FIFTH SEMESTER

'CIVIL
&
ENVIRONMENTAL ENGINEERING'

DESIGN OF STEEL AND RCC STRUCTURES

Course Code:	445001
Course Title	Design of Steel and RCC Structures
No. of Credits	8 (TH:4,T:0,P:8)

COURSE OUTCOMES: At the end of the course, the student will be able to:

1. Demonstrate a comprehensive understanding of structural steel and sections, including properties of structural steel as per IS Code and the designation of structural steel sections as per IS handbook and IS: 800-2007.
2. Analyze and design riveted connections, considering different types of rivets, permissible stresses & design specifications as per IS 800.
3. Apply knowledge of welded connections, understanding various types of welds, advantages, and disadvantages of welded joints, and design fillet and butt welds for structural components.
4. Analyze and design tension members using single and double angle sections with riveted & welded connections, including gusset plates, following the guidelines of IS: 800.
5. Analyze and design compression members (struts) using single and double angle sections with riveted and welded connections, considering IS: 800 specifications.
6. Understand the concepts of Reinforced Cement Concrete (RCC), reinforcement materials, loading on structures as per IS: 875, and the introduction to Working Stress Method and Limit State Method for RCC design.

DETAILED CONTENTS

1. Structural Steel and Sections:

1.1 Properties of structural steel as per IS Code

1.2 Designation of structural steel sections as per IS handbook and IS: 800-2007

2. Riveted Connections:

Types of rivets, permissible stresses in rivets, types of riveted joints, specifications for riveted joints as per IS 800. Failure of a riveted joint. Strength and efficiency of a riveted joint.

3. Welded Connections:

Types of welds & welded joints, advantages & disadvantages of welded joints, design of fillet and butt weld. Plug and slot welds **(Descriptive only no numerical on plug and slot welds)**

4. Tension Members

Analysis and design of single and double angle section tension members and their riveted and welded connections with gusset plate as per IS: 800

5. Compression Members

Analysis and design of single and double angle sections compression members (struts) and their riveted and welded connections with gusset plate as per BIS:800

6. Introduction to Reinforced Cement Concrete

6.1 Concept of Reinforced Cement Concrete (RCC)

6.2 Reinforcement Materials:

- Suitability of steel as reinforcing material
- Properties of mild steel and HYSD steel

6.3 Loading on structures as per IS: 875

6.4 Brief Introduction to Working stress method, Limit state method

7. Concept of Limit State Method

7.1 Definitions and assumptions made in limit state of collapse (flexure), assumptions & stress strain curve, neutral axis, balanced, under- reinforced & over reinforced beams, Moment of resistance of Beams

7.2 Partial factor of safety for materials

7.3 Partial factor of safety for loads

7.4 Design loads

7.5 Stress block, parameters

8. Singly Reinforced beam -

Theory and design of singly reinforced beam by Limit State Method. Check for shear, Check for deflection, check for development length, Theory of Doubly Reinforced beam.

9. RCC Slab175.0 170

Theory and design of simply supported one way slab by Limit State Method, Theory and design of two-way simply supported slab with corners free to lift, no provisions for torsional reinforcement by Limit State Method

10. Axially Loaded Column

10.1 Definition and classification of columns

10.2 Effective length of column,

10.3 Specifications for longitudinal & lateral reinforcement

10.4 Design of axially loaded square, rectangular and circular short columns by Limit State Method including sketching of reinforcement(sectional elevation and plan)

Important Note: Use of IS: 456 , IS: 800 is permitted in the examination.

(I) RCC Structures:

Reinforcement details from the given data for the following structural elements with bar bending schedules

Drawing No. 1: RCC Slabs - One way slab and Two way slab.

Drawing No. 2 : Beams - Singly and doubly reinforced rectangular beams and Cantilever beam (All beams with vertical stirrups)

Drawing No. 3 : Columns and Footings – Square, Rectangular and Circular Columns with lateral ties and their isolated sloped column footings.

(ii) Steel Structures :

Structural drawing from given data for following steel structural elements.

Drawing No. 1: Roof Truss – Drawing of Fink Roof Truss with details of joints, fixing details of purlins and roof sheets.

Drawing No.2 : Column and Column Bases - Drawing of splicing of steel columns. Drawings of slab base, gusseted base and grillage base for single section steel columns.

