## 20BS01 Linear Algebra and Univariate Calculus

**Teaching scheme**
Lectures: 3hrs/week
Tutorial: 1hr/week
Number of Credits: 4

**Examination scheme**
In-Sem Exam: **50** Marks
End-Sem Exam: **50** Marks

**Course Objectives:**

1. To familiarize the prospective engineers with techniques in linear algebra and calculus of one variable.
2. To equip the students with standard concepts and tools in linear algebra and calculus of one variable which they will find useful in their disciplines.

**Course Outcomes:**

**CO1: Use** matrix method to solve linear system of equations, Linear Transformations.
**CO2: Calculate** eigenvalues, eigenvectors and apply it to diagonalize a matrix.
**CO3: Apply** knowledge of linear algebra to solve simple real life problems.
**CO4: Compute** differentiation, series expansion, integration of function of one variable.

**Unit-I: Matrices** **(08)**

Rank of a matrix, Echelon form, System of linear equations, Euclidean vector spaces and Linear Transformations

**Unit-II: Diagonalization of a Matrix** **(08)**

Eigenvalues, Eigenvectors, Properties of Eigenvalues, Diagonalization of a matrix

**Unit-III: Applications of Linear Algebra** **(09)**

Introduction to Modular Arithmetic, Euclid's algorithm, Encrypt and decrypt the statement using matrix, Applications to simple real life problems

**Unit-IV: Differential Calculus** **(08)**

Successive differentiation, nth order derivatives of some standard functions, Taylor's and Maclaurin's theorem, Standard series expansions

**Unit-V: Integral Calculus** **(09)**

Reduction formulae, Beta Function, Gamma function, Differentiation under integral sign, Error

function

**Text-Books:**


1. David Poole,**‘ Linear Algebra: A Modern Introduction’**, 2nd Edition, Brooks/Cole (2005).
2. B. V. Ramana ,**‘Higher Engineering Mathematics’**, *Tata McGraw-Hill Publications*, (2007).
3. B.S. Grewal, ‘**Higher Engineering Mathematics**’, *Khanna publishers*, Delhi (40thedition), (2008).


**Reference Books:**


1. C.R. Wylie, L. C. Barrette, *‘***Advanced Engineering Mathematics***’, McGraw-Hill Publications, New Delhi* ( 6 th edition),(2006)
2. Maurice Weir, Joel Hass, Thomas **‘Calculus’** , 12th edition, *Pearson India*(2016)
3. George Thomas, Jr., Ross Finney, Late, **Calculus,** 9th edition, *Pearsons India*
4. Sudhir Ghorpade, Balmohan Limaye, *‘***A Course in Calculus and Real Analysis***’*, (Undergraduate Text in Mathematics), *Springer*(2006).
5. Erwin Kreyszig, ‘**Advanced Engineering Mathematics’**, *Wiley Eastern Ltd*(10thEdition), (2017)

## 20BS02 Chemistry

**Teaching Scheme**
Lectures: 3Hrs/week
Credits: 3

**Examination Scheme**
In-Semester: 50 Marks
End-Semester: 50 Marks

**Course Objectives**

The Chemistry course is designed such that the learners imbibe chemical principles relevant in the engineering context. The course facilitates undergraduates to understand chemical processes, methods of analysis, structure-property relationship and evaluate role of chemical substances for engineering applications. Further the course inculcates basic problem-solving skills involving chemistry principles.

**Course Outcomes**

The students will be able to –

1. Interpret properties and applications of molecules based on their atomic structure.
2. Analyse quality parameters for water, coal, petrol using analytical methods.
3. Solve given problems by applying chemical/electrochemical principles.
4. Outline the process of synthesis for inorganic substances and nanomaterials.
5. Rationalize the working principle of a pHmeter, conductometer, spectro/flame photometer, electrochemical cell or a given reagent for its function.

**Module 1: Physical Chemistry (13)**

**Unit 1.** Chemical Bonding: Types of bonds, intermolecular forces, bonding in molecules: valence bond theory, molecular orbital theory for diatomic molecules.

