:

Design an office automation where all interfaces of it might be used for controlling several of office items/machineries.

Experiment Contents:

1. Assembly Language Programs for Addition, Subtraction, Indirect Addressing Modes
2. LED Blinking and Control of LED with Switch using GPIO Peripheral in LPC2148
3. Serial Transmission and Reception using UART
4. Sensor Interfacing using ADC
5. Square Wave Generation using Timer
6. DC Motor Speed Control using PWM
7. LCD Interfacing
8. Term Project

Textbook(s)


References(s)

To provide hands-on experience in the training of ML models
To enable the performance analysis of Machine Learning algorithms
To enable the identification of optimal model hyperparameters

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

CO1: preprocess data
CO2: train ML models
CO3: analyze the performance of ML algorithms
CO4: optimize model performance

CO-PO Mapping

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Examination/evaluation for system level should have higher weightage of marks. They need to develop system (at least prototype) at the end, not on breadboard.

Example:
Develop a useful application (case study) which can be used directly by student, faculty, dept. management, school, university or anyone or organization.

Experiment Contents:
1. Data pre-processing: data cleaning, scaling, encoding
2. Descriptive Statistics - central tendency and dispersion
3. Regression- single- and multi-variable
4. Classification – logistic regression, KNN, Naïve Bayes’, decision trees
5. Clustering - K-Means, DBSCAN, GMM
6. Performance Evaluation: confusion matrix, accuracy, precision, recall, specificity, ROC, inertia, silhouette score, hyper-parameter tuning for optimizing the performance
7. Artificial Neural Networks - Case Studies involving classification

Textbook(s)

Reference(s)
- To enable an understanding of differential amplifier operation
- To provide hands-on experience in prototyping IC-based circuits
- To enable the implementation of simple analog communication circuits

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

CO1: use datasheets effectively
CO2: simulate complex circuits
CO3: characterise differential amplifiers
CO4: design & prototype op-amp based circuits
CO5: design & prototype simple analog communication circuits

CO-PO Mapping

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Syllabus

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Examination/evaluation for system level should have higher weightage of marks. They need to develop system (at least prototype) at the end, not on breadboard.

Example:
- To design transimpedance amplifier to amplify the AC signal of a photodiode. The circuit should reject DC signals. Switching speed should be more than 3MHz.

Reference:
Fsitesearch%252F%252Fen-us%252Fdocs%252Funiversalsearch.tsp%253FlangPref%253Den-US%2526searchTerm%253Dinstrumentation%252Bamplifier%2526nr%253D966034

- To design a low-noise analog signal chain for PIR-based motion detection subsystems in line-powered applications resulting in longer detection range.

Reference:
 tool%252FCIRCUIT060004

- Design an AM (approximately 1W power output) broadcast transmitter and receiver. Demonstrate with 1 Transmitter and multiple receivers in the lab. You can take any frequency around 755KHz.

Experiment Contents:
1. MOS Differential Amplifier
2. Characterization of operational amplifiers
3. Operational amplifier -Inverting, Non-inverting Amplifier and Difference Amplifiers.
4. Operational amplifier- Integrators, differentiator.
5. RC phase shift oscillator/ Wein-Bridge Oscillator.
6. Integrated-Circuit Timer Astable and Monostable multivibrator.
7. Generation and recovery of Amplitude modulated signal
8. DSB_SC Amplitude modulator using Ring modulator.
9. Circuit design (MOSFET) for envelop detector
10. Frequency Modulator
11. Pulse width modulator and pulse position modulator using 555 timer*
12. SSB-AM, VSB-AM using MATLAB
13. Frequency Division Multiplexing using MATLAB

Textbook(s)

Reference(s)

Pre-requisite(s): An inquisitive mind, basic English language skills, knowledge of high school level mathematics.

Course Objectives
- Assist students in inculcating Soft Skills and developing a strong personality.
- Help them improve their presentation skills.
- Aid them in developing their problem solving and reasoning skills.
- Facilitate them in improving the effectiveness of their communication.

Course Outcomes

CO1: Soft Skills: To develop greater morale and positive attitude to face, analyse, and manage emotions in real life situations, like placement process.

CO2: Soft Skills: To empower students to create better impact on a target audience through content creation, effective delivery, appropriate body language and overcoming nervousness, in situations like presentations, Group Discussions and interviews.

CO3: Aptitude: To analyze, understand and employ the most suitable methods to solve questions on arithmetic and algebra.

CO4: Aptitude: To investigate and apply suitable techniques to solve questions on logical reasoning and data analysis.

CO5: Verbal: To learn to use more appropriate words in the given context. To have a better understanding of the nuances of English grammar and become capable of applying them effectively.

CO6: Verbal: To be able to read texts critically and arrive at/predict logical conclusions. To learn to organize speech and incorporate feedback in order to convey ideas with better clarity.

CO-PO Mapping
Syllabus

Soft Skills


Presentations: Need, importance, preparations, research and content development, structuring and ensuring flow of the presentation. Ways and means of making an effective presentation: Understanding and connecting with the audience – using storytelling technique, managing time, appropriate language, gestures, posture, facial expressions, tones, intonations and grooming. Importance of practice to make an impactful presentation.

Aptitude

Problem Solving II

Equations: Basics, Linear, Quadratic, Equations of Higher Degree and Problems on ages.

Logarithms, Inequalities and Modulus: Basics


Time, Speed and Distance: Basics, Average Speed, Relative Speed, Boats & Streams, Races and Circular tracks.

Logical Reasoning: Arrangements, Sequencing, Scheduling, Venn Diagram, Network Diagrams, Binary Logic, and Logical Connectives.

Verbal

Vocabulary: Aid students learn to use their vocabulary to complete the given sentences with the right words. Usage of more appropriate words in different contexts is emphasized.

Grammar (Basic-intermediate): Help students master usage of grammatical forms and enable students to identify errors and correct them.

Reasoning: Emphasize the importance of avoiding the gap (assumption) in arguments / statements / communication.

Reading Comprehension (Basics): Introduce students to smart reading techniques and help them understand different tones in comprehension passages.
**Speaking Skills:** Make students be aware of the importance of impactful communication through individual speaking activities in class.

**Writing Skills:** Introduce formal written communication and keep the students informed about the etiquette of email writing.

**Reference(s)**

5. The hard truth about Soft Skills, by Amazon Publication.
6. Verbal Skills Activity Book, CIR, AVVP
7. English Grammar & Composition, Wren & Martin
8. Nova’s GRE Prep Course, Jeff Kolby, Scott Thornburg & Kathleen Pierce
9. Cracking the New GRE 2012
10. Kaplan’s – GRE Comprehensive Programme
14. How to Prepare for Data Interpretation for the CAT, Arun Sharma.

**Evaluation Pattern:** 50:50

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*CA - Can be presentations, speaking activities and tests.*
Course Objectives

To provide deeper understanding of the ethical grandeur of Indian culture, and be inspired to follow the ideals of the characters depicted therein.

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

CO1: understand the impact of itihāsas on Indian civilization with a special reference to the Adiparva of Mahābhārata
CO2: understand the importance of fighting adharma for the welfare of the society through Sabha and Vanaparva.
CO3: understand the nuances of dharma through the contrast between noble and ignoble characters of the epic as depicted in the Vana, Virata, Udyoga and Bhishma parvas
CO4: get deeper understanding of the Yuddha Dharma through the subsequent Parvas viz., Drona, Karna, Shalya, Sauptika Parvas
CO5: appreciate the spiritual instruction on the ultimate triumph of dharma through the presentations of the important episodes of the MB with special light on Shanti, Anushasana, Ashwamedhika, Ashramavasika, Mausala, Mahaprasthanika and Swargarohana Parvas

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Syllabus

Unit I
Mahābhārata - A Brief Summary- A Preamble to the Grand Itihāsa- The Unbroken Legacy; Dharmic Insights of a Butcher; The Vows We Take; Kingship and Polity Acumen

Unit II
Karna – The Maestro that Went Wide off the Mark; Tactics of Krishna; Yajnaseni; Popular Regional Tales; Maha Prasthamam – The Last Journey.

Unit III
Mahabharata - An All-Encompassing Text; Mahābhārata- What and What Nots; Nyayas in Mahabharata.

Textbooks/References
1. Leadership Lessons from the Mahabharat, ASCSS

Course Objectives

Indian Constitution
(Pre-requisite – Nil)
Course Outcomes: At the end of the course, the student should be able to
CO1: understand the functions of the Indian government
CO2: understand and abide the rules of the Indian constitution
CO3: understand and appreciate different culture among the people

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Syllabus

Unit I

Unit II
Union Government – Structures of the Union Government and Functions – President – Vice President – Prime Minister – Cabinet – Parliament – Supreme Court of India – Judicial Review.

Unit III

Textbook(s)

Reference(s)

SEMESTER V

23ECE301 Computer Systems and Architecture (Pre-requisite: Digital Electronics) L-T-P-C: 3-0-0-3

Course Objectives
- To provide introduction to Computer System Architecture
- To provide foundation on various building blocks of a Computer Architecture
- To introduce the concepts of Pipelining and Parallel Processing

Course Outcomes: At the end of the course, the student should be able to
CO1: understand various functional units and mathematical operations of Computer Systems
CO2: design data-path and control-path operations during execution
CO3: understand Memory Organization and Input Output interfacing
CO4: understand the effect of Pipelining and Parallel Processing

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Syllabus

Unit I
Introduction to computer system – Usage of basic digital blocks - Floating point number – IEEE single precision and double precision representation - Floating point arithmetic - Floating point adder/Subtractor - Addressing modes with examples - Data path and controller design – Single bus dataflow unit - Multi bus architecture

Unit II
Introduction to CPU design - Processor organization - Execution of complete instruction - Design of control unit - Hardwired Control - Microprogrammed Control - Memory and system organization – CPU and memory interaction - Organization of memory modules and interfacing - Cache memory: introduction, related mapping and replacement policies -

Unit III
Input/output processing - Introduction to Interrupts - Interrupt controlled I/O transfer DMA - Introduction to RISC and CISC approaches - Introduction to pipelining - Pipeline performance - Hazards in pipeline and types – Introduction to Parallel Processing - Parallel Processing Performance – Multithreading - Cache coherence for shared data - Message passing in distributed memory systems - Mathematical modeling of performance.

Textbook(s)

Reference(s)

Course Objectives
- To enable design of CMOS logic circuits at the schematic and layout level
- To enable an understanding of dc and transient characteristics of MOS circuits
- To enable the analysis of RC delays in CMOS circuits

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

CO1: design schematics and layout of CMOS circuits
CO2: characterize the DC and transient behaviour of CMOS circuits
CO3: analyze effect of device sizing on RC delays
CO4: understand different CMOS circuit enhancements for improved speed, area and delay

CO-PO Mapping

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Syllabus

Unit I
VLSI Design – Introduction, VLSI design flow - MOSFETs as logic switches – Pass Characteristics of MOSFETs, CMOS logic design, Transmission gates-based design, CMOS Layers, RC of an Interconnect, Design of FET Arrays, CMOS physical layouts and stick diagrams - Design Rules, CMOS Process Flow.

Unit II
MOSFET characteristics and sizing - MOSFET channel and current equations, Scaling Theory. FET RC Model, Elmore Delay calculation. DC switching characteristics of CMOS inverter - DC characteristics of NAND and NOR gates - Transient response of Inverter. Power Dissipation, Gate design for transient performance, Logical Effort.

Unit III
CMOS logic circuit design Techniques - Mirror circuits – Pseudo NMOS - Clocked CMOS - Dynamic CMOS logic circuits, Domino, MODL, CVSL.

Textbook(s)

Reference(s)

23ECE303 Radio Frequency and Microwave Engineering
(Pre-requisite: Electromagnetic Theory and Waves)

Course Objectives
- To provide fundamentals to analyze the parameters of transmission lines
- To enable characterize high frequency devices
- To understand microwave communication systems

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

CO1: model and analyze transmission line parameters
CO2: characterize high frequency passive devices
CO3: understand the working of passive microwave devices
CO4: understand microwave communication systems

CO-PO Mapping

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Syllabus

Unit I

Unit II
High Frequency analysis: Scattering matrix – S-parameter analysis of passive waveguide devices; Directional Couplers, Tees, Circulators. Noise in RF systems – Noise figure computations, Dynamic range.

Unit III
RF Systems: Antenna Systems – Antenna Parameters – Antenna Noise Temperature – Friis Formula – Link Budget Calculations- Carrier to Noise Ratio – Case studies: GPS, DTH

Textbook(s)

References(s)

Course Objectives

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- To introduce the concepts of digital modulation and demodulation techniques
- To provide an understanding of optimum receiver design
- To enable performance analysis of digital communication systems

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

CO1: understand the concepts of waveform coding and signal design
CO2: understand the principles of digital modulation techniques
CO3: design optimum receivers for digital communication systems
CO4: conduct performance analysis of digital modulation techniques

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Syllabus
Unit I
Introduction: Digital communication, importance, requirements; Main blocks and major functions; Analog to Digital Conversion; Waveform Coding –PCM –DPCM –DM; Time Division Multiplexing; Geometric representation of signal waveforms- Binary pulse modulation –Optimum receiver for binary modulated signals in additive white Gaussian noise: M-ary binary and orthogonal pulse modulation –Probability of error for binary and M-ary pulse modulation.

Unit II
Digital Transmission through band limited channel- Baseband, Bandpass, Band limited channels, Inter-Symbol Interference (ISI) - Signal design for band limited channels –Probability of error for detection of digital PAM –System design in the presence of channel distortion.

Unit III
Transmission of digital information via carrier modulation: Types of digital modulation –Amplitude shift keying (ASK) – Phase shift keying (BPSK, QPSK, M-PSK); Quadrature amplitude modulated signals (M-QAM) –Frequency modulated signals (FSK)- Minimum Shift Keying (MSK), Continuous phase shift keying-Comparison of Various Modulation Techniques; Derivation and calculation of probability of error, Performance analysis of different modulation techniques.
Textbook(s)

Reference(s)

Course Objectives
- To provide platform for creative and innovative thinking
- To enable understanding of available state of art in the identified area of interest
- To enable simulation/hardware-prototyping of solutions to effectively transform ideas to reality

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

CO1: analyze practical problems and investigate scope for applying technology to develop feasible solutions
CO2: design the required system using appropriate EDA tools and implement the hardware
CO3: analyze the implementation impact and suggest improvements or modifications
CO4: present the concept with adequate validation on technical aspects and cost analysis

CO-PO Mapping

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Course Objectives
- To provide hands-on experience on electromagnetic simulation software
- To provide exposure to working and characterization of microwave devices
- To provide exposure to microwave communication systems

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

CO1: design and simulate radio frequency devices
CO2: analyze and interpret simulated results
CO3: setup experiments to characterize passive microwave devices
CO4: conduct experiments on microwave communication systems
CO-PO Mapping

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Syllabus

Define a system which might cover most of the experiments. It is possible to define at most 2 systems for whole experiments of this course. In the beginning of the lab class, system level explanation must be given to the students.

Examination/evaluation for system level should have higher weightage of marks. They need to develop system (at least prototype) at the end, not on breadboard.

Example:

Establish a microwave link for a minimum of 10m distance to transmit and receive a data of around 10-100Mbps. What would you do to get this data rate? Study, measure and verify all stages in/output signal. Also, measure the radiation pattern around received antenna. Also, measure or calculate the received data rate within the radiation pattern.

Experiment Contents

1) Characterization of waveguide-based microwave setup.
2) Measurement of return loss and insertion loss of selected microwave component.
3) Material characterization using waveguide based set up.
4) Measurement of radiation pattern of horn antennas and Friis analysis.
5) Electromagnetic simulation and scattering matrix studies on coaxial transmission lines.
6) Electromagnetic simulation and scattering parameters study on microstrip lines.
7) Electromagnetic simulation and characterization of rectangular microstrip antenna.
8) Electromagnetic simulation and characterization of microstrip power dividers.
9) Electromagnetic simulation and characterization of rectangular microstrip resonator.
10) Electromagnetic simulation and characterization of hybrid ring couplers.

Textbook(s)


Reference(s)


Course Objectives

- To enable the use of simulation tools for analyzing CMOS circuits
- To provide hands-on experience in HDL modeling and simulation of digital subsystems
- To provide a background in the synthesis and implementation of HDL models

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

CO1: model and simulate combinational subsystems using HDLs
CO2: model and simulate sequential subsystems using HDLs
CO3: implement HDL models on FPGA
CO4: model and simulate CMOS logic circuits

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**Syllabus**

Define a system which might cover most of the experiments. It is possible to define at most 2 systems for whole experiments of this course. In the beginning of the lab class, system level explanation must be given to the students.

Examination/evaluation for system level should have higher weightage of marks. They need to develop system (at least prototype) at the end, not on breadboard.

1. Write Verilog code to design following combinational circuits using Gate level (Structural) modeling-
   (i) Half adder
   (ii) 2:1 Multiplexer
2. Write Verilog code to design following combinational circuits using Data flow modeling-
   (i) Half adder
   (ii) 2:1 Multiplexer
3. Write Verilog code to design following combinational circuits using Gate level (Structural) modeling-
   (i) Full adder using half adders and any other required logic gate
   (ii) 4:1 Multiplexer using 2:1 Multiplexers only
   (iii) 8:1 Multiplexer using 2:1 Multiplexers only
4. Write Verilog code to design following sequential circuits using behavioral modeling-
   (i) D Latch
   (ii) D Flip-flop
   (iii) T Flip-flop
   (iv) JK Flip-flop
5. Write a Verilog code to design 4-bit Up/Down counter using behavioral modeling.
6. Implementation of sequence detector using Mealy and/or Moore FSM.
7. Implementation of FIFO and LIFO.
8. Design and analyze the transient characteristics for CMOS logic schematics.
9. Design and analyze the transient Characteristics for Full Adder and Ripple Carry Adder using CMOS logic in schematic.
10. Design and analyze the transient characteristics for D-Flip Flop, JK Flipflop, and T-Flip Flop using CMOS logic in schematic.

**Textbook(s)**


**Reference(s)**

Course Objectives

- To provide hands-on exposure to digital communication techniques using ICs and discrete components
- To enable performance analysis of various digital modulation schemes
- To provide exposure to hardware platforms for communication systems

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

CO1: build electronic circuits for digital communication
CO2: simulate and verify digital modulation schemes
CO3: analyze the performance of digital modulation techniques
CO4: utilize hardware platforms to realize communication systems

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Syllabus

Define a system which might cover most of the experiments. It is possible to define at most 2 systems for whole experiments of this course. In the beginning of the lab class, system level explanation must be given to the students.

Examination/evaluation for system level should have higher weightage of marks. They need to develop system (at least prototype) at the end, not on breadboard.

Example:

- To design a BPSK wireless communication system.
- Record your audio (read above 4 Cos). Convert this audio to digital form. Modulate, transmit through wireless channel and receive at closed by (same board). Study, investigate, measure the signal in-out at each stage.
- Use any hardware platform like NooRadio, SDR, ZigBee and establish end-to-end communication. Measure all stages input and output. Create necessary interference/noise and record BER performance.

Experiment Contents:

1. Sampling and reconstruction of an analog signal by designing pulse amplitude modulator and demodulator circuits.
2. Application of sampling by designing time division multiplexer and demultiplexer circuits.
3. Amplitude modulator which can be used to transmit the digital information via carrier and be able to reconstruct the message signal.
4. Phase modulator which can be used to transmit the digital information via carrier and be able to reconstruct the message signal.
5. Pulse code modulator and Delta modulator
6. Geometric representation of the given signal using Gram Schmidt orthogonalization procedure implemented in MATLAB.
7. ASK (OOK) and BPSK modulator and demodulator and BER performance comparison
8. M-PSK and QAM modulator and demodulator and BER performance comparison
9. To study the effects of ISI by generating an Eye pattern
10. Specifications, characterization of Hardware platforms like NooRadio, SDR, etc.
11. Establishment of wireless communication link using a pair of hardware platform

Textbook(s)

Reference(s)

Pre-requisite(s): Willingness to learn, communication skills, basic English language skills, knowledge of high school level mathematics.

Course Objectives
- Help students understand corporate culture, develop leadership qualities and become good team players
- Assist them in improving group discussion skills
- Help students to sharpen their problem solving and reasoning skills
- Empower students to communicate effectively

Course Outcomes

CO1 - Soft Skills: To improve the inter-personal communication and leadership skills, vital for arriving at win-win situations in Group Discussions and other team activities.

CO2 - Soft Skills: To develop the ability to create better impact in a Group Discussions through examination, participation, perspective-sharing, ideation, listening, brainstorming and consensus.

CO3 - Aptitude: To identify, investigate and arrive at appropriate strategies to solve questions on geometry, statistics, probability and combinatorics.

CO4 - Aptitude: To analyze, understand and apply suitable methods to solve questions on logical reasoning.

CO5 - Verbal: To be able to use diction that is more refined and appropriate and to be competent in spotting grammatical errors and correcting them.

CO6 - Verbal: To be able to logically connect words, phrases, sentences and thereby communicate their perspectives/ideas convincingly.

CO-PO Mapping

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Syllabus

Soft Skills


**Group Discussions**: Advantages of group discussions, Types of group discussion and Roles played in a group discussion. Personality traits evaluated in a group discussion. Initiation techniques and maintaining the flow of the discussion, how to perform well in a group discussion. Summarization/conclusion.

Aptitude

**Problem Solving III**

**Geometry**: 2D, 3D, Coordinate Geometry, and Heights & Distance.

**Permutations & Combinations**: Basics, Fundamental Counting Principle, Circular Arrangements, and Derangements.

**Probability**: Basics, Addition & Multiplication Theorems, Conditional Probability and Bayes’ Theorem.

**Statistics**: Mean, Median, Mode, Range, Variance, Quartile Deviation and Standard Deviation.

**Logical Reasoning**: Blood Relations, Direction Test, Syllogisms, Series, Odd man out, Coding & Decoding, Cryptarithmetic Problems and Input - Output Reasoning.

Verbal

**Vocabulary**: Create an awareness of using refined language through idioms and phrasal verbs. **Grammar (Upper Intermediate-Advanced)**: Train Students to comprehend the nuances of Grammar and empower them to spot errors in sentences and correct them.

**Reasoning**: Enable students to connect words, phrases and sentences logically.

**Oral Communication Skills**: Aid students in using the gift of the gab to interpret images, do a video synthesis, try a song interpretation or elaborate on a literary quote.

**Writing Skills**: Practice closet tests that assess basic knowledge and skills in usage and mechanics of writing such as punctuation, basic grammar and usage, sentence structure and rhetorical skills such as writing strategy, organization, and style.

Reference(s)
Evaluation Pattern: 50:50

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*CA - Can be presentations, speaking activities and tests.

Course Objectives

- Identify and analyse the various challenge indicators present in the village by applying concepts of Human Centered Design and Participatory Rural Appraisal.
- Assess the user need through quantitative and qualitative measurements
- Design a solution by integrating human centered design concepts
- Devising proposed intervention strategies for sustainable social change management

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

**CO1:** learn ethnographic research and utilise the methodologies to enhance participatory engagement.

**CO2:** prioritize challenges and derive constraints using Participatory Rural Appraisal.

**CO3:** identify and formulate the research challenges in rural communities.

**CO4:** design solutions using human centered approach.
CO-PO Mapping

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Syllabus

This initiative is to provide opportunities for students to get involved in coming up with technology solutions for societal problems. The students shall visit villages or rural sites during the vacations (after 4th semester) and if they identify a worthwhile project, they shall register for a 3-credit Live-in-Lab project, in the fifth semester.

Thematic Areas

- Agriculture & Risk Management
- Education & Gender Equality
- Energy & Environment
- Livelihood & Skill Development
- Water & Sanitation
- Health & Hygiene
- Waste Management & Infrastructure

The objectives and the projected outcome of the project will be reviewed and approved by the department chairperson and a faculty assigned as the project guide.

SEMESTER VI

<table>
<thead>
<tr>
<th>23ECE311</th>
<th>Wireless Communication and Networks</th>
<th>L-T-P-C: 3-0-0-3</th>
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<td>(Pre-requisite: Digital Communication)</td>
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Course Objectives

- To introduce the characteristics of wireless channels
- To provide the fundamental techniques to combat fading channels
- To introduce multiple access techniques in wireless networks

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

CO1: characterize wireless channels  
CO2: apply techniques to improve performance in fading channels  
CO3: understand multiple access techniques in wireless networks  
CO4: understand working principles of modern wireless networks

CO-PO Mapping

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**Syllabus**

**Unit I**
Introduction: Wireless communication, importance and requirements, types and classifications; Block diagram, brief function of major blocks; Wireless channels- characterization of wireless channel, Communication link, propagation phenomenon, LoS, NLoS; Mobile wireless channel- multipath propagation, ISI, fading. Large scale Friss free-space path loss model, ray tracing model, two-ray tracing model, shadowing, small scale multipath measurements; Rayleigh, Rician model, Fading parameters like power-delay profile, coherence bandwidth, delay spread, etc., Passband representation of received signal; Channel capacity – AWGN, fading channel capacity, outage capacity, BER performance.

**Unit II**
Performance improvement techniques: Equalization-adaptive, DFE; Diversity techniques- types, receive diversity, transmit diversity. MIMO, MIMO-Channel, capacity, data rate; receiver architecture – combiners, rake receiver. Channel Coding – Parity, block codes, convolution codes, interleaving, randomizer. Multicarrier communication – Frequency selective channels, OFDM, Single-carrier vs multi-carrier. Multiple access techniques, TDMA, FDMA, CDMA, space division.

**Unit III**
Introduction to Wireless networks: Wireless Local Area Networks, 802.11n; Cellular mobile communication architecture, 2G network, evolution of cellular mobile communication 1G-5G;

**Textbook(s)**

**Reference(s)**
Circuit Switching- Packet Switching and Switches. PHY Layer and its functions, protocols; Data link layer and its functions- protocols, Frame, ARP - Error detection and correction - Medium Access control (MAC)- Random access- Controlled access- Ethernet.

Unit II

Unit III
Transport Layer and higher layers – TCP, UDP, Flow Control-Congestion Control. Application Layer - WWW and HTTP - DNS.

Textbook(s)

Reference(s)

Course Objectives

<table>
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<tr>
<th>23ECE313 Embedded Systems</th>
<th>L-T-P-C: 3-0-0-3</th>
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<td>(Pre-requisite: Microcontrollers and Interfacing)</td>
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- To provide foundation on Embedded System Platforms
- To enable configuration of advanced peripherals for Embedded Applications
- To provide basic understanding of Real Time Operating Systems

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

CO1: understand the architectural features of an Embedded System
CO2: configure the peripherals of an advanced Microcontroller
CO3: understand the concepts of Real Time Operating Systems
CO4: understand the design of an Embedded System

CO-PO Mapping

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Syllabus

Unit I
Introduction- Architecture, hardware and software requirements, applications; Cortex M3 architecture – Registers - Operating Modes - NVIC - Memory Map - MPU – Exceptions - Debug Support in Cortex M3 - Stack Pointer - Link Register - Program Status Registers - Interrupt Mask Registers - Control Registers - Stack Memory Operations - Reset Sequence - Bit Banding - Memory Access Attributes - Advantages of Bit Banding – Pipelining - Detailed Cortex M3 Architecture - Bus Interfaces - Reset Types - Preempt and Sub Priority - Interrupt Input and Pending Behavior

Unit II
Bus Faults - Memory Management Fault - Usage Fault - Hard Fault - Methods of dealing with Faults - Supervisory Call - Pendable Service Call - System Tick Timer - Sleep on Exit - Wake up Interrupt Controller - Multiprocessor Communication
- Self Reset Control - Debug Architecture - CoreSight Architecture, Modified CoreSight Architecture - TM4C123 Architecture - GPIO - ADC - Timers - PWM - External Interrupt

Unit III

Textbook(s)

Reference(s)
1. D. V. Gadre, S. Gupta, Getting Started with Tiva ARM Cortex M4 Microcontrollers, Springer, 2018

23ECE385 Open Laboratory -II (Pre-requisite: Nil) L-T-P-C: 0-0-6-2

Course Objectives
- To provide platform for creative and innovative thinking
- To enable understanding of available state of art in the identified area of interest
- To enable simulation/hardware-prototyping of solutions to effectively transform ideas to reality

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

CO1: analyze practical problems and investigate scope for applying technology to develop feasible solutions
CO2: design the required system using appropriate EDA tools and implement the hardware
CO3: analyze the implementation impact and suggest improvements or modifications
CO4: present the concept with adequate validation on technical aspects and cost analysis

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23ECE386 Wireless Communication and Networks Laboratory (Pre-requisite: Digital Communication) L-T-P-C: 0-0-3-1

Course Objectives
- To provide an exposure to wireless communication over fading channels through simulations
- To enable develop wireless networks using hardware modules
- To provide hands-on exposure to computer networks and protocols

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

CO1: analyze performance of wireless communication systems over fading channels
CO2: demonstrate wireless networks using hardware modules
CO3: simulate and configure wireless networks
CO4: analyze the performance of computer networks

CO-PO Mapping

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Syllabus

*Define a system which might cover most of the experiments. It is possible to define at most 2 systems for whole experiments of this course. In the beginning of the lab class, system level explanation must be given to the students.*

*Examination/evaluation for system level should have higher weightage of marks. They need to develop system (at least prototype) at the end, not on breadboard.*

Example:

Use SDR as Tx/Rx and design a prototype of a system, that is establish air interface connection.

