BACHELOR
IN
CIVIL ENGINEERING

Year : I **Part : I**

Teaching Schedule								Examination Scheme							
								Theory			Practical				
S. N.	Course Code	Course Title	Credits	L	T	P	Total	Assessment Marks	Final		Assessment Marks	Final		Total	Remark
									Duration hours	Marks		Duration hours	Marks		
1	SH 101	Engineering Mathematics I	3	3	2	-	5	40	3	60	-	-	-	100	
2	SH 103	Engineering Chemistry	3	3	1	3	7	40	3	60	25	-	-	125	
3	CT 101	Computer Programming	3	3	1	3	7	40	3	60	50	-	-	150	
4	EE 103	Basic Electrical and Electronics Engineering	3	3	1	1.5	5.5	40	3	60	25	-	-	125	
5	CE 101	Engineering Mechanics	4	4	2	-	6	40	3	60	-	-	-	100	
6	CE 102	Engineering Geology I	2	2	-	1	3	20	1.5	30	25	-	-	75	
7	CE 103	Civil Engineering Materials	2	2	-	1	3	20	1.5	30	25	-	-	75	
		Total	**20**	**20**	**7**	**9.5**	**36.5**	**240**	**-**	**360**	**150**	**-**	**-**	**750**	

Year : I **Part : II**

Teaching Schedule								Examination Scheme							
								Theory			Practical				
S. N.	Course Code	Course Title	Credits	L	T	P	Total	Assessment Marks	Final		Assessment Marks	Final		Total	Remark
									Duration hours	Marks		Duration hours	Marks		
1	SH 151	Engineering Mathematics II	3	3	2	-	5	40	3	60	-	-	-	100	
2	SH 152	Engineering Physics	4	4	1	2	7	40	3	60	25	-	-	125	
3	ME 158	Engineering Drawing	2	2	-	4	6	20	3	30	50	-	-	100	
4	CE 151	Strength of Materials	3	3	1	1	5	40	3	60	25	-	-	125	
5	CE 152	Engineering Geology II	2	2	-	1	3	20	1.5	30	25	-	-	75	
6	CE 153	Engineering Survey I	3	3	1	4	8	40	3	60	50	-	-	150	
		Total	**17**	**17**	**5**	**12**	**34**	**200**	**-**	**300**	**175**	**-**	**-**	**675**	

ENGINEERING MATHEMATICS I

SH 101

Lecture : 3 **Year : I**
Tutorial : 2 **Part : I**
Practical : 0

Course Objectives:
To equip the students with the essential mathematical skills and techniques that are relevant to the engineering fields and enable them to solve engineering problems using mathematical methods.

1 Derivatives and its Applications (10 hours)

1.1 Review of derivative and differentiability, mean value theorems with interpretations
1.2 Indeterminate forms, types and their real life examples, L-Hospital's Rule
1.3 Power series of single valued functions
  1.3.1 Taylor's series
  1.3.2 Maclaurin's series
1.4 Asymptotes to Cartesian and Polar curves
1.5 Pedal equation to Cartesian and Polar curves
1.6 Curvature and radius of curvature for Cartesian curves

2 Antiderivatives and its Applications (11 hours)

2.1 Review of definite and indefinite integrals
2.2 Differentiation under integral sign
2.3 Improper integrals
2.4 Application of Beta and Gamma functions
2.5 Area, arc length, volume and surface of revolution in plane for Cartesian curves
2.6 Centroid and moment of inertia under area of curve

3 Ordinary Differential Equations and its Applications (10 hours)

3.1 Review of: Order, degree, solution of first order first degree differential equations by variable separation method and solution of homogeneous equations.
3.2 Linear differential equation and equations reducible to linear differential equation of first order Bernoulli’s equation, modeling electric circuit
3.3 First order and higher degree differential equations; Clairaut’s form

3.4 Linear second order differential equations with constant coefficient and variable coefficients reducible to constant coefficients, Cauchy's equations and modeling mass spring system

3.5 Application in physical sciences and engineering

4 Plane Analytic Geometry (4 hours)

4.1 Transformation of coordinates: Translation and Rotation

4.2 Equation of conic in Cartesian and polar form, identification of conics

5 Three dimensional geometry (10 hours)

5.1 The Straight line: symmetrical and general form

5.2 Coplanar lines

5.3 Shortest Distance

5.4 Sphere: General equation, plane section by planes, tangent planes

5.5 Introduction to right circular cone and right circular cylinder

Tutorials

There shall be related tutorials exercised in class and given as regular homework exercise. Tutorial can be as following for each specified chapters

1. Derivatives and its Applications
2. Antiderivatives and its Applications
3. Ordinary Differential Equations and its Applications
4. Plane Analytic Geometry
5. Three dimensional geometry

Reference

1. Jeffery A., (2001), Advanced Engineering Mathematics (1st ed.), Academic Press.
2. O'Neill, P.V., (2003), Advanced Engineering Mathematics (5th ed.), Thomson Learning.
3. Kreyszig , A. (1993), Advanced engineering Mathematics (7th ed.), John Wiley & Sons.
4. Sastry S.S. (2008), Engineering Mathematics Volume I and II (4th ed.). PHI India.
5. Wylie C. and Barrett L.(1995), Advanced Engineering Mathematics (6th ed.), McGraw-Hill College.
6. Thomas, T. and Finny, R. (1984), Calculus and Analytic Geometry (6th ed.), Addison-Wesley.