**Unit 2.** Electrochemistry: Electrochemical cell, Nernst equation, EMF of cell, reference and indicator electrodes, battery characteristics, Lead-acid, Lithium-ion battery, Fuel cell technology.

**Module 2: Inorganic and Materials Chemistry (13)**

**Unit 3.** The Periodic table and properties; Chemistry of some elements like H, Si, extraction of Si to making a chip, $H_2$ gas as fuel.

**Unit 4.** (A) Engineering materials: Structural features, properties and applications of OLEDs - PPV (- solar cell), liquid crystal polymers, conducting polymers – as a chemical sensor, polymer composites.
(B) Nanomaterials:
Introduction to nanomaterials, synthesis by top down and bottom-up methods. Structure, synthesis and some typical applications of nanomaterials.

**Module 3: Analytical Chemistry** **(16)**

**Unit 5.** Analysis of -
(A) Water: hardness in water, TDS, effect of hard water in boilers, water softening techniques- zeolite and ion exchange method. Reverse osmosis. Waste water recycling: testing and removal methods.
(B) Carbon based fuels: Analysis of coal and petrol.

**Unit 6.** Analytical techniques such as pH-metry, conductometry, spectroscopy and their applications.

**Text Books:**

1. S.S. Dara 'Engineering Chemistry' S. Chand Publications (2010)
2. B.S. Chauhan 'Engineering Chemistry': Univ Sc Press. (Third edition)2009
3. Shashi Chawla 'A Text Book of Engineering Chemistry': Dhanpat Rai & Co. (2015) 4. Jain and Jain 'A Text Book of Engineering Chemistry' Dhanpat Rai & Co.
5. G.Chatwal 'Instrumental methods of Chemical Analysis' Himalaya publication house

**Reference Books:**

1. Steven S. Zumdahl, 'Chemistry concepts and applications', Cengage learning publication (2009)
2. Ram D. Gupta,'Hydrogen fuel 'C.R.C. Publications (2009)
3. Puri, Sharma, Pathania 'Principles of Physical Chemistry': Vishal Publ. Co.
4. Robert Braun' Instrumental methods of analysis' Pharma med press (2010)
5. J.D. Lee,'Concise Inorganic Chemistry', 4th edition, Wiley Publication (2019)

## 20ES01 Basic Electrical and Electronics Engineering

**Teaching Scheme:**
Lectures: 3 Hrs./Week
Credits: 3

**Examination Scheme**:
In-Semester: 50 Marks
End-Semester: 50 Marks

**Course Objectives:**

1. To educate the students about the realization of basic theoretical concepts & laws in electrical engineering in real physical world.
2. To make students familiar with three phase supply.
3. To make students familiar with single phase transformers.
4. To understand the construction and applications of diode and BJT
5. To understand basics of combinational logic, Boolean algebra and flip -flops.

**Course Outcomes:**

After completion of course, students will be able to

1. Analyze and calculate parameters of DC circuits
2. Analyze and calculate parameters of AC circuits
3. Calculate performance parameters of single phase transformer.
4. Analyze I-V characteristics of semiconductor diodes and transistors and design simple analog circuits using these devices
5. Build simple combinational and sequential logic circuits.

**Unit – I: DC Networks** **(08)**

Kirchhoff's laws, Mesh and Nodal Analysis, Thevenin and Superposition Theorems, maximum power transfer theorem, Network Simplifications using star-delta / delta-star transformations.

**Unit – II: AC Circuits** **(07)**

Series and parallel RL, RC and RLC circuits , concept of Impedance and admittance, power triangle and power factor. Resonance in series and parallel RLC circuit, Three phase voltage generation and waveform, star and delta balanced systems. Relationship between phase and line quantities, phasor diagram, power in a three phase circuit.

**Unit – III: Electromagnetism and Single Phase Transformers** **(06)**

Magnetic materials and B-H curve, self and mutual inductance,1 Φ transformer: concept, types, working, ideal transformer, practical transformer, equivalent circuit, phasor diagram, efficiency and regulation calculations.