**Experiment Contents:**

1. Study of Propagation Path loss Models: Indoor & Outdoor
2. Performance comparison of different propagation models including fading channels, Rayleigh, Rician, CDF, PDF
3. Outdoor Propagation – Okumura Model, Hata Model
4. Hardware based radio set up, communication through wireless channel using hardware platform like SDR
5. Network topology design using any tool like OMNET++, NS, Cisco Packet Tracer, NetSim
6. Simple topology, WAN design with few routers, study and configure of protocols
7. Study of TCP protocol using packet sniffers.
8. Study of application layer protocols - HTTP.
9. Client-server communication using socket programming (TCP and UDP).

**Textbook(s)**

2. A Hands-On Introduction to SDR with USRP and GNU Radio, ETUSS

**Reference(s)**

2. F Perez Fontan and P Martin Espinetra, Modeling the Wireless Propagation Channel: A Simulation Approach with MATLAB, Wiley Publication

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**23ECE387 Embedded Systems Laboratory**  
(L-T-P-C: 0-0-3-1)  
*(Pre-requisite: Microcontrollers and Interfacing)*

**Course Objectives**

- To provide hands-on experience to use peripherals of an advanced Microcontroller
- To enable implementation of Real Time Operating System (RTOS) concepts
- To enable design of an Embedded System using advanced Microcontroller

**Course Outcomes:** At the end of the course, the student should be able to
CO1: configure peripherals of an advanced Microcontroller
CO2: interface External Peripherals with an Embedded Platform
CO3: implement Task Management and Inter Task Communication using RTOS
CO4: prototype an Embedded System using advanced Microcontroller

### CO-PO Mapping

| PO/PS | PO   | PO   | PO   | PO   | PO   | PO   | PO   | PO   | PO   | PO 1 | PO 2 | PO 3 | PO 4 | PO 5 | PO 6 | PO 7 | PO 8 | PO 9 | PO1 0 | PO1 1 | PO1 2 | PSO 1 | PSO 2 | PSO 3 |
|-------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|
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| CO3   | 3    | 2    | 3    | 3    | 3    | 2    | 3    |
| CO4   | 3    | 3    | 3    | 3    | 3    | 2    | 3    |

### Syllabus

*Define a system which might cover most of the experiments. It is possible to define at most 2 systems for whole experiments of this course. In the beginning of the lab class, system level explanation must be given to the students.*

*Examination/evaluation for system level should have higher weightage of marks. They need to develop system (at least prototype) at the end, not on breadboard.*

**Example:**

Let them develop something for cafeteria a process of giving an order till customer has gone out of café.

### Experiment Contents:

1. GPIO Programming using Cortex M4
2. Delay Time Generation using Timer
3. Analog Sensor Interfacing using ADC
4. External DAC Interfacing using SPI
5. External RTC Interfacing using I2C
6. Task Management using FreeRTOS
7. Inter Task Communication using FreeRTOS
8. Term Project

### Textbook(s)


### Reference(s)


---

**Pre-requisite(s):** Self-confidence, presentation skills, listening skills, basic English languageskills, knowledge of high school level mathematics.

**Course Objectives**

- Help students prepare resumes and face interviews with confidence
- Support them in developing their problem-solving ability
- Assist them in improving their problem solving and reasoning skills
- Enable them to communicate confidently before an audience
Course Outcomes

CO1: Soft Skills: To acquire the ability to present themselves confidently and showcase their knowledge, skills, abilities, interests, practical exposure, strengths and achievements to potential recruiters through a resume, video resume, and personal interview.

CO2: Soft Skills: To have better ability to prepare for facing interviews, analyse interview questions, articulate correct responses and respond appropriately to convince the interviewer of one’s right candidature through displaying etiquette, positive attitude and courteous communication.

CO3: Aptitude: To manage time while applying suitable methods to solve questions on arithmetic, algebra and statistics.

CO4: Aptitude: To investigate, understand and use appropriate techniques to solve questions on logical reasoning and data analysis.

CO5: Verbal: To use diction that is less verbose and more precise and to use prior knowledge of grammar to correct/improve sentences.

CO6: Verbal: To understand arguments, analyze arguments and use inductive/deductive reasoning to arrive at conclusions. To be able to generate ideas, structure them logically and express them in a style that is comprehensible to the audience/recipient.

CO-PO Mapping

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Syllabus

Soft Skills


Leadership: Initiating and managing change, Internal problem solving, Evaluation and co-ordination, Growth and productivity, Importance of Professional Networking.

Facing an interview: Importance of verbal & aptitude competencies, strong foundation in core competencies, industry orientation / knowledge about the organization, resume writing (including cover letter, digital profile and video resume), being professional. Importance of good communication skills, etiquette to be maintained during an interview, appropriate grooming and mannerism.
**Aptitude**

**Problem Solving II**

**Sequence and Series**: Basics, AP, GP, HP, and Special Series.

**Data Sufficiency**: Introduction, 5 Options Data Sufficiency and 4 Options Data Sufficiency.

**Logical reasoning**: Clocks, Calendars, Cubes, Non-Verbal reasoning and Symbol based reasoning.

**Campus recruitment papers**: Discussion of previous year question papers of all major recruiters of Amrita Vishwa Vidyapeetham.

**Competitive examination papers**: Discussion of previous year question papers of CAT, GRE, GMAT, and other management entrance examinations.

**Miscellaneous**: Interview Puzzles, Calculation Techniques and Time Management Strategies.

**Verbal**

**Vocabulary**: Empower students to communicate effectively through one-word substitution. **Grammar**: Enable students to improve sentences through a clear understanding of the rules of grammar.

**Reasoning**: Facilitate the student to tap his reasoning skills through Syllogisms, critical reasoning arguments and logical ordering of sentences.

**Reading Comprehension (Advanced)**: Enlighten students on the different strategies involved in tackling reading comprehension questions.

**Public Speaking Skills**: Empower students to overcome glossophobia and speak effectively and confidently before an audience.

**Writing Skills**: Practice formal written communication through writing emails especially composing job application emails.

**References**

5. The hard truth about Soft Skills, by Amazon Publication.
6. Verbal Skills Activity Book, CIR, AVVP
7. English Grammar & Composition, Wren & Martin
8. Public Sector – Engineer Management Trainee Recruitment Exam (General English)
9. Nova’s GRE Prep Course, Jeff Kolby, Scott Thornburg & Kathleen Pierce
10. A Modern Approach to Verbal Reasoning – R.S. Aggarwal
14. How to Prepare for Data Interpretation for the CAT, Arun Sharma.
15. How to Prepare for Logical Reasoning for the CAT, Arun Sharma.
18. A Modern Approach to Verbal & Non-Verbal Reasoning, R S Aggarwal

**Evaluation Pattern**: 50:50
### Assessment

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*CA - Can be presentations, speaking activities and tests.

### Course Objectives

- Identify and analyse the various challenge indicators present in the village by applying concepts of Human Centered Design and Participatory Rural Appraisal.
- Assess the user need through quantitative and qualitative measurements
- Design a solution by integrating human centered design concepts
- Devising proposed intervention strategies for sustainable social change management

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

- CO1: learn ethnographic research and utilise the methodologies to enhance participatory engagement.
- CO2: prioritize challenges and derive constraints using Participatory Rural Appraisal.
- CO3: identify and formulate the research challenges in rural communities.
- CO4: design solutions using human centered approach.

### CO-PO Mapping

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### Syllabus

This initiative is to provide opportunities for students to get involved in coming up with technology solutions for societal problems. The students shall visit villages or rural sites during the vacations (after 4th semester) and if they identify a worthwhile project, they shall register for a 3-credit Live-in-Lab project, in the fifth semester.

**Thematic Areas**

- Agriculture & Risk Management
- Education & Gender Equality
- Energy & Environment
- Livelihood & Skill Development
- Water & Sanitation
- Health & Hygiene
- Waste Management & Infrastructure

The objectives and the projected outcome of the project will be reviewed and approved by the department chairperson and a faculty assigned as the project guide.
Course Objectives

- To define the problem of the proposed research work
- To apply the concepts of engineering design in solving the research problem
- To demonstrate and validate the results of the design concept

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

CO1: formulate a suitable research problem
CO2: develop solution to the problem
CO3: analyze and implement the solution
CO4: prepare report and present the outcomes

CO-PO Mapping

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Course Objectives

- To enable understand the importance of research publications, plagiarism and resources
- To provide technical writing skills
- To encourage and motivate for research publications following necessary ethics

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

CO1: understand various formats of technical writing
CO2: check the plagiarism and citations
CO3: understand the difference between publication and patent
CO4: write technical research article in a given format

CO-PO Mapping

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### Course Objectives

- To define the problem of the proposed research work
- To apply the concepts of engineering design in solving the research problem
- To demonstrate and validate the results of the design concept

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

- **CO1**: formulate a suitable research problem
- **CO2**: develop solution to the problem
- **CO3**: analyze and implement the solution
- **CO4**: prepare report and present the outcomes

### CO-PO Mapping

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**SEMESTER VIII**

**23ECE499**

**Project Phase II**

(Pre-requisite: Nil)

**L-T-P-C: 0-0-18-6**
Syllabus
Phase-1 project can be extended. However, it is also possible to present internship work as project. It is suggested that faculty can work closely with student and company manager with whom student is working.

Professional Electives

Wireless Communications

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Course Objectives

- To provide an overview of cellular systems
- To explore the performance analysis of multiple access techniques
- To introduce cellular standards

Course Outcomes: At the end of the course, the student should be able to
CO1: understand the basic concepts of cellular systems
CO2: analyze the effect of interference and system capacity
CO3: analyze performance of multiple access techniques
CO4: understand the working principles of cellular standards

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Syllabus
Unit I

Unit II
Channel Models: Properties of mobile radio channels - Intersymbol interference - Multipath and fading effects - Interleaving and diversity - Multiple access schemes (TDMA – FDMA – CDMA – SDMA – OFDMA) – Inter user interference - Traffic issues and cell capacity - Power control strategies.

Unit III
Introduction to modern cellular standards - GSM and CDMA – GPRS – UMTS – LTE – Introduction to 5G; AI/ML to improve channels and other functionalities of networks; Role of AI/ML in resource/channel allocation.

Textbook(s)

Reference(s)

Course Objectives
- To introduce the fundamental concepts and design principles in MIMO wireless communication
- To provide the performance improvement techniques and analysis of MIMO systems
- To introduce the MIMO-OFDM system

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

CO1: understand the fundamental concepts of MIMO wireless systems
CO2: model MIMO channels and obtain the channel capacity
CO3: apply diversity, spatial multiplexing and signal detection techniques
CO4: understand the concepts of MIMO-OFDM systems

CO-PO Mapping

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Syllabus
Unit I
Introduction - Crowded spectrum - Need for high data rates – Multiple input multiple output systems – Multi antenna systems and concepts - Spatial multiplexing - MIMO system model- MIMO system capacity- Channel known to the transmitter - Channel unknown to the transmitter - Water-pouring principle – Capacity calculation – SIMO - MISO - Ergodic capacity - Outage capacity – Influence of fading Correlation on MIMO capacity - Influence of LOS on MIMO capacity.

Unit II
Delay diversity scheme - Alamouti space-time code - Maximum likelihood decoding - Maximum ratio combining - Transmit diversity - Space-time block codes - STBC for real signal constellations - Decoding of STBC-OSTBC - Capacity of OSTBC channels - Space-time code Word design criteria – Multiplexing architecture - VBLAST architecture.

Unit III
Data transmission over multipath channels - Single carrier approach - Multicarrier approach - OFDM - OFDM generation - Cyclic prefix - Performance of space - Time coding on frequency-Selective fading channels - Capacity of MIMO - OFDM systems - Performance analysis of MIMO-OFDM systems; Case study – MIMO signal detection using machine learning.

Textbook(s)

Reference(s)

Course Objectives
- To introduce the fundamental concepts of Information theory
- To explore different source coding algorithms to ensure efficient encoding of information.
- To explore different channel coding algorithms to ensure efficient error detection and correction

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

CO1: understand the fundamental concepts of Information theory
CO2: apply the concepts of source entropy and efficient encoding of information
CO3: understand channel models and determine the channel capacity
CO4: understand error control coding schemes

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Syllabus

Unit I

Unit II
Channel Models- Channel Matrix, Joint probability Matrix-System Entropies, Channel Capacity, Channel coding theorem- Shannon-Hartley’s law.

Unit III

Textbook(s)
Course Objectives

- To introduce system level aspects of communication systems
- To provide modeling and simulation tools for performance analysis
- To enable design of communication systems for specific applications

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

CO1: understand the system level aspects of communication systems
CO2: use modelling and simulation tools for performance analysis
CO3: understand tradeoffs of various system parameters
CO4: design communication systems for specific applications

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Syllabus

Unit I
Introduction-challenges in design and optimization—Overview of deterministic and stochastic simulations—Tractable and intractable systems—Role of simulations for link budgeting—Behavior predictions; role of ML in behavior prediction.

Unit II
Simulation methodology—Simulation errors due to sampling and quantization—Baseband representation of band pass signals and systems—Time varying systems—Modeling of system building blocks - filters, amplifiers with internal noise- Modeling oscillator phase noise.

Unit III
Simulation of random process and noise sources—Post processing—Eye-diagrams—Spectrum and scatter plots—BER simulations using Monte-Carlo techniques—Introduction to simulation of nonlinear and time varying systems—Models of waveform channels—Guided and unguided channels, Radio channels, Multipath and fading channel—Introduction to discrete channel model; Case studies- Digital predistortion of amplifier using Machine learning.

Textbook(s)

Reference(s)
Course Objectives

- To introduce the fundamentals of OFDM
- To analyze the effects of different types of interference and synchronization techniques
- To provide different channel estimation methods and PAPR reduction techniques

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

CO1: understand the architecture of OFDM transceiver
CO2: apply different synchronization techniques to handle the effect of ISI and CSI
CO3: understand pilot structures and channel estimation techniques
CO4: understand the effect of PAPR and reduction techniques

CO-PO Mapping

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Syllabus

Unit I
Introduction to OFDM-Single-Carrier vs. Multi-Carrier Transmission, Basic Principle of OFDM, OFDM Modulation and Demodulation, OFDM Guard Interval, BER of OFDM Scheme, Coded OFDM, OFDMA: Multiple Access Extensions of OFDM, Resource Allocation.

Unit II
Synchronization for OFDM - Effect/estimation of symbol-time offset (STO), Effect/estimation of carrier-frequency offset (CFO), Effect/compensation of sampling clock offset (SCO).

Unit III
Channel Estimation- Pilot Structure, Training Symbol-Based Channel Estimation, DFT-Based Channel Estimation, Decision-Directed Channel Estimation-Introduction to PAPR- PAPR and oversampling, PAPR Reduction Techniques; AI/ML role in channel estimation or resource allocation.

Textbook(s)

Reference(s)
Course Objectives

- To introduce the fundamental principles of decision making under uncertainty
- To enable mathematical formulation of practical estimation and detection problems arising in communication systems
- To provide exposure to classical and Bayesian solution approaches for signal estimation and detection

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

CO1: understand the principles of optimal estimation and detection.
CO2: model specific problems in communication systems as standard estimation and detection problems
CO3: apply appropriate solution techniques
CO4: analyze the performance of estimation and detection techniques

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Syllabus

Unit I
Review of probability and random processes; Applications of statistical estimation and detection techniques in communication systems; Classical estimation – Bias and variance, Cramer Rao lower bound, Sufficient statistic, MVUE, Fischer Neyman factorization theorem, Rao-Blackwell theorem.

Unit II
Maximum Likelihood (ML) estimation; Linear models – BLUE; Least Squares – consistency, efficiency and asymptotics; Bayesian estimation – MMSE and MAP estimation, Kalman and Weiner filtering; Introduction to channel and spectrum estimation.

Unit III
Detection theory - Bayesian and Neyman-Pearson detection, Minimax Detection, Composite hypothesis testing, GLRT, Sequential detection, Performance analysis by Monte Carlo method, Signal detection in continuous time, Karhunen Loève (KL) theorem, Detection of random signals in Gaussian noise; ML role in channel estimation.

Textbook(s)

Reference(s)
Course Objectives

- To provide an overview of satellite communication systems
- To provide an understanding of design parameters
- To create an appreciation for design aspects in practical scenarios

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

CO1: understand the basic concepts of satellite communication
CO2: design link budget for satellite communication system
CO3: understand the various subsystems in satellite communication systems
CO4: apply appropriate multiple access schemes for specific applications

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Syllabus

Unit I
Review of Microwave Communications - Overview of satellite communications - Satellite orbits - Orbital mechanics and effects - Kepler’s laws - Configurations of various orbits - Orbital elements - Elevation and azimuth angles - Doppler effect - Effect of the sun and moon - Sun transit outage. Satellite link models and design - Satellite system parameters - Link budget design.

Unit II
Satellite subsystems – AOCS - TTC&M - Power and communication subsystems - Computations and controlling by processors - Satellite multiple access schemes – FDMA - TDMA and CDMA - Spread spectrum concepts - Comparison of multiple access schemes.

Unit III
Satellite applications – VSAT - DTH television principles - Direct broadcast radios - Principles of navigation – GPS - Satellites and launch vehicles – INSAT - IRS satellites – PSLVs – GSLVs, AI/ML role in satellite communication and satellite based navigation

Textbook(s)


Reference(s)

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

CO1: understand the signal propagation through optical fibers.
CO2: analyze the effect of various design parameters on the performance of optical detectors
CO3: design optical links for effective end-end communication
CO4: understand the concepts of measurements in fiber optic systems

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Syllabus

Unit I


Unit II


Unit III

Link design – System degradation and power penalty – Measurements on fiber optic systems – SONET – EDFA – WDM components and networks; Case Study-End to End deep learning for system optimization.

Textbook(s)


Reference(s)


Course Objectives

- To introduce the principles behind modern wireless local area networking standards
- To enable performance analysis and optimization of wireless local area networks
- To provide exposure to research literature in this area
Course Outcomes: At the end of the course, the student should be able to

CO1: understand the working of wireless local area networks
CO2: analyze the performance of wireless local area networks
CO3: understand techniques for optimization of its performance
CO4: understand research literature on specific topics

CO-PO Mapping

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Syllabus

Unit I
Overview of the IEEE 802.11; MAC Layer – Network Architecture, Frame Types and Formats, Distributed Channel Access, Medium Access Rules, Hidden Node Problem, EDCA, PCF, HCCA, AP Discovery, Connection Establishment and Termination, Fragmentation and Aggregation, Block ACK, Power Save Methods, PSMP, Interoperability, Roaming, AP Channel Switching.

Unit II
PHY Layer – OFDM, MIMO basics, High Throughput (HT), VHT, 802.11b, 802.11a, 802.11g, 802.11n, 802.11ac; Wi-Fi 6 – EHT, 802.11ax, OFDMA, Multiuser Operation, TWT, Spatial Reuse; Implementation Issues – Hardware, Software, Algorithms, Regulatory Requirements, Introduction to Wi-Fi 6E and 802.11be.

Unit III
Applications and Case Studies – Intelligent techniques (AI/ML) to optimize Channel Access, Rate Adaptation, Frame Aggregation, PHY parameters, Beamforming, Multiuser Communication, Spatial Reuse, Channel Bonding, Multiuser MIMO, and Network Management.

Textbook(s)

Reference(s)
- Selected Research papers.
CO4: understand research literature on specific topics

CO-PO Mapping

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Syllabus

**Unit I**
Introduction – networks and computing systems as discrete event systems, mathematical and simulation tools for modeling and analysis, performance metrics; Selected Topics in Random Variables and Processes with applications to modeling of networks and computing systems – memoryless property, moment generating function; Laplace-Stieljes transform (LST), stationary- and independent-increment processes, Bernoulli, Poisson, Gaussian and Markov processes, discrete- and continuous-time Markov chains, renewal processes.

**Unit II**
Queueing Theory – Little’s Law, PASTA, common queueing models (M/M/1, M/M/1/K, M/M/K/K, M/G/1, M/G/1/K, M/G/∞), multiclass queueing models, networks of queues, Discrete-Event Simulation of Queueing Systems.

**Unit III**
Applications to Computing Systems – availability analysis of web servers, CPU and I/O job scheduling in computing systems, shared and cache memories, multiprogramming and multiprocessor systems; Applications to Computer Networks – statistical multiplexing in links, packet buffering and queue overflows, Chernoff bound, dynamic channel allocation in circuit switched networks, throughput analysis of Wi-Fi MAC layer, coverage analysis in wireless sensor networks. ML based job scheduling.

**Textbook(s)**

**Reference(s)**
- Selected Research papers.

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**23ECE326 Molecular Communication**

**L-T-P-C:** 3.0-0-3

(Pre-requisites: Digital Communication, Nature Inspired Engineering)

**Course Objectives**
- To provide an overview of Molecular communication systems
- To provide an understanding of processes involved in Molecular communication
- To create an awareness for various application areas

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

CO1: understand the basic concepts of Molecular communication
CO2: understand the mechanism of transmission of information
CO3: understand the information theoretic foundations
CO4: understand the applications in various fields

CO-PO Mapping

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Syllabus

Unit I

Introduction to Molecular communication- Need for molecular communication-Examples to demonstrate the usage and to introduce the basic issues related to designing a molecular communication system - History of molecular communication- Early history and theoretical research- More recent theoretical research- Implementational aspects- Contemporary research - Applications areas-Biological engineering - Medical and healthcare applications-Industrial applications-Environmental applications -Information and communication technology applications.

Unit II

Molecular communication paradigm-Molecular communication model-General characteristics -Transmission of information molecules- Information representation -Slow speed and limited range -Stochastic communication- massive parallelization- Energy efficiency- Biocompatibility, Detection and estimation in molecular communication.

Unit III


Textbook(s)


Reference(s)

•Selected Research papers
• To introduce basic concepts and mathematical techniques of Quantum Information Theory
• To introduce the various mathematical tools in Quantum Information Theory
• To enable the understanding of communication over Quantum channels

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

CO1: understand the extension of Shannon theory to quantum domain
CO2: understand the mathematical tools used for measurement and analysis
CO3: understand resources used in quantum communication
CO4: understand tradeoffs among the resources

CO-PO Mapping

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Syllabus

Unit I

Unit II

Unit III
Classical communication over noisy quantum channels: Holevo information, and classical capacity, Examples of quantum channels, Super additivity of classical capacity, Classical communication over entanglement-assisted quantum channels. Capacity theorem. Coherent communication with noisy resources: entanglement-assisted quantum communication, private classical communication, Quantum communication, The quantum capacity theorem, Resource trade-offs and trade-off coding, Non-additivity and other open problems. Introduction to quantum machine learning (QML).

Textbook(s)

Reference(s)

Course Objectives
• To introduce 4G mobile network and evolution to 5G network
• To introduce the various technologies for 5G mobile networks
• To enable the understanding and functions of major network components

Course Outcomes: At the end of the course, the student should be able to
CO1: understand 4G network architecture and evolution to 5G
CO2: understand different technologies constituents of 5G mobile networks
CO3: understand the radio access network of 5G and analyze physical layer channels and procedures
CO4: understand radio interface and 5G architecture deployment options in designing such networks

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Syllabus

Unit I
Introduction- 4G (LTE-A) Mobile network architecture, technology, LTE-frequency band, LTE Frame structure, operating mode, LTE channel types; 5G Evolution.

Unit II
5G Enabling Technology –Major enabling technologies like multi-antenna techniques, spectrum, spectrum sharing, access techniques, air interface, mmWave, SDN/NFV, 5G NR, Network Slicing, etc.

Unit III
5G RAN Overview - Overall System Architecture, frame structure, physical channels and signals, physical layer procedures (MIMO, Power control, link adaptation, beam forming, massive MIMO); Radio Interface Architecture: 5G architecture options, core network architecture, RAN architecture.

Books and References


VLSI

23ECE331  Analog IC Design  L-T-P-C: 3-0-0-3
(Pre-requisite: Analog Electronics II)

Course Objectives

- To provide students with a fundamental understanding of MOS amplifier configurations.
- To enable students to analyze and design Cascode connections, with consideration of gain, bandwidth, and input/output impedance modification.
- To equip students with the skills necessary to analyze and design feedback systems, and compensation of amplifiers.
Course Outcomes: At the end of the course, the student should be able to

CO1: analyze the basic characteristics of single and multi-stage amplifier configurations.
CO2: analyze the design of multi-stage amplifiers.
CO3: evaluate and apply the different principles in amplifier design.
CO4: analyze the design of feedback systems for amplifiers.

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Syllabus

Unit 1

Unit II

Unit III
Telescopic and Folded cascode – Folded Cascode Biasing - Switched capacitors- ADCs, DACS, Programmable Gain Amplifiers. MOS switch regulators - StrongArm latch - Charge injection - rail-to-rail input and output - Ri, Ro and feedback noise; Circuit synthesis using AI/ML Techniques.

Textbook(s)

Reference(s)

Course Objectives

- To provide an understanding of basic building blocks of mixed logic digital circuits
- To understand the optimizing techniques available for combinational logic functions.
- To optimize the delay analysis in the sequential and combinational logic function

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

CO1: realize the mixed logic building block and optimized logic function.
CO2: understand the optimizing concepts of arithmetic building blocks.
CO3: understand the basic testing of the combinational circuits.
CO4: analysis the synchronous sequential state machine.

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Syllabus

Unit I

Unit II

Unit III

Textbook(s)

Reference(s)

Course Objectives
- To provide a practical approach for verification of VLSI circuits.
- To introduce hardware design languages for functional verification.
- To enable the need and use of reusable verification environments.

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

CO1: understand the process of functional verification and its different methodologies.
CO2: apply methodologies to design a verification environment using System Verilog.
CO3: analyze the device under test and to write test-benches using System Verilog.
CO4: analyze the verification process by use of assertion-based techniques.

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Syllabus

Unit I
- Data Types and Literals - Procedures and Procedural Statements - Operators - User-Defined Data Types - Hierarchy and Connectivity.

**Unit II**

**Unit III**

**Textbook(s)**

**Reference(s)**

<table>
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<tr>
<th>23ECE334</th>
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**Course Objectives**
- To provide an understanding of the physical design process
- To provide an understanding of the partitioning, floor planning and placement techniques.
- To provide an understanding of the routing algorithms and generation of GDS II file.

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

**CO1:** understand the steps by step process involved in the Physical design cycle.
**CO2:** analyze the different partitioning and floor planning methodologies used in the physical design of ICs.
**CO3:** analyze the different placement and routing methodologies used in the physical design of ICs.
**CO4:** generation of GDS II file after RC extraction.

**CO-PO Mapping**

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Syllabus

Unit I

Unit II

Unit III

Textbook(s)

Reference(s)
1999

Course Objectives
- Understand the concept and impact of electrical noise on circuit performance.
- Gain knowledge of data converter principles, architectures, and design considerations.
- Develop skills to design and apply fully-differential output op-amps and CMFB in mixed-signal circuits.

