Calculus and Linear Algebra - MATH 101

Course: Calculus and Linear Algebra
Course Code: MATH 101
Credit Hours: 3
Full Marks: 100 (75+25)

Course Objective : The objectives of this course are just to provide enough mathematical facts to cope with a wide variety of problems in Engineering and Science. The course demands explaining the fundamental ideas and showing how they are applied in different other disciplines mentioned above.

Contents:

A. Calculus

1. Increments

1.1 Average and instantaneous rates of change
1.2 The slope of a curve $y = f(x)$
1.3 Derivatives as the instantaneous rate of change
1.4 Velocity and other rates of change

2. Limits and continuity

2.1 Properties of limits
2.2 One sided limits, existence of limit at a given point
2.3 Infinity as a limit
2.4 Limits of exponential and logarithmic functions
2.5 Types of discontinuity

3. Differentiation

3.1 Formal definition
3.2 Polynomial functions and their derivatives
3.3 Product, Power and quotient rules
3.4 Implicit differentiation and fractional power
3.5 The chain rule and parametric equations
3.6 Angle between two curves
3.7 Derivatives of trigonometric functions, hyperbolic functions and their inverses
3.8 Derivative of Logarithmic functions and exponential functions and their applications
3.9 Differentials

4. Applications of derivatives

4.1 Curve sketching, the sign of first derivatives
4.2 Concavity and points of inflection

4.3 Asymptotes and symmetry
4.4 Maxima and minima; Theory and problems
4.5 Related rates
4.6 Rolle's Theorem and Mean value theorem
4.7 Indeterminate forms: L' hospital's rule

5. Integration
5.1 Introduction
5.2 Indefinite integration
5.3 Applications of determining constants of integration
5.4 Integrals of trigonometric functions including examples of product of powers of trigonometric functions
5.5 Definite integrals
5.6 Calculating areas as limits
5.7 The fundamental theorem of integral calculus (Statement and its application)
5.8 Basic integration formulas
5.9 Substitution methods:
i. a2 + u2, , ,
ii. Integrals involving ax2+bx+c
iii. z = tan (x/2)
5.10 Integration by parts
5.11 Improper integrals

6. Application of Definite integrals
6.1 Area between curves
6.2 Average value of a function
6.3 Length of a plane curve
6.4 Calculating volume by slicing
6.5 Area of surface of revolution

B. Linear Algebra

7. Sequence and infinite Series
7.1 Sequence of numbers
7.2 Limits that arise frequently
7.3 Infinite series
7.4 Test for convergence of series with non-negative terms
7.5 Absolute convergence
7.6 Alternating series, Conditional convergence

8. System of Linear Equations

8.1 Linear system, Consistent and inconsistent
8.2 Row rank, Unique and parametrically represented solutions

9. Vector spaces
9.1 Introduction to vectors
9 .2 Linear combinations
9 .3 Spans of vectors
9 .4 Linear dependence and independence
9 .5 Bases and basis selection
9 .6 Dimension and rank

10. Eigenvalues, Eigenvectors and Linear Mapping
10 .1 Characteristic equations
10 .2 Eigenvalue and Eigenvectors
10 .3 Linear transformation (upto R3) and its properties

Recommended Text Books
1. Thomas / Finney: *Calculus and Analytical Geometry*, 9th Editions Narosa Publishing House, New Delhi
2. J.W.Brown/ D.R. Sherbert: *Introductory Linear Algebra*, Bindle, Weber and Schmidt
3. D.T.Finkbeiner: *Introduction to Matrices and Linear Transformations*, 3rd edition CBS publisher and distributors, Delhi.

Reference Books:
1. S.S.Sastry: *Engineering Mathematics*, PHI.
2. H.K.Dass: *Advanced Engineering Mathematics*, S.Chand, New Delhi

CHEM 101

CHEM 101 GENERAL CHEMISTRY 3 Credits

Syllabus:

Mole Concept and properties of solutions: Chemical Equilibrium: Introduction; Equilibrium constant; Factors affecting equilibrium; Le ' Chateliers principle; Effects of change in temperature, pressure, concentration of the reactants and

products, and inert gas on some simple chemical reaction at equilibrium; Solubility product of sparingly soluble salts; Acids and bases, pH; Chemical equilibrium in acids and bases; Buffer solution; Acid-base titration and choice of suitable indicator.