**Unit – IV: Diodes and rectifiers** **(07)**

Construction and characteristic of p-n junction diode, LED, photodiode, Half wave, full wave and bridge rectifiers, need of capacitor filter, rectifier operation with capacitor filter, Zener diode as a voltage regulator, block diagram of Regulated power supply

**Unit – V: Junction Transistor Amplifiers** **(07)**

Bipolar junction transistor, Construction of BJT, Types of biasing:-fixed bias and self bias circuit, BJT characteristics for-CE, CB, CC configurations, relationship between α and β, load line for a transistor, application of transistor as a switch and amplifier.

**Unit – VI: Digital Electronics** **(07)**

Basic gates, implementation of basic gates using universal gates, Boolean algebra, standard representation of logic functions (SOP and POS forms), Introduction of Combinational logic circuits like multiplexer ,demultiplexer, half adder and full adder, Introduction of Sequential logic circuits like flip- flops (SR, D), counters and shift registers.

**Text Books:**

1. Hughes, 'Electrical and Electronic Technology', Pearson education, (10th edition), (2008)

**Reference Books:**

1. D.P. Kothari and I.J. Nagrath, 'Basic Electrical Engineering', McGraw-Hill, (3rd edition), (2010)
2. A.E.Fitzgerald, A.Grabiel,'Basic Electrical engineering',McGraw-Hill, (5th edition), (2009)
3. Floyd, 'Electronic Devices and Circuits', pearson education, (7th edition),(2008)
4. AP Malvino & Donald Leach,'Digital Principles and Applications', McGraw Hill Education,( 6 th edition), (2009)

## 20ES02 Fundamentals of Programming Language-1

**Teaching Scheme:**
Lecture: 1 Hr/week
Credits: 1

**Examination Scheme:**
End-Sem: 25 Marks

**Course Objectives:**

To facilitate the learners:

1. To learn the fundamentals of building blocks of computer system.
2. To develop problem solving ability by developing an algorithm, flowchart for given problem.
3. To implement the logic / solution for given problem using C programming language.
4. To understand the decision and iteration interpretation in a programming language.

**Course Outcomes:**

By taking this course, the learner will be able to:

1. Build algorithms and flowcharts for the given problem statement.
2. Develop a program in C language using appropriate control structure for the constructed algorithm.
3. Make use of variables, data types, operators, expressions, strings and array to program design and implementation.
4. Design and implement modular solution to given problem using functions.

**Unit 1: Introduction (2)**

Introduction to components of a Computer System, types of programming languages. Introduction to Algorithm: As flow chart, pseudo code, as a program.

**Unit 2: Fundamentals of Procedural Programming Language (1)**

Keywords, Identifiers, Constants and Variables, concept of memory, Structuring procedural program using exemplary language such as C.

**Unit 3: Data Types and operators (2)**

Data types, Typecasting, variable scope, Operators, Basic Input and Output Operations, Expressions and Precedence of Operators.
Illustration using real life examples and use cases.

**Unit 4: Control Structures** **(2)**

Selection (if-else ladder), Iteration (for loop, while loop).
Illustration using real life examples and use cases.

**Unit 5: Arrays and String** **(2)**

Introduction to linear structure (Arrays) and Strings,String functions
Illustration using real life examples and use cases.

**Unit 6: Functions** **(2)**

Use of function for modularization, Parameter passing.
Illustration using real life examples and use cases.

**Text Books:-**


1) Kernighan and Ritchie, " The C programming language" (2nd edition)., Prentice Hall of India, 1988.
2) G. Dromey, "How to Solve it by Computer", Prentice-Hall Inc., Upper Saddle River, NJ, 1982.
3) Yashwant Kanetkar, "Let's C", Allied Publishers, 1998.


**Reference books:-**


1) Reema Thareja, "Introduction to C programming", Oxford University Press (2nd edition), 2015.
2) Alan R. Feuer, "The C Puzzle book", Pearson, 1999

## 20ES03 Sustainable Engineering

**Teaching Scheme:**
Lectures: 3Hrs/Week
Tutorial: 1Hr/Week
**Credits: 4**

**Examination Scheme**
In-Semester: 50 Marks
End Semester: 50 Marks

**Course Objectives:**

1. To understand interdisciplinary approach towards sustainable development.
2. To acquire knowledge, skills, values & attitudes that empowers to contribute to sustainable development.
3. Understand the relevance and importance of natural resources & protection of environment for sustainability.
4. To understand the role of engineering & technology within sustainable development.

