

## 5.1 REINFORCED CONCRETE DESIGN

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### RATIONALE

This subject is an applied engineering subject. Diploma holders in Civil Engineering will be required to supervise RC Construction and fabrication. He may also be required to design simple structural elements, make changes in design depending upon availability of materials (bars of different diameters). This subject thus deals with elementary design principles as per IS:456-2000

### LEARNING OUTCOME

After undergoing the subject, students will be able to:

- Explain methods of RCC design i.e.
  - Working stress methods
  - Limit state methods
- Design singly, doubly reinforced rectangular and T&L beams as per IS Code
- Design one way and two way slab
- Design axially loaded column and their isolated footing

### DETAILED CONTENTS

- |    |   |          |
|----|---|----------|
| 1. | Introduction  | (02 hrs) |
|    | 1.1 Concept of Reinforced Cement Concrete (RCC)             |          |
|    | 1.2 Reinforcement Materials:                                |          |
|    | - Suitability of steel as reinforcing material              |          |
|    | - Properties of mild steel and HYSD steel                   |          |
|    | 1.3. Loading on structures as per IS: 875                   |          |
| 2. | Introduction to following methods of RCC design             | (04 hrs) |
|    | 2.1 Working stress method: Definition and basic assumptions |          |
|    | 2.2 Limit state method: Definition and basic assumptions    |          |
| 3. | Shear and Development Length                                | (04 hrs) |
|    | Shear as per IS:456-2000 by working stress method           |          |
|    | i) Shear strength of concrete without shear reinforcement   |          |
|    | ii) Maximum shear stress                                    |          |
|    | iii) Shear reinforcement                                    |          |

4. Concept of Limit State Method (08 hrs)
- 4.1. Definitions and assumptions made in limit state of collapse (flexure)
  - 4.2. Partial factor of safety for materials
  - 4.3. Partial factor of safety for loads
  - 4.4. Design loads
  - 4.5. Stress block, parameters
5. Singly Reinforced beam (10 hrs)
- Theory and design of singly reinforced beam by Limit State Method
6. Doubly Reinforced Beams (09 hrs)
- Theory and design of simply supported doubly reinforced rectangular beam by Limit State Method
7. Behaviour of T beam, inverted T beam, isolated T beam and 'L' beams (No Numericals) (04 hrs)
8. One Way Slab (10 hrs)
- Theory and design of simply supported one way slab including sketches showing reinforcement details (plan and section) by Limit State Method..
9. Two Way Slab (10 hrs)
- Theory and design of two-way simply supported slab with corners free to lift, no provisions for torsional reinforcement by Limit State Method including sketches showing reinforcement details (plan and two sections)
10. Axially Loaded Column (10 hrs)
- 10.1 Definition and classification of columns
  - 10.2. Effective length of column,
  - 10.3. Specifications for longitudinal and lateral reinforcement
  - 10.4. Design of axially loaded square, rectangular and circular short columns by Limit State Method including sketching of reinforcement (sectional elevation and plan)
11. Column Footing (04 hrs)
- 11.1 Strip footing for walls
  - 11.2 Isolated footing for axially load column with uniform thickness

12. Pre-stressed Concrete (05 hrs)
- 12.1 Concept of pre-stressed concrete
  - 12.2 Methods of pre-stressing : pre-tensioning and post-tensioning
  - 12.3 Advantages and disadvantages of pre-stressing
  - 12.4 Losses in pre-stress

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

### INSTRUCTIONAL STRATEGY

Teachers are expected to give simple problems for designing various RCC 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 form work for RCC as well as placement of reinforcement in various structural members. Commentary on BIS:456 may be referred along with code for relevant clauses.

### RECOMMENDED BOOKS

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

### SUGGESTED DISTRIBUTION OF MARKS

Topic No.	Time Allotted (Hrs)	Marks Allotted (%)
1	02	03
2	04	05
3	04	05
4	08	10
5	10	12
6	09	11
7	04	05
8	10	12
9	10	12
10	10	12
11	04	06
12	05	07
<b>Total</b>	<b>80</b>	<b>100</b>

## 5.2 HIGHWAY ENGINEERING

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### RATIONALE

Construction of roads is one of the major areas in which diploma holders in Civil Engineering may get very good opportunities for employment. The diploma holders are responsible for construction and maintenance of highways and airports. Basic concepts of road geo-metrics, surveys and plans, elements of traffic engineering, road materials, construction of rigid and flexible pavements, special features of hill roads, road drainage system and various aspects of maintenance find place in above course.

