Ramgarhia Polytechnic College, Phagwara

Civil Engineering Department

Head of Department: Er. Gurcharan Singh

Name of the Faulty: Er. NEERAJ SOBTI

Discipline: Civil Engineering Department

Semester: 5th

Subject: SOIL & FOUNDATION ENGG.

Lesson Plan Duration: 17 Weeks

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 Outcomes

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

PO ⇨ / CO ⇩	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1	✓						✓
CO2		✓					✓
CO3		✓					✓
CO4		✓					✓
CO5	✓						✓
CO6		✓	✓				✓
CO7	✓	✓					✓
CO8		✓	✓				✓
CO9	✓		✓				✓

Syllabus

Units	Details	Hours
1.	1. Introduction: 1.1 Importance of Soil Studies in Civil Engineering 1.2 Geological origin of soils with special reference to soil profiles in India: residual and transported soil, alluvial deposits, lake deposits, local soil found in 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	(3 hrs)
2.	Physical Properties of Soils: 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	(4 hrs)
3.	Classification and Identification of Soils 3.1. Particle size, shape and their effect on engineering properties of soil, particle size classification of soils 3.2 Gradation and its influence on engineering properties 3.3 Relative density 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 hrs)
4.	Flow of Water Through Soils: 4.1 Concept of permeability and its importance 4.2 Darcy's law, coefficient of permeability, seepage velocity and factors affecting permeability 4.3 Comparison of permeability of different soils as per BIS 4.4 Measurement of permeability in the laboratory	(4hrs)

5.	Effective Stress: (Concept only) 5.1 Stresses in subsoil 5.2 Definition and meaning of total stress, effective stress and neutral stress 5.3 Principle of effective stress 5.4 Importance of effective stress in engineering problems	(4 hrs)
6.	Deformation of Soils 6.1 Meaning, conditions/situations of occurrence with emphasis on practical significance of: a) Consolidation and settlement b) Creep c) Plastic flow d) Heaving e) Lateral movement f) Freeze and thaw of soil 6.2 Definition 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	(4 hrs)
7.	Shear Strength of Soil: 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	(9 hrs)
8	Compaction: 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	(4hrs)

9	Soil Exploration: 9.1 Purpose and necessity of soil exploration 9.2 Reconnaissance, methods of soil exploration, Trial pits, borings (auger, wash, rotary, percussion to be briefly dealt) 9.3 Sampling; undisturbed, disturbed and representative samples; selection of type of sample; thin wall and piston samples; area ratio, recovery ratio of samples and their significance, number and quantity of samples, resetting, sealing and preservation of samples. 9.4 Presentation of soil investigation results	(8 hrs)
10	Bearing Capacity of soil 10.1 Concept of bearing capacity 10.2 Definition and significance of ultimate bearing capacity, net safe bearing capacity and allowable bearing pressure 10.3 Guidelines of BIS (IS 6403) for estimation of bearing capacity 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.	(10 hrs)
11	Foundation Engineering: 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.	(10 hrs)

Reference Books:

1. Punmia, BC, "Soil Mechanics and Foundations"; Standard Publishers, Delhi

2. Bharat Singh and Shamsher Prakash; "Soil Mechanics and Foundations Engineering", Nem Chand and Bros, Roorkee

, 3. Sehgal, SB, "A Text Book of Soil Mechanics"; CBS Publishers and Distributors, Delhi,

4. 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

Delivery/Instructional Methodologies

Sr.No.	Description
1.	Chalk and Talk
2.	PowerPoint Presentation

Assessment Methodologies

Sr. No.	Description	Type
1.	Student Assignment	Direct
2.	Test	Direct
3.	Board Examination	Direct
4.	Student Feedback	Direct

Gaps in the syllabus - to meet industry/profession requirements

S.NO.	DESCRIPTION	PROPOSED ACTIONS	PO MAPPING
	N/A	N/A	N/A

Topics beyond syllabus/advanced topics

Units	Details	Hours
N/A	N/A	N/A

Web Source References

Sr. No.	URL
1.	https://nptel.ac.in/

Lesson Plan

Week	Theory		Practical	
	Lecture Day		Practical Day	
	1st	Importance of Soil Studies in Civil Engineering		N/A

1st	2nd	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.	
	3rd	Names of organizations dealing with soil engineering work in India, soil map of India		
	4th	Constituents of soil and representation by a phase diagram		
	5th	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		
2nd	6th	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.	N/A
	7th	Simple numerical problems with the help of phase diagrams		

	8th	Particle size, shape and their effect on engineering properties of soil, particle size classification of soils		
	9th	• Gradation and its influence on engineering properties • Relative density and its use in describing cohesionless soils		
	10th	• Behaviour of cohesive soils with change in water content, Atterberg's limit - definitions, use and practical significance • Field identification tests for soils		
3rd	11th	Soil classification system as per BIS 1498; basis, symbols, major divisions and sub divisions, groups, plasticity chart; procedure for classification of a given soil	3.	N/A
	12th	Concept of permeability and its importance		
	13th	Darcy's law, coefficient of permeability, seepage velocity and factors affecting permeability		
	14th	Comparison of permeability of different soils as per BIS		
	15th	Measurement of permeability in the laboratory		
4th	16th	Stresses in subsoil		