**Course Outcomes:**

A Student should be able to:

CO1: Identify the need of sustainable development
CO2: Analyse the inter-relationships between the built environment and natural environment.
CO3: Suggest materials and technologies to improve energy efficiency of building
CO4: Apply the knowledge in the area of sustainability for research and use of different natural resources including renewable and non-renewable resources
CO5: Apply concept of sustainability in smart city designing.
CO6: Analyse and explain local, national and global sustainability using multidisciplinary approach

**Unit I: Introduction to sustainable engineering (07)**

Need and concept of sustainability, Principles of sustainability, Pillars of sustainable development, Multidisciplinary approach for sustainable development, Case study on Innovative technologies

**Unit II: Environmental sustainability (07)**

Concept of natural and built environment, Concept of integrated built environment, Environmental global issue - Urban sprawl, Role of individual to protect environment

**Unit III: Green materials and green building (07)**

Basic concept of Green buildings & its co-relation with sustainability , Material selection for sustainable design of green building, Concept of circular economy, Concept of IGBC, Green building certification, Methods for increasing energy efficiency of buildings

**Unit IV: Sustainable use of water and energy resources (08)**

Water resources – use and conservation of water, sustainable use of drinking - water – waste water management- case study

Energy resources – Renewable and non-renewable sources of energy – conservation of non-renewable energy sources – case study, Definition & case study on LCA**.**

**Unit V: Smart city** **(07)**

Concept and features of smart city, Strategies, Concept of smart village, two case studies

**Unit VI: Role of community and society in sustainable development** **(06)**

Role of government, Global environmental agreements and protocols (Montreal& Kyoto protocol), Copenhagen summit, Role of citizen, Contribution of NGOs, social networking, Case study

**Text Books:**

R.L.Rag, Lekshmi dinachandran Ramesh - **Introduction to Sustainable engineering**

**Reference Books:**

Bhavik R. Bakshi - **Sustainable engineering (principles and practise)** -*Ohio state university*

Allen D.T and shonnard D. R- **Sustainability engineering concept design and case studies**

Mokia schoiz- **Sustainable Water treatment engineering solution for variable climate**

DT Allen,DR Shonnard- **Green engineering: environmentally conscious design of chemical processes**

R.Rajagopalan – **Environmental Studies from Crisis to Cure** – *Oxford Publication, Third edition,2016.*

Ajith Sankar R.N.- **Environmental Management** - *Oxford Publication, First edition,2015.*

Shah, Kale, Patki – **Building planning and Built environment** -*Tata McGraw Hill*

## 20BS02L: Chemistry Laboratory

**Teaching Scheme:**
2 hours per week
Number of Credit: 1

**Examination Scheme:**
Term Work: 25 Marks

**Course Objectives:**

The objective of the Chemistry Lab course is
To develop experimental skills.
To correlate the properties of a substance based on experimental observations.
To demonstrate use of analytical techniques for analyzing substance for its properties or quality.

**Course Outcomes:**

By taking this course, the students will be able to —
**CO- 1:** Identify analytical technique required for performing chemistry experiment.
**CO- 2:** Prepare and analyse substances based on certain parameters and evaluate their quality (zeolite/ coal/water/ polymer)
**CO – 3:** Measure observables for a chemical change in the experiment and draw inferences.
**CO - 4:** Justify the significance of a selected technique/ specific role of a reagent in a given chemical experiment

**List of Experiments: (Any 8)**

1. To determine Total hardness of water by EDTA Method (complexometric titration).
2. To determine alkalinity of given water sample.
3. Preparation of sodium zeolite and use it for water softening.
4. Estimation of sodium from soft water using flame photometry.
5. To determine concentration and strength of acid from given solution by pH metric titration.
6. To determine concentration of acetic acid in vinegar by potentiometric titration.
7. Conductometric titration to determine concentration of strong acid /base.
8. To determine Molecular weight of a Polymer by viscometric method.
9. Colorimetric estimation of KMnO4.
10. Proximate Analysis of coal.
11. Preparation of biodiesel and its characterization.