### LEARNING OUTCOME

After undergoing the subject, students will be able to:

- Classify the roads as per IRC types and geometrics
- Explain various components of a flexible/rigid pavement
- select various highway materials and test them for different quality parameters
- Supervise construction of a highway in plain areas and hilly areas
- Carry out repair and maintenance of roads
- Supervise preparation of bituminous mix in the hot mix plants
- Use various road construction equipment
- Describe the basic terminology of various components of an airport.

### DETAILED CONTENTS THEORY

- |    |   |          |
|----|---|----------|
| 1. | Introduction  | (02 hrs) |
|    | 1.1 Importance of Highway engineering   |          |
|    | 1.2 Functions of IRC, CRRI, MORT&H, NHAI  |          |
|    | 1.3 Classification of roads   |          |
| 2. | Road Geometrics   | (10 hrs) |
|    | 2.1 Glossary of terms used in road geo-metrics and their importance: Right of way, formation width, road margin, road shoulder, carriage way, side slopes, kerbs, formation levels, camber and gradient |          |
|    | 2.2 Average running speed, stopping and overtaking sight distance   |          |

- 2.3 Necessity of curves, horizontal and vertical curves including transition curves. Super elevation and methods of providing super elevation
- 2.4 Sketch of typical cross-sections in cutting and filling on straight alignment and at a curve  
**(Note: No design/numerical problem to be taken)**
- 3. Highway Alignment (10 hrs)
  - 3.1 Basic considerations governing alignment for a road in plain and hilly area
  - 3.2 Highway location, marking of alignment on ground, setting out alignment of road, setting out bench marks, control pegs for embankment and cutting
- 4. Road Materials (10 hrs)
  - 4.1 Different types of road materials in use; soil, aggregate and binders
  - 4.2 Introduction to California Bearing Ratio, method of finding CBR value and its significance. Aggregate : Source and types, important properties, strength, durability
  - 4.3 Binders: Common binders; bitumen, properties as per BIS specifications, penetration, softening point, ductility and viscosity test of bitumen, procedures and significance, cut back and emulsion and their uses, Bitumen modifiers (CRMB, PMB)
- 5. Road Pavements (12 hrs)
  - 5.1 Road pavement: Flexible and rigid pavement, their merits and demerits, typical cross-sections, functions of various components
  - 5.2 Sub-grade preparation:  
Borrow pits, making profiles of embankment, construction of embankment, compaction, preparation of subgrade, methods of checking camber, gradient and alignment as per recommendations of IRC, equipment used for subgrade preparation.
  - 5.3 Stabilization of subgrade. Types of stabilization mechanical stabilization, lime stabilization, cement stabilization, fly ash stabilization etc.(introduction only)
  - 5.4 Base Course:  
Granular base course:  
(a) Water Bound Macadam (WBM)  
(b) Wet Mix Macadam (WMM)

Bitumen Courses:

- (a) Bituminous Macadam
- (b) Dense Bituminous Macadam (DBM)

\*Methods of construction as per MORT&H

5.5 Surfacing:

\* Types of surfacing

- a) Prime coat and tack coat
- b) Surface dressing with seal coat
- c) Open graded premix carpet
- d) Mix seal surfacing
- e) Semi dense bituminous concrete
- f) Bituminous Concrete

\* Methods of constructions as per MORT&H specifications and quality control; equipments used for above.

5.6 Rigid Pavements:

Construction of concrete roads as per IRC specifications: Form work laying, mixing and placing the concrete, compacting and finishing, curing, joints in concrete pavement, equipment used. Roller compacted concrete.