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

CO1: develop a comprehensive understanding of electrical noise.
CO2: understand the design considerations of different data converters.
CO3: gain proficiency in designing mixed-signal circuits.
CO4: develop the skills to use switched-capacitor CMFB for op-amp design.

CO-PO Mapping

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Course: Mixed Signal IC Design
(Pre-requisite: Analog Electronics II)

L-T-P-C: 3-0-0-3
Syllabus

Unit I
Feedback and Topologies Review; Introduction to electrical noise- noise measurements, thermal noise, simulating MOSFET noise, noise equivalent bandwidth, kT/C noise, signal-to-noise ratio (SNR), noise figure (NF), white noise, shot noise, flicker noise, noise and feedback, op-amp noise modeling.

Unit II
Data converter fundamentals - DAC architectures: resistor string, R-2R, and current steering topologies. Cyclic and pipeline ADCs. ADC architectures including flash and two-step - successive approximation (charge redistribution) ADCs - segmentation, calibrating DAC offsets and gains, topologies without an op-amp, op-amps in data converters - bottom-plate sampling - S/H and Cyclic (algorithmic) converter - pipeline ADC.

Unit III

Textbook(s)

Reference(s)

Course Objectives
- To provide an understanding of the concepts of VLSI Testing and fault models
- To provide an understanding of the logic and fault simulation methods.
- To provide an understanding of the challenges involved in scan design and design for test

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

CO1: understand the fault equivalence and dominance collapsing for digital circuits
CO2: analyse the given fault as detectable or not using logic and fault simulation algorithms.
CO3: generate the test vector using combinational ATPG algorithms.
CO4: understand the scan and logic BIST architectures.

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23ECE336 VLSI Testing and Testability L-T-P-C: 3-0-3

(Pre-requisite: Digital Electronics)
Syllabus

Unit I

Unit II

Unit III

Textbook(s)

Reference(s)

Course Objectives

• To introduce ARM System on chip
• To introduce the NoC in advanced digital systems
• To introduce the concept of system-level design and transaction-level modelling

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

CO1: understand the concept of ARM System on a chip.
CO2: understand the interconnect topologies in ARM SoC.
CO3: understand the basic concepts of SystemC.
CO4: understand the basics of electronic system transaction Level Modelling.

CO-PO Mapping

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Syllabus

Unit I

Unit II

Unit III

Textbook(s)

Reference(s)
2. David J. Greaves” Modern System-on-Chip Design on Arm”, Arm education media

Course Objectives
- To introduce the preparation of wafer and cleanroom concept
- To provide the understanding of doping methods, oxidation and patterning of micro devices
- To provide the understanding of thin films deposition and etching techniques

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

CO1: understand the wafer preparation and impurities doping mechanisms and its importance.
CO2: understand the growth of oxide and lithography process to pattern microdevices.
CO3: understand the lithography and patterning process of microdevices.
CO4: understand the different methods of film deposition and wet and dry etching processes.

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Syllabus

Unit I
Brief History of Semiconductor technology. Scaling Trends and Scaling Methodologies - Scaling Challenges, ITRS Roadmap. Silicon structure and properties- Czochralski and Float Zone crystal growth, dopant distribution, and wafer preparation, Crystalline defects and their effects. Basic fabrication steps and their importance- Concepts of Clean room and safety requirements- Concepts of Wafer cleaning processes.

Unit II

Unit III

Textbook(s)

Reference(s)

Course Objectives

- To learn & understand the Memory hierarchy and array structure in the system.
- To learn various types of architecture for semiconductor memories in detail to understand their limitations and available solutions to improve them.
- To learn and understand memory cell structures, various parameters associated with them, and various aspects of reliability.

Course Outcomes: At the end of the course, the student should be

CO1: understand the SRAM cell structures with its advantages & disadvantages.
CO2: understand the variations in DRAM with its advantages & disadvantages.
CO3: understand other types of semiconductor memories to implement EEPROM and Flash memories etc.
CO4: understand MRAMs and FRAMs types of memories.
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Syllabus

Unit I

Unit II
CMOS DRAM, DRAM cell theory and cell structures, BICMOS DRAM, DDR, Non-volatile Memories: Masked ROMs, High density ROM, PROM, CMOS PROMS, EPROM, Floating gate EPROM cell, One-time programmable EPROM, EEPROM, Flash Memories, Advanced Flash memory architecture- RAM fault modeling - BIST techniques for memory.

Unit III
Radiation effects, Single Event Phenomenon (SEP), Radiation Hardening Process and Design Issues, FRAMs, GaAs FRAMs, Magneto resistive RAMs (MRAMS), Memory MCM testing and reliability issues, Memory cards, High Density Memory Packaging; Optimal memory cell design, detection and classification of defects using AI/ML techniques.

Text Book(s)

Reference(s)

Course Objectives
- To introduce programmable logic devices (PLDs).
- To understand the organization and implementation of an FPGA-based digital system.
- To familiarize the design of advanced digital hardware systems targeting FPGAs.

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

CO1: design digital circuits using programmable logic devices.
CO2: understand the architectures and features of various technology-based FPGAs.
CO3: comprehend the different phases of FPGA design flow and timing constraints.
CO4: understand advanced architectures of FPGA.

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**Syllabus**

**Unit I**

**Unit II**
FPGA Design Flow and Abstraction Levels - Verilog Design for Synthesis - One Hot Encoding - Memory Blocks - Block Memory Generator (BRAM/BROM) - Single Port Memory - Dual Port Memory - FIFO - Distributed RAM - Synthesis Pitfalls - Latch Inference - Static Timing Analysis - Speed Performance - Timing Constraints - Clock Management - Clock Buffers - Clock Tree Routing.

**Unit III**
Introduction to SoC Design - Hard Macros - Multipliers - DSP Block - Hard Core Processors - Interface Circuits - Configuration Chain - JTAG Interface - Zynq7000 Architecture; Case Study: FPGA implementation of AI/ML algorithms.

**Textbook(s)**

**Reference(s)**
CO4: analyze the ways in which trust can be incorporated in VLSI Design flow

CO-PO Mapping

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Syllabus

Unit I
Review of VLSI Design Flow - Hardware Trojan – Trojan taxonomy - Case study - Trojan detection – Classification of Trojan detection - Challenges in Trojan detection.

Unit II
Design for hardware trust – Delay-based methods – Shadow registers – Ring oscillators - Dummy scan Flip-Flop insertion - Trojan activation time analysis - Trojan detection and isolation flow – Architectural approaches; AI-based Hardware trojan detection techniques.

Unit III
Security and testing – Scan-based testing – Scan-based attacks and countermeasures - System-on-chip test infrastructure - Emerging areas of test security. Trojan prevention: Built-in self-authentication - BISA structure and insertion flow - Analysing BISA structure - Trusted design in FPGAs.

Textbook(s)

Reference(s)
CO3: design digital blocks using behavioral modeling and also synthesizable constructs in the same.

CO4: analyze the working and designing of standard VLSI System building blocks.

CO-PO Mapping

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Syllabus

Unit I
Review of VLSI Design Flow - Introduction to HDLs - Verilog modeling styles – Gate Level, Structural - Dataflow - Register Transfer Level (RTL) abstraction for HDL-Based Design Flow.

Unit II

Unit III

Textbook(s)

Reference(s)

Devices and Circuits

| 23ECE351 | Design of ICs for Optical Communication (Pre-requisite: Nil) | L-T-P-C: 3-0-3 |

Course Objectives

- To provide an understanding of a general optical system and random binary data
- To provide a foundation to design and analyse optical active and passive devices and circuits
- To provide an overview of design challenges and performance analysis of optical devices and systems

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

- CO1: understand the design challenges in transmission of random binary data in optical communication system
- CO2: design optical communication related circuits and systems
- CO3: analyze and characterize optical communication related circuits and systems
- CO4: carry out the performance evaluation of an optical communication system
CO-PO Mapping

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Syllabus

Unit I

Unit II

Unit III

Textbook(s)

Reference(s)

Course Objectives
- To provide an understanding of the optical semiconductor materials and device mechanisms
- To develop the fundamental knowledge on optoelectronic devices
- To understand the MOS dynamic effect, LED materials and configuration

Course Outcomes: At the end of the course, the student should be able to
CO1: understand the working principle of the optical devices
CO2: use the optical materials for different applications
CO3: design simple optoelectronics device
CO4: understand the behavioral characteristics of optical devices

CO-PO Mapping

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Syllabus

Unit I
Introduction - Optical mechanism in semiconductors, E-H pair generation and recombination, absorption and radiation in semiconductor, deep level transitions, Auger recombination, luminescence and time resolved photoluminescence, optical properties of photonic band-gap materials; Junction photodiode: PIN, heterojunction and avalanche photodiode; Comparisons of various photodetectors, measurement techniques for output pulse.

Unit II
Photovoltaic effect, V-I characteristics and spectral response of solar cells, heterojunction and cascaded solar cells, Schottky barrier and thin film solar cells, design of solar cell, Generative Adversial Network (GAN) to optimize nanostructure design for solar cells. Modulated barrier, MS and MSM photodiodes; Wavelength selective detection, coherent detection; Microcavity photodiode, Support Vector Regression (SVR) and particle swarm optimization (PSO) algorithms to optimize design parameters of microcavity photodiode.

Unit III
Dynamic effects of MOS capacitor, basic structure and frequency response of charge coupled devices, buried channel charge coupled devices. Electroluminescent process, choice of light emitting diode (LED) material, device configuration and efficiency; LED: Principle of operation, LED structure, frequency response, defects, and reliability.

Textbook(s)

Reference(s)
1. O. Wada “Optoelectronic Integration: Physics, Technology and Applications” 1994

Course Objectives
- To provide an understanding of the optical semiconductor materials and device mechanisms
- To develop the fundamental knowledge on optoelectronic devices
- To understand the MOS dynamic effect, LED materials and configuration

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

- CO1: understand the working principle of the optical devices
- CO2: use the optical materials for different applications
- CO3: design simple optoelectronics device
- CO4: understand the behavioral characteristics of optical devices

CO-PO Mapping
Syllabus

Unit I
Introduction - Optical mechanism in semiconductors, E-H pair generation and recombination, absorption and radiation in semiconductor, deep level transitions, Auger recombination, luminescence and time resolved photoluminescence, optical properties of photonic band-gap materials; Junction photodiode: PIN, heterojunction and avalanche photodiode; Comparisons of various photodetectors, measurement techniques for output pulse.

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Photovoltaic effect, V-I characteristics and spectral response of solar cells, heterojunction and cascaded solar cells, Schottky barrier and thin film solar cells, design of solar cell; Modulated barrier, MS and MSM photodiodes; Wavelength selective detection, coherent detection; Microcavity photodiode;

Unit III
Dynamic effects of MOS capacitor, basic structure and frequency response of charge coupled devices, buried channel charge coupled devices. Electroluminescent process, choice of light emitting diode (LED) material, device configuration and efficiency; LED: Principle of operation, LED structure, frequency response, defects, and reliability; Deep learning for the development of optoelectronic devices.

Textbook(s)

Reference(s)

Course Objectives
- To provide an overview of RF CMOS device characterization
- To enhance design capability for the RF IC designs
- To enrich the skills of computations by introducing modern engineering tools necessary for evaluating RF circuits.

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

CO1: understand RF CMOS device characteristics and its importance in RF ICs
CO2: apply RF computational techniques to design actively loaded RF amplifiers
CO3: design and analyze two port networks
CO4: evaluate the characteristics of RF CMOS sub blocks from top-level specifications and to model circuits using circuit simulators

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Syllabus

Unit I

Unit II

Unit III
Oscillators- Cross-Coupled Oscillator, Voltage-Controlled Oscillators, Low-Noise VCOs. Phase-Locked Loops- Type-I PLLs, Type-II PLLs, and PFD/CP Nonidealities. Power Amplifiers- Classification, High-Efficiency Power Amplifiers, Cascade Output Stages, and Basic Linearization Techniques. Doherty Power Amplifier, Polar Modulation, and Out phasing; ML based linearization techniques.

Textbook(s)

Reference(s)

Course Objectives
- To analyze microwave networks
- To design and implement matching networks
- To design and analyze microwave amplifiers

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

CO1: understand and apply the principles of electromagnetics and transmission lines
CO2: analyze microwave networks and determine the network parameters and characteristics
CO3: design and implement the matching networks and multisection matching transformers
CO4: design and analyze microwave amplifiers

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Syllabus

Unit I

Review of electromagnetics: Maxwell’s equations, plane wave solutions, transmission lines; types of transmission lines and their properties, coaxial lines, rectangular waveguides, microstrip. Microwave Network analysis; scattering matrix, transmission matrix formulations. Flow graphs, Mason’s rule.

Unit II

Matching networks: lumped element designs and limitations, single and double stub tuned designs. Quarter-wavelength transformers, multisection matching transformers; Active microwave circuit design, characteristics of microwave diodes and transistors. Linear and nonlinear behavior and models; Filter Synthesis by Using Artificial Intelligence Techniques-Neural Network Modeling, Experimental Design and Data Acquisition.

Unit III

Amplifier design: gain and stability, design for noise figure. Noise in microwave circuits; dynamic range and noise sources, equivalent noise temperature, system noise figure considerations.

Textbook(s)

Reference(s)

Course Objectives
- To provide foundation on the requirements for millimeter-wave (mmWave) radio, radar, and radiometer systems
- To provide understanding of the capabilities of silicon technology at mmWave frequencies
- To enable analyze and design the key integrated circuits in mmWave transceivers

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

CO1: understand the mmWave IC technology, its capabilities and limitations
CO2: analyze and optimize radio link budgets for wireless communication systems
CO3: design mmWave ICs
CO4: analyze the system-level requirements and trade-offs associated with various mmWave applications

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Syllabus

Unit I
Introduction to mmWave: Physics, Technology - Active components: SiGe BiCMOS Technology - SOI CMOS Technology - Passive components: transmission lines, Capacitor / Inductor / Transformer, Hybrid couplers.

Unit II
Millimeter-wave Communication Links and Budgets - Phased-Array: Beamforming, Architecture, ML techniques for beamforming; Metrics - Building Block: Low Noise Amplifier design and Power Amplifier design, layout and verification - mmWave Phase Shifters: Active and Passive.

Unit III

Textbook(s)

Reference(s)

Course Objectives
• To provide an understanding of sensor interface circuits and smart sensor systems
• To understand the fundamentals of precision and dedicated sensor circuits and systems
• To provide foundation on design MOS based sensor circuits for smart sensing applications

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

CO1: understand the concepts of design and calibration of sensor interface circuits and sensor interface system
CO2: apply the design principles on precision instrumentation amplifiers and dedicated sensor systems
CO3: analyze CMOS based sensor circuits and their characteristics
CO4: evaluate the performance of MOS based sensor interface circuits and systems using simulation tools

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Syllabus

Unit I

Unit II
Unit III

Textbook(s)

Reference(s)

Course Objectives
- To understand the Microelectromechanical (MEMS) system and MEMS materials
- To understand different MEMS micro sensor and actuators principle and mechanism
- To introduce the fabrication process involved in microsystem and packaging

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

CO1: understand the MEMS devices and MEMS materials used in fabrication
CO2: understand the different MEMS micro sensor principles and micro actuators mechanism
CO3: understand the engineering science of microsystem
CO4: understand the mechanism and fabrication process of microsystem and packaging

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Syllabus

Unit I

Unit II
Unit III
Microsystem fabrication process—photolithography, ion-implantation, diffusion, oxidation, thin films deposition methods—chemical vapor deposition, physical vapor deposition, epitaxy deposition, Etching—Anisotropic Wet Etching—Dry Etching of Silicon—Plasma Etching—Deep Reactive Ion Etching (DRIE)—Isotropic Wet Etching—Gas Phase Etchants; Micromanufacturing: Bulk micromachining, surface micromachining, and LIGA process; Assembly of 3D MEMS, Microsystems packaging and materials—Artificial Intelligence applications for MEMS Sensors and actuators and applications of MEMS devices.

Textbook(s)

Reference(s)

23ECE357 Energy Harvesting Technologies and Circuits
(Pre-requisite: Nil) L-T-P-C: 3-0-0-3

Course Objectives

- To understand the different energy harvesting methods
- To understand the fundamentals and circuit model of energy harvesting technologies
- To understand the energy harvesting interfacing and power conditioning circuits

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

CO1: understand various energy sources available in the environment
CO2: understand the fundamentals of energy harvesting technologies and methods
CO3: understand about the low power and high-power energy harvesting technologies and their model
CO4: understand different conditional circuits used for energy harvesting devices

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Syllabus

Unit I
Introduction—Energy sources, energy harvesting based sensor networks, photovoltaic cell technologies, generation of electric power in semiconductor PV cells, Thermoelectric energy harvesting—design and efficencuy, piezoelectric energy harvesting, types of Piezoelectric materials, Transducers. Micro scale harvesting, Strategy for Enhancing the generated power.

Unit II

Unit III
Harvesting circuits- Schottky diode, MOSFET as a diode, PWM and transistor switching, Interface/power conditioning circuit: linear DC-DC converters, Buck-boost Convertor, AC-DC boots rectifiers, Voltage Multipliers, and LT Spice Analysis of Power Conditioning Circuit; Role and application of AI/ML in energy systems.

Textbook(s)


Reference(s)


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Course Objectives

- To introduce MOSFET scaling challenges, Multi Gate MOS system, and FinFET region of operation
- To introduce the understanding of the physical effect, leakages, and parasitic of the FinFET
- To familiarize with materials, fabrication process, and challenges to FinFET process and devices

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

CO1: know the challenges of MOSFET scaling, oxide defects, and importance of FinFET
CO2: understand the MOS System, region of operation, physical effect of FinFET Technology
CO3: understand the different types of leakages and parasitic resistances in FinFET Technology
CO4: know the fabrication materials, process and various fabrication challenges

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Syllabus

Unit I


Unit II

Physical Effect and Leakage and Parasitic- Short Channel Effect on Threshold, Quantum Mechanical Effect, Surface Mobility, Subthreshold, Gate induced Drain and Source, Gate induced Source, Source Drain P-N Junction leakages, and Gate Oxide Tunneling leakages, Impact Ionization Current, Source-Drain Parasitic Resistance, Gate Resistance, Source Drain-P-N Junction Capacitances,
Unit III
FinFET-Fabrication—material, well formation, Fin patterning, Alternative well formation, Gate Definition, Source-Drain Extension, Raised Source-Drain, replacement metal gate formation, Challenges to FinFET Process—Lithography, Process Integration, Dopant Implantation, and Etching, Device Technology and FinFET circuit Design Challenges; Role of Al/ML in FinFET optimization and fabrication.

Textbook(s)

Reference(s)

Course Objectives
- To study deep sub-micron effects of MOSFETs and understand the latest trends in the technology and principles of nano-electronics
- To introduce the mathematical methods applied for advanced material based MOSFET models and familiarize new material devices and their performances
- To provide a unified applied treatment of fundamental mathematics of quantum transport and use it for device modeling using the principles learnt above

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

CO1: understand the deep sub-micron effects and limits of scaling on nano-electronic devices
CO2: use of wave – particle analysis in the development of transport properties
CO3: use mathematical methods for advanced nanomaterial studies
CO4: develop spice compatible models

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Syllabus
Unit I

Unit II

Unit III
Alternatives to Conventional Electronics – Drift Diffusion– Ballistic Transport –NEGF –Molecular Interconnects – Graphene–Carbon Nanotubes and Silicon Nanowire, Technology Devices and Circuits - 1 D transport - Reflection,
Transmission and the non-equilibrium Green Function Formalism (NEGF) - Contacting the schodinger - Density of states – Hamiltonian - and Spice compatible modeling of carbon-based advanced nanomaterial channels for MOSFET devices.

Textbook(s)

Reference(s)

Course Objectives
- To study solar cells and energy harvesting materials
- To introduce energy storage materials and synthesis methods of energy harvesting materials
- To provide a deep understanding of different characterization techniques of materials

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

CO1: understand the applications of different solar cells
CO2: understand the new generation energy harvesting materials
CO3: know the different synthesis methods of materials
CO4: understand various methods to analyze and characterize the materials

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Syllabus

Unit I

Unit II
Energy Storage Materials-Electrochemistry and electro-chemical Battery materials, Hydrogen Storage materials for fuel cells: Metal hybrids, Nanostructured metal hydrides, Non-metal hydrides, Carbohydrates, Synthesis of hydrocarbons, Aluminum, Liquid organic hydrogen carriers (LOHC), Ammonia, Amine borane complexes, Nano borohydrides and nano catalyst doping, imidazolium ionic liquids, phosphonium borate, Carbonite substances, Metal Organic frameworks,

Unit III

Textbook(s)

Reference(s)
Materials and Energy (Book Series), Leonard C Feldman (Ed. In Chief), World Scientific

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Course Objectives

- To provide understanding of thin electronic film materials and its property
- To explain thin film applications
- To provide conceptual principles of design and processing of thin film materials for electronic applications

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

CO1: understand the structure and fabrication of thin film materials used in electronics applications
CO2: understand the physics and technology behind electronic thin films materials used in engineering applications
CO3: understand the dependence of the electronic properties and characteristics on various parameters
CO4: understand the principles behind designing, and engineering of thin film materials for electronic applications

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Syllabus

Unit I
Introduction - Bonding and crystal structure of electronic materials, thin film vs bulk material considerations, thin film formation and structure – Physical Vapor Deposition, Chemical Vapor Deposition, Introduction to Artificial Intelligence for Thin film Manufacturing; Epitaxy; Nucleation and Kinetics; Structure of thin films; Electrical conduction in thin metal films, Skin Effect, Resistivity vs thickness, Interconnects in Microelectronics, Electromigration; Thin film diodes and transistors; Role of Defects.

Unit II
Thin films for Dielectric and magnetic applications - Polarization Mechanisms in thin films, electric susceptibility and polarizability, Clausius Mossotti Equation, high and low K materials, frequency dependence, dielectric loss and Breakdown, Piezoelectric and Ferroelectric thin films; Magnetic properties of thin films, Hard and Soft magnetic materials, Anisotropic and Giant Magnetoresistance, Spintronics and magnetic sensors, Magnetic Recording, Superconducting thin films.

Unit III
Thin films for Optical and electromagnetic applications - Light Propagation in materials, Total Internal Reflection, Luminescence, Optical Anisotropy, LCDs, Optoelectronic devices – LEDs, LASERs, Solar Cells, Photodetectors,
waveguides, Optical fibers; responses of materials to electromagnetic waves, metamaterials, materials for electromagnetic shielding, radars and antennas; smart materials, wide band gap materials.

Textbooks/References


EMBEDDED SYSTEMS

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<th>23ECE431</th>
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Course Objectives

- To provide understanding of the structure and implementation of modern operating systems, virtual machines and their applications
- To provide understanding of techniques for achieving process synchronization and managing resources like memory and CPU in an operation system
- To enable compare and contrasts the common algorithms used for both pre-emptive and non-pre-emptive scheduling of tasks in operating systems

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

CO1: understand the architecture and functionalities of modern OS.
CO2: understand and apply the algorithms for scheduling.
CO3: understand and apply the algorithms for resource management
CO4: apply semaphores and monitors for classical and real-world synchronization scenarios

CO-PO Mapping

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Syllabus

Unit I

Unit II

Unit III

Textbook(s)

Reference(s)

Course Objectives
- To provide foundations of real time systems
- To introduce concept of real time task-scheduling, and resource sharing and dependencies
- To enable real time communication using real time operating systems and develop real time systems

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

CO1: understand the foundations of real time systems
CO2: apply the concept of real time task-scheduling, and resource sharing
CO3: perform real time communication using real time operating systems
CO4: develop real time systems using real time operating systems

CO-PO Mapping

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Syllabus

Unit I
Introduction: Real-time and real time system, applications, models of real-time systems (RTS), characteristics, safety and reliability, types, timing constraints, examples of RTSs; Global Times: time and order, time measurement, dense time vs sparse time, internal clock synchronization, external clock synchronization; Real-time model: components and messages, component state, gateway component, linking interface specification, component integration.

Unit II
Temporal relations: real-time entities, observations (untimed, indirect, state and event), real-time images and objects, temporal accuracy, permanence and idempotency, determinism; Real-time task scheduling: types of real-time tasks, task scheduling, concepts and classification, algorithms – clock driven scheduling, hybrid schedulers, event driven scheduling, EDF scheduling, rate monotonic algorithm, multiprocessor task allocation, dynamic allocation of tasks. Resource sharing and Dependencies: resource sharing, priority inversion, basic concepts of faults, errors, failures, anomaly detection, fault tolerance, robustness.

Unit III
Real-time communication: requirements, design issues, communication model, flow control, event triggered communication, rate constrained communication, time-triggered communication; Real-time operating systems: features, inter-component communication, task management, time as data, inter-task interactions, Process I/O, error detection, Unix as a RTOS, POSIX, Contemporary RTOSs like PSOS, RT Linux et, benchmarking real time systems.

Textbook(s)
Reference(s)
3. Real-Time Systems - Course (nptel.ac.in)
4. Real Time Systems (iitpak.ac.in)

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Course Objectives

- To introduce to the MIPS architecture and its features
- To provide an understanding of the MIPS assembly language
- To enable design and implement basic MIPS programs using the assembly language

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

CO1: describe the MIPS architecture and its components
CO2: write basic MIPS assembly language programs
CO3: analyze and debug MIPS assembly language programs
CO4: design and implement simple embedded systems using the MIPS architecture

CO-PO Mapping

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Syllabus

Unit I
Introduction-Introduction to Computer Architecture, MIPS Architecture Overview, MIPS Instruction Set, MIPS Assembly Language Programming, Data Types and Addressing Modes

Unit II
MIPS Processor Design- MIPS Processor Architecture, MIPS Pipeline Design, MIPS Memory Hierarchy, Cache Memory and Virtual Memory, MIPS I/O System

Unit III
Advanced Topics in MIPS Architecture- Multithreading and Multicore Processing, Exception and Interrupt, Handling, MIPS Performance Analysis and Optimization, MIPS SIMD Architecture, MIPS Future and Emerging Trends

Textbook(s)

Reference(s)
1. MIPS Assembly Language Programming by Robert Britton
Course Objectives

- To learn different techniques to estimate, analyze, and enhance the performance of computing systems.
- To learn advanced hardware and software design principles of modern processors when going from single-core to multi-core systems.
- To apply multi-processor memory management techniques to enhance the processor performance.

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

CO1: interpret the performance of a processor based on different metrics.
CO2: predict the challenges of realizing different kinds of and leverage them for performance advancement.
CO3: apply the concept of memory hierarchy for efficient memory design and virtual memory to overcome the memory wall.
CO4: explore emerging computing trends, computing platforms, and design trade-offs.

CO-PO Mapping

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Syllabus

Unit I
Design Space Exploration and Optimizations: Performance metrics and performance enhancement techniques. Basic concepts of parallel processing and pipelining. Power dissipation in processors, power metrics, and low-power design techniques. Instruction set architecture design: Instruction set design, implementation and performance perspectives, relative advantages of RISC and CISC instruction set, Data Path Design.

Unit II

Unit III
Memory systems: Overview of memory hierarchy, Cache design considerations, instruction vs. data caches, write-policy and replacement policy, analysis of cache performance, and cache design for performance enhancement. Brief overview of memory technologies (SRAM, DRAM, and flash). Data Level Parallelism: Flynn Processor classification, SIMD, MIMD, GPU architectures, IO: types, models, protocols, Sockets, ISR.

Textbook(s)

Reference(s)
Course Objectives

- To introduce the fundamental concepts of shared and distributed memory, message passing, and synchronous/asynchronous send/receive algorithms
- To get familiarize with the network topologies that are used for parallel communication and the evaluating their performance using metrics, models and profiles
- To learn the designing of parallel codes, parallel I/O algorithms, bottlenecks, issues, and trends

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

CO1: understand significance of shared and distributed memory for parallel computing
CO2: understand parallel communication among the cores for carrying out the parallel computation
CO3: understand and analyze the parallel codes, and parallel I/O algorithms
CO4: develop efficient the parallel codes, and parallel I/O algorithms

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Syllabus

Unit I

Introduction: Parallel computing, Shared memory and distributed memory parallelism, Amdahl’s law, speedup and efficiency, supercomputers. Message passing: MPI basics, point-to-point communication, collective communication, synchronous/asynchronous send/receive, algorithms for gather, scatter, broadcast, reduce.

