

UNIVERSITY OF MUMBAI



Bachelor of Engineering

Civil Engineering (Third Year – Sem.V &VI),

Revised course (REV- 2012) from Academic Year 2014 -15,

Under

FACULTY OF TECHNOLOGY

(As per Semester Based Credit Grading System)

Preface

To meet the challenge of ensuring excellence in engineering education, the issue of quality needs to be addressed, debated and taken forward in a systematic manner. Accreditation is the principal means of quality assurance in higher education. The major emphasis of accreditation process is to measure the outcomes of the program that is being accredited. In line with this, the Faculty of Technology of University of Mumbai has taken a lead in incorporating philosophy of outcome based education in the process of curriculum development.

Faculty of Technology, University of Mumbai, in one of its meeting unanimously resolved that, each Board of Studies shall prepare some Program Educational Objectives (PEO's) and give freedom to affiliated Institutes to add few (PEO's) course objectives and course outcomes to be clearly defined for each course, so that all the faculty members in affiliated institutes understand the depth and approach of course to be taught, which will enhance learner's learning process. It was also resolved that, maximum senior faculty from colleges and experts from industry to be involved while revising the curriculum. I am happy to state that, each Board of studies, has adhered to the resolutions passed by the Faculty of Technology, developed curriculum accordingly. In addition to outcome based education, semester based credit grading system is also introduced to ensure quality of engineering education.

Semester based Credit Grading system enables a much-required shift in focus from teacher-centric to learner-centric education since the workload estimated is based on the investment of time in learning and not in teaching. It also focuses on continuous evaluation which will enhance the quality of education. University of Mumbai has taken a lead in implementing the system through its affiliated Institutes. Faculty of Technology has devised a transparent credit assignment policy and adopted ten points scale to grade learner's performance. Credit and grading based system was implemented for First Year of Engineering from the academic year 2012-2013. Subsequently, this system will be carried forward for Second Year Engineering in the academic year 2013-2014, for Third Year and Final Year Engineering in the academic years 2014-2015, 2015-2016, respectively.

Dr. S. K. Ukarande
Dean,
Faculty of Technology,
Member - Management Council, Senate, Academic Council
University of Mumbai, Mumbai

Preamble

The engineering education in India in general is expanding in manifolds. Now, the challenge is to ensure its quality to the stakeholders along with the expansion. To meet this challenge, the issue of quality needs to be addressed, debated and taken forward in a systematic manner. Accreditation is the principal means of quality assurance in higher education reflects the fact that in achieving recognition, the institution or program of study is committed open to external review to meet certain minimum specified standards. The major emphasis of this accreditation process is to measure the outcomes of the program that is being accredited. Program outcomes are essentially a range of skills knowledge that a student will have at the time of graduation from the program. In line with this, the Faculty of Technology of the University of Mumbai has taken a lead in incorporating philosophy of outcome based education in the process of curriculum development.

I am happy to state here that, Program Educational Objectives were finalized in a meeting where syllabus committee members were also present. The Program Educational Objectives finalized for undergraduate program in civil Engineering are as follows:

1. To prepare Learner's with a sound foundation in the mathematical, scientific engineering fundamentals
2. To prepare Learner's to use effectively modern tools to solve real life problems
3. To prepare Learner's for successful career in Indian Multinational Organisations to excel in Postgraduate studies
4. To encourage motivate Learner's for self-learning
5. To inculcate professional ethical attitude, good leadership qualities commitment to social responsibilities in the Learner's

In addition to above each institute is free to add few (2 to 3) more Program Educational Objectives of their own. In addition to Program Educational Objectives, the course objectives and expected course outcomes from learner's point of view are also included in the curriculum for each course of undergraduate program to support the philosophy of outcome based education. I believe strongly that a small step taken in right direction will definitely help in providing quality education to the stake holders.

Dr. S. K. Ukarande

Chairman, Board of studies in Civil Engineering

University of Mumbai, Mumbai

University of Mumbai
Scheme of Instructions and Examination
Second Year Engineering (Civil Engineering)
(With effect from 2013-2014)
Semester III

Course Code	Subject Name	Teaching Scheme (Contact Hours)			Credits Assigned					
		Theory	Pract.	Tut.	Theory	Pract.	Tut.	Total		
CE-C301	Applied Mathematics III *	4	--	--	4	--	--	4		
CE-C302	Surveying – I	3	2	--	3	1	--	4		
CE-C303	Strength of Materials	4	2	--	4	1	--	5		
CE-C304	Building Materials Construction	3	2	--	3	1	--	4		
CE-C305	Engineering Geology	3	2	--	3	1	--	4		
CE-C306	Fluid Mechanics – I	3	2	--	3	1	--	4		
CE-C307	Database Information Retrieval System*	--	4‡	--	--	2	--	2		
Total		20	14	--	20	7	--	27		
Course Code	Subject Name	Examination Scheme								
		Theory					Term Work	Pract.	Oral	Total
		Internal Assessment			End Sem. Exam.	Exam. Duration (in Hrs)				
		Test 1	Test 2	Avg.						
CE-C301	Applied Mathematics III *	20	20	20	80	3	--	--	--	100
CE-C302	Surveying – I	20	20	20	80	3	25	--	25	150
CE-C303	Strength of Materials	20	20	20	80	3	25	--	25	150
CE-C304	Building Materials Construction	20	20	20	80	3	25	--	25	150
CE-C305	Engineering Geology	20	20	20	80	3	25	--	25	150
CE-C306	Fluid Mechanics – I	20	20	20	80	3	25	--	--	125
CE-C307	Database Information Retrieval System*	--	--	--	--	--	25	25	--	50
Total		120	120	120	480	--	150	25	100	875

‡ For the course 'Database Information Retrieval System' although 4 (Four) clock hours are mentioned under the head of Practical, 2 (Two) clock hours out of these 4 (Four) clock hours may be utilized as the Theory at the Institute/ College level to impart the theoretical aspects of the said subject; accordingly, provision may be made in the Time Table.

*Course common for Civil, Mechanical, Automobile and Production Engineering.

Semester IV

Course Code	Subject Name	Teaching Scheme (Contact Hours)			Credits Assigned					
		Theory	Pract.	Tut.	Theory	Pract.	Tut.	Total		
CE-C401	Applied Mathematics – IV	4	--	--	4	--	--	4		
CE-C402	Surveying – II	3	3	--	3	1.5	--	4.5		
CE-C403	Structural Analysis – I	5	2		5	1	--	6		
CE-C404	Building Design and Drawing – I	2	3	--	2	1.5	--	3.5		
CE-C405	Concrete Technology	3	2	--	3	1	--	4		
CE-C406	Fluid Mechanics – II	3	2	--	3	1	--	4		
Total		20	12	--	20	6	7	26		
Course Code	Subject Name	Examination Scheme								
		Theory					Term Work	Pract	Oral	Total
		Internal Assessment			End Sem. Exam.	Exam. Duration (in Hrs)				
		Test 1	Test 2	Avg.						
CE-C401	Applied Mathematics – IV	20	20	20	80	3	--	--	--	100
CE-C402	Surveying – II	20	20	20	80	3	25	--	25*	150
CE-C403	Structural Analysis – I	20	20	20	80	3	25	--	25	150
CE-C404	Building Design and Drawing – I	20	20	20	80	4	25	--	25#	150
CE-C405	Concrete Technology	20	20	20	80	3	25	--	25	150
CE-C406	Fluid Mechanics – II	20	20	20	80	3	25	--	25	150
Total		120	120	120	480	--	125	--	125	850

*Oral and Practical # Oral and Sketching

University of Mumbai
Scheme of Instructions and Examination
Third Year Engineering (Civil Engineering)
(With effect from 2014-2015)
Semester V

Course Code	Subject Name	Teaching Scheme (Contact Hours)			Credits Assigned					
		Theory	Pract.	Tut.	Theory	Pract.	Tut.	Total		
CE-C501	Structural Analysis – II	4	2	--	4	1		5		
CE-C502	Geotechnical Engg.– I	4	2	--	4	1	--	5		
CE-C503	Building Design and Drawing – II	1	4*	--	1	2	--	3		
CE-C504	Applied Hydraulics – I	4	2		4	1	--	5		
CE-C505	Transportation Engg. – I	4	2	--	4	1	--	5		
CE-C506	Business and Communication Ethics	-	4†	-	-	2		2		
Total		17	16	--	17	8		25		
Course Code	Subject Name	Examination Scheme								
		Theory					Term Work	Pract	Oral	Total
		Internal Assessment			End Sem. Exam.	Exam. Duration (in Hrs)				
		Test 1	Test 2	Avg.						
CE-C501	Structural Analysis – II	20	20	20	80	3	25	--	25	150
CE-C502	Geotechnical Engg. – I	20	20	20	80	3	25	--	25	150
CE-C503	Building Design and Drawing – II	20	20	20	80	4	25	--	25 [#]	150
CE-C504	Applied Hydraulics – I	20	20	20	80	3	25	--	--	125
CE-C505	Transportation Engg. – I	20	20	20	80	3	25	--	--	125
CE-C506	Business and Communication Ethics	--	--	--	--	-	25	--	25 ^{**}	50
Total		100	100	100	400	-	150	-	100	750

Oral and Sketching

**Oral and Presentation (Internal)

* For Building Design Drawing- II, although 4 (Four) clock hours are mentioned under the head of Practical, 1 (One) clock hour out of these 4 (Four) clock hours may be utilized as the Theory at the College/ Institute level and accordingly, provision may be made in the Time Table.

† For Business and Communication Ethics, although 4 clock hours are mentioned under the head of Practical, 2 (Two) clock hours out of these 4 (Four) clock hours, may be utilized as the Theory at the Institute/ College level and accordingly, the provision may be made in the Time Table.