ENGINEERING CHEMISTRY

SH 103

Lecture : 3 **Year : I**
Tutorial : 1 **Part : I**
Practical : 3

Course Objectives:
To develop the basic concepts of physical chemistry, inorganic chemistry, analytical chemistry, environmental chemistry, green & sustainable chemistry, nano chemistry, polymer chemistry and organic chemistry relevant to the different disciplines of engineering.

1 Electrochemistry and Buffer (8 hours)

- 1.1 Electrochemistry
  - 1.1.1 Introduction
  - 1.1.2 EMF of galvanic cell, Nernst equation
  - 1.1.3 Polarization and Overpotential
  - 1.1.4 Butler-Volmer equation and Tafel plots
- 1.2 Electrode processes and mechanisms
  - 1.2.1 Charge transfer processes at electrodes
  - 1.2.2 Mass transfer and diffusion in electrochemical systems
- 1.3 Industrial and applied electrochemistry
  - 1.3.1 Batteries: Lead acid and lithium ion
  - 1.3.2 Solar-photovoltaic cell, fuel cell
  - 1.3.3 Corrosion
- 1.4 Buffer, buffer range, buffer capacity and buffer solution and its applications

2 Catalyst and Catalysis (4 hours)

- 2.1 Definition and types
- 2.2 Design and criteria
  - 2.2.1 Structure-activity relationships
  - 2.2.2 Selection criteria of catalyst
- 2.3 Photocatalysis and electrocatalysis
- 2.4 Catalysis for energy and environmental applications
  - 2.4.1 Catalytic conversion of fossil fuels
  - 2.4.2 Renewable energy catalysts
  - 2.4.3 Catalyst for pollution control

3 Analytical Techniques and their Applications (6 hours)

3.1 Chromatography
3.2 Mass spectroscopy
3.3 X – ray diffraction (XRD)
3.4 UV – visible spectroscopy
3.5 Infrared – spectroscopy (IR)
3.6 Nuclear magnetic resonance spectroscopy (NMR)

4 Metal Complexes, Rare Earth Elements and Metal alloys (6 hours)

4.1 Complexes
  4.1.1 Introduction and Werner's theory
  4.1.2 Geometry of complex by VBT and its applications
  4.1.3 Crystal Field Theory: Principle and applications
4.2 Rare earth elements: Introduction and applications
4.3 Metallic alloys and applications

5 Sustainable Chemistry (7 hours)

5.1 Green chemistry: Introduction and principles
5.2 Water chemistry
  5.2.1 Importance of water quality standards
  5.2.2 Degree of hardness, scale formation in boiler and softening of hard water
  5.2.3 Water pollution with reference to turbidity, COD, BOD, heavy metals, radioactive substances, and plastic
  5.2.4 Industrial wastewater and its treatment
5.3 Air pollution
  5.3.1 Particulate matter, SOx, NOx, GHGs, VOCs, their impacts and remedies
5.4 Waste management
  5.4.1 Segregation and management of solid waste
  5.4.2 Management of biodegradable waste into energy
  5.4.3 E-waste and its management

6 Nanoscience and Nanotechnology (3 hours)

6.1 Introduction and types of nano materials (0-, 1-, 2-, and 3- dimensional)
6.2 Nanoparticles, Nanofibers, Nanowires, Carbon nanotubes, graphene, Mxene, quantum dots, and their uses
6.3 Preparation of nanomaterials

7 Engineering Materials (7 hours)

7.1 Polymers
- 7.1.1 Natural and synthetic, organic and inorganic, conducting and non-conducting
- 7.1.2 Types of polymerizations: Addition and condensation polymerization
- 7.1.3 Preparation and applications of – Epoxy resin, polyurethane, Kevlar, polycarbonate, polymethyl methacrylate, polyacrylonitrile, silicones; phosphorus based polymer, Sulphur based polymer
- 7.1.4 Conducting polymers: Synthesis and application
- 7.1.5 Composite: Fiber reinforced polymer
- 7.1.6 Natural polymers: cellulose, chitin, chitosan, collagen

7.2 Cement: Hydration and setting chemistry of cement

8 Explosives, Lubricants and Paints (4 hours)

8.1 Explosives
- 8.1.1 Types of explosives: Primary, low and high explosives
- 8.1.2 Preparation and applications of TNT, TNG, Nitrocellulose and Plastic explosives

8.2 Lubricants: Introduction, function and classification

8.3 Paints
- 8.3.1 Introduction, requisites, types and applications
- 8.3.2 Environmental and health impact

Laboratory

1. Determine of total, temporary and permanent hardness of water sample using complexometric titration.
2. Determine the alkalinity of water sample A and B by double indicator titration.
3. Estimate the amount of residual chlorine in water by iodometric titration.
4. Prepare the standard buffer solution (acidic or basic) and measure the approximate pH of given unknown solution by using Universal Indicator.
5. Compare the cleansing power of two sample of detergents by determining the reduction they cause in surface tension of water.
6. Construct Daniell cell and study the variation of cell potential with concentration.
7. To separate the pigments through the process of paper / thin layer chromatography.
8. Determination of total iron in ground water using spectrophotometer technique.
9. Determination of amount of copper and iron in a given mixture solution by K2Cr2O7 titration.
10. To prepare Cross – linked polymer by condensation polymerization method.
11. Standardize Potassium Permanganate Solution and use it to estimate the amount of Iron and determine the Percentage purity in the sample of Ferrous salt Solution.
12. Prepare Ni-DMG Complex and to estimate the amount of Nickel in it.

