

## 4.1 CONCRETE TECHNOLOGY

L T P

Periods/week 4 - 2

### RATIONALE

Diploma holders in Civil Engineering are supposed to supervise concreting operations involving proportioning, mixing, transporting, placing, compacting, finishing and curing of concrete. To perform above functions, it is essential to impart knowledge and skills regarding ingredients of concrete and their properties; properties of concrete in plastic and hardened stage, water cement ratio and workability; proportioning for ordinary concrete; concreting operations and joints in concrete.

### DETAILED CONTENTS THEORY

1. Introduction: Definition of concrete, uses of concrete in comparison to other building materials. (03 periods)
2. Ingredients of Concrete: (07 periods)
  - 2.1 Cement: physical properties of cement; different types of cement as per IS Codes
  - 2.2 Aggregates:
    - 2.2.1 Classification of aggregates according to size and shape
    - 2.2.2 Characteristics of aggregates: Particle size and shape, surface texture, specific gravity of aggregate; bulk density, water absorption, surface moisture, bulking of sand, deleterious materials, soundness
    - 2.2.3 Grading of aggregates: coarse aggregate, fine aggregate; All-in- aggregate; fineness modulus; interpretation of grading charts
  - 2.3 Water: Quality requirements as per IS:456-2000
3. Water Cement Ratio: (03 periods)
  - 3.1 Hydration of cement, principle of water-cement ratio, Duff Abram's Water-cement ratio law: Limitations of water-cement ratio law and its effects on strength of concrete
4. Workability: (08 periods)
  - 4.1 Workability factors affecting workability, Measurement of workability: slump test, compacting factor and Vee Bee consistometer; Recommended slumps for placement in various conditions as per IS:456-2000/SP-23

5. Properties of Concrete: (09 periods)
  - 5.1 Properties in plastic state: Workability, Segregation, Bleeding and Harshness
  - 5.2 Properties in hardened state: Strength, Durability, Impermeability, Dimensional changes;
6. Proportioning for Normal Concrete: (05 periods)
  - 6.1 Objectives of mix design, introduction to various grades as per IS:456-2000; proportioning for nominal mix design as prescribed by IS 456-2000
  - 6.2 Adjustment on site for: Bulking of fine aggregate, water absorption of aggregate, workability
  - 6.3 Difference between nominal and controlled concrete
  - 6.4. Introduction to IS-10262-2009-Code for controlled mix design
7. Introduction to Admixtures (chemicals and minerals) for improving performance of concrete (04 periods)
8. Special Concretes (only features) (07 periods)
  - 8.1 Concreting under special conditions, difficulties and precautions before, during and after concreting
    - 8.1.1 Cold weather concreting
    - 8.1.2 Under water concreting
    - 8.1.3 Hot weather concreting
  - 8.2 Ready mix concrete
  - 8.3 Fibre reinforced concrete
  - 8.4 Polymer Concrete
  - 8.5 Fly ash concrete
  - 8.6 Silica fume concrete
9. Concreting Operations: (16 periods)
  - \*\*9.1 Storing of Cement:
    - 9.1.1 Storing of cement in a warehouse
    - 9.1.2 Storing of cement at site
    - 9.1.3 Effect of storage on strength of cement
    - 9.1.4 Determination of warehouse capacity for storage of Cement

- \*\*9.2 Storing of Aggregate: Storing of aggregate at site
- 9.3 Batching (to be shown during site visit )
  - 9.3.1 Batching of Cement
  - 9.3.2 Batching of aggregate by:
    - 9.3.2.1 Volume, using gauge box (farma) selection of proper gauge box
    - 9.3.2.2 Weight spring balances and batching machines
  - 9.3.3 Measurement of water
- \*\* 9.4 Mixing:
  - 9.4.1 Hand mixing
  - 9.4.2 Machine mixing - types of mixers, capacities of mixers, choosing appropriate size of mixers, operation of mixers
  - 9.4.3 Maintenance and care of machines
  - \*\*9.5 Transportation of concrete: Transportation of concrete using: wheel barrows, transit mixers, chutes, belt conveyors, pumps, tower crane and hoists etc.
- 9.6 Placement of concrete:  
Checking of form work, shuttering and precautions to be taken during placement
- \*\* 9.7 Compaction:
  - 9.7.1 Hand compaction
  - 9.7.2 Machine compaction - types of vibrators, internal screed vibrators and form vibrators
  - 9.7.3 Selection of suitable vibrators for different situations
- 9.8 Finishing concrete slabs - screeding, floating and trowelling
- 9.9 Curing:
  - 9.9.1 Objectives of curing, methods of curing like ponding, membrane curing, steam curing, chemical curing
  - 9.9.2 Duration for curing and removal of form work
- 9.10 Jointing: Location of construction joints, treatment of construction joints, expansion joints in buildings - their importance and location
- 9.11 Defects in concrete: Identification of and methods of repair

10. Importance and methods of non-destructive tests (introduction only) (02 periods)

NOTE: \*\* A field visit may be planned to explain and show the relevant things

**PRACTICAL EXERCISES:**

- i) To determine the physical properties of cement as per IS Codes
- ii) To determine flakiness and elongation index of coarse aggregates
- iii) To determine silt in fine aggregate
- iv) Determination of specific gravity and water absorption of aggregates
- v) Determination of bulk density and voids of aggregates
- vi) To determine surface moisture in fine aggregate by displacement method
- vii) Determination of particle size distribution of fine, coarse and all in aggregate by sieve analysis (grading of aggregate)
- viii) To determine necessary adjustment for bulking of fine aggregate
- ix) To determine workability by slump test:
- x) To verify the effect of water, fine aggregate/coarse aggregate ratio and aggregate/Cement ratio on slump
- xi) Compaction factor test for workability
- xii) Non destructive test on concrete by:
  - a) Rebound Hammer Test
  - b) Ultrasonic Pulse Velocity Test
- xiii) Tests for compressive strength of concrete cubes for different grades of concrete

**INSTRUCTIONAL STRATEGY**

This subject is of practical nature. While imparting instructions, teachers are expected to organize demonstrations and field visits to show various stages of concreting operations. While working in the laboratory, efforts should be made to provide extensive practical training to students so as to make them confident in the preparation and testing of concrete. Teachers should also organize viva examination so as to develop understanding about concepts and principles involved. The experiments may be demonstrated to students through video programmes developed in the field of „concrete technology“ by NITTTR, Chandigarh.

