

## 6.1 STEEL STRUCTURES DESIGN AND DRAWING

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### RATIONALE

This subject is an applied engineering subject. Diploma holders in Civil Engineering will be required to supervise steel construction and fabrication. He may also be required to design simple structural elements, make changes in design depending upon availability of materials. He must be able to read and interpret structural drawings of different elements. This subject thus deals with elementary design principles as per BIS code of practice BIS: 800 and their relevant drawings

### DETAILED CONTENTS

#### a) Theory

1. Structural Steel and Sections: (2 hrs)
  - 1.1 Properties of structural steel as per BIS Codes
  - 1.2 Designation of structural steel sections as per BIS handbook and BIS:800
2. Structural Steel and Connections: (12 hrs)
  - 2.1 Riveted connections, types of rivets, permissible stresses in rivets as per BIS:800, types of riveted joints, specifications as per BIS 800 for riveted joints, design of riveted joints for axially loaded members, testing and inspection of riveted joints as per BIS:800
  - 2.2 Welded connections: Types of welds, permissible stresses in welds, types of welded connections, design of butt and fillet welded connections subjected to axial loads, testing and inspection of welded joints as per BIS:800
3. Tension Members: (6 hrs)
 

Permissible stresses in tension for steel, design of tension members as per BIS:800 (flats, angles and tee sections only).
4. Compression Members: (10 hrs)
  - 4.1 Concept of buckling of columns, effective length and slenderness ratio, permissible stresses in compression as per IS:800, strength of columns of single and built up sections with the help of table of permissible compressive stresses.

- 4.2 IS specifications for design of compression members, design of angle, struts and axially loaded columns (no built up columns); use of tacking rivets
- 4.3 Beam and column, frame and seated connections (no design)
5. Beams (8 hrs)
- BIS specifications for the design of simply supported steel beams including design of base plate at the ends (laterally restrained beams only), structural behaviour, deflected shapes and function of various elements of a plate girder and freehand sketching of a plate girder and its elements.
6. Roof Truss (10 hrs)
- Form of trusses, pitch of roof truss, spacing of trusses, spacing of purlins, connection between purlin and roof covering, joint details of roof trusses, loading for roof truss, weight of roof truss, wind loads, snow loads, combination of loads, design of various elements of truss

#### **b) Steel Structures Drawing**

1. Preparation of a working drawing (elevation, plan, details of joints as ridge, eaves and other connections) for a riveted steel roof truss resting on a masonry wall with the given span, shape of the truss and the design data regarding the size of the members and the connections. Also calculate the quantity of steel for the truss.
2. Steel connections (a,b,c,d) rivetted and (e) welded all unstiffened
  - Beam to beam connections (Seated and framed)
  - Beam to column (Seated and framed)
  - Column base connections (Slab base, grillage base and gusseted base)
  - Details of column splices
  - Connections of a steel bracket with flange of a column
3. Detailed drawing showing plan and elevation for a riveted plate girder with the given design data regarding the sizes of its parts, with details at the supports and connections of stiffeners, flange angles and cover plates with the web

#### **INSTRUCTIONAL STRATEGY**

Teachers are expected to give simple problems for designing various steel structural members. For creating comprehension of the subject, teachers may prepare tutorial sheets, which may be given to the students for solving. It would be advantageous if

students are taken at construction site to show fabrication and erection of steel structures. Practice of reading structural drawings is another important feature of this course.

### **RECOMMENDED BOOKS**

1. Arya, AS and Ajmani, JL; "Design of Steel Structures", Roorkee, Nem Chand and Bros.
2. Ram Chandra, "Design of Steel Structures", Delhi, Standard Publishers Distributors.
3. Duggal SK, "Design of Steel Structures", Standard Publishers Distributors.
4. Kazimi and. Jindal, "Design of Steel Structures", Prentice Hall of India, New Delhi
5. LS Negi, "Design of Steel Structure", Tata McGraw Hill, New Delhi

## 6.2 EARTHQUAKE RESISTANT BUILDING CONSTRUCTION

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### RATIONAL

Diploma holders in civil engineering have to supervise construction of various earthquake resistant buildings. Therefore, the students should have requisite knowledge regarding terminology of earthquake and the precautions to be taken while constructing earthquake resistant buildings

