24MA101 **Linear Algebra, Series and Calculus**

Category: Basic Sciences (BS) **3L 0T 2P 4C**

Pre-requisite: 10+2 Mathematics

Course Description:

An overview of the fundamental concepts of linear algebra, infinite series, differential calculus, multiple integrals and vector calculus, with a focus on the applications in solving engineering problems

Course Aims and Objectives:

- Introduce techniques for solving systems of linear equations, determining eigenvalues and eigenvectors, and performing matrix diagonalization
- Explain methods to analyze the convergence and divergence of an infinite series and to expand functions using Taylor's or Maclaurin's series
- Familiarize differentiation rules and theorems to solve problems related to rates of change and optimization
- Explain the concept of double and triple integrals to calculate areas and volumes for two-dimensional and three-dimensional objects
- Teach operations on vector-valued functions, including line and surface integrals, as well as the concepts of curl and divergence, and their applications in engineering

Course Outcomes:

At the end of the course, the student will be able to…

- CO 1: solve the systems of equations and analyze engineering problems using linear algebra techniques [K3]
- CO 2: apply the convergence tests of an infinite series to solve engineering problems [K3]
- CO 3: use differential calculus to solve optimization problems and analyze rates of change in engineering applications [K3]
- CO 4: calculate areas and volumes using double and triple integrals[K3]
- CO 5: apply vector calculus concepts to solve problems involving work done by force fields and analyze related physical phenomena [K3]

Course Structure:

Unit 1: Linear Algebra

- **Contents**
  Rank of a matrix (Echelon form), Finding the inverse by Gauss-Jordan method, System of linear equations: Homogeneous and Non-Homogeneous, Linear transformations,

Orthogonal transformation, Eigenvalues and Eigenvectors, Reduction to Diagonal form

- **Description:** This unit familiarizes the students, the concept of linear algebra, which is essential for solving system of equations, analyzing data, modeling engineering problems
- **Exercises/Projects**:
  - Find the inverse of a matrix by Gauss-Jordan method
  - Solve a system of linear equations
  - Find the eigenvalues and eigenvectors of a given matrix
  - Diagonalization of a square matrix
- **Examples/Applications/Case Studies:**
  - Solve the system of linear equations representing currents in an electrical network to determine the voltage at each node
  - Diagonalize a symmetric matrix representing a physical system to simplify calculations of its behavior
  - Transforming a quadratic form into a canonical form for retrieval of shapes
- **Learning Outcomes:**
  - Find the rank of a matrix and use it to test for consistency of linear systems
  - Find eigenvalues and eigenvectors of a given matrix and perform diagonalization
- **Specific Resources:**
  - MIT OpenCourseWare: Linear Algebra https://ocw.mit.edu/courses/18-06-linear-algebra-spring-2010/
  - NPTEL: Linear Algebra https://archive.nptel.ac.in/courses/111/104/111104137/

Unit 2: Infinite Series

- **Contents**

  Infinite Sequence (Definition), Infinite Series, Comparison Tests, Integral Test, Ratio and Root Test, Alternating Series, Absolute and Conditional convergence
- **Description:** This unit covers infinite series, their convergence/ divergence, and applications in various engineering fields
- **Exercises/Projects:**
  - Finding the convergence/divergence of a given infinite series using appropriate tests
- **Examples/Applications/Case Studies:**
  - A ball is dropped from a height of 4m. Each time it strikes the pavement after falling from a height of h meters it rebounds to a height of 0.5h meters. Find the total distance the ball travels up and down
  - Define the sequence of partial sums $s_k = \sum_{n=1}^{n=k} \frac{1}{(sin^2 n)\, n^3}$. What happens, when

you try to find the limit of s_k as $k \to \infty$

- Apply the concept of series, to model periodic phenomena

- **Learning Outcomes:**
  - Apply various tests to determine the convergence/divergence of an infinite series
- **Specific Resources:**
  - Khan Academy: Infinite Series
    https://www.khanacademy.org/math/ap-calculus-bc/bc-series-new
  - NPTEL : Real Analysis I
    http://archive.nptel.ac.in/courses/111/106/111106142/

Unit 3: Differential Calculus

- **Contents**

  Mean value theorems: Rolle's theorem (without proof), Lagrange's mean value theorem (without proof), Taylor's and Maclaurin's theorems with Lagrange's form of remainder (without proof), Expansions of functions: Taylor's and Maclaurin's series

  Functions of Several Variables: Maxima and Minima of functions of two variables, Lagrange's method of undetermined multipliers

- **Description:** This unit focuses on expansion of functions as Taylor's and Maclaurin's series and finding extreme values of multi-variable functions with and without constraints
- **Exercises/Projects**:
  - Verification of mean value theorems
  - Taylor's and Maclaurin's series expansions of single variable functions
  - Examine the extreme values of a function
- **Examples/Applications/Case Studies:**
  - It took 14sec for a mercury thermometer to rise from -19^{0}C to 100^{0}C, when it was taken from a freezer and placed in boiling water. Show that somewhere along the way the mercury was rising at the rate of 8.5^{0}C per second.
  - On our moon, the acceleration of gravity is 1.6m/sec^2.If a rock is dropped into a crevasse, how fast will it be going just before it hits bottom 30sec later.
  - Show that the maximum value of $a^2b^2c^2$ on a sphere of radius r centered at the origin of Cartesian 'abc' coordinate system is $\left(\frac{r^2}{3}\right)^3$.
  - Show that for non-negative numbers a, b, c the geometric mean is less than or equal to their arithmetic mean.
- **Learning Outcomes**:
  - Apply the mean value theorems and find extreme values of multivariable functions

- **Specific Resources:**
  - MIT OpenCourseWare: Multivariable Calculus
    https://ocw.mit.edu/courses/18-02sc-multivariable-calculus-fall-2010/
  - NPTEL: Engineering Mathematics-I
    https://archive.nptel.ac.in/courses/111/105/111105121/

Unit 4: Multiple Integrals

- **Contents**

  Double integrals (Cartesian coordinates), Change of order of integration, Triple integrals, Change of variables to polar, cylindrical and spherical coordinates, Areas as double integration and Volumes as triple integration
- **Description:** This unit introduces double and triple integrals, which are essential for calculating areas and volumes of objects in two and three dimensions
- **Exercises/Projects:**
  - Evaluate a double integral to find the area enclosed by a region.
  - Evaluate a triple integral to find the volume of a solid
- **Examples/Applications/Case Studies:**
  - Calculating the center of mass using multiple integrals
- **Learning Outcomes:**
  - Evaluate double and triple integrals
  - Apply double and triple integrals to solve engineering problems involving areas and volumes
- **Specific Resources:**
  - MIT OpenCourseWare: Multivariable Calculus
    https://ocw.mit.edu/courses/18-02sc-multivariable-calculus-fall-2010/

Unit 5: Vector Calculus

- **Contents**

  Introduction to Gradient of a scalar field, Divergence and Curl of a vector field, Line integral, Green's theorem in the plane (without proof), Surface integrals, Stoke's theorem (without proof) and Gauss divergence theorem (without proof)
- **Description:** This unit covers vector-valued functions, curl and divergence, line integrals and surface integrals, which are used to analyze various physical phenomena in engineering
- **Exercises/Projects:**
  - Find gradient, divergence and curl of a point functions
  - Verification of Greens, Stokes and Gauss divergence theorems
- **Examples/Applications/Case Studies:**
  - Calculate work done by a force field using line integral.
  - Calculate total flux across the surface using surface integral

- **Learning Outcomes:**
  - Perform operations on vector-valued functions
  - Apply Green's theorem, Stoke's theorem, and the Divergence theorem to convert line integrals to area integrals and surface integrals to volume integrals for solving engineering problems
- **Specific Resources:**
  - MIT OpenCourseWare: Multivariable Calculus
    https://ocw.mit.edu/courses/18-02sc-multivariable-calculus-fall-2010/

Textbook(s) / Reference(s)

Text book:

1. Weir Maurice D., Hass Joel & Giodano Frank R. (2013). *Thomas' Calculus.* (11th Edition). Pearson Education,inc..
2. Grewal B. S. (2017). *Higher Engineering Mathematics.* (44th Edition). Khanna Publishers.

References:

1. Kreyszig Erwin. (2013). *Advanced Engineering Mathematics.*(9th Edition).Wiley Publishers.
2. Ramana B.V.(2007). *Higher Engineering Mathematics.*Tata Mc.Graw Hill

Mapping of Course Outcomes to Program Outcomes:

PO / CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO1	M	M	-	-	L	-	-	-	-	-	-	-
CO2	M	M	-	-	L	-	-	-	-	-	-	
CO3	M	M	-	-	L	-	-	-	-	-	-	-
CO4	M	M	-	-	L	-	-	-	-	-	-	-
CO5	M	M	-	-	L	-	-	-	-	-	-	-

Key:

- M: Moderate emphasis
- L: Low emphasis
- H: High emphasis
- '-': Not applicable

24MA101 Linear Algebra, Series and Calculus (LAB)

Category: Basic Sciences (BS)

Pre-requisite: 10+2 Mathematics

Course Description:

An overview of the functions of MathWorks Symbolic Math Tool Box to solve problems in Matrix algebra, differential calculus, multiple integrals, vector calculus and to test the nature of series.

Course Objectives:

The objective of the lab course is to demonstrate built-in functions to

- find inverse, rank, eigen values, eigen vectors of a matrix and solution of system of linear equations.
- analyze the convergence and divergence of infinite series.
- find ordinary and partial derivatives
- expand functions as Taylor's and Maclaurin's series.
- determine extreme values of multi-variable function with and without constraints.
- Calculate areas and volumes using double and triple integrals.
- find gradient, divergent and curl.

Course Outcomes:

At the end of the course, the student will be able to…

- CO 1: find rank, solution of systems of equations and eigen values & eigen vectors of matrix [K3]
- CO 2: examine the convergence/divergence of infinite series. [K3]
- CO 3: use differential calculus to solve optimization problems. [K3]
- CO 4: calculate areas and volumes using double and triple integrals [K3]
- CO 5: find gradient, divergent and curl. [K3]

List of experiments:

Unit 1: CO 1 [K3]

1. inv() function to find inverse of a matrix
2. rank() function to find rank of a matrix
3. rref() function to solve system of linear equations
4. eig() function to find eigen values and eigen vectors of a matrix

- **Specific Resources:**
  MathWorks Linear Algebra Documentation
  Linear Algebra - MATLAB & Simulink - MathWorks India

Unit 2: CO 2 [K3]

1. vpa() function to evaluate numerically each term of series
2. symsum() function to test the nature of the series

- **Specific Resources:**
  MathWork Symbolic Calculus Tool Box
  Calculus - MATLAB & Simulink - MathWorks India

Unit 3: CO 3 [K3]

1. diff() function to find ordinary and partial derivatives
2. taylor() function to expand functions as Taylor's and Maclaurin's series
3. fmincon() function to find minimum of a function with constraints

- **Specific Resources:**
  MathWork Symbolic Math Tool Box
  Symbolic Math Toolbox Documentation - MathWorks India
  MathWork Optimization Tool Box
  Optimization Toolbox Documentation - MathWorks India

Unit 4: CO 4 [K3]

1. int() function to find double and triple integrals

- **Specific Resources:**
  MathWork Symbolic Calculus Tool Box
  Calculus - MATLAB & Simulink - MathWorks India

Unit 5: CO 5 [K3]

1. gradient() function to find gradient of a scalar point function
2. divergence() function to find divergence of a vector point function
3. curl() function to find curl of a vector point function

- **Specific Resources:**
  MathWork Symbolic Calculus Tool Box
  Calculus - MATLAB & Simulink - MathWorks India

24CY102 **Engineering Chemistry**

(EEE, ECE, EIE branches only)

Category: Basic Sciences (BS) **3L 0T 0P 3C**

***Pre-requisite*: 10+2 Chemistry**

Course Description:

The course is designed for B.Tech. Electrical, Electronics and Communications and Instrumentation Engineering students, providing essential and applied knowledge of Chemistry relevant to their fields. Understanding the specific application of materials based on their characteristic properties, which are determined by their structural and bonding aspects, is crucial for appropriate utilization. With this focus, the course covers the working of electrodes, sensors, batteries, fuel cells and super capacitors which are application of principles of electrochemistry. Also, the course enlightens the students on mechanistic aspects of corrosion and its control, chemical aspects of materials useful in electrical and electronics engineering. Further, it focuses on the principles and instrumentation of various instrumental techniques.