Drawing No.3 : Column Beam Connections

Sealed and Framed Beam to Beam Connections

Sealed and Framed beam to Column Connections

PRACTICAL OUTCOMES: At the end of the course, the student will be able to:

1. Demonstrate a comprehensive understanding of structural steel and sections, including properties of structural steel as per IS Code and the designation of structural steel sections as per IS handbook and IS: 800-2007.
2. Analyze and design riveted connections, considering different types of rivets, permissible stresses, and design specifications as per IS 800. Students will also comprehend the failure of riveted joints and apply assumptions in the theory of riveted joints for design purposes.
3. Apply knowledge of welded connections, understanding various types of welds, advantages, and disadvantages of welded joints, and design fillet and butt welds for structural components.
4. Analyze and design tension members using single and double angle sections with riveted and welded connections, including gusset plates, following the guidelines of IS: 800.
5. Analyze and design compression members (struts) using single and double angle sections with riveted and welded connections, considering IS: 800 specifications.
6. Understand the concepts of Reinforced Cement Concrete (RCC), reinforcement materials, loading on structures as per IS: 875, and the introduction to Working Stress Method and Limit State Method for RCC design.

List of Practicals:

1. Properties of Structural Steel Objective: Determine the mechanical properties of structural steel specimens, such as yield strength, tensile strength, and ductility, in accordance with IS code specifications.
2. Identification of Structural Steel Sections Objective: Identify & classify different structural steel sections based on their designations as per IS handbook & IS: 800-2007.
3. Rivet Types and Specifications Objective: Examine different types of rivets, their dimensions, and materials. Understand permissible stresses in rivets as per IS 800.
4. Joint Design - Riveted and Welded Connections Objective: Design riveted and welded joints for axially loaded members and analyze their strength and efficiency. Study the assumptions made in the theory of riveted joints.
5. Analysis and Design of Tension Members Objective: Analyze and design single and double angle section tension members with riveted and welded connections, including the use of gusset plates, as per IS: 800.
6. Analysis and Design of Compression Members Objective: Analyze and design single and double angle section compression members (struts) with riveted and welded connections, including the use of gusset plates, as per IS: 800.
7. Reinforcement Materials Testing Objective: Test and compare the properties of mild steel and HYSD steel reinforcement used in RCC.
8. Loading on Structures and Limit State Method Objective: Calculate the loads on different structural members as per IS: 875. Understand the concept of the Limit State Method.

9. Design of Singly Reinforced Beam Objective: Design a singly reinforced beam using the Limit State Method, and check for shear, deflection, and development length.
10. RCC Slab Design Objective: Design a simply supported one-way slab and a two-way simply supported slab with corners free to lift, without provisions for torsional reinforcement, using the Limit State Method.
11. Design of Axially Loaded Columns Objective: Design axially loaded square, rectangular, and circular short columns using the Limit State Method, and sketch the reinforcement details.

Recommended Books:

1. Punmia, BC; "Reinforced Concrete Structure Vol I", Standard Publishers, Delhi
2. Ramamurtham, S; "Design and Testing of Reinforced Structures", Dhanpat Rai and Sons, Delhi
3. Gambhir, M.L., "Reinforced Concrete Design", Macmillan India Limited
4. Singh, Birinder "RCC Design and Drawing", Kaption Publishing House, New Delhi
5. Singh Harbhajan "Design of Reinforced Concrete Structures" Abhishek Publishers Ltd., Chandigarh
6. Mallick, SK; and Gupta, AP; "Reinforced Concrete", Oxford and IBH Publishing Co, New Delhi.
7. Singh Harbhajan "Limit State RCC Design" Abhishek Publishers Ltd., Chandigarh

*****

GEOTECHNICAL ENGINEERING

Course Code:	025002
Course Title	Geotechnical Engineering
No. of Credits	8 (TH:4,T:0,P:8)

COURSE OUTCOMES: After completion of the course the Student will be able to:

1. Understand the importance of soil studies in Civil Engineering, including the geological origin of soils and their engineering characteristics.
2. Determine the physical properties of soils, such as void ratio, porosity, water content, degree of saturation, specific gravity, unit weight, bulk density, dry unit weight, and submerged unit weight.
3. Classify and identify soils based on particle size, shape, gradation, relative density, and Atterberg limits.
4. Study the flow of water through soils, including permeability, Darcy's law, coefficient of permeability, and laboratory tests for measuring permeability.
5. Learn about the concept of effective stress and its importance in engineering problems.
6. Gain knowledge of soil deformation, including consolidation, settlement, creep, plastic flow, heaving, lateral movement, and freeze-thaw effects.

DETAILED CONTENTS

1. Introduction:

1.1 Importance of soil studies in Civil Engineering

1.2 Geological origin of soils with special reference to soil profiles in India: residual and transported soil, alluvial deposits, lake deposits, local soil found in J&K, dunes and loess, glacial deposits, black cotton soils,conditions in which above deposits are formed and their engineering characteristics.

