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

PO2: principles of Electronic System Design

PO3: development of Very Large Scale Integrated Circuits

PO4: principles of Computing & Embedded Systems

PO5: principles of Computer Engineering
Program Specific Outcomes (PSO)

PSO1: To design, develop and prototype Electronic Systems

PSO2: To develop Cyber-Physical & Automated Systems

POS3: To design and develop Embedded 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.
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**Total Credits**: 160

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**Cyber Physical Systems**

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- Continuous assessment can be quiz/assignment/mix of quiz and assignment totaling up to four (4)
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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:
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

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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)**

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### 23ECE103 Fundamentals of Electrical Engineering
(Pre-requisite: Nil)  
L-T-P-C: 3-0-0-3

#### Course Objectives
- To provide an understanding of fundamental electrical quantities and their measurements
- To help in the use of analytical tools for circuit analysis
- To provide an understanding of electromagnetic machines

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

- **CO1**: understand fundamental electrical quantities
- **CO2**: understand the principles of electrical measurements
- **CO3**: analyse ac and dc circuits
- **CO4**: understanding the operation of electromagnetic machines

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#### 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)**


### 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)

23ECE181 Electrical Engineering Laboratory
(Pre-requisite: Nil) L-T-P-C: 0-0-3-1

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

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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)
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

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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

- 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 fulfilment 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.

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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 dietin supporting meditation. (Pre-recorded video with Dr. Ram Manohar)

https://www.mayoclinic.org/tests-procedures/meditation/in-depth/meditation/art-20045858 (PDF provided)


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, subspaces, linear independence, basis, row, column and null spaces and dimension theorem. Inner product space, orthogonally, Gram-Schmidt orthogonalization. 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 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

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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 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

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Syllabus

Unit I

Unit II

Unit III

Textbook(s)

Reference(s)
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 Objectives

- To provide understanding of the organization of hardware and interfacing peripherals of a computer system
- To enable installation of an operating system and troubleshooting using system tools
- To introduce PC architecture and processors

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

CO1: understand the basic components of computer systems and its functionality
CO2: understand internal interfaces and external peripherals
CO3: understand the concepts of operating systems and their functionalities
CO4: understand different PC architecture and processors
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Syllabus

**Unit I**

Introduction: Building block of Computer, CPU, memory, motherboards, internal components IDE and SATA Devices, hard disk drive and CD/DVDs drives, SCSI devices, expansion cards- LAN card, IDE card, VGA and SVGA cards, sound card, interface cards, I/O cards; external components monitors: CRT, LCD and LED displays, printers: Inkjet printer, laser printer scanner; photo scanner, document scanner, bar code scanner keyboards, mouse, external modems, ports and connectors, batteries, power supply, pen drives, SCSI interface devices, laptop computers, digital advance storage technology.

**Unit II**


**Unit III**

Different PC architecture and processors: Pentium, i3, i5, i7 Processor Basics of Processor, AMD, Concept of Core, multicore, Raspberry Pi, etc.

**Textbook(s)**

1. B. Govinda Rajalu, PC and Clones Hardware, Troubleshooting and Maintenance Tata Mc-graw-Hill Publication

**References(s)**

2. Electronics and Radio Engineering M.L. Gupta Dhanpat rai & Sons, New Delhi
3. PC Troubleshooting and Repair Stephen J. Bigelow Dream tech Press, New Delhi

**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

**23ECE184**

*Introduction to Internet of Things*  
*(Pre-requisite: Nil)*  
*L-T-P-C: 0-0-3-1*
**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

**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 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)**


**Reference(s)**

Course Objectives

- To familiarize with different hardware and software in computer systems and peripherals
- To provide hands-on experience in setting up PC and unplugging devices
- To provide hands-on experience on installation of operating systems, device drivers and peripherals

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

CO1: identify components of computer system and its peripheral devices
CO2: install-uninstall device drivers and application software
CO3: use system commands for configuration, set ups, troubleshoot and manage
CO4: Demonstrate simple applications using processors

CO-PO Mapping

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Syllabus

1. Familiarisation with components of computer systems and peripheral
2. Configure BIOS setup program and troubleshoot the typical problems using BIOS utility.
3. Install Hard Disk and configure to the PC’s
4. Install and configure Scanner, Web cam, Cell phone and bio-metric device with system and troubleshoot the problems
5. Install and Configure Dual operating system
6. Printer Installation, Servicing and troubleshoot
7. Assemble a system with add on cards and check the working condition of the system
8. Assembling and Disassembling of Laptop to identify the parts and to install OS and configure it
9. Set up RaspberryPi as PC
10. Basic programming using microprocessor

Textbook(s)
Meizhong Wang, Key Concepts of Computer Studies
https://opentextbc.ca/computerstudies/front-matter/for-students-how-to-access-and-use-this-book/

References(s)
Ajay Rana and Ajit Mittal, Mastering PC Hardware & Networking 1st Edition, Computech Publications Limited

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

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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:
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
   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 exposure to programming in C
- To facilitate usage of Integrated Development Environment (IDE)
- To enable development and debugging 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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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

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<th>22ADM111</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 Vedānta
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

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Syllabus

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

Unit II
Bhagavadgītā: From Soldier to Saṁsārin 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)

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 enable the design of diode-based circuits
- To enable the design of MOSFET-based amplifiers
- To enable an understanding of BJTs & FinFETs

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

CO1: understand diode operation
CO2: analyse diode-based circuits for specific applications
CO3: understand the operation of transistors
CO4: analyse MOSFET-based amplifiers

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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; Rectification – Half-wave, Full-wave and Bridge; Rectifier with and without filter; Wave shaping circuits: Clipping & Clamping Circuits, voltage multiplier; Zener Diodes - Shunt voltage regulator.

Unit II
MOSFET – Introduction, Regions of Operation, MOSFET Characteristics; MOSFET biasing - Voltage divider biasing & Constant current biasing; MOSFET as a switch and an amplifier; Single-stage amplifier configurations- Common Source, Common Gate & Source Follower; Parasitic capacitances in MOSFET, MOSFET Frequency response.

Unit III
Introduction to BJT – BJTs, NPN transistors, VI characteristics-Region of operation; BJT Transistor biasing and as an amplifier and switch. FinFET - Introduction, Construction, advantages, VI characteristics and applications.

Textbook(s)
2. “FinFET and Other Multi-Gate Transistors”-by J.P Colinge

References(s)
Course Objectives

- To introduce the concepts of Signals and Systems
- To provide the foundation of transforms
- To enable the design of digital filters

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

CO1: understand the concepts of Signals and Systems
CO2: understand transform techniques
CO3: signals and systems using transform techniques
CO4: design simple digital filters for specific applications

CO-PO Mapping

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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, Time Domain characterization of continuous time and discrete time LTI system-Convolution Integral-Convolution Sum.

Unit II

Unit III

Textbook(s)

References(s)
Course Objectives

- To introduce data structures and algorithmic approaches
- To provide exposure to implement data structures
- To introduce basic performance measures and analysis techniques for algorithms

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

CO1: understand data structures and abstract data types
CO2: understand various algorithmic approaches
CO3: understand performance measures and categorize algorithms
CO4: apply data structures and algorithms to solve classical problems

CO-PO Mapping

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Syllabus

Unit I


Unit II


Unit III


Textbook(s)


References(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)

Course Objectives
- To introduce the concepts and working principles of Sensors and Transducers
- To provide the foundation of sensors technology
- To enable understanding of measurement and instrumentation systems

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

CO1: understand the physical phenomena behind the operation of different types of sensors and actuators
CO2: identify and use suitable sensors for targeted applications
CO3: measure various performance parameters of the sensors
CO4: understand calibration and its importance

CO-PO Mapping

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Syllabus

Unit I
Introduction- Sensors and Transducers, Definition and types of Sensors, Physical principles of Sensors, Example of Smart Sensors in nature, Classification of sensors – Resistive Sensors – Principle of operation, construction details, characteristics and applications of Potentiometer, Strain gauge, Resistance Temperature Detector (RTD), Thermistors, Light Dependent Resistor (LDR). Instrumentation and Industrial Instrumentation, Design and selection of Sensors, Characteristics of sensors – Static characteristics and Dynamic characteristics - Range, Resolution, Sensitivity, Error, Accuracy and Precision, Repeatability, Impedance, Response Time, Linearity, Dead band, Backlash.