Semester VI

Course Code	Subject Name	Teaching Scheme (Contact Hours)			Credits Assigned					
		Theory	Pract.	Tut.	Theory	Pract.	Tut.	Total		
CE-C601	Geotechnical Engineering – II	4	2	--	4	1	--	5		
CE-C602	Design and Drawing of Steel Structures	4	2	--	4	1	--	5		
CE-C603	Applied Hydraulics – II	3	2	--	3	1	--	4		
CE-C604	Transportation Engineering – II	4	2	--	4	1	--	5		
CE-C605	Environmental Engineering – I	3	2	--	3	1	--	4		
CE-C606	Theory of Reinforced and Pre-stressed Concrete	4	2	--	4	1	--	5		
Total		22	12	--	22	6	--	28		
Course Code	Subject Name	Examination Scheme								
		Theory					Term Work	Pract	Oral	Total
		Internal Assessment			End Sem. Exam.	Exam. Duration (in Hrs)				
		Test 1	Test 2	Avg.						
CE-C601	Geotechnical Engineering. – II	20	20	20	80	3	25	--	25	150
CE-C602	Design and Drawing of Steel Structures	20	20	20	80	4	25	--	25 [@]	150
CE-C603	Applied Hydraulics – II	20	20	20	80	3	25	--	25	150
CE-C604	Transportation Engineering. – II	20	20	20	80	3	25	--	25	150
CE-C605	Environmental Engineering – I	20	20	20	80	3	25	--	--	125
CE-C606	Theory of Reinforced and Pre-stressed Concrete	20	20	20	80	3	25	--	25	150
Total		120	120	120	480		150		125	875

[@]Oral and Sketching

University of Mumbai
Scheme of Instruction and Examination
Fourth Year Engineering (Civil Engineering)
(With effect from 2015-2016)
Semester VII

Course Code	Subject Name	Teaching Scheme (Contact Hours)			Credits Assigned					
		Theory	Pract.	Tut.	Theory	Pract.	Tut.	Total		
CE-C701	Limit State Method for Reinforced Concrete Structures	4	2	--	4	1	-	5		
CE-C702	Quantity Survey, Estimation and Valuation	4	2	--	4	1	-	5		
CE-C703	Irrigation Engineering	4	2	--	4	1	-	5		
CE-C704	Environmental Engineering – II	4	2	--	4	1	--	5		
CE-E705	Elective – I	4	2	--	4	1	--	5		
CE-P706	Project – Part I	--	4	--	--	2	--	2		
Total		20	14	--	20	7	--	27		
Course Code	Subject Name	Examination Scheme								
		Theory					Term Work	Pract	Oral	Total
		Internal Assessment			End Sem. Exam.	Exam. Duration (in Hrs)				
		Test 1	Test 2	Avg.						
CE-C701	Limit State Method for Reinforced Concrete Structures	20	20	20	80	3	25	--	--	125
CE-C702	Quantity Survey Estimation and Valuation	20	20	20	80	4	25	--	25	150
CE-C703	Irrigation Engineering	20	20	20	80	3	25	--	25	150
CE-C704	Environmental Engineering – II	20	20	20	80	3	25	--	25	150
CE-E705	Elective – I	20	20	20	80	3	25	--	25	150
CE-P706	Project – Part I	--	--	--	--	--	50	--	25 [@]	75
Total		100	100	100	400	--	175	--	125	800

[@] Seminar on Project (Internal)

Semester VIII

Course Code	Subject Name	Teaching Scheme (Contact Hours)			Credits Assigned					
		Theory	Pract.	Tut.	Theory	Pract.	Tut.	Total		
CE-C801	Design and Drawing of Reinforced Concrete Structures	4	2	--	4	1	--	5		
CE-C802	Construction Engineering	4	2	--	4	1	--	5		
CE-C803	Construction Management	4	2	--	4	1	--	5		
CE-E804	Elective – II	4	2	--	4	1	--	5		
CE-P805	Project – Part II	--	8	--	--	4	--	4		
Total		16	16	--	16	8	--	24		
Course Code	Subject Name	Examination Scheme								
		Theory					Term Work	Pract	oral	Total
		Internal Assessment			End Sem. Exam.	Exam. Duration (in Hrs)				
		Test 1	Test 2	Avg.						
CE-C801	Design and Drawing of Reinforced Concrete Structures	20	20	20	80	4	25	--	25	150
CE-C802	Construction Engineering	20	20	20	80	3	25	--	25	150
CE-C803	Construction Management	20	20	20	80	3	25	--	25	150
CE-E804	Elective – II	20	20	20	80	3	25	--	25	150
CE-P805	Project – Part II	--	--	--	--	--	50	--	50 [#]	100
Total		80	80	80	320		150	--	150	700

[#] Presentation on Project Oral

N.B.: Guidelines for Project, i.e., Dissertation (Part-I and II)

- (i) Students can form groups with minimum of 2 (Two) and not more than 4 (Four)
- (ii) Faculty load: In Semester VII – 1 (One) period of 1 hour per week per project group.
- (iii) In Semester VIII- 2 (Two) periods of 1 hour each per week per project group.
- (iv) Each faculty member shall be permitted to guide maximum 4 (Four) project groups.

University of Mumbai

Fourth Year Civil Engineering

List of Electives

Semester VII (Theory: 4, Practical: 2)

1. Advanced Surveying
2. Rock Mechanics
3. Applied Hydrology and Flood Control
4. Solid Waste Management
5. Systems Approach in Civil Engineering
6. Risk and Value Management
7. Advanced Structural Analysis
8. Structural Dynamics
9. Advanced Structural Mechanics
10. Advanced Foundation Engineering
11. Ground Water Hydrology
12. Pavement Subgrade and Materials
13. Air Pollution
14. Prestressed Concrete
15. Traffic Engineering and Control
16. Reinforced Concrete Repairs and Maintenance
17. Advanced Computational Techniques

Semester VIII (Theory: 4, Practical: 2)

1. Advanced Construction Engineering
2. Advanced Engineering Geology
3. Geographical Information Systems
4. Water Resources Engineering and Management
5. Bridge Design and Engineering
6. Environmental Impact Assessment and Audit
7. Appraisal Implementation of Infrastructure Projects
8. Disaster Management
9. Pavement Design and Construction
10. Advanced Design of Steel Structures
11. Earthquake Engineering
12. Soil Dynamics
13. Building Services
14. Design of Hydraulic Structures
15. Industrial Waste Treatment
16. Transportation Planning and Economics
17. Advanced Repairs and Rehabilitation of Structures
18. Geosynthetics and Reinforced Structures

Semester V

Course Code	Subject Name	Credits
CE – C501	Structural Analysis -II	05

Teaching Scheme

Contact Hours			Credits Assigned			
Theory	Practical	Tutorial	Theory	Practical	Tutorial	Total
04	02	-	04	01	-	05

Evaluation Scheme

Theory				Term work / Practical / Oral			Total	
Internal Assessment			End Sem Exam	Duration of End Sem Exam	TW	PR	OR	
Test 1	Test 2	Average						
20	20	20	80	03 Hrs.	25	-	25	150

Rationale

There are various types of the components of any civil engineering structures which are subjected to different types of loading or combination thereof. The knowledge gained in the subjects such as Engineering Mechanics, Strength of Materials and Structural Analysis-I is extended in this subject. The scope of the subject is to evaluate the response in the form of Shear Forces, Bending Moments, Axial Forces, and Twisting Moment in various statically indeterminate structures such as beams, rigid and pin jointed frames; and two hinged arches. The subject involves the concept of the displacement and flexibility approach for analyzing the indeterminate structures. The subject also involves the analysis of the indeterminate structures using the concept of plastic analysis.

Objectives

- To revise the various concepts involved in the analyses of the structures studied in the subject Structural Analysis-I.
- To analyze the statically determinate structures with reference to the variation in the temperature.

- To understand the concept of static kinematic indeterminacy (degrees of freedom) of the structures such as beams rigid and pin jointed frames.
- To understand the concepts/ broad methods sub-methods involved in the analysis of indeterminate structures.
- To apply these methods for analyzing the indeterminate structures evaluate the response of such structures in the form of bending moment, shear force and axial force.
- To study the analyses of two hinged arches.

Detailed Syllabus

Module	Sub Modules/Contents	Periods
1.	<p>General</p> <p>Types of structures occurring in practice their classification. Stable and unstable structures, static and kinematic determinacy and indeterminacy of structure. Symmetric structures, symmetrical and anti-symmetrical loads, distinction between linear and non-linear behaviors of material and geometric non-linearity.</p>	06
2.	<p>Deflection of statically determinate structures</p> <p>Review of general theorems based on virtual work and energy methods, introduction to the concept of complimentary energy, absolute and relative deflection caused by loads, temperature changes and settlement of supports, application to beams, pin jointed frames and rigid jointed frames.</p>	06
3.	<p>Analysis of indeterminate structures by flexibility method</p> <p>Flexibility coefficients their use in formulation of compatibility equations. Fixed Beams, Application of the Clapeyron's Theorem of Three Moments. Castigliaonos theorem of least work, application of above methods to propped cantilevers, fixed beams, continuous beam. Simple pin jointed frames including effect of lack of fit for members. Simple rigid jointed frames and two hinged parabolic arches.</p>	14
4.	<p>Analysis of indeterminate structures by stiffness method</p> <p>Stiffness coefficients for prismatic members, their use for formulation of equilibrium equations, Direct stiffness method, Slope deflection method, Moment distribution method. Application of the above methods to</p>	14

	indeterminate beams, simple rigid jointed frames, rigid jointed frames with inclined member but having only one translation degree of freedom including the effect of settlement of supports.	
5.	Introduction to plastic analysis of steel structures	08
	Concept of plastic hinge, plastic moment carrying capacity, shape factor, determination of collapse load for single multiple span beams.	

Contribution to Outcomes

On completion of this course, the students will be able to understand the behaviour of various statically indeterminate structures including two hinged arches. They will be able to analyze these structures to find out the internal forces. Further, the students shall be able to extend the knowledge gained in this subject further in the subjects related to structural and engineering mechanics in the higher years of their UG programme. The knowledge gained in this subject shall be useful for application in the structural design in later years.

Theory Examination:

1. Question paper will comprise of **six** questions; each carrying 20 marks.
2. The **first** question will be **compulsory** and will have the short questions having weightage of 4-5 marks covering the entire syllabus.
3. The remaining **five** questions will be based on all the modules of entire syllabus. For this, the module shall be divided proportionately and further, the weightage of the marks shall be judiciously awarded in proportion to the importance of the sub-module and contents thereof.
4. There can be an **internal** choice in various questions/ sub-questions in order to accommodate the questions on all the topics/ sub-topics.
5. The students will have to attempt any **three** questions out of remaining five questions.
6. Total **four** questions need to be attempted.

Oral Examination:

The oral examination shall be based upon the entire syllabus and the term work.

Term Work:

The term-work shall comprise of the neatly written report of the assignments. The assignments shall be given covering the entire syllabus in such a way that the students would attempt at least four problems on each modules/ sub-modules or contents thereof further.

Distribution of Term-work Marks

The marks of the term-work shall be judiciously awarded depending upon the quality of the term work including that of the report on assignments. The final certification and acceptance of term-work warrants the satisfactory and the appropriate completion of the assignments; and the minimum passing marks to be obtained by the students. The following weightage of marks shall be given for different components of the term work.

- Assignments : 20 Marks
- Attendance : 05 Marks

Further, while giving weightage of marks on the attendance, following guidelines shall be resorted to.

- 75%- 80% : 03 Marks; 81%- 90%: 04 Marks; 91% onwards: 05 Marks

Recommended books:

1. Basic Structural Analysis: *C.S. Reddy*, Tata McGraw Hill Publishing House, New Delhi.
2. Mechanics of Structures (Vol-I and II): *S. B. Junnarkar and H.J. Shah*, Charotar Publishers.
3. Structural Analysis: *L.S. Negi and R.S. Jangid*, Tata Mc-Graw Hills Publishing House, New Delhi
4. Analysis of Structures: Vol. I II, *Vazirani and Ratwani*, Khanna Publishers
5. Structural Analysis: *Bhavikatti*, Vikas Publishing House Pvt, Ltd.
6. Structural Analysis: *Devdas Menon*, Narosa Publishing House.
7. Basic Structural Analysis: *K.U. Muthu, Azmi Ibrahim, M. Vijyan, Maganti Janadharn. I.K.* International Publishing House Pvt. Ltd.
8. Comprehensive Structural Analysis (Vol-I and II):*Vaidyanathan R. and Perumal R.*;Laxmi Publications, New Delhi.
9. Fundamentals of Structural Analysis: *Sujit Kumar Roy and Subrota Chakrabarty*, S. Chand and Co., New Delhi
10. Structural Analysis: *T.S. Thavamoorthy*, Oxford University Press.
11. Structural Analysis: *Manmohan Das and Bharghab Mohan*, Pentice Hall International.