6. Hill Roads: (06 hrs)

6.1 Introduction: Typical cross-sections showing all details of a typical hill road, partly in cutting and partly in filling

6.2 Special problems of hill areas

6.2.1 Landslides: Causes, prevention and control measures, use of geogrids, geoflexbiles, geo synthetics

6.2.2 Drainage

6.2.3 Soil erosion

6.2.4 Snow: Snow clearance, snow avalanches, frost

6.2.5 Land Subsidence

7. Road Drainage: (06 hrs)

7.1 Necessity of road drainage work, cross drainage works

7.2 Surface and subsurface drains and storm water drains. Location, spacing and typical details of side drains, side ditches for surface drainage. Intercepting drains, pipe drains in hill roads, details of drains in cutting embankment, typical cross sections

8. Road Maintenance: (06 hrs)
- 8.1 Common types of road failures of flexible pavements: Pot hole, cracks, rutting, alligator, cracking, upheaval - their causes and remedies (brief description)
- 8.2 Maintenance of bituminous road such as crack sealing, patch-work and resurfacing.
- 8.3 Maintenance of concrete roads-filling cracks, repairing joints, maintenance of shoulders (berms)
9. Road Construction Equipment: (08 hrs)
- Output and use of the following plant and equipment
- 9.1 Hot mix plant
- 9.2 Tipper, tractors (wheel and crawler) scraper, bulldozer, dumpers, shovels, grader, roller, dragline
- 9.3 Asphalt mixer and tar boilers
- 9.4 Road pavers
- 10 Airport Engineering :- (10 hrs)
- 10.1 Necessity of study of airport engineering, aviation transport scenario in India.
- 10.2 Factors to be considered while selecting a site for an airport with respect to zoning laws.
- 10.3 Introduction to Runways, Taxiways, Apron and Hanger
- \* An expert may be invited from field/industry for extension lecture on this topic.

### **PRACTICAL EXERCISES**

1. Determination of penetration value of bitumen
2. Determination of softening point of bitumen
3. Determination of ductility of bitumen
4. Determination of impact value of the road aggregate
5. Determination of abrasion value (Los Angeles') of road aggregate
6. Determination of crushing strength of aggregate
7. Determination of flakness and elongation index of aggregate
8. Determination of the California bearing ratio (CBR) for the sub-grade soil
9. Demonstration of working of hot mix plant through a field visit

10. Visit to highway construction site for demonstration of operation of:  
Tipper, tractors (wheel and crawler), scraper, bulldozer, dumpers, shovels, grader, roller, dragline, road pavers, JCB
11. Demonstration of working of mixing and spraying equipment through a field visit

### **INSTRUCTIONAL STRATEGY**

While imparting instructions, it is recommended that emphasis should be laid on constructional details and quality control aspects. Students should be asked to prepare sketches and drawings, clearly indicating specifications and constructional details for various sub components of a highway. It will be also advantageous to organize field visits to show the actual construction of roads at site.

### **RECOMMENDED BOOKS**

- i) Khanna, SK and Justo, CEG, "Highway Engineering", Nem Chand and Bros., Roorkee
- ii) Vaswani, NK, "Highway Engineering", Roorkee Publishing House, Roorkee,
- iii) Priyani, VB, "Highway and Airport Engineering" Anand, Charotar Book Stall
- iv) Sehgal, SB; and Bhanot, KL; "A Text Book on Highway Engineering and Airport" S Chand and Co, Delhi
- v) Bindra, SP; "A Course on Highway Engineering", Dhanpat Rai and Sons, New Delhi
- vi) Sharma, RC; and Sharma, SK; "Principles and Practice of Highway Engineering", Asia Publishing House, New Delhi
- vii) Duggal AK, Puri VP., "Laboratory Manual in Highway Engineering", New Age Publishers (P) Ltd, Delhi,
- viii) NITTTR, Chandigarh "Laboratory Manual in Highway Engineering",
- ix) RK Khitoliya, "Principles of Highway Engineering (2005)", Dhanpat Rai Publishing Co., New Delhi
- x) Rao, GV' Transportation Engineering
- xi) Duggal AK, "Maintenance of Highway – a Reader", NITTTR, Chandigarh
- xii) Duggal AK "Types of Highway constitution ", NITTTR Chandigarh
- xiii) Rao, "Airport Engineering"
- xiv) Singh, Jagroop, "Highway Engineering", Eagle Publications, Jalandhar

### **IRC Publications**

- i) MORTH Specifications for Road and Bridge Works (Fifth Revision)
- ii) MORTH Pocket book for Highway Engineers, 2001
- iii) MORTH Manual for Maintenance of Roads, 1983