Unit II


Unit III

Designing parallel codes: Domain decomposition, communication-to-computation ratio, load balancing, adaptivity, AI/ML role in load balancing; case studies: weather and material simulation codes. Parallel I/O: MPI I/O algorithms, contemporary large-scale I/O architecture, I/O bottlenecks Job scheduling, RDMA, one-sided communication, NVM, extreme scale computing: issues and trends.

Textbook(s)


Reference(s)

23ECE436 Embedded Systems for Robotics
(Pre-requisite: Embedded Systems)

L-T-P-C: 3-0-0-3

Course Objectives
- To provide an overview of robotic systems
- To understand the design parameters involved in the design of robots
- To analyze different robot designs

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

CO1: understand the concept of controllers in robotic systems
CO2: understand the different sensors and actuators required for robotic systems
CO3: analyze different types of robot designs
CO4: develop mobile robot application

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Syllabus

Unit I
Robots and Embedded Systems-Robots and Controllers: Mobile Robots-Embedded Controllers-Interfaces-Operating System, Robot operating system (ROS), Sensors, Actuators in Robots - Control - On-Off Control, PID Control, Velocity Control and Position Control, Recent Trends in Robotics

Unit II
Mobile Robot Design: Driving Robots- Single Wheel Drive- Differential Drive- Tracked Robots- Synchro-Drive-Ackermann Steering- Drive Kinematics, Omni-Directional Robots, Balancing Robots, Walking Robots
Unit III
Mobile Robots, Concepts of Localization, and path planning, Maze Exploration, Map Generation

Textbook(s)

Reference(s)

Course Objectives
- To understand multi-core architectures and their design principles
- To introduce to the challenges and opportunities of multi-core architectures in embedded systems
- To equip with the necessary knowledge and skills on multi-core architectures

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

CO1: analyze and evaluate the performance of multi-core architectures
CO2: design and develop software for multi-core architectures using parallel programming paradigms and techniques
CO3: apply the knowledge of multi-core architectures to solve real-world problems in embedded systems
CO4: develop applications using multi-core architecture

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Syllabus
Unit I
Introduction to Multi-Core Architectures - Introduction to parallel computing and multi-core architectures - Characteristics and design principles of multi-core architectures - Challenges and opportunities of multi-core architectures in embedded systems - Case studies of multi-core architectures in industry and research

Unit II
Programming Multi-Core Architectures - Parallel programming paradigms and models - Synchronization and communication mechanisms for multi-core architectures - Performance analysis and optimization of parallel programs - Tools and libraries for programming multi-core architectures.

Unit III
Applications of Multi-Core Architectures in Embedded Systems - Multi-core architectures for real-time and safety-critical systems - Multi-core architectures for multimedia and signal processing applications - Multi-core architectures for Internet of Things (IoT) and Cyber-Physical Systems (CPS) - Case studies of multi-core architectures in embedded systems.

Textbook(s)
1. "Multi-Core Embedded Systems" by Georgios Keramidas and Stamatis Vassiliadis
2. "Programming Multi-Core and Many-Core Computing Systems" by Sabri Pllana and Fatos Xhafa

Reference(s)
1. "Multi-Core Embedded Systems" edited by Georgios Keramidas and Stamatis Vassiliadis
2. "Parallel Computing: Principles and Practice" by Michael J. Quinn
3. "Parallel Programming in C with MPI and OpenMP" by Michael J. Quinn
4. "OpenMP: Portable Shared Memory Parallel Programming" by Barbara Chapman, Gabriele Jost, and Ruud van der Pas

Course Objectives
- To provide an overview of an embedded automotive system
- To enable understanding of the architecture involved in the design of automotive technology
- To provide communication concepts and the software development phase in automotive embedded system

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

CO1: understand the automotive architecture
CO2: understand the protocol functioning in the automotive network
CO3: understand the communication involved in automotive system
CO4: understand the software development process in automotive industry

CO-PO Mapping

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Syllabus

Unit I

Unit II

Unit III

Textbook(s)

Reference(s)
2. James D Halderman: “Automotive Electricity and Electronics”, PHI Publication

Course Objectives
- To provide foundation on the fundamental concepts of real time operating systems (RTOS)
- To enable understanding of different aspects of task management
- To provide implementation knowledge and skills of real time applications using RTOS

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

CO1: understand the basic concepts in real time systems
CO2: understand the RTOS architecture and kernel service
CO3: analyze various real-time scheduling algorithms
CO4: design and develop real time applications using RTOS

CO-PO Mapping

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Syllabus
Unit I
Overview of concepts of GPOS, GPOS functionalities, Evolution of operating systems. Introduction to real-time systems, RTOS basic architecture, RTOS vs. GPOS. Architecture of OS (Monolithic, Microkernel, Layered, Exokernel and Hybrid kernel structures). POSIX Standards. RTOS Kernel services.

Unit II
Task Management -tasks, process and threads, task attributes and types, preemption-context switching, task states and transition, task control block. Introduction to real-time task scheduling, clock-driven and priority-driven scheduling, uniprocessor scheduling algorithms- RM-response time analysis, DM, EDF-processor demand analysis, Least Laxity First (LLF), and introduction to multiprocessor scheduling concepts. Blocking, deadlock, priority inversion and solutions.

Unit III
Task Communication and Synchronization - Semaphores and Mutex, Mailbox, Queue, Pipes. Timer Management, Interrupt handling, Memory Management-Cache and virtual memory, Input-Output handling. Familiarization of Free RTOS – architecture, porting, Real time applications using RTOS.

Textbook(s)

Reference(s)

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<th>23ECE440</th>
<th>FPGA based Embedded Systems</th>
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Course Objectives
- To provide in depth understanding of FPGA architecture and its features
- To enable the knowledge for the design of sub-systems, usage of existing sub-systems on FPGA
- To enable the understanding of FPGA based embedded system design

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

CO1: understand the architecture and specifications of FPGA
CO2: understand synthesizable HDL modeling of digital subsystems
CO3: understand the design flow of embedded systems including design of the data path, control unit subsystems and interpreting reports
CO4: develop block-based embedded system using FPGA resources and I/O interfaces

CO-PO Mapping

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Syllabus

Unit I

Unit II

Unit III
FPGA processor fabrics and bus interfaces – ADC interface, DAC interface, I/O interfaces - Block-based design flow – System Level synthesis from high level languages - Case study of design of FPGA based embedded systems.

Textbooks/References
Course Objectives

- To provide fundamental concepts of antenna arrays and smart antennas
- To understand the benefits of smart antenna systems for adaptive beamforming
- To understand concepts of various angle of arrival estimation methods

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

CO1: study and design different types of antenna arrays
CO2: understand types of adaptive antenna systems
CO3: comprehend spatial diversity and radio receiver techniques for smart antennas
CO4: understand and analyse different beamforming algorithms

CO-PO Mapping

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Syllabus

Unit I


Unit II


Unit III


Textbook(s)

References(s)


Course Objectives

- To provide understanding of problems and challenges in electromagnetic computation
- To provide the skills required to understand numerical techniques for solving generalized practical electromagnetic problems
- To provide understanding of simulation tools for analysis

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

CO1: understand the concept of computational electromagnetic techniques for modeling wireless communication devices
CO2: understand the concept of finite difference method and FDTD analysis techniques
CO3: comprehend finite element analysis and method of moment techniques
CO4: apply the computational methods for solving electromagnetics problems

CO-PO Mapping

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Syllabus

Unit I

Classification of Electromagnetic Problems, Classification of methods of analysis, mathematical framework, Overview of Computational methods, Analytical methods and orthogonal functions.

Unit II


Unit III
Basic Steps in finite element analysis, finite element method (FEM) analysis in one dimension, FEM analysis in two
dimension. Eigenvalue Analysis using method of moments (MoM), Solution of Integral Equations using MoM, Fast
Multipole Solution Methods for MoM, Comparison of FDM, FDTD, FEM and MoM, selected problems in electromagnetics
using modern tools.

Textbook(s)

References(s)

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Course Objectives
- To provide fundamental concepts of Radar technology
- To understand different types of RADAR systems
- To understand concepts of RADAR receivers and sources of error in radar signal detection/estimation

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

CO1: understand system specifications of Radar
CO2: understand architecture of different RADAR systems
CO3: understand the concepts of RADAR receivers
CO4: understand performance of RADAR systems under noise

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Syllabus

Unit I
Introduction-Nature of Radar, Maximum Unambiguous Range, Radar Waveforms, Simple form of Radar Equation, Radar
Block Diagram and Operation, Radar Frequencies and Applications, Radar Equation: Prediction of Range Performance,
Minimum Detectable Signal, Receiver Noise and SNR, Integration of Radar Pulses, Radar Cross Section of Targets (simple
targets - sphere, cone-sphere), Transmitter Power, PRF and Range Ambiguities.

Unit II
CW and Frequency Modulated Radar : Doppler Effect, CW Radar – Block Diagram, Isolation between Transmitter and
Receiver, Non-zero IF Receiver, Receiver Bandwidth Requirements, Applications of CW radar. FM-CW Radar, Range and
Doppler Measurement, Block Diagram and Characteristics (Approaching/ Receding Targets), FM-CW altimeter, Measurement Errors, Multiple Frequency CW Radar.

Unit III


Textbook(s)


Reference(s)


Course Objectives

- To congregate the basic concepts and fundamentals of physical principles of remote sensing
- To understand the working principle of remote sensing systems
- To understand the various applications of remote sensing systems

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

CO1: understand fundamental principles of remote sensing
CO2: understand interaction of electromagnetic radiation with homogeneous and multi-layered medium
CO3: understand the working principles of different remote sensing systems
CO4: understand the remote sensing data processing

23ECE472 Remote Sensing Systems (Pre-requisite: Nil)
L-T-P-C: 3-0-0-3

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Syllabus
Unit I
Electromagnetics basis: Electromagnetic waves, Polarization, Spectra and Fourier transform, Doppler effect, Angular distribution of radiation, Thermal radiation, diffraction, Interactions of electromagnetic radiation: Propagation through homogeneous materials, Reflection and emission from real materials, Propagation through the atmosphere Molecular absorption and scattering, Radiative transfer equation

Unit II

Unit III

Textbook(s)

References(s)

Course Objectives
- To understand the electrical properties of biological tissues
- To understand electromagnetic interaction with biological materials
- To understand the principles of RF systems for various biomedical applications

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

CO1: understand the dielectric properties of biological tissues
CO2: comprehend how biological materials interact with electromagnetic fields
CO3: understand the thermal effects on biological tissues due to electromagnetic waves
CO4: understand RF system concepts for biomedical applications

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Syllabus
Unit I
Introduction: Fundamentals of electromagnetics - Electromagnetics, RF/Microwave energy, Penetration in Biological tissues and skin effect, Dielectric measurements and exposure; Environmental electromagnetic field and Bio-systems

Unit II

Unit III
RF Systems for Therapeutic applications: transmission lines and waveguides for medical applications; antennas; RF/Microwave ablation, Perfusion chamber, Endometrial ablation, E. M. based method for measuring blood perfusion in hear muscle, Lumen measurements of arteries using RF equipments, RF tissue Welding, Principles of computerized Tomography (CT) scan equipment.

Textbook(s)
1. V. Vorst, A Rosen and Y Kotsuka, “RF/Microwave Interaction with Biological Tissues”, John Wiley & Sons

Reference(s)

Course Objectives
- To understand fundamental concepts of RFID technology
- To understand various network protocols and standards of RFID systems
- To understand the application of RFID solutions to various logistic and monitoring applications and to evaluate the system advantages and cost structure

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

CO1: understand physical principles of RFID components
CO2: understand protocol standards used in RFID systems
CO2: understand system design and evaluation from component and network specifications
CO4: understand broad potential applications of RFID systems

CO-PO Mapping

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Syllabus
Unit I
Introduction to RFID – Comparison with other identification systems – Operating and physical principles. Types of tags – Passive, active, semi-passive, security issues, memory capacity – Radio regulatory issues and frequency ranges.

Unit II

Unit III


Textbook(s)


Reference(s)


Course Objectives

<table>
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<th>23ECE376</th>
<th>Software Defined Radio Architecture</th>
<th>L-T-P-C: 3-0-0-3</th>
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- To provide advanced level of theoretical knowledge on baseband processing
- To enable analysis, configuration and programming for software defined radio
- To introduce integration of programmable hardware baseband processing with RF modules

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

CO1: understand baseband processing techniques including multi-rate systems
CO2: understand Multi-standard radio systems
CO3: understand the integration of baseband techniques with radio systems
CO4: analyze the performance of baseband techniques for SDR

CO-PO Mapping

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Syllabus

Unit I

Introduction to wireless communication systems – Baseband signal processing – overview of wireless digital communication – Digital modulation and demodulations techniques: transmitter for complex PAM – symbol mapping – pulse shaping – wireless channel: source and channel coding schemes – channel impairments techniques: time and frequency offset corrections - Signal processing with passband signals – Multi-rate signal processing – down sampling – up sampling – polyphase structure – changing the sampling rate – Digital generation of signals – Analog to Digital (ADC) and Digital to Analog (DAC) conversion architectures.

Unit II


Unit III

**Textbook(s)**


**References(s)**


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### Signal Processing

**23ECE441**  
**Agent based Modeling**  
*(Pre-requisite: Nil)*  
**L-T-P-C: 3-0-0-3**

#### Course Objectives

- To introduce the concept of artificial agents
- To provide an understanding of the features and design considerations for developing a multi-agent system
- To provide an overview of the applicability of data mining techniques for design of intelligent agents

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

- CO1: apply the concepts of data mining for designing a simple agent based model
- CO2: analyze and formulate an agent-based solution
- CO3: design a simple multi-agent system model to solve complex engineering problems
- CO4: implement artificial agents using agent based modeling software

#### CO-PO Mapping

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#### Syllabus

**Unit-I**


**Unit II**

Data mining techniques for intelligent Agents - Association rule mining – A priori, DHP, DIC, k-Profile- Clustering – K-means, PAM, EM, Classification- ID 3, C4.5, CLS, σ-FLNMap Evolutionary algorithms-Genetic Algorithm, Particle Swarm optimisation-Ant Colony Optimization.

**Unit III**


**Textbook(s)**

Reference(s)

23ECE442 Computer Vision
(Pre-requisite: Image Processing) L-T-P-C: 3-0-0-3

Course Objectives

- To introduce the fundamental concepts and techniques in basic image formation models.
- To familiarize with various feature extraction models.
- To familiarize with concepts of camera geometry models.

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

CO1: Understand the basics concepts of image formation models.
CO2: Understand the various feature extraction models.
CO3: Understand and apply the calibration and geometry models.
CO4: Use simulation tools to develop applications using computer vision techniques.

CO-PO Mapping

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Syllabus

Unit I


Unit II

Local Feature Detectors and Descriptors: Hessian corner detector, Harris Corner Detector, LOG detector, DOG detector, SIFT, PCA-SIFT, GLOH, SURF, HOG, Pyramidal HOG, PHOW-Calibration Methods: Linear, Direct, Indirect and Multiplane methods - Pose Estimation.

Unit III

Stereo and Multi-view Geometry: Epipolar Geometry, Rectification and Issues related to Stereo, General Stereo with E Matrix Estimation, Stratification for 2 Cameras, Extensions to Multiple Cameras, Self-Calibration with Multiple Cameras, 3D reconstruction of cameras and structures, Three View Geometry.

Textbook(s)

Reference(s)
Course Objectives

- To introduce the origin and characteristics of biomedical signals
- To provide an understanding of the application of signal processing concepts in analyzing biomedical signals
- To enable implementation of algorithms for various biomedical signal-processing tasks

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

CO1: understand techniques for various levels of tasks in biomedical signal analysis
CO2: adopt appropriate algorithms according to the nature of the signal and acquisition characteristics
CO3: develop contemporary algorithms to address complex problems
CO4: implement biomedical signal processing algorithms using appropriate tools

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Syllabus

Unit I
Introduction to Biomedical Signals- Action Potential and Its Generation- Origin and Waveform Characteristics of Basic Biomedical Signals - Electrocardiogram (ECG), Electroencephalogram (EEG), Electromyogram (EMG), Phonocardiogram (PCG), Electroneurogram (ENG), Event-Related Potentials (ERPS), Electrogastrogram (EGG)- Objectives of Biomedical Signal Analysis, Difficulties in Biomedical Signal Analysis, Computer-Aided Diagnosis

Unit II
Cardiological and Neurological signal Analysis-Data Acquisition- ECG signals -Basic electrocardiography, ECG lead systems, ECG signal characteristics- Filtering for Removal of Artifacts in ECG – Algorithms for QRS Detection – Morphological Analysis of ECG, Arrhythmia analysis-Heart sounds and Murmurs- Data acquisition -EEG Rhythms - Waves and Transients – Correlation Analysis of EEG Channels.

Unit III

Textbook(s)

Reference(s)

Course Objectives

- To introduce the leading trends and systems in Natural Language Processing.
- To enable understanding of the basic representations used in syntax, the semantics of NLP
- To familiarize with the models used for word/sentence representations for various NLP applications.
Course Outcomes: At the end of the course, the student should be able to

**CO1**: Generate word representation to solve NLP problems
**CO2**: Implement machine learning models for NLP
**CO3**: Implement sequence-to-sequence models for NLP
**CO4**: Assess NLP models using various evaluation metrics

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### Syllabus

#### Unit I

#### Unit II
Language Model-n-gram, Sequences and sequential data: Part-of-Speech tagging-HMM and CRF, Named Entity Recognition, Dependency parsing. Evaluation metrics for NLP models: Precision, Recall, F score, ROUGE, BLEU scores and Visualization.

#### Unit III
Machine learning and deep learning for NLP, Sequence to sequence modelling (Encoder decoder), Attention mechanism, Transformer Networks – BERT, A brief introduction to Reinforcement learning for NLP. NLP application introduction-Sentiment Analysis, Machine translation, Question Answering, Text summarization.

### Textbook(s)

### Reference(s)

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**23ECE445**

**AI in Speech Signal Processing**

(Pre-requisite: Signal Processing II)

**L-T-P-C: 3-0-0-3**

### Course Objectives

- To provide understanding of acoustic theory behind human speech production and perception systems.
- To enable the analysis and estimation of the acoustic features from a speech signal.
- To enable the understanding of the AI-based algorithms used for speech modelling.

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

**CO1**: explain the acoustics of speech production and perception
CO2: differentiate the characteristics of different speech sounds
CO3: analyse the time-domain and frequency-domain features of the speech signal
CO4: realize various algorithms on AI-based speech modelling

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Syllabus

Unit I

Unit II
Short-time processing of speech - Windows – Rectangular, Hamming, Hanning-Time Domain parameters: Pitch, Short-time energy of speech, Zero crossing rate, Autocorrelation - Frequency domain parameters: Feature extraction for speech processing: Short term Fourier transform –Mel frequency cepstral coefficients (MFCC), Linear Prediction Analysis

Unit III

Textbook(s)

Reference(s)

Course Objectives

- To enable analysis of images in time and frequency domain
- To enable implementation of various operations on images
- To familiarize with various applications of image processing

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

CO1: understand the basic mathematical concepts used in image processing.
CO2: analyze different techniques adapted for image enhancement in spatial and frequency domain.
CO3: understand different morphological operations on images.
CO4: implement various image processing techniques.

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Syllabus

Unit I
Image processing- Introduction- Different types of images- Visual perception, Image sensing and Acquisition, Quantization, Sampling, Revision of Mathematical concepts for image processing, Image negatives, Log transformations, Histogram processing, Spatial filter: smoothing and Sharpening, Discrete Fourier transform, properties of 2-D DFT, Image smoothing and Sharpening in Fourier domain, Image restoration- Inverse filter, Weiner filter, Constrained Least squares filter.

Unit II
Morphological Image Analysis: Erosion, Dilation, Opening, Closing, Hit or Miss transformation, Application of Morphological operations- Boundary detection, Region filling, Connected components, Convex hull, Shape thinning and thickening, Skeletonization, Edge Detection: Gradient and Laplacian based edge detection, Diffusion based edge detection: Isotropic and anisotropic diffusion.

Unit III

Textbook(s)

Reference(s)

Course Objectives
- To provide conceptual background in multi-rate filter banks, wavelets and multiresolution signal analysis
- To enable understanding of the principles behind device or algorithm based on structures
- To enable practical application of multi-rate signal processing and wavelets

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

CO1: understand Time-frequency decomposition of signals
CO2: understand Multi-rate filtering and filter banks
CO3: understand Multi-resolution analysis and its connection to filter banks
CO4: demonstrate the applications of multi-rate signal processing and wavelets

CO-PO Mapping

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Syllabus
Unit I
Fundamentals of multi-rate digital signal processing, Up sampling, down sampling, interpolation, decimation, Polyphase decomposition, Multi-stage Interpolation and Decimation systems, Two-channel quadrature-mirror filter bank, Perfect reconstruction of two-channel FIR filter banks.

Unit II
Introduction to wavelets, Vector Space—Functions and function spaces, Continuous-time Fourier Transforms, Short time Fourier transforms, the uncertainty principle and time-frequency tiling, Discrete wavelet transforms, Scaling and Wavelet Functions, Filter Banks- Legendre Polynomials – Recurrence Formula – Laplace’s Integral Formula – Design of Orthogonal Wavelet Systems.

Unit III

Textbook(s)
1. P.P Vaidyanathan “Multi-rate systems and filter banks”, Prentice Hall India, 1993

Reference(s)

Course Objectives
- To enable the understanding of discrete-time random process and fundamentals of signal models
- To provide the concepts of optimum filters
- To introduce various spectrum estimation methods

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

CO1: understand discrete-time random processes and various signal models
CO2: analyze and develop algorithms for linear filtering and adaptive filtering
CO3: understand spectral estimators and design solution for estimation problems
CO4: formulate and apply frequency estimation algorithms

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Syllabus

Unit I

Unit II

Unit III

Textbook(s)

Reference(s)

Course Objectives
- To introduce the adaptive filter for estimation and tracking
- To enable development of various adaptive algorithms for communication systems
- To enable practical application of adaptive signal processing theory

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

CO1: understand spectral estimators and design solution for estimation problems.
CO2: design filter to meet performance requirements derived from various real life applications
CO3: develop algorithms for the design of filters to track variations of non-stationary random process
CO4: demonstrate the applications of adaptive filters.

CO-PO Mapping

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Syllabus

Unit I

Unit II
Unit III

Textbook(s)

Reference(s)

Common Electives

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Course Objectives

- To provide students with a comprehensive understanding of the fundamental concepts, architectures, and protocols used in sensor networks.
- To enable students to design and implement sensor networks for various applications
- To introduce students to the latest developments and emerging trends in the field of sensor networks

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

CO1: analyze and evaluate the performance of sensor networks based on various metrics
CO2: design and implement sensor networks using various hardware and software platforms
CO3: identify and solve the challenges and issues related to sensor network design
CO4: apply the knowledge and skills in sensor networks to real-world problems and applications

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Syllabus

Unit I
Introduction to Sensor Networks- Introduction to sensor networks: definitions, applications, and characteristics; Sensor network architecture and components: sensors, microcontrollers, communication modules, and power sources; Communication protocols and standards for sensor networks: IEEE 802.15.4, ZigBee, and LoRaWAN; Energy-efficient design principles for sensor networks: power management, duty cycling, and sleep/wake scheduling: Data collection and processing in sensor networks: data aggregation, compression, and filtering.

Unit II
Sensor Network Design and Implementation - Sensor network topology and deployment: star, mesh, and tree topologies; Localization and tracking in sensor networks: triangulation, trilateration, and fingerprinting; Security and privacy in sensor networks: encryption, authentication, and key management; Programming and development tools for sensor networks: Arduino, Contiki, and TinyOS; Hands-on lab sessions: designing and implementing a sensor network using wireless sensor nodes and microcontrollers.
Unit III
Advanced Topics in Sensor Networks - Emerging trends and applications in sensor networks: smart cities, precision agriculture, and healthcare; Big data analytics and machine learning for sensor networks: data mining, classification, and prediction; Cloud-based sensor networks: architecture, services, and platforms; Integration of sensor networks with other systems and technologies: Internet of Things (IoT), Cyber-Physical Systems (CPS), and Wireless Sensor-Actuator Networks (WSANs); Final project: developing a sensor network application for a specific domain or problem.

Textbook(s)
1. Feng Zhao and Leonidas Guibas, "Wireless Sensor Networks: An Information Processing Approach,
2. N. Sastry and S. Shakkottai, "Building Wireless Sensor Networks: Theoretical and Practical Perspective,
3. Chiara Buratti, Marco Stango, and Roberto Verdone "Sensor Networks with IEEE 802.15.4 Systems: Distributed Processing, MAC, and Connectivity"

Reference(s)

23ECE450 Deep Learning L-T-P-C: 3-0-0-3
(Pre-requisite: Machine Learning)

Course Objectives
- To introduce the idea of artificial neural networks and their architecture
- To enable students to design an artificial neural network for classification
- To enable students to design and deployment of deep learning models for machine learning problems

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

CO1: understand the mathematics behind the functioning of artificial neural networks
CO2: design deep learning models for sequential and image data
CO3: carry out design and implementation of deep learning models for signal processing applications
CO4: design and deploy simple TensorFlow-based deep learning solutions to classification problems

CO-PO Mapping

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Syllabus

Unit I

Unit II

Unit III

Textbook(s)

Reference(s)

Course Objectives
- To familiarize mathematical foundations of reinforcement learning.
- To enable understanding of various reinforcement learning algorithms.
- To implementation of various reinforcement learning algorithms for practical applications.

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

CO1: understand the mathematics behind reinforcement learning algorithms
CO2: implement probabilistic reinforcement learning algorithms
CO3: implement model free Reinforcement learning techniques
CO4: understand function approximation and deep learning-based reinforcement learning solutions

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Syllabus

Unit I
Introduction- Markov Decision Process: Markov property, Markov chains, Markov reward process (MRP). Bellman equations for MRPs, Introduction to Markov decision process (MDP), state and action value functions, Bellman expectation equations, optimality of value functions and policies, Bellman optimality equations, Overview of dynamic programing for MDP- principle of optimality, iterative policy evaluation, policy iteration
Unit II
Overview of Monte Carlo methods for model free RL, First visit and every visit Monte Carlo, Monte Carlo control, On policy and off policy learning, Importance sampling, Incremental Monte Carlo Methods for Model Free Prediction - TD(0), TD(1) and TD(λ), k-step estimators, unified view of DP, MC and TD evaluation methods, TD Control methods - SARSA, Q-Learning and their variants.

Unit III
Function approximation methods- Gradient MC and Semi-gradient TD(0) algorithms, Control with function approximation, Least squares, Experience replay in deep Q-Networks-Policy Gradient methods - Log-derivative trick, Naive REINFORCE algorithm, actor-critic methods- Introduction to deep reinforcement learning methods and multi-agent reinforcement learning.

Textbook(s)

Reference(s)

Course Objectives
- To provide the foundation of IoT and major elements
- To enable understanding of various protocols and standards for IoT
- To provide foundation of designing and building IoT applications

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

CO1: understand the fundamentals of IoT technology
CO2: visualize and appreciate the business opportunity and applications
CO3: understand the technology and standard for IoT
CO4: develop and design IoT networks for identified applications

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Syllabus

Unit I
Introduction- IoT definition, use-cases and business Opportunities; IoT Architecture: Objects Layer, Object Abstraction Layer, Service Management Layer, Application Layer, Business Layer.
Unit II
IoT Elements- Identification, Sensing, Communication, Computation, Services, Semantics; IoT Common standards: ZigBee, BLE, WiFi, LoRa, LPWAN, IPV6, AMPQ, MQTT; Support to the IoT: Big Data Analytics, Cloud computing, and Fog computing;

Unit III
QoS Criteria: Reliability, Mobility, Performance, Scalability, Management, Interoperability; Security and Privacy in IoT: Confidentiality, Integrity, Availability, Privacy; IoT Applications: smart city, smart health, smart farming, smart manufacturer.