Reference

1. S.H. Maron and C. Prutton, Principles of Physical Chemistry, 4th Edition, Oxford and IBH Pub. Co., 1992.
2. J.D. Lee, Concise Inorganic Chemistry, 5th Edition, John Wiley and sons, Inc., 2007.
3. R.D. Madan & Satya Prakash, Inorganic Chemistry, S. Chand & Company Ltd., 1994.
4. S. Bahl, G.D. Tuli & A. Bahl, Essential of Physical Chemistry, Revised Multicolor Edition, S. Chand & Co. Ltd., New Delhi, 2009.
5. A.K. Bhagi & G.R.T. Morrison & R.N. Boyd, Organic Chemistry, 6th and 7th Edition, Prentice – Hall of India Pvt. Ltd., 2008.
6. R.T. Morrison & R.N. Boyd, Organic Chemistry, 6th and 7th Edition, Prentice – Hall of India Pvt. Ltd., 2008.
7. Vogel's Textbook of Quantitative Chemical Analysis, 6th Edition, Pearson Education 2008.
8. B.S. Murthy, P. Shankar, Baldev R, B. B. Rath & James Murday, Textbook of Nanoscience and Nanotechnology, Series in Metallurgy and Materials Science, Baldev Raj (Ed.), Universities Press Private Hyderabad, India, 2012.. Chatwal, Environmental Chemistry, Himalaya Publishing House, Mumbai.

COMPUTER PROGRAMMING

CT 101

Lecture : 3 **Year : I**
Tutorial : 1 **Part : I**
Practical : 3

Course Objectives:

The primary goal of this course is to provide students with a solid foundation in the principles of programming and to impart practical skills in the C programming language. This course ensures that students comprehend the fundamental concepts of variables, data types, control structures, and functions within the context of C. Advanced topics such as pointers, structures, file handling and the Standard C Library are explored to broaden students' programming capabilities. Also, through project-based assessments and evaluations, students apply their knowledge to real-world scenarios, fostering creativity and project development skills.

1 Introduction to Computer Programming (3 hours)

1.1 Definition of a computer program and programming language
1.2 Types and Generations of Programming Languages
1.3 Problem-Solving using a Computer
  1.3.1 Problem Analysis
  1.3.2 Algorithm and Flowchart
  1.3.3 Programming
  1.3.4 Compilation, Linking and Execution
  1.3.5 Debugging and Testing
  1.3.6 Documentation

2 Overview of C Programming (3 hours)

2.1 Introduction to C programming
2.2 History and Importance of C
2.3 C Headers and Library Functions
2.4 Basic Structure of a C Program
2.5 Preprocessor Directives
2.6 Tokens in C (Character set, Keywords and Identifiers)
2.7 Type Casting (Implicit and Explicit)
2.8 Data Types, Variables and Constants
2.9 Compiler and IDE for C Programming

3 Operators and Expressions (4 hours)

- 3.1 Introduction to Operators and Expressions
- 3.2 Arithmetic, Relational and Logical Operators
- 3.3 Assignment, Increment and Decrement Operators
- 3.4 Conditional, Bitwise and Special Operators
- 3.5 Comma Operator, size of Operator
- 3.6 Evaluation and Type Conversion in Expressions
- 3.7 Operator Precedence and Associativity

4 Input and Output (3 hours)

- 4.1 Introduction to data I/O in C
- 4.2 Unformatted I/O
  - 4.2.1 Character I/O
  - 4.2.2 String I/O
- 4.3 Formatted I/O
  - 4.3.1 Control String (flags, field width, precision, and specifier)
  - 4.3.2 Formatted I/O (scanf(), printf())

5 Control Structures (8 hours)

- 5.1 Introduction to Simple and Compound Statement
- 5.2 Sequential Statement
- 5.3 Branching Statement
  - 5.3.1 Simple if Statement
  - 5.3.2 if-else Statement
  - 5.3.3 Nested if-else Statement
  - 5.3.4 else-if Ladder
  - 5.3.5 switch Statement
  - 5.3.6 go to statement
- 5.4 Looping Statement
  - 5.4.1 for loop
  - 5.4.2 while loop
  - 5.4.3 do while
  - 5.4.4 Nested loop
- 5.5 Loop Interruption
  - 5.5.1 break
  - 5.5.2 continue

6 Array and Pointer (7 hours)

6.1 Introduction to an Array
6.2 One-dimensional Array
6.3 Two-dimensional Array
6.4 Multidimensional Array
6.5 Introduction to String
6.6 String Handling Functions
6.7 Definition of a Pointer
6.8 Pointer Declaration
6.9 Pointer Arithmetic
6.10 Relationship between Pointer and Arrays

7 User-defined Functions (6 hours)

7.1 Introduction to Function
7.2 Advantages of Function
7.3 Elements of User-defined Function
  7.3.1 Function Definition
  7.3.2 Function Prototype
  7.3.3 Function Parameters
7.4 Storage Class
7.5 Scope Rules
7.6 Category of Functions
  7.6.1 Functions with no arguments and no return values
  7.6.2 Functions with arguments and no return values
  7.6.3 Functions with arguments and return values
  7.6.4 Functions with no arguments and return values
7.7 Recursive functions
7.8 Function Call by Values and Reference
7.9 Passing Array and String to Function

