

Civil Engineering

4.1 CONCRETE TECHNOLOGY

L T P

3 - 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. (2 hrs)
2. Ingredients of Concrete: (6 hrs)
 - 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: (2 hrs)
 - 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: (4 hrs)
 - 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: (8 hrs)
 - 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: (4 hrs)

- 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 (3 hrs)
 - 8. Special Concretes (only features) (6 hrs)
 - 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: (12 hrs)
 - **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 on 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
- 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:
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:
Objective 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) (1 hr)

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
 - 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

Topic No.	Time Allotted (Hrs)	Marks Allotted (%)
1	2	4
2	6	12
3	2	4
4	4	8
5	8	18
6	4	8
7	3	7
8	6	12
9	12	25
10	1	2
Total	48	100

4.2 WATER SUPPLY AND WASTE WATER ENGINEERING

L T P
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

THEORY

A. WATER SUPPLY

1. Introduction (2 hrs)
 - 1.1 Necessity and brief description of water supply system.
2. Quantity of Water (6 hrs)
 - 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 (4 hrs)
 - 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
4. Water Treatment (brief introduction) (9 hrs)
 - **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 (9 hrs)
 - **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 (6 hrs)
 - 6.1 Setting out alignment of pipes
 - 6.2 Excavation for laying of pipes and precautions to be taken
 - 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 (2 hrs)
 - 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 (4 hrs)
 - 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 (5hrs)
 - 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 hrs)
 - 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

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|-----|--|---------|
| 11 | Sewage characteristics: | (4hrs) |
| | 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 hrs) |
| | 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 hrs) |
| | 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 hrs) |
| | 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 study and demonstrate the joining/threading of GI Pipes, CI Pipes, SW pipes, D.I. pipes and PVC pipes.
- 10) To demonstrate the laying of SW pipes for sewers
- 11) Study of water purifying process by visiting a field lab.
- 12) To test house drainage

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.

REFERENCES

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

Topic No.	Time Allotted (Hrs)	Marks Allotted (%)
1	2	3
2	6	7
3	4	5
4	9	12
5	9	11
6	6	7
7	2	3
8	4	5
9	5	6
10	6	7
11	4	5
12	5	6
13	9	12
14	9	11
Total	80	100

4.3 IRRIGATION ENGINEERING

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4 - -

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 THEORY

1. Introduction: (2 hrs)
 - 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 (6 hrs)

Principal crops in India and their water requirements

 - 2.2 Crop seasons – Kharif and Rabi
 - 2.3 Soil water, soil crop and crop water relationships, Duty, Delta and Base Period, their relationship
 - 2.4 Gross commanded area (GCA), culturable commanded area (CCA), Intensity of Irrigation, Irrigable area
3. Hydrological Cycle Catchment Area and Run-off (6 hrs)

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 (7 hrs)

Flow irrigation - its advantages and limitations
Lift Irrigation – Tubewell, submersible and well irrigation advantages and disadvantages
Sprinkler irrigation conditions favourable and essential requirements for sprinkler irrigation, sprinkler system – classification and component parts
Drip irrigation, suitability of drip irrigation, layout, component parts, advantages
5. Canals (8 hrs)

- 5.1 Classification, apurtenancs of a canal and their functions, sketches of different canal cross-sections
 - 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 (9 hrs)
- 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 and their choice-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, construction of recharge pits and recharge wells and their maintenance.
7. Dams (7 hrs)
- 7.1 Classification of dams; earth dams - types, causes of failure; cross-section of zoned earth dam, 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 (6 hrs)
Definition, object, general layout, functions of different parts of head works. Difference between weir and barrage
9. Cross Drainage Works (4 hrs)
- 9.1 Functions and necessity of the following types: aqueduct, super passage, level crossing, inlet and outlet
 - 9.2 Sketches of the above cross drainage works
10. Definitions of following Hydraulic Structures with Sketches (2 hrs)
- Falls
 - 10.2 Cross and head regulators
 - 10.3 Outlets
 - 10.4 Canal Escapes
11. River Training Works (4 hrs)
Methods of river training, guide banks, retired (levees) embankments, groynes and spurs, pitched island, cut-off
12. Water Logging and Drainage and Ground Water Re-charge (3 hrs)