**RECOMMENDED BOOKS**

- i) Kulkarni, PD; Ghosh, RK and Phull, YR; "Text Book of Concrete Technology"; Oxford and IBH Publishing Co. New Delhi
- ii) Krishnamurthy, KT; Rao, A Kasundra and Khandekar, AA; "Concrete Technology"; Dhanpat Rai and Sons, Delhi,

- iii) Gupta BL and Gupta Amit; "Text Book of Concrete Technology"; Standard Publishers Distributors, Delhi.
- iv) Varshney, RS; "Concrete Technology";, Oxford and IBH Publishing, New Delhi
- v) Neville, AM; "Properties of Concrete", Pitman (ELBS Edition available), London
- vi) Orchard; "Concrete Technology"; Vol I, II, and III
- vii) Handoo, BL; Puri, LD and Mahajan Sanjay "Concrete Technology"; Satya Prakashan, New Delhi,
- viii) Sood, Hemant, Mittal LN and Kulkarni PD; "Laboratory Manual on Concrete Technology", CBS Publishers, New Delhi, 2002
- ix) Vazirani, VN; and Chandola, SP; "Concrete Technology"; Khanna Publishers, Delhi,
- x) Gambhir, ML; "Concrete Technology";, MacMillan India Ltd., New Delhi
- xi) Siddique, R., "Special Structural Concretes", , Galgotia Publishers Pvt. Ltd. Delhi
- xii) Birinder Singh, "Concrete Technology", Kaption Publications, Ludhiana,
- (xiii) Module on „Special Concretes by Dr Hemant Sood , NITTTR Chandigarh
- (xiv) Concrete Technology by P Dayaratman
- (xv) Video programme on different experiments in „Concrete Technology“ developed by NITTTR, Chandigarh.

#### **SUGGESTED DISTRIBUTION OF MARKS**

<b>Topic No.</b>	<b>Time Allotted (Periods)</b>	<b>Marks Allotted (%)</b>
1	03	04
2	07	12
3	03	04
4	08	08
5	09	18
6	05	08
7	04	07
8	07	12
9	16	25
10	02	02
<b>Total</b>	<b>64</b>	<b>100</b>

## 4.2 SOIL AND FOUNDATION ENGINEERING

**L T P**  
**Periods/week 4 - 2**

### RATIONALE

Civil Engineering diploma engineers are required to supervise the construction of structural buildings, roads, pavements, dams, embankments, and other Civil Engineering structures. As such the knowledge of basic soil engineering is the pre-requisite for these engineers for effective discharge of their duties. This necessitates the introduction of Soil and Foundation Engineering subject in the curriculum for Diploma Course in Civil Engineering.

The subject covers only such topics which will enable the diploma engineers to identify and classify the different types of soils, their selection and proper use in the field for various types of engineering structures.

The emphasis will be more on teaching practical aspect rather than theory.

### DETAILED CONTENTS

#### THEORY

1. Introduction: (03 periods)
  - 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: (04 periods)
  - 2.1 Constituents of soil and 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 (04 periods)
  - 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 and its use in describing cohesionless soils
  - 3.4 Behaviour of cohesive soils with change in water content, Atterberg's limit - definitions, use and 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: (04 periods)
- 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. Effective Stress: (Concept only) (04 periods)
- 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 (04 periods)
- 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 and 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: (09 periods)
- 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: (04 periods)
- 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: (08 periods)
- 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 periods)
- 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 geosynthetics.
11. Foundation Engineering: (10 periods)
- 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, type of piles and their suitability; pile classification on the basis of material, pile group and pile cap.

### **PRACTICAL EXERCISES**

1. To determine the moisture content of a given sample of soil
2. Auger Boring and Standard Penetration Test
  - a) Identifying the equipment and accessories
  - b) Conducting boring and SPT at a given location
  - c) Collecting soil samples and their identification
  - d) Preparation of boring log and SPT graphs
  - e) Interpretation of test results
3. Extraction of Disturbed and Undisturbed Samples
  - a) Extracting a block sample
  - b) Extracting a tube sample
  - c) Extracting a disturbed samples for mechanical analysis.
  - d) Field identification of samples

4. 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
  
5. 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
  
6. 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
  
7. 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
  
8. Demonstration of Unconfined Compression Test
  - a) Specimen preparation
  - b) Conducting the test
  - c) Plotting the graph
  - d) Interpretation of results and finding/bearing capacity
  
9. Demonstration of:
  - a) Direct Shear and Vane Shear Test on sandy soil samples
  - b) Permeability test apparatus

## **INSTRUCTIONAL STRATEGY**

The teacher while imparting instructions are expected to lay greater emphasis on the practical aspects rather than theory and mathematical treatment. To bring clarity regarding concepts and principles involved, teachers should organize demonstrations in the laboratories and fields. It is necessary to create understanding that soils fail either under shear or settlement due to heavy loads. This can be shown by making use of photographs on working models of such failures. Efforts should be made in the practical classes that students perform practical exercises individually. Conduct of viva examination at the end of each practical work will develop clear understanding about the concepts and principles related to this subject.