1.3 Names of organizations dealing with soil engineering work in India, soil map of India

2. Physical Properties of Soils:

2.1 Constituents of soil & representation by a phase diagram

2.2 Definitions of void ratio, porosity, water content, degree of saturation, specific gravity, unit weight, bulk density/bulk unit weight, dry unit weight, saturated unit weight and submerged unit weight of soil grains and correlation between them

2.3 Simple numerical problems with the help of phase diagrams

3. Classification and Identification of Soils

3.1.Particle size, shape and their effect on engineering properties of soil, particle size classification of soils

3.2 Gradation and its influence on engineering properties

3.3 Relative density & its use in describing cohesionless soils

3.4 Behaviour of cohesive soils with change in water content, Atterberg"s limit - definitions, use & practical significance

3.5 Field identification tests for soils

3.6 Soil classification system as per BIS 1498; basis, symbols, major divisions and sub divisions, groups, plasticity chart; procedure for classification of a given soil

4. Flow of Water Through Soils:

4.1 Concept of permeability and its importance

4.2 Darcy's law, coefficient of permeability, seepage velocity and factors affecting permeability

4.3 Comparison of permeability of different soils as per BIS

4.4 Measurement of permeability in the laboratory

5. Effictive Stress: (Concept only)

5.1 Stresses in subsoil

5.2 Definition and meaning of total stress, effective stress and neutral stress

5.3 Principle of effective stress

5.4 Importance of effective stress in engineering problems

6. Deformation of Soils

6.1 Meaning, conditions/situations of occurrence with emphasis on practical significance of:

a) Consolidation and settlement

b) Creep

c) Plastic flow

d) Heaving

e) Lateral movement

f) Freeze and thaw of soil

6.2 Definition & practical significance of compression index, coefficient of consolidation, degree of consolidation.

6.3 Meaning of total settlement, uniform settlement and differential settlement; rate of settlement and their effects

6.4 Settlement due to construction operations and lowering of water table

6.5 Tolerable settlement for different structures as per BIS

7. Shear Strength Characteristics of Soils:

7.1 Concept and Significance of shear strength

7.2 Factors contributing to shear strength of cohesive and cohesion less soils, Coulomb's law

7.3 Examples of shear failure in soils

8. Compaction:

8.1 Definition and necessity of compaction

8.2 Laboratory compaction test (standard and modified proctor test as per BIS) definition and importance of optimum water content, maximum dry density; moisture dry density relationship for typical soils with different compactive efforts

8.3. Compaction control; Density control, measurement of field density by core cutter method and sand replacement method, moisture control, Proctor's needle and its use, thickness control, jobs of an embankment supervisor in relation to compaction

9. Soil Exploration:

9.1 Purpose and necessity of soil exploration

9.2 Reconnaissance, methods of soil exploration, Trial pits, borings (auger, wash, rotary, percussion to be briefly dealt)

9.3 Sampling; undisturbed, disturbed and representative samples; selection of type of sample; thin wall and piston samples; area ratio, recovery ratio of samples and their significance, number and quantity of samples, resetting, sealing and preservation of samples.

9.4 Presentation of soil investigation results

10. Bearing Capacity of soil

10.1 Concept of bearing capacity

10.2 Definition and significance of ultimate bearing capacity, net safe bearing capacity and allowable bearing pressure

10.3 Guidelines of BIS (IS 6403) for estimation of bearing capacity of soil

10.4 Factors affecting bearing capacity

10.5 Concept of vertical stress distribution in soils due to foundation loads, pressure bulb

10.6 Applications of SPT, unconfined compression test and direct shear test in estimation of bearing capacity.

10.7 Plate load test (no procedure details) and its limitations.

10.8 Improvement of bearing capacity by sand drain method, compaction, use of geo-synthetics.

11. Foundation Engineering:

Concept of shallow and deep foundation; types of shallow foundations: isolated, combined, strip, mat, and their suitability. Factors affecting the depth of shallow foundations, deep foundations, types of well foundation and their suitability, type of piles and their suitability; pile classification on the basis of material, pile group and pile cap.

PRACTICAL OUTCOMES: At the end of the course, the student will be able to:

1. To determine the moisture content of a given sample of soil.
2. Auger Boring and Standard Penetration Test.
3. Identify & Test the field tests of the Soils.
4. Identifying the equipment and accessories
5. Conducting boring and SPT at a given location
6. Preparation of boring log and SPT graphs
7. Interpretation of test results

List of Practicals:

1. To determine the moisture content of a given semple of soil.
2. Extraction of Disturbed and Undisturbed Samples Extracting a block sample
   a. Extracting a tube sample
   b. Extracting disturbed samples for mechanical analysis.
   c. Field identification of samples
3. Field Density Measurement (Sand Replacement and Core Cutter Method)
   a. Calibration of sand
   b. Conducting field density test at a given location
   c. Determination of water content
   d. Computation and interpretation of results
4. Liquid Limit and Plastic Limit Determination:
   a. Identifying various grooving tools
   b. Preparation of sample

c. Conducting the test

d. Observing soil behaviour during tests

e. Computation, plotting and interpretation of results

3. Mechanical Analysis

a. Preparation of sample

b. Conducting sieve analysis

c. Computation of results

d. Plotting the grain size distribution curve

e. Interpretation of the curve

4. Laboratory Compaction Tests (Standard Proctor Test)

a. Preparation of sample

b. Conducting the test

c. Observing soil behaviour during test

d. Computation of results and plotting

e. Determination of optimum moisture content and maximum dry density

5. Demonstration of Unconfined Compression Test

a. Specimen preparation

b. Conducting the test

c. Plotting the graph

d. Interpretation of results and finding/bearing capacity

6. Demonstration of:

a. Direct Shear and Vane Shear Test on sandy soil samples

b. Permeability test apparatus.

Recommended Books:

1. Punmia, BC, "Soil Mechanics and Foundations"; Standard Publishers, Delhi
2. Bharat Singh and Shamsher Prakash; "Soil Mechanics and Foundations Engineering", Nem Chand and Bros, Roorkee,
3. Sehgal, SB, "A Text Book of Soil Mechanics"; CBS Publishers and Distributors, Delhi,
4. Gulati, SK and Manoj Dutta, "Geotechnical Engineering ", Tata McGraw Hill, Delhi,
5. Ranjan Gopal and Rao ASR "Basic and Applied Soil Mechanics", New Age Publication (P) Ltd., New Delhi
6. Singh Harbhajan "Soil and Foundation Engineering", Abhishek Publishers, Chandigarh
7. S Mittal and JP Shukla, "Soil Testing for Engineers", Khanna Publishers Ltd., Delhi
8. BIS Codes IS 6403 (latest edition) and IS 1498 (latest edition)
9. Jagroop Singh, "Soil and Foundation Engineering", Eagle Parkashan, Jalandhar
10. Rabinder Singh, "Soil and Foundation Engg." SK Kataria and Sons, Ludhiana
11. NITTTR, Chandigarh, "Shallow Foundations"
12. Video films on Geo-technical Laboratory Practices by NITTTR, Chandigarh

*****

'Elective 1-1'
GREEN BUILDING & ENERGY CONSERVATION

Course Code:	445002
Course Title	Green Building & Energy Conservation
No. of Credits	5 (TH:5,T:0,P:0)

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

1. Understand the principles and concepts of green building design, energy conservation, and sustainable construction materials and techniques.
2. Analyze the environmental impacts of conventional construction methods and evaluate the performance of green buildings and energy conservation measures.
3. Design and implement energy-efficient systems in buildings, incorporating renewable energy sources in building design.
4. Comprehend the importance of green certifications and standards in construction projects, and apply cost-benefit analysis to assess the economic feasibility of green building initiatives.
5. Demonstrate an understanding of sustainable site planning and landscape design, and advocate for sustainable practices and energy-efficient solutions in civil and environmental engineering projects.

COURSE CONTENTS

1. **Introduction to Green Building and Sustainability**
- Definition and principles of green building
- Benefits and challenges of sustainable construction
- Environmental impacts of conventional buildings
- Global & local green building certifications & standards

2. **Sustainable Construction Materials and Techniques**
- Eco-friendly construction materials and their properties
- Low-impact construction techniques
- Waste reduction and recycling in construction

3. **Energy Conservation in Buildings**
- Energy-efficient building design principles (Overview only)
- Idea of HVAC system and energy management
- Lighting design and energy-efficient appliances
- Passive cooling and heating strategies

4. **Renewable Energy Integration**
- Solar energy systems for buildings
- Wind energy utilization

5. **Green Building Design and Performance Evaluation**
- Green building design considerations
- Life cycle assessment of buildings
- Building energy modeling and simulation

6. **Sustainable Site Planning and Landscape Design**
- Site selection and orientation for energy efficiency
- Rainwater harvesting
- Sustainable landscaping techniques

7. **Green Building Case Studies**
- Examination of successful green building projects

Reference Books:

1. "Green Building: Guidebook for Sustainable Architecture" by Michael Bauer, Hans-Dieter Schilling, and Uta Pottgiesser
2. "Sustainable Construction: Green Building Design and Delivery" by Charles J. Kibert
3. "Energy Efficient Buildings with Solar and Geothermal Resources" by Ursula Eicker
4. "LEED v4 Green Associate Exam Guide (LEED GA): Comprehensive Study Materials, Sample Questions, Green Building LEED Certification, and Sustainability" by Gang Chen
5. "Solar Energy Engineering: Processes and Systems" by Soteris A. Kalogirou
6. "Green Building and LEED Core Concepts Guide" by U.S. Green Building Council
7. "Sustainable Building Systems and Construction for Designers" by Lisa M. Tucker.
8. "Energy Conservation Guidebook" by Dale R. Patrick and Stephen W. Fardo