Redox Reaction: Oxidation state; Half reaction; Balancing the redox reaction; Redox titration

Electrochemistry: Electromechanical equivalence and Faraday's law; Conductivity of electrolytes and Arrhenius ionization theory; Dependence of cooductivity upon the concentration and temperature; Activity and activity coefficient; Debye Hukel theory of ionic attraction; Application of conductivity measurements; Electrochemical cells; Reversible and irreversible cells; EMF and its measurement; Cell reaction and EMF; Single electrode potential; Thermodynamics of electrode potential; Types of electrodes and electrochemical cells (chemical cells and concentration cells)

Chemical Kinetics: Introduction; Order and molecularity; Rate constant; Reactions of different orders; Kinetics of parallel opposing and consecutive reactions; Kinetics and mechanism of some simple chemical reactions; Effect of temperature on reaction velocity; Qualitative approach to 'collision' and 'activated state' theory.

Catalysis: Homogeneous and heterogeneous catalysis; Mechanism of catalysis; Transition metals as catalysts; Enzymes catalysis; Catalytic poisoning

Nuclear Chemistry: Natural radioactivity; Types of radioactivity; Rate of radioactive decay; Use of radioactive isotopes; Stability of nucleus binding energy; Nuclear reactions.

References:

1. H Mahan, University Chemistry, Narosa Publishing house

ENGG 101

ENGG 101 ENGINEERING PROJECT PREPARATION 2 Credits

Objective: *To introduce students to the concepts of project work and to give practice in basic engineering skills*

Syllabus:

Introduction: Definition of project; Practical exercises to draw out importance of setting goals; Planning, working as a team and assessing final achievements.

Workshop Skills: Various workshop skills such as metalworking, woodworking, use of hand tools, drilling and soldering, printed circuit board fabrication, and soldering practice

EDRG 101

EDRG 101 ENGINEERING DRAWING I 2 Credits

Objective: *To introduce with engineering drawing skills*

Syllabus:

Introduction: Introduction to engineering drawing and instruments used in engineering drawing: examples- drafter, types of pencil, set squares etc.; Layout of drawing sheets; Types of lines; Lettering and its types; Layout and lettering practice.

Dimensioning: Unit of dimensions; System of dimensioning; Shape identification dimensioning

Engineering Scale: Representative factor; Construction and types of scales: plain scales, diagonal scales, Vernier scales, comparative scales, and scale of chords.

Geometrical Constructions: To divide the lines into any number of equal parts; To divide a given angle into even number of divisions; To draw an arc tangential to a line and passing through a point; Construction of regular polygons.

Introduction Of Engineering Curves: Terminology used in engineering curves and brief discussion about types and applications of engineering curves; Definition and terminology of conic section and applications; Construction of conic sections

Ellipse: Definition, terminology, and applications; Finding out foci when major and minor axis are given; Drawing tangents to ellipse at a point on the ellipse or from a point outside the ellipse;

Different methods of construction of ellipse: Pin and Thread Method, Intersecting Method, Rectangle Method, Circle Method, Trammel Method, Concentric Circle Method, Parallelogram Method, and Four Centers Approximate Method

Parabola: Definition, terminology and applications; To find the axis, focus and directrix of a parabola; Drawing tangents to the parabola either at a point on the parabola or from a point outside the parabola when the focus and directrix are given and when the focus and directrix are not given; Different methods of construction of parabola: Rectangle Method, Parallelogram Method and Tangent Method

Hyperbola: Definition, terminology and applications; Drawing tangents to the hyperbola either at a point on the hyperbola or from the point outside the hyperbola; Different methods of construction of hyperbola; Definition and construction of rectangular hyperbola

Involutes: Definition, terminology, and applications; Drawing tangent and normal at a point on involutes; Definition and construction of involutes by involute of a line, involute of a triangle, involute of a polygon

Spirals: Definition, terminology, and applications; Definition and construction of Archemedian and Logarithmic spirals; Drawing tangent and normal at a point on spirals

Cycloidal Curves: Definition, terminology, and applications; Definition and construction of epicycloid and hypocycloid; Drawing tangent and normal at a point on cycloidal curves; Definition, terminology and applications of trochoid, epitroichoid and helix

Orthographic Projections: Projection of an object; Principal views and principal planes of projection; Four quadrants and system of projection; First angle and third angle projection, Difference between them and their advantages; Symbols of projection; Projection of points; Projection of lines; Definition, true length and true

inclination of a line, line parallel to both the planes, line parallel to one plane and perpendicular to other plane, line parallel to one plane and inclined to other, line inclined to both horizontal and vertical plane; Convention for line thickness

Projection of Plane Surfaces: Definition; True shape of a plane surface; Plane surface parallel to one of the principal planes and perpendicular the other two; Plane surfaces perpendicular to one of the three principle planes and inclined to other two; Plane surfaces inclined to all the three principal planes of projection