## **RECOMMENDED BOOKS**

- i) Punmia, BC, "Soil Mechanics and Foundations"; Standard Publishers, Delhi
- ii) Bharat Singh and Shamsheer Prakash; "Soil Mechanics and Foundations Engineering", Nem Chand and Bros, Roorkee,
- iii) Sehgal, SB, "A Text Book of Soil Mechanics"; CBS Publishers and Distributors, Delhi,
- iv) Gulati, SK and Manoj Dutta, "Geotechnical Engineering ", Tata McGraw Hill, Delhi,
- v) Ranjan Gopal and Rao ASR "Basic and Applied Soil Mechanics", New Age Publication (P) Ltd., New Delhi
- vi) Singh Harbhajan "Soil and Foundation Engineering", Abhishek Publishers, Chandigarh
- vii) S Mittal and JP Shukla, "Soil Testing for Engineers", Khanna Publishers Ltd., Delhi
- viii) BIS Codes IS 6403 (latest edition) and IS 1498 (latest edition)
- ix) Jagroop Singh, "Soil and Foundation Engineering", Eagle Parkashan, Jalandhar
- x) Rabinder Singh, " Soil and Foundation Engg." SK Kataria and Sons, Ludhiana
- xi) NITTTR, Chandigarh, "Shallow Foundations"
- xii) Video films on Geo-technical Laboratory Practices by NITTTR, Chandigarh

### SUGGESTED DISTRIBUTION OF MARKS

<b>Topic No.</b>	<b>Time Allotted (Periods)</b>	<b>Marks Allotted (%)</b>
1	03	05
2	04	06
3	04	06
4	04	06
5	04	06
6	04	06
7	09	14
8	04	06
9	08	16
10	10	12
11	10	17
<b>Total</b>	<b>64</b>	<b>100</b>

### 4.3 WATER SUPPLY AND WASTE WATER ENGINEERING

	L	T	P
Periods/week	5	-	2

#### RATIONALE

One of the basic necessities of life is water which is not easily available to a lot of people. Providing potable water at the first place then collection and disposal of waste solids and liquids are important activities of civil engineering field. This subject provides basic knowledge and skills in the field of water supply system and waste disposal system. Classroom instructions should be supplemented by field visits to show functional details of water supply and waste disposal systems. It will also be advantageous to invite professionals from field to deliver extension lectures on specialised operations.

#### DETAILED CONTENTS

##### A. WATER SUPPLY

1. Introduction (02 periods)
  - 1.1 Necessity and brief description of water supply system.
2. Quantity of Water (06 periods)
  - 2.1 Water requirement
  - 2.2 Rate of demand and variation in rate of demand
  - 2.3 Per capita consumption for domestic, industrial, public and fire fighting uses as per BIS standards (no numerical problems)
  - 2.4 Population Forecasting
3. Quality of Water (04 periods)
  - 3.1 Meaning of pure water and methods of analysis of water
  - 3.2 Physical, Chemical and bacteriological tests and their significance
  - 3.3 Standard of potable water as per Indian Standard
  - 3.4 Maintenance of purity of water (small scale and large scale quantity)
4. Water Treatment (brief introduction) (09 periods)
  - \*\*4.1 Sedimentation - purpose, types of sedimentation tanks
  - \*\*4.2 Coagulation flocculation - usual coagulation and their feeding
  - \*\*4.3 Filtration - significance, types of filters, their suitability
  - 4.4 Necessity of disinfection of water, forms of chlorination, break point chlorine, residual chlorine, application of chlorine.
  - 4.5 Flow diagram of different treatment units, functions of (i) Aeration fountain (ii) mixer (iii) flocculator, (iv) classifier, (v) slow and rapid sand filters (vi) chlorination chamber.

5. Conveyance of Water (09 periods)
- \*\*5.1 Different types of pipes - cast iron, PVC, steel, asbestos cement, concrete and lead pipes. Their suitability and uses, types of joints in different types of pipes.
  - 5.2 Appurtenances: Sluice, air, reflux valves, relief valves, scour valves, bib cocks, stop cocks, fire hydrants, water meters their working and uses
  - 5.3 Distribution site: Requirement of distribution, minimum head and rate, methods of layout of distribution pipes
    - 5.3.1 Systems of water supply - Intermittent and continuous service reservoirs - types, necessity and accessories.
    - 5.3.2 Wastage of water - preventive measures
    - 5.3.3 Maintenance of distribution system
    - 5.3.4 Leakage detection
6. Laying out Pipes (06 periods)
- 6.1 Setting out alignment of pipes
  - 6.2 Excavation for laying of pipes and precautions to be taken in laying pipes in black cotton soil.
  - 6.3 Handling, lowering beginning and jointing of pipes
  - 6.4 Testing of pipe lines
  - 6.5 Back filling
  - 6.6 Use of boring rods
7. Building Water Supply (02 periods)
- 7.1 Connections to water main (practical aspect only)
  - \*\*7.2 Water supply fixtures and installations and terminology related to plumbing

## **B. WASTE WATER ENGINEERING**

8. Introduction (04 periods)
- 8.1 Purpose of sanitation
  - 8.2 Necessity of systematic collection and disposal of waste
  - 8.3 Definition of terms in sanitary engineering
  - 8.4 Collection and conveyance of sewage
  - 8.5 Conservancy and water carriage systems, their advantages and Disadvantages
  - 8.6 (a) Surface drains (only sketches) : various types, suitability  
(b) Types of sewage: Domestic, industrial, storm water and its seasonal variation
9. Sewerage System (05 periods)
- 9.1 Types of sewerage systems, materials for sewers, their sizes and joints
  - 9.2 Appurtenance: Location, function and construction features. Manholes, drop manholes, tank hole, catch basin, inverted siphon, flushing tanks grease and oil traps, storm regulators, ventilating shafts