8 Structures (5 hours)

8.1 Defining a Structure
8.2 Declaring and Accessing Structure Elements
8.3 Initializing Structure
8.4 Array of Structure
8.5 Array as member to Structure
8.6 Pointer as member to Structure
8.7 Structure as a member to Structure
8.8 Passing and Returning Structures to/from Function

9 File management (4 hours)

- 9.1 Introduction
- 9.2 Binary and Text File in C
- 9.3 File Opening Modes
- 9.4 Defining, Opening and Closing File
- 9.5 Input-output operations on files
  - 9.5.1 Character I/O (fputc(), fgetc())
  - 9.5.2 String I/O (fgets(), fputs())
  - 9.5.3 Formatted I/O (fscanf(), fprintf())
  - 9.5.4 Record I/O (fwrite(), fread())
- 9.6 Overview of Random File Access
- 9.7 Error handling

10 Recent Trends in Programming (2 hours)

- 10.1 Introduction to Object Oriented Programming (OOP)
- 10.2 Definitions of Class, Method and Object in OOP
- 10.3 Difference between Procedure Oriented and OOP
- 10.4 Overview of other High Level Programming Languages

Laboratory

1. Lab 1: Introduction and Demonstrations of projects written in C
2. Lab 2: Formatted and Unformatted Input/output in C
3. Lab 3: Branching in Control Structure
4. Lab 4: Looping in Control Structure
5. Lab 5: Array in C
6. Lab 6: String in C
7. Lab 7: Pointers in C
8. Lab 8: User Defined functions in C
9. Lab 9: Structure in C
10. Lab 10: File handling in C
11. Group project on C maximum 4 students in a group at the end of the course.

Reference

1. Robert Lafore, “C Programming Using Turbo C++”, SAMS publication
2. E. Balagurusamy, “Programming in Ansi C”, McGraw Hill Education
3. Bryons S. Gotterfried, “Programming with C”, TMH ….

BASIC ELECTRICAL AND ELECTRONICS ENGINEERING

EE 103

Lecture : 3 **Year : I**
Tutorial : 1 **Part : I**
Practical : 1.5

Course Objectives:
The course aims to provide a comprehensive understanding of electrical engineering basics, encompassing circuits, components, and related laws, emphasizing safety in installations. It also seeks to familiarize students with electrical machines, semiconductor devices, and initiate them into applications in digital electronics.

1 Fundamentals of Electrical and Electronics Circuits (12 hours)

- 1.1 Current and Potential
- 1.2 Circuit Components: Source, Conductor, Resistor, Inductor, Capacitor
- 1.3 Ohms Law
- 1.4 Series and Parallel Circuits
- 1.5 Kirchhoff's Law and its application
  - 1.5.1 Nodal Analysis
  - 1.5.2 Mesh Analysis
- 1.6 Introduction to AC Circuits and Parameters
  - 1.6.1 Generation of AC Voltage
  - 1.6.2 Waveforms
  - 1.6.3 Average value
  - 1.6.4 RMS Value
- 1.7 Single Phase AC Circuit Analysis with R, RL, RC and RLC Load
- 1.8 Three phase AC Circuits
  - 1.8.1 Waveform and Advantage
  - 1.8.2 Line and Phase Quantities in Star and Delta Connection
  - 1.8.3 Voltage & current computation in Balance Circuits
  - 1.8.4 Power Measurement in Three Phase Circuits

2 Electrical Machines (14 hours)

- 2.1 Faraday's Law of Electromagnetic Induction
- 2.2 Dynamically and Statically Induced EMFs
- 2.3 Transformer
  - 2.3.1 Introduction of Single-Phase Transformer
  - 2.3.2 Working Principle of Transformer
  - 2.3.3 Components of Transformer
  - 2.3.4 Transformation Ratio
  - 2.3.5 EMF Equation of Transformer
  - 2.3.6 Types of Transformers
  - 2.3.7 Load and No-Load Operation
  - 2.3.8 Ideal and Practical Transformer
  - 2.3.9 Losses and Efficiency
  - 2.3.10 Applications
- 2.4 Three phase induction motor
  - 2.4.1 Construction
  - 2.4.2 Rotating Magnetic Field
  - 2.4.3 Working Principle
  - 2.4.4 Direction of Rotor and Slip
  - 2.4.5 Types of Rotors
  - 2.4.6 Standstill and Running Condition
  - 2.4.7 Modes of Operation
  - 2.4.8 Torque Equations
  - 2.4.9 Torque-Slip Characteristics
  - 2.4.10 Applications
- 2.5 DC Motors
  - 2.5.1 Construction
  - 2.5.2 Working Principle
  - 2.5.3 Back EMF and its Significance
  - 2.5.4 Power Torque Relationships
  - 2.5.5 Types of Motors
  - 2.5.6 Losses and Efficiency
  - 2.5.7 Applications
- 2.6 Synchronous Generator
  - 2.6.1 Construction
  - 2.6.2 Working Principle
  - 2.6.3 EMF Equation
  - 2.6.4 Applications

3 Introduction to Electronics Engineering (11 hours)

3.1 Semiconductor and Doping
3.2 Introduction to Diode
3.3 Characteristics of PN junction diode
3.4 Half-wave and full-wave rectifiers
3.5 Zener Effect
3.6 Zener diode and its characteristics
3.7 Zener diode as a Voltage regulation
3.8 Bipolar junction transistor
  3.8.1 Biasing
  3.8.2 BJT as a switch
  3.8.3 BJT as an amplifier
3.9 Introduction to Digital Electronics
3.10 Logic Gates and Boolean Algebra