## 20ES01L Basic Electrical and Electronics Engineering Lab

**Teaching Scheme:**
Practical: 2 Hrs./Week
Credit: 1

**Examination Scheme:**
Term Work: 25 marks

**Course Outcomes:**

After completion of course, students will be able to

- Perform basic domestic wiring
- Apply circuit laws to find the parameters of given electrical network
- Build a basic regulated DC power supply
- Obtain frequency response of CE amplifier
- Build basic digital circuits

**List of experiments:**

- Introduction of different electrical and electronics components and instruments.
- To perform electrical wiring to control lamps using one way and two-way switches.
- To verify Thevenin's theorem & superposition theorem.
- To determine phase angle of L-C-R series circuit.
- To perform load test on single phase transformer to determine regulation and efficiency.
- To determine output voltage and ripple voltage of half wave, full wave rectifier with center tap transformer and bridge rectifier with and without filter.
- Assemble and build simple DC regulated power supply.
- To determine frequency response of CE amplifier.
- Assemble and build half adder & full adder circuits.

## 20ES02L Fundamentals of Programming Language -1 Lab

**Teaching Scheme:**
Practical: 2 Hr/week
Credit: 1

**Examination Scheme:**
In-Sem: 25 Marks

**Course Objectives:**

To facilitate the learners:
1.To learn the fundamentals of C programming for logic building.
2.To implement solution of given problem using appropriate data type, operators of C language.
3.To understand the decision and iteration interpretation in a programming language.
4.To implement the logic using arrays, strings, functions and structures of C programming language.

**Course Outcomes:**

By taking this course, the learner will be able to:
1. Apply logic development skills to solve simple real life problems.
2. Implement, test and execute developed logic or algorithm to C program using appropriate data type, operators.
3. Implement the given problem using appropriate control structures available in C language.
4. Identify different functions for a problem to construct a modular solution.

Following example list of problems are grouped into A, B and C, with increasing level of difficulty and understanding. Group A problem statements addresses the concepts of constant, variable, data type, operator and expressions. Group B problem statements addresses the concept of control structures and Group C includes problem which can be solved using functions and string concepts along with the concept covered in Group A and Group B.
Assignments can be framed and expanded in such a way that it explores concepts, language constructs, logic of solution and simple application. Students will be encouraged to solve open problems in different domains. Course tutor will set up assignments to challenge students through code debugging, code improvisation and code transformation. Course tutor will appropriately adopt assignments on similar lines as the examples shown here.

Instructors can conduct a total 10 assignments . Four assignments from Group A, four assignments from Group C and two assignments from Group C.

**Example List of Assignments**

**(Minimum 10 assignments to be implemented, covering maximum Four from each Group.Assignment number 9,10,11 from Group C can be considered as extra assignments. Students can explore more on C constructs to implement these assignments. ) :-**

**Group A**

Group A problem statements addresses the concepts of constant, variable, data type, operator and expressions.

1) Write C programs for basic problems Engineering Mathematics and Physics like area calculation, sin wave calculation, speed calculation, determine type of trainagle, verify pythogarous theorem etc.
2) Write C program to convert feet to inches, convert inches to centimeters, and convert centimeters to meters. Write a program that prompts a user for a measurement in feet and converts and outputs this value in meters. Facts to use: 1 ft = 12 inches, 1 inch = 2.54 cm, 100 cm = 1 meter.
3) Write a C program to swap 2 numbers.
4) Write C program to convert Kilograms to grams, convert grams to milligrams and vice a versa.
5) Write C program to convert Dollar to Rupees, convert Euro to Rupees, and vice a versa.
6) Write C program for temperature conversion Degree to Fahrenheit and vice a versa.
7) Write a C program to convert specified days into years, weeks and days.
8) Write a C program that accepts three integers and find the maximum of three.

**Group B**

Group B problem statements addresses the concept of control structures such as for loop, while loop.