Unit II

Unit III
Introduction to measurements and instrumentation; Measurement of Non Electrical Quantities, Non Electrical quantities and their measurement, Types of Non Electrical quantities, Measurement techniques for Non Electrical quantities;

Textbook(s)

Reference(s)

**23EAC281**
**Electronic Circuits – I Laboratory**
*(Pre-requisite: Physics of Semiconductors)*
L-T-P-C: 0-0-3-1

**Course Objectives**
- To enable the study and extraction of device parameters from datasheets
- To provide hands-on experience on the design of diode-based circuits
- To provide hands-on experience on the design of amplifiers

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

**CO1**: Use datasheets effectively
**CO2**: Simulate diode and transistor based circuits
**CO3**: Prototype and characterize diode and transistor circuits
**CO4**: Prototype and Characterize transistor amplifiers

**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 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.
Contents for experiment

1. Familiarization of Electronic Components.
2. VI Characteristics of Semiconductor diode.
3. VI Characteristics of Zener diode.
4. Rectifiers with and without filters.
5. Zener shunt regulator.
7. MOSFET as switch
8. Common source amplifier using MOSFET.
9. Frequency response of MOSFET
10. Characteristics of BJT in CE configuration.
11. Common emitter amplifier using BJT.

Textbook(s)

References(s)

Course Objectives

- To provide hands-on exposure to generation and visualization of signals
- To provide hands-on experience to process signals using Linear Time Invariant (LTI) systems
- To enable frequency domain analysis of signals and systems

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

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:**

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**

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<th>23EAC283</th>
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To provide hands-on experience on implementing data structures
To enable implementation of simple algorithms
To enable apply algorithms to specific problems

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

- **CO1:** implement data structures
- **CO2:** implement and execute algorithms
- **CO3:** analyze run-time complexity
- **CO4:** apply algorithms to specific problems

**CO-PO Mapping**

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Syllabus

Experiment Contents:

1. Stacks, queue, binary trees using arrays
2. Linked list - hash tables
3. Sorting algorithms – bubble, insertion, shell, selection, heap, quick
4. Graph representation and traversal algorithms
5. Single source shortest path algorithm-minimum spanning tree algorithms.
6. Run time complexity on (2) and (3)
7. Applications

Textbook(s)


Reference(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

CO-PO Mapping

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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

<table>
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<tr>
<th>23ENV300</th>
<th>Environmental Science</th>
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<td>(Pre-requisite: Nil)</td>
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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

CO-PO Mapping

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Syllabus

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)**

<table>
<thead>
<tr>
<th>23LSE201</th>
<th>LIFE SKILLS FOR ENGINEERS I</th>
<th>L-T-P-C: 1 0 2-P/F</th>
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**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 word analysis 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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*CA - Can be presentations, speaking activities and tests.

SMESTER 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
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 negative feedback and its effect on amplifier performance
- To enable the design of linear circuits using opamps
- To enable the design of non-linear circuits using opamps

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

CO1: understand the concept of negative feedback and its effects
CO2: understand the specifications and parameters of opamps
CO3: analyse linear circuits based on opamps
CO4: analyse non-linear circuits based on opamps

CO-PO Mapping

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

Unit II
Operation Amplifier- Ideal Characteristics, DC imperfections, Input offset voltage, slew rate, input offset current, CMRR, input impedance. Linear applications of opamp- Inverting and Non-inverting Amplifier, Voltage follower, Summing amplifier, Difference & Instrumentation Amplifier, Integrator and Differentiator.

Unit III
Non-Linear Applications of opamps- Comparators, Schmitt Trigger - Precision Rectifiers - Peak detectors- Principles of Sinusoidal Oscillators - RC phase shift oscillator, Wein-Bridge Oscillator, LC and Crystal Oscillators; Multivibrators-astable and monostable multivibrator.

Textbook(s)

References(s)

Course Objectives

<table>
<thead>
<tr>
<th>23EAC213</th>
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- 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)

<table>
<thead>
<tr>
<th>23EAC212</th>
<th>Electronic Systems Design and Automation</th>
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Course Objectives
- To familiarize with the basics of designing the physical architecture of electronic systems
- To provide the concept and importance of EMI/EMC in electronic system design
- To provide foundation for design and automation

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

CO1: understand the physical architectural design fundamentals for electronic systems
CO2: examine the impact of interconnections on electronic system performance at various abstraction levels
CO3: understand the EMC & EMI issues in electronic systems design
CO4: understand and develop the frameworks required for automation

CO-PO Mapping

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Syllabus

Unit I
Introduction – Introduction to electronic (industrial electronics) system Design, Product development process, Life Cycle, Product architecture, Electronic Product design and development Methodology, product innovations. Introduction to the concept of reliability and quality, Reliability mathematics, Calculation of system Reliability

Unit II
Circuit diagrams- Computer Aided Design(CAD) – PCB fabrication -Creating circuit design with capture -Designing PCB with layout -Project structures and layout tool set, PCB design rules for Digital, High Frequency, Analog, Power Electronics and Microwave circuits; Introduction to EMI/EMC- Design concerns for Engineers -Electromagnetic environment –
Potential emission levels - Methods of noise coupling - Nature of interference - EMC and PCB - Open area test sites: OATS measurements, measurement precautions.

Unit III

Electronic Design Automation (EDA) - EDA tool, steps like simulation, design, validation with some example like Synopsis, Cadence; PLC/SCADA - File structure and addressing formats – PLC project development - Instruction Set - PLC Applications – Open PLC with Rpi – Open PLC and Modbus – Simple automation projects with Open PLC and Rpi.

Textbook(s)/References


Course Objectives

<table>
<thead>
<tr>
<th>23ECE216</th>
<th>Machine Learning</th>
<th>L-T-P-C: 3-0-0-3</th>
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<td>(Pre-requisite: Foundations of Data Science)</td>
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- 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

CO-PO Mapping

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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); Naive 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, RMSP, ADAM; Dropout; Applications of ANN to regression and classification.

Textbook(s)


Reference(s)

23ECE284 Microcontrollers and Interfacing Laboratory
(Pre-requisite: Digital Electronics)

L-T-P-C: 0-0-3-1

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)
Course Objectives

- 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, Naive 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)
Course Objectives

- To enable the study and extraction of device parameters from datasheets
- To provide a hands-on experience of the effect of negative feedback
- To provide hands-on experience on the design of linear and non-linear circuits

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

CO1: use datasheets effectively
CO2: simulate Linear and Non-linear circuits
CO3: understand the effect of negative feedback
CO4: prototype and characterize Linear and Non-Linear circuits using opamps

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:
https://www.ti.com/lit/an/sboa324/sboa324.pdf?ts=1684025930170&ref_url=https%253A%252F%252Fwww.ti.com%252Fstisearch%252Fen-us%252Fdocs%252Funiversalsearch.tsp%253FlangPref%253Den-US%252FsearchTerm%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:

Contents for Experiments

1. Voltage/Current series Feedback amplifier
2. Current/Voltage shunt Feedback amplifier
3. Inverting and Non-inverting Amplifier and Voltage Follower
4. Difference and Summing Amplifiers.
5. Instrumentation Amplifier
6. Integrator and Differentiator.
7. Precision Rectifier-Half wave and Full wave
8. Comparator and Schmitt Trigger
9. RC phase shift oscillator/ Wein-Bridge Oscillator.
10. Astable and Monostable multivibrators

Textbook(s)

References(s)

23LSE211 LIFE SKILLS FOR ENGINEERS II L-T-P-C: 1-0-2-2

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

Communication: Process, Language Fluency, Non-verbal, Active listening. Assertiveness vs. aggressiveness. Barriers in communication. Digital communication

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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<tr>
<th>Assessment</th>
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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 itihasas on Indian civilization with a special reference to the Adiparva of Mahabharata

**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, Mahaprasthani 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 Prasthanam – The Last Journey.

Unit III

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

Textbooks/References

1. Leadership Lessons from the Mahabharat, ASCSS

Course Objectives

To know about Indian constitution, Indian society, central and state government functionalities in India

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
CO-PO Mapping

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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)**

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**SEMESTER V**

**Course Objectives**

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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

Unit III

Textbook(s)

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

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)**


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**Course Objectives**

- To introduce fundamental concepts of database management systems
- To enable systematic design of relational databases
- To provide the knowledge of SQL programming constructs for building relational databases and querying information

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

CO1: understand basic concepts of database systems
CO2: apply programming constructs in SQL effectively
CO3: apply E-R models and formal methods to design relational databases
CO4: understand database management concepts

CO-PO Mapping

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Syllabus

Unit I
Introduction - General introduction to database systems; Database - DBMS distinction, approaches to building a database, data models, three-schema architecture of a database, challenges in building a DBMS, components of a DBMS. E/R Model - Conceptual data modeling - motivation, entities, entity types, attribute types, relationship types, E/R diagram notation. Relational Data Model - Concept of relations, schema-instance distinction, keys, referential integrity and foreign keys, relational algebra operators: selection, projection, cross product, joins, division, example queries, tuple relation calculus, domain relational calculus, converting the database specification in E/R notation.