Course Aims and Objectives:

1. Impart knowledge on the functioning of electrodes, potentiometric and conductometric sensors.
2. Discuss construction and working of different types of batteries, fuel cells and super capacitors based on the principles of electrochemistry.
3. Analyse various corrosion processes and propose control methods depending on the principles of corrosion.
4. Explore the chemical aspects of various materials used in electrical, electronics and communications engineering.
5. Explain the principles, instrumentation of different instrumental techniques and their applications.

Course Outcomes:

At the end of the course, the student will be able to...

CO1: apply the principles of electrochemistry to analyse working of electrodes and sensors **[K3]**.

CO2: analyse various electrochemical energy systems for their application in engineering **[K4]**.

CO3: assess the challenges arising due to corrosion of electronic devices **[K4]**.

CO4: demonstrate the knowledge of materials for their use in manufacture of electrical and electronic devices **[K3]**.

CO5: compare different analytical techniques and their instrumentation for their application in qualitative and quantitative analysis **[K4]**.

Course Structure:

Unit 1: Electrochemistry

Contents

- Electrodes, electrode potentials and electrochemical cells
- The Nernst equation with numerical problems for calculating electrode potential and emf
- Reference electrodes – Calomel and Ag/AgCl electrodes, Ion-selective electrodes, glass electrode - construction, working, advantages, and disadvantages
- Potentiometry – redox titrations
- Conductometry (acid-base reactions)
- Electrochemical sensors – principle and applications

Description:

This unit covers the fundamentals of various electrodes and sensors, and deals with their working and applications.

Examples/Applications/Case Studies:

- Determination of pH using glass electrode
- Applications of electrodes and sensors in water quality analysis

Exercises/Projects:

- Numerical problems based on calculation of emf of cells uisng Nernst equation
- Conductometric titrations with examples of acid-base reactions
- Potentiometric titrations of redox reactions

Learning Outcomes:

- Understand the working mechanisms of various electrodes and the chemical reactions involved
- Explore the electrochemical principles underlying the operation of sensors
- Select appropriate electrodes and sensors for specific applications in their respective fields

Specific Resources:

- https://www.sciencedirect.com/topics/chemistry/electrochemistry
- https://wme-z1.pwr.edu.pl/wp-content/uploads/2017/05/Basics-of-Electrochemistry.pdf

Unit 2: Electrochemical Energy Systems

Contents

- Types of electrochemical energy systems – charging vs. discharging
- Primary vs. secondary batteries
- Lithium-ion batteries – Lithium iron phosphate and lithium cobalt oxide – construction and working of the batteries including cell reactions
- Fuel cells – hydrogen-oxygen fuel cell and polymer electrolyte membrane fuel cell
- Super capacitors – principle, classification and applications
- Chemistry of fast charging EVs

Description:

This unit provides the knowledge of different electrochemical energy systems including batteries, fuel cells and super capacitors useful in the domains of electrical, electronics, communications and instrumentation engineering.

Examples/Applications/Case Studies:

- Study of the working of lead-acid battery and effect of concentration of electrolyte on the working of battery
- Identification of applications of commercially available batteries and correlating with the properties of the batteries.

Exercises/Projects:

- Preparation of a comparative report on different batteries with reference to their efficiency, cycle life, self discharge and other characteristics.
- Correlating the characteristics of batteries and their applications.

Learning Outcomes:

- Understand the working and chemistry involved in different batteries and fuel cells
- Explore the advantages and disadvantages of different electrochemical energy systems
- Predict the suitable energy system that can be employed for a particular application in electrical and electronics domains.

Specific Resources:

- https://ocw.mit.edu/courses/10-626-electrochemical-energy-systems-spring-2014/pages/lecture-notes/
- https://pressbooks.online.ucf.edu/chemistryfundamentals/chapter/batteries-and-fuel-cells-2/

Unit 3: Corrosion and Its Control

Contents

- Introduction to corrosion, causes and examples
- Electrochemical corrosion: hydrogen evolution and oxygen absorption corrosion
- Differential aeration corrosion
- Galvanic corrosion and its control, including the galvanic series
- Corrosion in microelectronic devices
- Factors influencing corrosion
- Electroplating and electroless plating

Description:

This unit introduces the fundamentals of corrosion, its mechanisms, and various forms. It also covers methods for controlling corrosion through surface coatings.

Examples/Applications/Case Studies:

- Corrosion of metals in acidic medium
- Water drop experiment
- Corrosion of bolts and nuts fitted to wooden structures
- Practical examples of corrosion in electronic and electrical devices

Exercises/Projects:

- Identify practical corrosion processes, determine their forms, and propose appropriate control methods
- Determine corrosion rates of different metal in any specific corrosive medium

Learning Outcomes:

- Describe the principles and various forms of corrosion
- Explore the mechanistic aspects of corrosion processes
- Predict the probable causes of corrosion and identify suitable methods to minimize it

Specific Resources:

- https://pesjournal.net/journal/v3-n1/2.pdf
- https://www.researchgate.net/publication/275028997_Corrosion_and_Corrosion_Control

Unit 4: Chemistry of Electrical and Electronic Materials

Contents

- Conducting polymers: Types of conducting polymers, mechanisms of conduction in undoped, doped polyacetylene and engineering applications of conducting polymers.
- Other materials of conduction: Production of electronic grade silicon from quartz and its applications, metal compounds as semiconductors, applications of carbon nanotubes and graphene in electrical and electronic industry.

Description:

This unit focuses on the chemistry of electrical and electronic materials with reference to their structural changes during conduction. It also includes applications of silicon, metal compounds and nanomaterials in electrical and electronic engineering.

Examples/Applications/Case Studies:

- Practical examples of conducting polymers and their applications
- Illustrations of application of conducting polymers in electrical and electronic applications.

Exercises/Projects:

- Comparison of conductivities of different types of materials such as polymers, pure elements, and nano materials.
- Preparation of a report on the conduction performance of solid conducting materials

Learning Outcomes:

- Understand the chemical structural changes in materials that lead to variation of conductivity.
- Explore different steps involved in the production of silicon from quartz
- Select appropriate materials for specific applications in electrical and electronic industry.

Specific Resources:

- https://pubs.rsc.org/en/content/articlehtml/2021/ra/d0ra07800j
- https://nanografi.com/blog/application-areas-of-nanotechnology-in-display-and-communication-technology/

Unit 5: Analytical Instrumentation Techniques

Contents

- Electromagnetic spectrum, Interaction of radiation with matter.
- UV-Visible spectroscopy: principle, electronic transitions, various shifts in UV-Visible spectroscopy, Lambert-Beer's law, Instrumentation, qualitative and quantitative applications of UV-Visible spectroscopy.
- Infrared spectroscopy: principle, types of vibrations, selection rule for vibrations in diatomic molecules, Instrumentation, qualitative and quantitative applications of IR spectroscopy.

Description:

This unit explores the principles, instrumentation and applications of spectroscopic techniques such as UV-Visible spectroscopy and Infrared spectroscopy.

Examples/Applications/Case Studies:

- Practical applications of Lambert-Beer's law
- Comparison of the two instrumental techniques namely UV-Visible and IR spectroscopy with reference to their principles and applications.

Exercises/Projects:

- Verification of the Lambert-Beer's law with different solutions
- Determination of wavelength (max) of different organic compounds using UV-Visible spectrophotometer, and comparing the values with literature reported values.
- Determination of wavelength (max) of different coloured compounds using colorimeter, and comparing the values with literature reported values.

Learning Outcomes:

- Understand the principles of spectroscopic techniques and instrumentation involved in each technique
- Explore the role of each component in the instrumentation of the selected analytical techniques
- Apply the knowledge of principles and instrumentation of the analytical techniques for their suitable applications

Specific Resources:

- https://personal.utdallas.edu/~goeckner/plasma_tech_class/AgilentSpectroPub4.pdf
- https://personal.utdallas.edu/~scortes/ochem/OChem_Lab1/recit_notes/ir_presentation.pdf

Textbook(s) / Reference(s):

Textbooks:

1. Ramesh, S. (2013). *Engineering chemistry* (2nd ed.). Wiley India.
2. Shikha Agarwal, (2015). *Engineering chemistry: fundamentals and applications* (1st ed.). Cambridge University Press.
3. Jain, P.C. (2018). *Engineering chemistry* (17th ed.). Dhanpat Rai.

References:

1. Prasantha Rath, & Aruna Kumari, S. (2023). *Engineering chemistry* (1st ed.). Cengage.
2. Arun Bahl, Bahl, B. S., & Tuli, G. D. (2020). *Essentials of physical chemistry* (28th ed.). S. Chand.
3. Haghi, A. K., Mercader, A. G., Balkoese, D., & Mukbaniani, O. V. (2021). *Applied chemistry and chemical engineering*, (1st ed.). CRC Press, Taylor & Francis Group.
4. Skoog, D. A., West, D. M., Holler, F. J., & Crouch, S. R. (2022). *Fundamentals of analytical chemistry* (10th ed.). Cengage.
5. Fontana, M. G. (2017). *Corrosion engineering* (3rd ed.). McGraw-Hill Education.
6. Swaminathan, P. (2017). *Semiconductor materials, devices, and fabrication*. Wiley.
7. Banwell, C. N., & McCash, E. M. (2017). *Fundamentals of molecular spectroscopy* (4th ed.). McGraw-Hill Education.

Mapping of Course Outcomes to Program Outcomes:

(**H**=high; **M**=medium; **L**=low)

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1	H	L	M									
CO2	H		M		L							
CO3	H	M	L									
CO4	H		M		L							
CO5	H	M		L								

24CY103 **Chemistry for Engineers**

(For CE and ME branches only)

Category: Basic Sciences (BS) **3L 0T 0P 3C**

***Pre-requisite*: 10+2 Chemistry**

Course Description:

The course is designed for Civil and Mechanical Engineering first year students, providing essential and applied knowledge of Chemistry relevant to their fields. Understanding the specific application of materials based on their characteristic properties, which are determined by their structural and bonding aspects, is crucial for appropriate utilization. With this focus, the course covers the working principles of electrodes, sensors, batteries, and fuel cells, applying principles of electrochemistry. Additionally, it delves into the mechanistic aspects of lubricants and the composition of cement, concrete, composites, refractories, glasses, and alloy steels. Furthermore, the course emphasizes the principles and control methods of corrosion in various metal structures.

Course Aims and Objectives:

1. Impart knowledge on the functioning of electrodes, batteries and fuel cells, grounded in electrochemical principles.
2. Analyse various corrosion processes and propose control methods based on corrosion principles.
3. Discuss structural and compositional aspects of engineering materials such as polymers, glasses, and alloy steels.
4. Explore the composition, nature, properties, and applications of different types of cements, concrete, and refractories.
5. Explain the mechanisms and properties of lubricants, and the composition of composite materials, highlighting their engineering applications.

Course Outcomes:

At the end of the course, the student will be able to...

CO1: apply the knowledge of basic electrochemistry principles to electrodes, batteries and fuel cells **[K3]**.

CO2: analyse various corrosion processes and control methods **[K4]**.

CO3: analyse the dependence of applications of polymers, glasses and alloy steels on their composition, bonding and structures **[K4]**.

CO4: correlate the characteristic features of cements, concrete and refractories with chemical composition and chemical reactions involved **[K4]**.