**SUGGESTED DISTRIBUTION OF MARKS**

<b>Topic No.</b>	<b>Time Allotted (Hrs)</b>	<b>Marks Allotted (%)</b>
1	02	04
2	10	12
3	10	12
4	10	12
5	12	14
6	06	08
7	06	08
8	06	08
9	08	10
10	10	12
<b>Total</b>	<b>80</b>	<b>100</b>

### 5.3 R.C.C. DRAWINGS

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#### RATIONALE

Diploma holders in Civil Engineering are required to supervise the construction of RC structures. Thus one should be able to read and interpret drawings of RC structures. The competence to read and interpret structural drawings is best learnt by being able to draw these drawings. Hence there is a need to have a subject devoted to preparation of structural drawings.

#### LEARNING OUTCOME

After undergoing the subject, students will be able to:

- Draw the reinforcement details for various structural elements from the given data
- Calculate reinforcement details from the given drawings
- Draw bar bending schedule from drawing
- Read and interpret R.C.C. drawings

#### DETAILED CONTENTS

##### 1. RC Drawing:

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

- (i) Drawing No. 1: RC Slabs - One way slab, Two way slab and Cantilever Slab.
- (ii) Drawing No.2 : Beams - Singly and doubly reinforced rectangular beams and Cantilever beam (All beams with vertical stirrups)
- (iii) Drawing No.3 : Columns and Footings – Square, Rectangular and Circular Columns with lateral ties and their isolated sloped column footings.
- (iv) Drawing No. 4 : Portal Frame – Three bay two storey RC portal frame with blow up of column beam junctions.
- (v) Drawing o. 5 : Draw atleast one sheet using AutoCAD software

**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
5. Singh, Birinder “RCC Design and Drawing” Kaption Publishing House, New Delhi.
6. Singh, Birinder “Steel Structures Design and Drawing”, Kaption Publishing House, New Delhi

## 5.4 SURVEY CAMP

**10 Days Duration**

### **Purpose**

- a. To impart intensive training in the use of surveying instruments
- b. To train the students to appreciate practical difficulties in surveying on the field
- c. Making the students conversant with the camp life
- d. Training the students to communicate with the local population
- e. Providing an opportunity to the students to develop team spirit
- f. To train the students for self management

### **LEARNING OUTCOME**

After undergoing the survey camp, students will be able to:

- Interpret the contours
- Work in a teamwork
- Mark a road alignment of a given gradient connecting any two stations on the map
- Calculate the earth work
- Prepare a topographical plan of a given area

### **Task:**

Preparation of topographical plan of a given area. The survey camp will be organized for a duration of 10 days time span.

The students may be assigned an undulated area of about 1.5 to 2.00 sq.km. with level difference of 15m consisting of good number of physical features such as buildings, roads, bridges, culverts, railway tracks, electric lines etc. They are required to prepare the topographic map of above areas showing various features along with contours using a suitable contour intervals. They will mark a road alignment of given gradient connecting any two stations on the map consisting some horizontal and vertical curves and will prepare estimate of earthwork and submit the detailed technical report indicating therein practical difficulties faced during surveying for the features like ridge, line, valley lines, saddle cliffs etc.

The students should be divided in the groups consisting of 10-15 in numbers. They are required to submit the Report of workdone, during survey camp, which will be dully examined, while awarding the internal assessment.

## 5.5 COMPUTER APPLICATIONS IN CIVIL ENGINEERING

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### RATIONALE

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

### LEARNING OUTCOME

After undergoing the subject, students will be able to:

- Draw 2D drawings on AutoCAD viz. plan, section and elevation of a residential building
- Use various civil engineering software

### DETAILED CONTENTS

### PRACTICAL EXERCISES

1. Introduction and use of AutoCAD for making 2D Drawings and develop plan, section and elevation of a residential building
2. Demonstration of various civil engineering softwares like STAAD-Pro, Revit or Primavera Project Planner, BIM, ArcGIS or any other equivalent software for above mentioned software

### Note:

- i) The polytechnic may use any other software available with them for performing these exercises
- ii) If the above softwares are not available in the institution, the demonstration of the above said software should be arranged outside the institute.