Unit II
SQL - Introduction, data definition in SQL, table, key and foreign key definitions, update behaviors. Querying in SQL - basic select-from-where block and its semantics, nested queries - correlated and uncorrelated, notion of aggregation, aggregation functions group by and having clauses, embedded SQL. Dependencies and Normal forms - Importance of a good schema design, problems encountered with bad schema designs, motivation for normal forms, dependency theory - functional dependencies, Armstrong's axioms for FD's, closure of a set of FD's, minimal covers, definitions of 1NF, 2NF, 3NF and BCNF, decompositions and desirable properties of them, algorithms for 3NF and BCNF normalization, multi-valued dependencies and 4NF, join dependencies and definition of 5NF.

Unit III
Data Storage and Indexes - file organizations, primary, secondary index structures, various index structures - hash-based, dynamic hashing techniques, multi-level indexes, B+ trees. Transaction processing and Error recovery - concepts of transaction processing, ACID properties, concurrency control, locking based protocols for CC, error recovery and logging, undo, redo, undo-redo logging and recovery methods.

Textbook(s)

References(s)

Course Objectives
- To provide an introduction to the concepts of data communication
- To enable an understanding of the principles of computer networks
- To provide an introduction to standard protocols
Course Objectives: At the end of the course, the student should be able to

- 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 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: configures 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**

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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 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)**

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

Reference(s)

---

### 23ECE383 VLSI Design Laboratory

**L-T-P-C:** 0-0-3-1

*(Pre-requisite: Digital Electronics)*

#### 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:

- **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)


23EAC382                   Database Management Systems Laboratory               L-T-P-C: 0-0-3-1

(Pre-requisite: Data Structure and Algorithms)

Course Objectives

- To provide hands-on experience on the SQL programming language
- To enable efficient query of information from relational databases
- To enable implementation and management of relational databases

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

CO1: create and perform basic operations on tables
CO2: apply queries to efficiently retrieve information
CO3: apply SQL features for data and access management
CO4: develop relational databases 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.

Experiment Contents:

1. Set up a local database, schema and management console
2. Create and modify SQL tables
3. Basic SQL query structure and variations
4. Set operations, aggregation functions
5. Nested subqueries
6. Joins
7. Indexing
8. Views and authorization
9. Data types, schemas, and integrity constraints
10. PL/SQL Programs using Triggers, Stored Procedures, Functions and Exception Handling.
Textbook(s)


References(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
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.


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)**

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
11. Quantitative Aptitude for All Competitive Examinations, Abhijit Guha.
13. How to Prepare for Data Interpretation for the CAT, Arun Sharma.
15. Quantitative Aptitude for Competitive Examinations, R S Aggarwal.

**Evaluation Pattern:** 50:50

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<th>Assessment</th>
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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>
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<tr>
<th>Course Code</th>
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<td>Cyber Physical Systems</td>
<td>L-T-P-C: 3-0-0-3</td>
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<td>(Pre-requisite: Nil)</td>
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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

CO-PO Mapping

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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

<table>
<thead>
<tr>
<th>23EAC312</th>
<th>Software Engineering</th>
<th>L-T-P-C: 3-0-0-3</th>
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Course Objectives

- To introduce the challenges in software engineering
- To provide exposure to life-cycle models
- To introduce the concepts of specification, design and testing

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

CO1: understand concepts of software engineering
CO2: understand the models for software development life-cycle
CO3: understand software specification and design processes
**Course Objectives**

- To provide understanding of Access Technologies and underlying Protocols
- To provide foundation on Cloud Layers and Deployment Models
- To enable integration of IoT and Cloud Computing

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

- CO1: understand IoT Technologies and Protocols
- CO2: understand IoT based system design
- CO3: understand different Cloud Deployment Models and their uses
- CO4: understand integration of IoT and Cloud Computing Platforms

**CO-PO Mapping**

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Syllabus

Unit I
Drivers behind New Network Architectures - IoT Architecture - Core IoT Functional Stack - IoT Data Management and Compute Stack - Sensor and Actuators - Smart Object - Connecting Smart Objects - IoT Access Technology - 802.15.4

Unit II
LoRaWAN - IP as IoT Network Layer - Need for IP Optimization in IoT - IoT Transport Methods - IoT Application Layer Protocols - CoAP - MQTT - Data Analytics for IoT – Introduction to Big Data Analytics - Basic Hadoop Architecture - IoT Strategies for Smart Cities, Transportation

Unit III

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 study about the modelling of CPS
- To understand the data flow mechanisms and time driven events with CPS
- To develop the CPS for the given specifications

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

CO1: understand the design paradigms of CPS
CO2: select the suitable modeling and tools to develop CPS
CO3: describe the required interfacing for modeling with CPS
CO4: develop optimal computational options for cyber-physical systems for the given requirement

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.

Experiment Contents:
1. Finite state machines - Timed automata
2. Data flow modeling - Synchronous data flow
3. Generating discrete events
4. Modeling interfaces for CPS - Asynchronous modeling with CPS
5. Simple hybrid systems with sensors (Mouse double click detector, motion detector, fast clip speed test)
6. Scheduling real time control tasks with RTOS
7. Case studies

Textbook(s)

Reference(s)


<table>
<thead>
<tr>
<th>23EAC385</th>
<th>IoT and Cloud Computing Laboratory</th>
<th>L-T-P-C: 0-0-3-1</th>
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<td>(Pre-requisite: Fundamental of IoT)</td>
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Course Objectives

- To provide hands-on experience on IoT Hardware
- To provide exposure to Cloud Computing Platforms
- To enable integration of IoT with Cloud Computing Systems

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

CO1: prototype simple IoT based Systems
CO2: use Cloud Computing Platforms for Data Processing
CO3: integrate IoT with Cloud Computing
CO4: demonstrate simple IoT Applications on Cloud

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.

Experiment Contents:
1. GPIO and Motor Control using Raspberry Pi
2. Sensor interfacing and Data Logging using Raspberry Pi with SenseHAT
3. LCD Interfacing using Raspberry Pi
4. Web Server Implementation using Raspberry Pi
5. Raspberry Pi and IoT Cloud Server Interface using MQTT Protocol
7. Image Processing using Raspberry Pi
9. Training Deep Neural Networks on Azure

Textbook(s)

References


LIFE SKILLS FOR ENGINEERS IV

Pre-requisite(s): Self-confidence, presentation skills, listening skills, basic English language skills, 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
### Syllabus

#### Soft Skills

**Teamwork:** Value of teamwork in organizations, Definition of a team. Why team? Effective team building. Parameters for a good team, roles, empowerment and need for transparent communication, Factors affecting team effectiveness, Personal characteristics of members and its influence on team. Project Management Skills, Collaboration 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

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

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**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.

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**SEMESTER VII**

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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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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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SEMESTER VIII

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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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
Cyber Physical Systems

Modeling and Analysis of Cyber Physical Systems
(Pre-requisite: Cyber Physical Systems)

Course Objectives

- To introduce the principles of modeling and analysis of cyber-physical systems
- To provide exposure to various analytical tools to study cyber-physical systems
- To enable the modeling and analysis of specific cyber-physical systems

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

CO1: understand the techniques for modeling and analysis of cyber-physical systems
CO2: apply analytical techniques to model cyber-physical systems
CO3: apply modeling language and software tools to model the processes and requirements
CO4: develop detailed models and specifications for specific cyber-physical systems

CO-PO Mapping
Syllabus

Unit I
Modeling of CPS – Synchronous and Asynchronous Models; Safety and Liveness Requirements; Dynamical Systems Modeling – Continuous-Time and Linear Systems, Design and Analysis; Timed Models – timed processes, timing protocols, timed automata; Real-Time Scheduling; Hybrid Systems Modeling.

Unit II
Model Based System Engineering of CPS – approach and concepts; SysML Modelling - process and requirements modelling.

Unit III
Applications and Use Cases – smart city, smart grid, intelligent transport systems, precision agriculture.