	17th	Definition and meaning of total stress, effective stress and neutral stress	4.	N/A
	18th	Principle of effective stress		
	19th	Importance of effective stress in engineering problems		
	20th	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		
5th	21st	Definition and practical significance of compression index, coefficient of consolidation, degree of consolidation.	5.	N/A
	22nd	Meaning of total settlement, uniform settlement and differential settlement; rate of settlement and their effects		
	23rd	• Settlement due to construction operations and lowering of water table • Tolerable settlement for different structures as per BIS		
	24th	Concept and Significance of shear strength		
	25th	Factors contributing to shear strength of cohesive and cohesion less soils, Coulomb's law		

6th	26th	Determination of shearing strength by direct shear test, unconfined compression test and vane shear test. Drainage conditions of test and their significance	6.	N/A
	27th	Stress and strain curve, peak strength and ultimate strength, their significance		
	28th	Stress and strain curve, peak strength and ultimate strength, their significance		
	29th	Examples of shear failure in soils		
	30th	Examples of shear failure in soils		
7th	31st	Numerical problems	7.	N/A
	32nd	Numerical problems		
	33rd	Definition and necessity of compaction		N/A
	34th	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		
	35th	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		

8th	36th	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	8.	N/A
	37th	Purpose and necessity of soil exploration		
	38th	Purpose and necessity of soil exploration		
	39th	Reconnaissance, methods of soil exploration, Trial pits, borings (auger, wash, rotary, percussion to be briefly dealt)		
	40th	Reconnaissance, methods of soil exploration, Trial pits, borings (auger, wash, rotary, percussion to be briefly dealt)		
9th	41st	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.	N/A
	42nd	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.		
	43rd	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.		
	44th	Presentation of soil investigation results		
	45th	Concept of bearing capacity		
10th	46th	Definition and significance of ultimate bearing capacity, net safe bearing capacity and allowable bearing pressure	10. .	N/A
	47th	Guidelines of BIS (IS 6403) for estimation of bearing capacity		
	48th	Guidelines of BIS (IS 6403) for estimation of bearing capacity		
	49th	Factors affecting bearing capacity		
	50th	Concept of vertical stress distribution in soils due to foundation loads, pressure bulb		
11th	51st	Applications of SPT, unconfined compression test and direct shear test in estimation of bearing capacity	11	N/A
	52nd	Applications of SPT, unconfined compression		

		test and direct shear test in estimation of bearing capacity		
	53rd	Plate load test (no procedure details) and its limitations		
	54th	Improvement of bearing capacity by sand drain method, compaction, use of geo-synthetics.		
	55th	Concept of shallow and deep foundation		
12th	56th	Concept of shallow and deep foundation	12.	N/A
	57th	Types of shallow foundations		
	58th	Types of shallow foundations: combined, isolated, strip, mat, and their suitability.		
	59th	Factors affecting the depth of shallow foundations		
	60th	Factors affecting the depth of deep foundations		
13th	61st	Type of piles and their suitability	13.	N/A
	62nd	Pile classification on the basis of material		
	63rd	Pile group and pile cap		
	64th	Pile group and pile cap		
	65th	Revision of Physical Properties of Soils		
14th	66th	Revision of Physical Properties of Soils		N/A

	67th	Revision of Classification and Identification of Soils	14.	
	68th	Revision of Classification and Identification of Soils		
	69th	Revision of Flow of Water Through Soils		
	70th	Revision of Flow of Water Through Soils		
15th	71st	Revision of Effective Stress: (Concept only)	15.	N/A
	72nd	Revision of Effective Stress: (Concept only)		
	73rd	Revision of Deformation of Soils		
	74th	Revision of Deformation of Soils		
	75th	Revision of Shear Strength of Soil		
16th	76th	Revision of Shear Strength of Soil	16.	N/A
	77th	Revision of Compaction		
	78th	Revision of Compaction		

17th	79th	Revision of Soil Exploration		
	80th	Revision of Bearing Capacity of soil		
	81st	Revision of Foundation Engineering		
	82nd	Revision of Foundation Engineering		

NBA has defined the following seven POs for an Engineering diploma graduate:

i) **Basic and Discipline specific knowledge**: Apply knowledge of basic mathematics, science and engineering fundamentals and engineering specialization to solve the engineering problems.

ii) **Problem analysis:** Identify and analyze well-defined engineering problems using codified standard methods.

iii**)** **Design/ development of solutions**: Design solutions for well-defined technical problems and assist with the design of systems components or processes to meet specified needs.

iv) **Engineering Tools, Experimentation and Testing**: Apply modern engineering tools and appropriate technique to conduct standard tests and measurements.

v) **Engineering practices for society, sustainability and environment**: Apply appropriate technology in context of society, sustainability, environment and ethical practices.

vi) **Project Management**: Use engineering management principles individually, as a team member or a leader to manage projects and effectively communicate about well-defined engineering activities.

vii) **Life-long learning**: Ability to analyze individual needs and engage in updating in the context of technological changes.

Program Specific Outcomes (PSOs)

PSOs are a statement that describes what students are expected to know and be able to do in a specialized area of discipline upon graduation from a program. Program may specify 2-4 program specific outcomes, if required.

These are the statements, which are specific to the particular 11 program. They are beyond POs. Program Curriculum and other activities during the program must help in the achievement of PSOs along with POs.