Reference Books:

12. Structural Analysis: *Hibbler*, Pentice Hall International.
13. Structural Analysis: *Chajes*, EIBS London.
14. Theory of Structures: *Timoshenko and Young*, Tata McGraw Hill, New Delhi.
15. Structural Analysis: *Kassimali*, TWS Publications.
16. Element of Structural Analysis: *Norries and Wilbur*, McGraw Hill.
17. Structural Analysis: *Laursen H.I*, Mc-Graw Hill Publishing Co.
18. Structural Theorem and Their application: *B.G. Neal*, Pergaman Press.
19. Fundamentals of Structural Analysis: *K.M. Leet, C.M. Uangand and A.M. Gilbert*, Tata McGraw Hill New Delhi.
20. Elementary theory of Structures: *Hseih*, Prentice Hall.
21. Fundamentals of Structural Analysis: *Harry, H.W. and Louis, F.G.*, Wiley India

Semester V

Course Code	Subject Name	Credits
CE-C502	Geotechnical Engineering -I	05

Teaching Scheme

Contact Hours			Credits Assigned			
Theory	Practical	Tutorial	Theory	Practical	Tutorial	Total
04	02	-	04	01	-	05

Evaluation Scheme

Theory				Term work / Practical / Oral			Total	
Internal Assessment			End Sem Exam	Duration of End Sem Exam	TW	PR	OR	
Test 1	Test 2	Average						
20	20	20	80	03 Hrs.	25	-	25	150

Rationale

All the civil engineering structures, e.g., buildings, dams, bridges, highways, etc., are supported on the ground, i.e., supported by soil and the rock. The geotechnical analysis depends on the basics of the physical properties which are useful for determining the strength, compressibility, drainage etc. The soil mechanics is the basic tool for all branches of geotechnical engineering. Soil is used as construction materials; thus, it is necessary to study this curriculum.

Objectives

- To study the composition, types relationships involving weight, volume weight-volume of soil.
- To study the index properties of soil that is indicative of the engineering properties.
- To characterize the soil based on size, shape, index properties plasticity.
- To classify the soil based on different classification systems.
- To study the properties of soil related to flow of water
- To understand the concept of total stress, effective stress pore water pressure in soil.

- To understand the load-deformation process in soils through compaction consolidation.
- To study the shear strength of soil.
- To understand the techniques of site exploration, assessing the subsoil conditions the engineering properties of the various strata method of reporting.
- To perform different laboratory tests.

Detailed Syllabus

Module	Sub Modules/Contents	Periods
1.	Introduction	01
	<ul style="list-style-type: none"> i. Definitions: Rock, Soil - origin and formation, Soil mechanics, Rock mechanics, Soil engineering, Geotechnical engineering. ii. Scope of soil engineering- Importance of field exploration and characterization, design construction phases of foundations, post construction phase monitoring. iii. Limitations of soil engineering. iv. Cohesionless cohesive soil; Terminology of different types of soil. 	
2.	Basic definitions and relationships	05
	<ul style="list-style-type: none"> i. Soil as three phase and two phase system in terms of weight, volume, void ratio, porosity. ii. Weight, volume weight–volume relationships: water content, void ratio, porosity, degree of saturation, air voids, air content, unit weights, specific gravity of solids, mass absolute specific gravity. iii. Relationships between: different unit weights with void ratio-degree of saturation-specific gravity; different unit weights with porosity; void ratio-water content; different unit weights with water content; unit weight – air voids. iv. Mention different methods to find water content, specific gravity, unit weight of soil (Detailed description to be covered during practical). 	
3.	Particle size analysis and Plasticity characteristics of soil	06
	<ul style="list-style-type: none"> i. Mechanical analysis: dry sieve analysis, combined sieve sedimentation analysis; Stoke’s law, theory of sedimentation; introduction to hydrometer method of analysis, relation between 	

	<p>percentage finer hydrometer reading, Limitation of sedimentation analysis, Particle size distribution curve its uses.</p> <p>ii. Relative density</p> <p>iii. Plasticity of soil, consistency limits- determination of liquid limit, plastic limit, shrinkage limit, definitions of: shrinkage parameters, plasticity, liquidity consistency indices, measurement of consistency, flow toughness indices, uses of consistency limits.</p> <p>iv. Clay mineralogy:- gravitational surface forces, primary valence bond, hydrogen bond, secondary valence bonds, basic structural units of clay minerals, difference in kaolinite, montmorilloniteillite minerals, adsorbed water, soil structure.</p> <p>v. Sensitivity, thixotropy activity of soils.</p>	
4.	Classification of soils	03
	<p>i. Necessity of soil classification, Indian standard particle size classification, Indian standard soil classification system, boundary classifications</p> <p>ii. General characteristics of soils of different groups.</p>	
5.	Permeability of soils	06
	<p>i. Introduction: ground water flow- water table, types of aquifers; capillary water – types of soil water, surface tension, capillary rise in small diameter tubes, capillary tension, capillary rise in soils.</p> <p>ii. Hydraulic head hydraulic gradient, Darcy’s law, validity of Darcy’s law.</p> <p>iii. General laminar flow, Laminar flow through soil, Factors affecting permeability of soil.</p> <p>iv. Determination of coefficient of permeability of soil: Laboratory methods: constant head and variable head; Field methods: pumping out and pumping in tests; Indirect methods: Consolidation test data.</p> <p>v. Permeability of stratified soil.</p>	
6.	Seepage analysis	05
	<p>i. Two dimensional flow- Laplace equation, analytical solution: stream potential functions, graphical representation: flow net, characteristics of flow net, uses of flow nets.</p>	

	<ul style="list-style-type: none"> ii. Other solution methods for Laplace equation- numerical methods. iii. Soil migration and filtration: Seepage velocity; Effect of seepage pressure soil migration in structures such as earth dams, retaining walls, pavements, basements; soil migration prevention through graded soil filters, geotextile and geo-composite filters. iv. Geosynthetics: Definition, basic functions, types of geosynthetics- geotextiles, geogrids, geo cells, geomembranes, geo composites; geotextile types– woven nonwoven, Apparent Opening Size (AOS), basic hydraulic properties- permittivity and transmissivity of geotextiles v. Filter design criteria for graded soil geotextile filters. 	
7.	Effective stress principle	03
	<ul style="list-style-type: none"> i. Sources of stress in the ground- geostatic stresses induced stresses; vertical, horizontal shear stresses, effective stress principle, and nature of effective stress. ii. Effect of water table fluctuations, surcharge, capillary action, seepage pressure on effective stress; quick s condition 	
8.	Compaction of soils	02
	<ul style="list-style-type: none"> i. Introduction, theory of compaction, laboratory methods of determination of optimum moisture content maximum dry density, ii. Factors affecting compaction, effect of compaction on properties of soil; Relative compaction. 	
9.	Consolidation of soils	06
	<ul style="list-style-type: none"> i. Compressibility and settlement, comparison between compaction & consolidation, concept of excess pore water pressure, initial, primary secondary consolidation, spring analogy for primary consolidation, consolidation test results, coefficient of compressibility, coefficient of volume change , compression, expansion recompression indices, normally over consolidated soils. ii. Terzaghi's theory of consolidation- assumptions, coefficient of vertical consolidation, distribution of hydrostatic excess pore water pressure with depth and time, time factor, relationship between time factor degree of consolidation, determination of coefficient of vertical 	

	consolidation, pre-consolidation pressure. iii. Final settlements of a soil deposit in the field, time settlement curve, field consolidation curve.	
10.	Shear strength	06
	<p>i. Introduction, three dimensional state of stress in soil mass, principal stresses in soil, shear failure in soils- frictional cohesive strength, general shear stress-strain curves in soil definition of failure, graphical method of determination of stresses on a plane inclined to the principal planes through Mohr's circle, important characteristics of Mohr's circle.</p> <p>ii. Mohr-Coulomb theory: shear strength parameters; Mohr-Coulomb failure criterion- relation between major minor principle stresses, total and effective stress analysis.</p> <p>iii. Different types of shear tests and drainage conditions: Direct shear test, Triaxial compression test (UU, CU CD), Unconfined compression test, Vane shear test; comparison between direct and triaxial tests, interpretation of test results of direct shear and triaxial shear tests- stress-strain curves Mohr failure envelopes</p> <p>iv. Determination of shear strength of soil with geosynthetics- pull out test: ASTM procedure for finding shear strength of soil-geosynthtic system.</p>	
11.	Soil exploration	05
	Introduction, methods of investigation, methods of boring, soil samplers, sampling, number and disposition of trial pits and borings, penetrometers tests- SPT,CPT; borehole logs	

Contribution to outcomes

With the completion of this course, the students will be able to:

- To classify soils with a view towards assessing the suitability of a given soil for use in a designed, constructed facility, e.g., foundation, embankment, or highway.
- To evaluate the compaction characteristics interpret field compaction result with respect to compaction specification.

- To evaluate consolidation properties of soils and apply those properties to settlement problems frequently encountered in civil engineering.
- To apply engineering science principles, using shear strength and compressibility parameters; and to analyze the response of soil under external loading.
- To obtain soil properties required for many design applications
- To design and conduct laboratory experiments to collect, analyze, interpret, present data.
- To understand the soil boring data for foundation design.

Theory Examination:-

1. Question paper will comprise of **six** questions; each carrying 20 marks.
2. The **first** question will be **compulsory** which will have the short questions having weightage of 4-5 marks covering the entire syllabus.
3. The remaining **five** questions will be based on all the modules of entire syllabus. For this, the module shall be divided proportionately and further, the weightage of the marks shall be judiciously awarded in proportion to the importance of the sub-module contents thereof.
4. There can be an **internal** choice in various sub-questions/ questions in order to accommodate the questions on all the topics/ sub-topics.
5. The students will have to attempt any **three** questions out of remaining five questions.
6. Total **four** questions need to be attempted.

Oral Examination:

The oral examination shall be based upon the entire syllabus and the term work consisting of the report of experiments performed in the laboratory as well as assignments.

List of Experiments/ Practical: *(At least ten to be performed)*

1. Determination of natural moisture content using oven drying method.
Following other methods to find moisture content shall be explained briefly.
 - a) Pycnometer method,
 - b) S bath method,
 - c) Alcohol method,
 - d) Torsional balance method,
 - e) Radio activity method,
 - f) Moisture meter.

2. Specific gravity of soil grains by density bottle method or pycnometer method.
3. Field density using core cutter method.
4. Field density using replacement method.
5. Field identification of fine grained soils.
6. Grain size distribution by sieve analysis
7. Grain size distribution by hydrometer analysis
8. Consistency limits: Liquid limit, plastic limit
9. Consistency limit: Shrinkage limit
10. Permeability test using constant head method
11. Permeability test using falling head method
12. Compaction test: Standard and Proctor / IS light compaction
13. Compaction test: Modified proctor / IS heavy compaction
14. Relative density
15. Differential free swell index test/ un-restrained swell test

Term Work:

The term-work shall comprise of the neatly written report based on the experiments performed in the laboratory as well as assignments. The assignments shall be given covering the entire syllabus in such a way that the students would attempt at least two problems on each modules/ sub-modules or contents thereof further.

Distribution of Term Work Marks

The marks of term-work shall be judiciously awarded depending upon the quality of the term work including that of the report on experiments as well as assignments. The final certification and acceptance of term-work warrants the satisfactory and the appropriate completion of the report on experiments as well as assignments; and the minimum passing marks to be obtained by the students. The following weightage of marks shall be given for different components of the term work.