### DETAILED CONTENTS

1. Introduction to Seismic Design Parameters (10 hrs)
  - 1.1 Introduction to Earthquakes
  - 1.2 Causes of earthquakes
  - 1.3 Epicenter, Hypocenter
  - 1.4 Earthquake waves: Primary waves, secondary waves, long waves
  - 1.5 Seismic Region: Seismic zones in India
  - 1.6 Intensity and isoseismal of an earthquake
  - 1.7 Magnitude and energy of earthquake
2. Performance of buildings under past earthquakes (2 hrs)
3. Introduction to provisions of IS: 1893:2002 (4 hrs)
4. Introduction to ductile detailing provisions of IS:13920 for Reinforced Concrete Buildings (6 hrs)
5. Introduction to IS:4326 for construction of earthquake resistant masonry buildings (6 hrs)
6. Special construction methodologies, tips and precautions to be observed while planning, designing and construction of earthquake resistant buildings (8 hrs)
7. Disaster Management (6 hrs)
 

Disaster rescue, psychology of rescue, rescue workers, rescue plan, rescue by steps, rescue equipment, safety in rescue operations, debris clearance and casualty management

## **INSTRUCTIONAL STRATEGY**

The student may be taken for visit to various building construction sites where precautions related to earthquake resistant construction are being taken so that the students may appreciate the importance of the subject.

## **RECOMMENDED BOOKS**

1. Elements of Earthquake Engineering by Jai Krishana and AR Chandrasekaran; Sarita Parkashan, Meerut.
2. Building Construction by BL Gupta and NL Arora, Satya Prakashan, New Delhi
3. Manual Published by Earthquake Engineering department, IIT Roorkee
4. IS 1893-2002
5. IS 13920
6. IS 4326

### 6.3 COMPUTER APPLICATIONS IN CIVIL ENGINEERING - II

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#### RATIONALE

Computers play a very vital role in present day life, more so, in all the professional life of engineering. In order to enable the students use the computers effectively in problem solving, this course offers various engineering applications of computers in civil engineering.

#### DETAILED CONTENTS

1. Estimate and costing by the use of software Civil-Pro
2. Networking techniques of the project using Primavera
3. Introduction and use of software like Auto Survey, Auto Read, Auto Water
4. Introduction and use of software for regarding structural analysis and design of buildings

## 6.4 TENDERING AND VALUATION

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### RATIONALE

A good percentage of diploma engineers start working as small contractors. They require the knowledge of contractorship and associated skills like estimating and costing, tendering and preparation of specifications for various types of jobs. Also diploma holders adopt valuers as their profession. To promote entrepreneurship amongst these engineers, knowledge and associated skills in above field becomes essential. Hence this subject is of great importance to diploma engineers.

### DETAILED CONTENTS

1. Contractorship (8 hrs)
  - Meaning of contract
  - Qualities of a good contractor and their qualifications
  - Essentials of a contract
  - Types of contracts, their advantages, dis-advantages and suitability, system of payment
  - Single and two cover-bids; tender, tender forms and documents, tender notice, submission of tender and deposit of earnest money, security deposit, retention money, maintenance period
  - Types of contracting firms/construction companies
  
2. Preparation of Tender Document (12 hrs)
  - Exercises on writing specifications of different types of building works from excavation to foundations, superstructure and finishing operation
  - Exercises on preparing tender documents for the following
    - a) Earth work
    - b) Masonry works
    - c) Construction of a small house as per given drawing
    - d) RCC works
    - e) Pointing, plastering and flooring

- f) White-washing, distempering and painting
  - g) Wood work including polishing
  - h) Sanitary and water supply installations
  - i) False ceiling, aluminium (glazed) partitioning of tile flooring
  - j) Construction of an Industrial shed
3. Preparation of tender documents for: ( 6 hrs)
- Highways
  - Culverts
  - Layout of sewer lines
4. Exercises on preparation of comparative statements for item rate contract (2 hrs)
5. Valuation (4 hrs)
- a) Purpose of valuation, principles of valuation
  - b) Definition of various terms related to valuation like depreciation, sinking fund, salvage and scrap value, market value, fair rent, year's purchase etc.
  - c) Methods of valuation (i) replacement cost method (ii) rental return method