Textbook(s)

References(s)

Course Objectives
- To address the Privacy and Security issues and concerns faced in CPS environments
- To teach how to encrypt a message using encryption methods and make privacy and security choices
- To implement CPS security projects

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

CO1: understand how to provide security to the cyber-physical systems components
CO2: understand how to conduct attacks on cyber-physical systems protocols and systems
CO3: design cyber-physical systems and architectures that preserves the privacy of the CPS components
CO4: implement security protocols for CPS

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Syllabus

Unit I

Unit II

Unit III

Textbook

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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: model control systems in the continuous domain using classical control approach.
CO2: analyze control systems using state space models.
CO3: understand the nonlinear systems characteristics and analyze the stability of nonlinear Systems.
CO4: understand the control schemes used for different applications.

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Syllabus

Unit I
Mathematical Modeling of physical systems- Transfer function-stability with reference to ’s’ plane, transient and steady state analysis, steady state errors, Performance Indices. controllers- P, PI and PID modes of feedback control.

Unit II
Analysis of control systems in state space - State space model of a system, state transition matrix, state space representation in canonical forms, solution of homogeneous state equations, controllability and observability.

Design of control systems in state space - Design by pole placement, State Feedback gain using Ackerman’s formula. State Observers - Full order observer, reduced order observer, Design of control system with observers.

Unit III
Nonlinear systems: Introduction - characteristics of nonlinear systems. Types of nonlinearities. Analysis through Linearisation about an operating point. Stability Analysis - Definition of stability- asymptotic stability and instability - Liapunov methods to stability of linear and nonlinear systems; System level design of control schemes

Textbooks and References

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Course Objectives

- To introduce the fundamentals of predictive control.
- To provide the knowledge of different types of Model Predictive Control strategies.
- To enable application of Model Predictive control strategies for physical processes.

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

CO1: understand the concepts of predictive control.
CO2: understand working of discrete-time and continuous-time model predictive control algorithms.
CO3: apply model predictive control algorithms for design of controllers for constrained control problems.
CO4: apply model predictive control strategies to regulate processes.

CO-PO Mapping

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Syllabus

Unit I
Day-to-day Application Example of Predictive Control- Models Used in the Design-State-space Models with Embedded Integrator-Predictive Control within One Optimization Window- Receding Horizon Control- Predictive Control of MIMO Systems-State Estimation-State Estimate Predictive Control.

Unit II

Unit III
Continuous time MPC-Model Structures for CMPC Design-Model Predictive Control Using Finite Prediction Horizon-Optimal Control Strategy-Receding Horizon Control-Continuous time MPC with Constraints-Formulation of the

Textbook(s)

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### 23EAC325 Intelligent Control Systems
(Pre-requisite: Control Theory)

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Course Objectives
- To introduce the concepts of Artificial Neural Networks and Fuzzy Logic
- To provide an understanding of nonlinear control systems
- To enable application of Artificial Neural Network and Fuzzy Logic for design of nonlinear control systems

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

CO1: understand the basics of artificial neural network and fuzzy logic applications for nonlinear control
CO2: understand the concepts of nonlinear controller design.
CO3: analyse the given process to identify the appropriate control strategy.
CO4: design a simple control strategy for a nonlinear system.

CO-PO Mapping

Syllabus

**Unit I**

**Unit II**

**Unit III**
Fuzzy Model Based Control: T-S Fuzzy model - Linear Matrix Inequality (LMI) Technique - Fixed Gain state Feedback Controller Design Technique - Variable Gain Controller Design using Single Linear Nominal Plant and each Linear Subsystem as Nominal Plant - Controller Design using Discrete T-S Fuzzy System.
References


Course Objectives

- To introduce the fundamentals of process control
- To provide the working knowledge of different types of actuators used in process control industry.
- To enable understanding of different control strategies used in process control industries.

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

CO1: understand the concepts of process control.
CO2: understand controller design principles for process control applications.
CO3: understand working of different actuators used in process control.
CO4: apply control strategies to regulate physical processes.

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Syllabus

Unit I

Unit II

Unit III

Textbook(s)

Course Objectives

- To acquire knowledge about Industry 4.0 and Industrial IoT (IIoT)
- To understand smart factories, smart sensors, and cyber-physical systems
- To introduce the role of AI and ML in the context of Industry 4.0

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

CO1: understand the concepts of Industry 4.0 and IIoT
CO2: understand the role of data analytics and communication
CO3: understand the concepts of secure manufacturing infrastructure
CO4: understand industrial IoT security and fog computing

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Syllabus

Unit I
Introduction to Industry 4.0 – Need for Industry 4.0, Challenges in integrated development vs Distributed development, Cyber physical systems, Role of data analytics and communication, Smart sensors, Miniaturizations, Cloud, Fog computing, Augmented Reality and Virtual Reality, Artificial Intelligence, Big Data and Advanced Analysis, Cybersecurity in Industry 4.0.

Unit II

Unit III

Textbook(s)

1. “Industry 4.0: The Industrial Internet of Things”, by Alasdair Gilchrist (Apress)
2. Industry 4.0 – Development towards the fourth Industrial revolution Kaushik Kumar, Divya Zindani J. Paulo Davim

References(s)

To provide the fundamentals of Robotic systems and terminologies associated with it
To provide mathematical foundation related to Kinematics, Dynamics, path planning and Control of Robots
To enable the students to design appropriate robotic systems for specified applications

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

CO1: understand the fundamentals of robotic systems and their terminologies
CO2: analyse kinematics and dynamics of various manipulator configurations
CO3: understand the fundamentals of mobile robots
CO4: apply the concept of robots to solve real-world problem.

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Syllabus

Unit I


Unit II

Linear and angular velocity vector and matrix – Forward and inverse velocity kinematics (Jacobian) – Fundamentals of robot manipulator dynamics. Path planning – trajectory planning – Continuous trajectory recording (Trajectory following) – Control of Single Robot Joint – Manipulator motion control systems – Force Control – Hybrid Control.

Unit III


References

CO1: understand the fundamentals of medical robots
CO2: understand the fundamentals of robotic systems in medical field and their terminologies
CO3: analyse kinematics and dynamics of various manipulator configurations for medical applications
CO4: apply the concept of robots to solve real-world medical problems

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Syllabus

Unit I
Basics of robots, types of robots, robotic joints, workspace characteristics, performance characteristics. Kinematics of manipulators, rotational, translation and transformation, homogeneous transformations, types of trajectories, trajectory planning and path planning. Existing clinical applications - Cardiac, abdominal, and urologic procedures with tele-operated robots - Orthopaedic surgery with cooperative robots - Robotic catheters for heart electrophysiology - Mobile robots in the body, Instrument-tissue interaction modelling, Autonomous robotic surgery - Other types of healthcare robots: Physically assistive robotics, Socially assistive robotics

Unit II

Unit III
Electrical actuating systems, Mechanical actuating systems, Pneumatic and hydraulic actuating systems. Robot programming: languages and software packages - MATLAB/Simulink, OpenRDK, ADAMS. Medical robots used for telepresence, surgical assistance, rehabilitation, transportation and sanitation, Tactile Internet.

References

Course Objectives
- To demonstrate the potential benefits of smart technology in eHealth
- To help simplify the care for both patients and their care providers using enabling technologies, and efficiently reduce the burden of treatment
- To understand the underlined technology in this application

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

CO1: understand the fundamentals of smart healthcare models and informatics
CO2: understand various network technologies involved with smart healthcare
CO3: study the technology related to security in healthcare.
CO4: study the connectivity and advanced technologies of health care

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**Syllabus**

**Unit I**


**Unit II**

Networking and communication Issues for pervasive healthcare, E-health through satellite Networks, E-health via Mobile Networks, Personal area Networks-On body networks, off body networks, A health care scenario, healthcare information system architecture, access control framework, context information management, prototype implementation

**Unit III**


**References**

To introduce the fundamental principles of estimation and filtering of random signals
To provide the working knowledge of Kalman filtering for fusion of data from multiple sensors
To enable application of Kalman filtering for specific problems in cyber-physical systems

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

CO1: understand the concepts of random processes and estimation
CO2: understand the concepts of Bayesian filtering
CO3: apply appropriate filtering algorithms for sensor data fusion
CO4: develop solutions for specific estimation and tracking problems in cyber-physical systems

CO-PO Mapping

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Syllabus

Unit I
Review of probability and random variables – joint and conditional distribution; Estimation – bias and variance, maximum likelihood (ML) estimation; Linear models – BLUE; Least Squares – consistency and efficiency, the orthogonality principle, MMSE and MAP estimation.