- Report of the Experiments: 10 Marks
- Assignments : 10 Marks
- Attendance : 05 Marks

Further, while giving weightage of marks on the attendance, following guidelines shall be resorted to.

- 75%- 80% : 03 Marks; 81%- 90%: 04 Marks; 91% onwards: 05 Marks

Recommended Books:

1. Soil Engineering in Theory Practice: *Alam Singh*, CBS Publishers Distributors, New Delhi.
2. Soil Mechanics & Foundation Engineering: *V. N. S. Murthy*, Saitech Publications
3. Soil Mechanics & Foundation Engineering: *K. R. Arora*, Standard Publishers Distributors, New Delhi.
4. Soil Mechanics & Foundation Engineering: *B.C. Punimia*, Laxmi Publications, New Delhi
5. Geotechnical Engineering: *C. Venkatramaiah*, New Age International.
6. Fundamentals of Soil Engineering: *D. W. Taylor*, John Wiley & sons.
7. An Introduction to Geotechnical Engineering: *R. D. Holtz*, Prentice Hall, New Jersey.
8. Soil Mechanics: *R. F. Craig*, Chapman and Hall.
9. Soil Mechanics: *T. W. Lambe R. V. Whitman*, John Wiley and Sons.
10. Theoretical Soil Mechanics: *K. Terzaghi*, John Wiley and Sons.
11. Designing with geosynthetics: *R. M. Koerner*, Prentice Hall, New Jersey.
12. An introduction to soil reinforcement geosynthetics: *G. L. Sivakumar Babu*, Universities Press.
13. Geosynthetics- an introduction: *G. Venkatappa Rao*, SAGES.
14. Relevant Indian Standard Specifications Codes, BIS Publications, New Delhi
15. ASTM D6706: Standard Test Method for measuring Geo-synthetic Pull-out Resistance in soil.
16. ASTM D5321: Standard Test Method for determining Shear Strength of Soil Geo-synthetic or Geo-synthetic Friction by Direct Shear Method

Semester V

Course Code	Subject Name	Credits
CE-503	Building Design and Drawing – II	03

Teaching Scheme

Contact Hours			Credits Assigned			
Theory	Practical	Tutorial	Theory	Practical	Tutorial	Total
01	04#	--	01	02	--	03

Evaluation Scheme

Theory					Term Work/Practical/Oral			Total
Internal Assessment			End Sem. Exam	Duration of End Sem. Exam	Term Work	Practical	Oral	
Test-I	Test-II	Average						
20	20	20	80	04 Hrs.	25	--	25#	150

Rationale

The complete knowledge of planning, designing and drawing of public buildings, which includes offices like bank, post-office, commercial complex, hostels, hotel, rest houses; buildings for education like schools, colleges including library; buildings for health like primary health center to hospitals etc. is essential for civil engineering students. The structures include load bearing and framed type with respect to plan, elevation, section, foundation plan, roof plan, and site plan for the same. The subject also involves drawings of one-point and two-point perspectives for public buildings, workshops, which will give represent the real impression of building when one see them from a long distance, may be seeing by sting on ground level from top like bird's eye-view. This subject imparts the theoretical knowledge to students like concept of green buildings, town planning concepts with reference to development of a town or large urban area, slum clearance redevelopment of old dilapidated buildings in a broader way. This subject also outlines the drawings of different plans, elevations and sections at various levels using latest software techniques like AUTO-CAD with reference to drafting of various types of public buildings.

Objectives

1. To understand the planning concepts, rules, regulations, various bye-laws of local administration/authorities with reference to all types of public buildings.
2. To understand the application of bye-laws in planning, designing and drawing of all types of public buildings.
3. To understand all the concepts involved in drawing the different perspective, drawings for public buildings and workshops.
4. To prepare various types of drawings for the public building structures planned and designed, satisfying the functional market requirements.
5. To study and apply the provisions made in the relevant Indian Specifications pertaining to the practice for public buildings, the society needs for over all development.

Detailed Syllabus

Module	Sub-Module/Contents	Periods
1.	Planning and Design of Public Buildings such as: i) Buildings for education: Schools, Colleges, Institutions, Libraries ii) Buildings for health: Hospitals, Primary Health Centers iii) Industrial Buildings, Workshops, Warehouses iv) Buildings for entertainment: Theaters, Cinema Halls, Club houses, sports club v) Offices: Banks, Post Offices, Commercial Complex vi) Hostels, Hotels, Boarding houses, Rest houses vii) Bus Depot	10
2.	Perspective Drawing : One Point Perspective and Two Point Perspective	04
3.	Town Planning: Objectives Principles, Master Plan, Road Systems, Zoning, Green Belt, Slums	02
4.	Redevelopment of Buildings, Introduction to Residential Township	02
5.	Architectural Planning, massing composition, concept of built environment its application in planning	02
6.	Principles of modular planning, planning as recommended by National	01

	Building Organization	
7.	Use of Computers in Building Planning and Designing	01
8.	Introduction to Green Buildings, under sting certification methods (TERI,LEEDS)	02

Contribution to Outcomes

On successful completion of the course work, the students shall be able to understand the principles of planning designing of public buildings. They will demonstrate the ability to plan the public buildings according to the requirements, design the various components involved therein by keeping all the principles of planning following the extant bye-laws of the local authorities. The students will also understand the different control rules of the local authorities besides provisions made in the relevant Indian specifications meant for practice for architectural drawings. They will further demonstrate the ability of preparing different types of drawings showing complete details therein with respect to public buildings as a whole. Over all, by the end of semester, the civil engineering students will have the complete knowledge with reference to planning, designing and drawing concepts of all types of public buildings.

Theory Examination:

1. The question paper will comprise of **six** questions, each carrying 20 marks.
2. Question No.1 will be **compulsory** which will be based on the planning of any one public building mentioned in the syllabus.
3. The remaining **five** questions will be based on all the modules sub-modules, consisting of Plan, Elevation, Section, Foundation Plan theoretical concepts mentioned in the entire syllabus.
4. These five questions shall be based on Plan, Elevation, Section, Elevation, Foundation Plan; Roof/Terrance Plan on the public buildings (may be on framed or load bearing structure). Some questions could be asked on the theoretical portion mentioned in the module/sub-modules also.
5. The students will have to attempt **any three** questions from the **remaining five** questions.
6. Total **four** questions need to be attempted.

Oral Examination:

There shall be an oral examination in conjunction with the sketching examination. The oral examination shall be based on the entire syllabus and the term work.

Contents of the Practical /Site Visit:

1. Planning and drawings of different public buildings.
2. Writing of the report related to the buildings that are planned drawn by the students.
3. One-day site visit could be arranged for students to visit any one public building near the college like commercial complex, library, Bank etc. They need to study in detail that building, take the measurements of the various components/ constituents of that that building and should submit as a site report with detailed drawing according to some suitable scale. This will become a part of Term Work.

Term Work:

The Term Work shall consist of all the following:

1. A-1 size drawing sheets drawn for one public building as Framed Structure as (G+1) with Ground Floor Plan, First Floor Plan, Front Elevation, Sectional Elevation, Foundation Plan, Roof/Terrace Plan, Site Plan, Schedule of Openings, Construction Notes Area Statement for the building.
2. A-1 size drawing sheets drawn for one public building as Load Bearing Structure for Single storied structure with Ground Floor Plan, Front Elevation, Sectional Elevation, Foundation Plan, Schedule of Openings and Construction Notes.
3. Perspective drawings for One-Point Two-Point.
4. One public building one workshop can be considered for the perspective drawings.
5. Report on the problem taken for the drawing sheets with respect to public buildings.
6. Report of the site visit with drawings.

Distribution of Term Work Marks:

The marks of the term work shall be judiciously awarded for the various components depending upon the quality of the term work. The final certification and acceptance of term work warrants the satisfactory performance of drawing work by the student, appropriate completion of the report on the said drawing sheets; and the minimum passing marks to be obtained by the student. The following weightage of marks shall be given for different components of the term work.

- Drawing Sheets : 10 Marks
- Report of the Drawing : 05 Marks
- Report on the Site Visit : 05 Marks
- Attendance : 05 Marks

Further, while giving weightage of marks on the attendance, following guidelines shall be resorted to.

- 75%- 80% : 03 Marks; 81%- 90%: 04 Marks; 91% onwards: 05 Marks

Recommended Books:

1. Building Drawing : *M. G. Shah, C. M .Kale and Patki*; Tata McGraw Hill Publishers, Delhi
2. Civil Engineering Drawing: *Chakraborty M*; Monojit Chakraborty Publication, Kolkata
3. Building Drawing Detailing : *B. T. S. Prabhu, K.V. Paul and C.Vijayan*; SPADES Publications, Calicut, Kerala
4. Planning Designing Buildings : *Y.S. Sane*; Modern Publication House, Pune
5. Civil Engineering Drawing: *Sushilkumar*, Standard Publishers
6. IS: 962-Code of Practice for Architectural Drawings: BIS, New Delhi
7. Town Planning : *Rangwala*, Charotar Publishers

Reference Books:

1. Time Saver Standards for Building Types: Joseph De Chiara and John Callender

Semester V

Course Code	Subject Name	Credits
CE-C504	Applied Hydraulics – I	05

Teaching Scheme

Contact Hours			Credits Assigned			
Theory	Practical	Tutorial	Theory	Practical	Tutorials	Total
04	02	--	04	01	--	05

Evaluation Scheme

Theory			Term Work/ Practical/Oral			Total		
Internal Assessment			End Sem Exam	Duration of End Sem exam	TW	PR	OR	
Test 1	Test 2	Average						
20	20	20	80	03 Hrs.	25	--	--	125

Rationale

The applied hydraulics in civil engineering is essential to design hydraulic machinery. The application of momentum equation in lawn sprinklers pipe bends is also important to study. The course deals with application of fluid mechanics.

Course Objectives

- To study hydraulic machines consist of study of turbines pumps.
- To study devices based on the principals of fluid statics fluid kinematics.
- To study the mathematical technique used in research work for design for conducting model tests.
- To impart the dynamic behavior of the fluid flow analyzed by the Newton's second law of motion.

Detailed Syllabus

Module	Sub Modules/Contents	Periods
1	Dynamics of Fluid Flow: Momentum principle (applications: pipe bends) moment of momentum equation (applications: sprinkler).	06
2	Dimensional Analysis: Dimensional homogeneity, Buckingham's π theorem, Reyleigh's method, dimensionless numbers their significance, Model (or similarity) laws, Types of models, application of model laws: Reynold's model law Froude's model law, scale effect in models.	07
3	Impact of Jets: Introduction, Force exerted on stationary flat plate: held normal to jet, held inclined to jet, curved plate: symmetrical unsymmetrical (jet striking at centre tangentially), jet propulsion of ships.	09
4	Hydraulic Turbines: General layout of hydro-electric plant, heads efficiencies of turbine, classification, Pelton Wheel Turbine, Reaction Turbine, Francis Turbine, Kaplane Turbine, draft tube theory, specific speed, unit quantities, Characteristic curves, Governing of turbines, Cavitations.	13
5	Centrifugal Pumps: Work done, heads, efficiencies, Minimum speed: series parallel operation, Multistage pumps, specific speed, model testing, priming, characteristic curves, cavitations, Brief introduction to reciprocating pump.	09
6	Miscellaneous Hydraulic Machines: Introduction: Hydraulic ram, Hydraulic press, Hydraulic accumulator, Hydraulic intensifier, Hydraulic crane, Hydraulic lift.	04

Contribution to Outcomes

On completion of this course the student will be able to understand the design of turbines pumps. They will be able, further, to understand the forces acting on pipe, bends and sprinklers. They will be

able to study the dimensional analysis model laws and apply the principle of momentum to fluid flow problems.