CO5: apply the chemical aspects of lubricants and composite materials to assess their engineering applications **[K3]**.

Course Structure:

Unit 1: Electrochemistry

Contents

- Electrodes, electrode potentials and electrochemical cells
- The Nernst equation with numerical problems for calculating electrode potential and emf
- Reference electrodes – Calomel and Ag/AgCl electrodes, Ion-selective electrodes, glass electrode - construction, working, advantages, and disadvantages
- Conductometric analysis (acid-base reactions)
- Batteries, with a focus on lithium-ion ($LiCoO_2$) battery
- Fuel cells, specifically the hydrogen-oxygen fuel cell

Description:

This unit covers the fundamentals of various electrodes, sensors, batteries, and fuel cells, focusing on their working principles and applications.

Examples/Applications/Case Studies:

- Determination of pH using glass electrode
- Analysis of various parameters of water and soil using electrodes

Exercises/Projects:

- Numerical problems based on calculation of emf of cells using Nernst equation
- Conductometric titrations with examples of acid-base reactions

Learning Outcomes:

- Understand the working mechanisms of various electrodes and the chemical reactions involved
- Explore the electrochemical principles underlying the operation of sensors and batteries
- Select appropriate electrodes, batteries, fuel cells, and sensors for specific applications in their respective fields

Specific Resources:

- https://www.sciencedirect.com/topics/chemistry/electrochemistry
- https://chem.libretexts.org/Bookshelves/General_Chemistry/Map%3A_Chemistry
- 20.7: Batteries and Fuel Cells - Chemistry LibreTexts

Unit 2: Corrosion and its control

Contents

- Introduction to corrosion and its causes
- Electrochemical corrosion: hydrogen evolution and oxygen absorption corrosion
- Differential aeration corrosion
- Scaling and corrosion in boilers and their control
- Galvanic corrosion and its control, including the galvanic series
- Surface coatings: types of metallic coatings
- Hot dipping processes: galvanizing and tinning

Description:

This unit introduces the fundamentals of corrosion, its mechanisms, and various forms. It also covers methods for controlling corrosion through surface coatings, such as hot dipping.

Examples/Applications/Case Studies:

- Corrosion of metals in acidic medium
- Water drop experiment
- Corrosion of bolts and nuts fitted to wooden structures

Exercises/Projects:

- Identify practical corrosion processes, determine their forms, and propose appropriate control methods
- Determine corrosion rates of different metal in any specific corrosive medium

Learning Outcomes:

- Describe the principles and various forms of corrosion
- Explain the mechanistic aspects of corrosion processes
- Predict the probable causes of corrosion and identify suitable methods to minimize it

Specific Resources:

- https://pesjournal.net/journal/v3-n1/2.pdf
- https://www.researchgate.net/publication/275028997_Corrosion_and_Corrosion_Control

Unit 3: Polymer Chemistry, Glasses and Alloy Steels

Contents

- Polymer chemistry: Introduction, types of polymerization, thermoplastics and thermosetting plastics, preparation, properties and applications of PVC, Nylon-6,6, Urea-formaldehyde and Polyurethane.
- Glasses: Composition, types of glasses, properties and engineering applications.
- Alloy Steels: Types of steels, specific effects of alloying elements, industrial applications of alloy steels.

Description:

This unit explores materials such as polymers, glasses and alloy steels, focusing on the interrelation between their structures, bonding, and composition with their properties and applications in engineering domains.

Examples/Applications/Case Studies:

- Applications of polymers and glasses in the preparation of composites
- Examples of different steels and other alloys used in the construction industry and other applications.

Exercises/Projects:

- Analyse industrial applications of alloy steels in different sectors such as aerospace, automotive, construction, and manufacturing.
- Alloy steel sustainability assessment: Investigate the environmental impact of alloy steel production and use life-cycle assessment (LCA) methodologies to evaluate the sustainability of different alloy steels.

Learning Outcomes:

- Differentiate between different types of polymers, glasses, and alloy steels
- Investigate the correlation between the structural characteristics of these materials and their respective properties
- Analyse and select the most appropriate polymers, glasses, and alloy steels for specific engineering applications within their domain.

Specific Resources:

- https://www.snexplores.org/article/explainer-what-are-polymers
- https://books.google.co.in/books/about/Glass_Chemistry.html?id=2yTyCAAAQBAJ&redir_esc=y
- https://kdmfab.com/alloy-steel/

Unit 4: Chemistry of Cement and Refractories

Contents

- Cement: Composition, manufacture of Portland cement, setting and hardening of cement and chemical reactions involved, concrete and RCC, reactions involved in corrosion of reinforcement steel, degradation and protection of concrete.
- Refractories: Classification and properties – refractoriness, RUL test, porosity, and applications of refractories.

Description:

This unit focuses on the chemistry involved in cement and refractory materials, covering their composition, manufacturing processes, setting and hardening mechanisms, properties and various applications of refractory materials.

Examples/Applications/Case Studies:

- Various concrete compositions tailored for different structural types
- Real-world instances illustrating the corrosion of reinforcement steels embedded in concrete
- Discuss the environmental impacts and sustainability considerations associated with cement production
- Examine case studies of corrosion-related failures in reinforced concrete structures, such as parking garages, marine structures, and highway bridges.

Exercises/Projects:

- Analyse the composition of Portland cement and compare it with other types of cement (e.g., slag cement, fly ash cement)
- Investigate the electrochemical reactions involved in the corrosion of reinforcement steel in concrete, including the formation of rust and the role of chlorides and carbonation

Learning Outcomes:

- Describe the chemical composition and reactions occurring in cement, concrete, and refractories
- Investigate the correlation between material strength and other properties with the chemical makeup of these materials
- Select suitable cement, concrete, and refractory materials for specific construction applications based on their compositions and properties

Specific Resources:

- https://www.mdpi.com/2076-3417/13/1/203
- https://www.rhimagnesitaindia.com/blog/major-types-of-refractories,-characteristics,-and-their-applications-/26

Unit 5: Lubricants and Composite Materials

Contents

- Lubricants: Friction and effects of frictional heat, lubricants, mechanisms of lubrication, types of lubricants based on physical state, properties of lubricants – viscosity, flash and fire points, mechanical stability.
- Composite materials: Constituents of composites, types of composites and engineering applications of composites.

Description:

This unit delves into necessity of lubricants and composite materials, emphasising their chemical compositions. It offers insights into the mechanistic workings of lubricants, along with a comprehensive study of various types, properties, and applications of both lubricants and composite materials.

Examples/Applications/Case Studies:

- Practical applications of composite materials
- Real-world applications of lubrication in different machinery

Exercises/Projects:

- Friction and heat effects experiment: Design and conduct an experiment to investigate the effects of frictional heat on different surfaces.
- Conduct research on various types of lubricants based on their physical state and prepare a report or presentation comparing their properties, advantages, and applications in different industries.
- Preparation of a presentation discussing different types of composites such as polymer matrix composites (PMCs), metal matrix composites (MMCs), and ceramic matrix composites (CMCs), and include examples of engineering applications for each type of composite.

Learning Outcomes:

- Describe the mechanisms of lubrication and delve into the chemical composition of lubricants and composite materials
- Investigate the diverse properties exhibited by lubricants and composites
- Utilise the understanding of the chemistry behind lubricants and composite materials to accurately evaluate their suitability for industrial applications

Specific Resources:

- https://tameson.com/pages/lubricants
- https://www.toppr.com/guides/geography/mineral-and-energy-resources/composite-materials-definition-and-its-types/

Textbook(s) / Reference(s):

Textbooks:

1. Ramesh, S. (2013). *Engineering chemistry* (2nd ed.). Wiley India.
2. Shikha Agarwal, (2015). *Engineering chemistry: fundamentals and applications* (1st ed.). Cambridge University Press.
3. Jain, P.C. (2018). *Engineering chemistry* (17th ed.). Dhanpat Rai.

References:

1. Prasantha Rath, & Aruna Kumari, S. (2023). *Engineering chemistry* (1st ed.). Cengage.
2. Arun Bahl, Bahl, B. S., & Tuli, G. D. (2020). *Essentials of physical chemistry* (28th ed.). S. Chand.
3. Billmeyer Jr, F. W. (2007). *Textbook of polymer science* (3rd ed.). John Wiley & Sons.
4. Haghi, A. K., Mercader, A. G., Balkoese, D., & Mukbaniani, O. V. (2021). *Applied chemistry and chemical engineering*, (1st ed.). CRC Press, Taylor & Francis Group.
5. Skoog, D. A., West, D. M., Holler, F. J., & Crouch, S. R. (2022). *Fundamentals of analytical chemistry* (10th ed.). Cengage.
6. Fontana, M. G. (2017). *Corrosion engineering* (3rd ed.). McGraw-Hill Education.
7. Taylor, H. F. W. (1997). *Cement chemistry* (2nd ed.). Thomas Telford.

Mapping of Course Outcomes to Program Outcomes:

(**H**=high; **M**=medium; **L**=low)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	H	L	M									
CO2	H	M	L									
CO3	H		M	L								
CO4	H		M	L								
CO5	H		M	L								

24BY101 **Biology for Engineers**

Category: Basic Sciences (BS) **3L 0T 0P 3C**

Pre-requisite: 10 + 2 Science

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

CO1: demonstrate a fundamental understanding of basic biological principles, such as cell biology, genetics, and physiology, and their application in engineering contexts.

CO2: analyse and evaluate biomaterials based on their mechanical properties and design biomedical devices using biomechanical principles.

CO3:apply bio-inspired design principles and synthetic biology techniques to propose innovative engineering solutions and understand their practical applications in biotechnology.

CO4: develop proficiency in using bioinformatics tools, constructing computational models, and applying systems biology approaches to study and interpret biological data and systems.

CO5: critically analyse and evaluate current research trends and innovations in advanced areas of biological engineering, demonstrating the ability to apply advanced concepts in real-world engineering scenarios.

COURSE CONTENTS:

Unit 1: Introduction to Biology for Engineers

- Overview of interdisciplinary nature and importance of biology for engineers
- Basic biological concepts relevant to engineering applications
- Introduction to engineering challenges addressed by biology-inspired solutions
- Introduction to the structure and functions of Biomolecules

Unit 2: Biomaterials and Biomechanics

- Properties and applications of biomaterials in engineering (e.g., tissue engineering, drug delivery systems)
- Biomechanical principles applied to engineering (e.g., mechanics of bones and joints, biomechanics of tissues)
- Case studies: Design and development of biomaterials for medical implants, prosthetics, and tissue engineering

Unit 3: Bio inspired Design, Synthetic Biology and Biotechnology

- Introduction to bioinspired design, biomimicry, synthetic biology and genetic engineering(Genetically modified Crops & Animals)
- Examples of biological systems inspiring engineering innovations (e.g., bird flight, gecko adhesion, shark skin, human eye camera)
- Applications of biotechnology in engineering (e.g., bioprocessing, bioremediation, biosensors)
- Case studies: Biomimetic design in robotics, materials science, architecture, Development of biofuels, bioplastics, and biopharmaceuticals

Unit 4: Bioinformatics and Systems Biology

- Introduction to bioinformatics tools and databases
- Engineering applications of bioinformatics (e.g., genome sequencing, protein structure prediction, drug discovery)
- Systems biology approaches to understanding complex biological systems and networks

- Case studies: Computational modelling of biological systems, personalized medicine, and synthetic biology

Unit 5:Advanced Topics in Biology for Engineers

- Emerging trends and cutting-edge research in biology for engineers
- Advanced applications and case studies in specific engineering fields (e.g., nanotechnology, energy, environmental engineering)
- Ethical considerations(Bio-Safety) and societal implications (Biopiracy & Biopatent)

Textbook(s) / Reference(s):

Textbooks:

1. Johnson, A. T. (2011). Biology for Engineers. CRC Press.

2. Renneberg, R. (2017). Biotechnology for Engineers: Biological Processes and Technologies (1st ed.). Elsevier.

3. Mount, D. W. (2004). Bioinformatics: Sequence and Genome Analysis (2nd ed.). Cold Spring Harbor Laboratory Press.

References:

1. Enderle, J., & Bronzino, J. (2011). Introduction to Biomedical Engineering (3rd ed.). Academic Press.

2. Ratner, B. D., Hoffman, A. S., Schoen, F. J., & Lemons, J. E. (2012). Biomaterials Science: An Introduction to Materials in Medicine (3rd ed.). Academic Press.