Unit II
Random Processes – auto- and cross-correlation, stationarity, power spectral density, white noise, Gaussian processes; Linear State-Space Models – continuous-time, sampled continuous-time, and discrete-time models; Discrete Kalman Filter – prediction, smoothing and filtering, Information Filter.

Unit III
Smoothing of Sensor Data – fixed-interval, fixed-point and fixed-lag smoothing; Delayed State Measurements; Decentralized Filtering; Extended Kalman Filter. Applications and Use Cases – Inertial Navigation System (INS), Global Positioning System (GPS), Simultaneous Localization and Mapping (SLAM), Trajectory Tracking of Ground and Space Objects, Monte Carlo simulation examples.

Textbook(s)

References(s)

Course Objectives

<table>
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<tr>
<th>23EAC332</th>
<th>Brain Computer Interface (Pre-requisite: Nil)</th>
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<td>To provide an understanding of the basics of processing the signals acquired from brain computer interface (BCI) devices</td>
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<td>To enable the appropriate usage of BCI for medical and non-medical tasks</td>
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Course Outcomes: At the end of the course, the student should be able to

CO1: understand the basics features appropriate for the task from various BCIs
CO2: implement a machine learning solution for the BCI task
CO3: analyse signal patterns derived from the BCI
CO4: analyze examples of BCI usage in human service

CO-PO Mapping

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Syllabus

Unit I
Introduction to neurons, spikes - Recording brain signals – Invasive, non-invasive recording. Frequency domain, time domain analysis – Chaos and dynamic analysis – Artifact reduction – PCA, ICA, feature extraction.

Unit II
Statistical learning approaches for BCI – Adaptive learning approaches - Transfer Learning for BCI. Invasive BCI in animals, humans – Non-invasive BCI, EEG, fMRI, MEG – Issues in BCI

Unit III

References

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)
1. Wenbo Mao, Wei Li, and Sushil Jajodia, "Security in wireless sensor networks"

Electronics System Design and Automation

23EAC340 Digital Controller Design and Embedded Systems
(Pre-requisite: Microprocessors and Microcontrollers) L-T-P-C: 3-0-0-3
Course Objectives

1. To understand digital controller design techniques and their application in embedded systems
2. To designing and implementing digital controllers for real-time control systems
3. To analyze, optimize, and troubleshoot digital control systems implemented in embedded systems

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

CO1: understand the principles and concepts of digital controller design.
CO2: design and implement digital controllers for real-time control applications.
CO3: understand and work with different components of embedded systems.
CO4: analyze, optimize, and troubleshoot digital control systems implemented in embedded systems.

CO-PO Mapping

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Syllabus

Unit I
Introduction: Digital control systems: digital control, discrete-time systems, Z-transform, control applications; Digital controller design: PID controllers, state-space controllers, adaptive controllers, control algorithms; Stability analysis: Routh-Hurwitz criterion, root locus, frequency response, stability analysis methods; Digital control system implementation: implementation techniques, hardware/software co-design, real-time control.

Unit II
Embedded systems: Embedded Systems Architecture, embedded systems definition, characteristics, applications, real-time systems; Embedded system components: microcontrollers, microprocessors, memory, I/O devices, peripherals; Real-time operating systems (RTOS): RTOS, scheduling algorithms, task scheduling, synchronization; Sensor and actuator interfacing: sensor interfaces, actuator interfaces, input/output interfacing.

Unit III
Embedded System Design and Optimization: Embedded system design methodologies, top-down design, hardware/software co-design, design principles; Real-time control in embedded systems: real-time control, task scheduling, synchronization, communication; Power-aware design: power management techniques, power optimization, energy efficiency; Testing and debugging: testing techniques, debugging tools, embedded system debugging; Performance optimization: code optimization, memory optimization, power optimization, performance tuning.

Textbook(s):


Reference(s):

Course Objectives:

1. To understand advanced microcomputer system architecture and design principles.
2. To design and implement complex microcomputer-based systems.
3. To analyze, optimize, and troubleshoot advanced microcomputer-based systems.

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

CO1: understand the architecture and design principles of advanced microcomputer systems.
CO2: design and implement complex microcomputer-based systems.
CO3: apply advanced techniques for interfacing peripherals and devices to microcomputer systems.
CO4: analyze, optimize, and troubleshoot advanced microcomputer-based systems.

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Syllabus

Unit I

Introduction: Advanced Microcomputer System Architecture, Microcomputer system fundamentals: microprocessors, memory, I/O, bus architecture, system components; Advanced microcomputer architectures: superscalar, pipelining, RISC, CISC, parallel processing; Memory systems: cache memory, virtual memory, memory management techniques; Bus protocols and standards: PCI, USB, I2C, SPI, Ethernet; Microcomputer system design considerations: performance, power consumption, reliability

Unit II

Complex Microcomputer System Design: System-on-Chip (SoC) design: integration, components, chip design, hardware integration; Hardware description languages (HDL): VHDL, Verilog, FPGA, design tools; Design methodologies: complex system design, design approaches, system-level design; Integration of peripherals and devices: UART, ADC, DAC, timers, external memory; System-level design challenges: power management, thermal management, system integration

Unit III

Advanced Techniques for Microcomputer Systems: Advanced interfacing techniques: DMA, interrupts, memory-mapped I/O, direct I/O; Real-time operating systems (RTOS) for microcomputer systems: RTOS, scheduling, real-time constraints; Embedded software development and debugging techniques: software development, debugging tools, firmware; Performance analysis and optimization of microcomputer systems: performance metrics, optimization techniques; Troubleshooting and debugging: system debugging, fault diagnosis, troubleshooting techniques

Textbook(s):

4. "Microprocessor Architecture, Programming, and Applications with the 8085/8080A" by Ramesh S. Gaonkar.

Reference(s):

3. "Digital Design and Computer Architecture” by David Harris and Sarah Harris.
Course Objectives

- To provide foundation on robotics design
- To provide fundamentals of trajectory and control
- To enable design exploration for various applications

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

CO1: understand the required engineering in robotics design
CO2: configure and classify robots
CO3: design the trajectory and control
CO4: design and robot for some specific application

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Syllabus

Unit I

Introduction: Robotics; Types of Robots- Manipulators, Mobile Robots-wheeled &Legged Robots, Aerial Robots; Anatomy of a robotic manipulator-links, joints, actuators, sensors, controller; open kinematic vs closed kinematic chain; degrees of freedom; Robot configurations-PPP, Classification of robots based on motion control methods and drive technologies; 3R concurrent wrist; Classification of End effectors - mechanical grippers, special tools, Magnetic grippers, Vacuum grippers, adhesive grippers, Active and passive grippers, selection and design considerations of grippers in robot; Direct Kinematics- Rotations-Fundamental and composite Rotations, Homogeneous coordinates, Translations and rotations, Composite homogeneous transformations, Screw transformations, Kinematic parameters, The Denavit-Hartenberg (D-H) representation, The arm equation, direct kinematics problems (upto 3DOF) Inverse kinematics- general properties of solutions, Problems (upto 3DOF) Inverse kinematics of 3DOF manipulator with concurrent wrist; Tool configuration Jacobian, relation between joint and end effector velocities.

Unit II

Trajectory Planning and control: Trajectory planning Tasks, Path planning, Joint space trajectory planning- cubic polynomial, linear trajectory with parabolic blends, trajectory planning with via points; Cartesian space planning. Point to point vs continuous path planning. Obstacle avoidance methods- Artificial Potential field, AI algorithms; The control problem, Single axis PID control-its disadvantages, PD gravity control, computed torque control. Motion Control (Kinematic Control), Open loop control (trajectory-following), Feedback control.

Unit III

Industrial Applications: Material handling, welding, Spray painting, Machining. Case study for robotic applications including robot selection considerations for a typical industrial application- number of axes, work volume, capacity & speed, stroke & reach, Repeatability, Precision and Accuracy, Operating environment. foreg – the robotic configuration for pick
and place robot, spot welding robot in a car manufacturing industry, peg in hole assembly. Applications in the medical, mining, space, defence, security, domestic, entertainment.

**Textbook/References**

3. Introduction to Robotics by S K Saha, Mc Graw Hill Education

<table>
<thead>
<tr>
<th>23EAC343</th>
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**Course Objectives**

- To provide foundation on industrial automation
- To provide fundamentals knowledge on programmable logic controller and its applications
- To provide the concept and foundation on distributed control systems

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

CO1: understand the need and components for industrial automation
CO2: understand and apply PLC design concept
CO3: apply PLC and SCADA for automation
CO4: understand and design simple distributed control systems

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**Syllabus**

**Unit I**


**Unit II**

Programmable logic controllers: Programmable controllers, Programmable logic controllers, Analog digital input and output modules, PLC programming, Ladder diagram, Sequential flow chart, PLC Communication and networking, PLC selection, PLC Installation, Advantage of using PLC for Industrial automation, Application of PLC to process control industries.