Textbooks and References

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Course Objectives
- To provide the foundation on security and blockchain technology
- To enable understanding of various evolution of blockchain technology
- To provide skill to develop blockchain for specified applications

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

CO1: understand the fundamentals of blockchain technology
CO2: understand development and evolution of blockchain technology
CO3: understand the distributed technology and system and importance of blockchain
CO4: develop and design platform for blockchain for the specified applications

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Syllabus

Unit I
Introduction- Blockchain, Basic Cryptographic primitives used in Blockchain – Secure, Collison-resistant hash functions, digital signature, public key cryptosystems, zero-knowledge proof systems; Basic Distributed System concepts – distributed consensus and atomic broadcast, Byzantine fault-tolerant consensus methods.

Unit II
(Blockchain 1.0 and 2.0) – Concepts germane to Bitcoin and contemporary proof-of-work based consensus mechanisms, operations of Bitcoin blockchain, crypto-currency as application of blockchain technology; Blockchain 2.0 – blockchains with smart contracts and Turing complete blockchain scripting – issues of correctness and verifiability, Ethereum platform and its smart contract mechanism.
Unit III
Blockchain 3.0- Plug-and-play mechanisms for consensus and smart contract evaluation engines, Hyperledger fabric platform; Applications, limitation and research direction in blockchain.

Textbooks and references

23ECE454 Understanding ICT Standardization: Principles and Practices (Pre-requisite: Nil) L-T-P-C: 3-0-0-3

Course Objectives
- To provide information on the purpose of standards and the basic concepts of the SDOs’ processes
- To provide basic knowledge of the international, regional and national standardization landscape
- To identify the characteristics of formal and de facto standardization, and to be aware of the processes through which de facto standards are adopted by SDOs

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

CO1: understand the purpose of ICT standards and SDOs process
CO2: understand landscape of national, regional and international standardization
CO3: understand and distinguish between formal and de facto standardization
CO4: learn the process of de facto standards get adopted by SDOs

CO-PO Mapping

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Syllabus

Unit I

Unit II
Standard organizations-formal standardization and standards development organizations, De facto standards, consortia and standardization, selecting relevant SDOs, identifying SDO documents, structure and formalism of the standards; standardization documents, classification and naming conventions.

Unit III
National, regional and international standardization – cooperation and coordination, geographical scope in standardization, guidance for the regional and national adoption of international standards; standards supporting regulation, legislation and policy.
Textbooks and references

Course Objectives
- To introduce system engineering concepts and development methods
- To provide knowledge on requirement analysis and modelling
- To enable understanding of system integration, validation and testing

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

CO1: describe processes, methods, and practices of systems engineering
CO2: apply systems engineering practices and methods to relevant examples.
CO3: develop requirements, architectures, specifications, verifications, and tests.
CO4: analyze systems using systems engineering approaches to increase performance.

CO-PO Mapping

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Syllabus

Unit I

Unit II

Unit III
Implementing the System Building Blocks, Requirements Analysis, Functional Analysis and Design, Component Design, Design Validation, Integration, testing and evaluating total system; Test planning and preparation, system integration, Developmental and operational test and evaluation, Engineering for production, transition from development to production, Production operations, Installation, maintenance and upgrading, Installation testing, In-service support, Upgrades and modernization.
Textbooks and references


Other Electives

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<tr>
<th>23ECE461</th>
<th>Software Defined Networks</th>
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Course Objectives

- To introduce the principles of software defined networks (SDN)
- To introduce modern software defined networking standards and practices
- To enable the appreciation for the strengths and limitations of various techniques and protocols in SDN

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

CO1: understand the principles of software defined networking
CO2: understand standard protocols and practices in the data and control plane.
CO3: understand the concept of network function virtualization and provide examples of its usage.
CO4: understand the application of SDN in various scenarios and the challenges involved

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Syllabus

Unit I
Introduction – Packet switching, switch architecture, forwarding tables; Evolution of Switches and Networking – Data and control planes, cost and other constraints- Data center architecture and requirements, orchestration, virtualization- Evolution towards SDN, How SDN Works – Characteristics, operation, SDN switches and controllers, SDN Applications.

Unit II
OpenFlow – Overview and basics, OpenFlow 1.1-1.5, interoperability, limitations, and drawbacks of SDN, SDN via APIs and overlays- Network Function Virtualization – OPNFV, NFV vs. SDN, in-line network functions, Open Daylight and ONOS controller.

Unit III
Applications and Use Cases – Applications in data centers, WANs, ISPs, campus networks, optical networks, and mobile networks, reactive vs. proactive applications, internal vs. external applications.

Textbook(s)

Reference(s)

Course Objectives

- To introduce the cryptography algorithm suitable for information security
- To enable the understanding of firewall design for System Security
- To provide the knowledge about network layer security and embedded security design

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

CO1: identify and analyze various Cryptographic algorithms used in Information Security
CO2: analyze the firewall design and firewall characteristics for system security
CO3: understand the concept related to various network layers security
CO4: understand the various features related to physical cryptographic platform

CO-PO Mapping

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Syllabus

Unit I
key Cryptography - Diffie- Hellman, RSA, ECC. Introduction to Hash Algorithm, Introduction to Digital Signature, Introduction to PKI.

Unit II

Unit III

Textbooks

Reference(S)
2. Information Security for Technical Staff-SEI.
3. Guide to firewalls & network security: with intrusion detection & VPNs- HOLDEN, GREG.

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<tr>
<th>23ECE463</th>
<th>Neuroengineering</th>
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Course Objectives
- To introduce the concepts of neurosciences for engineering applications
- To develop knowledge in biological realistic neural circuit-based procedure and bioengineering techniques
- To provide knowledge in designing and developing systems and learning models

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

CO1: understand aspects of neuroscience and bioengineering techniques for data-based modelling
CO2: adopt appropriate techniques to stimulate neural system
CO3: develop simple electronic for acquisition of brain signal
CO4: develop model for neuron and extracts the characteristics

CO – PO Mapping:

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Syllabus
Unit I

Unit II

Neuro-recording methods – EEG, single unit recording, Near-infrared spectroscopy, Transcranial direct-current stimulation (TDCS), Transcranial magnetic stimulation (TMS), Functional magnetic resonance imaging (fMRI).

Unit III

Mixed Signal Electronics in Neuroengineering - device-tissue interactions, bioelectronics recording/stimulation interface – experiments, hardware and methods; Computational Neuroscience – Membrane modelling, Single neurons, Excitatory and Inhibitory Synapses, Simple Neural circuits and models; Neuroscience to Artificial Intelligence – Models and circuits, Learning, Hebbian and backpropagation in biological circuits, reinforcement learning, Large-scale models and abstractions.

Textbook(s)


Reference(s)


Course Objectives

23ECE455 Robotic System Design (Pre-requisite: Nil) L-T-P-C: 3-0-0-3

- To introduce robotic design essential
- To provide mathematical foundations necessary to analyze and design
- To provide foundation on different controls and design aspects of robotic system

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

CO1: understand the different terminology and mechanical subsystems
CO2: understand and analyze the controls involved in robotic system
CO3: use and apply necessary sensors and controls for robotic design
CO4: design a robot for a specific applications

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Syllabus
Unit I

Introduction: Classification of robots, Three laws, Robot terminologies: work volume, Degree of Freedom, resolution, accuracy, repeatability, dexterity, compliance, payload capacity, speed of response, Wrist assembly, Joint notations, Selection criteria of any robot, Industrial applications of robot, Industrial robot system, Types, Centralized robotics system controllers, decentralized robotics system controller. Real time communication and timing; Futuristic robotics; Types of drives – Hydraulic, Pneumatic and Electric, Comparison of all such drives, DC servo motors, Stepper motors, AC servo motor – salient features and applications, pulse count calculations End effectors - Types of Grippers – Mechanical, Magnetic, vacuum, pneumatic and hydraulic, selection and design considerations.

Unit II


Unit III


Textbook/References


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Course Objectives

- To introduce the mathematical foundation for modeling CPS
- To enable build models of CPS for simple use cases
- To introduce networking, intelligence and security aspects of CPS

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

CO1: understand the mathematical concepts of CPS
CO2: apply model based design to build CPS models
CO3: analyze the performance of simple CPS models
CO4: understand the role of networking, sensing, security and intelligent systems

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Syllabus

Unit I
Introduction – Overview of CPS, characteristics, CPS in the real world, Computational vs. Physical Systems, Fundamental approach, CPS Genesis, Modeling, Design, Verification and Validation, Assembly and Deployment; trends and challenges of modern cyber-physical systems.

Unit II
Modeling Cyber-Physical Systems: Overview of Continuous, Discrete, and Hybrid Models, dynamics of a physical system; Properties of Systems - Causal Systems, Memoryless Systems, Linearity and Time Invariance, Stability; Feedback Control, Controller Design techniques, Logic based system specification; Discrete Systems - Discrete Signals, Modeling Actors as Functions; The Notion of State- Finite-State Machines, Transitions, When a Reaction Occurs, Update Functions, Software Tools Supporting FSMs, Moore Machines and Mealy Machines;

Unit III
Requirements and Design - Processors and Sensors: Sensors and CPS – trends, Sensors, CPS, and IoT, Actuators and servos, Embedded CPS architectures, Communications, Security, Processors; CPS design and analysis of their performance- Canonical Example: Stopping a car, Feedback, Reduced-gravity Drone; Trajectory Planning and examples, Aviation example, Typical requirements; Guidance techniques, Classical optimization and examples, Dynamic Programs, Automotive example.

Textbook(s)

References(s)
http://LeeSeshia.org

Course Objectives
- To provide an understanding of physical properties of semiconductor materials
- To introduce the effect of defects on physical properties
- To understand the growth and processing of semiconductor materials

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

CO1: understand the physical properties of semiconductors
CO2: understand the impact of defects in semiconductors
CO3: understand growth of semiconductor materials
CO4: understand the processing of semiconductor materials

CO-PO Mapping

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Syllabus

Unit I

Unit II

Unit III

Textbook(s)

Reference(s)

Courses offered under the framework of

Amrita Values Programmes I and II

22AVP201 Message from Amma’s Life for the Modern World

Amma’s messages can be put to action in our life through pragmatism and attuning of our thought process in a positive and creative manner. Every single word Amma speaks and the guidance received in on matters which we consider as trivial are rich in content and touches the very inner being of our personality. Life gets enriched by Amma’s guidance and She teaches us the art of exemplary life skills where we become witness to all the happenings around us still keeping the balance of the mind.
22ADM211 Leadership from the Ramayana

Introduction to Ramayana, the first Epic in the world – Influence of Ramayana on Indian values and culture – Storyline of Ramayana – Study of leading characters in Ramayana – Influence of Ramayana outside India – Relevance of Ramayana for modern times.

22ADM201 Strategic Lessons from the Mahabharata

Introduction to Mahabharata, the largest Epic in the world – Influence of Mahabharata on Indian values and culture – Storyline of Mahabharata – Study of leading characters in Mahabharata – Kurukshetra War and its significance - Relevance of Mahabharata for modern times.

22AVP204 Lessons from the Upanishads

Introduction to the Upanishads: Sruti versus Smrti - Overview of the four Vedas and the ten Principal Upanishads - The central problems of the Upanishads – The Upanishads and Indian Culture – Relevance of Upanishads for modern times – A few Upanishad Personalities: Nachiketas, SatyakamaJabala, Aruni, Shvetaketu.

22AVP205 Message of the Bhagavad Gita


22AVP206 Life and Message of Swami Vivekananda

Brief Sketch of Swami Vivekananda’s Life – Meeting with Guru – Disciplining of Narendra - Travel across India - Inspiring Life incidents – Address at the Parliament of Religions – Travel in United States and Europe – Return and reception India – Message from Swamiji’s life.

22AVP207 Life and Teachings of Spiritual Masters India

Sri Rama, Sri Krishna, Sri Buddha, AdiShankaracharya, Sri Ramakrishna Paramahamsa, Swami Vivekananda, Sri RamanaMaharshi, Mata Amritanandamayi Devi.

22AVP208 Insights into Indian Arts and Literature

The aim of this course is to present the rich literature and culture of Ancient India and help students appreciate their deep influence on Indian Life - Vedic culture, primary source of Indian Culture – Brief introduction and appreciation of a few of the art forms of India - Arts, Music, Dance, Theatre.

22AVP209 Yoga and Meditation

The objective of the course is to provide practical training in YOGA ASANAS with a sound theoretical base and theory classes on selected verses of Patanjali’s Yoga Sutra and Ashtanga Yoga. The coverage also includes the effect of yoga on integrated personality development.

22AVP210 Kerala Mural Art and Painting

Mural painting is an offshoot of the devotional tradition of Kerala. A mural is any piece of artwork painted or applied directly on a wall, ceiling or other large permanent surface. In the contemporary scenario Mural painting is not restricted to the permanent structures and are being done even on canvas. Kerala mural paintings are the frescos depicting mythology and legends, which are drawn on the walls of temples and
churches in South India, principally in Kerala. Ancient temples, churches and places in Kerala, South India, display an abounding tradition of mural paintings mostly dating back between the 9th to 12th centuries when this form of art enjoyed Royal patronage. Learning Mural painting through the theory and practice workshop is the objective of this course.

22AVP213 Traditional Fine Arts of India

India is home to one of the most diverse Art forms world over. The underlying philosophy of Indian life is “Unity in Diversity” and it has led to the most diverse expressions of culture in India. Most art forms of India are an expression of devotion by the devotee towards the Lord and its influence in Indian life is very pervasive. This course will introduce students to the deeper philosophical basis of Indian Art forms and attempt to provide a practical demonstration of the continuing relevance of the Art.

22AVP214 Principles of Worship in India

Indian mode of worship is unique among the world civilizations. Nowhere in the world has the philosophical idea of reverence and worshipfulness for everything in this universe found universal acceptance as it in India. Indian religious life even today is a practical demonstration of the potential for realization of this profound truth. To see the all-pervading consciousness in everything, including animate and inanimate, and constituting society to realise this truth can be seen as the epitome of civilizational excellence. This course will discuss the principles and rationale behind different modes of worship prevalent in India.

22AVP215 Temple Mural Arts in Kerala

The traditional percussion ensembles in the Temples of Kerala have enthralled millions over the years. The splendor of our temples makes art enthusiast spellbound, warmth and grandeur of color combination sumptuousness of the outline, crowding of space by divine or heroic figures often with in vigorous movement are the characteristics of murals.

The mural painting specially area visual counterpart of myth, legend, gods, dirtsies, and demons of the theatrical world, Identical myths are popular the birth of Rama, the story of Bhima and Hanuman, Shiva, as Kirata, and the Jealousy of Uma and ganga the mural painting in Kerala appear to be closely related to, and influenced by this theatrical activity the art historians on temple planes, wood carving and painting the architectural plane of the Kerala temples are built largely on the pan-Indians almost universal model of the Vasthupurusha.

22AVP218 Insights into Indian Classical Music

The course introduces the students into the various terminologies used in Indian musicology and their explanations, like Nadam, Sruti, Svaram – svara nomenclature, Stayi, Graha, Nyasa, Amsa, Thala, Saptatalas and their angas, Shadangas, Vadi, Samavadi, Anuvadi. The course takes the students through Carnatic as well as Hindustani classical styles.

22AVP219 Insights into Traditional Indian Painting

The course introduces traditional Indian paintings in the light of ancient Indian wisdom in the fields of aesthetics, the Shadanga (Six limbs of Indian paintings) and the contextual stories from ancient texts from where the paintings originated. The course introduces the painting styles such as Madhubani, Kerala Mural, Pahari, Cheriyal, Rajput, Tanjore etc.

22AVP220 Insights into Indian Classical Dance

The course takes the students through the ancient Indian text on aesthetics the Natyasastra and its commentary the AbhinavaBharati. The course introduces various styles of Indian classical dance such as Bharatanatyam,
Mohiniyatton, Kuchipudi, Odissy, Katak etc. The course takes the students through both contextual theory as well as practice time.

**22AVP221 Indian Martial Arts and Self Defense**

The course introduces the students to the ancient Indian system of self-defense and the combat through various martial art forms and focuses more on traditional Kerala’s traditional KalariPayattu. The course introduces the various exercise technique to make the body supple and flexible before going into the steps and techniques of the martial art. The advanced level of this course introduces the technique of weaponry.

**PROFESSIONAL ELECTIVES UNDER SCIENCE STREAM**

**CHEMISTRY**

**23CHY240 COMPUTATIONAL CHEMISTRY AND MOLECULAR MODELLING L-T-P-C: 3-0-0-3**

**Course Outcomes:**

CO1: Get to understand the structure of molecules using symmetry.

CO2: Understanding Quantum mechanical approach to calculate the energy of a system.

CO3: Applying mathematical knowledge and quantum mechanical approach in finding out the characteristics-reactivity, stability, etc., of the molecule.

CO4: To get a brief idea about molecular mechanics based chemical calculations.

CO5: To get an idea about general methodology of molecular modeling.

**Syllabus**

**Unit 1**

Introduction: Stability, symmetry, homogeneity and quantization as the requirements of natural changes - Born - Haber cycle – Energetic – kinetics - Principles of spectra.

Computational techniques: Introduction to molecular descriptors, computational chemistry problems involving iterative methods, matrix algebra, Curve fitting.


Introduction to Quantum mechanics - Schrödinger equation - Position and momentumMO formation - Operators and the Hamiltonian operator - The quantum oscillator Oscillator Eigen value problems - Quantum numbers - labeling
of atomic electrons.

**Unit 2**

Molecular Symmetry: Elements of symmetry - Point groups - Determination of point groups of molecules.

Huckel’s MO theory: Approximate and exact solution of Schrodinger equation - Expectation value of energy - Huckel’s theory and the LCAO approximation - Homogeneous simultaneous equations - Secular matrix - Jacobi method - Eigen vectors: Matrix as operator - Huckel’s coefficient matrix - Wheeland’s method - Hoffmann’s EHT method - Chemical applications such as bond length, bond energy, charge density, dipole moment, Resonance energy.

**Unit 3**

Self consistent fields: Elements of secular matrix - Variational calculations - Semi empirical methods - PPP self consistent field calculation - Slater determinants - Hartree equation - Fock equation – Roothaan - Hall equation - Semi empirical models and approximations.

Ab-initio calculations: Gaussian implementations – Gamess - Thermodynamic functions - Koopman’s theorem - Isodesmic reactions, DFT for larger molecules - Computer aided assignments/mini projects with softwares - Introduction to HPC in Chemical calculations.

Molecular modelling software engineering - Modeling of molecules and processes

Signals and signal processing in Chemistry - QSAR studies and generation of molecular descriptors - Applications of chemical data mining - Familiarization with open source softwares useful for molecular modeling - Introduction to molecular simulation - M.D. simulation.

**TEXTBOOKS:**

REFERENCES:


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*CA – Can be Quizzes, Assignment, Projects, and Reports.
Course Outcomes:

CO1: Understand the fundamental concepts of electrochemistry through electrode potential and reaction kinetics

CO2: Learn the application of the electrochemical principles for the functioning and fabrication of industrial batteries and fuel cells

CO3: Acquire knowledge in solving numerical problems on applied electrochemistry

CO4: Analysis and practical problem solving in fabrication of batteries and fuel cells

CO5: Application of concepts and principle in industrial electrochemical processes

CO6: Evaluation of comprehensive knowledge through problem solving

Syllabus

Unit 1

Background Theory: Origin of potential - electrical double layer - reversible electrode potential - standard hydrogen electrode - emf series - measurement of potential - reference electrodes (calomel and silver/silver chloride) indicatorand ion selective electrodes - Nernst equation - irreversible processes - kinetic treatment - Butler-Volmer equation - Overpotential, activation, concentration and IR overpotential - its practical significance - Tafel equation and Tafel plots - exchange current density and transfer coefficients.

Unit 2

Batteries: Primary batteries: The chemistry, fabrication and performance aspects, packing classification and rating of the following batteries: (The materials taken their function and significance, reactions with equations, their performance in terms of discharge, capacity, and energy density to be dealt with). Zinc-carbon (Leclanche type), zinc alkaline (Duracell), zinc/air, zinc-silver oxide batteries; lithium primary cells - liquid cathode, solid cathode and polymer electrolyte types and lithium-ferrous sulphide cells (comparative account).

Secondary batteries: ARM (alkaline rechargeable manganese) cells, Lead acid and VRLA (valve regulated (sealed)lead acid), nickel-cadmium, nickel-zinc, nickel- metal hydride batteries, lithium ion batteries, ultra thin lithium polymer cells (comparative account). Advanced Batteries for electric vehicles, requirements of the battery - sodium-beta and redox batteries.

Unit 3


Electrochemical Processes: Principle, process description, operating conditions, process sequence and applications of Electroforming – production of waveguide and plated through hole (PTH) printed circuit boards by electrodeposition; Electroless plating of nickel, copper and gold; Electropolishing of metals; Anodizing of aluminium; Electrochemical
machining of metals and alloys.

TEXTBOOKS:


REFERENCES:


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*CA – Can be Quizzes, Assignment, Projects, and Reports.
Course Objectives:

To provide the basic knowledge about fuels, rocket propellants and explosives.

Course Outcomes:

CO1: Understand the types of fuels and variation in their properties
CO2: Able to analyze the fuel content
CO3: Obtain knowledge in identifying a proper fuel as per the requirement
CO4: Ability to know the preparation and working of propellants and explosives

Syllabus

Unit 1

Fuels - Solid fuels - Classification, preparation, cleaning, analysis, ranking and properties - action of heat, oxidation, hydrogenation, carbonization, liquefaction and gasification.

Liquid fuels – Petroleum - origin, production, composition, classification, petroleum processing, properties, testing - flow test, smoke points, storage and handling.


Unit 2

Gaseous fuels - Types, natural gas, methane from coal mine, water gas, carrier gas, producer gas, flue gas, blast furnace gas, biomass gas, refinery gas, LPG - manufacture, cleaning, purification and analysis. Fuels for spark ignition engines, knocking and octane number, anti knock additives, fuels for compression, engines, octane number, fuels for jet engines and rockets.

Flue gas analysis by chromatography and sensor techniques.

Unit 3

Rocket propellants and Explosives - classification, brief methods of preparation, characteristics; storage and handling.

**TEXTBOOK:**


**REFERENCES:**


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*CA – Can be Quizzes, Assignment, Projects, and Reports.
Course Objectives:

1. Understand the principles of green chemistry and its contribution to the development of sustainable products
2. Possess knowledge of the migration from a hydrocarbon-based economy to carbohydrate-based economy
3. Evaluate the deficiencies of traditional process and acknowledge the invention of new processes
4. Distinctly map the culmination of academic research to industrial chemistry

Course Outcomes:

CO1: Understand the evolving concept of Green Chemistry and its application to the manufacture of sustainable products

CO2: Appreciate the need for Renewable energy and Feed stock along with carbon sequestration through the fundamentals of Green Chemistry Techniques

CO3: Develop a coherence to evaluate systematic deficiencies in traditional Chemical science process and products

CO4: Undertake a purposeful Journey through the microscopic domain of academic research to the macroscopic domain of Industrial chemistry

Syllabus

Unit 1

Our environment and its protection, chemical pollution and environmental regulations, environmental chemistry, pollution prevention strategies, challenges to the sustainability of chemical industry, Pollution Prevention Act 1990, USA, Green Chemistry and its 12 principles, toxicity of chemicals, material safety data sheet (MSDS), concept of zero pollution technologies, atom economy, functional toxicity vs non-functional toxicity, alternative solvents, energy minimization, microwave and sonochemical reactions, renewable feed stock, carbon dioxide as a feed stock.

Unit 2

Greener strategies of the synthesis of ibuprofen synthesis, teraphthalic acid etc. phase behaviour and solvent attributes of supercritical CO2, use of supercritical carbon dioxide as a medium chemical industry, use of ionic liquids as a synthetic medium, gas expanded solvents, superheated water, etc. Synthesis of various chemicals from bio mass, polycarbonate synthesis and CO2 fixation, green plastics, green oxidations, etc.

Unit 3

Processes involving solid catalysts – zeolites, ion exchange resins, Nafion/silica nano composites and enhanced activity. Polymer supported reagents, green oxidations using TAML catalyst, membrane reactors. Green chemistry in material science, synthesis of porous polymers, green nanotechnology.

REFERENCES:

1. Hand Book of Green Chemistry and Technology; by James Clarke and Duncan Macquarrie; Blakwell
Publishing.


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*CA – Can be Quizzes, Assignment, Projects, and Reports.
Course Outcomes:

CO1: To develop an understanding of principle and working of the range of instrumental methods in analytical chemistry

CO2: To provide an understanding and skills in contemporary methods of separation and appropriate selection of instruments for the successful analysis of chemical compounds

CO3: To impart skills in the scientific method of planning, conducting, reviewing, reporting experiments and problem solving in chemical analysis.

Syllabus

Unit 1


Separation Techniques: Brief outline of column, paper and thin layer chromatography - Ion exchange methods - principle and application - HPLC.

Unit 2

Gas chromatography - principle and applications - gel chromatography.


Unit 3


Thermal and Diffraction techniques: Principles and applications of DTG - DTA DSC - X-ray - Electron Diffraction Studies - SEM, TEM.

TEXTBOOKS:

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*CA – Can be Quizzes, Assignment, Projects, and Reports.
Course Objective:

To provide sound knowledge on the application of electrochemistry in energy storage systems.

Course Outcome

CO1: Understand the fundamental concepts of electrochemistry through electrode potential and reaction kinetics
CO2: Learn the application of the electrochemical principles for the functioning and fabrication industrial batteries and fuel cells
CO3: Analysis of practical problem solving in fabricating batteries and fuel cells
CO4: Evaluation of comprehensive knowledge through problem solving

Syllabus

Unit 1

Background Theory: Origin of potential - electrical double layer - reversible electrode potential - standard hydrogen electrode - emf series - measurement of potential - reference electrodes (calomel and silver/silver chloride) indicator and ion selective electrodes - Nernst equation - irreversible processes - kinetic treatment - Butler-Volmer equation - Overpotential, activation, concentration and IR overpotential - its practical significance - Tafel equation and Tafelplots - exchange current density and transfer coefficients.

Unit 2

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Secondary batteries: Lead acid and VRLA (valve regulated (sealed) lead acid), nickel-cadmium, nickel-zinc, nickel-metal hydride batteries, lithium ion batteries, ultrathin lithium polymer cells (comparative account). Advanced Batteries for electric vehicles, requirements of the battery - sodium-beta and redox batteries.

Unit 3

Fuel Cells: Description, working principle, anodic, cathodic and cell reactions, fabrication of electrodes and other
components, applications, advantages, disadvantages and environmental aspects of the following types of fuel cells: Proton Exchange Membrane Fuel Cells, alkaline fuel cells, phosphoric acid, solid oxide, molten carbonate, direct methanol fuel cells.

Membranes for fuel cells: Nafion – Polymer blends and composite membranes; assessment of performance – recent developments.


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*CA – Can be Quizzes, Assignment, Projects, and Reports.
Course Outcome:

CO1: Development of skill in identifying the nature and type of corrosion
CO2: Understanding the mechanism of various types of corrosion
CO3: Analysing the problem and find out a solution to combat corrosion in any sort of environment.

CO-PO Mapping

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| CO3 | -   | 3   | 3   | 3   | 2   | 3   | 3   | -   | -   | -    | 1    | 3    | 2    | 3    | -    | -    |

Syllabus

Unit 1

Basic principles: Free energy concept of corrosion - different forms of corrosion - Thermodynamic & Kinetic aspects of corrosion: The free energy criterion of corrosion possibility - Mechanism of Electrochemical corrosion - Galvanic and Electrochemical series and their significance.

Corrosion Control: Materials selection - metals and alloys - metal purification - non metallic - changing medium.

Unit 2

Anodic and cathodic protection methods - Coatings - metallic and other inorganic coatings - organic coatings - stray current corrosion - cost of corrosion control methods.

Unit 3

Stress and fatigue corrosion at the design and in service condition - control of bacterial corrosion.


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*CA – Can be Quizzes, Assignment, Projects, and Reports.
PHYSICS

23PHY240 ADVANCED CLASSICAL DYNAMICS  L-T-P-C: 3-0-0-3

Course Outcomes:

CO1: Able to use the Lagrangian formalism to solve simple dynamical system

CO2: Able to understand Hamiltonian formalism and apply this in solving dynamical systems

CO3: Able to apply Lagrangian formalism in bound and scattered states with specific reference to Kepler’s laws and Scattering states

CO4: Able to solve problems in the Centre of Mass frame and connect it to Laboratory Frame of Reference

CO5: Understand and solve problems in rigid body rotations applying Euler’s equations.