3. Benyus, J. M. (2002). Biomimicry: Innovation Inspired by Nature. Harper Perennial.

Gr. Indusree

S. Srinivas

COURSE CODE: 24CS102
PROGRAMMING USING C

Course Category:	Engineering Science (ES)	**Credits:**	3
Course Type:	Theory	**Lecture -Tutorial-Practice:**	3-0-0
Pre-requisites:		**Continuous Evaluation:** **Semester end Evaluation:** **Total Marks:**	40 60 100

Course Description

This course introduces foundational programming concepts, covering algorithms, flowcharts, and pseudo code. It explores the C language structure, data types, operators, control structures, loops, arrays, strings, and functions. Advanced topics include pointers, dynamic memory allocation, structures, unions, enumerations, and file handling. Students gain hands-on experience with inter-function communication, recursion, sorting/searching techniques, and memory management. The course emphasizes practical coding skills, problem-solving, and program design, providing a solid foundation for software development using the C language.

Course Objectives

- *To introduce students to the fundamentals of computer programming.*
- *To provide hands-on experience with coding and debugging.*
- *To foster logical thinking and problem-solving skills using programming.*
- *To familiarize students with programming concepts such as data types, control structures, functions, and arrays.*
- *To encourage collaborative learning and teamwork in coding projects.*
- *To evaluate and apply C programming techniques proficiently for searching and sorting.*

Course Outcomes

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

	Course Outcomes	BTL	POI
CO1	Understand fundamental programming concepts in C through algorithms, flowcharts, and selection statements.	K2	1.7.1,2.5.1, 2.5.2, 2.7.1
CO2	Develop efficient C programs using loops, arrays, and strings using control structures.	K3	1.7.1,2.5.1, 2.5.2, 2.6.3,3.5.1
CO3	Implement modular C programs using functions, pointers, and memory optimizations.	K3	1.7.1, 2.5.2, 2.6.3, 3.5.1, 5.4.1
CO4	Develop C programs using structures and unions for user defined data types.	K3	2.5.2, 2.6.3,3.5.1
CO5	Analyze the use of enumerations and file handling techniques in C to manage data efficiently and solve real-world programming problems.	K4	1.7.1,2.5.1, 2.5.2, 2.6.3,3.5.1

Contribution of Course Outcomes towards achievement of Program Outcomes

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1	3	2												
CO2	3	3	2										2	2
CO3	2	2	2		2								2	2
CO4	2	2	2										2	2
CO5	2	2	2										2	2

(1- Low, 2 - Medium, 3 – High)

Unit-I : Introduction to C & Problem solving

Introduction to the C Language: Introduction to Programming Languages, Basics of a Computer Program, Algorithms, flowcharts (Using Dia Tool), pseudo code. Introduction to Compilation and Execution, Background of C program, Identifiers, Types, Variables, Constants, Memory Layout, Input/Output, Programming Examples.

Structure of a C Program: Logical Data and Operators, Expressions, Precedence and Associatively, Evaluating Expressions, Type Conversion, Statements, Storage Class.

Selection: Two-way Selection, Multiway selection, More Standard Functions.

Unit-II: Repetition, Arrays & Strings

Repetition: Concept of Loops in C, Loop Examples, the Calculator Program.

Arrays: Array Concepts in C, Inter-Function Communication, Array Applications, One Dimensional Arrays, Linear Search and Binary Search Techniques, Selection Sort, Bubble Sort, Two Dimensional Arrays, Multidimensional Arrays.

Strings: String Concepts, C Strings, String Input/output Functions, Arrays of Strings, String Manipulation Functions, String- Data Conversion.

Unit-III: Functions, Pointers & Memory Allocations

Functions: Functions in C, User Defined Functions, Call by Value, Call Value Reference, Inter-Function Communication, Standard Functions, Scope, Recursion and advantages.

Pointers: Introduction to Pointers, Pointers for Inter-Function Communications, Pointers to Pointers, Compatibility, Lvalue and Rvlaue. Arrays and Pointers, Pointers Arithmetic and Arrays, Passing an Array to a Function, Array of Pointers.

Memory Allocation: Need of dynamic memory allocation, malloc(), calloc(), free(), realloc(), NULL, Stack vs. Heap Allocation.

Unit-IV: Structures & Unions

Structures: Structure Type Declaration, Initialization, Accessing Structures, Operations on Structures, Complex Structures, Structures and Functions, Sending the Whole Structure, Passing individual structure members, passing structure via pointer, nested structure.

Unions: Referencing Unions, Initializers, Unions and Structures, Internet Address, Programming Applications.

Unit-V: Enumerations & Files

Enumerations: The Type Definition (Typedef), Enumerated Types: Declaring an Enumerated Type, Operations on Enumerated Types, Enumeration Type Conversion, Initializing Enumerated Constants, Anonymous Enumeration: Constants, Input/Output Operators.

Files: introduction to the files, Uses of Files, Text files Vs. Binary files, Opening and closing FILE , Modes of FILE operation, Command line arguments, Standard Library Input /Output functions ,Character i/o functions, File Handling functions.

Text Books:

1. "The C Programming Language", Brian W. Kernighan and Dennis M. Ritchie, Prentice-Hall, 1988
2. Behrouz A. Forouzan and Richard F. Gilberg, "Computer Science A Structured Programming Approach Using C", CENGAGE Learning, Third Edition.
3. Schaum's Outline of Programming with C, Byron S Gottfried, McGraw-Hill Education, 1996

Reference Books:

1. Computing fundamentals and C Programming, Balagurusamy, E., McGraw-Hill Education, 2008.
2. Programming in C, Rema Theraja, Oxford, 2016, 2nd edition
3. C Programming, A Problem Solving Approach, Forouzan, Gilberg, Prasad, CENGAGE, 3rd edition
4. Horowitz Sahni and Anderson-Freed, "Fundamentals of Data Structures in C", 2nd edition, Universities Press, 2011

Web Resources:

1. NPTEL, "NOC: Introduction to Programming in C," [Online]. Available: https://nptel.ac.in/courses/106/104/106104128/. [Accessed: Feb. 25, 2025].
2. Coursera, "C for Everyone: Structured Programming," [Online]. Available: https://www.coursera.org/learn/c-structured-programming/. [Accessed: Feb. 25, 2025].
3. GeeksforGeeks, "Arrays, Pointers and Functions in C," [Online]. Available: https://www.geeksforgeeks.org/arrays-and-pointers-functions-in-c/. [Accessed: Feb. 25, 2025].
4. GeeksforGeeks, "C Enumerations," [Online]. Available: https://www.geeksforgeeks.org/enumeration-enum-c/. [Accessed: Feb. 25, 2025].

5. Codeforwin, "Understanding malloc, calloc, realloc, and free," [Online]. Available: https://codeforwin.org/2018/07/malloc-calloc-realloc-free-functions-c-programming.html. [Accessed: Feb. 25, 2025].
6. GeeksforGeeks, "Unions in C," [Online]. Available: https://www.geeksforgeeks.org/union-c/. [Accessed: Feb. 25, 2025].
7. Programiz, "Structures in C," [Online]. Available: https://www.programiz.com/c-programming/c-structures. [Accessed: Feb. 25, 2025].
8. TutorialsPoint, "Formatting Input/Output Functions and Character Input/Output Functions," [Online]. Available: https://www.tutorialspoint.com/cprogramming/c_file_io.htm. [Accessed: Feb. 25, 2025].
9. Programiz, "Command-Line Arguments," [Online]. Available: https://www.programiz.com/c-programming/c-command-line-arguments. [Accessed: Feb. 25, 2025].
10. W3Schools, "C Programming Language," [Online]. Available: https://www.w3schools.com/c/index.php. [Accessed: Feb. 25, 2025].

COURSE CODE: 24CS181
PROGRAMMING USING 'C' LAB

Course Category:	Engineering Science (ES)	**Credits:**	1.5
Course Type:	Practical	**Lecture -Tutorial-Practice:**	0-0-3
Pre-requisites:		**Continuous Evaluation:** **Semester end Evaluation:** **Total Marks:**	60 40 100

Course Description

This hands-on course introduces students to the foundational principles of the C programming language, integrating essential Linux command-line skills and compiler tools such as GCC and Turbo C. The course emphasizes problem-solving, logical thinking, and algorithm development. Students will work through a structured progression from simple input/output to complex file operations and data structures, including practical projects and assignments.

Course Objectives

The primary objective of this C Programming Lab course is to provide hands-on practical experience in writing, debugging, and executing C programs. It aims to develop students' understanding of fundamental programming concepts such as input/output operations, control structures, arrays, strings, functions, and pointers through practical exercises. By the end of the course, students will be proficient in using essential C programming tools, developing logical problem-solving skills, and applying programming concepts to build efficient programs in a Linux environment using compilers like Turbo C and GCC.

Course Outcomes

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

	Course Outcomes	BTL	POI
CO1	Understand basic Linux shell commands to compile and run C programs using GCC.	K2	1.7.1,2.5.1, 2.5.2, 2.7.1
CO2	Select the right control structure for solving the problem.	K3	1.7.1, 2.5.1,2.5.2, 2.6.3,3.5.1
CO3	Develop C programs which utilize memory efficiently using programming constructs like pointers.	K3	1.7.1, 2.5.2, 2.6.3,3.5.1 5.4.1
CO4	Develop, Debug and Execute programs to demonstrate the applications of arrays, functions, basic concepts of pointers in C.	K3	2.5.2, 2.6.3,3.5.1
CO5	Analyze the use of enumerations and file handling techniques in C to manage data efficiently and solve real-world programming problems.	K4	1.7.1, 2.5.1,2.5.2, 2.6.3,3.5.1

Contribution of Course Outcomes towards achievement of Program Outcomes

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1	2	2												
CO2	3	2	3										2	2
CO3	3	2	3		2								2	2
CO4	3	2	3										2	2
CO5	2	3	3										2	2

(1- Low, 2 - Medium, 3 – High)

Course Content:

WEEK- 1

1. Basic Linux environment and its editors like Vi, Vim & Emacs etc.

2. Exposure to Turbo C, gcc

3. Write a C program to print the following output Input:

Enter a Character: *
Enter a Number: 1
Output:

```
* * * * * * *
*       1     *
*       1     *
*       1     *
*       1     *
*     1 1 1   *
* * * * * * *
```

4. Write a C program that takes two numbers and an arithmetic operator (+, -, *, or /) as input from the user using scanf(), performs the corresponding operation, and displays the result using printf().

5. Write a C program that reads two numbers from the user using `scanf()`, and then swaps their values using both methods:

1. With a third variable
2. Without using a third variable

Finally, display the swapped values using `printf()`.

6. Declare three variables of integer data type. User has to input three valid numbers. Display Sum and average of user entered numbers.
Approach is to take three numbers and find their sum and average using the formula given below-

Sum: a+b+c
Average: (a+b+c)/3
Where a,b,c are the three numbers.
Sample Input:
Enter 3 Values: 10 20 30
Sample Output: Sum: 60 Average: 20

WEEK-2

1. Input the temperature in Fahrenheit and output the equivalent temperature in Celsius and Vice – Versa. Input two numbers. The first is for a Celsius value, and the second is for a Fahrenheit value. Input Celsius value, convert it to Fahrenheit. Use the formula F = C*9/5 + 32 for conversion. In case of decimals, show up to 1 decimal value.
Input the Fahrenheit value, convert it to Celsius.
Use the formula C= (F−32)×5/9 for conversion. In case of decimals, show up to 1 decimal value.
Sample Input: 0 100
Sample Output: 32 37.7

2. You can calculate a Simple Interest by just providing the Principle Amount, Rate of Interest and Time or Periods provided by the user input. We can calculate the Simple Interest by the using the below Formula.