*****

'Elective 1-2'
BUILDING SERVICES & MAINTENANCE

Course Code:	445003
Course Title	Building Services & Maintenance
No. of Credits	5 (TH:5,T:0,P:0)

COURSE OUTCOMES : At the end of the course, the student will be able to:

1. Recognize the significance of building services in the functionality of a building and understand the design principles and considerations involved in building services planning.
2. Design and implement plumbing and drainage systems, understanding different types of systems and complying with relevant plumbing codes and regulations.
3. Comprehend the principles of HVAC systems and select appropriate types of HVAC systems for buildings, considering energy efficiency standards.
4. Design and implement fire protection and detection systems, ensuring compliance with fire safety regulations and performing maintenance and testing of these systems.
5. Understand electrical distribution and lighting systems in buildings, following electrical codes and regulations for safe and efficient installations.
6. Implement lifts and escalators in buildings, considering design and safety aspects and adhering to maintenance and safety regulations.

DETAILED CONTENTS

1. **Introduction to building services & their significance**
   - Importance of building services in the overall functionality of a building
   - Building services design principles and considerations
   - Roles & responsibilities of building services professionals

2. **Plumbing and drainage systems:**
   - Design and installation of plumbing and drainage systems in buildings
   - Types of plumbing and drainage systems (e.g. gravity, pressure, vacuum)
   - Plumbing codes and regulations

3. **HVAC (Heating, Ventilation & Air Conditioning) systems:**
   - Principles of heating, ventilation, and air conditioning in buildings
   - Types of HVAC systems (e.g. centralized, decentralized, VRF)
   - Energy efficiency considerations and standards

4. **Fire protection and detection systems:**
   - Types of fire protection and detection systems (e.g. fire sprinklers, fire alarms, smoke detectors)
   - Fire safety regulations and codes
   - Maintenance and testing of fire protection and detection systems

5. **Electrical systems in buildings:**
    - Electrical distribution and wiring systems
    - Design & installation of lighting systems in buildings
    - Electrical codes and regulations

6. **Lifts and escalators:**
    - Types of lifts and escalators and their applications
    - Design and installation considerations
    - Maintenance and safety regulations

7. **Building management systems (BMS):**
    - Building automation and control systems
    - Integration of building services with BMS
    - Energy management and optimization

8. **Sustainable building services and green building design:**
    - Design principles for sustainable building services
    - Green building rating systems and certifications
    - Renewable energy and energy efficiency considerations

9. **Maintenance of building services:**
    - Preventive and corrective maintenance strategies
    - Maintenance planning and scheduling
    - Importance of maintenance in the longevity and efficiency of building services

Reference Books:

1. "Building Services Engineering: A Review of Its Development" by P. B. Jackson
2. "Building Services Engineering: 4th Edition" by David V. Chadderton
3. "Facilities Management and the Business of Space" by Wes McGregor
4. "Facilities Management Handbook" by David G. Cotts, Kathy O. Roper, and Richard P. Payant
5. "Introduction to Building Services" by F. Hall and R. Greeno
6. "Building Maintenance Management" by Barrie Chanter and Peter Swallow
7. "Building Maintenance Processes and Practices: The Case of a Fast Developing Country" by Eziyi Offia Ibem
8. "Practical Guide to Inspection, Testing and Certification of Electrical Installations" by Christopher Kitcher and George Ellison
9. "Heating, Ventilating, and Air Conditioning: Analysis and Design" by Faye C. McQuiston, Jerald D. Parker, and Jeffrey D. Spitler
10. "Introduction to Plumbing and Heating Systems Design" by Jerome F. Mueller.

*****

'Elective- 2-1'
FOUNDATION ENGINEERING

Course Code:	445004
Course Title	Foundation Engineering
No. of Credits	5 (TH:5,T:0,P:0)

COURSE OUTCOMES : At the end of the course, the student will be able to:

1. Recognize the importance of foundation engineering in civil engineering and understand the properties and behavior of soil as a foundation material.
2. Identify and differentiate between different types of shallow foundations, analyze their bearing capacity, and evaluate settlement characteristics.
3. Comprehend the types and applications of deep foundations, including pile foundations, drilled shafts, and caissons, and understand their design principles.
4. Understand the theories of lateral earth pressure and apply them to the design of various retaining wall types, along with stability analysis.
5. Analyze foundation design principles, select appropriate foundation types based on project requirements, and design both shallow and deep foundations effectively.