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Syllabus

Unit 1

Introduction to Lagrangian dynamics

Survey of principles, mechanics of particles, mechanics of system of particles, constraints, D'Alembert's principle and Lagrange's equation, simple applications of the Lagrangian formulation, variational principles and Lagrange's equations, Hamilton's principles, derivation of Lagrange's equations from Hamilton's principle, conservation theorems and symmetry properties.

Unit 2

Central field problem
Two body central force problem, reduction to the equivalent one body problem, Kepler problem, inverse square law of force, motion in time in Kepler’s problem, scattering in central force field, transformation of the scattering to laboratory system, Rutherford scattering, the three body problem.

Rotational kinematics and dynamics

Kinematics of rigid body motion, orthogonal transformation, Euler’s theorem on the motion of a rigid body.

Unit 3

Angular momentum and kinetic energy of motion about a point, Euler equations of motion, force free motion of rigid body.
Practical rigid body problems

Heavy symmetrical spinning top, satellite dynamics, torque-free motion, stability of torque-free motion - dual-spin spacecraft, satellite manoeuvering and attitude control - coning maneuver - Yo-yo despin mechanism - gyroscopic attitude control, gravity-gradient stabilization.

TEXTBOOKS:


REFERENCE BOOKS:


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*CA – Can be Quizzes, Assignment, Projects, and Reports.
Course Outcomes

CO1: To understand the nature of interaction between atoms in crystalline solid materials that determines their dielectric, magnetic and electrical properties.

CO2: Analyze the relation between the macroscopic dielectric constant and the atomic structure of an insulator.

CO3: Fundamental concepts of magnetic fields required to illustrate the magnetic dipoles. This forms the basis to understand the magnetic properties of dia, para, ferro, antiferro and ferrimagnetic materials.

CO4: Fundamentals concerned with conduction mechanism in metals and superconductors.

CO5: Understand the basics for classification of materials based on its conductivity, nature of chemical bonds in Si and Ge, carrier density, energy band structure and conduction mechanism in intrinsic and extrinsic semiconductors.

CO-PO Mapping

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Syllabus

Unit 1

Conducting materials: The nature of chemical bond, crystal structure Ohm’s law and the relaxation time, collision time, electron scattering and resistivity of metals, heat developed in a current carrying conductor, thermal conductivity of metals, superconductivity.

Semiconducting materials: Classifying materials as semiconductors, chemical bonds in Si and Ge and its consequences, density of carriers in intrinsic semiconductors, conductivity of intrinsic semiconductors, carrier densities in n type semiconductors, n type semiconductors, Hall effect and carrier density.

Unit 2
Magnetic materials: Classification of magnetic materials, diamagnetism, origin of permanent, magnetic dipoles in matter, paramagnetic spin systems, spontaneous magnetization and Curie Weiss law, ferromagnetic domains and coercive force, anti ferromagnetic materials, ferrites and it’s applications.

Unit 3

Dielectric materials: Static dielectric constant, polarization and dielectric constant, internal field in solids and liquids, spontaneous polarization, piezoelectricity.

PN junction: Drift currents and diffusion currents, continuity equation for minority carriers, quantitative treatment of
the p-n junction rectifier, the n-p-n transistor.

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*CA – Can be Quizzes, Assignment, Projects, and Reports.
Unit 1

Review of some basic concepts and principle of laser.


Unit 2

Properties of LASERS

Gain mechanism, threshold condition for PI (derivation), emission broadening - line width, derivation of FWHM natural emission line width as deduced by quantum mechanics - additional broadening process: collision broadening, broadening due to dephasing collision, amorphous crystal broadening, Doppler broadening in laser and broadening in gases due to isotope shifts. Saturation intensity of laser, condition to attain saturation intensity.

Properties – coherency, intensity, directionality, monochromaticity and focussibility. LASER transition – role of electrons in LASER transition, levels of LASER action: 2 level, 3 level and 4 level laser system.

Unit 3

Types of LASERS


Liquid chemical and dye LASERS. Semiconductor LASER: Principle, characteristics, semiconductor diode LASERS, homo-junction and hetero-junction LASERS, high power semi conductor diode LASERS.

Applications in Communication field:

LASER communications: Principle, construction, types, modes of propagation, degradation of signal, analogue communication system, digital transmission, fiber optic communication.
Applications of LASERS in other fields:


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*CA – Can be Quizzes, Assignment, Projects, and Reports.
Course Outcomes

CO1: Understand, Comprehend and acquaint with concepts of NanoPhysics

CO2: To familiarize the material’s property changes with respect to the dimensional confinements.

CO3: Acquire knowledge on the modern preparation process and analysis involved in the nanomaterial’s research

CO4: To learn about the technological advancements of the nano-structural materials and devices in the engineering applications

CO-PO Mapping

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Syllabus Unit 1

Introduction

Introduction to nanotechnology, comparison of bulk and nanomaterials – change in band gap and large surface to volume ratio, classification of nanostructured materials. Synthesis of nanomaterials - classification of fabrication methods – top down and bottom up methods.

Concept of quantum confinement and phonon confinement

Basic concepts – excitons, effective mass, free electron theory and its features, band structure of solids. Bulk to nano transition – density of states, potential well - quantum confinement effect – weak and strong confinement regime.

**Unit 2**

Tools for characterization:


Nanoscale materials – properties and applications:

Carbon nanostructures – structure, electrical, vibration and mechanical properties. Applications of carbon nanotubes

**Unit 3**

Nanoelectronics and nanodevices:

Impact of nanotechnology on conventional electronics. Nanoelectromechanical systems (NEMs) – fabrication (lithography) and applications. Nanodevices - resonant tunneling diode, quantum cascade lasers, single electron transistors – operating principles and applications.

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*CA – Can be Quizzes, Assignment, Projects, and Reports.
Course Outcomes:

CO1: Understand, comprehend and acquaint with the basics working principles and governing equations of electronic devices like diodes, Bipolar junction transistors, Mosfet and heterojunction transistors.

CO2: Analyze and Solve physics problems pertaining to various process like charge conduction across semiconductor device.

CO3: Apply the knowledge for the development and design of new methods to determine semiconductor parameters and devices.

Syllabus

Unit 1

Introduction: Unit cell, Bravais lattices, crystal systems, crystal planes and Miller indices, symmetry elements. Defects and imperfections – point defects, line defects, surface defects and volume defects.


Unit 2


Theory of p-n junctions – diode and transistor: p-n junction under thermal equilibrium, forward bias, reverse bias, carrier density, current, electric field, barrier potential. V-I characteristics, junction capacitance and voltage breakdown.

Unit 3


Semiconducting devices: Optical devices: optical absorption in a semiconductor, e−-hole generation. Solar cells – p-n junction,
conversion efficiency, heterojunction solar cells. Photo detectors – photo conductors, photodiode, p-i-n diode. Light emitting diode (LED) – generation of light, internal and external quantum efficiency.

Modern semiconducting devices: CCD - introduction to nano devices, fundamentals of tunneling devices, design considerations, physics of tunneling devices.

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*CA – Can be Quizzes, Assignment, Projects, and Reports.
Course Outcomes:

After completion of the course students should be able to

CO1: Get a broad knowledge of scientific and technical methods in astronomy and astrophysics. CO2: Apply mathematical methods to solve problems in astrophysics.

CO3: Develop critical/logical thinking, scientific reasoning and skills in the area of modern astrophysics.

CO-PO Mapping:

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Syllabus

Unit 1


Practical astronomy - telescopes and observations & techniques – constellations, celestial coordinates, ephemeris.

Celestial mechanics - Kepler’s laws - and derivations from Newton’s laws.

Sun: Structure and various layers, sunspots, flares, faculae, granules, limb darkening, solar wind and climate.

Unit 2


Variable stars: Cepheid, RR Lyrae and Mira type variables - Novae and Super novae. Binary and multiple star system - measurement of relative masses and velocities. Interstellar clouds - Nebulae.
Unit 3

Galactic astronomy: Distance measurement - red shifts and Hubble’s law – age of the universe, galaxies – morphology

- Hubble’s classification - gravitational lens, active galactic nuclei (AGNs), pulsars, quasars.


Cosmology: Comic principles, big bang and big crunch – cosmic background radiation - Nucleo-synthesis - planklength and time, different cosmic models - inflationary, steady state. Variation of G. anthropic principle.

REFERENCES:

5. ‘Stellar Astronomy’ by K. D Abhayankar.

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*CA – Can be Quizzes, Assignment, Projects, and Reports.
Syllabus

Unit 1


Unit 2


Unit 3

Regression: Introduction, Least Squares Estimators of the Regression Parameters, Distribution of the Estimators, Statistical Inferences about the Regression Parameters, the Coefficient of Determination and the Sample Correlation Coefficient, Analysis of Residuals, transforming to Linearity, Weighted Least Squares, Polynomial Regression, Multiple Linear Regression, Predicting Future Responses, Logistic Regression Models for Binary Output Data.

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*CA – Can be Quizzes, Assignment, Projects, and Reports.
Syllabus

Unit 1
Elements of Game theory, examples, Strategic Games, 2 Player Strategy Games, payoffs, Minimax, Weak and Strong Domination, Saddle Points, Nash Equilibrium, Prisoner’s Dilemma, Stag Hunt, Matching pennies, BOS, Multi NE, Cooperative and Competitive Games, Strict and Non Strict NE, Best response functions for NE.

Unit 2
Combinatorial games, Winning and losing positions, Subtraction Game, 3-Pile and K-Pile Games, Proof of Correctness, Variations of K-Pile Games, Graph Games, Construction, Proof of finiteness, SG theorem for sum of games.

Unit 3
Cournot’s Oligopoly, Bertrand’s Oligopoly, Electoral Competition, Median Voter Theorem, Auctions, role of knowledge, Decision making and Utility Theory, Mixed Strategy Equilibrium, Extensive Games with Perfect Information, Stackelberg’s model of Duopoly, Buying Votes, Committee Decision making, Repeated Games, Prisoner’s Dilemma, Supermodular Game and Potential games

TEXTBOOK:
1. Martin Osborne, An Introduction to Game Theory, Oxford University Press.

REFERENCES:

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Syllabus

09 (a) Roots finding methods:

Roots of Transcendental and Polynomial Equations: Bisection method, Iteration methods based on first degree equation, Rate of convergence, system of nonlinear equations.

09 (b) Interpolations:

Interpolation and Approximation: Lagrange, Newton’s Divided Difference, Newton’s Forward and Backward interpolations.

07 (b) Multivariable optimization (2 Credits)


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*CA – Can be Quizzes, Assignment, Projects, and Reports.
FREE ELECTIVES OFFERED UNDER MANAGEMENT STREAM
COMMON TO ALL PROGRAMS

23MNG331
FINANCIAL MANAGEMENT
L-T-P-C: 3-0-3

Course Objectives

- Understand the overview of financial management
- Inculcate methods and concepts on valuation
- Familiarize with working capital management, financial analysis and planning

Course Outcomes

CO1: Understand and apply time value concept of money and use this for investment criteria decisions.

CO2: Evaluate the risk and return for various alternatives of investment.

CO3: Apply the capital budgeting techniques and evaluate the investment decisions.

CO4: Understand working capital management, cash and liquidity management and financial statements. CO/PO

Mapping

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Syllabus

Unit 1


Unit 2

Unit 3


Mergers and Takeovers-International trade.

TEXT BOOKS

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*CA – Can be Quizzes, Assignments, Projects, and Reports
Course Objectives

- Understand the complexity and key issues in supply chain management.
- Describe logistics networks, distribution planning, routing design and scheduling models.
- Familiarize dynamics of supply chain and the role of information in supply chain.
- Understand the issues related to strategic alliances, global supply chain management, procurement and outsourcing strategies.

Course Outcomes

CO1: Analyze the complexity and key issues in supply chain management

CO2: Evaluate single and multiple facility location problems, logistics network configuration, vehicle routing and scheduling models

CO3: Analyze inventory management models and dynamics of the supply chain

CO4: Develop the appropriate supply chain through distribution requirement planning and strategic alliances

CO5: Identify the issues in global supply chain management, procurement and outsourcing strategies

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Syllabus Unit 1

Introduction: Introduction to SCM—the complexity and key issues in SCM—Location strategy—facility location decisions—single facility and multiple location models.

Unit 2

Inventory: Inventory Management and risk pooling-managing inventory in the SC. Value of Information-bullwhip effect-lead time reduction.


Unit 3


TEXT BOOK

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*CA – Can be Quizzes, Assignments, Projects, and Reports
Course Objective

To educate the students to apply concepts and techniques in marketing so that they become acquainted with the duties of a marketing manager with an emphasis to make the students exposed to the development, evaluation, and implementation of marketing management in a variety of business environments.

Course Outcomes

On successful completion of the Course students will be able to:

CO1: Illustrate key marketing concepts, theories and techniques for analysing a variety of marketing situations

CO2: Identify and demonstrate the dynamic nature of the environment in which marketing decisions are taken and appreciate the implication for marketing strategy determination and implementation

CO3: Develop the ability to carry out a research project that explores marketing planning and strategies for a specific marketing situation

CO4: Understand the need and importance of sales promotions and make use of advertising

CO5: Manage a new product development process from concept to commercialization.

CO6: Illustrate the importance of modern trends in retailing and marketing logistics

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Syllabus

Unit 1

Marketing Process: Definition, Marketing process, dynamics, needs, wants and demands, value and satisfaction, marketing concepts, environment, mix. Philosophies, selling versus marketing, organizations, industrial versus consumer marketing, consumer goods, industrial goods, product hierarchy.

Buying Behaviour and Market Segmentation: Major factors influencing buying behaviour, buying decision process, business buying behaviour. Segmenting consumer and business markets, market targeting.

UNIT 2

Product Pricing and Marketing Research: Objectives, pricing, decisions and pricing methods, pricing management. Introduction, uses, process of marketing research.

UNIT 3


Advertising Sales Promotion and Distribution: Characteristics, impact, goals, types, and sales promotions- point of
purchase- unique selling proposition. Characteristics, wholesaling, retailing, channel design, logistics, and modern trends in retailing.

TEXT BOOKS


REFERENCE BOOKS


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*CA – Can be Quizzes, Assignments, Projects, and Reports
Course Objectives

- To discuss the project life cycle and build a successful project from pre-implementation to completion.
- To introduce different project management tools and techniques

Course Outcomes

CO1: Appraise the selection and initiation of individual projects and its portfolios in an enterprise.
CO2: Analyze the project planning activities that will predict project costs, time schedule, and quality.
CO3: Develop processes for successful resource allocation, communication, and risk management.
CO4: Evaluate effective project execution and control techniques that results in successful project completion

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Syllabus

Unit 1

Overview of Project Management: Verities of project, Project Features, Project Life Cycle – S-Curve, J-C Project
Selection: Project Identification and Screening – New ideas, Vision, Long-term objectives, SWOT Analysis (Strength, Weakness, Opportunities, Threats).


Project Selection – Decision Matrix, Technique for Order Preference using Similarity to Ideal Solution (TOPSIS), Simple Additive Weighting (SAW).
**Project Presentation:** WBS, Project Network – Activity on Arrow (A-O-A), Activity on Node (A-O-N).

**Project Scheduling:** Gant Chart, Critical Path Method (CPM), Project Evaluation & Review Technique (PERT). *(6hrs)*

Linear time cost trade-offs in project - Direct cost, indirect cost, Project crashing

Resource Consideration - Profiling, Allocation, Levelling.

**Introduction to project management software:** Primavera/ Microsoft project

---

**Unit 3**

**Project Execution:** Monitoring control cycle, Earned Value Analysis (EVA), Project Control – Physical control, Human control, financial control.

**Organizational and Behavioral Issues:** Organizational Structure, Selection-Project Manager, Leadership Motivation, Communication, Risk Management.

**Project Termination:** Extinction, Addition, Integration, Starvation.

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**TEXT BOOKS**

REFERENCE BOOKS


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*CA – Can be Quizzes, Assignments, Projects, and Reports
Course Objectives

- To impart knowledge on the fundamentals of costing, pricing methods and strategies.
- To give an overview of production operations planning.
- To summarize various quantitative methods of plant location, layout and lean manufacturing.
- To familiarize the concepts of e-commerce, e-purchasing, MRP and ERP in business

Course Outcomes

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

**CO1:** Understand the concepts of cost and pricing of goods and appraise project proposals

**CO2:** Design and analyze manufacturing and service processes and to measure the work performed.

**CO3:** Understand and analyze the key issues of supply chain Management

**CO4:** Understand the application of lean manufacturing tools and six sigma concepts

**CO5:** Select appropriate plant location and their layout methods

**CO6:** Create capacity plan, aggregate plan, schedule, ERP & MRP systems

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Syllabus Unit 1


Unit 2


– importance, planning process, methods – problems.

Unit 3


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*CA – Can be Quizzes, Assignments, Projects, and Reports.
Course Objectives

Familiarizing the students with quantitative tools and techniques, which are frequently applied in operational decisions.

Course Outcomes

CO1: Formulate operations research models to optimize resources.
CO2: Solve transportation and assignment problems using suitable techniques.
CO3: Apply appropriate technique to analyze a project with an objective to optimize resources.
CO4: Solve operational problems using decision theory approaches.
CO5: Select suitable inventory model for effective utilisation of resources.

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Syllabus

Unit 1


Unit 2

leveling and smoothing - shortest route problem, minimal spanning tree problem, maximal flow problem.

**Unit 3**

Sequencing model – 2 machines ‘n’ jobs, ‘m’ machines ‘n’ jobs – n jobs 2 machines.


Simulation –Monte Carlo simulation: simple problems

**Lab session:** Practicing case problems with excel solver/MatLab/LINGO package

**TEXT BOOK**


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*CA – Can be Quizzes, Assignments, Projects, and Reports
Course Objectives

- To inculcate the concepts of work study and its application to industrial practice
- Impart skills to design, develop, implement, and improve manufacturing/service systems

Course Outcomes

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

**CO1:** Create value to organizations through the analysis, evaluation, and improvement of work systems using work study and method study

**CO2:** Develop work systems through motion economy principles

**CO3:** Apply work measurement techniques to improve productivity, fix wages and incentives

**CO4:** Apply systematic layout planning techniques and work station design principles based on ergonomics and material handling.

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Syllabus

**Unit 1**

Work System: Elements of work, maintenance of machines, interaction, effect of working conditions and environment, physical and mental fatigue.

Productivity: Productivity, factors affecting production, Measurement of productivity.

Work Study: Definition and scope of work study; Areas of application of work study in industry; Human aspects of work study.
Method Study: Information collection, recording techniques, and processing aids; critical examination; development, installation and maintenance of improved methods.

Unit 2

Motion Economy and Analysis: Principles of motion economy; Motion analysis; Micromotion and Memomotion study; Therbligs and SIMO charts; Normal work area and design of work places; Basic parameters and principles of work design.

Work Measurement: Work measurement techniques; Calculation of standard time, work sampling and predetermined motion time systems.

Wages and Incentive Schemes: Introduction, wage payment of direct and indirect labour, wage payment plans and incentives, various incentive plans, incentives for indirect labour

Unit 3

Plant Layout: Concept of plant layout, types of layout; factors affecting plant layout.


Material Handling: Introduction and functions of material handling equipment, selection of material handling equipment for different requirements, safety requirements.
Recent advances in Industrial Engineering.

**TEXT BOOKS**


**REFERENCE BOOKS**


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*CA – Can be Quizzes, Assignments, Projects, and Reports
Course Objective

To impart the knowledge of basic statistical tools for analysis and interpretation of qualitative and quantitative data for decision making

Course Outcomes

CO1: Apply basic probability and statistics concepts for various business problems
CO2: Perform test of hypothesis
CO3: Compute and interpret the result of regression and correlation analysis for forecasting
CO4: Solve real time problems by applying different decision making methods.

CO/PO Mapping

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SyllabusUnit 1

Quantitative methods: Basic terminology in probability, probability rules, conditions of statistical dependence and independence, Bayes Theorem, Discrete Random Variables review of probability distributions, measure of central tendency.

Sampling and sampling distributions: Introduction to sampling, random sampling, design of experiments, introduction to sampling distributions

Estimation: point estimates, interval estimates and confidence intervals, calculating interval estimates of mean from large samples, using t test, sample size estimation.
Testing hypothesis: Introduction, basic concepts, testing hypothesis, testing when population standard deviation is known and not known, two sample tests.

Chi-square and analysis of variance: introduction, goodness of fit, analysis of variance, inferences about a population variation

Unit 3

Regression and correlation: Estimation using regression line, correlation analysis, finding multiple regression equation, modelling techniques,

Non parametric methods and time series and forecasting: Sign test for paired data, rank sum test, rank correlation, Kolmogrov – smirnov test, variations in time series, trend analysis, cyclic variation, seasonal variation and irregular variation. Decision theory: Decision tree analysis

TEXT BOOKS


REFERENCE BOOKS

March 2000 - 2nd Edition


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*CA – Can be Quizzes, Assignments, Projects, and Reports
23MEE323    TOTAL QUALITY MANAGEMENT    L-T-P-C: 3-0-0-3

Course Objective

To impart knowledge on quality management principles, tools, techniques and quality standards for real life applications

Course Outcomes

**CO1:** Evaluate the principles of quality management and to explain how these principles can be applied within quality management systems.

**CO2:** Evaluate the performance measures using various quality and management tools

**CO3:** Apply the Quality Function Deployment, Taguchi principles, Total Productive Maintenance and Failure Mode and Effect Analysis concepts to solve industrial problems.

**CO4:** Practice the various quality system in industry.

CO/PO Mapping

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Syllabus

**Unit 1**
Definition of quality - dimensions of quality. Quality planning - quality costs. Total Quality Management: historical review and principles –leadership - quality council - quality statements - strategic planning - Deming philosophy. Barriers to TQM implementation

**Unit 2**
Customer satisfaction – Customer retention - Employee involvement - Performance appraisal - Continuous process improvement - Supplier partnership - Performance measures. Seven tools of quality. Statistical fundamentals - Control Charts for variables and attributes - Process capability - Concept of six sigma - New seven management tools - Benchmarking.

**Unit 3**

**TEXT BOOK**


**REFERENCE BOOKS**

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*CA – Can be Quizzes, Assignments, Projects, and Reports
Course Objectives

- Understand Lean manufacturing principles and tools
- Inculcate the concepts of value stream mapping
- Familiarize lean implementation practices

Course Outcomes

CO1: Identify key requirements and concepts in lean manufacturing.

CO2: Initiate a continuous improvement change program in a manufacturing organization

CO3: Analyze and improve a manufacturing system by applying lean manufacturing tools

CO4: Build value stream map for improving the productivity

CO5: Improve productivity through lean practices

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Syllabus

Unit 1

Introduction to Lean and Factory Simulation: History of Lean and comparison to other methods - The 7 Wastes, their causes and the effects - An overview of Lean Principles / concepts / tools - Stockless Production.


Ford production systems – FPS gear model

Unit 2

Value Stream Mapping – Current state: Preparation for building a Current State Value Stream Map – Building a Current State Map (principles, concepts, loops, and methodology) – Application to the factory Simulation scenario.
Unit 3

Value Stream Mapping – Future State: Key issues in building the Future State Map – Process tips in building the map and analysis of the customer loop, supplier loop, manufacturing loop and information loop – Example of completed Future State Maps – Application to factory simulation


TEXT BOOKS


REFERENCES BOOKS

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*CA – Can be Quizzes, Assignments, Projects, and Reports*
Course Objectives

- This course describes the key aspects of a software project.
- It introduces the basic principles of Engineering Software Projects. Most, if not all, students' complete projects as part of assignments in various courses undertaken. These projects range in size, subject and complexity but there are basic project essentials that need to be understood and practiced for successful team project outcomes.
- The course provides an understanding of the purpose, methods and benefits of process management by exposing the student to the concepts, practices, processes, tools and techniques used in process management for software development.

Course Outcomes

CO 1: To understand the basic concepts, terminologies and issues of software project management.

CO 2: To apply appropriate methods and models for the development of solutions.

CO 3: To analyze the cost-benefits of calculations so as to optimize the selection strategy.

CO 4: To evaluate methods, models and technologies towards achieving project success.

CO 5: To design and evaluate network planning models with criticality.

CO-PO Mapping

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Syllabus

Unit 1: Introduction to Software Project Management - ways of categorizing software projects – problems with software projects - Project Life Cycle - Management - Setting objectives - Stakeholders - Project Team - Step-wise

Estimation Techniques, Function Point Analysis - Object Point-COCOMO.
Unit 2

Activity planning -- project schedules - sequencing and scheduling projects - Network planning model – AON and AOA - identifying critical activities - Crashing And Fast Tracking - Risk management - Categories, Risk planning, Management and Control - Evaluating risks to the schedule. PERT - Resource Allocation, Monitoring and Tracking - Monitoring and control - allocation - identifying resource requirements - scheduling resources - creating critical paths

- publishing schedule - cost schedules - sequence schedule.

Unit 3

Monitoring and control – Visualizing Progress, Earned value analysis, managing people and organizing teams - organizational structures - Planning for small projects. Case Study: PMBOK, Agile Development

TEXT BOOK(S)


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*CA – Can be Quizzes, Assignment, Projects, and Reports.*
Pre-Requisite(s): 19MAT112 Linear Algebra, 19MAT205 Probability and Random Processes

Course Objectives

- This course serves as an introduction to financial engineering including cash flows, financial decision making etc
- It gives a thorough yet highly accessible mathematical coverage of standard and recent topics of introductory investments: fixed-income securities, modern portfolio theory, optimal portfolio growth and valuation of multi-period risky investments.

Course Outcomes

CO1: Apply basic concepts to understand and evaluate cash flows
CO2: Evaluate and arrive at a financial investment decision employing the underlying knowledge of stocks and derivatives
CO3: Analyse and design Portfolio selection methods
CO4: Understand capital market theory for stock performance evaluation

CO-PO Mapping

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Syllabus

Unit 1

Cash Flows and Fixed income securities: Investments and markets - Principal and interest - Present and future values of streams - IRR. Fixed income securities - Market value for future cash - Bond value - Bond details - Yields - Convexity - Duration - Immunization. Bond portfolio management - Level of market interest rates, Term structure of interest-rate theories.
Unit 2


- Black Scholes formula - Utility functions - Applications in financial decision making.

Unit 3


TEXT BOOK(S)

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*CA – Can be Quizzes, Assignment, Projects, and Reports.
Course Objectives

- Prepare engineering students to analyze and understand the business, impact of economic environment on business decisions

Course Outcomes

CO1: Understand and evaluate the economic theories, cost concepts and pricing policies and draw inferences for the investment decisions for appraisal and profitability

CO2: Appraise the dynamics of the market and market structures and portray implication for profit and revenue maximization

CO3: Employ operations research and allied techniques in managerial economics for an enhanced analysis and decision making

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Syllabus

Unit 1


- Cost of capital. Appraising project profitability

Unit 2

Research techniques in managerial economics: Inventory models. Theory of games. Decision theory, Risk and Uncertainty,
Measuring risk, Consumer behavior and risk aversion, Decision making under uncertainty with complete ignorance

TEXT BOOK(S)


REFERENCE(S)

## Evaluation Pattern

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*CA – Can be Quizzes, Assignment, Projects, and Reports.
Course Objectives

- This course is to expose the students to the managerial issues relating to information systems and also understand the role of Business Process Reengineering technique in an organization.
- The course also focuses on the management of information technology to provide efficiency and effectiveness or strategy decision making.

Course Outcomes

CO1: Understand the fundamental concepts of Information Systems in business.

CO2: Understand and analyse the strategic role played by Information Systems in e-commerce.

CO3: Analyse management challenges in Global Businesses predominantly dependent on IS functions.