Simple Interest = (Principal*Rate*Time)/100

Principal (P): The principal is the amount that was initially borrowed (loan) from the bank or invested.

Rate (R): It is the rate of interest at which the principal amount is given to someone for a certain time; the rate of interest can be 5%, 10%, or 13%, etc.

Time (T): Time is the duration for which the principal amount is given to someone.

Constraints: 1<=Principal<=10000 1<=Rate<=10

1<=T<=30

Sample Input: 100 3 10

Sample Output: 30

3. You are working on a program that tracks the daily sales of a small bookstore. The owner wants to calculate the total sales and average sales for three consecutive days to better understand business trends. Write a program that takes the sales figures for three days as input, calculates the total sales, and finds the average sales. How will you implement this in C?

4. Write a C program to evaluate and display the result of the following expressions. Use the given variable declarations and initialize them with appropriate values. Also, print the results of each expression.

- A+B*C+(D*E) + F*G
- A/B*C-B+A*D/3
- A+++B---A
- J= (i++) + (++i)

5. Write a C program to calculate electricity bill according to the given condition:

For first 50 units Rs. 0.50/unit

For next 100 units Rs. 0.75/unit

For next 200 units Rs. 1.20/unit

For unit above 250 Rs. 1.50/unit

An additional surcharge of 20% is added to the bill.

WEEK- 3

1. To find factorial of the any given positive number. The factorial of a positive number n is given by: 1*2*3*4 ...Note: This program should take a positive integer from the user as the factorial of a negative number doesn't exist and, the factorial of 0 is 1. Compute the factorial using any loop. Since the factorial of a number
may be very large, the type of factorial variable is declared as unsigned long. If the user enters a negative number, the program should display a custom error message.

2. Input a number, check the given number is a prime or not. A prime number should be a natural number greater
than 1 that has no positive divisors other than 1 and itself.
Test Data and Output: Enter n: 5
Output: Prime
Enter n: 6
Output: Not Prime

3. Checking a number palindrome. Number should be a positive integer having more than one digit as all the single digits are palindromes.
Test Data and output:
Input : 2002 Input: 1234
Output: true Output: false

4. Construct a pyramid of numbers. A pyramid of numbers represents the number of individuals per unit area of various trophic areas where producers are kept at the base and the tip is occupied by top carnivores.

The pyramid of numbers is mostly upright. The members of successive higher trophic levels are higher than the previous one.

1. A higher trophic level has fewer individuals than that of the lower trophic levels.

1

2 2 2

3 3 3 3 3

4 4 4 4 4 4 4

5 5 5 5 5 5 5 5 5

5.Develop a C program that takes an integer as input from the user and prints 'Yes' if the number is an Armstrong number, and 'No' otherwise.(This adds specific input/output requirements.)

WEEK- 4

1. Write a C program to delete all duplicate elements from an array.
The program should:

- Ask the user to enter the number of elements in the array.
- Accept the array elements from the user.
- Remove all duplicate values from the array.
- Display the new array with only unique elements.

2. Write a C program to insert an element into a specific position in an array.
The program should:

- Ask the user to enter the size of the array and its elements.
- Ask the user to enter the element to insert and the position at which it should be inserted.
- Insert the element at the specified position by shifting the existing elements.
- Display the updated array.

3. Find 2's complement of the given binary number.
To get 2's complement of a binary number, simply invert the given number and add 1 to the least significant bit (LSB) of given result.
Test Data and Output:
Find 2's complement of binary number 10101110.
Simply invert each bit of given binary number, which will be 01010001. Then add 1 to the LSB of this result, i.e., 01010001+1=01010010 which is answer.
Find 2's complement of binary number 10001.001.
Simply invert each bit of given binary number, which will be 01110.110 Then add 1 to the LSB of this result, i.e., 01110.110+1=01110.111 which is answer.

4. Write a C program to sort array elements in ascending or descending order.

5. Given an array of integers **nums** and an integer **target,** return indices of the two numbers such that they add up to target. You may assume that each input would have exactly one solution and you may not use the same element twice. You can return the answer in any order.
Sample Input:
Enter the size of an array: 4
Enter array elements: 2 7 11 15
Enter target: 9
Output: [0,1]

WEEK- 5

1. A matrix can only be added to another matrix if the two matrices have the same dimensions. To add two matrices, just add the corresponding entries, and place this sum in the corresponding position in the matrix which results.
Input elements in 3x3 matrix1: 1 2 3
4 5 6
7 8 9
Input elements in 3x3 matrix2: 9 8 7
6 5 4
3 2 1
Sum of both matrix = 10 10 10
10 10 10
10 10 10

2. Matrix multiplication is a binary operation that produces a matrix from two matrices. For matrix multiplication, the number of columns in the first matrix must be equal to the number of rows in the second matrix. The resulting matrix, known as the **matrix product**, has the number of rows of the first and the number of columns of the second matrix. The product of matrices **A** and **B** is denoted as AB.

3. Concatenate two strings without using built-in functions
Note: User would be asked to enter two strings and then the program would concatenate them. For concatenation we have not used the standard library function strcat(), instead we have written a logic to append the second string at the end of first string.
Test Data and Output:
Str1: Good Str2: Morning Output: Good Morning

4. Reverse a string using built-in and without built-in string functions
Using built-in function: The function is used for reversing a string. The reversed string will be stored in the same string.

5. Input two strings **str1** in lowercase, **str2** in uppercase. Print the lower case string **str1** in uppercase and the uppercase string **str2** in lowercase.

WEEK- 6

1. Write a C program using a user-defined function to find the biggest number given any three numbers.

2. Write a **C program** to calculate the **factorial of a given number** using recursion. The program should prompt the user to enter a number and then compute its factorial using a recursive function.

3. Write a **C program** to generate the **Fibonacci series up to N terms** using a recursive function. The program should prompt the user to enter a number **N**, then compute and display the first **N Fibonacci numbers**.

4. Write a **C program** to swap two numbers using **call by value and call by reference**. The program should demonstrate that changes made inside the function do not affect the original values in the main function.

5. How can recursion be used to calculate NCR? Write a C program to demonstrate this.

WEEK- 7

1. String is a sequence of characters. Input two strings str1 and str2. Copy the contents of str1 to str2 using functions and pointers. Define a function copystr() with two pointer arguments copystr(*str1,*str2) Approach :
1. Scan string str from 0 to length-1.
2. check one character at a time based on ASCII values
- if(str[i] >= 65 and str[i] <=90), then it is uppercase letter, .
- if(str[i] >= 97 and str[i] <=122), then it is lowercase letter,
- if(str[i] >= 48 and str[i] <=57), then it is number,
- else it is a special character

3. Print all the counters
Sample Input:
Enter a string: Programming
Sample Output:
String1: Programming
String2: Programming

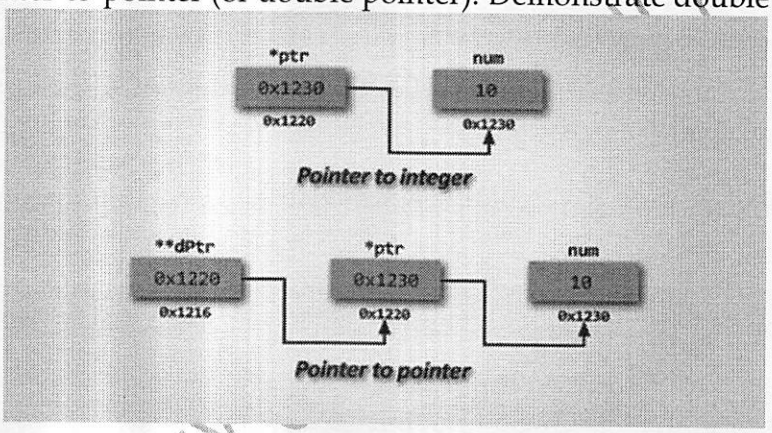
2. Given a string, write a program to count the occurrence of Lowercase characters, Uppercase characters, Special characters, and Numeric values. Define a function to count.
Input : #CseAi01dOr@gAIml07
Output :
Upper case letters : 5
Lower case letters : 8
Numbers : 4

Special Characters : 2
Input : *AiMlC4AiDsS*
Output :
Upper case letters : 6
Lower case letters : 4
Numbers : 1
Special Characters : 2

3. Write a c program to perform simple pointer arithmetic operations in c.

4. Write a c program to find sum of array elements by using array of pointers in c

5. When a pointer holds the address of another pointer then such type of pointer is known as pointer-to-pointer or double pointer. ptr is a normal pointer that holds the address of an integer variable num. There is another pointer **dptr in the diagram that holds the address of another pointer ptr, the pointer dptr here is a pointer-to-pointer (or double pointer). Demonstrate double pointers using the following representation.



WEEK- 8

1. Write a C program to define a structure named Student that contains the following members:

- name (character array)
- rollNumber (integer)
- age (integer)

Using a structures concept, store and display the details of two students.

.

2. Write a C program to define a structure named Student with the following members:

- name (character array) - to store the student's name.
- rollNumber (integer) - to store the roll number.
- marks (array of 3 integers) - to store marks obtained in 3 subjects.

Using an array of structures, read the details of two students from the keyboard. Calculate and display:

- Name of the student
- Roll number

- Marks in 3 subjects
- Total marks obtained

3. Write a C program to define a structure named Book with the following members:
- title (character array) – to store the book's title.
- author (character array) – to store the author's name.
- price (float) – to store the price of the book.

Using an array of structures, read the details of **five books** from the keyboard and display them in a formatted output.

4. Write a C program to define a structure **Student** that includes the following details:
- Name (character array)
- Roll Number (integer)
- Age (integer)
- Date of Birth (another structure with day, month, and year as integers)

Note: Student Details (with Date of Birth as a Nested Structure)

5. Write a C program to define a structure **Employee**, which contains the following details:
- **Employee Name** (character array)
- **Employee ID** (integer)
- **Salary** (float)

Additionally, the structure **Employee** should have a **nested structure Address**, which includes:
- **City** (character array)
- **State** (character array)
- **Pin Code** (integer)

The program should:
- Accept details of an employee, including their address.
- Display the entered details in a proper format.

Write the complete C program, including structure definition, input, and output statements.
Note: Employee Records (with Address as a Nested Structure)

WEEK- 9

1. Write a C program to demonstrate **passing individual structure members** to a function. Define a structure for a student with members: name, roll number, and marks. Pass individual members to a function to display the details.

2. Explain the concept of **passing an entire structure** to a function in C. Write a program to define a structure for an Employee with members: name, ID, and salary. Pass the entire structure to a function to display the details.

3. Define a union Data with members: i (integer), f (float), str (string). Write a program to assign and print values to each member of the union one by one. Observe what happens to the values.

4. Explain the concept of **passing a structure through pointers** in C. Write a program to define a structure for a Student with members: name, roll number, and marks. Pass the address of the structure to a function and display the student details using pointers.

5. Write a C program to **add two complex numbers**.

- Define a **structure** Complex with two members: real (to store the real part)
- imag (to store the imaginary part)
- Take input for two complex numbers from the user.

Perform the addition of the two complex numbers: Add the **real parts** separately.

- Add the **imaginary parts** separately.
- Display the **sum** of the two complex numbers in the form **(a + bi)**.

Sample output:
Enter first complex number: 3 2
Enter second complex number: 1 7
Sum: 4 + 9i

WEEK- 10

1. Write a C program that defines an enumeration for different car brands and asks the user to enter a number. Display the corresponding car brand.

2. Create an enum for traffic signals (Red, Yellow, Green). Write a function that takes an enum value as input and prints its meaning (e.g., Red → Stop).