### RECOMMENDED BOOKS

1. Pasrija, HD; Arora, CL and S. Inderjit Singh, "Estimating, Costing and Valuation (Civil)", Delhi, New Asian Publishers
2. Rangwala, BS; Estimating and Costing". Anand, Charotar Book Stall
3. Kohli, D; and Kohli, RC; "A Text Book on Estimating and Costing (Civil) with Drawings", Ambala Ramesh Publications
4. Chakraborti, M; "Estimating, Costing and Specification in Civil Engineering", Calcutta
5. Dutta, BN; "Estimating and Costing
6. STAAD – Research Engineers - USA



## 6.5 CONSTRUCTION MANAGEMENT AND ACCOUNTS

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### RATIONALE

This is an applied engineering subject. The subject aims at imparting basic knowledge about construction planning and management, site organisation, construction labour, control of work progress, inspection and quality control, accidents and safety and heavy construction equipment.

### DETAILED CONTENTS

#### THEORY

#### CONSTRUCTION MANAGEMENT:

1. Introduction: (6 hrs)
  - 1.1 Significance of construction management
  - 1.2 Main objectives of construction management
  - 1.3 Functions of construction management, planning, organising, staffing, directing, controlling and coordinating, meaning of each of these with respect to construction job.
  - 1.4 Classification of construction into light, heavy and industrial construction
  - 1.5 Stages in construction from conception to completion
  - 1.6 The construction team: owner, engineer and contractors, their functions and inter-relationship
  - 1.7 Resources for construction industry: Men, machines, materials and money.
2. Construction Planning: (8 hrs)
  - 2.1 Importance of construction planning
  - 2.2 Developing work break down structure for construction works
  - 2.3 Stages of construction planning
    - Pre-tender stage
    - Contract stage

- 2.4 Scheduling construction works by bar charts
- Preparation of bar charts for simple construction work
  - Preparation of schedules for labour, materials, machinery and finances for small works
  - Limitations of bar charts
- 2.5 Scheduling by network techniques
- Introduction to network techniques; PERT and CPM, differences between PERT and CPM terminology
  - Developing CPM networks
  - Analysis of CPM networks, determining completion time, identifying critical activities and critical path, floats etc.
3. Organization: (4 hrs)
- 3.1 Types of organizations: Line, line and staff, functional and their characteristics
- 3.2 Principles of organisation (only meaning and significance of the following)
- Span of control
  - Delegation of authority
  - Ultimate responsibility
  - Unity of command
  - Job definition
4. Site Organization: (4 hrs)
- 4.1 Factors influencing selection and design of temporary services for a construction
- 4.2 Principle of storing and stacking materials at site
- 4.3 Location of equipment
- 4.4 Preparation of actual job layout for a building
- 4.5 Organizing labour at site

5. Construction Labour: (7 hrs)
- 5.1 Conditions of construction workers in India, wages paid to workers
- 5.2 Trade Unions connected with construction industry
- 5.3 Important provisions of the following Acts:
- Trade Union Act 1926 (as amended)
  - Labour Welfare Fund Act 1936 (as amended)
  - Payment of Wages Act 1936 (as amended)
  - Minimum Wages Act 1948 (as amended)
  - Workman Compensation Act 1923 (as amended)
  - Contract Labour (Regulation and Abolition) Act 1970 (as amended)
6. Control of Progress: (4 hrs)
- 6.1 Methods of recording progress
- 6.2 Analysis of progress
- 6.3 Taking corrective actions keeping head office informed
- 6.4 Cost time optimization for simple jobs - Direct and indirect cost, variation with time, cost optimization
7. Inspection and Quality Control: (6 hrs)
- 7.1 Need for inspection and quality control
- 7.2 Principles of inspection
- 7.3 Major items in construction job requiring quality control
- 7.4 Stages of inspection and quality control for
- Earth work
  - Masonry
  - RCC
  - Sanitary and water supply services
  - Electrical services

8. Accidents and Safety in Construction: (6 hrs)
- 8.1 Accidents – causes
- 8.2 Safety measures for
- Excavation work
  - Drilling and blasting
  - Hot bituminous works
  - Scaffolding, ladders, form work
  - Demolitions
- 8.3 Safety campaign