CO-PO Mapping

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Syllabus

Unit 1


Unit 2


Unit 3


TEXT BOOK(S)

REFERENCE(S)

Laudon K, Laudon JP. Management Information Systems; 2010

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*CA – Can be Quizzes, Assignment, Projects, and Reports.
FREE ELECTIVES OFFERED UNDER HUMANITIES / SOCIAL SCIENCE STREAMS COMMON TO ALL PROGRAMS

23CUL230 ACHIEVING EXCELLENCE IN LIFE - AN INDIAN PERSPECTIVE          L-T-P-C: 2-0-0-2

Course Objectives:

The course offers to explore the seminal thoughts that influenced the Indian Mind on the study of human possibilities for manifesting excellence in life. This course presents to the students, an opportunity to study the Indian perspective of Personality Enrichment through pragmatic approach of self analysis and application.

Syllabus

Unit 1

Goals of Life – Purusharthas

What are Purusharthas (Dharma, Artha, Kama, Moksha); Their relevance to Personal life; Family life; Social life & Professional life; Followed by a Goal setting workshop;

Yogic way of Achieving Life Goals – (Stress Free & Focused Life)

Introduction to Yoga and main schools of Yoga; Yogic style of Life & Time Management (Work Shop); Experiencing life through its Various Stages

Ashrama Dharma; Attitude towards life through its various stages (Teachings of Amma);

Unit 2

Personality Development

What is Personality – Five Dimensions – Pancha Kosas (Physical / Energy / Mental / Intellectual / Bliss); Stress Management & Personality; Self Control & personality; Fundamental Indian Values & Personality;

Learning Skills (Teachings of Amma)

Art of Relaxed Learning; Art of Listening; Developing ‘Shraddha’ – a basic qualification for obtaining Knowledge; Communication Skills - An Indian Perspective;

Unit 3

Developing Positive Attitude & Friendliness - (Vedic Perspective);

Achieving Work Excellence (Karma Yoga by Swami Vivekananda & teachings based on Amma);

Leadership Qualities – (A few Indian Role models & Indian Philosophy of Leadership);
REFERENCE BOOKS:

1. Awaken Children (Dialogues with Sri Mata Amritanandamayi) Volumes 1 to 9
2. Complete works of Swami Vivekananda (Volumes 1 to 9)
3. Mahabharata by M. N Dutt published by Parimal publications – New Delhi (Volumes 1 to 9)
4. Universal message of Bhagavad-Gita (An exposition of Gita in the light of modern thought and Modern needs) by Swami Ranganathananda. (Vols.1 to 3)
7. Art of Man Making - Swami Chinmayananda published by Chinmaya Mission, Bombay
10. Yoga In Daily Life - Swami Sivananda – published by Divine Life Society
12. All about Hinduism – Swami Sivananda - Published by Divine Life Society
15. Valmiki Ramayana – Four volumes- published by Parimal Publications, Delhi
17. Mind Sound Resonance Technique (MSRT) Published by Swami Vivekananda Yoga Prakashana, Bangalore.
18. Yoga & Memory - Dr H R Nagendra & Dr. Shirley Telles, published by Swami Vivekananda Yoga Prakashana, Bangalore.

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*CA – Can be Quizzes, Assignment, Projects, and Reports.
Syllabus

Unit 1
1. The anatomy of ‘Excellence’. What is ‘excellence’? Is it judged by external factors like wealth?
2. The Great Flaw. The subject-object relationship between individual and world. Promote subject enhanceexcellence.
3. To work towards excellence, one must know where he is. Our present state... An introspective analysis.Our faculties within.

Unit 2
4. The play of the mind. Emotions – convert weakness into strength.
5. The indispensable role of the intellect. How to achieve and apply clear thinking?
7. Increase Productivity, reduce stress.. work patterning.

Unit 3
8. The art of right contact with the world. assessment, expectations.
9. Myths and Realities on key issues like richness, wisdom, spirituality.
10. Collect yourself, there is no time to waste. The blue-print of perfect action.

REFERENCES:

The Bhaja Govindam and the Bhagavad Gita.

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OBJECTIVES:

This course offers a journey of exploration through the early developments in India of astronomy, mathematics, technologies and perspectives of the physical world. With the help of many case studies, the students will be equipped to understand concepts as well as actual techniques.

Syllabus

Unit 1
1. General introduction: principles followed and sources;
2. Astronomy & mathematics from the Neolithic to the Indus civilization;
3. Astronomy & mathematics in Vedic literature;
4. Vedanga Jyotisha and the first Indian calendars;
5. Shulba Sutras and the foundations of Indian geometry;

Unit 2
1. Astronomy & mathematics in Jain and Buddhist literature;
2. The transition to the Siddhantic period; Aryabhata and his time;
3. The Aryabhatiya: concepts, content, commentaries;
4. Brahmagupta and his advances;
5. Other great Siddhantic savants;
6. Bhaskara II and his advances;

Unit 3
1. The Kerala school of mathematics;
2. The Kerala school of astronomy;
3. Did Indian science die out?;
4. Overview of recent Indian scientists, from S. Ramanujan onward;
5. Conclusion: assessment and discussion;

TEXTBOOK:
Indian Mathematics and Astronomy: Some Landmarks, by S. Balachandra Rao

REFERENCE:
IFIH’s interactive multimedia DVD on Science & Technology in Ancient India.

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OBJECTIVES:

This course offers the foundation necessary to understand Eastern approaches to psychology and spirituality. The course includes experiential components centering on meditation and spiritual practice.

Syllabus

Unit 1

Introduction

Introduction to Modern Psychology

A short history of Modern Psychology - Major Schools of Modern Psychology - The three major forces in Western Psychology - Freudian Psychoanalysis; Behaviourism; Humanistic Psychology.

Introduction to Indian Psychology

What is Yoga? - Rise of Yoga Psychology tradition - Various schools of Yoga Psychology - Universal Goal of all Yoga schools.

Patanjali Yoga Sutra – 1


Patanjali Yoga Sutra – 2


Unit 2

Patanjali Yoga Sutra – 3

Two formulae - Necessity of Abhyasah and Vairagyah - Foundation of Abhyasah - Foundation of Vairagyah.

Patanjali Yoga Sutra – 4

Main obstacles in the path of Yoga - other obstructions - removal of obstacles by one – pointedness; by controlling Prana - by observing sense experience - by inner illumination - by detachment from matter - by knowledge of dream and sleep - by meditation as desired.


Patanjali Yoga Sutra – 10

Asanam – Pranayamah - various kinds of Pranayamah - Pratyaharah - Mastery over the senses. Report review Conclusion

REFERENCES:

1. The course book will be “The four chapters of Freedom” written by Swami Satyananda Saraswati of Bihar School of Yoga, Munger, India.
3. Eight Upanishads with the commentary of Sankaracharya, Translated by Swami Gambhirananda, Published by Advaita Ashram, Uttaranjal.
4. ‘Hatha Yoga Pradipika’ Swami Muktibodhananda, Yoga Publications Trust, Munger, Bihar, India

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*CA – Can be Quizzes, Assignment, Projects, and Reports.
OBJECTIVES:

To introduce business vocabulary; to introduce business style in writing and speaking; to expose students to the cross-cultural aspects in a globalised world; to introduce the students to the art of persuasion and negotiation in business contexts.

Course Outcomes

CO1: Familiarize and use appropriate business vocabulary and etiquettes in verbal communication in the professional context

CO2: Understand organizational structures, pay structures and performance assessments

CO3: Apply language skills in drafting various business documents and other necessary communications in the business context

CO4: Understand and address cross cultural differences in the corporate environment

CO5: Participate in planned and extempore enactments of various business situations

CO-PO Mapping

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Syllabus

Unit 1

Unit 2

Writing: Style and vocabulary - Business Memorandum, letters, Press Releases, reports – proposals – Speaking: Conversational practice, telephonic conversations, addressing a gathering, conducting meetings.

Unit 3

Active Listening: Pronunciation – information gathering and reporting - Speaking: Cross-Cultural Issues, Group Dynamics, negotiation & persuasion techniques.

Activities

Case studies & role-plays.

BOOKS RECOMMENDED:


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OBJECTIVES:

To expose the students to the greatness of Indian Thought in English; to develop a sense of appreciation for the lofty Indian Thought; to develop an understanding of the eclectic Indian psyche; to develop an understanding about the societal changes in the recent past.

Syllabus

Unit 1

Poems
Rabindranath Tagore’s Gitanjali (1-10); Nizzim Ezekiel’s Enterprise; A.K. Ramanujam’s Small-Scale Reflections on a Great House.

Unit 2

Prose
Khushwant Singh’s The Portrait of a Lady; Jhumpa Lahiri’s Short Story - Interpreter of Maladies.

Unit 3

Drama and Speech
Vijay Tendulkar’s Silence, the Court is in Session; Motivational speeches by Jawaharlal Nehru/ S. Radhakrishnan / A. P. J. Abdul Kalam’s My Vision for India etc. (any speech).

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OBJECTIVES:

To expose the students to different genres of Literature; to hone reading skills; to provide deeper critical and literary insights; to enhance creative thinking; to promote aesthetic sense.

Syllabus

Unit 1

Poems

Unit 2

Short Stories

Unit 3

Prose

Practicals:

Role plays: The Proposal, Chekov / Remember Ceaser, Gordon Daviot / Final Solutions, Mahesh Dattani, Bookreviews, Movie reviews.

SUGGESTED READING:

The Old Man and the Sea, Hemingway / Any one of the novels of R.K. Narayan, etc.

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OBJECTIVES:

To introduce the students to the elements of technical style; to introduce the basic elements of formal correspondence; to introduce technical paper writing skills and methods of documentation; to improve oral presentation skills in formal contexts.

Course Outcomes:

After the completion of the course the student will be able to:

CO1: Understand and use the basic elements of formal correspondence and methods of documentation.
CO2: Learn to edit technical content for grammatical accuracy and appropriate tone and style.
CO3: Use the library and internet resources for research purposes.
CO4: Demonstrate the ability to communicate effectively through group mock-technical presentations and other activities.

Mapping of course outcomes with program outcomes:

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Syllabus:
Unit 1


Unit 2

Different kinds of written documents: Definitions – descriptions – instructions – recommendations - manuals -reports – proposals; Formal Correspondence: Letter Writing including job applications with Resume.

Unit 3


Practice in oral communication and Technical presentations

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*CA – Can be Quizzes, Assignment, Projects, and Reports.*
OBJECTIVES:

To help the students learn the fine art of story writing; to help them learn the techniques of story telling; to help them study fiction relating it to the socio-cultural aspects of the age; to familiarize them with different strategies of reading short stories; to make them familiar with the morals and values held in high esteem by the ideals of Indianness.

**Syllabus**

**Unit 1**


**Unit 2**


**Unit 3**

Masti Venkatesha Iyengar: The Curds-Seller; Manohar Malgonkar: Upper Division Love; Romila Thapar: The Spell; Premchand: The Voice of God.

**TEXT:**

*M. G. Narasimha Murthy (ed), Famous Indian Stories. Hyderabad: Orient Black Swan, 2014*

**REFERENCE:**


**Evaluation Pattern**

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*CA – Can be Quizzes, Assignment, Projects, and Reports.*
Syllabus

Unit 1

Population - Identity

How to introduce yourself (name, age, address, profession, nationality); Numbers; How to ask questions; Grammar – Pronouns - subjects; Regular verbs of 1st group (er) in the present; Être (to be) and avoir (to have) in the present; Interrogative sentence; Gender of adjectives.

Unit 2

The suburbs - At the train station

Introduce someone; Buy a train ticket or a cinema ticket; Ask for information; Official time; Ask for a price; The city (church, town hall, post office...)

Grammar – Pronouns - subjects (continuation); Gender of adjectives (continuation); Plural of nouns and adjectives; Definite and indefinite articles; Interrogative adjectives; I would like (Je voudrais).

Unit 3

Paris and the districts - Looking for a room

Locate a room and indicate the way; Make an appointment; Give a price; Ordinal numbers; Usual time; Ask for the time.

Grammar - Imperative mode; Contracted articles (au, du, des); negation.

TEXTBOOK:

Metro St Michel - Publisher: CLE international

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*CA – Can be Quizzes, Assignment, Projects, and Reports.*
Syllabus

Unit 1

The first room of a student

A party to celebrate the 1st room; Description of a room; furniture; Locate objects: prepositions (devant, derrière, dans...), Read advertisement; Appreciation (I like, I prefer,).

Grammar - Perfect past tense with avoir; Possessive adjectives (mon, ton, son...); Demonstrative adjectives (ce, cet, cette); Yes (oui, si).

Unit 2 Small jobs

Conversation on the phone; Give Time indications; Answer a job offer; Describe a job; Suggest a meeting time.
Grammar - Perfect past tense with être and avoir (continuation); Possessive adjectives (notre, votre, leur); Prepositions (à, pour, avec ...); Pronoun as direct object (le, la, l’, les).

Unit 3

University Restaurant

Inquiry; Express an opinion; Ask questions (continuation); Food, meals, taste, preferences; Nutrition, diet, choose a menu or diet, Expression of quantities (beaucoup, peu).

Grammar - Partitif (expressing quantity) (du, de la, pas de...); Comparison (plus...que, moins....que, autant ...que); Interrogation (continuation), inversion, Est-ce que, qu’est-ce que?.

TEXTBOOK:

Metro St Michel - Publisher: CLE International

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Syllabus

Unit 1
Greetings; Introducing one-self (formal and informal context), saying their name, origin, living place, occupation. Numbers 1-100; Saying the telephone number. Countries and Languages.

Grammar: Structure – W - Questions and Yes/No questions and statements, personal pronouns, verb conjugations. Articles.

Vocabulary: Professions.

Unit 2
Giving the personal details. Name, age, marital status, year of birth, place of birth, etc. Numbers till 1000. Saying a year. Alphabets – spelling a word.

Filling up an application form; In the restaurant – making an order.

Grammar: Definite, indefinite and negative article in nominative. Accusative: indefinite and negative Article Vocabulary: Food items

Unit 3

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Syllabus

Unit 1
Shopping and orientation in supermarket; Conversation between the customer and salesman; Where one finds what in supermarket; Asking for requests and suggestions.

Grammar: Dative of personal pronouns. Imperative form. Vocabulary: Consumables and measurements;

Unit 2
Appointments; Work and leisure time activities; Time, weekdays, months and seasons; saying the date; fixing up an appointment.

Grammar: Model verbs; Prepositions with time and place; Ordinal numbers. Vocabulary: Leisure activities, weekdays, months and seasons.

Unit 3
Family and household; Family and relations; household and daily routine. Grammar: Possessive articles; Divide and indivisible verbs.

Vocabulary: Family circle; Household articles.

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*CA – Can be Quizzes, Assignment, Projects, and Reports.
Syllabus

To have an elementary exposure to German language; specifically

1. to have some ability to understand simple spoken German, and to be able to speak it so as to be able to carry on life in Germany without much difficulty (to be able to do shopping, etc.);
2. to be able to understand simple texts, and simple forms of written communication;
3. to have a basic knowledge of German grammar;
4. to acquire a basic vocabulary of 500 words;
5. to be able to translate simple letters with the use of a dictionary; and
6. to have some familiarity with the German life and culture.

(This will not be covered as part of the regular classroom teaching; this is to be acquired by self-study.) Some useful websites will be given.

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Syllabus

The basic vocabulary and grammar learned in the earlier course is mostly still passive knowledge. The endeavour of this course is to activate this knowledge and develop the skill of communication.

Topics are: Airport, railway station, travelling; shopping; invitations, meals, meeting people; around the house; the human body; colours; professions.

Past and future tenses will be introduced. Applying genitive, dative and accusative. Some German culture. Films.

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*CA – Can be Quizzes, Assignment, Projects, and Reports.
OBJECTIVES:

To teach Hindi for effective communication in different spheres of life - Social context, Education, governance, Media, Business, Profession and Mass communication.

Course Outcomes:

After the completion of the course the student will be able to:

CO1: Gain knowledge about the nature and culture of Hindi language
CO2: Understand the structural aspects of Hindi language
CO3: Apply the knowledge of the grammatical structures to communicate in Hindi
CO4: Analyse the social significance of modern literature.
CO5: Develop the ability to translate a given text to Hindi

CO-PO Mapping:

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Syllabus

Unit 1

Introduction to Hindi Language, National Language, Official Language, link Language etc. Introduction to Hindilanguage,
Devanagari script and Hindi alphabet.


Unit 2

Common errors and error corrections in Parts of Speech with emphasis on use of pronouns, Adjective and verb in different tenses – Special usage of adverbs, changing voice and conjunctions in sentences, gender& number - General vocabulary for conversations in given context –understanding proper pronunciation - Conversations, Interviews, Short speeches.

Unit 3

Poems – Kabir 1st 8 Dohas, Surdas 1st 1 Pada; Tulsidas 1st 1 Pada; Meera 1st 1 Pada

Unit 4


Unit 5

Kahani – Premchand: Kafan, Abhilasha, Vidroh, Poos ki rath, Julioos.
BOOKS:

1. Prem Chand Ki Sraveshrestha Kahaniyam: Prem Chand; Diamond Pub Ltd. New Delhi
2. Vyavaharik Hindi Vyakaran, Anuvad thaha Rachana: Dr. H. Parameswaran, Radhakrishna publishing House, New Delhi

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*CA – Can be Quizzes, Assignment, Projects, and Reports.
OBJECTIVES:

Appreciation and assimilation of Hindi Literature both drisya & shravya using the best specimens provided as anthology.

Course Outcomes:

After the completion of the course the student will be able to:

CO1: Understand the grammatical structures of Hindi
CO2: Understand the post modern trends of literature
CO3: Enhance critical thinking and writing skills
CO4: Identify and analyse different literary and audio-visual material
CO5: Apply fundamental knowledge of Hindi in formal and informal writing

CO-PO Mapping:

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Syllabus:

Unit 1
Kavya Tarang; Dhumil ke Anthim Kavitha [Poet-Dhumil]; Dhabba [Poet-Kedarnath Singh]; Proxy [Poet-Venugopal]; Vakth [Poet-Arun Kamal]; Maachis [Poet-Suneeta Jain].

Unit 2
Communicative Hindi - Moukhik Abhivyakthi

Unit 3
Audio-Visual Media in Hindi – Movies like Tare Zameen par, Paa, Black etc., appreciation and evaluation. Newsreading and presentations in Radio and TV channels in Hindi.

Unit 4
Gadya Manjusha – Budhapa, Kheesa, Sadachar ka Thavis

Unit 5

BOOKS:

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Syllabus

Unit 1
Emotional Intelligence: Concept of Emotional Intelligence, Understanding the history and origin of Emotional Intelligence, Contributors to Emotional Intelligence, Science of Emotional Intelligence, EQ and IQ, Scope of Emotional Intelligence.

Unit 2

Unit 3
Emotional Intelligence at Work place: Importance of Emotional Intelligence at Work place? Cost-savings of Emotional Intelligence, Emotionally Intelligent Leaders, Case Studies Measuring Emotional Intelligence: Emotionally Intelligence Tests, Research on Emotional Intelligence, Developing Emotional Intelligence.

REFERENCES:

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Syllabus

Unit 1
Introduction

General Introduction; ‘His + Story’ or ‘History’ ?; The concepts of ‘nation’, ‘national identity’ and ‘nationalism’; Texts and Textualities: Comparative Perspectives.

Unit 2

Selected writings / selections from the complete works of the following authors will be taken up for study in a chronological order:

Raja Ram Mohan Roy; Dayananda Saraswati; Bal Gangadhar Tilak; Rabindranath Tagore;

Unit 3

Selected writings / selections from the complete works of the following authors will be taken up for study in a chronological order:

Swami Vivekananda; Sri Aurobindo; Ananda K. Coomaraswamy; Sister Nivedita; Mahatma Gandhi; Jawaharlal Nehru; B.R. Ambedkar; Sri Chandrasekharendra Saraswati, the Paramacharya of Kanchi; Dharampal; Raja Rao;

V.S. Naipaul.

Conclusion.

REFERENCES:

1. Tilak, Bal Gangadhar. The Orion / Arctic Home in the Vedas.
2. Tagore, Rabindranath. The History of Bharatavarsha / On Nationalism / Greater India.

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Syllabus

Unit 1

Introduction

A peep into India’s glorious past

Ancient India – the vedas, the vedic society and the Sanatana Dharma – rajamandala and the Cakravartins – Ramarajya – Yudhisthira’s ramarajya; Sarasvati - Sindhu Civilization and the myth of the Aryan Invasion; Classical India – Dharma as the bedrock of Indian society – Vaidika Brahmanya Dharma and the rise of Jainism and Buddhism

– the sixteen Mahajanapadas and the beginning of Magadhan paramountcy - Kauutilya and his Arthasastra – Chandragupta Maurya and the rise of the Mauryan empire – Gupta dynasty Indian art and architecture – classical sanskrit literature – Harsavardhana; Trade and commerce in classical and medieval India and the story of Indian supremacy in the Indian ocean region; The coming of Islam – dismantling of the traditional Indian polity – the Mughal empire – Vijayanagara samrajya and days of Maratha supremacy.

Unit 2

India’s contribution to the world: spirituality, philosophy and sciences

Indian Philosophy – the orthodox (Vaidika) and the heterodox (atheistic) schools; Ramayana and Mahabharata; Bhagavad Gita; Saints and sages of India; Ancient Indian medicine: towards an unbiased perspective; Ancient Indian mathematics; Ancient Indian astronomy; Ancient Indian science and technology.

The arrival of Europeans, British paramountcy and colonization

What attracted the rest of the world to India?; India on the eve of the arrival of European merchants; The story of colonization and the havoc it wreaked on Indian culture and civilization; Macaulay and the start of the distortion of Indian education and history; Indian economy – before and after colonization: a brief survey; The emergence of modern India.

Unit 3

Women in Indian society

The role and position of women in Hindu civilization; Gleanings from the Vedas, Brihadarnyaka Upanishad, Saptasati Devi Mahatmyam, Ramayana, Mahabharata, Manusmriti, Kauutilya’s Arthasastra and Mrichchhakatikam of Sudraka; The role and position of Indian women vis-a-vis Islam and European cultures; The great women of India.

Modern India

The national movement for freedom and social emancipation; Swami Vivekananda, Sri Aurobindo, Rabindranath Tagore;
Understanding Mahatma Gandhi; A new nation is born as a republic – the pangs of birth and growth; India since Independence – the saga of socio-political movements; Problems facing the nation today; Globalization and Indian Economy; Bharatavarsha today and the way ahead: Regeneration of Indian National Resources.

Conclusion

The Wonder that was India; The ‘politics’ and ‘purpose’ of studying India.

REFERENCES:

17. Aurobindo, Sri. The Indian Renaissance / India’s Rebirth / On Nationalism.
26. Danino, Michel. The Invasion That Never Was.
34. Dharampal. Archival Compilations (unpublished)

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*CA – Can be Quizzes, Assignment, Projects, and Reports.*
23HUM233  GLIMPSES OF INDIAN ECONOMY AND POLITY  L-T-P-C: 2-0-0-2

Syllabus

Unit 1
Introduction

General Introduction; Primitive man and his modes of exchange – barter system; Prehistoric and proto-historic polity and social organization.

Ancient India – up to 600 B.C.

Early India – the vedic society – the varnashramadharma – socio-political structure of the various institutions based on the four purusarths; The structure of ancient Indian polity – Rajamandala and Cakravartins – Prajamandala; Socio-economic elements from the two great Epics – Ramayana and Mahabharata – the concept of the ideal King (Sri Rama) and the ideal state (Ramarajya) – Yudhisthira’s ramarajya; Sarasvati - Sindhu civilization and India’s trade links with other ancient civilizations; Towards chiefdoms and kingdoms – transformation of the polity: kingship – from gopati to bhupati; The mahajanapadas and the emergence of the srenis – states and cities of the Indo-Gangetic plain.

Unit 2

Classical India: 600B.C. – 1200 A.D.

The rise of Magadha, emergence of new religions – Buddhism and Jainism – and the resultant socio-economic impact; The emergence of the empire – the Mauryan Economy and Kautilya’s Arthasastra; of Politics and trade – the rise of the Mercantile Community; Elements from the age of the Kushanas and the Great Guptas; India’s maritime trade; Dharma at the bedrock of Indian polity – the concept of Digvijaya: dharma-vijaya, lobha-vijaya and asura-vijaya; Glimpses into the south Indian economies: political economies of the peninsula – Chalukyas, Rashtrakutas and Cholas.

Medieval India: 1200 A.D. – 1720 A.D.

Advent of Islam – changes in the social institutions; Medieval India – agrarian economy, non-agricultural production and urban economy, currency system; Vijayanagara samrajya and maritime trade – the story of Indian supremacy in the Indian Ocean region; Aspects of Mughal administration and economy; The Maratha and other provincial economies.

Unit 3

Modern India: 1720 - 1947

the Indian market and economy before the arrival of the European traders; Colonisation and British supremacy (dismantling of everything that was ‘traditional’ or ‘Indian’) – British attitude towards Indian trade, commerce and economy and the resultant ruining of Indian economy and business – man-made famines – the signs of renaissance: banking and other business undertakings by the natives (the members of the early Tagore family, the merchants of Surat and Porbander, businessmen of Bombay, etc. may be referred to here) – the evolution of the modern banking system; Glimpses into British administration of India and administrative models; The National movement and nationalist undertakings in business and industry: the Tatas and the Birlas; Modern India: the growth of large-scale industry – irrigation and railways –
money and credit – foreign trade; Towards partition – birth of two new nations

– division of property; The writing of the Indian Constitution – India becomes a democratic republic – a new polity is in place.

Independent India – from 1947

India since Independence – the saga of socio-political movements; Indian economy since Independence – the fiscal system – the five year plans – liberalisation – the GATT and after; Globalisation and Indian economy; Impact of science and (new/emerging) technology on Indian economy; Histories of select Indian business houses and business entrepreneurship.

Conclusion

REFERENCES:

1. The Cultural Heritage of India. Kolkata: Ramakrishna Mission Institute of Culture.
   Kautilya. Arthasastra.

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*CA – Can be Quizzes, Assignment, Projects, and Reports.
Syllabus

Unit 1

Introduction to Health

Health is wealth; Role of lifestyle habits on health; Importance of adolescence; Stages, Characteristics and changes during adolescence; Nutritional needs during adolescence why healthy lifestyle is important for adolescence. Eating Habits - eating disorders, skipping breakfast, junk food consumption.

Practicals - Therapeutic Diets

Unit 2

Food and Nutritional Requirements during Adolescence

Fluid intake; nutrition related problems; lifestyle related problems, Role of physical activity; resting pattern and postures, Personal habits – alcoholism, and other tobacco products, electronic addiction etc

Practicals - Ethnic Foods

Unit 3

Need for a Positive Life Style Change

Peer pressure & procrastination, Stress, depression, suicidal tendency, Mini project review and viva, Whole portions revision.

Practical - Cooking without Fire or Wire-healthy Snacks

TEXTBOOKS:

**REFERENCE BOOKS:**

2. WHO Report on Adolescent Health: 2010

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*CA – Can be Quizzes, Assignment, Projects, and Reports.
Syllabus

Unit 1
Introductory study of the Bhagavad Gita and the Upanishads.

Unit 2
The relevance of these classics in a modern age.

Unit 3
Goals of human life - existential problems and their solutions in the light of these classics etc.

REFERENCE:

The Bhagavad Gita, Commentary by Swami Chinmayananda

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*CA – Can be Quizzes, Assignment, Projects, and Reports.
PREAMBLE:

This paper will introduce the students to the multiple dimensions of the contribution of India to the fields of philosophy, art, literature, physical and social sciences. The paper intends to give an insight to the students about the far-reaching contributions of India to world culture and thought during the course of its long journey from the hoary antiquity to the present times. Every nation takes pride in its achievements and it is this sense of pride and reverence towards the achievements that lays the foundation for its all-round progress.

Syllabus

Unit 1

A brief outline of Indian history from prehistoric times to the present times.

Contributions of India to world culture and civilization: Indian Philosophy and Religion; Art and Literature; Physical and Social Sciences.

Unit 2

Modern India: Challenges and Possibilities.

Scientific and technological progress in post-independence era; Socio-cultural and political movements after independence; Challenges before the nation today - unemployment – corruption – degradation of cultural and moral values - creation of a new system of education; Creation of a modern and vibrant society rooted in traditional values.

Unit 3

Modern Indian Writing in English: Trends in Contemporary Indian Literature in English.