## 5.6 RAILWAYS, BRIDGES AND TUNNELS

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### RATIONALE

The subject will cater to the needs of those technicians who would like to find employment in the construction of railway tracks, bridges and tunnels. The subject aims at providing broad based knowledge regarding various components and construction of railway track, bridges and tunnels

### LEARNING OUTCOME

After undergoing the subject, students will be able to:

- Describe different component parts of permanent way such as rails, sleepers and ballest
- Distinguish different types of rail gauges used in India
- Use of different types of rail fastenings and fixtures
- Classify bridges and select suitable type of bridge for a particular purpose
- Describe essential components of a ROB and RUB
- Supervise construction of a tunnel
- Carry out ventilation, drainage and lightening of tunnels

### DETAILED CONTENTS

#### PART – I: RAILWAYS

(35 hrs)

1. Introduction to Indian Railways
2. Railway surveys: Factors influencing the railways route, brief description of various types of railway survey
3. Classification of permanent way describing its component parts
4. Rail Gauge: Definition, types, practice in India
5. Rails – types of rails
6. Rail Fastenings: Rail joints, types of rail joints, fastenings for rails, fish plates, bearing plates
7. Sleepers: Functions of sleepers, types of sleepers, requirements of an ideal material for sleepers.

8. Ballast: Function of ballast, requirements of an ideal material for ballast
9. Crossings and signalling: Brief description regarding different types of crossings/ signalling
10. Maintenance of track: Necessity, maintenance of track, inspection of soil, track and fixtures; maintenance and boxing of ballast maintenance gauges, tools
11. Earth work and drainage: Features of rail road, bed level, width of formation, side slopes, drains, methods of construction, requirement of drainage system
12. Station and yards: purpose and types of stations and yards

## **PART-II: BRIDGES**

(35 hrs)

13. Introduction

Bridge – its function and component parts, difference between a bridge and a culvert

14. Classification of Bridges

Their structural elements and suitability:

- 14.1 According to life-permanent and temporary
- 14.2 According to deck level – Deck, through and semi-through
- 14.3 According to material –timber, masonry, steel, RCC, pre-stressed
- 14.4 According to structural form;
  - Grade Separators-Railway Road Over Bridges (ROB), Road Under Bridge (RUB)
  - Beam type –RCC, T-Beam, steel girder bridges, plate girder and box girder, balanced cantilever, Trussed bridges.
  - Arch type – open spandrel and filled spandrel barrel and rib type
  - Suspension type – unstiffened and stiffened and table (its description with sketches)
  - According to the position of highest flood level submersible and non submersible
- 14.5 IRC classification
- 14.6 Concept of Railway ROB and RUB – Precast components of ROB, drainage problems and solutions of RUB

15. Bridge Foundations: Introduction to open foundation, pile foundation, well foundation
16. Piers, Abutments and Wingwalls
  - 16.1 Piers-definition, parts; types –solid (masonry and RCC), open
  - 16.2 Abutments and wing walls – definition, types of abutments (straight and tee), abutment with wing walls (straight, splayed, return and curved)
17. Bridge bearings

Purpose of bearings; types of bearings – fixed plate, rocker and roller, Elastomeric bearings.
18. Maintenance of Bridges
  - 18.1 Inspection of bridges
  - 18.2 Routine maintenance

**PART - III: TUNNELS**

(10 hrs)

19. Definition and necessity of tunnels
20. Typical section of tunnels for a national highway and single and double broad gauge railway track
21. Ventilation –necessity and methods of ventilation, by blowing, exhaust and combination of blowing and exhaust
22. Drainage method of draining water in tunnels
23. Lighting of tunnels

- Notes:** i) Field visits may be organized to Bridge construction site or a Bridge/Tunnel construction site/Railways tracks to explain the various components and a field visit report shall be prepared by the students, as teamwork
- ii) Examiners should set questions from all the parts



## INSTRUCTIONAL STRATEGY

This subject is of practical nature. While imparting instructions, teachers are expected to organize demonstrations and field visits to show various components and construction of railway track, bridges and tunnel.