4 Electrical Installations (8 hours)

4.1 Consumer Power Supply System
4.2 Overview of Electrical Wiring Components: Switches, Sockets, and Distribution Boards
4.3 Protective devices, their constructions and Sizing,
  4.3.1 Fuse
  4.3.2 MCB
  4.3.3 MCCB
4.4 Wires and Power Cable
4.5 Types of Wiring System
4.6 Determination of Size of Conductor
4.7 Earthing System and its importance
4.8 Electrical Safety Rules

Tutorial

The tutorial sessions will focus on chapter-specific exercises aimed at enhancing understanding and application in Electrical and Electronics Engineering (15 hours)

Assignment

1. Numerical and theory works

Laboratory

1. Verification of Ohms law and Kirchhoff's law
2. Measurement of AC quantities using oscilloscope and study phase relation of RL and RC load.
3. Measurement of line, phase and power in three-phase balanced load.
4. Load test on single phase transformer and T-S characteristics of induction Machine.
5. Connection of electrical installations of residential buildings.
6. To study Characteristics of PN and Zener Diodes and Perform Half wave

and Full Wave rectifiers.

Reference

1. Mehta, V. K., and Mehta Rohit. Principle of Electrical Engineering and Electronics. S. Chand Publishing, 2014.
2. Bhattacharya, S. K. Basic Electrical and Electronics Engineering I, Pearson Education India, 2010.
3. Bakshi, Uday A., and Mayuresh V. Bakshi. Electrical technology. Technical Publications, 2020.
4. Floyd, Thomas L. Digital fundamentals, 10/e. Pearson Education India, 2011.
5. Neidle, Michael. Electrical installation technology. Elsevier, 2016

ENGINEERING MECHANICS
CE 101

Lecture : 4 **Year : I**
Tutorial : 2 **Part : I**
Practical : 0

Course Objectives:
This course helps to analyze the effect of various types of Forces on the particle and rigid body at rest and motion. It also provides concept and knowledge of Engineering Application and helps to understand Structural Engineering in later courses by using basics of Mechanics in their branch of engineering.

1 Basic Concept of Mechanics and Static Equilibrium (5 hours)

1.1 Definitions, Type and Scope of Mechanics
1.2 Fundamental Concepts and Principles of Engineering Mechanics
1.3 Concept of Particle, Rigid and Deformed Bodies
1.4 Physical Meaning of Equilibrium and its Essence in Structural Application
1.5 Equation of Equilibrium in 2D and 3D Analysis of Particle and Rigid Body
1.6 Concept of Free Body Diagram with Examples

2 Forces Acting on Particle and Rigid Body (9 hours)

2.1 Different Types of Forces: Internal/External Force, Adhesive/ Cohesive Force, Point/ Line/ Surface Force and Contact/ Body Force
2.2 Resolution and Composition of Forces
2.3 Principle of Transmissibility and Equivalent Forces
2.4 Varignon's Theorem and it's Application
2.5 Moments of a Force About a Point and About an Axis
2.6 Definition, Types and Characteristics of Couple
2.7 Resolution of a Force into a Force and a Couple
2.8 Resultant of Force and Moment for a System: Coplanar, Concurrent and General Force System
2.9 Concept and Formation of Wrench (Force and Couple Lying on a Single Plane)

3 Friction (4 hours)

3.1 Definition, Types and Uses of Friction, Laws of Friction, Static and Dynamic Coefficient of Friction, Angle of Friction
3.2 Sliding and Overturning Condition of a Body
3.3 Concept and Working Principle of Jackscrew
3.4 Practical Examples of Dry Friction (Ladder and Wedge Friction)

4 Analysis of Simple Beams and Frames (10 hours)

4.1 Introduction to Structures
4.2 Various Types of Load on the Structure
4.3 Various Types of Supports; Reactions and Degree of Freedom
4.4 Internal and External Forces in the Structure
4.5 Relationship Between Load, Shear Force and Bending Moment
4.6 Statically and Geometrically Stable/ Unstable Beams and Frames
4.7 Statically Determinate and Indeterminate Beams and Frames, Degree of Static Indeterminacy
4.8 Axial Force, Shear Force and Bending Moment Diagrams for Determinate Beams and Frames

5 Analysis of Plane Trusses (5 hours)

5.1 Definition of Truss, Assumption of Ideal Truss, Types and Uses of Truss in Engineering
5.2 Statically and Geometrically Stable and Unstable Truss
5.3 Statically Determinate and Indeterminate Truss, Degree of Static Indeterminacy
5.4 Analysis of Truss by the Method of Joint and Section/ Moment

5 Centre of Gravity, Centroid, Moment of Inertia, and Mass Moment of Inertia (5 hours)

6.1 Concepts of Centre of Gravity and Centroid of Line, Area and Volume
6.2 Second Moment of Area/Moment of Inertia and Radius of Gyration
6.3 Perpendicular and Parallel Axis Theorem for Moment of Inertia
6.4 Concept of Mass Moment of Inertia

7 Kinematics of Particles (Rectilinear and Curvilinear Motion) (7 hours)

7.1 Position, Velocity and Acceleration of a Particle for Rectilinear Motion
7.2 Dependent and Relative Motion of Particles
7.3 Position, Velocity and Acceleration of a Particle for Curvilinear Motion
7.4 Projectile Motion
7.5 Tangential and Normal Components of Velocity and Acceleration
7.6 Radial and Transverse Components of Velocity and Acceleration