### **CONSTRUCTION EQUIPMENT**

9. Introduction: (4 hrs)
- Construction economy: Factors affecting the selection of construction equipment, rolling resistance, effect of grade on required tractive effort, effect of altitude and temperature on the performance of internal combustion engines, drawbar pull, rimpull, and acceleration
10. Earth Moving Equipment: (7 hrs)
- Crawler and wheel tractors: their functions, types and specifications, gradability; bull dozers and their use, tractors pulled scrapers, their sizes and output; effect of grade and rolling resistance on the output of tractor pulled scrapers, earth loaders, placing and compacting earth fills.
- Power shovels: Functions, selection, sizes, shovel dimensions and clearances, output; Draglines: Functions, types, sizes, output; clamshells; safe lifting capacities and working ranges of cranes; hoes, trenching machines: types and production rates

### **ACCOUNTS**

11. PUBLIC WORK ACCOUNTS: (8 hrs)
- Introduction, accounts, work- major, repair, administrative approval – expenditure, Technical sanction, allotment of funds, bill, contractor ledger, Running and final account bills complete, completion certificate & report, hand receipt, establishment-permanent, temporary-aquittance roll. WC, Establishment, MR labour, casual labour roll-duties and responsibility of different cadres,

budget-stores, returns, direct material, road metal return, account of stock, misc. P.W. advances T & P – verification, survey , returns, account- expenditure & revenue head, remittance and deposit head, cash book, imprest account, temp advance, treasury challan.

### **INSTRUCTIONAL STRATEGY**

This is highly practice-based course and efforts should be made to relate process of teaching with direct experiences at work sites. Participation of students should be encouraged in imparting knowledge about this subject. To achieve this objective the students should be taken to different work sites for clear conception of particular topics, such as site organization, inspection of works at various stages of construction and working of earth moving equipment

### **RECOMMENDED BOOKS**

1. Shrinath, LS, "PERT and CPM - Principles and Applications", New Delhi, East West Press
2. Harpal Singh, "Construction Management and Accounts", New Delhi, Tata McGraw Hill Publishing Company.
3. Peurifoy, RL, "Construction Planning, Equipment and Methods" Tokyo, McGraw Hill
4. Wakhlo, ON; "Civil Engineering Management", New Delhi Light and Life Publishers
5. Verma, Mahesh; "Construction Equipment and its Planning and Application
6. Dharwadker, PP; "Management in Construction Industry", New Delhi, Oxford and IBH Publishing Company.
7. Gahlot PS; Dhir, BM; "Construction Planning and Management", Wiley Eastern Limited, New Delhi
8. MS Project – Microsoft USA
9. Primavera

## 6.6 ENTREPRENEURSHIP DEVELOPMENT AND MANAGEMENT

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### RATIONALE

Entrepreneurship Development and Management is one of the core competencies of technical human resource. Creating awareness regarding entrepreneurial traits, entrepreneurial support system, opportunity identification, project report preparation and understanding of legal and managerial aspects can be helpful in motivating technical/vocational stream students to start their own small scale business/enterprise. Based on the broad competencies listed above, following detailed contents are arrived to develop the stated competencies.

### DETAILED CONTENTS

- |     |  |         |
|-----|--|---------|
| (1) | Entrepreneurship   | (4 hrs) |
|     | 1.1 Concept/Meaning  |         |
|     | 1.2 Need   |         |
|     | 1.3 Competencies/qualities of an entrepreneur  |         |
| (2) | Entrepreneurial Support System   | (6 hrs) |
|     | 2.1 District Industry Centres (DICs)   |         |
|     | 2.2 Commercial Banks   |         |
|     | 2.3 State Financial Corporations   |         |
|     | 2.4 Small Industries Service Institutes (SISIs), Small Industries Development Bank of India (SIDBI), National Bank for Agriculture and Rural Development (NABARD), National Small Industries Corporation (NSIC) and other relevant institutions/organizations at State level |         |
| (3) | Market Survey and Opportunity Identification (Business Planning)   | (6 hrs) |
|     | 3.1 How to start a small scale industry  |         |
|     | 3.2 Procedures for registration of small scale industry  |         |
|     | 3.3 List of items reserved for exclusive manufacture in small scale industry   |         |
|     | 3.4 Assessment of demand and supply in potential areas of growth   |         |
|     | 3.5 Understanding business opportunity   |         |
|     | 3.6 Considerations in product selection  |         |
|     | 3.7 Data collection for setting up small ventures  |         |
| (4) | Project Report Preparation   | (6 hrs) |
|     | 4.1 Preliminary Project Report   |         |
|     | 4.2 Techno-Economic feasibility report   |         |