DETAILED CONTENTS

Reference Books:

1. "Foundation Design: Principles and Practices" by Donald P. Coduto, William A. Kitch, and Man-chu Ronald Yeung
2. "Foundation Engineering Handbook" by Robert W. Day
3. "Geotechnical Engineering: Principles and Practices" by Donald P. Coduto
4. "Principles of Foundation Engineering" by Braja M. Das
5. "Soil Mechanics and Foundations" by Muni Budhu

*****

'Elective- 2-2'
ENVIRONMENTAL ACT & LEGISLATION

Course Code:	445005
Course Title	Environmental Act and Legislation
No. of Credits	5 (TH:5,T:0,P:0)

COURSE OUTCOMES: At the end of the course, the student will be able to:

1. Understand the importance of environmental protection & the key international efforts to address environmental issues.
2. Comprehend the concept of sustainable development and its legal implications, including the international Protocols.
3. Familiarize themselves with the Environment (Protection) Act, 1986, along with the provisions related to the prevention, control, and abatement of environmental pollution.
4. Analyze the prevalent laws related to the preservation of different environmental constituents.
5. Recognize the role of judicial activism in environmental protection.
6. Evaluate the role of Non-Governmental Organizations (NGOs) in promoting and protecting the environment.

DETAILED CONTENTS

4. Natural resource conservation and the law

4.1 Wildlife (Protection) Act, 1972: Salient Features

4.2 Protected Areas and Trade & Commerce under WPA

4.3 National Forest Policy

4.4 Forest Conservation Act, 1986

4.5 Biological Diversity Act, 2002 (Note: Only relevant provisions of the above Acts)

5. Judicial activism and environmental protection

5.1 Indian Constitution and Environmental Protection

5.2 Judicial Response towards Environmental Protection

5.3 Role of NGO's for the promotion and protection of Environment.

Suggested Learning Resources:

1. Diwan, P. (1997). Environmental Administration-Law & Judicial Attitude, Vol. I, II. Deep & Deep Pub. New Delhi.
2. Divan, S. and Roscencranj, A. (2001). Environmental Law& Policy in India. Oxford Pub. New Delhi.
3. Lal, S. (1990). Commentaries on Water, Air pollution & Environment (protection) Law. Law Pub. Pvt. Ltd. India.
4. Leelakrishnan, P. (1999). Environmental Lawin India. Butterworths Publications, N. Delhi.
5. Singh, G. (1995). Environmental Law: International & National Perspectives.

*****

'Open Elective'
RENEWABLE ENERGY TECHNOLOGIES

Course Code:	435008
Course Title	Renewable Energy Technologies
No. of Credits	4 (TH:4,T:0,P:0)

COURSE OUTCOMES : At the end of the course, the student will be able to:

1. Understand present and future energy scenario of the world.
2. Understand various methods of solar energy harvesting.
3. Identify various wind energy systems.
4. Evaluate appropriate methods for Bio energy generations from various Bio wastes.
5. Identify suitable energy sources for a location.

COURSE CONTENTS

Unit - I : Introduction :

World Energy Use; Reserves of Energy Resources; Environmental Aspects of Energy Utilization; Renewable Energy Scenario in India and around the World; Potentials; Achievements/Applications; Economics of renewable energy systems.

Unit - II : Solar energy :

Solar Radiation; Measurements of Solar Radiation; Flat Plate and Concentrating Collectors; Solar direct Thermal Applications; Solar thermal Power Generation Fundamentals of Solar Photo Voltaic Conversion; Solar Cells; Solar PV Power Generation; Solar PV Applications.

Unit - III : Wind Energy :

Wind Data and Energy Estimation; Types of Wind Energy Systems; Performance; Site Selection; Details of Wind Turbine Generator; Safety and Environmental Aspects.

Unit - IV : Bio-Energy :

Biomass direct combustion; Biomass gasifiers; Biogas plants; Digesters; Ethanol production; Bio diesel; Cogeneration; Biomass Applications.

Unit - V : Other Renewable Energy Sources (Brief Idea Only):

Tidal energy; Wave Energy; Open and Closed OTEC Cycles; Small Hydro-Geothermal Energy; Hydrogen and Storage; Fuel Cell Systems; Hybrid Systems.

Reference Books :

1. O.P. Gupta, Energy Technology, Khanna Publishing House, Delhi (ed. 2018)
2. Renewable Energy Sources, Twidell, J.W. & Weir, A., EFN Spon Ltd., UK, 2006.
3. Solar Energy, Sukhatme. S.P., Tata McGraw Hill Publishing Company Ltd., New Delhi, 1997.
4. Renewable Energy, Power for a Sustainable Future, Godfrey Boyle, Oxford University Press, U.K., 1996.
5. Fundamental of Renewable Energy Sources, GN Tiwari and MK Ghoshal, Narosa, New Delhi, 2007.
6. Renewable Energy and Environment-A Policy Analysis for India, NH Ravindranath, UK Rao, B. Natarajan, P. Monga, Tata McGraw Hill.
7. Energy and The Environment, RA Ristinen and J J Kraushaar, Second Edition, John Willey & Sons, New York, 2006.
8. Renewable Energy Resources, JW Twidell and AD Weir, ELBS, 2006.