10. Laying and Construction of Sewers: (6 periods)  
 10.1 Setting out/alignment of sewers  
 10.2 Excavations, checking the gradient with boning rods preparation of bedding, handling and jointing testing and back filling of sewers/pipes.  
 10.3 Construction of surface mains and different sections required
- 11 Sewage characteristics: (4 periods)  
 11.1 Properties of sewage and IS standards for analysis of sewage  
 11.2 Physical, chemical and bacteriological parameters
12. Natural Methods of Sewerage Disposal (5 periods)  
 12.1 General composition of sewage and disposal methods  
 12.2 Disposal by dilution  
 12.3 Self purification of stream  
 12.4 Disposal by land treatment  
 12.5 Nuisance due to disposal
13. Sewage Treatment (9 periods)  
 13.1 Meaning and principle of primary and secondary treatment and activated sludge process their flow diagrams  
 13.2 Introduction and uses of screens, grit chambers, detritus tanks, skimming tanks, plain sedimentation tanks, primary clarifiers, secondary clarifiers, filters, control beds, intermittent sand filters, trickling filters, sludge treatment and disposal, oxidation ponds (Visit to a sewage treatment plant)
14. Building Drainage (9 periods)  
 14.1 Aims of building drainage and its requirements  
 \*\*14.2 Different sanitary fittings and installations  
 14.3 Traps, seals, causes of breaking seals

\*\* A field visit may be planned to explain and show the relevant things.

### **LIST OF PRACTICALS**

- 1) To determine turbidity of water sample
- 2) To determine dissolved oxygen of given sample
- 3) To determine pH value of water
- 4) To perform jar test for coagulation
- 5) To determine BOD of given sample
- 6) To determine residual chlorine in water
- 7) To determine conductivity of water and total dissolved solids
- 8) To study the installation of following:
  - a) Water meter
  - b) Connection of water supply of building with main
  - c) Pipe valves and bends
  - d) Water supply and sanitary fittings
- 9) To determine Bacteriological Quality of Drinking Water

- 10) To study and demonstrate the joining/threading of GI Pipes, CI Pipes, SW pipes, D.I. pipes and PVC pipes.
- 11) To demonstrate the laying of SW pipes for sewers
- 12) Study of water purifying process by visiting a field lab.
- 13) To test house drainage
- 14) To determine TDS by TDS meter.

### **INSTRUCTIONAL STRATEGY:**

Before imparting the instructions in the class room, visits to water works and sewage treatment plants can go a long way for increased motivation of students for learning in the class room. As the subject is of practical nature, lecture work be supplemented by field visits from time to time. Home assignments related to collection of information, pamphlets and catalogues from hardware shop dealing water supply and sanitary fittings will be very helpful for the students.

### **RECOMMENDED BOOKS**

1. Duggal, KN; "Elements of Public Health Engineering";, S. Chand and Co. New Delhi
2. Rangwala, SC; "Water Supply and Sanitary Engineering"; Anand Charotar Book Stall
3. Kshirsagar, SR; "Water Supply Engineering"; Roorkee Publishing House, Roorkee
4. Kshirsagar, SR; "Sewage and Sewage Treatment"; Roorkee, Roorkee Publishing House
5. Hussain, SK; "Text Book of Water Supply and Sanitary Engineering"; Oxford and IBH Publishing Co, New Delhi,
6. Birdie, GS; "Water Supply and Sanitary Engineering"; Dhanpat Rai and Sons, Delhi
7. Garg, Santosh Kumar; "Water Supply Engineering"; Khanna Publishers, Delhi
8. Garg, Santosh Kumar; "Sewage and Waste Water Disposal Engineering"; Khanna Publishers, Delhi
9. Steel, EW; "Water Supply and Sewerage"; McGraw Hill.
10. Duggal, Ajay K and Sharma, Sanjay, "A Laboratory Manual in Public Health Engineering", , Galgotra Publications, 2006, New Delhi
11. Gurjar,B.R. " Sludge Treatment & Disposal" Oxford and IBH Co Pvt Ltd New Delhi.
12. Mahajan Sanjay, Water Supply and Waste Water Engineering, Satya Prakashan Ltd., Delhi.



### SUGGESTED DISTRIBUTION OF MARKS

<b>Topic No.</b>	<b>Time Allotted (Periods)</b>	<b>Marks Allotted (%)</b>
1	02	03
2	06	07
3	04	05
4	09	12
5	09	11
6	06	07
7	02	03
8	04	05
9	05	06
10	06	07
11	04	05
12	05	06
13	09	12
14	09	11
<b>Total</b>	<b>80</b>	<b>100</b>

#### 4.4 IRRIGATION ENGINEERING

	<b>L</b>	<b>T</b>	<b>P</b>
<b>Periods/week</b>	<b>4</b>	<b>-</b>	<b>-</b>

#### RATIONALE

Diploma holders in civil engineering have to supervise the construction, repair and maintenance of canals, head works, river training works, cross drainage works, regulatory and other works. Some of diploma holders are also engaged for preventing water logging and irrigation by tubewells. This subject imparts knowledge regarding hydrology, flow irrigation – storage and distribution system, constructional features of head works, river training works, cross drainage works, causes and prevention of water logging and construction of tube wells.