## RECOMMENDED BOOKS

1. Vaswani, NK, "Railway Engineering", Publishing House, Roorkee
2. Rangwala, SC, "Railway Engineering", Anand, Charotar Book Stall
3. Deshpande, R, "A Text Book of Railway Engineering", Poonam United Book Corporation
4. Algia, JS "Bridge Engineering", Anand, Charotar Book Stall
5. Victor Johnson, "Essentials of Bridge Engineering" Oxford and IBH, Delhi
6. Rangwala S.C., "Bridge Engineering", Anand, Charotar Book Stall
7. IRC Bridge Codes
8. MORTH drawings for various types of bridges
9. MORTH pocket books for bridge Engineers, 2000 (First Revision)
10. Subhash C Saxena, "Tunnel Engineering", Dhanpat Rai and Sons, Delhi

## SUGGESTED DISTRIBUTION OF MARKS

Topic No.	Time Allotted (Hrs)	Marks Allotted (%)
1	35	43
2	35	43
3	10	14
<b>Total</b>	<b>80</b>	<b>100</b>

## 5.7 SOIL AND FOUNDATION ENGINEERING

**L T P**  
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### RATIONALE

Civil Engineering diploma engineers are required to supervise the construction of 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.

### LEARNING OUTCOME

After undergoing the subject, students will be able to:

- Identify and classify various types of soils
- Select particular type of foundation according to loading of structure
- Determine shear strength of soil
- Carry out compaction of soils as per density
- Calculate bearing capacity of soil
- Calculate liquid limit and plastic limit of soil
- Calculate maximum dry density of soil and optimum moisture content of soil
- Perform various tests of the soil

### DETAILED CONTENTS

#### THEORY

1. Introduction: (03 hrs)
  - 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 Punjab, 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 hrs)
  - 2.1 Constituents of soil and representation by a phase diagram
  - 2.2 Definitions of void ratio, porosity, degree of saturation, water content, 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 hrs)
  - 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 hrs)
  - 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 hrs)
  - 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 hrs)
  - 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 of Soil: (09 hrs)
  - 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 Determination of shearing strength by direct shear test, unconfined compression test and vane shear test. Drainage conditions of test and their significance
  - 7.4 Stress and strain curve, peak strength and ultimate strength, their significance
  - 7.5 Examples of shear failure in soils
  - 7.6 Numerical problems

8.     Compaction: (4 hrs)
- 8.1     Definition and necessity of compaction
  - 8.2     Laboratory compaction test (standard and modified proctor test as per IS) 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: (8 hrs)
- 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 hrs)
- 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
  - 10.4    Factors affecting bearing capacity
  - 10.5    Concept of vertical stress distribution in soils due to foundation loads, pressure bulb
  - 10.6    Applications of SPT, unconfined compression test and direct shear test in estimation of bearing capacity

- 10.7 Plate load test (no procedure details) and its limitations
- 10.8 Improvement of bearing capacity by sand drain method, compaction, use of geo-synthetics.
11. Foundation Engineering: (10 hrs)
- Concept of shallow and deep foundation; types of shallow foundations: combined, isolated, 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 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**

1. Punmia, BC, "Soil Mechanics and Foundations"; Standard Publishers, Delhi
2. Bharat Singh and Shamsheer Prakash; "Soil Mechanics and Foundations Engineering", Nem Chand and Bros, Roorkee,
3. Sehgal, SB, "A Text Book of Soil Mechanics"; CBS Publishers and Distributors, Delhi,
4. Bowles, Joseph E, "Engineering Properties of soils and their Measurement"; Tata McGraw Hill., Delhi,
5. Gulati, SK and Manoj Dutta, "Geotechnical Engineering ", Tata McGraw Hill, Delhi,
6. Khan, Iqbal H, "A Text Book of Geotechnical Engineering", Prentice Hall of India, Delhi,
7. Ranjan Gopal and Rao ASR "Basic and Applied Soil Mechanics", New Age Publication (P) Ltd., New Delhi
8. S Mittal and JP Shukla, "Soil Testing for Engineers", Khanna Publishers Ltd., Delhi
9. Duggal, AK., Ramana, TR., Krishnamurthy, S., "Soil Sampling and Testing - A Laboratory Manual, Galgitra Publications, Delhi
10. BIS Codes IS 6403 (latest edition) and IS 1498 (latest edition)
11. Jagroop Singh, "Soil and Foundation Engineering", Eagle Parkashan, Jalandhar
12. Rabinder Singh, "Soil and foundation engg" SK Kataria and Sons, Ludhiana
13. NITTTR, Chandigarh, "Shallow Foundations"
14. Video films on Geo-technical Laboratory Practices by NITTTR, Chandigarh