8 Kinetics of Particles: Force, Acceleration, Energy and Momentum (8 hours)

8.1 Newton's Second Law of Motion, Linear Momentum and Impulsive Motion
8.2 Equation of Motion and Dynamic Equilibrium
8.3 Angular Momentum and Rate of Change of Angular Momentum
8.4 Equation of Motion for Rectilinear and Curvilinear Motion (Rectangular Components, Tangential & Normal Components and Radial & Transverse Components) of Particle
8.5 Work and Energy Principle
8.6 Principle of Conservation of Energy, Concept of Conservative and Non-Conservative System

8.7 Definition and Types of Impact

9 Kinematics and Kinetics of Rigid Body in Plane Motion, Energy and Momentum Methods (7 hours)

9.1 Translation, Rotation and General Plane Motion
9.2 Absolute and Relative Velocity in Plane Motion
9.3 Instantaneous Centre of Rotation
9.4 Equation of Motion: D'Alembert's Principle
9.5 Angular Momentum of Rigid Body
9.6 Principle of Work and Energy for a Rigid Body
9.7 Kinetic Energy for a Rigid Body

Tutorials

There shall be related tutorials exercised in class and given as regular homework exercise. Tutorial can be as following for each specified chapters

1. Basic Concept of Mechanics and Static Equilibrium (2 hours)
2. Forces Acting on Particle and Rigid Body (4 hours)
3. Friction (2 hours)
4. Analysis of Simple Beams and Frames (6 hours)
5. Analysis of Plane Trusses (3 hours)
6. Centre of Gravity, Centroid, Moment of Inertia and Mass Moment of Inertia (4 hours)
7. Kinematics of Particles (Rectilinear and Curvilinear Motion) (3 hours)
8. Kinetics of Particles: Force, Acceleration, Energy and Momentum (3 hours)
9. Kinematics and Kinetics of Rigid Body in Plane Motion, Energy and Momentum Methods (3 hours)

Reference

1. Beer F.P. and E.R. Johntson "Vector Mechanics for Engineers", Tata McGraw Hill Publishing Co.Ltd.
2. R.C. Hibbler, Ashok Gupta, "Engineering Mechanics –Statics and Dynamics", New Delhi, Pearson,
3. I.C. Jong and B.G. Rogers, "Engineering Mechanics- Statics and Dynamics",
4. R. Suwal, "A Text Book of Applied Mechanics" Second Edition, Mark Line Publication
5. H.R. Parajuli and S. Neupane "Applied Mechanics for Engineers" M.K. Publishers and Distributors
6. H.R. Parajuli and S. Neupane "Applied Mechanics II (Dynamics) for Engineers" M.K. Publishers and Distributors
7. M.R. Dhital, "A Course Manual on Applied Mechanics I (Statics)", TU, IOE, CIMDU,
8. M.R. Dhital, "A Course Manual on Applied Mechanics II (Dynamics)", TU, IOE, CIMDU,
9. Shame, I.H., "Engineering Mechanics- Statics and Dynamics", Prentice Hall of India, New Delhi,

10. D.K. Anand and P.F. Cunnif, “Engineering Mechanics- Statics and Dynamics”,
11. R.S. Khurmi, “A Text Book of Engineering Mechanics”,
12. Egor. P. Popov “Engineering Mechanics of Solids”, New Delhi, Prentice Hall of India.

ENGINEERING GEOLOGY I

CE 102

Lecture : 2 **Year : I**
Tutorial : 0 **Part : I**
Practical : 1

Course Objectives:
The course will provide the basic knowledge of engineering geology to the civil engineering students. Students will be able to understand the fundamental of engineering geology and various natural process and their influence on the surface as well as sub-surface features, identification of rocks and their significance, enhance the knowledge of mountain building process and importance in the field of civil engineering

1 Introduction to Engineering Geology (2 hours)

1.1 Introduction to Geology, its branches, and their interrelationships
1.2 Definition of engineering geology and its importance in civil engineering
1.3 Importance of engineering geology in the context of Nepal

2 Structure of the Earth (3 hours)

2.1 Origin, and internal structure of earth
2.2 Plate tectonics and mountain building process
2.3 Geological time scale and evolution of life

3 Mineralogy and Petrology (7 hours)

3.1 Formation of minerals, crystal morphology, physical and chemical properties of minerals
3.2 Rock forming minerals and their engineering significance
3.3 Formation of rocks and their classifications
3.4 Introduction, classification, structure, texture, uses, engineering significance and field identification criteria of igneous rock, sedimentary rock, and metamorphic rock

4 Structural Geology (8 hours)

4.1 Introduction of geological plane and its orientation (Dip, Strike, Plunge, and Trend)
4.2 Study of different geological structures: Primary sedimentary structures (bedding, lamination, cross-bedding, ripple marks etc.) and secondary structures (Lineation, foliation, folds, joints, faults, and thrusts)
4.3 Field identification criteria of the different geological structure with their importance in civil engineering

5 Physical Geology (6 hours)

5.1 Introduction, definition, different geological agents (river, groundwater, glacier, wind, and sea water)
5.2 Weathering and erosion, different geomorphological features produced by geological agents
5.3 Volcanism