Definition of water logging – its causes and effects, detection, prevention and remedies
 Surface and sub-surface drains and their layout
 12.3 Concept and various techniques used for ground water re-charge

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,
- Varshney RS, Gupta SC, Gupta RL at all. "Theory and Design of Irrigation Structures", Vol. I and II,
 Saharsabudhe SR, "Irrigation Engineering and Hydraulic Structures"
 Priyani BB, 'The Fundamental Principles of Irrigation and Water Power
 BIS Codes
 Wan. E. Houk, "Irrigation Engineering" Vol. I and II
 Central Ground Water Board and Central Water Commission Guidelines and Reference Books.

SUGGESTED DISTRIBUTION OF MARKS

Topic No.	Time Allotted (Hrs)	Marks Allotted (%)
1	2	3
2	6	8
3	6	8
4	7	13
5	8	12
6	9	15
7	7	12
8	6	9
9	4	6
10	2	3
11	4	6
12	3	5
Total	64	100

4.4 SURVEYING – II

L T P
2 - 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: (5 hrs)

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: (9 hrs)

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 (4 hrs)

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: (12 hrs)

- 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:
(2 hrs)
 EDM or Distomat
 Planimeter
 Total station
 Introduction to remote sensing and GPS

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, Pantagraph, 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 Parkashan, 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 (Hrs)	Marks Allotted (%)
1	5	16
2	9	28
3	4	12
4	10	34
5	2	5
6	2	5
Total	32	100

4.5 STRUCTURAL MECHANICS

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4 - 2

RATIONALE

This is a basic engineering subject. The purpose of the subject is to impart basic knowledge and skill regarding properties of materials, concept of stresses and strains, bending moment and shear force diagrams, second moment of area, bending and shear stresses, slope and deflection and analysis of trusses. The above knowledge will be useful for designing simple structural components. This subject is very important to develop basic concepts and principles related to strength of materials. This subject will also enable the students to continue their further education.

DETAILED CONTENTS

THEORY:

1. Properties of Materials (2 hrs)
 - 1.1 Classification of materials, elastic materials, plastic materials, ductile materials, brittle materials.
 - 1.2 Introduction to tensile test, compressive test, impact test, fatigue test, torsion test on metals.
2. Simple Stresses and Strains: (12 hrs)
 - 2.1 Concept of stress, normal and shear stresses,
 - 2.2 Concept of strain and deformation, longitudinal and transverse strain, poisson's ratio, volumetric strain
 - 2.3 Hooke's law, moduli of elasticity and rigidity, Bulk modulus of elasticity, relationship between the elastic constants.
 - 2.4 Stresses and strains in bars subjected to tension and compression. Extension of uniform bar under its own weight, stress produced in compound bars (two or three) due to axial load.
 - 2.5 Stress-strain diagram for mild steel and HYSD steel, mechanical properties, factor of safety.
Temperature stresses and strains
3. Shear Force and Bending Moment: (16 hrs)
 - 3.1 Concept of a beam and supports (Hinges, Roller and Fixed), types of beams: simply supported, cantilever, propped, over hang, cantilever and continuous beams (only concept).
 - 3.2 Types of loads (dead load, live load, snow load, wind load seismic load as per IS Codes etc) and types of loading (point, uniformly distributed and uniformly varying loads)