#### DETAILED CONTENTS

1. Introduction: (02 periods)
  - 1.1 Definition of irrigation
  - 1.2 Necessity of irrigation
  - 1.3 History of development of irrigation in India
  - 1.4 Major, medium and minor irrigation projects
2. Water Requirement of Crops (06 periods)
  - 2.1 Principal crops in India and their water requirements
  - 2.2 Crop seasons – Kharif and Rabi
  - 2.3 Soil water, soil crop and water relationships, duty, delta and base period, their relationship and evapotranspiration
  - 2.4 Gross commanded area (GCA), culturable commanded area (CCA), intensity of irrigation, irrigable area
3. Hydrological Cycle, Catchment Area and Run-off (06 periods)

Rainfall, definition rain-gauges – automatic and non-automatic, methods of estimating average rainfall (Arithmetic system); catchment area runoff, factors affecting runoff, hydrograph, basic concept of unit hydrograph.
4. Methods of Irrigation (07 periods)
  - 4.1 Flow irrigation - its advantages and limitations
  - 4.2 Lift Irrigation – Tube well and open well irrigation, their advantages and disadvantages

- 4.3 Sprinkler irrigation conditions favourable and essential requirements for sprinkler irrigation, sprinkler system – classification and component parts
- 4.4 Drip irrigation, suitability of drip irrigation, layout, component parts, advantages
- 5. Canals (08 periods)
  - 5.1 Classification, apurtenancs of a canal and their functions, sketches of different canal cross-sections (unlined)
  - 5.2 Various types of canal lining - their related advantages and disadvantages, sketches of different lined canal x-sections
  - 5.3 Breaches and their control
  - 5.4 Maintenance of lined and unlined canals
- 6. Tube Well Irrigation (09 periods)
  - 6.1 Introduction, occurrence of ground water, location and command, advantages and disadvantages, comparison with canal irrigation
  - 6.2 Tube wells, explanation of terms: water table, radius of influence, depression head, cone of depression, confined and unconfined aquifers. Yield of a well and methods of determining yield of well
  - 6.3 Types of tube wells, cavity, strainer and slotted type;
  - 6.4 Method of boring, installation of well assembly, development of well, pump selection and installation and maintenance
  - 6.5 Water Harvesting Techniques: Need and requirement of various methods, Run-off from roof top and ground surface, techniques for ground water recharge construction of recharge pits and recharge wells and their maintenance.
- 7. Dams (07 periods)
  - 7.1 Classification of dams; earthen dams - types, causes of failure; cross-section of zoned earthen dams, method of construction, gravity dams – types, cross-sections of a dam, method of construction
  - 7.2 Concept of small and micro dams
  - 7.3 Concept of spillways and energy dissipators

8. Canal Head Works and Regulatory Works (06 periods)  
Definition, object, general layout, functions of different parts of head works. Difference between weir and barrage
9. Cross Drainage Works (04 periods)
- 9.1 Functions and necessity of the following types: aqueduct, super passage, level crossing, inlet and outlet, pipe crossing
- 9.2 Sketches of the above cross drainage works
10. Definitions of following Hydraulic Structures with Sketches (02 periods)
- 10.1 Falls
- 10.2 Cross and head regulators
- 10.3 Outlets
- 10.4 Canal Escapes
11. River Training Works (04 periods)  
Methods of river training, guide banks, retired (levees) embankments, groynes and spurs, pitched island, cut-off
12. Water Logging and Drainage (03 periods)
- 12.1 Definition of water logging – its causes and effects, detection, prevention and Remedies
- 12.2 Reclamation of soil
- 12.3 Surface and sub-surface drains and their layout

### **INSTRUCTIONAL STRATEGY**

The teaching of the subject should be supplemented by field visits at regular intervals of time to expose the students to irrigation works. Students should be asked to prepare and interpret drawings of various irrigation works.

## RECOMMENDED BOOKS

1. Bharat Singh, `Fundamentals of Irrigation Engineering', , Nem Chand and Bros, Roorkee
2. Garg, Santosh Kumar, `Irrigation Engineering and Hydraulics Structures', Khanna Publishers, Delhi,
3. Punmia, BC; and Pande Brij Bansi Lal, `Irrigation and Water Power Engineering', Delhi, Standard Publishers Distributors, Delhi,
4. Sharma, RK; `Text Book of Irrigation Engineering and Hydraulics Structures', , Oxford and IBH Publishing Company, New Delhi
5. Sharma, SK; `Principles and Practice of Irrigation Engineering', Prentice Hall of India Pvt. Ltd., New Delhi,
6. Varshney RS, Gupta SC, Gupta RL at all. “Theory and Design of Irrigation Structures”, Vol. I and II,
7. Saharsabudhe SR, “Irrigation Engineering and Hydraulic Structures”
8. Priyani BB, „The Fundamental Principles of Irrigation and Water Power
9. BIS Codes
10. Wan. E. Houk, “Irrigation Engineering” Vol. I and II
11. Central Ground Water Board and Central Water Commission Guidelines and Reference Books.

## SUGGESTED DISTRIBUTION OF MARKS

Topic No.	Time Allotted (Periods)	Marks Allotted (%)
1	02	03
2	06	08
3	06	08
4	07	13
5	08	12
6	09	15
7	07	12
8	06	09
9	04	06
10	02	03
11	04	06
12	03	05
<b>Total</b>	<b>64</b>	<b>100</b>

## 4.5 SURVEYING – II

	L	T	P
Periods/week	3	-	6

### RATIONALE

The important functions of a civil engineer includes the jobs of detailed surveying, plotting of survey data, preparation of survey maps and setting out works

While framing the curriculum for the subject of surveying, stress has been given to the development of knowledge and skill in theodolite surveying; tachometry surveying, curves and use of minor and modern instruments have been included in this subject.