**Unit III**
SCADA and DCS: SCADA, Distributed Control System: Overview of DCS, DCS software configuration, DCS communication, DCS Supervisory Computer Tasks, DCS integration with PLC and Computers, Features of DCS, Advantages of DCS.

Textbook/References
1. JOHN WEBB: Programmable Logic Controllers Principles & applications, PHI.
2. D. PATRANABIS: Principles of Process Control, TMH

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Course Objectives
- To provide an introduction to the types of ASIC and typical ASIC design Flow
- To provide an understanding of HDL coding guidelines and synthesizable HDL constructs
- To introduce the SoC design, optimization, and programming.

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

CO1: understand the different types of ASICs and design flows.
CO2: synthesize the given design by considering various constraints and optimizing the same.
CO3: demonstrate an ability to identify, formulate and treat complex issues in the field of SoC.
CO4: improve the performance of SoC-based design with various advanced techniques.

CO-PO Mapping

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Syllabus

Unit I

Unit II

Unit III

Textbook(s)

Reference(s)

Course Objectives

- To introduce the concept and fundamentals of electronic packaging
- To provide foundation on chip level packaging and relevant technology
- To introduce the issues and necessity of testing in the process

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

CO1: understand the basic principles and concept of electronic system packaging for different applications
CO2: understand different chip level technology and packaging
CO3: design PCB with required standard
CO4: test and analyse various issues in packaging and PCB design process

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Syllabus

Unit I

Electronic systems and needs, physical integration of circuits, packages, Packaging Hierarchy, IC packaging: MEMS packaging, consumer electronics packaging, medical electronics packaging. Trends and Challenges, boards and complete electronic systems; system applications like computer, automobile, medical and consumer electronics with case studies and packaging levels. Materials for Microelectronic packaging, Packaging Material Properties, Ceramics, Polymers, and Metals in Packaging, Material for high density interconnect substrates.

Unit II


Unit III

Textbook/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.

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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


### Course Objectives

- To introduce the concept and impact of signals and filters in mixed signal systems.
- To provide knowledge on data converter principles, architectures, and design considerations
- To provide foundation on designing a mixed signal system

### Course Outcomes:

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

- **CO1**: understand basic analog and digital filters used in mixed signal systems.
- **CO2**: understand the design considerations of different data converters.
- **CO3**: understand the impact of noise in mixed signal systems.
- **CO4**: gain proficiency in designing mixed-signal systems

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### Syllabus

#### Unit I

#### Unit II

#### Unit III

### Text Book(s)


Reference(s)


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23EAC349 Data Acquisition System Design (Pre-requisite: Microprocessor and Microcontroller) L-T-P-C: 3-0-0-3

Course Objectives

- To introduce the concepts of acquiring the data from transducers.
- To provide foundation on data interfacing and analysis.
- To enable develop and design instrumentation systems

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

CO1: elucidate the elements of data acquisition techniques.
CO2: design and simulate signal conditioning circuits.
CO3: explain various data transfer techniques
CO4: understand the components of the data acquisition system

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Syllabus

Unit I

Analog and digital data acquisition, Sensor/Transducer interfacing, unipolar and bipolar transducers, Sample and hold circuits, Interference, Grounding and Shielding.

Unit II

Operational Amplifiers, CMRR, Slew Rate, Gain, Bandwidth. Zero crossing detector, Peak detector, Window detector. Difference Amplifier, Instrumentation Amplifier AD 620, Interfacing of IA with sensors and transducer, Basic Bridge amplifier and its use with strain gauge and temperature sensors, Filters in instrumentation circuits.

Unit III

Serial data transmission methods and standards RS232-C: specifications connection and timing, 4-20 mA current loop, GPIB/IEEE-488, LAN, Universal serial bus, HART protocol, Foundation Fieldbus, Modbus, Zigbee and Bluetooth. Single channel and multichannel, Graphical Interface (GUI) Software for DAS, RTUs, and PC-Based data acquisition systems.

Textbook(s)


Reference(s)


Course Objectives

- To provide the concept of various physical phenomena of different types of sensors and micro systems.
- To provide foundation on design of basic circuit building blocks of sensors and understanding their materials with interface as a complete system.
- To provide the concept and understanding on the sensors fabrication process and their applications.

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

CO1: understand various physical phenomena behind the operation of different types of sensors and microsystem.
CO2: understand the building blocks and designing of sensors with complete interface circuit.
CO3: know the different materials for sensors and microsystem.
CO4: understand the process of MEMS fabrication.

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Syllabus

Unit I


Unit II


Unit III


Textbook(s)


Reference(s)

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### Course Objectives
- To introduce the concept of automotive vehicle
- To provide foundation and fundamentals of CAN and other controls
- To enable students to gain auxiliary systems in and outside vehicle and their controls

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

**CO1**: understand the basic principles and concept of automotive vehicle  
**CO2**: understand various controls and embedded controller in vehicle  
**CO3**: analyze the performance of CAN, LIN and other data transfer buses  
**CO4**: understand data transfers towards auxiliaries and controls

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### Syllabus

#### Unit I


#### Unit II

Automotive networking - Cross-system functions, Requirements for bus systems, Classification of bus systems, Applications in the vehicle, coupling of networks, CAN bus - Applications, Topology, Data transmission system, CAN protocol, data transfer sequence, standardization, characteristics. LIN bus: Overview, Applications, Data transfer, Bus access, LIN protocol, network management, Lighting system: Lighting fundamentals Lighting circuits, Gas discharge and LED lighting, Case studies, Diagnosing lighting system faults, Advanced lighting technology, New developments in lighting systems

#### Unit III
Auxiliaries in vehicles - Windscreen washers and wipers, signaling circuits, Other auxiliary systems, Case studies, Diagnosing auxiliary system faults Advanced auxiliary systems technology, new developments in auxiliary systems Chassis Electrical systems - Anti-lock brakes, Active suspension, Traction control , Automatic transmission, Other chassis electrical systems, Case studies, Diagnosing chassis electrical system faults, Advanced chassis systems technology, New developments in chassis electrical systems

Textbook/References


VLSI

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<th>23ECE331</th>
<th>Analog IC Design</th>
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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.

CO-PO Mapping

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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)

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### 23ECE332 Digital IC Design

**(Pre-requisite: Digital Electronics)**

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**Course Objectives**

- To provide an understanding of basic building blocks of mixed logic digital circuits
- To understand the optimizing techniques available for combinatorial 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.

**CO-PO Mapping**

**Syllabus**

**Unit I**

**Unit II**

**Unit III**
Textbook(s)

Reference(s)

23ECE333 Functional Verification (Pre-requisite: VLSI Design) L-T-P-C: 3-0-0-3

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.

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 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)
2. Christoph Meinel and Thorsten Theobold, —Algorithm and Data Structures for VLSI Designl, KAP, 2002.

Reference(s)
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.

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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 DACs. 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)

• 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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Syllabus

Unit I

Unit II

Unit III

Textbook(s)

Reference(s)

23ECE337 System on Chip (Pre-requisite: VLSI Design) L-T-P-C: 3-0-0-3

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.

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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
Deposition requirements and techniques – Physical- Evaporation and sputtering techniques. Failure mechanisms in metal interconnect - multilevel metallization schemes. Chemical Vapor Deposition- CVD techniques for deposition of polysilicon - silicon dioxide, silicon nitride and metal films. Epitaxial growth of silicon- PECVD.
Etching - wet chemical etching techniques. Plasma etching and RIE techniques- Chemical Mechanical Polishing, Process integration and characterization techniques.

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.

**CO-PO Mapping**

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**Syllabus**

**Unit I**
Random Access Memory Technologies: SRAM Cell structures, MOS SRAM Architecture, Advanced SRAM architectures and technologies, Application specific SRAMs.