1) Write C program to calculate Least common multiple (LCM) and Greatest Common Divisor (GCD) of given number.
2) Write C program to check whether the given number is prime or not.
3) Write C program to print a given pattern.
4) Write a C program to obtain the first 25 numbers of a Fibonacci sequence. In a Fibonacci sequence the sum of two successive terms gives the third term. Following are the first few terms of the Fibonacci sequence: 1 1 2 3 5 8 13 21 34 55 89...
5) Write C program for simple interest and compound interest calculation.

**Group C**

Group C includes problem which can be solved using functions and string concepts along with the concept covered in Group A and Group B.

1) Write a C program to swap 2 integers using user defined functions (call by value, call by reference).
2) Write a program in C to compute the factorial of the given positive integer using function.
3) Write a menu driven program to perform following operations using Array of integers like (accept, display, sum of all numbers, search a number, maximum and minimum of number).
4) Write a menu driven program to perform string operations.
5) Write a program in C to compute addition / subtraction / multiplication of two matrices.
6) Write a C program to perform employee operations such as accept, display, search by name, search by number, update a record. Explore the possibility of modularity for implementation.
7) Write a C program to perform bank account related operations such as accept, display, withdraw and deposit money, check balance.
8) A string is provided from the user. Calculate the total number of characters in the string and the total number of vowels in the string with the number of occurrence in the string.

9) For a class an examination is conducted and the results for the students of all the 5 subjects are recorded. Write C program to display the record of students. On the basis of the record compute:
   i. The average score of class
   ii. Highest score and lowest score of class
   iii. Marks scored by most of the students
   iv. List of students who were absent for the test
10) Write a menu-based modular program in C to perform following operations for complex numbers:
   i. reading a complex number
   ii. writing a complex number
   iii. addition of two complex numbers
   iv. subtraction of two complex numbers
   v. multiplication of two complex numbers
11) Two friends issued 5 books each from the library, Write a program in C to compute set operations
   i. List of all books with them
   ii. List common titles with them
   iii. List of books with friend1 but not with friend 2

## 20ES07 Technical Skill Development Laboratory

**Teaching Scheme:**

Practical: 2 Hrs/Week

Credit: 01

**Examination Scheme**:

In-Semester: 25 Marks

**Course Objective**: Student will able to learn

I. To identify tools, work material and measuring instruments useful for assembly dissemble of products and different machining operations
2. To handle tools and instruments and use them to prepare joints of specific shape and size.
3. To install software and Operating system on computers

**Course Outcome**: Student will able

1. To select suitable tools for assembly- dissemble a product.
2. To produce joints using materials of specific shape and size by a suitable set of operations and check the accuracy of shape and dimensions using measuring instruments
3. To install operating systems and software on computers

Content:

| Sr. No | Description | Hrs |
|---|---|---|
| 1 | Use of measuring devices and instruments: Vernier Calliper, Micrometer, Digital Multi-meter, Tachometer, Lux meter etc. | 2 |
| 2 | Assembly -disassembly of products: Electric Iron, Water Purifier, Fan, Mixer Grinder etc. | 4 |
| 3 | Use of joining methods: Soldermg and Welding. | 4 |
| 4 | Study and Hands on different day to day machining operations: such as drilling, tapping PVC pipe fitting, hacksaw cutting and filing. | 2 |

| | | |
|---|---|---|
| 5 | Use of Machine Tool (Lathe machine) | 6 |
| 6 | Basic troubleshooting computer System in Hardware and Software.<br>Installing and Uninstalling software's (OS 4 APPS)<br>Computer system security aspects (Physical and logical) | 6 |

**NOTE: Practical No. 5 is For Mechanical Engineering Branch and Practical No. 6 is for COMP/IT/E&TC/INSTRU Branch

**Text Books:**

I. Elements of Mechanical Engineering - Hajra Choudhury & others, Media Promoters 2010.
2. The Elements of Workshop Technology - Vol I & Il, SK. Hajra Choudhury, A.K. Hajra Choudhury, Nirjhar Roy, I Ith edition 2001 others, Media Promoters and Publishers, Mumbai.

**Reference:**

I. Workshop manual prepared by Department of Mechanical Engineering.