Field work should be a selected one so that student can check his work and have an idea of the results the extent of error in the work done by him. As far as possible, the surveys done should be got plotted, as this will also reveal errors in the work and develop skill in plotting.

### DETAILED CONTENTS

1. Contouring: (08 periods)  
Concept of contours, purpose of contouring, contour interval and horizontal equivalent, factors effecting contour interval, characteristics of contours, methods of contouring: Direct and indirect, use of stadia measurements in contour survey, interpolation of contours; use of contour map, Drawing cross section from a contour map; marking alignment of a road, railway and a canal on a contour map, computation of earth work and reservoir capacity from a contour map
2. Theodolite Surveying: (12 periods)  
Working of a transit vernier theodolite, axes of a theodolite and their relation; temporary adjustments of a transit theodolite; concept of transiting, swinging, face left, face right and changing face; measurement of horizontal and vertical angles. Prolonging a line (forward and backward) measurement of bearing of a line; traversing by included angles and deflection angle method; traversing by stadia measurement, theodolite triangulation, plotting a traverse; concept of coordinate and solution of omitted measurements (one side affected), errors in theodolite survey and precautions taken to minimize them; limits of precision in theodolite traversing. Height of objects – accessible and non-accessible bases
3. Tacho-metric surveying (06 periods)  
Tachometry, Instruments to be used in tachometry, methods of tachometry, stadia system of tachometry, general principles of stadia tachometry, examples of stadia tachometry and Numerical problems.

4. Curves: (15 periods)
- 4.1 Simple Circular Curve:  
Need and definition of a simple circular curve; Elements of simple circular curve - Degree of the curve, radius of the curve, tangent length, point of intersection (Apex point), tangent point, length of curve, long chord deflection angle, Apex distance and Mid-ordinate. Setting out of simple circular curve:
- a) By linear measurements only:
    - Offsets from the tangent
    - Successive bisection of arcs
    - Offsets from the chord produced
  - b) By tangential angles using a theodolite
- 4.2 Transition Curve:  
Need (centrifugal force and super elevation) and definition of transition curve; requirements of transition curve; length of transition curve for roads; by cubic parabola; calculation of offsets for a transition curve; setting out of a transition curve by tangential offsets only
- 4.3 Vertical curve  
Setting out of a vertical curve
5. Introduction to the use of Modern Surveying equipment and techniques such as: (03 periods)
- a) EDM or Distomat
  - b) Total station
  - c) Introduction to remote sensing and GPS
6. Minor Instruments:- (04 periods)
- 6.1. Introduction and use of minor instruments like Ceylon Ghat Tracer, Clinometer, Pantograph, Abney Level etc.
- 6.2. Use of planimeter for computing areas

**NOTE:** No sketch of the instruments may be asked in the examination

### **PRACTICAL EXERCISES**

- I. Contouring:
- i) Preparing a contour plan by radial line method by the use of a Tangent Clinometer/Tachometer
  - ii) Preparing a contour plan by method of squares

- iii) Preparing a contour plan of a Road/Railway track/Canal by taking cross sections.

## II. Theodolite:

- i) Taking out the Theodolite, mounting on the tripod and placing it back in the box
- ii) Study of a transit vernier theodolite; temporary adjustments of theodolite
- iii) Reading the vernier and working out the least count, measurement of horizontal angles by repetition and reiteration methods
- iv) Measurement of vertical angles and use of tachometric tables
- v) Measurement of magnetic bearing of a line
- vi) Running a closed traverse with a theodolite (at least five sides) and its plotting
- vii) Height of objects with and without accessible bases

## III. Curves

- i) Setting out of a simple circular curve with given data by the following methods
  - a) Offsets from the chords produced
  - b) One theodolite method

## IV Minor instruments:

- i) Demonstration and use of minor instruments like Ceylon Ghat Tracer, Tangent Clinometer, Pantograph, Abney level etc.
- ii) Use of planimeter for computing areas

## V Demonstration of digital instruments through field visits to Survey of India and other government agencies.

## VI Total Station (only demonstrations).

## **INSTRUCTIONAL STRATEGY**

This is highly practice-oriented course. While imparting theoretical instructions, teachers are expected to demonstrate the use of various instruments in surveying, stress should be laid on correct use of various instruments so as to avoid/minimize errors during surveying. It is further recommended that more emphasis should be laid in conducting practical work by individual students



## RECOMMENDED BOOKS

1. Hussain, SK and Nagraj, MS "Text Book of Surveying";, S Chand and Co Ltd., New Delhi
2. Deshpande, RS "A Text Book Surveying and Levelling"; United Book Corporation, Pune,
3. Kocher, CL; "A Text Book of Surveying"; Katson Publishing House Ludhiana,
4. Kanetkar,TP and Kulkarni, SV., "Surveying and Leveling", Poona, AVG Parkashan, Pune
5. Kanetkar, TP; and Kulkarni, SV; "Surveying and Leveling-Vol.2" AVG Prakashan, Pune
6. Punima, BC; "Surveying and Leveling ", Standard Publishers Distributors, Delhi
7. Shahai, PB; "A Text Book of Surveying ", Oxford and IBH Publishing Co.
8. Lilly Sant "Remote Sensing and Image Interpretation"
9. Mahajan, Sanjay, "Surveying-II", Satya Prakashan, Delhi

## SUGGESTED DISTRIBUTION OF MARKS

Topic No.	Time Allotted (Periods)	Marks Allotted (%)
1	08	16
2	12	28
3	06	12
4	15	34
5	03	05
6	04	05
<b>Total</b>	<b>32</b>	<b>100</b>

## 4.6 Strength of Materials

L T P  
4 - 2

### RATIONALE

Diploma holders in this course are required to analyse reasons for failure of different components and select the material for different applications. For this purpose, it is essential to teach them concepts, principles, applications and practices covering stress, strain, bending moment, shearing force, shafts, columns and springs. Hence this subject has been introduced.