*****

'Open Elective'
ENGINEERING ECONOMICS & ACCOUNTING

Course Code:	445006
Course Title	Engineering Economics & Accounting
No. of Credits	4 (TH:4,T:0,P:0)

COURSE OUTCOMES: At the end of the course, the student will be able to:

1. Understand the fundamental concepts of engineering economics, including the time value of money and its implications on project decision-making.
2. Apply various methods to compare and evaluate alternative investment options, such as present worth, future worth, annual equivalent, and rate of return.
3. Analyze financial statements, including balance sheets, income statements, and cash flow statements, to assess a project's financial health and make informed financial decisions.
4. Evaluate the cost of capital by understanding the components of debt and equity, and calculate the weighted average cost of capital (WACC) for a project.
5. Utilize project management techniques, including network analysis, PERT/CPM, resource allocation, and cost control, to ensure effective project planning and execution.
6. Comprehend cost accounting and control principles, such as cost-volume-profit analysis, marginal costing, budgeting, and standard costing, for optimizing project financial performance and budget management.

DETAILED CONTENTS

1. **Introduction to Engineering Economics:** Meaning, Definition, Scope, Importance, and Concepts.
2. **Time Value of Money:** Simple Interest, Compound Interest, Present Value, Future Value, Annuity, and Perpetuity.
3. **Methods of Comparing Alternatives:** Present Worth Method, Future Worth Method, Annual Equivalent Method, and Rate of Return Method.
4. **Depreciation and Taxes:** Types of Depreciation, various methods of determining depreciation.
5. **Cost of Capital:** Cost of Debt, Cost of Equity, and Weighted Average Cost of Capital (WACC).
6. **Financial Statements and Analysis:** Basic idea of Balance Sheet, Income Statement, and Cash Flow Statement.
7. **Break-Even Analysis:** Meaning, Assumptions, and Applications.
8. **Project Management Techniques:** Network Analysis, PERT / CPM, Resource Allocation, and Cost Control.
9. **Cost Accounting and Control:** Elements of Cost, Cost-Volume-Profit Analysis methods (Overview only)
10. **Financial Planning and Control:** Salient features of Capital Budgeting, Working Capital Management, and Financial Ratios.

Reference Books:

1. "Engineering Economics and Financial Accounting" by A. Ramachandra Aryasri
2. "Engineering Economics" by R. Panneerselvam
3. "Engineering Economics and Cost Analysis" by M. Mahesh
4. "Engineering Economics and Management" by Sullivan and Wicks
5. "Engineering Economy" by Leland Blank and Anthony Tarquin
6. "Financial Management for Engineers" by G. A. Sullivan
7. "Engineering Economics and Economic Design for Process Engineers" by Thane Brown
8. "Managerial Accounting" by Ray H. Garrison, Eric W. Noreen, Peter C. Brewer
9. "Cost Accounting: Principles and Practice" by M. N. Arora
10. "Financial Management and Analysis" by J. J. Massaquoi

*****

BUILDING INFORMATION MODELLING

Course Code:	445007
Course Title	Building Information Modelling
No. of Credits	4 (TH:4,T:0,P:0)

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

1. Explain the fundamental principles and concepts of Building Information Modelling (BIM).
2. Utilize BIM software tools to create and manage parametric models for construction projects.
3. Apply clash detection techniques to identify and resolve conflicts in BIM models.
4. Employ BIM for construction sequencing and simulation.
5. Understand the integration of BIM with facility management systems for post-construction operations.

COURSE CONTENTS

1. **Introduction to Building Information Modelling (BIM)**
- Overview of BIM and its evolution in the Architectural Engineering and Construction (AEC) industry.
- BIM concepts and benefits in construction projects.

2. **BIM Software Tools and Platforms**
- Introduction to popular BIM software applications (e.g., Autodesk Revit, Graphisoft Archi CAD, Bentley AECOsim).
- Basic functionalities and interface navigation of BIM tools.

3. **BIM Data and Parametric Modelling**
- Creating parametric models and intelligent objects in BIM.
- BIM elements

4. **BIM Coordination and Collaboration**
- Steps involved in BIM project setup & collaboration processes.
- Clash detection and resolution in BIM models.

5. **BIM for Construction Planning and Management**
- 4D BIM and construction sequencing.
- Simulation and visualization of construction processes.

6. **BIM for Facility Management and Operations**
- BIM integration with facility management systems.
- BIM for asset management and maintenance planning.