- 4.3 Project Viability
- (5) Managerial Aspects of Small Business (8 hrs)
- 5.1 Principles of Management (Definition, functions of management viz planning, organisation, coordination and control)
- 5.2 Operational Aspects of Production
- 5.3 Basic principles of financial management
- 5.4 Marketing Techniques
- 5.5 Personnel and Inventory Management
- 5.6 Importance of Communication in business
- (6) Legal Aspects of Small Business (6 hrs)
- 6.1 Elementary knowledge of Income Tax, Sales Tax, Patent Rules, Excise Rules
- 6.2 Factory Act and Payment of Wages Act
- (7) Environmental considerations (6 hrs)
- 7.1 Concept of ecology and environment
- 7.2 Factors contributing to Air, Water, Noise pollution
- 7.3 Air, water and noise pollution standards and control
- 7.4 Personal Protection Equipment (PPEs) for safety at work places
- (8) Miscellaneous (6 hrs)
- 8.1 Human and Industrial Relations
- 8.2 Human relations and performance in organization
- 8.3 Industrial relations and disputes
- 8.4 Relations with subordinates, peers and superiors
- 8.5 Labour Welfare
- 8.6 Workers participation in management

### RECOMMENDED BOOKS

1. A Handbook of Entrepreneurship, Edited by BS Rathore and Dr JS Saini; Aapga Publications, Panchkula (Haryana)
2. Entrepreneurship Development by CB Gupta and P Srinivasan, Sultan Chand and Sons, New Delhi
3. Environmental Engineering and Management by Suresh K Dhamija, SK Kataria and Sons, New Delhi

4. Sharma BR, Environmental and Pollution Awareness : Satya Prakashan , New Delhi
5. Thakur Kailash, Environmental Protection Law and policy in India: Deep and Deep Publications, New Delhi
6. Handbook of Small Scale Industry by PM Bhandari
7. Marketing Management by Philip Kotler, Prentice Hall of India, New Delhi
8. Total Quality Management by Dr DD Sharma, Sultan Chand and Sons, New Delhi
9. Principles of Management by Philip Kotler TEE Publication



## 6.7 ELECTIVES

### 6.7.1 REPAIR AND MAINTENANCE OF BUILDINGS

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#### RATIONALE

One of the major concerns of a civil engineer is to take care of the building works, already constructed, in order to keep these buildings in utmost workable conditions. Usually it is being felt that the buildings deteriorate faster for want of care and proper maintenance. The buildings usually have a shabby appearance due to cracks, leakage from the roofs and sanitary/water supply fittings. Thus the need for teaching the subject is proper perspective has arisen making students aware of importance of maintenance of buildings.

#### DETAILED CONTENTS

1. Need for Maintenance (6 hrs)
  - 1.1 Importance and significance of repair and maintenance of buildings
  - 1.2 Meaning of maintenance
  - 1.3 Objectives of maintenance
  - 1.4 Factors influencing the repair and maintenance
  
2. Agencies Causing Deterioration (Sources, Causes, Effects) (6 hrs)
  - 2.1 Definition of deterioration/decay
  - 2.2 Factors causing deterioration, their classification
    - 2.2.1 Human factors causing deterioration
    - 2.2.2 Chemical factors causing deterioration
    - 2.2.3 Environmental conditions causing deterioration
    - 2.2.4 Miscellaneous factors
  - 2.3 Effects of various agencies of deterioration on various building materials  
i.e. bricks, timber, concrete, paints, metals, plastics
  
3. Maintenance Management (Principles, inspections, Practices) (6 hrs)
  - 3.1 Importance of maintenance management
  - 3.2 Organisational structure for maintenance