### DETAILED CONTENTS

#### 1. Introduction to Material Properties

03 Period

Mechanical properties of materials such as elasticity, plasticity, ductility, brittleness, toughness, hardness, fatigue, malleability, stiffness. Elastic bodies, plastic bodies and rigid bodies, deformation.

#### 2. Stresses and Strains

08 Period

- 2.1 Force, its definition and types, units, different types of loads.
- 2.2 Definition of stress and strain, axial loading, different types of stresses and strains, tensile and compressive stress and strain, elastic limit, Hooke's law, stress-strain curve for ductile and brittle material, salient features of stress-strain curve. Young's modulus of elasticity
- 2.3 Factor of safety.
- 2.4 Stress and strain in straight, stepped bars and taper bar of circular cross section, determination of stress and elongation of a bolt in a bolted joint when subjected to direct external load only
- 2.5 Stress and strain on composite section under axial loading, stress and strain due to temperature variations in homogeneous and composite bars.
- 2.6 Shear load, shear stress and strain, modulus of rigidity, lateral strain, Poisson's ratio
- 2.7 Volumetric strain, bulk modulus. Relation between modulus of elasticity, modulus of rigidity and bulk modulus

#### 3. Shear Force and Bending Moment

06 Period

- 3.1 Types of beams.
- 3.2 Concept of shear force and bending moment.
- 3.3 Shear force and bending moment diagram for cantilever and simply supported beams subjected to point load and uniformly distributed loads only. Maximum bending moment and point of contraflexure.

#### 4. Theory of Simple Bending

06 Period

- 4.1 Concept of pure bending, neutral axis, moment of resistance, section Modulus, bending equation, bending of simple, beams of uniform strength.
- 4.2 Application of flexural formula for solid rectangular and circular section, Channel section, hollow rectangular and circular section.

## **5. Strain Energy**

**06 Period**

- 5.1 Concept of strain energy, proof resilience and modulus of resilience.
- 5.2 Stresses developed due to gradual, sudden and impact load.
- 5.3 Strain energy stored due to gradual, sudden and impact load.
- 5.4 Strain energy due to bending and torsion.

## **6. Slope and Deflection**

**06 Period**

- 6.1 Introduction, determination of slope and deflection by Macaulay's method, moment area of method
- 6.2 Simple cases of slope and deflection in simply supported beam with uniformly distributed load on whole of the length and a point load at the centre
- 6.3 Cantilever beam with uniformly distributed load on whole length and a point load at the end.

## **7. Torsion**

**05 Period**

- 7.1 Pure torsion, torsion equation (relation between twisting moment, shear stress and angle of twist), polar modulus of section
- 7.2 Assumptions in theory of pure torsion
- 7.3 Strength of circular solid shaft and hollow shaft in pure torsion
- 7.4 Power transmitted by shaft

## **8. Springs**

**05 Period**

- 8.1 Effect of falling load helical spring
- 8.2 Helical Springs closed coiled and open coiled helical springs subjected to axial load
- 8.3 Angle of twist, strain energy, shear stress and maximum deflection under axial load
- 8.4 Laminated spring (semi-elliptical and quarter-elliptical type), determination of number of plates, maximum deflection under axial load

## **9. Thin Cylinder and spheres**

**07 Period**

- 9.1 Introduction
- 9.2 Thin cylinder Vessel Subjected to internal Pressure
- 9.3 Stresses in a Thin cylinder Vessel Subjected to internal Pressure
- 9.4 Expression for circumferential stresses
- 9.5 Expression for longitudinal stresses
- 9.6 Stresses in a Thin cylinder Vessel Subjected to internal Pressure and external pressure
- 9.7 Stresses in a thin sphere shells subjected to internal Pressure

## **10. Riveted Joints**

**06 Period**

- 10.1 Introduction
- 10.2 Types of rivets joints
- 10.3 Failure of riveted joints
- 10.4 Strength of the riveted joints
- 10.5 Efficiency of riveted joints

## 11. Columns and struts

06 Period

- 11.1 Definition, Types of column
- 11.2 Buckling load, crushing load
- 11.3 Slenderness ratio.
- 11.4 Factors affecting strength of column
- 11.5 Euler's formula for long columns
- 11.6 End restraints, effective length for different end conditions
- 11.7 Rankine Gourdan formula
- 11.8 Direct and eccentric loading with stress diagram
- 11.9 Direct and bending stresses and their combination

### LIST OF PRACTICALS

- 1. Perform tensile test on bars of mild steel and aluminum.
- 2. Perform shear test on specimen of two different metals.
- 3. Carry out bending tests on a steel bar or wooden beam.
- 4. Perform following impact test:
  - (a) Izod impact test
  - (b) Charpy test
- 5. Perform torsion test on specimen of different metals for determination of angle of twist for a given torque.
- 6. Determine the stiffness of a helical spring and to plot a graph between load and extension.
- 7. Perform hardness test on metal and finding the Brinell hardness, Rockwell hardness and Vicker's hardness.

### INSTRUCTIONAL STRATEGY

- 1 Use computer based learning aids for effective teaching-learning
- 2 Expose the students to real life problems.
- 3 Plan assignments so as to promote problem solving abilities and develop continued learning skills.