- 3.3 Concept of bending moment and shear force, sign conventions
- 3.4 Bending Moment and shear force diagrams for cantilever, simply supported and overhanging beams subjected to concentrated, uniformly distributed
- 3.5 Relationship between load, shear force and bending moment, point of maximum bending moment, and point of contraflexure.
4. Moment of Inertia: (4 hrs)
- Concept of moment of inertia and second moment of area and radius of gyration, theorems of parallel and perpendicular axis, second moment of area of common geometrical sections: rectangle, triangle, circle (*without derivations*). Second moment of area for L, T and I sections, section modulus.
5. Bending Stresses in Beams: (6 hrs)
- 5.1 Concept of pure/simple bending
- 5.2 Assumptions made in the theory of simple bending, derivation and application of bending equation to circular cross-section, I section, T&L sections only
- Moment of resistance
Calculations of bending stresses in simply supported beam
6. Combined Direct and Bending Stresses: (6 hrs)
- Concentric and eccentric loads single axis eccentricity only
Effect of eccentric load on the section stresses due to eccentric loads, Numerical in the case of short columns.
Simple problems on stability of masonry dams and retaining walls
7. Shear Stresses in Beams (4 hrs)
- 7.1 Concept of shear stresses in beams, shear stress distribution in rectangular, circular I, T, L sections (Formula to be stated, no derivation)
8. Slope and Deflection: (4 hrs)
- Necessity for determination of slope and deflection
Moment area theorem (no derivation, numerical problems)
9. Columns: (4 hrs)
- 9.1 Theory of columns
- 9.2 Eulers and Rankine Formula (No derivation)
10. Analysis of Trusses: (6 hrs)
- 10.1 Concept of a perfect, redundant and deficient frames
- 10.2 Assumptions and analysis of trusses by:
- (a) Method of joints
Method of sections
Graphical method

PRACTICAL EXERCISES

- i) Determination of yield stress, ultimate stress, percentage elongation and plot the stress strain diagram and compute the value of young's modulus on mild steel
- ii) Testing of HYSD Steel
- iii) Determination of Young's modulus of elasticity for steel wire with sear's apparatus
- iv) Determination of modulus of rupture of a concrete beam
- v) Determination of maximum deflection and young's modulus of elasticity in simply supported beam with load at middle third point
- vi) Verification of forces in a framed structure

INSTRUCTIONAL STRATEGY

Teachers are expected to give simple exercises involving the applications of various concepts and principles being taught in the subject. Efforts should be made to prepare tutorial sheets on various topics and students should be encouraged/guided to solve tutorial sheets independently. In the practical works, individual students should be given opportunities to do practical work, make observations and draw conclusions. Teachers should also conduct viva examination in which stress should be given on the understanding of basic concepts and principles.

RECOMMENDED BOOKS

- i) Ramamrutham, S., "Strength of Materials", Dhanpat Rai and Sons., New Delhi
- ii) Ram Chandra, "Applied Mechanics and Strength of Materials", Standard Publishers. Delhi:
- iii) Punmia, BC., "Strength of Materials", Standard Publishers, Delhi,
- iv) Prasad VS " Structural mechanics Galgotia publications Pvt Ltd, Delhi
- v) Sadhu Singh "Strengths of Materials" Standard Publishers, New Delhi
- vi) Singh Birinder "Structural Mechanics" Kaption Publishers, Ludhiana
- vii) Singh Harbhajan, " Structure Mechanics" ., Abhishek Publishers, Chandigarh
- viii) Singh Harbhajan, "Design of Masonry and Timber Structures" Abhishek Publishers, Chandigarh.

SUGGESTED DISTRIBUTION OF MARKS

Topic No.	Time Allotted (Hrs)	Marks Allotted (%)
1	2	4
2	12	17
3	16	27
4	4	4
5	6	10
6	6	10
7	4	6
8	4	6
9	4	6
10	6	10
Total	64	100

4.6 PUBLIC HEALTH AND IRRIGATION ENGINEERING DRAWING

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

PART A :

WATER SUPPLY AND WASTE WATER ENGINEERING DRAWING

1. Drains and Sewers
Cross section of standard types of open drains (circular, v-shaped and μ -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 5-10 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.
7. Detailed Layout Plan of Sewage Treatment Plant for a residential area and Effluent Treatment Plant for an industrial unit.

PART B

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
 - Homogeneous
 - Zoned type
 - Diaphragm type
5. Cross section of a tube well
6. Layout and cross section of rain water harvesting system.

Important Note: Use of BIS: 456-2000 is permitted in the examination

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

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