3. Write a C program to store and process student data using dynamic memory allocation with calloc(). The program should:

- Allow the user to enter the number of students (n).
- Dynamically allocate memory for n students using calloc().
- For each student, input details such as **roll number, name, and marks**.
- Display the list of students who have **failed** (consider marks less than 40 as failed).

4. Write a C program to print the corresponding weekday name for a given integer value (1 to 7) using enumeration constants. The program should define an enum for the weekdays, take an integer input from the user, and display the corresponding weekday name. If the input is out of range, display an appropriate error message.

5. Write a C program to write and read text into a file.The program should prompt the user to enter a string and write it to a text file. Then, it should open the same file, read the content, and display it on the screen.

6. Write a C program to copy the contents of one file to another using command-line arguments. The program should accept the source filename and the destination filename as command-line arguments. It should read the contents from the source file and write them to the destination file. If the source file does not exist or an error occurs, display an appropriate error message.

Web Resources:

1. LinuxCommand.org, "Basic Linux Environment, Editors, Turbo C, GCC," [Online]. Available: https://linuxcommand.org/. [Accessed: Feb. 25, 2025].
2. Programiz, "Pattern Printing & Block Letters in C," [Online]. Available: https://www.programiz.com/c-programming/examples/pattern-printing. [Accessed: Feb. 25, 2025].
3. GeeksforGeeks, "Arithmetic Operations & Swapping Numbers," [Online]. Available: https://www.geeksforgeeks.org/swap-two-numbers-without-using-temporary-variable/. [Accessed: Feb. 25, 2025].
4. CodingCompiler, "Sum and Average of Numbers," [Online]. Available: https://codingcompiler.com/c-program-find-sum-average-three-numbers/. [Accessed: Feb. 25, 2025].
5. TutorialsPoint, "Reading and Printing Multiple Integers," [Online]. Available: https://www.tutorialspoint.com/cprogramming/c_arrays.htm. [Accessed: Feb. 25, 2025].
6. Programiz, "Mixed Data Types Input & Format Specifiers," [Online]. Available: https://www.programiz.com/c-programming/c-input-output. [Accessed: Feb. 25, 2025].
7. GeeksforGeeks, "Files in C," [Online]. Available: https://www.geeksforgeeks.org/basics-file-handling-c/. [Accessed: Feb. 25, 2025].

24ME181 Engineering Graphics

Category: Engineering Sciences (ES) 0L 1T 3P 2.5C

Pre-requisite: Nil

Course Description:

This course introduces students to the principles and practices of engineering graphics using Computer-Aided Design (CAD) tools. This course covers Plane and Descriptive geometry, orthographic and isometric projections. Students will learntocreate, modify, andanalyze2Dand3Ddrawings, focusing onapplications in engineering.

Course Aims and Objectives:

- To familiarize students with CAD software and its application in technical drawing.
- To make students proficient in creating and editing 2D and 3D engineering drawings.
- To teach the drawing of plane curves and their applications
- To explain the projection of points, lines, Planes and solids.
- To enable students to visualize and represent 3D objects through orthographic projections, isometric views and development of surfaces.
- To cultivate skills in preparing engineering drawings following standard conventions and practices.

Course Outcomes:

After completion of the course, students will be able to:

1. Construct plane curves and identify their applications.
2. Draw orthographic projections of points, lines and planes
3. Develop 2D drawings of solids and surfaces.
4. Demonstrate proficiency in creating isometric projections.
5. Identify the 3D objects through orthographic projections.

Course Structure:

Unit 1: Plane Curves

Contents

- Circles, ellipses, parabolas, hyperbolas.
- Involutes, cycloids.

Description

- This unit introduces the different types of plane curves and their construction using CAD tools.

Examples /Applications /Case-studies: Gear profiles, cam profiles, architectural curves.

Exercise/Project Problems: Drawing and dimensioning plane curves using CAD tools.

Learning Outcomes:

- Visualize different plane curves and their applications
- Construct and identify the usage of helical and spiral curves

Unit 2: Projection of Points, Lines, and Planes

Contents

- Orthographic projection fundamentals,
- Projections of points, lines and planes.

Description:

- This unit covers the principles of orthographic projection, projections of points, lines, and planes.

Examples/Applications/Case-studies: Projection of lines and planes in different orientations.

Exercise/Project Problems: Drawing projections of lines and plane surfaces.

Learning Outcomes:

- Represent the points and lines in 3-D space on a 2-D plane
- Identify the plan and elevation of planes in different orientations.

Unit3: Projection of Solids and Development of Surfaces

Contents

- Projections, Section of solids and development of surfaces.

Description:

- This unit provides the techniques for projecting 3D solids on to 2D planes and developing surfaces.

Examples/Applications/Case-studies: Projections of regular solids and their sections, Sheet metal development, pipe fittings.

Exercise/Project Problems: Creating projections and developments using CAD tools.

Learning Outcomes:

- Represent 3-D solids and their sections on a 2-D plane.
- Develop surfaces of complex solids on a 2-D plane.

Unit4: Orthographic Projection

Contents

- Orthographic projection conventions, first angle projections.
- Conversion of Isometric views into orthographic projections

Description:

- This unit covers the principles of orthographic projection and its application in engineering graphics.

Examples/Applications/Case-studies: Manufacturing drawings of engineering components.

Exercise/Project Problems: Creating orthographic projections of simple and complex objects using CAD tools.

Learning Outcomes:

- Represent machine parts in plan and elevation.
- Identify the details of drawings in first angle projections.

Unit5: Isometric Projection

Contents

- Isometric projection principles, isometric views of objects.
- Conversion of orthographic projections into Isometric views

Description:

- This unit focuses on isometric projection and its application in engineering drawings.

Examples/Applications/Case-studies: Isometric views of engineering components.

Exercise/Project Problems: Drawing isometric views using CAD tools.

Learning Outcomes:

- Convert 2-D drawings into a pictorial drawing.

Text Books:

1.Kulkarni,D.M.,Rastogi,A.P.,&Sarkar,A.K.(2009).EngineeringgraphicswithAutoCAD (reviseded.).PHILearningPvt.Ltd.

References/e-Resources:

1. Bethine.A.Fishel,JayD.Helsel, (2014).EngineeringGraphicswithAutoCAD,Pearson Education.
2. CADFolks,(2023).AutoCAD2023forBeginners,CADFolksPublications.

24CY181 Chemistry Lab

Category: Basic Sciences (BS) 0L 0T 2P 1C

***Pre-requisite*: 10+2 Chemistry**

Course Description:

The course is designed for students of B.Tech., providing essential practical knowledge of Chemistry concepts relevant to their fields. This hands-on laboratory course provides the students with practical experience in applied chemical techniques and experiments. The course is useful for students to develop essential skills of proper handling of instruments and apparatus, accurate measurements and recording data, as well as interpretation of data to arrive at the correct conclusion. The course includes the experiments based on different instrumental techniques for the quantitative analysis of different solutions. Also, the course enlightens the students on preparation of polymers, and corrosion related experiments. Further, it focuses on the conventional method of quantitative determination of samples using volumetric method.

Course Aims and Objectives:

1. Enhance understanding of chemical principles involved in instrumental methods of chemical analysis.
2. Develop skills in handling analytical instruments that can measure various chemical parameters.
3. Promote critical thinking and problem-solving through the interpretation of data obtained from the instruments.
4. Familiarize students with advantages and limitations of instrumental methods of analysis compared to conventional volumetric analysis.
5. Explore the practical aspects of chemical processes involved in preparation of polymers, metallic coatings, etc.

Course Outcomes:

At the end of the course, the student will be able to...

CO1: demonstrate a comprehensive understanding of various instrumental methods of chemical analysis [**K3**].
CO2: analyse quantitatively different redox systems and neutralization systems using volumetric analysis [**K4**].
CO3: compare corrosion tendencies of different metals and their protection by surface coatings [**K4**].
CO4: apply theoretical knowledge and skills of preparation of polymers, complexes on substrates, adsorption processes, porosity, viscosity, etc. [**K3**].

Course Structure:

Contents

List of experiments: Following is the list of experiments common to all branches of engineering followed by the specific experiments proposed for different groups of branches:

Experiments common to all branches:

1. Determination of strength of acid in a lead-acid battery
2. Determination of strength of base using pH metric titration
3. Conductometric analysis of a base using a standard acid
4. Determination of ferrous iron by permanganometry
5. Comparison of corrosion rates of different metals/alloys
6. Preparation of Urea-formaldehyde resin
7. Determination of amount of iron in a solution by colorimetry
8. Chemistry of blueprinting
9. Adsorption of acetic acid on charcoal

Experiments for CE and ME branches:

10. Determination of total hardness of a water sample
11. Determination of calcium in Portland cement
12. Determination of porosity of a refractory material
13. Determination of viscosity of lubricating oil by Redwood viscometer

Experiments for ECE, EEE and EIE branches:

10. Determination of ferrous iron by dichrometry
11. Determination of ferrous iron by potentiometry
12. Verification of Lambert-Beer's law
13. Electroplating of copper on iron article

Experiments for CSE, AI and IT branches:

10. Determination of ferrous iron by dichrometry
11. Determination of ferrous iron by potentiometry
12. Conductometric analysis of mixture of acids
13. Preparation of conducting polyaniline from aniline

Textbook(s) / Reference(s):

Textbooks:

1. Mendham, J. (2009). *Vogel's Quantitative Chemical Analysis* (6^{th} ed.). Pearson Education.
2. Theodore, J., & George Pope, F. (2021). *Elementary Practical Chemistry. Inorganic and Organic* (1^{st} ed.). Legare Street Press.

References:

1. Akhil, N., Deepak, L., Atul, B., & Chaudari, P.B. (2023). *Practical Manual of Inorganic, Organic and Medicinal Chemistry* (1^{st} ed.). IP Innovative.
2. Venkateswaran, V. (2012). *Basic Principles of Practical Chemistry* (2^{nd} ed.). S. Chand & Sons.

E-Resources:

1. https://nitm.ac.in/ckfinder/userfiles/files/CY%20151_Labmanual%20Chemistry%20B_Tech%201st%20year.pdf
2. http://icv-au.vlabs.ac.in/inorganic-chemistry/Water_Analysis_Determination_of_Physical_Parameters/
3. http://pcv-au.vlabs.ac.in/physical-chemistry/EMF_Measurement/
4. http://pcv-au.vlabs.ac.in/physical-chemistry/Determination_of_Viscosity_of_Organic_Solvents/
5. http://vlabs.iitb.ac.in/vlabs-dev/labs/nitk_labs/Environmental_Engineering_1/experiments/determination-of-chloride-nitk/simulation.html
6. https://chemcollective.org/vlabs

Mapping of Course Outcomes to Program Outcomes:

(**H**=high; **M**=medium; **L**=low)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	M	H		M	H							
CO2	M	H		M		L						
CO3	M	H			M	L						
CO4	M	H			M							

24ME182 **Workshop Practice**

(for Civil Engineering Students only)

Category: Engineering Science (ES) **0L 0T 3P 1.5C**

Pre-requisite: 10+2 Physics

PART-1: Exercises common to all branches of engineering students

Course Description: (Part-1)

This part of the course provides first-year engineering students with comprehensive hands-on experience in electrical systems, electronics, and computer science fundamentals. The course covers practical exercises in electrical wiring and circuit design, electronics component handling, and computer hardware and software configuration. Students will engage in activities such as electrical switching circuits, distribution board assembly, electronic component identification, and basic IoT (Internet of Things) projects. The course is designed to equip students with essential skills for diagnosing and constructing electrical and electronic systems, as well as understanding computer hardware and IoT applications.

Course Outcomes: (Part-1)

At the end of this part of the course, the student will be able to...

CO1: design, assemble, and test various electrical circuits, including stair case, two-way, and fan connections, and accurately measure electrical parameters such as voltage, current, power, and energy using digital meters.