**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.

**Textbook(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.

CO-PO Mapping

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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)


Course Objectives

- To introduce Hardware Trojan taxonomy
- To familiarize Trojan insertion methods and detection approaches at various levels of abstraction
- To introduce VLSI design flow incorporating trust at different levels

Course Outcomes: At the end of the course, the student should be able to
CO1: understand typical hardware security vulnerabilities at various phases of VLSI Design flow
CO2: understand fundamental approaches used in Trojan insertion
CO3: understand different approaches for Trojan and Piracy detection and analysis
CO4: analyze the ways in which trust can be incorporated in VLSI Design flow

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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)

Course Objectives
- To introduce the various modeling styles for Hardware Description Languages (HDLs).
- To introduce Register Transfer Level (RTL) abstraction for HDL based design flow.
- To understand the behavioral HDL modeling of combinational and sequential subsystems.

Course Outcomes: At the end of the course, the student should be able to
CO1: understand the basic constructs of Verilog.
CO2: design digital blocks using Gate level and Data flow modeling style of Verilog.
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.

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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

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<tr>
<th>23ECE351</th>
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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

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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

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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 Adversarial 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

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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; 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 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
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Unit II

Unit III

Textbook(s)

Reference(s)

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23ECE356 Microelectromechanical Devices (Pre-requisite: Nil) L-T-P-C: 3-0-0-3

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)

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 efficacy, 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)

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
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)

23ECE359  Nano Electronics  L-T-P-C:  3-0-0-3  
(Pre-requisite: Semiconductor Physics)

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
Lattice – Quantum Well– Wire and Dot Devices - Scattering Rates and Lifetimes in Electronic Devices - CVD and Other Processes in Fabrication of Nano Devices.

Unit II

Unit III

Textbook(s)

Reference(s)

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**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**
**Solar and Energy Harvesting Materials**- First generation solar cell materials; single and polycrystalline Silicon, amorphous silicon, contact materials. Second generation solar cell materials: CdSe, CdTe, Copper Indium Gallium Selenide (CIGS), Gallium Arsenide for applications in photovoltaics, Materials for thin film solar cells, thin film processing, and properties. Contact materials for second generation solar cells. Third generation solar cell materials; Quantum Dots, Organic materials, Composites, Dyes, Perovskites and their synthesis, characterization and properties, Interface energetics, photoactive layers and their materials. Piezoelectric, Pyroelectric and Thermo-electrics materials, Electrostatic (capacitive)
Energy Harvesting and materials, energy from Magnetic Induction, Metamaterial, energy from atmospheric pressure changes, electroactive polymers (EAPs); Use of Machine Learning and Artificial Intelligence for Energy Materials.

Unit II

Unit III

Textbook(s)

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

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**EMBEDDED SYSTEMS**

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<th>23ECE431 Operating Systems</th>
<th>L-T-P-C: 3-0-0-3</th>
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<td>(Pre-requisite: Nil)</td>
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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)

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<td>To provide foundations of real time systems</td>
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<td>To introduce concept of real time task-scheduling, and resource sharing and dependencies</td>
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<td>To enable real time communication using real time operating systems and develop real time systems</td>
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</table>

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 (iitpkd.ac.in)

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<table>
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<tr>
<th>Course Objectives</th>
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<tbody>
<tr>
<td>• To introduce to the MIPS architecture and its features</td>
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<td>• To provide an understanding of the MIPS assembly language</td>
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<td>• To enable design and implement basic MIPS programs using the assembly language</td>
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</tbody>
</table>

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)
4. Advanced Computer Architecture (iitpkd.ac.in)
5. NPTEL
6. advanced-computer-architecture.pdf (abit.edu.in)

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: analyse different types of robot designs
CO4: develop mobile robot application

CO-PO Mapping

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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)

<table>
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<th>23ECE437</th>
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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

CO-PO Mapping

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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)

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


Signal Processing

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(Pre-requisite: Nil)

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)

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.

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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)

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23ECE443 Biomedical Signal Processing

(Pre-requisite: Signal Processing)

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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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)

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)

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**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.

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Syllabus

Unit I

Unit II

Unit III

Textbook(s)

Reference(s)

Common Electives

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<td>(Pre-requisite: Machine Learning)</td>
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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
Long Short-Term Memory (LSTM) Units - TensorFlow Primitives for RNN Models - Augmenting Recurrent Networks with Attention.

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

CO-PO Mapping

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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 programming 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)**

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**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

**CO-PO Mapping**

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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

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**23ECE454 Understanding ICT Standardization: Principles and Practices**

(Pre-requisite: Nil)

**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

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**Syllabus**

**Unit I**


**Unit II**

Standard organizations-formal standardization and standrds 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

<table>
<thead>
<tr>
<th>23ECE455</th>
<th>Robotic System Design (Pre-requisite: Nil)</th>
<th>L-T-P-C: 3-0-0-3</th>
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<td>To introduce robotic design essential</td>
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<td>To provide mathematical foundations necessary to analyze and design</td>
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<td>CO3</td>
<td>To provide foundation on different controls and design aspects of robotic system</td>
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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

CO-PO Mapping

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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


Other Electives

<table>
<thead>
<tr>
<th>23ECE461</th>
<th>Software Defined Networks</th>
<th>L-T-P-C: 3-0-0-3</th>
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<td>(Pre-requisite: Computer Networks and Protocols)</td>
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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

CO-PO Mapping

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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)

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<th>23ECE462</th>
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**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**

**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.
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, Largescale models and abstractions.

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)
23ECE465  Computer Networks and Protocols  L-T-P-C: 3-0-0-3  
(Pre-requisite: Nil)

Course Objectives

- To provide an understanding of layered architecture of computer networks
- To provide fundamentals of internetworking
- To provide foundations on network protocols

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

CO1: understand layered architecture of computer networks
CO2: understand the concepts of addressing, switching, routing and reliable transport of data
CO3: understand the working of network protocols
CO4: analyze the qualitative aspects of protocols

CO-PO Mapping

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Syllabus

Unit I

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

- 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

CO-PO Mapping

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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 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)

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 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

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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.
Course Objectives

- To introduce the mathematical foundations required for modeling and analysis of computer networks and computing systems.
- To enable performance analysis and optimization of networks and computing systems
- 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 necessary mathematical foundations.
CO2: apply mathematical tools to model and analyze networks and computing systems
CO3: carry out discrete event simulations of networks and computing systems
CO4: understand research literature on specific topics

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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)

2.  Selected Research papers.

Course Objectives

- 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

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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)

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

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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)

23ECE473  
Physical Chemistry of Materials and Processes  
(Pre-requisite: Nil)  
L-T-P-C: 3-0-0-3

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

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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, diets, 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 - Schrodinger equation - Position and momentum MO 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:**


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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) 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 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:**


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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, terephthalic 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


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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.

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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 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 batteries; Lithium primary cells - liquid cathode, solid cathode and lithium-ferrous sulphide cells (comparative account).

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

| CO  | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 | PSO3 | PSO4 |
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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.


TEXTBOOKS:


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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 lawsand Scattering states

CO4: Able to solve problems in the Centre of Mass frame and connect it to Laboratory Frame of ReferenceCO5: Understand and solve problems in rigid body rotations applying of Euler’s equations.

CO-PO Mapping

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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:


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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

Solid state LASER: (i) Ruby LASER – principle, construction, working and application. (ii) Neodymium (Nd) LASERS.

Gas LASER: (i) He-Ne LASER - principle, construction, working and application. (i) CO2 LASER - principle, construction, working and application.

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
Quantum dots and Magnetic nanomaterials – applications.

Nanoelectronics and nanodevices:

Impact of nanotechnology on conventional electronics. Nanoelectromechanical systems (NEMSs) – 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.

TEXTBOOKS:


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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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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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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


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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


Project Selection – Decision Matrix, Technique for Order Preference using Similarity to Ideal Solution (TOPSIS), Simple Additive Weighting (SAW).

Unit 2

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.

TEXT 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


TEXT BOOKS

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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.
CO6: Solve Operations Research problems using software package

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Syllabus

Unit 1

Unit 2
Decision Theory: Decision Trees. Game theory - 2 person zero sum; mixed strategies; 2 x n and m x 2 games. Network Models - Project Networks - CPM / PERT - Project Scheduling – crashing networks and cost considerations - Resource
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


REFERENCE BOOKS


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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**


**Evaluation Pattern**

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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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Syllabus

Unit 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.

Unit 2
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
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.

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Syllabus

Unit 1


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

CO/PO Mapping

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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

## Evaluation Pattern

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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**


- An overview of project planning - project Evaluation - Selection Of Appropriate Project Objectives- Software Effort 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)


REFERENCE(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


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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 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

**CO-PO Mapping**

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**Syllabus Unit 1**


Unit 2


Unit 3

TEXT BOOK(S)

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**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

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<td>ACHIEVING EXCELLENCE IN LIFE - AN INDIAN PERSPECTIVE</td>
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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 blueprint 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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*CA – Can be Quizzes, Assignment, Projects, and Reports.*
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 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

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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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*CA – Can be Quizzes, Assignment, Projects, and Reports.*
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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*CA – Can be Quizzes, Assignment, Projects, and Reports.
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 Caesar, Gordon Daviot / Final Solutions, Mahesh Dattani; Book reviews, 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

REFERENCES:

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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.