- 3.3 Building inspections and reports
- 3.4 Maintenance budgets and estimates
- 3.5 Specifications for maintenance jobs
- 4. Investigation and Diagnosis of Defects (6 hrs)
  - 4.1 Systematic approach/procedure of investigation
  - 4.2 Objectives of investigation of building defects
  - 4.3 Sequence of detailed steps for diagnosis of building defects/problems
  - 4.4 Various tests for correct diagnosis of building defects
  - 4.5 Various tests on materials for investigatng defects
  - 4.6 List non-destructive tests on building elements and materials to evaluate the condition of the building and study of three most commonly used tests
- 5. Defects and their root causes (6 hrs)
  - 5.1 Define defects in buildings
  - 5.2 Describe importance and classification of defects
  - 5.3 Main causes of building defects
  - 5.4 List three main defects and their main causes in various building elements
    - 5.4.1 Foundations, basements and DPC
    - 5.4.2 Walls
    - 5.4.3 Column and Beams
    - 5.4.4 Roof and Terraces
    - 5.4.5 Joinery
    - 5.4.6 Decorative and protective finishes
    - 5.4.7 Services
  - 5.5 Defects caused by dampness
- 6. Materials for Repair, maintenance and protection (6 hrs)
  - 6.1 Basic characteristics of repair materials
  - 6.2 Compatibility aspects of repair materials

- 6.3 List various types of repair materials
  - 6.4 State characteristics of:
    - 6.4.1 Anti corrosion coatings
    - 6.4.2 Adhesives/bonding aids
    - 6.4.3 Repair mortars
    - 6.4.4 Curing compounds
    - 6.4.5 Joints sealants
    - 6.4.6 Waterproofing systems for roofs
    - 6.4.7 Protective coatings
  - 6.5 Selection procedure of repair materials for specific job
7. Remedial Measures for Building Defects (12 hrs)
- 7.1 Preventive maintenance considerations
  - 7.2 Precautions during repair and maintenance
  - 7.3 Surface preparation for repair
  - 7.4 Crack repair methods
    - 7.4.1 Epoxy injection
    - 7.4.2 Grooving and sealing
    - 7.4.3 Stitching
    - 7.4.4 Adding reinforcement and grouting
    - 7.4.5 Flexible sealing by sealant
  - 7.5 Repair of surface defects of concrete
    - 7.5.1 Bug holes
    - 7.5.2 Form tie holes
    - 7.5.3 Honey comb and larger voids
  - 7.6 Repair of corrosion in RCC elements
    - 7.6.1 Steps in repairing
    - 7.6.2 Prevention of corrosion in reinforcement
  - 7.7 Material placement techniques with sketches
    - 7.7.1 Pneumatically applied (The gunite techniques)
    - 7.7.2 Open top placement
    - 7.7.3 Pouring from the top to repair bottom face
    - 7.7.4 Birds mouth
    - 7.7.5 Dry packing
    - 7.7.6 Form and pump
    - 7.7.7 Preplaced – aggregate concrete
    - 7.7.8 Trowel applied method

- 7.8 Repair of DPC against Rising Dampness
  - 7.8.1 Physical methods
  - 7.8.2 Electrical methods
  - 7.8.3 Chemical methods
  
- 7.9 Repair of walls
  - 7.9.1 Repair of mortar joints against leakage
  - 7.9.2 Efflorescence removal
  
- 7.10 Waterproofing of wet areas and roofs
  - 7.10.1 Water proofing of wet areas
  - 7.10.2 Water proofing of flat RCC roofs
  - 7.10.3 Various water proofing systems and their characteristics
  
- 7.11 Repair of joints in buildings
  - 7.11.1 Sealing of joints
  - 7.11.2 Types of sealant and their characteristics
  
- 7.12 Repair and maintenance of public health Services
  - 7.12.1 Low pressure
  - 7.12.2 Cisterns defects, blocked drains, damaged china ware
  - 7.12.3 Maintenance of GI Pipes
  - 7.12.4 Repair of traps
  - 7.12.5 Repair of overhead and underground water tanks

## **INSTRUCTIONAL STRATEGY**

This is very important course and efforts should be made to find damaged/defective work spots and students should be asked to think about rectifying/finding solution to the problem. Visits to work site, where repair and maintenance activities are in progress can be very useful to students.