CO2: identify and use electronic components (resistors, capacitors, diodes, switches) to construct and test a simple calling bell circuit, demonstrating understanding of circuit design and component functionality.

CO3: install and configure peripheral devices on a desktop system and apply basic IoT principles using an Arduino board to measure and interpret environmental data such as temperature, humidity, and distance.

Course Contents: (Part-1)

1. **Electrical Workshop Practice Exercises: (3 hrs)**
    - Stair case/Two-way /Gowdown Switching/Fan connection
    - 3Φ Distribution board with fuse, MCB, two way switches, light indicator,4 switches, fan regulator
    - Measurement of voltage, current, power, Energy by using digital meters

2. **Electronics Workshop Practice Exercises: (1 hr)**
    - Familiarization of electronic components such as resistors, capacitors, diodes, and switches.
    - Preparation of a simple calling bell circuit board and and testing its operation.

3. **Computer science Workshop Practice Exercises: (2 hrs)**
    - Hardware components of a desktop system: Peripheral Installation: Install and configure peripheral devices such as printers, scanners, and external hard drives.
    - Basics of Internet of things (IOT):
    - Demonstration of different components and pin configuration of Arduino board
    - To measure Temperature, humidity and distance using Arduino board.

Modern Manufacturing methods:

- Demonstration of 3-D printing process.

PART-2: Exercises to Civil Engineering students only

Course Description: (Part-2: CE)

This part of workshop practice course provides first-year civil engineering students with hands-on training in fundamental construction and environmental monitoring techniques, essential for residential building projects. Students will explore various construction materials and methods, including carpentry, plumbing, wall construction, and flooring installation. Additionally, the course covers essential environmental monitoring practices to ensure site safety and compliance. Through practical exercises and demonstrations, students will gain valuable skills applicable to real-world construction scenarios, preparing them for more advanced studies and professional work in the field of construction.

Course Outcomes: (Part-2: CE)

At the end of this part of the course, the student will be able to...

CO1: identify and apply common construction materials such as concrete, bricks, wood, and steel in residential building projects, demonstrating an understanding of their properties and uses.

CO2: use carpentry tools and techniques to construct and assemble basic wooden structures, including windows and wall frames, showcasing their proficiency in essential carpentry skills.

CO3: install and repair plumbing systems in residential buildings, including water supply lines, drainage pipes, and fixtures, demonstrating practical knowledge of plumbing installation and maintenance.

CO4: construct various types of walls, including stud walls, masonry walls, and concrete block walls, and perform related tasks such as laying bricks or blocks, framing, and installing insulation and sheathing.

CO5: prepare subfloors and install various types of flooring materials, including hardwood, tile, and carpet, demonstrating competence in flooring installation techniques and material handling.

CO6: use environmental monitoring instruments, such as air quality meters, air velocity meters, TDS meters, noise meters, and lux meters, to assess and ensure safe and compliant conditions on construction sites.

Course Contents: (Part-2: CE) (6 hrs)

1. **Introduction to Construction Materials:**
    - Application of common construction materials used in residential buildings such as concrete, bricks, wood, and steel**.**
2. **Basic Carpentry Techniques:**
    - Carpentry tools and techniques in building construction including sawing, drilling, nailing, and framing. Practice assembling of simple wooden structures like windows and wall frames.
3. **Plumbing Installation and Repair:**
    - Basic plumbing methods and installation techniques for residential buildings. Practice installing water supply lines, drainage pipes, and fixtures like sinks, toilets, and showers.
4. **Wall Construction Methods:**
    - Construction methods of different walls such as stud walls, masonry walls, and concrete block walls used in residential buildings. Practice laying bricks or blocks, framing walls, and installing insulation and sheathing**.**
5. **Flooring Installation:**
    - Flooring materials and installation methods such as hardwood flooring, tile flooring, and carpeting for residential buildings. Practice preparing subfloors and installing flooring materials.
6. **Introduction to Environmental Monitoring:**
    - Environmental monitoring techniques for construction sites. Practice monitoring by using air quality meter, air velocity meter, TDS meter (water quality), noise meter and lux meter.

REFERENCES:

1. Khanna P.N, “Indian Practical Civil Engineering Handbook”, Engineers Publishers.
2. Arora S.P and Bindra S.P, " Building Construction", Dhanpat Rai Publications
3. S. C. Rangwala, “Engineering Materials,” Charotar Publishing House.
4. Bawa H S, “Workshop Technology”, 2nd edition, 2017.
5. Howard C. Massey,” Basic Plumbing with Illustrations”, Craftsman Book Co.

24ME182 **Workshop Practice**

(for CSE / AI&DS / AI&ML / IT branches only)

Category: Engineering Science (ES) **0L 0T 3P 1.5C**

Pre-requisite: 10+2 Physics

PART-1: Exercises common to all branches of engineering students

Course Description: (Part-1)

This part of the course provides first-year engineering students with comprehensive hands-on experience in electrical systems, electronics, and computer science fundamentals. The course covers practical exercises in electrical wiring and circuit design, electronics component handling, and computer hardware and software configuration. Students will engage in activities such as electrical switching circuits, distribution board assembly, electronic component identification, and basic IoT (Internet of Things) projects. The course is designed to equip students with essential skills for diagnosing and constructing electrical and electronic systems, as well as understanding computer hardware and IoT applications.

Course Outcomes: (Part-1)

At the end of this part of the course, the student will be able to...

CO1: design, assemble, and test various electrical circuits, including stair case, two-way, and fan connections, and accurately measure electrical parameters such as voltage, current, power, and energy using digital meters.

CO2: identify and use electronic components (resistors, capacitors, diodes, switches) to construct and test a simple calling bell circuit, demonstrating understanding of circuit design and component functionality.

CO3: install and configure peripheral devices on a desktop system and apply basic IoT principles using an Arduino board to measure and interpret environmental data such as temperature, humidity, and distance.

Course Contents: (Part-1)

1. **Electrical Workshop Practice Exercises: (3 hrs)**
    - Stair case/Two-way /Gowdown Switching/Fan connection
    - 3Φ Distribution board with fuse, MCB, two way switches, light indicator,4 switches, fan regulator
    - Measurement of voltage, current, power, Energy by using digital meters

2. **Electronics Workshop Practice Exercises: (1 hr)**
    - Familiarization of electronic components such as resistors, capacitors, diodes, and switches.
    - Preparation of a simple calling bell circuit board and and testing its operation.

3. **Computer science Workshop Practice Exercises: (2 hrs)**
    - Hardware components of a desktop system: Peripheral Installation: Install and configure peripheral devices such as printers, scanners, and external hard drives.
    - Basics of Internet of things (IOT):
    - Demonstration of different components and pin configuration of Arduino board
    - To measure Temperature, humidity and distance using Arduino board.

Modern Manufacturing methods:

- Demonstration of 3-D printing process.

PART-2: Exercises to Computers group students only (CSE/ AI&DS/ AI&ML/ IT)

Course Description: (Part-2: CSE/ AI&DS/AI&ML/ IT)

This part of course provides first year CSE/AI&DS/IT students an in-depth exploration of the fundamental components and operations of modern computer systems. Through hands-on experience, students will gain practical knowledge in disassembling and reassembling computers, troubleshooting hardware issues, installing peripherals, setting up and configuring networks, interfacing sensors with microcontrollers, and implementing basic digital logic design. The course emphasizes real-world applications and problem-solving skills, enabling students to confidently manage and maintain computer hardware and network systems.

Course Outcomes: (Part-2: CSE/ AI&DS/ IT)

At the end of this course, students will be able to:

CO1: identify and explain the function of each major computer component by disassembling and reassembling a desktop computer, including the CPU, motherboard, RAM, HDD/SSD, and GPU.

CO2: examine and troubleshoot common hardware issues such as RAM failures and CPU overheating, using systematic problem-solving techniques.

CO3: demonstrate the installation of peripheral device software including printers, scanners, and external hard drives, ensuring full functionality within the system.

CO4: design and set up a network topology of a local area network (LAN)**,** including routers, switches, and computers, with proper IP addressing and network service configuration.

CO5: interface sensors with microcontrollers to acquire and display data using platforms like Arduino, demonstrating practical skills in sensor-based data acquisition.

CO6: illustrate basic digital logic operations using breadboards and logic Integrated Circuits (ICs), reinforcing foundational knowledge in digital logic design.

Course Contents: (Part-2: CSE/ AI&DS/ IT) (6 hrs)

1. Computer Components:

- Disassemble and reassemble a desktop computer to understand the role of each component (CPU, motherboard, RAM, HDD/SSD, GPU, etc.).

2. Hardware Troubleshooting & Peripheral Installation:

- Simulate common hardware issues (e.g., RAM failure, CPU overheating) and identify the procedures to resolving them.

3. Peripheral Installation:

- Install and configure peripheral devices such as printers, scanners, and external hard drives.

4. Network Setup and Configuration:

- Set up a small LAN network with routers, switches, and computers. Configure IP addresses, subnet masks, and basic network services.

5. Sensor Interfacing and Data Acquisition:

- Acquire the data by interfacing sensors (e.g., temperature, light, motion) through microcontrollers.
- Execute the program on Arduino IDE & display the measured values.

6. Digital Logic Design Basics:

- Implement basic digital logic gate (AND, OR, NOT) operations using breadboards and logic Integrated Circuits (ICs).

24ME182 **Workshop Practice**

(for EEE/ECE/EIE branches only)

Category: Engineering Science (ES) **0L 0T 3P 1.5C**

Pre-requisite: 10+2 Physics

PART-1: Exercises common to all branches of engineering students

Course Description: (Part-1)

This part of the course provides first-year engineering students with comprehensive hands-on experience in electrical systems, electronics, and computer science fundamentals. The course covers practical exercises in electrical wiring and circuit design, electronics component handling, and computer hardware and software configuration. Students will engage in activities such as electrical switching circuits, distribution board assembly, electronic component identification, and basic IoT (Internet of Things) projects. The course is designed to equip students with essential skills for diagnosing and constructing electrical and electronic systems, as well as understanding computer hardware and IoT applications.

Course Outcomes: (Part-1)

At the end of this part of the course, the student will be able to...

CO1: design, assemble, and test various electrical circuits, including stair case, two-way, and fan connections, and accurately measure electrical parameters such as voltage, current, power, and energy using digital meters.

CO2: identify and use electronic components (resistors, capacitors, diodes, switches) to construct and test a simple calling bell circuit, demonstrating understanding of circuit design and component functionality.

CO3: install and configure peripheral devices on a desktop system and apply basic IoT principles using an Arduino board to measure and interpret environmental data such as temperature, humidity, and distance.

Course Contents: (Part-1)

1. **Electrical Workshop Practice Exercises: (3 hrs)**
    - Stair case/Two-way /Gowdown Switching/Fan connection
    - 3Φ Distribution board with fuse, MCB, two way switches, light indicator,4 switches, fan regulator
    - Measurement of voltage, current, power, Energy by using digital meters

2. **Electronics Workshop Practice Exercises: (1 hr)**
    - Familiarization of electronic components such as resistors, capacitors, diodes, and switches.
    - Preparation of a simple calling bell circuit board and and testing its operation.

3. **Computer science Workshop Practice Exercises: (2 hrs)**
    - Hardware components of a desktop system: Peripheral Installation: Install and configure peripheral devices such as printers, scanners, and external hard drives.
    - Basics of Internet of things (IOT):
    - Demonstration of different components and pin configuration of Arduino board
    - To measure Temperature, humidity and distance using Arduino board.

Modern Manufacturing methods:

- Demonstration of 3-D printing process.

PART-2: Exercises to Electrical & Electronics group students only (EEE/ ECE/ EIE)

Course Description: (Part-2: EEE/ ECE/ EIE)

This part of course provides first year EEE/ECE/EIE students with comprehensive hands-on experience in usage of breadboard for designing electronic circuits, testing the components using tools in the laboratory and troubleshooting, soldering technics in assembling the electronic circuits. Also, this course enables the analysis of electronic circuits using Multisim software, knowing logic gates and implementing the logic for realization, basics of Aurdino board structure and pin configuration. The exercises are tailored for students in EEE, ECE, and EIE to develop key practical skills essential for their future careers.