TEXTBOOK:

Material given by the Faculty

BACKGROUND LITERATURE:

1. Selections from The Cultural Heritage of India, 6 volumes, Ramakrishna Mission Institute of Culture (Kolkata) publication.
2. Selections from the Complete Works of Swami Vivekananda, Advaita Ashrama publication.
3. Invitations to Indian Philosophy, T. M. P. Mahadevan, University of Madras, Chennai.
4. Outlines of Indian Philosophy, M. Hiriyanna, MLBD.
5. An Advanced History of India, R. C. Majumdar et al, Macmillan.
6. India Since 1526, V. D. Mahajan, S. Chand & Company
7. The Indian Renaissance, Sri Aurobindo.
8. India’s Rebirth, Sri Aurobindo.
13. Awaken Children: Conversations with Mata Amritanandamayi
15. Indian Philosophy of Beauty, T. P. Ramachandran, University of Madras, Chennai.
16. Web of Indian Thought, Sister Nivedita
17. Essays on Indian Nationalism, Anand Kumaraswamy
18. Comparative Aesthetics, Volume 2, Kanti Chandra Pandey, Chowkhamba, Varanasi
19. The Invasion That Never Was, Michel Danino
20. Samskara, U. R. Ananthamurthy, OUP.
21. Hayavadana, Girish Karnard, OUP.
22. Naga-Mandala, Girish Karnard, OUP.

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*CA – Can be Quizzes, Assignment, Projects, and Reports.
OBJECTIVES:

To familiarize students with Sanskrit language; to introduce students to various knowledge traditions in Sanskrit; to help students appreciate and imbibe India’s ancient culture and values.

Syllabus

Unit 1

Sanskrit Language – Vakya Vyavahara - Introduction to Sanskrit language - Devanagari script and


Unit 2

Language Studies - Role of Sanskrit in Indian & World Languages.

Unit 3


Unit 4


Unit 5

Indology Studies – Perspectives and Innovations.

TEXTBOOKS AND REFERENCE BOOKS:

1. Vakya Vyavahara- Prof. Vempaty Kutumba Sastri, Rashtriya Sanskrit Sansthan, New Delhi
2. The Wonder that is Sanskrit - Dr. Sampadananda Mishra, New Delhi

Evaluation Pattern
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*CA – Can be Quizzes, Assignment, Projects, and Reports.*
**Syllabus**

**Unit 1**

Introduction to Basic Concepts of NSS: History, philosophy, aims and objectives of NSS, Emblem, flag, motto, song, badge etc., Organisational structure, roles and responsibilities of various NSS functionaries.

NSS Programmes and Activities: Concept of regular activities, special campaigning, Day Camps, Basis of adoption of village / slums, methodology of conducting survey, financial pattern of the scheme, other youth programme/schemes of GOI, Coordination with different agencies, Maintenance of the Diary.

**Unit 2**

Volunteerism and Shramdan: Indian Tradition of volunteerism, Needs and importance of volunteerism, Motivation and Constraints of volunteerism, Shramdan as part of volunteerism, Amalabharatam Campaign, Swatch Bharath.

**Unit 3**

Understanding youth: Definition, profile and categories of youth, Issues, challenges and opportunities for youth, Youth as an agent of social change.

Youth and Yoga: History, philosophy and concept of Yoga, Myths and misconceptions about Yoga, Different Yoga traditions and their impacts, Yoga as a preventive and curative method, Yoga as a tool for healthy life style

**Unit 4**

Youth Development Programmes in India: National Youth Policy, Youth development programmes at the national level, state level and voluntary sector, youth-focused and youth-led organizations.


**Unit 5**

Environmental Issues: Environment conservation, enrichment and sustainability, climate change, waste management, rain water harvesting, energy conservation, waste land development.

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Project Work / Practical
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*CA – Can be Quizzes, Assignment, Projects, and Reports.*
Course Objectives

1. To help students acquire the basic knowledge of behavior and effective living
2. To create an awareness of the hazards of health compromising behaviours
3. To develop and strengthen the tools required to handle the adversities of life

Course Outcome

CO 1: Understand the basic concepts of Behavioral Psychology
CO 2: Demonstrate self reflective skills through activities
CO 3: Apply the knowledge of psychology to relieve stress
CO 4: Analyse the adverse effects of health compromising behaviours.
CO 5: Evaluate and use guided techniques to overcome and cope with stress related problems.

CO-PO Mapping

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Syllabus

Unit 1

Self-Awareness & Self-Motivation
Self analysis through SWOT, Johari Window, Maslow’s hierarchy of motivation, importance of self esteem and enhancement of self esteem.

Unit 2

The Nature and Coping of Stress


Unit 3

Application of Health Psychology

Health compromising behaviours, substance abuse and addiction.

TEXTBOOKS:

1. V. D. Swaminathan & K. V. Kaliappan “Psychology for effective living - An introduction to Health
REFERENCE BOOKS:


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*CA – Can be Quizzes, Assignment, Projects, and Reports.
Course Objectives:

1. To strengthen the fundamental knowledge of human behavior
2. To strengthen the ability to understand the basic nature and behavior of humans in organizations as a whole
3. To connect the concepts of psychology to personal and professional life

Course Outcome

CO 1: Understand the fundamental processes underlying human behavior such as learning, motivation, individual differences, intelligence and personality.
CO 2: Apply the principles of psychology in day-to-day life for a better understanding of oneself and others.
CO 3: Apply the knowledge of Psychology to improve study skills and learning methods
CO 4: Apply the concepts of defense mechanisms to safeguard against abusive relationships and to nurture healthy relationships.

CO-PO Mapping

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Syllabus

Unit 1
Psychology of Adolescents: Adolescence and its characteristics.

Unit 2
Learning, Memory & Study Skills: Definitions, types, principles of reinforcement, techniques for improving study skills,
Mnemonics.

Unit 3

Attention & Perception: Definition, types of attention, perception.

TEXTBOOKS:


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*CA – Can be Quizzes, Assignment, Projects, and Reports.
Syllabus

Unit 1
Introduction
Western and Indian views of science and technology
Introduction; Francis Bacon: the first philosopher of modern science; The Indian tradition in science and technology: an overview.

Unit 2
Indian sciences
Introduction; Ancient Indian medicine: towards an unbiased perspective; Indian approach to logic; The methodology of Indian mathematics; Revision of the traditional Indian planetary model by Nilakantha Somasuvan in circa 1500 AD

Science and technology under the British rule
Introduction; Indian agriculture before modernization; The story of modern forestry in India; The building of New Delhi

Unit 3
Science and technology in Independent India
Introduction; An assessment of traditional and modern energy resources; Green revolution: a historical perspective; Impact of modernisation on milk and oilseeds economy; Planning without the spirit and the determination.

Building upon the Indian tradition
Introduction; Regeneration of Indian national resources; Annamahatmyam and Annam Bahu Kurvita: recollecting the classical Indian discipline of growing and sharing food in plenty and regeneration of Indian agriculture to ensure food for all in plenty.

Conclusion
REFERENCES:

18. The Cultural Heritage of India. Kolkata: Ramakrishna Mission Institute of Culture.

*The syllabus and the study material in use herein has been developed out of a ‘summer programme’ offered by the Centre for Policy Studies (CPS), Chennai at the Indian Institute of Advanced Study (IIAS), Rashtrapati Nivas, Shimla, sometime ago. The same has been very kindly made available to us by Professors Dr M.D. Srinivas (Chairman) and Dr J.K. Bajaj (Director) of the CPS.

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*CA – Can be Quizzes, Assignment, Projects, and Reports.*
Syllabus

Unit 1
Introduction: Relevance of Bhagavad Gita today – Background of Mahabharatha. ArjunaVishada

Yoga: Arjuna’s Anguish and Confusion – Symbolism of Arjuna’s Chariot.


Unit 2
Karma Yoga: Yoga of Action – Living in the Present – Dedicated Action without Anxiety over Results - Concept of Swadharma.

Dhyana Yoga: Tuning the Mind – Quantity, Quality and Direction of Thoughts – Reaching Inner Silence.

Unit 3


TEXTBOOKS / REFERENCES:


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*CA – Can be Quizzes, Assignment, Projects, and Reports.
OBJECTIVES:

To give students an introduction to the basic ideas contained in the Upanishads; and explores how their message can be applied in daily life for achieving excellence.

Syllabus

Unit 1
An Introduction to the Principal Upanishads and the Bhagavad Gita - Inquiry into the mystery of nature - Sruti versus Smrti - Sanatana Dharma: its uniqueness - The Upanishads and Indian Culture - Upanishads and Modern Science.

Unit 2
The challenge of human experience & problems discussed in the Upanishads -- the True nature of Man -- the Moving power of the Spirit -- The Message of Fearlessness -- Universal Man - The central problems of the Upanishads -- Ultimate reality -- the nature of Atman - the different manifestations of consciousness.

Unit 3
Upanishad Personalities - episodes from their lives and essential teachings: Yajnavalkya, Aruni, Uddalaka, Pippalada, Satyakama Jabala, Svetaketu, Nachiketas, Upakosala, Chakrayana Ushasti, Raikva, Kapila and Janaka. Important verses from Upanishads - Discussion of Sage Pippalada’s answers to the six questions in Prasnopanishad.

REFERENCES:

1. The Message of the Upanishads by Swami Ranganathananda, Bharatiya Vidya Bhavan
2. Eight Upanishads with the commentary of Sankaracharya, Advaita Ashrama
3. Indian Philosophy by Dr. S. Radhakrishnan, Oxford University Press
4. Essentials of Upanishads by R L Kashyap, SAKSI, Bangalore
5. Upanishads in Daily Life, Sri Ramakrishna Math, Mylapore.
7. Upanishad Ganga series – Chinmaya Creations

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*CA – Can be Quizzes, Assignment, Projects, and Reports.
Course Objectives:

- To introduce the significance of food, nutrients, locally available food resources, synergic food combinations, good cooking methods and importance of diversity in foods.
- To understand nutritional imbalances and chronic diseases associated with the quality of food.
- To gain awareness about the quality of food - Organic food, genetically modified food, adulterated food, allergic food, food poisoning and food safety.
- To understand food preservation processing, packaging and the use of additives.

Course Outcome:

CO1: Acquire knowledge about the various food and food groups

CO2: Understand nutritional imbalances and chronic diseases prevailing among different age groups.

CO3: Understand the significance of safe food and apply the food safety standards.

CO4: Demonstrate skills of food processing, preservation and packaging methods with or without additives.

CO5: Evaluate the quality of food based on the theoretical knowledge of Food and Nutrition.

CO-PO Mapping:

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Syllabus

Unit 1

Food and Food Groups

Introduction to foods, food groups, locally available foods, Nutrients, Cooking methods, Synergy between foods, Science behind foods, Food allergies, food poisoning, food safety standards.
Cookery Practicals - Balanced Diet

Unit 2

Nutrients and Nutrition
Nutrition through life cycle, RDA, Nutrition in disease, Adulteration of foods & Food additives, Packaging and labeling of foods.

Practicals - Traditional Foods

Unit 3

Introduction to Food Biotechnology
Future foods - Organic foods and genetically modified foods, Fortification of foodsvalue addition of foods, functional foods, Nutraceuticals, supplementary foods, Processing and preservation of foods, applications of food
technology in daily life, and your prospects associated with food industry – Nanoparticles, biosensors, advanced research.

Practicals - Value added foods

TEXTBOOKS:


REFERENCE BOOKS:


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*CA – Can be Quizzes, Assignment, Projects, and Reports.
Syllabus

This paper will introduce the basics of Japanese language. Students will be taught the language through various activities like writing, reading, singing songs, showing Japanese movies etc. Moreover this paper intends to give a thorough knowledge on Japanese scripts that is Hiragana and Katakana. Classes will be conducted throughout in Japanese class only. Students will be able to make conversations with each other in Japanese. Students can make self-introduction and will be able to write letters in Japanese. All the students will be given a text on Japanese verbs and tenses.

Students can know about the Japanese culture and the lifestyle. Calligraphy is also a part of this paper. Informal sessions will be conducted occasionally, in which students can sing Japanese songs, watch Japanese movies, do Origami – pattern making using paper.

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*CA – Can be Quizzes, Assignment, Projects, and Reports.
Syllabus

Students will be taught the third and the most commonly used Japanese script, Kanji. Students will be taught to write as well as speak.

Students will be given detailed lectures on Calligraphy.

This version of the course includes a new project where the students should make a short movie in Japanese language selecting their own topics.

By the end of the semester they will master the subject in all means. They will be able to speak Japanese as fluently as they speak English. Students will be encouraged to write stories and songs in Japanese language themselves.

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*CA – Can be Quizzes, Assignment, Projects, and Reports.
OBJECTIVES:

To enable the students to acquire basic skills in functional language; to develop independent reading skills and reading for appreciating literary works; to analyse language in context to gain an understanding of vocabulary, spelling, punctuation and speech.

Syllabus

Unit 1
Adalitha Kannada: bhashe, swaroopa, belavanige yaa kiru parichaya Paaribhaashika padagalu
Vocabulary Building

Unit 2
Prabhandha – Vyaaghra Geethe - A. N. Murthy Rao

Unit 3
Mochi – Bharateepriya
Mosarina Mangamma – Maasti Venkatesh iyengar Kamalaapurada Hotelnalli – Panje Mangesh Rao Kaanike – B.
M. Shree
Geleyanobbanige bareda Kaagada – Dr. G. S. Shivarudrappa Moodala Mane – Da. Ra. Bendre
Swathantryada Hanate – K. S. Nissaar Ahmed

Unit 4
Letter Writing - Personal: Congratulation, thanks giving, invitation, condolence

Unit 5
Reading Comprehension; nudigattu, gaadegalu Speaking Skills: Prepared speech, pick and speak
REFERENCES:

1. H. S. Krishna Swami Iyangar – Adalitha Kannada – Chetana Publication, Mysuru
2. N. Murthy Rao – Aleyuva Mana – Kuvepu Kannada Adyayana Samste
3. Nemi Chandra – Badhuku Badalisabahu – Navakarnataka Publication
4. Sanna Kathegalu - Prasaranga, Mysuru University, Mysuru
5. B. M. Shree – Kannadada Bavuta – Kannada Sahitya Parishattu
6. K. S. Nissar Ahmed – 75 Bhaavageetegalu – Sapna Book House (P) Ltd.
7. Dr. G. S. Shivarudrappa – Samagra Kavya – Kamadhenu Pustaka Bhavana

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OBJECTIVES:

To enable the students to acquire basic skills in functional language; to develop independent reading skills and reading for appreciating literary works; to develop functional and creative skills in language; to enable the students to plan, draft, edit & present a piece of writing.

Syllabus

Unit 1
Official Correspondence: Adhikrutha patra, prakatane, manavi patra, vanijya patra

Unit 2
Nanna Hanate - Dr. G. S. Shivarudrappa
Ella Marethiruvaga - K. S. Nissaar Ahmed Saviraru Nadigalu – S Siddalingayya

Unit 3

Unit 4
Sarva Sollegala turtu Maha Samelana - Beechi Swarthakkaagi Tyaga - Beechi

Unit 5
Essay writing: Argumentative & Analytical Précis writing

REFERENCES:

1. H. S. Krishnaswami Iyangar – Adalitha Kannada – Chetan Publication, Mysuru
2. Dr. G. S. Shivarudrappa – Samagra Kavya. - Kamadhenu Pustaka Bhavana
4. K. S. Nissar Ahmed – 75 Bhaavageetegalu – Sapna book house
5. Dr. Da. Ra. Bendre – Saayo Aata – Shri Maata Publication

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Course Objectives:

To appreciate the aesthetics & cultural implications; to enhance creative thinking in mother tongue; to learn our culture & values; to equip students read & write correct Malayalam; to correct the mistakes in pronunciation; to create awareness that good language is the sign of complete personality

Course Outcome:

After the completion of the course the student will be able to:

CO1: Understand and inculcate philosophical thoughts and practices
CO2: Understand and appreciate the post modern trends of literature.
CO3: Analyse the literary texts and comprehend the cultural diversity of Kerala
CO4: Distinguish the different genres in Malayalam literature
CO5: Demonstrate the ability to effectively communicate in Malayalam

CO-PO Mapping:

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Syllabus Unit 1
Ancient poet trio: Adhyatmaramayanam,

Lakshmana Swanthanam (valsa soumitre... mungikidakayal), Ezhuthachan - Medieval period classics -Jnanappana (kalaminnu... vilasangalingane), Poonthanam

Unit 2


Unit 3

Short stories from period 1/2/3, Poovanpazham - Vaikaom Muhammed Basheer - Literary & Cultural figures of Kerala and about their literary contributions.

Unit 4

Literary Criticism: Ithihasa studies - Bharatha Paryadanam - Vyasante Chiri - Kuttikrishna Mararu - Outline of literary Criticism in Malayalam Literature - Introduction to Kutti Krishna Mararu & his outlook towards literature & life.

Unit 5

Error-free Malayalam: 1. Language; 2. Clarity of expression; 3. Punctuation – Thettilatha Malayalam
Writing - a. Expansion of ideas; b. Precis Writing; c. Essay Writing; d. Letter writing; e. Radio Speech; f. Script / Feature / Script Writing; g. News Editing; h. Advertising; i. Editing; j. Editorial Writing; k. Critical appreciation of literary works (Any one or two as an assignment).

REFERENCES:


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OBJECTIVES:

To appreciate the aesthetics & cultural implications; to enhance creative thinking in mother-tongue; to learn our culture & values; to equip students read & write correct Malayalam; to correct the mistakes in pronunciation; to create awareness that good language is the sign of complete personality.

Course Outcome:

After the completion of the course the student will be able to:

CO1: Understand the different cultural influences in linguistic translation
CO2: Identify and appreciate the Romantic elements of modern literature
CO3: Analyze the genre of autobiographical writing
CO4: Critically evaluate the significance of historical, political and socio cultural aspects in literature
CO5: Demonstrate good writing skills in Malayalam

CO-PO Mapping:

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Syllabus

Unit 1
Ancient poet trio: Kalayanasougandhikam, (kallum marangalun... namukkennarika vrikodara) Kunjan Nambiar - Critical analysis of his poetry - Ancient Drama: Kerala Sakunthalam (Act 1), Kalidasan (Translated by Attor Krishna Pisharody).
Unit 2

Unit 3
Anthology of short stories from period 3/4/5: Ninte Ommayku, M. T. Vasudevan Nair - literary contributions of his time

Unit 4
Part of an autobiography / travelogue: Kannerum Kinavum, V. T. Bhattathirippadu - Socio-cultural literature - historical importance.

Unit 5
Error-free Malayalam - 1. Language; 2. Clarity of expression; 3. Punctuation - Thettillatha Malayalam
Writing - a. Expansion of ideas; b. Précis Writing; c. Essay Writing; d. Letter writing; e. Radio Speech; f. Script / Feature / Script Writing; g. News Editing; h. Advertising; i. Editing; j. Editorial Writing; k. Critical appreciation of literary works (Any one or two as an assignment).

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OBJECTIVES:

To familiarize students with Sanskrit language and literature; to enable them to read and understand Sanskrit verses and sentences; to help them acquire expertise for self-study of Sanskrit texts and communication in Sanskrit; to help the students imbibe values of life and Indian culture as propounded in scriptures.

Syllabus

Unit 1

Introduction to Sanskrit language, Devanagari script - Vowels and consonants, pronunciation, classification of consonants, conjunct consonants, words – nouns and verbs, cases – introduction, numbers, Pronouns, communicating time in Sanskrit. Practical classes in spoken Sanskrit

Unit 2

Verbs- Singular, Dual and plural – First person, Second person, Third person. Tenses – Past, Present and Future – Atmanepadi and Parasmaipadi-karthariprayoga

Unit 3

Words for communication, slokas, moral stories, subhashithas, riddles (from the books prescribed)

Unit 4

Selected slokas from Valmiki Ramayana, Kalidasa’s works and Bhagavad Gita. Ramayana – chapter VIII - verse5, Mahabharata - chapter 174, verse -16, Bhagavad Gita – chapter - IV verse 8, Kalidasa’s Sakuntalam Act IV – verse 4

Unit 5

Translation of simple sentences from Sanskrit to English and vice versa.

ESSENTIAL READING:

1. Praveshaha; Publisher: Samskrita bharati, Aksharam, 8th cross, 2nd phase, girinagar, Bangalore - 560 085
2. Sanskrit Reader I, II and III, R. S. Vadhyan and Sons, Kaipathi, Palakkad
3. Prakriya Bhashyam written and published by Fr. John Kunnappally
4. Sanskrit Primer by Edward Delavan Perry, published by Ginn and Company Boston
5. Sabdamanjari, R. S. Vadyar and Sons, Kaipathi, Palakkad
6. *Namalinganusasanam* by Amarasimha published by Travancore Sanskrit series

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OBJECTIVES:

To familiarize students with Sanskrit language and literature; to enable them to read and understand Sanskrit verses and sentences; to help them acquire expertise for self-study of Sanskrit texts and communication in Sanskrit; to help the students imbibe values of life and Indian culture as propounded in scriptures.

Syllabus

Unit 1

Seven cases, indeclinables, sentence making with indeclinables, Saptha karakas.

Unit 2


Unit 3

Words and sentences for advanced communication. Slokas, moral stories (Pancatantra) Subhashitas, riddles.

Unit 4

Introduction to classical literature, classification of Kavyas, classification of Dramas - The five Mahakavyas, selected slokas from devotional kavyas- Bhagavad Gita – chapter - II verse 47, chapter - IV verse 7, chapter -VI verse 5, chapter -VIII verse 6, chapter - XVI verse 21, Kalidasa’s Sakuntala act IV – verse 4, Isavasyopanishat 1st Mantra, Mahabharata chapter 149 verses 14 - 120, Neetisara chapter - III

Unit 5

Translation of paragraphs from Sanskrit to English and vice versa.

ESSENTIAL READING:

1. Praveshaha; Publisher: Samskrita bharati, Aksharam, 8th cross, 2nd phase, girinagar, Bangalore -560 085
2. Sanskrit Reader I, II and III, R.S. Vadhyar and Sons, Kalpathi, Palakkad
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Syllabus

Unit 1
Understanding CSR - Evolution, importance, relevance and justification. CSR in the Indian context, corporate strategy, CSR and Indian corporate. Structure of CSR - In the Companies Act 2013 (Section 135); Rules underSection 13; CSR activities, CSR committees, CSR policy, CSR expenditure CSR reporting.

Unit 2
CSR Practices & Policies - CSR practices in domestic and international area; Role and contributions of voluntary organizations to CSR initiatives. Policies; Preparation of CSR policy and process of policy formulation; Government expectations, roles and responsibilities. Role of implementation agency in Section 135 of the Companies Act, 2013. Effective CSR implementation.

Unit 3
Project Management in CSR initiatives - Project and programme; Monitoring and evaluation of CSR Interventions. Reporting - CSR Documentation and report writing. Reporting framework, format and procedure.

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Syllabus

Unit 1

Unit 2
Mental Health Issues in the Workplace: Emotions, Common emotions at the workplace, Mental Health issues - Anger, Anxiety, Stress & Burnout, Depression, Addictions – Substance and Behavioural, Psychotic Disorders - Schizophrenia, Bipolar Disorder, Personality disorders. Crisis Situations - Suicidal behavior, panic attacks, reactions to traumatic events. Stigma and exclusion of affected employees. Other issues -work-life balance, Presenteeism, Harassment, Bullying, Mobbing. Mental Health First Aid - Meaning. Case Study, Activity.

Unit 3
Strategies of Help and Care: Positive impact of work on health, Characteristics of mentally healthy workplace, Employee and employer obligations, Promoting mental health and well being- corporate social responsibility (CSR), an inclusive work environment, Training and awareness raising, managing performance, inclusive recruitment, Supporting individuals-talking about mental health, making reasonable adjustments, Resources and support for employees - Employee Assistance Programme / Provider (EAP), in house counsellor, medical practitioners, online resources and telephone support, 24 hour crisis support, assistance for colleagues and care givers, Legislations. Case Study, Activity.

REFERENCES:
3. Canadian Mental Health Association, Ontario “Workplace mental health promotion, A how to guide”wmhp.cmhaontario.ca/
6. Mental Health Act 1987 (India) www.tnhealth.org/mha.htm
7. Persons with disabilities Act 1995 (India) socialjustice.nic.in
8. The Factories Act 1948 (India) www.caaa.in/Image/19ulabournawsb.pdf

**Evaluation Pattern**

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*CA – Can be Quizzes, Assignment, Projects, and Reports.
Course Objectives:

- To introduce the students to different literature: Sangam literature, Epics, Bhakthi literature and modern literature.
- To improve their ability to communicate with creative concepts, and also to introduce them to the usefulness of basic grammatical components in Tamil.

Course Outcomes

CO 1: To understand the Sangam literature
CO 2: To understand the creative literature
CO 3: To understand the literary work on religious scriptures
CO 4: To improve the communication and memory skills
CO 5: To understand the basic grammar components of Tamil language and their usage and applications.
CO 6: Understand creative writing aspects and apply them.

CO-PO Mapping

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Syllabus

Unit 1

The history of Tamil literature: Nāṭṭupuṟap pāṭalkal, kataikkal, pajamolikal - ciṟukataikal tōṟṟamum vajarcciyum, ciṟilakkiyankal: Kalinkattup paraṇi (pōrpaiyatu) - mukkūṭaṟ paḻḷu 35.

Kāppiyankal: Cilaippatikāraṁ – maṇimēkalai nāṭaiyiyal āyvu maṟṟum aipperum – aiṅciṟu kāppiyankal toṭarpāṇa ceypikaṟ.

Unit 2
Unit 3

Tamil Ilakkaṇam: Vākkiya vakaikaḷ – taṉviṉai piṟaviṉai – nērkkūṟṟu ayaṟkūṟṟu

Unit 4


Unit 5


Textbooks:

6. poṉ maṇimāṟaṉ “aṭōṉ tamiḻ ilakkaṇam “aṭōṉ papḷišiṇ kurūp, vaṉciyūr,

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*CA – Can be Quizzes, Assignment, Projects, and Reports.
Course Objectives

- To learn the history of Tamil literature.
- To analyze different styles of Tamil Language.
- To strengthen the creativity in communication, Tamil basic grammar and use of computer on Tamil Language.

Course Outcomes

CO 1: Understand the history of Tamil literature.
CO 2: Apply practical and comparative analyses on literature.
CO 3: Understand thinai literature, literature on justice, Pathinenkeelkanaku literature.CO 4: Understand the tamil scholars’ service to Tamil language and society.
CO 5: Understand components of Tamil grammar and its usage
CO 6: Understand creative writing aspects and apply them

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Syllabus Unit 1

The history of Tamil literature: ṛṟṟuṇṟai pāṭalkal, kataikkal, pāḷamolikal - ciṟukataikaḷ tōṟṟamum valarciyum, ciṟṟiḷakkiyankal; Kalinḵattup paṟaṇi (pōṟpāṭiyatu) - mukkūṭaṟ pāḷu 35.

Kăppiyankal: Ciḷappatikāram - măṇimēkalai nāṭaiyiyal āyvu marṟum aimperum - aiṅciṟuṅ kăppiyankal tōṟṟaṟpāṇa ceytiykal.
Unit 2

tiṇai ilakkiyamum nītiyilakkiyamum - patiṇenkikkakanakku nūlkaḻ toṭarpāṇa piṟa ceytikaḻ - tirukkuṟṟal (aṉpu, paṉpu, kalvi, oḻukkam, natpu, vāymai, kēḻvi, ceynāṟi, periyrāittuṇakkōṭal, vilippuṇarvu pēṇṟa atikārattil uļja ceytikaḻ.

Aṟanūḷkal: Ulakanīti (1-5) – ēlāti (1,3,6). - Cittarkaḻ: Kaṭuveḷi cittar pāṭalkaḻ (aṉantak kalippu –1, 4, 6, 8), marṟum akappēy cittar pāṭalkaḻ (1-5).

Unit 3

tamil ilakkanam: Vākkiya vakaikaḻ – taṉviṇai piṟaviṇai – nērkkuṟṟu ayaṟkuṟṟu

Unit 4

Unit 5


Text Books / References

Mu.Varatarācaṉ “tamil ilakkiya varalāṟu” cāhitya akatemi paplikēṉs, 2012

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