6 Geology of the Himalaya (4 hours)

6.1 Evolution of the Himalayas
6.2 Tectonic sub-division of the Himalaya (Indo-Gangetic Plain, Siwalik, Lesser Himalayas, Higher Himalaya, Tibetan-Tethys Himalayan zone) and physiographic sub-division of the Himalaya
6.3 Major discontinuities systems and their engineering significance and engineering geological problems in the different tectonic sub-division of the Himalaya

Laboratory

1. Identification of common rock forming minerals (Quartz, Feldspar, Muscovite, Biotite, Chlorite, Calcite, Dolomite, Tourmaline, Pyrite, Talc, Fluorite, Apatite, Corundum, Diamond, Kyanite, Sillimanite, Garnet and clay minerals)
2. Identification of rocks: Shale, Limestone, Sandstone, Siltstone, Conglomerate, Slate, Phyllite, Schist, Gneiss, Quartzite, Marble, Granite, Rhyolite, Gabbro, Basalt, Amphibolite, Syenite)
3. Study of different geological structures in the block diagram
4. Study of maps: Topographic and geological maps, construction of geological cross-section and their interpretation

Field works (2 days)

A two-day fieldwork to provide practical on-site knowledge on preparation and interpretation of engineering geological mapping (measurement of geological plane using geological compass, identification of minerals and rocks, geomorphology, and geological structures etc). Students submit report after the fieldwork **(Attendance in Fieldwork is Compulsory)**.

Reference

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5. Dhital, M.R. (2015), Geology of the Nepal Himalaya, Springer International Published, Switzerland

6. Price, D. (2009). Engineering Geology- Principles and Practice. (M. H. de Freitas, Ed.) Springer.Hoek, E., and Brown, E.T. (2019). The Hoek-Brown failure criterion and GSI-2018 edition, Journal of Rock Mechanics and Geotechnical Engineering, 11, 445-463.
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CIVIL ENGINEERING MATERIALS

CE 103

Lecture : 2 **Year : I**
Tutorial : 0 **Part : I**
Practical : 1

Course Objectives:
To provide students an introductory knowledge about the wide range of materials used in the construction of engineering projects. This course emphasizes on the property, defects, productions, preservation, alternatives and utilities of various civil engineering materials which would help in selection of the suitable materials for construction projects. This helps to build a base for the selection, adequate consideration and precautions in aspect of materials during design and construction.

1 Basics of Civil Engineering Materials (2 hours)

1.1 Materials used in engineering constructions: buildings; road and bridges; irrigation and hydropower; water, gas and petroleum supply
1.2 Classification of materials on various basis: existence in nature, functions or usage; metallurgy; composition of materials
1.3 Properties: physical; chemical; mechanical; thermal; optical; electrical; magnetic
1.4 Failure of materials: ductile and brittle failure
1.5 Factors affecting selection of materials: properties and performance; attributes and suitability; durability, safety and requirements; availability, reliability and disposability; and economy and environment
1.6 Material and environment interactions: corrosion; weathering; erosion; thermal strain; exposure to moisture, sunlight, and chemicals

2 Stones (3 hours)

2.1 Classification of rocks and aggregates: geological, physical and chemical classifications of rocks; introduction to coarse and fine aggregates
2.2 Properties of stones: physical, chemical and mechanical properties
2.3 Characteristics of good stones: appearance; structure; strength; porosity and absorption; weathering; fire resistance; hardness and toughness; specific gravity; thermal properties
2.4 Selection and use of stones: selection criteria; various uses of stones in engineering constructions
2.5 Deterioration and preservation of stones: deterioration and its retardation; preservation and preservatives used in stones
2.6 Production, storage and handling of stones: natural bed of stones; selection of quarry site; methods of quarrying; dressing of stones

3 Clay and Clay Products (3 hours)

3.1 Clay: use of clay in constructions; classification/types of clays; properties of clays

3.2 Brick earth: constituents; properties, testing (consistency test; molding property test; deformation and shrinkage test on burning, strength and quality of brick test)

3.3 Bricks: use of bricks; manufacturing of local bricks; classification and properties (including) mechanical properties) of bricks (unburnt and burnt bricks); characteristics of good bricks; standard tests for bricks (shape and size test; color test; structure test; soundness test; hardness test; water adsorption test; efflorescence test; compressive strength test)

3.4 Tiles: use of tiles; manufacturing process of tiles; types and properties of tiles (roof tiles, wall tiles, floor tiles, drain tiles); characteristics of good tiles

3.5 Terracotta, earthenware and glazing: properties; use; composition; production

3.6 Storage and handling of clay and clay products

4 Lime (2 hours)

4.1 Sources and constituent of limestones: limestones and stone lime; kankar lime; shell lime; magnesian lime; impurities in limestones

4.2 Classification/types of limes: quick lime; flat lime, hydraulic lime, poor lime; hydrated lime; milk lime; lump lime

4.3 Characteristics of lime, hydration of lime, slaking nature of lime, solidification of lime

4.4 Manufacture/production of lime: Flow diagram of lime production from limestone and kankar

4.5 Storage, handling and use of different types of lime

4.6 Types of pozzolanic materials and use with lime: volcanic ash; calcinated clay products; clay/kaolin pozzolana; mineral slag; ashes of organic origin

5 Cement (4 hours)

5.1 Fundamentals of cement: ingredients of cement; type and properties of cement; storage, handling and use of cement; characteristics of good cement

5.2 Classification of cements: natural and artificial; different types of cements, their composition, properties and applications (ordinary Portland cement (OPC), rapid hardening cement, slow setting cement, Portland pozzolana cement (PPC), white cement, colored cement)

5.3 Manufacture of ordinary cement: dry manufacturing process; wet manufacturing process

5.4 Tests of cement: field test; laboratory tests (fineness test, consistency test, initial and final setting time test, soundness test, compressive and tensile strength test)

5.5 Cement clinkers: compounds of cement clinkers and their functions in cement

5.6 Hydration of cement and admixtures: function and examples of admixture like water proofers, accelerators, retarders, plasticizers, air entraining agents.