Course Outcomes: (Part-2: EEE/ ECE/ EIE)

At the end of this part of the course, the student will be able to...

CO1: demonstrate the ability to effectively assemble electronic circuits on a breadboard, following circuit schematics. Troubleshoot and correct errors in circuit assembly on breadboards, ensuring accurate circuit functionality.

CO2: identify and test a variety of electronic components, including resistors, capacitors, BJTs, FETs, relays, diodes, Zener diodes, LEDs, LDRs, photodiodes, and transformers.

CO3: demonstrate proficiency in soldering techniques, ensuring strong and durable connections between electronic components. Apply best practices in soldering to prevent common issues such as cold joints, bridging, and component damage, thereby ensuring circuit reliability and integrity.

CO4: use Multisim software to analyze and simulate electronic circuits, accurately predicting circuit behavior under various conditions.

CO5: employ and test basic logic gates (AND, OR, NOT, NAND, NOR, XOR, XNOR) using Logic ICs.

CO6: Execute microcontroller programming tasks on Arduino development boards, including setting up basic input/output operations.

Course Contents: (Part-2: EEE/ ECE/ EIE) (6 hrs)

1. **Breadboarding Skills:**
    - Understand and apply the principles of breadboarding to assemble and troubleshoot electronic circuits.
2. **Electronic component testing:**
    - A pack of components consisting of resistors, presets, electrolytic and disc capacitors, BJTs, FETS, Relays, Diodes, Zener Diodes, LED, LDR, Photo Diodes, Transformers.
3. **Soldering Techniques:**
    - Acquire and demonstrate proficiency in soldering electronic components, ensuring reliable connections and circuit integrity.
4. **Electronic Circuit Analysis and Synthesis Using Multisim:**
    - Analyze, simulate, and synthesize electronic circuits using Multisim software, gaining a deeper understanding of circuit behavior and design principles.
5. **Implementation of Logic Gates Using Logic ICs:**
    - Implement and test logic gates using Logic ICs, reinforcing knowledge of digital logic and its applications in circuit design.
6. **Arduino Development Board Experiments:**
    - Conduct experiments using Arduino development boards to learn microcontroller programming, basic circuit interfacing, and application development.

24ME182 **Workshop Practice**

(for Mechanical Engineering students only)

Category: Engineering Science (ES) **0L 0T 3P 1.5C**

Pre-requisite: 10+2 Physics

PART-1: Exercises common to all branches of engineering students

Course Description: (Part-1)

This part of the course provides first-year engineering students with comprehensive hands-on experience in electrical systems, electronics, and computer science fundamentals. The course covers practical exercises in electrical wiring and circuit design, electronics component handling, and computer hardware and software configuration. Students will engage in activities such as electrical switching circuits, distribution board assembly, electronic component identification, and basic IoT (Internet of Things) projects. The course is designed to equip students with essential skills for diagnosing and constructing electrical and electronic systems, as well as understanding computer hardware and IoT applications.

Course Outcomes: (Part-1)

At the end of this part of the course, the student will be able to...

CO1: design, assemble, and test various electrical circuits, including stair case, two-way, and fan connections, and accurately measure electrical parameters such as voltage, current, power, and energy using digital meters.

CO2: identify and use electronic components (resistors, capacitors, diodes, switches) to construct and test a simple calling bell circuit, demonstrating understanding of circuit design and component functionality.

CO3: install and configure peripheral devices on a desktop system and apply basic IoT principles using an Arduino board to measure and interpret environmental data such as temperature, humidity, and distance.

Course Contents: (Part-1)

1. **Electrical Workshop Practice Exercises: (3 hrs)**
    - Stair case/Two-way /Gowdown Switching/Fan connection
    - 3Φ Distribution board with fuse, MCB, two way switches, light indicator,4 switches, fan regulator
    - Measurement of voltage, current, power, Energy by using digital meters

2. **Electronics Workshop Practice Exercises: (1 hr)**
    - Familiarization of electronic components such as resistors, capacitors, diodes, and switches.
    - Preparation of a simple calling bell circuit board and and testing its operation.

3. **Computer science Workshop Practice Exercises: (2 hrs)**
    - Hardware components of a desktop system: Peripheral Installation: Install and configure peripheral devices such as printers, scanners, and external hard drives.
    - Basics of Internet of things (IOT):
    - Demonstration of different components and pin configuration of Arduino board
    - To measure Temperature, humidity and distance using Arduino board.

Modern Manufacturing methods:

- Demonstration of 3-D printing process.

PART-2: Exercises to Mechanical Engineering students only

Course Description: (Part-2: ME)

This part of workshop practice course provides first-year mechanical engineering students with hands-on experience across multiple fundamental areas of engineering, including carpentry, welding, and mechanical components. The course is designed to develop practical skills and technical proficiency through targeted exercises in woodworking, metalworking, and mechanical assembly. Students will gain familiarity with essential tools and techniques, including woodworking tools and joinery, welding processes, and mechanical component handling. By engaging in these practical exercises, students will enhance their ability to apply theoretical concepts in real-world scenarios, laying a strong foundation for advanced engineering studies.

Course Outcomes: (Part-2: ME)

At the end of this part of the course, the student will be able to...

CO1: effectively use woodworking hand and power tools, and apply joinery techniques such as cross half lap and dovetail joints to produce precise and durable wood assemblies.

CO2: proficiently perform arc welding on lap, butt, and corner joints, and carry out gas welding processes, demonstrating skill in producing high-quality welds with attention to safety and technique.

CO3: perform bench work operations, such as drilling and tapping, and assemble mechanical components including gears, bearings, and springs, demonstrating competency in mechanical assembly and precision machining.

Course Contents: (Part-2: ME)

I. Carpentry Workshop Practice Exercises: **(2 hrs)**

1. **Woodworking Tools Familiarization:**
   - Practice to work with woodworking hand tools and operations using power tools.
2. **Joinery Techniques:**
   - Practice various joinery techniques such as cross half lap and Dove tail joints.
   - Practice to work with various wood adhesives and fasteners.

II. Welding workshop practice exercises: **(2 hrs)**

- Preparation of Lap, Butt & Corner joints using Arc Welding.
- Practice of Gas welding process.

III. Introduction to Mechanical Components & operations: (3 hrs)

1**. Bench Work Techniques**:

- Practice to work with various materials like metals and plastics.
- Practice of drilling, tapping, and reaming operations on the above materials.

2**. Mechanical Components**

- Practice of assembling lap and butt joints with various types of bolts, nuts, screws and single, double studs.
- Practice to work with various types of mechanical components such as

  I. Gears - Bevel, Spur, Helical and Worm.

  II**.** Bearings – Ball, roller, plain, needle and flexure.

  III**.** Springs – Compression, Extension, Conical, Torsion and leaf.

24UC183 **Sports & Yoga**

(Common to all branches)

Category: Mandatory Course (MC) **0L 0T 3P 0C**

***Pre-requisite*: ---**

Course Description:

The course is designed for first year B.Tech. students of all branches. It provides essential and applied knowledge of physical and mental health.Introducing the course is more crucial in the present days, particularly undergraduate students, who require awareness on their physical and mental health. With this focus, the course covers various aspects of physical fitness, wellness and lifestyle, fundamental aspects of anatomy, physiology in physical education, yoga and lifestyle, different types of sports, etc. Although, the basic theoretical aspects of sports and yoga are discussed, major focus will be on the practice of yoga asanas and participation in various sports by the students.

Course Aims and Objectives:

1. Make the students understand the importance of sound health and fitness principles as they relate to better health.
2. Expose the students to a variety of physical and yogic activities aimed at stimulating their continued inquiry about yoga, physical education, health and fitness.
3. Create a safe, progressive, methodical and efficient activity-based plan to enhance improvement and minimize risk of injury.
4. Develop among students an appreciation of physical activity as a lifetime pursuit and a means to better health.

CourseOutcomes:

At the end of the course, the student will be able to...

CO 1: Apply the knowledge of physical activities and Hatha Yoga on himself/herself and practice them**[K3]**.

CO 2: Understand basic skills associated with yoga and physical activities including strength, flexibility, balance and coordination**[K2]**.

CO 3: Practice yoga asanas, pranayama and meditation in daily life for the health of body and balance of mind **[K3]**.

CO 4: Apply correctly the biomechanical and physiological principles elated to exercise and training**[K3]**.

CO 5: Practice techniques for increasing concentration and decreasing anxiety which leads to stronger academic performance**[K3]**.

Course Structure:

Unit 1: Introduction to physical education, physical fitness, wellness and life style

- Meaning and definition of physical education, aims and objectives, changing trends in physical education.
- Meaning and importance of physical fitness and wellness, components of physical fitness.
- Components of health related fitness, components of wellness.
- Preventing health threats through lifestyle change and concept of positive lifestyle.
- Awards and honours in the field of sports in India (Dronacharya Award, Arjuna Award, Dhayanchad Award, Rajiv Gandhi KhelRatna Award, etc.)

Unit 2: Fundamentals of anatomy, physiology, kinesiology, biomechanics and sports

- Meaning of anatomy, physiology and their importance in the context of physical education and sports.
- Effect of exercise on the functioning of various body systems like circulatory system, respiratory system, neuromuscular system, etc.
- Meaning and importance of kinesiology and biomechanics in physical education and sports, Newton's law of motion and its application in sports, friction and its effects in sports.
- Concept of postures, causes of bad posture, advantages of correct posture, advantages and disadvantages of weight training, common postural deformities – knock knee, flat foot, round shoulders, lordosis, kyphosis, bow legs and scoliosis.

Unit 3: Psychology in Sports

- Definition and importance of psychology in physical education and sports, differentiation between growth and development.
- Adolescent problems and their management, concept and types of emotions, control of emotions, meaning and types of aggressions in sports, psychological benefits of exercise.
- Anxiety and fear and their effects on sports performance, motivation – types and techniques, understanding stress and coping strategies.
- Concept and meaning of doping, prohibited substances and methods, side effects of prohibited substances.
- First aid – definition and objectives, sports injuries – classification, causes and prevention, management of injuries – soft tissue injuries and bone and joint injuries.

(Following subtopics related to any one game/sport of choice of student out of: Athletics, Badminton, Basketball, Chess, Cricket, Kabaddi, Lawn Tennis, Swimming, Table Tennis, Volleyball, etc.: History of the game/sport, latest general rules of the game/sport, specifications of play fields and related sports equipment, important tournaments and venues, sports personalities, proper sports gear and its importance.)

Unit 4: Theoretical aspects of Yoga and practice of Asanas

- Meaning, history and basic concepts of yoga, three bodies of human system, panchakoshas, trigunas, and ashtanga yoga.
- Meaning of asanas, practice of sukshmavyayama (warm up for asanas), asanas as preventive measures, practice of various asanas in the four categories – standing, sitting, prone and supine – at least 5 postures from each category, variations, contraindications and benefits of the asanas, Sun salutations.
- Asanas for hypertension, back pain, diabetes, asthama, obesity, etc.

Unit 5: Theory and practice of pranayama and meditation

- Meaning of pranayama, instructions for practice of pranayama, practice of various pranayama techniques – abdominal breathing, kapalabhati, anulom-vilom pranayama, bhramari, etc.

- Relaxation techniques for improving concentration – Yognidra
- Meaning of meditation, difference between concentration and meditation, various meditation methods, heartfulness meditation practice, benefits of meditation.

Textbook(s) / Reference(s):

1. Modern trends and physical education – Prof. Ajmer Singh.
2. Health and Physical Education – NCERT (11^{th} and 12^{th} Classes).
3. Light on Yoga – B.K.S. Iyengar.
4. Light on Pranayama – B.K.S. Iyengar.