7. **BIM Standards and Guidelines**
- International and local BIM standards and protocols.
- Best practices in BIM implementation.

8. Comply with BIM standards and guidelines to ensure efficient collaboration in AEC projects.

Text & Reference Books:

1. "Building Information Modeling: A Strategic Implementation Guide for Architects, Engineers, Constructors, and Real Estate Asset Managers" by Dana K. Smith, Michael Tardif, and Dennis Rodriguez.
2. "BIM Handbook: A Guide to Building Information Modeling for Owners, Managers, Designers, Engineers, and Contractors" by Chuck Eastman, Paul Teicholz, Rafael Sacks, and Kathleen Liston.
3. "BIM and Construction Management: Proven Tools, Methods, and Workflows" by Brad Hardin and Dave McCool.
4. "The BIM Manager's Handbook: Guidance for Professionals in Architecture, Engineering, and Construction" by Dominik Holzer.
5. "Introducing BIM in Small and Medium-Sized Enterprises" by Ruud van den Heuvel, Pieter Pauwels, and Jos Brouwers.

*****

SUMMER INTERNSHIP-II

Course Code:	AS501
Course Title	Summer Internship - II
No. of Credits	3 (TH:0,T:0,P:0)

Summer Internship provides an invaluable opportunity for students pursuing their Diploma in Engineering to gain real-world experience and exposure to various industrial production units and commercial activities related to their field of study. This program aims to bridge the gap between theoretical knowledge and practical application, equipping students with the necessary skills and expertise to thrive in the branch related industry.

At the end of the **Fourth semester,** students will undertake a minimum **6-week** Summer Internship, scheduled during the semester break following the Fourth Semester examinations. The respective Heads of Departments (HoDs) and experienced faculty members will guide and assist students in securing suitable training opportunities that align with their specialization. Each student will have a personalized training schedule developed in collaboration with the training providers, ensuring a comprehensive and enriching learning experience.

Before starting their training, students will receive a comprehensive briefing about the organizational setup, product range, manufacturing processes, and significant machinery and materials used in the training organization. This preliminary understanding will enhance their engagement and productivity during the internship.

To ensure a fruitful learning experience, faculty members will supervise students during their training in the industry or field organization. Each teacher will mentor a small group of 4-5 students, providing personalized attention and guidance. Students will be encouraged to maintain daily reports in their diaries, which will assist them in composing their final training report and presentation.

The evaluation process for the Summer Internship will include both internal and external assessments, as per the study and evaluation scheme of the **Fifth Semester.** During the viva-voce/presentation examination, students' understanding of materials, industrial processes, practices in the industry, and problem-solving abilities will be assessed. The evaluation will also focus on their application of knowledge and skills in real-life situations.

The components of evaluation will comprise:

(a) Punctuality and regularity: 15%

(b) Initiative in learning new things: 15%

(c) Relationship with peers and colleagues: 10%

(d) Summer Internship report: 25%

(e) Viva-Voce: 35%

We believe that this Summer Internship program will be a transformative experience for our students, empowering them to excel in their future careers and make meaningful contributions to the Engineering industry. The collaborative efforts of our experienced faculty members and industry partners will ensure that students gain valuable insights and practical skills during this immersive learning journey.

*****

MAJOR PROJECT-I

Course Code:	AS502
Course Title	Major Project - I
No. of Credits	1 (TH:0,T:0,P:2)

The evaluation of Major Project-I will be conducted to assess students' understanding, application, and presentation of their chosen project topic. The following evaluation criteria will be used to measure their performance:

1. **Project Identification (10%):**
   - Clarity and relevance of the chosen project topic.
   - Demonstration of understanding of the industry or community needs addressed by the project.
   - Adequate justification for selecting the particular project topic.

2. **Project Proposal (10%):**
   - Comprehensive description of project objectives and scope.
   - Logical and well-structured methodology for project execution.
   - Feasibility of the proposed project, considering available resources.

3. **Literature Review (10%):**
   - Thoroughness of the research conducted in relevant academic and professional sources.
   - Critical analysis of existing literature, identifying gaps and potential contributions of the project.

4. **Feasibility Study (10%):**
    - Evaluation of the project's practicality and viability.
    - Assessment of potential risks and proposed mitigation strategies.

5. **Project Planning (20%):**
    - Detailed project plan, including timeline, milestones, and resource allocation.
    - Realistic budgeting and cost management strategies.

6. **Proposal Presentation (30%):**
    - Clarity and effectiveness of communication during the presentation.
    - Ability to address questions and defend the project proposal confidently.
    - Professionalism and engagement with the panel and audience.

7. **Overall Impression (10%):**
    - Demonstrated commitment and effort throughout the project.
    - Creativity and innovation in problem-solving.
    - Adherence to project management principles and best practices.

*****