## **RECOMMENDED BOOKS**

1. Nayak, BS; "Maintenance Engineering for Civil Engineers", Khanna Publishers, Delhi
2. Ransom, WH; "Building Failures - Diagnosis and Avoidance", Publishing E and F.N. Span
3. Hutchinson, BD;etc, "Maintenance and Repair of Buildings", Published by Newness - Butterworth

## 6.7.2 ENVIRONMENTAL ENGINEERING

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### RATIONALE

Civil Engineering diploma holders must have the knowledge of different types of environmental aspects due to development activities so that they may help in maintaining the ecological balance and control pollution. They should also be aware of the environmental laws for effectively combating environmental pollution. The class room instructions should be supplemented by field visits to show the pollution caused by urbanization and the combatment measures being adopted at site. Extension lectures by experts may be encouraged.

### DETAILED CONTENTS

1. Environment and Ecology (4 hrs)

Definition and understanding of environment and ecology concept, ecosystem and types of ecosystems, energy flow in an ecosystem, food chain, ecological pyramids, consortium and ecological balance, important biogeo chemical and material cycles, (water, carbon, sulphur, oxygen and nitrogen etc)
2. Protection of Environment (2 hrs)

Importance of clean environment, control of environmental pollution with respect to air, land and water. Conservation of natural resources, environmental education and awareness
3. Water Pollution (8 hrs)

Causes of pollution in surface and underground water; BIS standards for water quality, preventive measures to control water pollution, harmful effects of domestic wastes and industrial effluent, BIS standards for waste water disposal, measures to combat pollution due to waste water, eutrophication of lakes
4. Air Pollution (6 hrs)

Definition, principal air pollutants, atmospheric parameters influencing air pollution, types of air contaminants and their sources, effects of air pollution on human beings, plants, animals and economic effects, automobile pollution, BIS ambient air quality standards and measures to combat air pollution

5. Noise Pollution (2 hrs)  
Definition, unit of measurement of noise, sources and effects of noise pollution and control of noise pollution
6. Effects of mining, blasting and deforestation (6 hrs)  
Environmental deterioration due to mining, open cast mining; land damage by subsidence, blocking of land by refuse heaps; effects of deforestation and killing of wild animals. Case studies on mining, blasting and deforestation
7. Land Use (6 hrs)  
Effect of land use on environmental quality, land use and natural disasters, soil degradation problems - erosion, salinization and water logging, soil pollution, planning for land use and environmental improvement, environmental consideration in housing and city planning, Land reclamation - waste land and wet land development and case studies
8. Environmental Impact Assessment (4 hrs)  
Definition and requirements, environmental impact assessment as a result of constructional activities – housing, dams, multi-storeyed buildings, roads, etc, case studies, environmental auditing - basic concepts, sustainable development – concept of carrying capacity
9. Legislation to Control Environmental Pollution (4 hrs)  
Indian legislative acts for water, land and air pollution control – provisions, scope and implementation
10. Global Issues of Environmental Engineering (4 hrs)  
Global warming, ozone depletion, acid rain, oil pollution; radiation hazards and their control
11. Renewable Source of Energy (2 hrs)  
Role of non-conventional sources of energy (biogas, solar, wind etc) in environmental protection

### **INSTRUCTIONAL STRATEGY**

Students should be encouraged to undertake project work related to environmental problems. They should visit at least three industrial effluent treatment plants and study the impact of utilization of reclaimed by products

**RECOMMENDED BOOKS**

1. Environmental Engineering by Deswal and SS Deswal; Dhanpat Rai and Company (P) Ltd., Delhi
2. Odum EP, "Fundamentals of Ecology", Amarind publication Co., Delhi
3. Environmental Engineering and Management by SK Dhamija; SK kataria and Sons, Delhi
4. De AK, "Engineers Chemistry", New Age Publication, Delhi
5. Kendeigh SC, "Ecology", Prentice Hall of India, Delhi

### 6.7.3 RURAL TECHNOLOGY

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#### RATIONALE

Considerable employment opportunities are available in rural sector if diploma holders in civil engineering are trained to undertake small entrepreneur activity in the rural areas. This subject aims at imparting knowledge and skill in the use of local materials for low cost housing, rural water supply and sanitation rural roads and other appropriate technologies, which can be promoted for upgrading standards of life in rural areas.

#### DETAILED CONTENTS

1. Introduction:

Scope and concept of appropriate technology as applicable to civil engineering, importance of low cost construction in rural areas.