Theory Examination:-

1. Question paper will comprise of **six** questions; each carrying 20 marks.
2. The **first** question will be **compulsory** and will have to short questions having weightage of 4-5 marks covering the entire syllabus.
3. The remaining five questions will be based on all the modules of entire syllabus. For this, the module shall be divided proportionately and further, the weightage of the marks shall be judiciously awarded in proportion to the importance of the sub-module or contents thereof.
4. The students will have to attempt **any three** questions out of remaining five questions.
5. Total **four** questions need to be attempted.

List of Experiments: *(At least six to be performed)*

1. Impact of jet on flat plate
2. Impact of jet on flat inclined plate
3. Impact of jet on curved plate
4. Performance of Pelton wheel- full gate opening
5. Performance of Pelton wheel- half gate opening
6. Performance of Centrifugal pumps
7. Performance of Kaplan turbine
8. Performance of Francis turbine
9. Hydraulic ram
10. Pumps in series
11. Pumps in parallel

Term Work:

The term-work shall comprise of the neatly written report based on the afore-mentioned experiments and the assignments. The assignments shall comprise of minimum 15 problems covering the entire syllabus divided properly and module wise.

Distribution of Term Work Marks:

The marks of the term work shall be judiciously awarded for the various components depending upon the quality of the term work. The final certification and acceptance of term work warrants the satisfactory performance of the experiments in the laboratory, appropriate completion of the report thereof along with that of assignments; and the minimum passing marks to be obtained by the student. The following weightage of marks shall be given for different components of the term work.

- Report of the Experiments: 10 Marks
- Assignments : 10 Marks
- Attendance : 05 Marks

Further, while giving weightage of marks on the attendance, following guidelines shall be resorted to.

- 75%- 80% : 03 Marks; 81%- 90%: 04 Marks; 91% onwards: 05 Marks

Recommended Books:

1. Hydraulics and Fluid Mechanics: *Dr. P. M. Modi and Dr. S. M. Seth*, Standard Book House, Delhi.
2. Fluid Mechanics and Hydraulics: *Dr. S. K. Ukarande*, Ane's Books Pvt. Ltd. (Revised Ed.2012), ISBN 97893 81162538
3. Theory Application of Fluid Mechanics: *K. Subramanya*, Tata Mc-Graw Hill publishing Company, New Delhi.
4. Fluid Mechanics and Fluid Power Engineering: *Dr. D. S. Kumar*, S. K. Kataria and Sons.
5. Fluid Mechanics: *Dr. A. K. Jain*, Khanna Publishers.
6. Fluid Mechanics: *Dr. R. K. Bansal*, Laxmi Publications Ltd., New Delhi

Reference Books:

7. Fluid Mechanics Fundamentals Applications, *Yunus A. Cengel & John M. Cimbala*, Tata Mc-Graw Hill Education Private Limited, New Delhi.
8. Fluid Dynamics: *Daiy Harleman*; Addition Wesley, New York, 1973.
9. Fluid Mechanics: *R.A. Granger*; Dover Publications, New York, 1995.

Semester V

Course Code	Subject Name	Credits
CE-C505	Transportation Engineering – I	05

Teaching Scheme

Contact Hours			Credits Assigned			
Theory	Practical	Tutorials	Theory	Practical	Tutorials	Total
04	-	02	04	-	01	05

Evaluation Scheme

Theory			Term Work/Practical/Oral			Total		
Internal Assessment			End Sem Exam	Duration of End Sem Exam	TW		PR	OR
Test I	Test II	Average						
20	20	20	80	03Hrs	25	-	-	125

Rationale

Transportation contributes to the economical, industrial, social and cultural development of any country. The adequacy of transportation system of a country indicates its economic and social development. Three basic modes of transportation include land, water and air. The land mode further includes highways and railways. This course is developed so as to impart the basic principles behind railway engineering, airport engineering and water transportation engineering in respect of various types of materials used, function of component parts, methods of construction, planning principles, aspects of supervision and maintenance.

Objectives

- To enable the students to study the various elements pertaining to air transportation, water transportation, railway transportation.
- To study the various components of railway track, materials used functions of component parts.

- To study the various imaginary surfaces of an airport, geometric standards, runway and taxiway lighting.
- To study the various parking system, holding apron, hangars and drainage system.
- To study the various modes of water transportation, types of breakwater, harbours and port facilities equipment.
- To study the various aspects of jetties, wharves, piers, dolphins, fenders, buoyancy etc.

Detailed Syllabus

Module	Sub Modules/Contents	Periods
01	<p>Introduction:</p> <p>Role of transportation in Society, objectives of transportation system, different types of modes, planning coordination of different modes for Indian conditions.</p>	03
02	<p>Railway Engineering</p> <p>i Role of Indian Railways in national development-Railways for urban transportation-Engineering surveys for track alignment-Obligatory points-Conventional modern methods(Remote sensing, GIS)</p> <p>ii Permanent way-track components their functions, sleeper – functions types, sleeper density, ballast functions different ballast materials.</p> <p>iii Rails: coning of wheels tilting of rails, rail cross sections, wear creep of rails, rail fastenings.</p> <p>iv Geometrics: gradients, transition curves, widening of gauge on curves, cant deficiency.</p> <p>v Points crossing: design of turnouts, description of track junctions, different types of track junctions.</p> <p>vi Yards: details of different types of railway yards their functions.</p> <p>vii Signaling and interlocking: classification of signals, interlocking of signals points, control of train movement.</p> <p>viii Construction and maintenance of railway track, methods of construction, material requirements, maintenance of tracks traffic operations.</p>	19

	ix Modernization of track railway station for high speed trains special measures for high speed track.	
03	<p>Airport Engineering</p> <ul style="list-style-type: none"> i Aircraft component parts and its function, aircraft characteristics, their influence on airport planning. ii Airport planning: topographical and geographical features, existing airport in vicinity, air traffic characteristics, development of new airports, factors affecting airport site selection. iii Airport obstruction: zoning laws, classification of obstructions, imaginary surfaces, approach zones, turning zones. iv Airport layout: runway orientation, wind rose diagrams, basic runway length, corrections for runway length, airport classification, geometric design, airport capacity, runway configuration, taxiway design, geometric standards, exit taxiways, holding aprons, location of terminal buildings, aircraft hangers parking. v Airport marking, lighting, marking, lighting of runways, taxiway, approach other areas. vi Terminal area and airport layout: terminal area, planning of terminal buildings, apron: size of gate position, number of gate position, aircraft parking system, hanger, general planning considerations blast considerations. vii Air traffic control: Air traffic control aids, en-route aids, ling aids. viii Airport drainage: requirement of airport drainage, design data, surface drainage design. ix Airport airside capacity delay: runway capacity delays, practical hourly capacity, practical annual capacity, computation of runway system, runway gate capacity, taxiway capacity. x Air traffic forecasting in aviation: forecasting methods, forecasting requirement applications. 	21
04.	<p>Water Transportation</p> <p>Introduction of water transportation system, harbors docks, port facilities.</p>	05

Contribution to Outcomes

On successful completion of this course, the students shall be able to:

1. Understand the knowledge of various systems of railway, airport and water transportation.
2. Understand the design concept of railway track, runway, taxiways, etc.
3. Apply the concept of geometric design of railway track, runway, taxiway, etc.
4. Apply the knowledge of various signaling system for railway engineering, air traffic control navigational aids.

Theory Examination:

1. Question paper will comprise of **six** questions; each carrying 20 marks.
2. The **first** question will be **compulsory** which will have the short questions having weightage of 4-5 marks covering the entire syllabus.
3. The remaining **five** questions will be based on all the modules of entire syllabus. For this, the module shall be divided proportionately and further, the weightage of the marks shall be judiciously awarded in proportion to the importance of the sub-module contents thereof.
4. There can be an **internal** choice in various questions/ sub-questions in order to accommodate the questions on all the topics/ sub-topics.
5. The students will have to attempt any **three** questions out of remaining five questions.
6. Total **four** questions need to be attempted.

Site Visit:

The visit to any two principal components of the modes of transportation engineering (Airports/ Railways/ Docks and Harbors) involved in this subject may be arranged. The students shall prepare a report based on these visits and shall submit it as a part of the term work.

Term Work:

The term-work shall comprise of the neatly written report of the assignments and the report of the site visit. The assignments shall be given covering the entire syllabus in such a way that the students would attempt at least four problems on each modules/ sub-modules contents thereof further. There shall be theory questions as well.

Distribution of Term-work Marks

The marks of the term-work shall be judiciously awarded depending upon the quality of the term work including that of the report on assignments. The final certification and acceptance of term-work warrants the satisfactory and the appropriate completion of the assignments; and the minimum passing marks to be obtained by the students. The following weightage of marks shall be given for different components of the term work.

- Assignments : 15 Marks
- Report of the site visit : 05 Marks
- Attendance : 05 Marks

Further, while giving weightage of marks on the attendance, following guidelines shall be resorted to.

- 75%- 80% : 03 Marks; 81%- 90%: 04 Marks; 91% onwards: 05 Marks

Text Books:

1. A Course of Railway Engineering: *Saxena, S. C. and Arora, S. P.*; Dhanpat Rai and Sons, New Delhi.
2. Airport Planning Design: *Khanna, S.K., Arora, M.G. and Jain, J.J.*; *Nem Chand and Bros., Roorkee.*
3. Docks and Harbour Engineering: *Bindra, S. P.*; Dhanpat Rai and Sons, New Delhi.
4. Principles and Practice of Bridge Engineering: *Bindra, S.P.*; Dhanpat Rai and Sons, New Delhi.
5. Harbour, Dock and Tunnel Engineering: *Shrinivas, R.*; Chrotar Publishing House, Anand
6. A Text Book on Highway Engineering and Airports: *Sehgal, S. E. and Bhanot, K. L., S. Chand and Co. Ltd., New Delhi*
7. Airport Engineering: *Rao, G. V.*, Tata Mc-Graw Hill India Publishing House, New Delhi

Reference Books:

1. Indian Railway Track: *Agarwal, M. M.*, Suchdeva Press New Delhi.
2. Planning Design of Airport: *Horonjeff Mckelrey*, Tata Mc-Graw, Hill India Publishing House, New Delhi.
3. Design and Construction of Ports and Marine Structures: *Quinn, A. D.*, Tata Mc-Graw Hill India Publishing House

Semester V

Course Code	Subject Name	Credits
CE-C506	Business and Communication Ethics	2

Teaching Scheme

Contact Hours			Credits Assigned			
Theory	Practical	Tutorials	Theory	Practical	Tutorials	Total
-	4	-	-	2	-	2

Evaluation Scheme

Theory			Term Work/Practical/Oral			Total	
Internal Assessment			TW	PR	OR		
Test I	Test II	Average				End Sem Exam	Duration of End Sem Exam
-	-	-	-	25	-	25	50

Rationale

With the advancement in technology and diverse need of the corporate world, proficiency in English and communication is considered essential for the student's personal and professional growth. Also it is necessary to equip with desired qualities required in an employee and provide tips for achieving success in interviews. The exposure to various interpersonal skills helps to make a conscious attempt of how to communicate and improve one's personality.