Projection of Solids: Definition of solids; Classification of solids, e.g. polyhedrons, prisms, and pyramids; Projection of solids placed in different positions: axis of the solid perpendicular to HP, axis of the solid perpendicular to VP, axis of the solid perpendicular to HP and parallel to VP, axis of the solid inclined to VP and parallel to HP, and axis of the solid inclined to both HP and VP; Methods of solving the problems of cubes, cones, prisms, cylinders, and pyramids

Surface Development: Methods of development: parallel line development, radial line development, triangulation development, and approximate development

ENGG 111 Elements of Engineering I

Department of Mechanical Engineering - Course Catalogue 2

Objective: This course will accommodate the civil engineering foundations in the existing Basic

Mechanical Engineering taking advantage of commonalities in the topics shared by those courses

Including Mechanics, Strength of Materials and Fluid Mechanics. The topics covered by Basic

Mechanical Engineering will be restructured and made into three major topics instead of existing five

topics. The additional topics will include the topics in basic civil engineering will include building

materials, components and structure; and surveying.

Engineering Mechanics and Strength of Materials [9 hr.]

Equivalent force systems: equilibrium, friction, cables, centre of gravity. Velocity, acceleration,

momentum, Newton's second law of motion, the moment law, work and energy, rotation about a fixed

axis. Concepts of stress, strain, stress-strain diagram, Hook's law.

Building Materials, Components and Structure

Civil Engineering Materials: Bricks, stones, sand, cement, concrete, steel sections. Foundations: Types,

bearing capacity. Requirements of good foundations. Superstructure: Brick masonry, stone masonry,

beams, columns, lintels, roofing, flooring, plastering. Mechanics: Internal and external forces. Types of

Bridges and Dams. Basics of Interior Design and Landscaping.

Surveying

Fundamental Definitions and Concepts, Chain Surveying, The compass leveling, Plane table surveying,

Theodolite, EDM & Total station, Contouring, GIS and remote sensing

Thermal Engineering and Thermal Power Plants

Laws of thermodynamics, heat engines, gas power cycles – Otto, Diesel, Brayton, Rankine cycles.

Internal combustion engines. Vapour power cycles and thermal power plants. Refrigeration and air

conditioning.

Fluid Mechanics and Hydraulic Machineries

Introductory concepts, fluid properties, fluid in motion, types of flows, continuity equation, mass

conservation equation, Bernoulli's equation, boundary layer. Turbo machines, types of hydro turbines,

axial flow and centrifugal flow machines. Pumps.

COMP 103: Structured Programming [2 Credit]

Objectives

This course introduces the fundamental concepts of procedural programming in C.Topics include data types, control structures, functions, arrays, etc. This course also focuses on the development of problem solving skills using programs.

Contents:

1. Introduction to Computer System

1.1. Brief History of Computation

1.2. Architecture and Peripherals

2. Introduction to Software Systems

2.1. System Software

2.2. Application Software

2.3. Programming Language

3. Introduction to Software Life Cycle

3.1. Problem Solving and Software Engineering – a brief introduction

(SDLC)

3.2. Algorithms and Flowchart

4. Fundamentals of C

4.1. The C Character set

4.2. Identifiers and Keywords

4.3. Data Types

4.4. Variables, Constants, Declarations Statement

5. Operators and Expressions

5.1. Introduction

5.2. Arithmetic Operators

5.3. Unary Operators

5.4. Relational and Logical Operators

5.5. Assignment Operators

5.6. Conditional Operators

5.7. Operator Precedence

6. Decision Control Statements

6.1. Introduction

6.2. The if-else Construct

6.3. The nested if-else Constructs

6.4. The else-if Ladder Construct

6.5. The switch Construct

7. Loop Control Statement

7.1. Introduction

7.2. The While Construct

7.3. The do-while Construct

7.4. The For Construct

8. Functions

8.1. Anatomy of a Function (Defining a function, accessing a function)

8.2. Function Prototype

8.3. Recursion (Introduction and Some Program)

9. Program Structure

9.1. Storage Classes

9.2. Automatic, External and Static variables

10. Arrays

10.1. Introduction

10.2. Processing and Array

10.3. Passing Arrays to Functions

10.4. Multidimensional Array

11. Structures

11.1. Understanding C's Structures

11.2. Referencing a Structure Member

11.3. Using Structure with Function Calls

11.4. Arrays of Structures

11.5. Understanding Unions

12. Pointers

12.1. Introduction

12.2. Passing Pointers to Functions

12.3. Pointers and One Dimensional Array

12.4. Pointers to Structures

12.5. Dynamic Memory Allocation

12.6. Operations in Pointers

Text Books:

Byron s. Gottfried, "Theory and Problems of Programming with C, 2/e", McGrawHill.

Robert L Wood, "C Programming for Scientists and Engineers", Penton Press.

Evaluation:

Internal = 50

Final = 50