**SUGGESTED DISTRIBUTION OF MARKS**

<b>Topic No.</b>	<b>Time Allotted (Hrs)</b>	<b>Marks Allotted (%)</b>
1	3	5
2	4	6
3	4	6
4	4	6
5	4	6
6	4	6
7	9	14
8	4	6
9	8	16
10	10	12
11	10	17
<b>Total</b>	<b>64</b>	<b>100</b>



## **5.8 MINOR PROJECT WORK (CONSTRUCTION SITE ORIENTED)**

**L T P**  
**- - 4**

### **RATIONALE**

Minor project work aims at exposing the students to field practices, size and scale of operations and work culture at works sites. For this purpose, students during middle of course, are required to be sent at different work sites where some construction activities are in progress or some operations are going on.

### **LEARNING OUTCOMES**

After undergoing the subject, students will be able to:

- Apply concepts, principles and practices taught in the classroom in solving field problems.

### **GENERAL GUIDELINES**

Depending on the interests of the students, they may be sent to following (or any other field project related to Civil Engineering):

- i) Building construction sites
- ii) Water treatment plant, Sewage treatment plant
- iii) Crusher plant, Cement Manufacturing Plant, Brick kiln
- iv) Highway construction site
- v) Material and Soil testing laboratory, Soil investigation projects
- vi) Hydel Power Project
- vii) Land surveying projects
- viii) Community development works
- ix) Constructional site like building, bridge, tunnel, canal lining, highway, railway track, irrigation works etc

As a minor project activity, each student is supposed to study the operations at site and prepare a detailed project report of the observations/processes seen by him/her and give seminar using computer aided presentation slides using photographs. These students

should be guided by respective subject teachers. Each teacher may guide a group of 10 – 15 students.

The teachers along with field supervisors will conduct performance assessment of students. Some of the projects are suggested below:

1. Survey of a village approach road, drawings of L-section and x-sections
2. Estimation of white washing and distempering in hostel building
3. Preparation of detailed estimate with drawings of septic tank for 30-40 users
4. Plumbing work and installation of PVC over-head water tank on a toilet block and then prepare report
5. Construction of different components of a building
6. Identification of water-supply fittings and replacement of defective fittings and then prepare report.
7. Construction of a pipe/slab culvert
8. Ferro-cement construction techniques
  - a) Low cost housing
  - b) New construction materials
9. Study and preparation of models of hydraulic pumps.

This Industry oriented minor project work will carry 50 marks for internal assessment.

A group of students not exceeding 5 may work on any one project. Each student will prepare the project report of the activities observed by him. They will study the whole process of the plant, and explain the same in their project report. Further they are required to present the Project Report of work done by them through seminar in the class for internal assessment. External examiner will ask the questions on the construction, working, processes observed by the students during their project work: Shortcomings in the works (site) and their remedial measures may be suggested by the students.

**NOTE:**

This is only a suggestive list. The students may take any other problem as per their interest. The students of the class may be divided into five groups and work may be assigned to each group as per their interest.

The components of evaluation will include the following :

	<b><u>Component</u></b>	<b><u>Weightage</u></b>
a)	Punctuality and regularity	15%
b)	Initiative in learning new things	15%
c)	Relationship with others/workers	15%
d)	Project Report/ Technical report	55%

### **PERSONALITY DEVELOPMENT AWARENESS CAMP**

This is to be organized at a stretch for two to three days during fifth or sixth semester. Extension Lectures by experts or teachers from the polytechnic will be delivered on the following broad topics. There will be no examination for this subject.

1. Communication Skills
2. Correspondence and job finding/applying/thanks and follow-up
3. Resume Writing
4. Interview Techniques: In-Person Interviews; Telephonic Interview' Panel interviews; Group interviews and Video Conferencing etc.
5. Presentation Techniques
6. Group Discussions Techniques
7. Aspects of Personality Development
8. Motivation
9. Leadership
10. Stress Management
11. Time Management
12. Interpersonal Relationship
13. Health and Hygiene