Course Pre-requisite:

- FEC206 Communication Skills

Objectives

- To inculcate in students professional ethical attitude, effective communication skills, teamwork, skills, multidisciplinary approach an ability to understand engineer's social responsibilities.

- To provide students with an academic environment where they will be aware of the excellence, leadership lifelong learning needed for a successful professional career.
- To inculcate professional ethics codes of professional practice
- To prepare students for successful careers that meets the global Industrial Corporate requirement' provide an environment for students to work on Multidisciplinary projects as part of different teams to enhance their team building capabilities like leadership, motivation, teamwork etc.

Detailed Syllabus

Module	Sub Modules/Contents	Periods
1.	Report Writing	08
	1.1 Objectives of report writing	
	1.2 Language Style in a report	
	1.3 Types of reports	
	1.4 Formats of reports: Memo, letter, project survey based	
2.	Technical Proposals	02
	2.1 Objective of technical proposals	
	2.2 Parts of proposal	
3.	Introduction to Interpersonal Skills	08
	3.1 Emotional Intelligence	
	3.2 Leadership	
	3.3 Team Building	
	3.4 Assertiveness	
	3.5 Conflict Resolution	
	3.6 Negotiation Skills	
	3.7 Motivation	
	3.8 Time Management	

4.	Meetings Documentation		02
	4.1	Strategies for conducting effective meetings	
	4.2	Notice	
	4.3	Agenda	
	4.4	Minutes of the meeting	
5.	Introduction to Corporate Ethics etiquettes		02
	5.1	Business Meeting etiquettes, Interview etiquettes, Professional work etiquettes, Social skills	
	5.2	Greetings Art of Conversation	
	5.3	Dressing Grooming	
	5.4	Dinning etiquette	
	5.5	Ethical codes of conduct in business corporate activities (Personal ethics, conflicting values, choosing a moral response, the process of making ethical decisions)	
6.	Employment Skills		06
	6.1	Cover letter	
	6.2	Resume	
	6.3	Group Discussion	
	6.4	Presentation Skills	
	6.5	Interview Skills	

Contribution to Outcomes

On successful completion of the students, the students will be able to:

1. Communicate effectively in both verbal written form demonstrate knowledge of professional ethical responsibilities
2. Participate succeed in Campus placements competitive examinations like GATE, CET.
3. Possess entrepreneurial approach ability for life-long learning.

4. Able to have education necessary for understanding the impact of engineering solutions on Society demonstrate awareness of contemporary issues

Reference Books:

1. Organizational Behaviour: *Fred, Luthans*; Mc-Graw Hill
2. Report Writing for Business: *Lesiker, Petit*; Mc-Graw Hill
3. Technical Writing Professional Communication: *Huckin, Olsen*; Mc-Graw Hill
4. Personal Development for Life Work: *Wallace Masters*, Thomson Learning, 12thEd.
5. Effective Business Communication: *Heta, Murphy*, Mc-Graw Hill
6. Business Correspondence Report Writing: *Sharma, R. C. and Krishna Mohan*
7. Managing Soft Skills for Personality Development: *Ghosh, B. N.*, Tata Mc-Graw Hill
8. BCOM: *Sinha*, Cengage Learning (2ndEd.)
9. Management Communication: *Bell, Smith*; Wiley India Edition (3rd Ed.)
10. Handbook for Technical Writing: *McMurrey, David A. and Buckley, Joanne*, CENGAGE Learning
11. Soft Skills: *Dr. Alex, K.*; S. Chand Co. Ltd.

Oral Examination:

The oral examination shall be based upon the entire syllabus and the report of the assignments prepared by the students. The oral examination shall be conducted by the internal examiner/s.

Term Work:

The term work shall be comprised of the neatly written report comprising below-mentioned assignments.

List of Assignments for Term Work:

- Assignment 1- Report Writing (Synopsis or the first draft of the Report)
- Assignment 2- Technical Proposal (Group activity, document of the proposal)
- Assignment 3- Interpersonal Skills (Group activity Role play)
- Assignment 4- Interpersonal Skills (Documentation in the form of soft copy or hard copy)
- Assignment 5- Meetings Documentation (Notice, Agenda, Minutes of Mock Meetings)
- Assignment 6- Corporate ethics etiquettes (Case study, Role play)
- Assignment 7- Cover Letter Resume

Assignment 8- Printout of the PowerPoint presentation

Distribution of Term-Work Marks

The marks of term-work shall be judiciously awarded depending upon the quality of the term work. The final certification and acceptance of the term-work warrants the satisfactory and the appropriate completion of the assignments; and the minimum passing marks to be obtained by the students. The following weightage of marks shall be given for different components of the term work.

- Assignments : 20 Marks
- Attendance : 05 Marks

Further, while giving weightage of marks on the attendance, following guidelines shall be resorted to.

- 75%- 80% : 03 Marks; 81%- 90%: 04 Marks; 91% onwards: 05 Marks

Distribution of Marks on Oral Examination:**

The marks meant for oral examination will be distributed as below:

- Presentation of the Project Report: 15 Marks
- Group discussion: 10 Marks

Semester VI

Course Code	Subject Name	Credits
CE-C601	Geotechnical Engineering – II	05

Teaching Scheme

Contact Hours			Credits Assigned			
Theory	Practical	Tutorial	Theory	Practical	Tutorial	Total
04	02	-	04	01	-	05

Evaluation Scheme

Theory			Term work / Practical / Oral			Total		
Internal Assessment			End Sem	Duration of	TW	PR	OR	
Test 1	Test 2	Average	Exam	End Sem Exam				
20	20	20	80	03 Hrs.	25	-	25	150

Rationale

The basic knowledge of the analysis and design foundation in the context of geotechnical engineering is very important for the civil engineering students. The subject provides the power of analyzing the laboratory and field experiments, their results and further, its suitability in the analysis and design of geotechnical projects. The stability and suitability of foundation plays the important role in the field of civil engineering.

Objectives

- To understand the concepts of the stability of slopes and study various methods of evaluating the stability of slopes.
- To understand the importance and basics of foundation engineering in the civil engineering projects.

- To study the classical theories of earth pressure, load bearing capacity and settlement of foundations.
- To study the geotechnical aspects of foundations in view of safety and economy.
- To study the braced cuts and underground conduits.
- To understand the concept of reinforced soil.
- To understand the use of various BIS codes in the geotechnical design of foundation

Detailed Syllabus

Module	Sub Modules/Contents	Periods
1.	<p>Stability of Slopes</p> <ul style="list-style-type: none"> i. Introduction, Types of slope failures, Different factors of safety, Analysis of infinite and finite slopes: ii. Analysis of infinite slopes in cohesionless, cohesive and cohesive-frictional soil under dry, submerged and steady seepage along slope conditions. iii. Analysis of finite slopes- planar failure plane (wedge failure) and circular failure plane by Swedish circle method, friction circle method, stability numbers and charts. 	05
2.	<p>Lateral earth pressure theories</p> <ul style="list-style-type: none"> i. Introduction, Concept of lateral earth pressure based on vertical and horizontal stresses, At rest, active and passive state of soil. ii. Earth retaining structures: Rigid and flexible types, mechanically stabilized retaining wall. iii. Rigid retaining wall: Failure planes in back fill for active and passive condition; Classical earth pressure theories by Rankine and Coulomb. iv. Rankine's lateral earth pressure theory: active and passive earth pressure for horizontal and inclined backfill for cohesionless and cohesive soils. v. Coulombs wedge theory: active and passive lateral earth pressure conditions (no proof). vi. Graphical methods: Rebhann's construction for active pressure, Culmann's method for active pressure, Friction circle method for 	10

	passive pressure in cohesion less and cohesive soils.	
3.	Earth Retaining Structures: <ol style="list-style-type: none"> i. Stability analysis of rigid retaining walls. ii. Cantilever sheet piles (no anchors) in cohesion-less and cohesive soils: lateral earth pressure diagram, computation of embedment depth. 	05
4.	Bearing Capacity of Shallow Foundation <ol style="list-style-type: none"> i. Definitions: Ultimate bearing capacity, safe bearing capacity and allowable bearing pressure, types of shallow foundations, Bearing capacity estimation by theoretical and field methods : ii. Theoretical methods: Terzaghi's Theory: Assumptions, zones of failure, concept behind derivation of general bearing capacity equation, modes of failure, ultimate bearing capacity in case of local shear failure, factors influencing bearing capacity, limitations of Terzaghi's theory. Bearing capacity for different geometries: square, rectangle and circular footings, effect of water table on bearing capacity. iii. Vesic's Theory: Bearing capacity equation. iv. IS Code Method: Bearing capacity equation. v. Field Methods: vi. Standard Penetration Test: Estimation of bearing capacity from corrected SPT "N". vii. Field plate load test based on IS: 1888: Estimation of bearing capacity, footing size and settlement. 	12

<p>5.</p>	<p>Axially Loaded Pile Foundations:</p> <ul style="list-style-type: none"> i. A) Introduction to deep foundations, Necessity of pile foundation, Construction methods of bored and driven piles, types of pile foundations. ii. Pile capacity estimation in Cohesion-less and Cohesive soil: Single pile: <ul style="list-style-type: none"> a) Static methods, b) Dynamic methods, c) In-situ Penetration Test (SCPT) and d) Pile load test as per IS: 2911. iii. Pile Groups : <ul style="list-style-type: none"> a) Ultimate Capacity b) Settlement of pile group in cohesion-less and cohesive soils as per IS 2911. 	<p>07</p>
<p>6.</p>	<p>Underground Conduits:</p> <p>Types of underground conduits, load on ditch conduit, positive and negative projecting conduits, settlement ratio, plane of equal settlement, ditch and projection condition, imperfect ditch conduit (no proofs).</p>	<p>02</p>
<p>7.</p>	<p>Open Cuts:</p> <ul style="list-style-type: none"> i. Difference in open cut and retaining wall theories, apparent earth pressure diagram, ii. Average apparent earth pressure diagram for cohesion-less and cohesive soils. iii. Estimation of strut loads in braced cuts placed in cohesion-less and cohesive soils. 	<p>02</p>
<p>8.</p>	<p>Reinforced Soils:</p> <ul style="list-style-type: none"> i) Reinforcing materials: metal strips, geotextiles, geogrids, geocells, mechanism of soil- reinforcement interaction. ii) Physical, mechanical, hydraulic, degradation and endurance properties of geotextiles. iii) Applications areas of reinforced soil: <ul style="list-style-type: none"> a) Mechanically stabilized retaining wall: Stability analysis of mechanically 	<p>05</p>

	<p>stabilized (metallic strip and geotextile) retaining wall.</p> <p>b) Geotextile as roadway reinforcement: concept of load distribution in pavement with and without geotextile.</p> <p>c) Geotextile reinforced embankment: Embankment on soft foundation and potential embankment failure modes.</p>	
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Contribution to Outcomes

On successful completion of the course, the students shall have the:

- Ability to apply the principle of shear strength and settlement analysis for foundation system.
- Ability to design shallow and deep foundations
- Ability to analyze and design earth retaining structures.
- Ability to analyze load carrying capacity of conduits and open cuts.
- Ability to understand the concepts of reinforced soil and its application in the field.