6 Mortar (2 hours)

6.1 Function and use of mortar

6.2 Properties of mortar: workability, inertness, setting and hardening, adhesion

6.3 Types of mortars: classification (on the basis of binding materials, bulk density, nature of applications; special mortars); properties and use of different types of mortar

6.4 Preparation, storage and handling of mortar: hand mixing, machine mixing; storage and handling of mortar

6.5 Selection of mortar for different construction works: selection criteria; characteristics of a good mortar

6.6 Testing of mortars: crushing strength test, tensile strength test, adhesiveness test on building unit

7 Timber (3 hours)

7.1 Tree and timber: growth and structure of tree; properties (including mechanical) and use of timber; defects in timber (during growth of trees, after felling of trees); characteristics of good timber

7.2 Classification of tree and properties of wood: hard wood, soft wood

7.3 Seasoning of timber: definition and importance of seasoning; types of seasoning (natural and artificial seasoning)

7.4 Deterioration and preservation of timber: deterioration (physical, chemical, biological); types of preservatives; methods of preservation

7.5 Commercial product of timber: veneers and ply wood; boards (laminated boards, fiber boards, block boards, and batten boards); impreg and compreg timbers

7.6 Bamboo: properties (including mechanical) of bamboo; structural use of bamboo

8 Metals and Alloys (4 hours)

8.1 Metals: classification (ferrous and nonferrous metals); properties (physical, chemical, mechanical, electrical, thermal, magnetic)

8.2 Sources, composition, properties and uses of ferrous metals: pig iron, cast iron, wrought iron, steel, alloys of steel

8.3 Sources, properties and uses of nonferrous metals: aluminum, copper, lead, tin, zinc, magnesium, nickel

8.4 Heat treatment process and its importance in metals: annealing, normalizing, quenching or hardening, tempering, surface hardening (case hardening, nitriding, cyaniding, flame/ induction/laser hardening), defects in heat treatments

8.5 Commercial forms of metals and their uses: sheets, channel sections (I, C, angle, tubular), bars

8.6 Corrosion and its prevention in steel: theory of corrosion and its prevention with enameling; applying metal coatings – galvanizing, tin plating, electroplating; applying coatings – painting and tarring.

9 Paints and Varnishes (3 hours)

9.1 Paints: function and ingredients of paints; characteristics of good paint

9.2 Type, composition, properties and uses of paints: Oil paints; Aluminum paints; Asbestos paints; Bituminous paints; Cellulose paints; Cement paints; Colloidal paints; Emulsion paints; Enamel paints; Graphite paints; Silicate paints; Anticorrosion paints; Plastic paints; Synthetic rubber paints; Distempers

9.3 Varnishes: function and ingredients of varnishes; characteristics of good varnishes

9.4 Type, composition, properties and uses of varnishes: Oil varnish; Turpentine varnish; Spirit varnish; Water varnish; Asphalt varnish; Spar varnish; Flat varnish

9.5 Process of application of different paints and varnishes: application in new surfaces; application in old surfaces

9.6 Defects in paints and varnishes: effects of background (dampness, cleanness movement reactions); effects of weather (blistering, peeling, checking, cracking, flaking, chalking, alligatoring, wrinkling, running and sagging, mildew, bloom, flashing, grining)

10 Miscellaneous Materials (4 hours)

10.1 Asphalt: origin, composition, properties, types and uses

10.2 Bitumen: origin, composition, properties, types and uses

10.3 Tar: origin, composition, properties, types and uses

10.4 Other materials: composition, properties, types and uses of – glass, plastic materials, rubber materials, insulating materials, gypsum products, adhesive and sealant materials, anti-termite treatment, water proofers, geosynthetics , carbon fiber)

10.5 Composite materials: composition, properties, types and uses of – cement steel reinforced concrete, fiber reinforced plastics, glass fiber reinforced cement concrete or plastics, metal matrix composite

10.6 Emerging materials: Calcium silicate bricks; Concrete blocks; Aerated Autoclave Concrete blocks (AAC blocks); Interlocking Compressed Stabilized Earth Blocks (Interlocking CSEB), panels and boards

Assignments

1. Various ways to join timbers and metals
2. Commercially available other new materials used in constructions

Laboratory

1. Water absorption test and bulk density, specific gravity test on brick sample
2. Compressive strength test of brick and stones
3. Consistency test of cement

4. Fineness and soundness test of cement
5. Setting time test of cement
6. Compressive strength of cement
7. Toughness test on steel and timber

Reference

1. Duggal, S. K. (2008). Building Materials. New Delhi: New Age International (P) Ltd., Publishers.
2. Mamlouk, M. S., & Zaniewski, J. P. (2018). Materials for Civil and Construction Engineers. Harlow: Pearson Education Limited.
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