2. Materials:

Importance of locally available material, bomboo, tree bushes, grass, mud, sand etc., treatment of materials for protection against termite, decay and for increasing their strength

3. Mud Walls:

Construction of plane and block mud walls, bamboo/bush reinforced mud walls, water proofing of mud walls, thickness of mud walls, mud plaster, Bitumen combine and plaster.

4. Thatched Roofs:

Constructional method of thatched roofs, fire proofing of thatched roof, low cost treatment of thatched roof.

5. Low Cost Housing:

Planning and construction of low cost houses, cluster of houses, ventilation, low cost doors, construction of mud floors, construction of smokeless chullaha, construction of cement treated gunny bags, sheds, construction of sheds for animals

6. Rural Water Supply:

Construction of open well, chlorination of open well, construction of hand pumps, constructions of bathing cubicals, construction of low cost drains.



7. Rural Sanitations:

Construction of low cost latrines, construction of pre-fabricated septic tanks, construction of soak pits.

8. Soil stabilization and construction of fair weather roads, construction of bunds

9. Miscellaneous:

Low lift pumps, Ferro-cement storage tanks, Ferro-cement grain bins, red clay tiles for roof and floors, construction of rapid burning low cost brick kilns solar seasoning plants. Solar cookers, fiber corrugated sheets, individual and community biogas plants. Concrete blocks for wall construction, Brick, panels, precast lintels, slabs and beam etc.

## 6.8 PROJECT WORK

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- - 9

As far as possible students should be given live project problems with a view to :

- i) Develop understanding regarding the size and scale of operations and nature of field work in which students are going to play their role after completing the courses of study.
- ii) Develop understanding of subject based knowledge given in the classroom in the context of its application at work places.
- iii) Develop first hand experience and confidence amongst the students to enable them to use and apply polytechnic/institute based knowledge and skills to solve practical problems of the world of work.
- iv) Develop special skills and abilities like interpersonal skills, communication skills, attitudes and values.

For the fulfillment of above objectives, polytechnic may establish close linkage with 8-10 relevant organization for providing such an experience. It is necessary that each organisation is visited well in advance and activities to be performed by students are well defined. The chosen activities should be such which are of curricular interest to students and of professional value to industrial/field organisations. Each teacher is expected to supervise and guide 5-6 students.

Effort should be made to identify actual field problems to be given as project work to the students. Project selected should not be too complex which is beyond the level of the students. The placement of the students for such a practical cum project work should match with the competency profile of students and the project work assigned to them. Students may be assessed both by industry and polytechnic faculty. The suggested performance criteria is given below:

- a) Punctuality and regularity
- b) Initiative in learning/working at site
- c) Level/proficiency of practical skills acquired
- d) Sense of responsibility
- e) Self expression/Communication skills
- f) Interpersonal skills
- g) Report Writing skills
- h) Viva voce

**Some of suggested projects are given below:**

1. Construction of a small concrete road consisting of following activities
  - Survey and preparation of site plan
  - Preparation of drawings i.e. L-Section and X-Section
  - Estimating and earth work
  - Preparation of sub grade with stone ballast
  - Laying of concrete
  - Testing of slump, casting of cubes and testing
  - Material estimating and costing with specifications
  - Technical report writing
2. Water Supply system for a one or two villages
  - Surveying
  - Design of water requirements and water distribution system
  - Preparation of drawing of overhead tank
  - Material estimating and costing
  - Specifications
  - Technical report writing
3. Construction of sitting benches in polytechnic campus
4. Welding of angle iron and Expanded metal jali to prepare fencing in polytechnic campus
5. Construction of toilets and baths for a shopping complex in a township
6. Construction of a Chowkidar hut
7. Construction of bridal path 4 kms long
8. Construction of shopping complex detailing of RCC drawings, estimating and costing of material
9. Rainwater harvesting
  - Assessment of catchment area
  - Intensity of rainfall
  - Collection of water
  - Soak pit design
  - Supply of water
  - Monitoring during rainy season
10. Providing of septic tank with soak pits

11. Preparing plumbing detailed drawings of a two storey building and material estimate and costing
12. Planning and design of sports stadium in a township or cluster of villages
13. Design and drawings of fishery ponds in a village
14. Design of small residential building including structural members, specifications, estimating and costing of materials, report writing and municipal drawings for water supply and sewerage system