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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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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
Numbers above 1000. Orientation in Shopping plazas: asking the price, where do I find what, saying the opinion.


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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; Divisible and indivisible verbs.

Vocabulary: Family circle; Household articles.

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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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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, Juloos.
BOOKS:

1. Prem Chand Ki Sravahrestha 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 Abhyakthi

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:

2. *Gadya Manjusha: Editor: Govind, Jawahar Pustakalay, Mathura*

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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.

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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 - Kautilya 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, Brihadaranya Upanishad, Saptasati Devi Mahatmyam, Ramayana, Mahabharata, Manusmriti, Kautilya’s Arthasastra and Mrichchhakatikamof 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.
25. Danino, Michel. The Invasion That Never Was.
34. Dharampal. Archival Compilations (unpublished)

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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 purusarthas; 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: 600 B.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:


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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

Evaluation Pattern

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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.
6. *India Since 1526*, V. D. Mahajan, S. Chand & Company
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
18. *Comparative Aesthetics, Volume 2*, Kanti Chandra Pandey, Chowkhamba, Varanasi
19. *The Invasion That Never Was*, Michel Danino
22. *Naga-Mandala, Girish Karnard, OUP.*

**Evaluation Pattern**

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*CA – Can be Quizzes, Assignment, Projects, and Reports.*
# INTRODUCTION TO SANSKRIT LANGUAGE AND LITERATURE

**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
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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.

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.

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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:


Evaluation Pattern

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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:


REFERENCE BOOKS:

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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 Somasutvan 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, Pipplelada, 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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23HUM244  UNDERSTANDING SCIENCE OF FOOD AND NUTRITION  L-T-P-C: 2-0-0-2

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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SyllabusUnit 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 foods, value 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 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, belavanigeya kiru parichaya Paaribhaashika padagalu
Vocabulary Building

Unit 2
Prabhandha – Vyaaghra Geethe - A. N. Murthy Rao
Prabhandha – Baredidi...baredidi, Baduku mugiyuvudilla allige...- Nemi Chandra Paragraph writing –Development: comparison, definition, cause & effect Essay – Descriptive & Narrative

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 W riting - 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 Iyanger – Adalitha Kannada – Chetana Publication, Mysuru
2. N. Murthy Rao – Aleyuva Mana – Kuvepnu Kannada Adyayana Samste
3. Nemi Chandra – Badhuku Badalisabahudu – 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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*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 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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*CA – Can be Quizzes, Assignment, Projects, and Reports.*
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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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 - Vyasaante 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 – Thettillatha 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 Ormmayku, M. T. Vasudevan Nair - literary contributions of his time

Unit 4
Part of an autobiography / travelogue: Kannerum Kinavum, V. T. Bhattachirippadu - Socio-cultural literature - historical importance.

Unit 5
Error-free Malayalam - 1. Language; 2. Clarity of expression; 3. Punctuation - Thettillatha Malayalam
W riting - 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 appreciationof literary works (Any one or two as an assignment).

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*CA – Can be Quizzes, Assignment, Projects, and Reports.
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. Vadhyar 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*
7. *Subhashita Ratna Bhandakara by Kashinath Sharma, published by Nirnayasagar press*

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*CA – Can be Quizzes, Assignment, Projects, and Reports.*
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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6. Namalinganusingham by Amarsimha published by Travancore Sanskrit series
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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.

REFERENCES:


Evaluation Pattern

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*CA – Can be Quizzes, Assignment, Projects, and Reports.
Syllabus

Unit 1


Unit 2


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/19ulabourlawshb.pdf

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*CA – Can be Quizzes, Assignment, Projects, and Reports.
Course Objectives:

- To introduce the students to different literature: Sangam literature, Epics, Bhakti 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: Nāṭṭupurap pāṭalkāl, Kataikkāl, Pajamolikāl - cirukataikāl tōṟṟum valarcciyum, cirilakkiyankāl: Kālīṅkattup paraṇī (pōrpāṭiyatu) - mukkūṭār paḻḷu 35.

Kāppiyankāl: Cilappatikāram – manimēkalai nāṭaiyiyal āyvu maṟṟum aimpērum – aiṅciṟūn kāppiyankāl tōṟṟu pāṇa ceytila.
சின்ன இலக்கியம் நிதியுலக்கியம் - பதிவுகிக்கன்று நுகல் சோட்டர்பான பிரா செய்திகள் - திருக்கரை (நுபு, பன்பு, கல்வி, ஊழ்கம், நாட்பு, வாய்மை, கெல்வி, கெனாரிய, பெரியராய்துண்மைக்கோட்டை, விளிப்புணர்வு பொருள் தமிழகர் உல்லா செய்திகள்.

அரசுகள்: உளகணிதி (1-5) – எல்லை (1,3,6). - சிறைகள்: காதுவெளி சிறந்த பாதகரை (ஏழான் காலிப்பு –1, 4, 6, 7, 8), மாறும் கப்பேய் சிறந்த பாதகரை (1-5).

Unit 3

தமிழ் இலக்காணம்: வாக்கியா வகால கால் - தாண்டினா பிளாவினா - நேர்குர்சு நெர்குர்சு

Unit 4

தமிழக ஆர்காண்டிகம் தமிழ் தொன்றும் சமுதயா தொன்றும்: பாரதியர், பாரதித்தாண், பாதுக்கோத்தைக் கல் மண்டா உண்டாராம், குரடா, குஜாதா, சிரி, மெட்டா, ஆப்டு ரகுமான், நா.பிக்ஸ்முர்த்தி, கிள்ளா, கிள்ளி, தி.யு.புப், விராமமுண்டிர அந்நா, பரிசமம் கலைஞர், மாசைமலாய் திட்திகள்.

Unit 5

தமிழ் மோழி அயிவ கனின் பாசபது - கருத்துப் பரிமார்சம் - விலம்புரம் மோழியாமைப்பு - பெசு - நாளிகம் பாதாப்பு - சிறுகளை, காடதி, புதுயம் பாதாப்பு.

Textbooks:

5. nā.வாணமாமலை, “தமிழ் நாய்த்தப்பாதகரை” பொிசு இறுது பாட்டாக்காக்கம் 1964,2006
6. poṉ manimāṇa “ஷொ தமிழ் இலக்காணம் “ஷொ பாப்பிஸின் குறுப், வாநியர்,

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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, Pathinenkeelakana 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

CO-PO Mapping

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Syllabus

Unit 1

The history of Tamil literature: Nāṭṭupuṟap pāṭalkaḷ, kataikkaḷ, pajamolikkaḷ - cīrukataikaḷ tōṟṟamum vāḷarcCLUyum, cīruḷakkiyankaḷ: Kalinkattup pariṇ (pōṛpāṭiyatu) - mukkūṭar paḷḷu 35.

Kāppiyaṅkaḷ: Cilappatikāram – maṇimēkalai naṭaiyiyal āyyu maṟṟum aimerum – aṁciṟuṅ kāppiyaṅkaḷ tōṟṟapāṇa ceytikaḷ.

Unit 2

thinai ilakkiyamum nīṭinilakkiyamum - patinēnkkīkanakku nūlkā tōṟṟapāṇa piṟa ceytikaḷ - tirukkuṟaḷ (aṇpu, paṇpu, kalvi, oḷukkam, natpu, vāymai, kēḷvi, ceynaṟig, periyāraittunakkōṭal, vilppunarvu pēṟa atikārattu ulḷa ceytikāḷ.
Aṟanūlkaḷ: Ulakanīti (1-5) – ēlāti (1,3,6). Cittarkaḷ: Kaṭuveḷi cittar pāṭalkaḷ (āṉantak kalippu –1, 4, 6, 7, 8), marṟum akappēy cittar pāṭalkaḷ (1-5).

Unit 3

tamil ilakkaṇam: Vākkiya vakaikaḷ – tāṇviṆai pīṟaviṆai – nērkkūṟṟu ayaṟkūṟṟu

Unit 4

Unit 5


Text Books / References

Mu.Varatarācaṉ “tamil īlakkiya varalāṟu” cāhitya ağaṭemi papliṅsas, 2012

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