Theory Examination:

1. Question paper will comprise of **six** questions; each carrying 20 marks.
2. The **first** question will be **compulsory** which will have the short questions having weightage of 4-5 marks covering the entire syllabus.
3. The remaining **five** questions will be based on all the modules of entire syllabus. For this, the module shall be divided proportionately and further, the weightage of the marks shall be judiciously awarded in proportion to the importance of the sub-module contents thereof.
4. There can be an **internal** choice in various questions/ sub-questions in order to accommodate the questions on all the topics/ sub-topics.
5. The students will have to attempt any **three** questions out of remaining five questions.
6. Total **four** questions need to be attempted.

Oral Examination:

The oral examination shall be based upon the entire syllabus and the term work comprising the report of the experiments performed in the laboratory and assignments.

List of Practical: (*At least five to be conducted*)

1. Determination of Pre-consolidation pressure coefficient of consolidation from one dimensional consolidation Test.
2. Determination of shear parameters form unconsolidated undrained tri-axial compression test.
3. Determination of shear parameters from direct shear Test.
4. Determination of cohesion from unconfined compression test.
5. Determination of CBR value from CBR Test.
6. Determination of shear strength of soft clays from vane shear test
7. Determination of swelling pressure of clays.

Term Work:

The term work shall comprise of the neatly written report based on the afore-mentioned experiments and the assignments. The assignments shall comprise of the minimum 15 problems based on the above syllabus, distributed as far as evenly so as to cover all the modules/ sub-modules.

Distribution of Term Work Marks:

The marks of the term work shall be judiciously awarded for the various components depending upon the quality of the term work. The final certification and acceptance of term work warrants the satisfactory performance of the experiments by the student, appropriate completion of the report thereof along with that of assignments; and the minimum passing marks to be obtained by the student. The following weightage of marks shall be given for different components of the term work.

- Report of the Experiments: 10 Marks
- Assignments : 10 Marks
- Attendance : 05 Marks

Further, while giving weightage of marks on the attendance, following guidelines shall be resorted to.

- 75%- 80% : 03 Marks; 81%- 90%: 04 Marks; 91% onwards: 05 Marks

Recommended books:

1. Soil Engineering in Theory and Practice: *Alam Singh*; CBS Publishers Distributors, New Delhi.
2. Soil Mechanics and Foundation Engineering: *V. N. S. Murthy*; Saitech Publications

3. Soil Mechanics and Foundation Engineering: *K. R. Arora*; Standard Publishers and Distributors, New Delhi.
4. Geotechnical Engineering: *C. Venkatramaiah*; New Age International.
5. Fundamentals of Soil Engineering: *D. W. Taylor*; John Wiley and sons.
6. An Introduction to Geotechnical Engineering: *R. D. Holtz*; Prentice Hall, New Jersey.
7. Soil Mechanics: *R. F. Craig*; Chapman and Hall.
8. Soil Mechanics: *T. W. Lambe and R. V. Whitman*; John Wiley and Sons.
9. Theoretical Soil Mechanics: *K. Terzaghi*; John Wiley and Sons.
10. Designing with Geosynthetics: *R. M. Koerner*; Prentice Hall, New Jersey.
11. An Introduction to Soil Reinforcement and Geosynthetics: *G. L. Sivakumar Babu*; Universities Press.
12. Geosynthetics- An introduction: *G. Venkatappa Rao*; SAGES.
13. Relevant Indian Standard Specifications Code: BIS Publications, New Delhi

Semester VI

Course Code	Subject Name	Credits
CE – C 602	Design and Drawing of Steel Structures	05

Teaching Scheme

Contact Hours			Credits Assigned			
Theory	Practical	Tutorial	Theory	Practical	Tutorials	Total
04	02	-	04	01	-	05

Evaluation Scheme

Theory			Term Work/ Practical/Oral			Total		
Internal Assessment		End Sem Exam	Duration of End Sem Exam	TW	PR		OR	
Test	Test					Average		
20	20	20	80	04 Hrs.	25	-	25	150

Rationale

There are various types of the civil engineering structures which are subjected to various types of loading and their combination. Most of the structures are made up of steel. These structures are designed by the working stress method limit state method. The design method of different component is given in the syllabus and is based on limit state method.

Objectives

- To understand the design concept of design of tension compression member
- To understand the design concept of laterally supported unsupported beams
- To understand the concept of plastic analysis of simple beam
- To understand the design concept of welded plate girder

Detailed Syllabus

Module	Sub – Modules / Contents	Periods
I	<p>Introduction to Steel Structure</p> <p>Introduction to type of steel, mechanical properties of Structural steel, advantages of steel as structural material, design philosophies of Working Stress Method (WSM)</p>	02
II	<p>Introduction to Limit State Method</p> <p>Limit state Method, limit state of strength serviceability (deflection, vibration, durability, fatigue, fire) characteristics, partial safety factor design loads, partial safety factor for material. Structural steel section .Classification of cross section-plastic, compact, semi-compact slender, limiting with to thickness ration.</p>	03
III	<p>Simple Connection Bolted Welded</p> <p>Introduction to bolted welded connection by working stress method limit state method, Type of bolts, advantage of bolts & welds simple connection for bolted welded connection.</p>	05
IV	<p>Tension Members</p> <p>Design of tension members with welded /bolted end connection using single angle section double angle section by Limit State Method, design strength due to yielding of gross section, rupture of critical section block shear.</p>	04
V	<p>Compression Members as Struts</p> <p>Design of compression members as struts with welded/bolted end connection using single angle section double angle section by Limit State Method ,effective length of compression members, buckling class of various cross sections, limiting values of effective slenderness ratio.</p>	04
VI	<p>Compression Member as Column</p> <p>Design of column with single built-up section, design of lacing batten plates with bolted welded connection using Limit State Method, column buckling curves, effective length of compression members, buckling class of various</p>	06

	cross sections, limiting values of effective slenderness ratio,	
VII	Column Bases	03
	Design of slab base gusseted base using bolted welded connection by Limit State Method,	
VIII	Design of Member subjected to Bending	06
	Design of member subjected to bending by Limit State Method ,design strength in bending, effective length, design strength of laterally supported beams in bending, design strength of laterally unsupported beams, single built-up rolled steel section using bolted welded connection, shear strength of steel beam, web buckling web crippling ,shear lag effect	
XI	Bracket Connection Beam to Column Connection	05
	Bolted welded connection by Limit State Method, beam to beam, beam to column connection (simple frame connection, unstiffened stiffened seat connections.	
XII	Design of Trusses	04
	Determinate truss, imposed load on sloping roof, wind load on sloping roof vertical cladding including effect of permeability wind drag, analysis of pin jointed trusses under various loading cases, design detailing of member end connection support, design of purlin's , wind bracing for roof system.	
XIII	Design of Welded Plate Girder	06
	Introduction of plate girder , design of plate girder using IS 800 provision, load bearing stiffeners, vertical stiffeners, horizontal stiffener	

Contribution to Outcomes

On completion of this course, the students will be able to understand the design of tension member, compression member, laterally supported beam laterally un-supported beam by limit state method. They will be able to design truss. The students will be able to independently design steel structures using relevant IS codes.

Theory Examination:-

1. Question paper will comprise of **five** questions.
2. The first question will be **compulsory** which will carry **32** marks. This will be based on the projects.
3. The remaining **four** questions will be based on rest of the modules in the syllabus and will carry 16 **marks** each. For this, the module shall be divided proportionately and further, the weightage of the marks shall be judiciously awarded in proportion to the importance of the sub-module contents thereof.
4. There can be an **internal** choice in various questions/ sub-questions in order to accommodate the questions on all the topics/ sub-topics.
5. The students will have to attempt **any three** questions out of **remaining** four questions.
6. Total **four** questions need to be attempted.

Oral Examination:

The oral examination shall be conducted in conjunction with the sketching examination and it will be based upon the entire syllabus; and the term work consisting of the assignments, projects including drawing sheets thereof.

Term Work:

The Term work shall consists of a neatly written Design Report including Detail Drawings on any of the two projects as indicated below:

1. Roofing system including details of supports
2. Flooring system including column.
3. Welded plate girder

The drawing should be drawn in pencil only on minimum of A-1 (imperial) size drawing sheets. In addition, the term work shall consist of the neatly written assignments covering the remaining syllabus.

Distribution of Term Work Marks:

The marks of the term work shall be judiciously awarded for the various components depending upon the quality of the term work. The final certification and acceptance of term work warrants the satisfactory performance of drawing work by the student, appropriate completion of the report on the

said drawing sheets; and the minimum passing marks to be obtained by the student. The following weightage of marks shall be given for different components of the term work.

- Design Report and Drawing : 10 Marks
- Assignments : 10 Marks
- Attendance : 05 Marks

Further, while giving weightage of marks on the attendance, following guidelines shall be resorted to.

- 75%- 80% : 03 Marks; 81%- 90%: 04 Marks; 91% onwards: 05 Marks

Recommended Books:

1. Design of Steel Structures: *N Subramanian*, Oxford- University Press.
2. Limit State Design of Steel Structures: *V. L. Shah and Veena Gore*, Structures Publication, Pune.
3. Design of Steel Structures: *Duggal, S.K.*, Tata Mc-Graw Hill India Publishing House
4. Design of Steel Structures: *Sairam, K.S.*, Pearson
5. Limit State Design in Structural Steel: *Shiyekar, M.R.*, PHI Publishing House
6. Design of Steel Structures (By Limit State Method as per IS: 800-2007): *Bhavikatti, S.S.*, I.K. International Pvt. Ltd.
7. Limit State Design of Steel Structures: *Dr. Ramchandra and Gahlot, Virendra*, Scientific Publishers (India)

Reference Books:

1. LRFD Steel Design: *William T. Segui*, PWS Publishing
2. Design of Steel Structures: *Edwin H. Gaylord, Charles N. Gaylord James, Stallmeyer*, Mc-Graw-Hill
3. Design of Steel Structures: *Mac. Ginely T.*
4. Design of Steel Structures: *Dayaratnam*, Wheeler Publications, New Delhi.
5. Design of Steel Structures: *Punamia, A. K. Jain and Arun Kumar Jain*, Laxmi Publication
6. Design of Steel Structures: *Kazimi S. M. and Jindal R. S.*, Prentice Hall India.
7. Design of Steel Structures: *Breslar, Lin Scalzi*, John Willey, New York.
8. Design of Steel Structures: *Aryaand Ajmani*, Nem Chand and Bros., Roorkee
9. Structural Design in Steel: *Sarwar AlamRaz*; New Age International Publsiher
10. Relevant Indian Secifications, Bureau of Indian Specifications, New Delhi.

Semester VI

Course Code	Subject Name	Credits
CE-C603	Applied Hydraulics – II	04

Teaching Scheme

Contact Hours			Credits Assigned			
Theory	Practical	Tutorial	Theory	Practical	Tutorials	Total
03	02	--	03	01	--	04

Evaluating scheme

Theory			Term Work/ Practical/Oral			Total		
Internal Assessment			End Sem Exam	Duration of End Sem exam	TW	PR	OR	
Test 1	Test 2	Average						
20	20	20	80	03 Hrs	25	--	25	150

Rationale

The applied hydraulics in civil engineering is essential to design most efficient open channel. The course also deals with design of irrigation channels, boundary layer formation flow around submerged bodies.

Objectives

- To compute slope of a channel
- To calculate rate of flow in a channel
- To compute wetted perimeter hydraulic radius of open channel flow
- To identify normal depth in an open channel
- To compute critical depth of a an open channel
- To use Manning's equation
- To design irrigation channel.