### RECOMMENDED BOOKS

- 1. Strength of Materials by Srivatava & Gope, PHI Publication.
- 1. Strength of Materials by R.S. Khurmi; S. Chand and Company, Delhi.
- 2. Strength of Materials by S. Ramamurtham; Dhanpat Rai Publishing Co.(P) Limited, Delhi.
- 3. Mechanics of Materials by Kirpal Singh; Standard Publishers, New Delhi.
- 4. Elements of Strength of Materials by D.R. Malhotra and H.C, Gupta; Satya Parkashan, New Delhi.
- 5. Mechanics of Solids by VS Prasad; Galgotia Publications, New Delhi.
- 6. Strength of materials Dr. B.C Puniya & S.Rama Murthi; Laxmi Publication, New Delhi.
- 7. Mechanics of solids by J.K.Kapoor; Bharat Bharati Prakashan, Meerut

### SUGGESTED DISTRIBUTION OF MARKS

<b>Topic No.</b>	<b>Time Allotted (Period)</b>	<b>Marks Allotted (%)</b>
1.	03	05
2.	08	10
3.	06	10
4.	06	10
5.	06	10
6.	06	10
7.	05	10
8.	05	05
9.	07	10
10.	06	10
11	06	10
<b>Total</b>	<b>64</b>	<b>100</b>

## 4.7 PHE & IRRIGATION ENGINEERING DRAWING

Periods/week - L T P  
- - 6

### RATIONALE

Diploma holders in Civil Engineering are expected to supervise construction of water supply and wastewater treatment works and irrigation structures. This subject aims at imparting skills for preparing water supply and waste water and irrigation engineering drawings to develop competencies for reading the drawings, and their execution in their field

### DETAILED CONTENTS

#### Drawings Exercises

#### A) WATER SUPPLY AND WASTE WATER ENGINEERING DRAWING

##### 1. Drains and Sewers

Cross section of standard types of open drains (circular, v-shaped and  $\mu$ -shaped) with their foundations

Cross section of earthen ware and RCC sewer pipes

Cross sections of masonry sewers (circular and egg shaped)

##### 2. Traps, manholes and inspection chamber

Detailed section of floor trap and gully trap

Detailed plan and section of an inspection chamber

Detailed plan and section of a manhole

##### 3. Septic Tank and Soak Pit

Detailed plan and cross sections of a domestic septic tank with soak pit for 25 users

##### 4. Bath room and W.C connections:

4.1 Cross-section through the external wall of lavatories at ground and first floor showing the one and two pipe system and the connections of the lavatory to inspection chamber

4.2. Plan of a bathroom showing positions of lavatory, bath tub, wash-basin, taps and showers

##### 5. Draw sectional elevation of a two storeyed building showing details of one pipe and two pipes systems with sanitation system.

6. Practice of reading water supply and sanitary engineering working drawings (PWD/urban Development agencies) including hot water and cold water supply system of a two room set.

**B) IRRIGATION ENGINEERING DRAWING:**

1. Typical cross-section of a channel
  - L-section of a channel for given data
  - Typical cross section of an unlined and lined channel in cutting, partly cutting and partly filling and fully in filling with given design data.
2. Layout plan of a canal head works.
3. Draw the typical L-section of a weir
4. Draw the X-section of an Earthen Dam
  - i) Homogeneous
  - ii) Zoned type
  - iii) Diaphragm type
5. Cross section of a tube well
6. Layout and cross section of rain water harvesting system.

**INSTRUCTIONAL STRATEGY**

Teachers are expected to develop skills in preparation and interpretation of water supply and waste water engineering drawings as per BIS codes of practice. Attention must be paid towards line work, specifications writing, dimensioning, proportioning and accuracy for industrial unit at different intervals of time. Reading and interpreting actual field drawings should also be practiced so as to develop necessary competency in the students.

**RECOMMENDED BOOKS**

1. Loyal JS “Civil Engineering Drawing”, Satya Parkashan, New Delhi
2. Chandel RP “ Civil Engineering Drawings”
3. Kumar; NS “ Civil Engineering Drawing “ IPH, New Delhi
4. Malik RS and Meo GA, “Civil Engineering Drawing” Asian Publishing House, New Delhi

#### 4.8 INDUSTRIAL TRAINING

Industrial training provides an opportunity to students to experience the environment and culture of industrial production units and commercial activities undertaken in field organizations. It prepares student for their future role as diploma engineers in the world of work and enables them to integrate theory with practice.

For this purpose, students at the end of fourth semester need to be sent for industrial training for a minimum of 4 weeks duration to be organised during the semester break starting after IV Semester examinations. The concerned HODs along with other teachers will guide and help students in arranging appropriate training places relevant to their specific branch. It is suggested that a training schedule may be drawn for each student before starting of the training in consultation with the training providers. Students should also be briefed in advance about the organizational setup, product range, manufacturing process, important machines and materials used in the training organization.

Equally important with the guidance is supervision of students training in the industry/organization by the teachers. A teacher may guide a group of 4-5 students. A minimum of one visit by the teacher is recommended. Students should be encouraged to write daily report in their diary to enable them to write final report and its presentation later on.

Internal assessment and external assessment have been provided in the study and evaluation scheme of V Semester. Evaluation of professional industrial training report through viva-voce/presentation aims at assessing students understanding of materials, industrial process, practices in industry/field organization and their ability to engage in activities related to problem solving in industrial setup as well as understanding of application of knowledge and skills learnt in real life situations. The formative and summative evaluation may comprise of weightage to performance in testing, general behaviour, quality of report and presentation during viva-voce examination. It is recommended that such evaluations may be carried out by a team comprising of concerned HOD, teachers and representative from industry, if any. The components of evaluation will include the following.

a) Punctuality and regularity	15%
b) Initiative in learning new things	15%
c) Relationship with workers	15%
d) Industrial training report	55%