Detailed Syllabus

Module	Sub – Modules / Contents	Periods
1.	<p>Boundary layer theory:</p> <p>Development of boundary layer over flat curved surfaces, laminar I turbulent boundary layer. boundary layer thickness, displacement thickness, momentum thickness, energy thickness, drag force on a flat plate due to a boundary layer, turbulent boundary layer on a flat plate, analysis of turbulent boundary layer, total drag on a flat plate due to laminar turbulent boundary layer, boundary layer separation control.</p>	5
2.	<p>Flow around submerged bodies:</p> <p>Force exerted by a flowing fluid on a stationary body, expression for drag lift, drag on a sphere, terminal velocity of a body, drag on a cylinder. Development of a lift on a circular cylinder, development of a lift on an airfoil.</p>	5
3.	<p>Flow through open channel:</p> <p>i. Classification.</p> <p>ii. Uniform flow, Chezy's formula. Manning's formula, Prismatic non-prismatic channels, hydraulically efficient channel cross-section, Velocity distribution in open channels, and pressure distribution in open channels. Applications of Bernoulli's equation to open channel flow.</p> <p>iii. Non— uniform flow. Specific energy, Discharge curve, Dimensionless specific energy discharge curve, applications of specific energy. Mom rum principle, application to open channel flow, specific force. Small waves surges in open channels. Gradually varied flow. Surface profiles. Control section. Hydraulic jumps location of hydraulic jump.</p>	17
4.	<p>Fluvial Hydraulics:</p> <p>Kennedy's theory, Kennedy's methods of channel designs silt supporting capacity according to Kennedy's theory. Drawbacks in Kenned' % theory Lacey's regime theory, Lacey's theory applied to channel design. Comparison of Kennedys Lace 'S theory defects in Lacey's theory. Introduction to Sediment transport in channels.</p>	9

Contribution to Outcomes

On completion of this course the student will be able to:

1. Develop the understanding of the flow phenomena (e.g. hydraulic jump, backwater waves, critical depth, etc.) using experiments.
2. Understand the impact of engineering solutions for boundary layer theory in the context of submerged bodies.
3. Develop the understanding of the design and measurement of flow velocity in open channel.
4. Understand the different slope profiles and its effect on the flow characteristics
5. Study the specific energy and its applications

Theory Examination:-

1. Question paper will comprise of **six** questions; each carrying 20 marks.
2. The **first** question will be **compulsory** which will have the short questions having weightage of 4-5 marks covering the entire syllabus.
3. The **remaining five** questions will be based on all the modules of entire syllabus. For this, the module shall be divided proportionately and further, the weightage of the marks shall be judiciously awarded in proportion to the importance of the sub-module contents thereof.
4. The students will have to attempt **any three** questions **out** of **remaining five** questions.
5. Total **four** questions need to be attempted.

Oral Examination:

The oral examinations shall be based on the entire syllabus, the report of the experiments conducted by the students including assignments.

List of Experiments: (At least Six)

1. Determine Chazys roughness factor
2. Determination of gradually varied flow
3. Study of Hydraulic jump and its characteristics.
4. Calibration venture flume
5. Calibration of sting wave flume
6. Determination of mean velocity of flow in open channel.

7. Studies in wind Tunnel
8. Calibration of Broad crested
9. Calibration of submerged weir

Term Work:

The term-work shall comprise of the neatly written report based on the afore-mentioned experiments and the assignments. The assignments shall comprise of minimum 15 problems covering the entire syllabus divided properly and module wise.

Distribution of Term Work Marks:

The marks of the term work shall be judiciously awarded for the various components depending upon the quality of the term work. The final certification and acceptance of term work warrants the satisfactory performance of the experiments by the student, appropriate completion of the report thereof and that of assignments; and further the minimum passing marks to be obtained by the student. The following weightage of marks shall be given for different components of the term work.

- Report of the Experiments: 10 Marks
- Assignments : 10 Marks
- Attendance : 05 Marks

Further, while giving weightage of marks on the attendance, following guidelines shall be resorted to.

- 75%- 80% : 03 Marks; 81%- 90%: 04 Marks; 91% onwards: 05 Marks

Recommended Books:

1. Hydraulics and Fluid Mechanics: *P. M. Modi and S. M. Seth*; Standard Book House, Delhi.
2. Fluid Mechanics and Hydraulics: *Dr. S. K. Ukarande*, Ane's Books Pvt. Ltd. (Revised Edition 2012), ISBN 97893 81162538
3. Theory and Application of Fluid Mechanics: *K. Subramanya*; Tata McGraw Hill India Publishing Company, New Delhi.
4. Fluid Mechanics and Fluid Power Engineering: *D. S. Kumar*; S. K. Kataria and Sons.
5. Fluid Mechanics: *A. K. Jain*; Khanna Publishers.
6. Fluid Mechanics: *R. K. Bansal*; Laxmi Publications Pvt. Ltd.

7. Fluid Mechanics: Fundamentals and Applications: *Yunus A. Cengel John M. Cimbala*, Tata Mc-Graw Hill Education Private Limited, New Delhi.
8. Fluid Dynamics: *Daiy Harleman*, Addition Wesley, New York, 1973.
9. Fluid Mechanics: *R.A. Granger*; Dover Publications, New York, 1995.
10. Flow in Open Channels: *Subramanya K.*; Tata Mc-Graw Hill Publishing House Pvt. Ltd.
11. Irrigation and Water Power Engineering: *B. C. Purnnia.*; Standard Publishers, New Delhi

Semester VI

Course Code	Subject Name	Credits
CE-C604	Transportation Engineering. – II	05

Teaching Scheme

Contact Hours			Credits Assigned			
Theory	Practical	Tutorials	Theory	Practical	Tutorials	Total
04	02	-	04	01	-	05

Evaluation Scheme

Theory			Term Work/Practical/Oral			Total		
Internal Assessment			End Sem Exam	Duration of End Sem Exam	TW		PR	OR
Test I	Test II	Average						
20	20	20	80	03Hrs	25	-	25	150

Rationale

Transportation contributes to the economical, industrial, social and cultural development of any country. The adequacy of transportation system of a country indicates its economic and social development. Three basic modes of transportation include land, water and air. The land mode further includes highways and railways. The highways owing to its flexibility in catering door-to-door service are one of the important modes. This course deals with the investigation, planning, design, construction and maintenance of highways including urban roads. This course also deals with the traffic planning, operation and control. The bridges are the essential structures of highway and railway engineering. In view of this, the subject imparts the fundamental aspects of bridge engineering to the students.

Objectives

- To give insight of the development in the field of highway engineering right from inception up to construction and maintenance.
- To understand the principles of highway geometrics.
- To understand the concept of traffic planning, design, operation and control.
- To study the various materials required for pavement construction including their characterization
- To analyze the different types of pavements and subsequently, their design.
- To study the various methods of construction of different types of pavements.
- To study the functional and structural evaluation of existing pavements and methods to strengthen the distressed pavements.
- To study the fundamental concepts of bridge engineering including selection of site for bridge, different types of bridges, bridge hydrology and various components of bridge structures.

Detailed Syllabus

Module	Sub Modules/Contents	Periods
01	<p>Highway Planning</p> <p>i Classification of roads, brief history of road developments in India(Road development in India during twentieth and twenty first centuries), Twenty Year Road Development Plans (Nagpur, Bombay and Lucknow plans), National Highways Development Projects present status of roads in India, Pradhan Mantri Gram Sadak Yojana, Road Development Plan: Vision 2021 and Rural Road Development Plan: Vision 2015</p> <p>ii Highway alignment, basic requirement of ideal alignment, factors governing highway alignment</p> <p>iii Highway location survey, map study, reconnaissance, topographic surveys, highway alignment in hilly area, drawing report preparation</p>	04
02	<p>Geometric Design of Highways</p> <p>i Terrain classification, vehicular characteristics, highway cross section elements, salient dimensions, clearances, width of carriage way,</p>	09

	<p>shoulders, medians, width of road way, right of way, camber its profile.(IRC Standards)</p> <p>ii Design speed, sight distance, perception time, break reaction time, analysis of safe sight distance, analysis of overtaking sight distance, intersection sight distance</p> <p>iii Horizontal curves: design of super elevation, its provisions, minimum radius of horizontal curves, widening of pavement, transition curves.</p> <p>iv Gradients: different types, maximum, minimum, ruling exceptional, grade compensation in curves, vertical curves: design factors, comfort sight distance. Summit curve, valley curve.</p> <p>v Introduction of geometric design software.</p>	
03	<p>Pavement Materials:</p> <p>i Subgrade materials: desirable properties, modulus of elasticity, modulus of subgrade reaction, classification of subgrade soils, importance of CBR.</p> <p>ii Subbase material: desirable properties, different tests on aggregate, requirement of aggregate for different types of pavements.</p> <p>iii Bituminous materials: types of bituminous material, test on bituminous material, desirable properties, grade of bitumen</p>	04
04	<p>Pavement Design:</p> <p>i Types of pavements, different method of pavement design, comparison of flexible rigid pavements, design wheel load, equivalent single wheel load, equivalent wheel load factor,</p> <p>ii Flexible pavement design: GI method, IRC approach (IRC:37--1970; IRC:37- 1984; IRC: 37- 2001), Burmister's layers theory, introduction to AASHTO method</p> <p>iii Stress in rigid pavements, critical load position, stress due to load, stress due to temperature variation, combine loading temperature stress.; Analysis of rigid pavements for stresses using conventional formulae developed by various researchers and IRC Charts; Design of rigid pavements (IRC: 58- 1988; IRC: 58-2002; IRC: SP- 62-2004)</p> <p>iv Introduction to pavement design software, relationship between numbers of cumulative axle, strain value elastic modulus of materials.</p>	09

05	<p>Highway Construction</p> <p>i. Modern equipment for road construction, construction of different types of roads: water bound macadam (WBM) road, different types of bituminous pavements, cement concrete pavement.(As per IRC and MORTH specifications)</p> <p>ii. Constructions of stabilized roads: different method of soil stabilization, use of geo-textile and geogrid in highway subgrade.</p>	04
06	<p>Highway Maintenance and Rehabilitation</p> <p>i. Pavement failure: flexible pavement failure, rigid pavement failure, maintenance of different types of pavements.</p> <p>ii. Evaluation of pavements: structural evaluation of pavements, functional evaluation of pavement,</p> <p>iii. Strengthening of existing pavement: objective of strengthening, types of overlay, different types of overlay, overlay design methodologies- effective thickness approach, deflection approach and mechanistic-empirical approach, design of overlays using effective thickness approach and deflection approach resorting to Benkeleman Beam method (IRC: 81-1981; IRC: 81-1997)</p>	05
07	<p>Traffic Engineering and Control</p> <p>i. Traffic study and surveys: speed studies, presentation of data, journey time delay studies, use of various methods, merits demerits</p> <p>ii. Vehicular volume count: types, various available methods, planning of traffic count.</p> <p>iii. O- D survey, need uses, various available methods</p> <p>iv. Parking survey, need types, traffic sign marking, signals, miscellaneous traffic control aids, traffic regulations, traffic signals.</p> <p>v. Intersection types: at grade separation, factors influencing design.</p> <p>vi. Introduction to traffic design related software's.</p>	06
08	<p>Highway Drainage: Necessity, surface drainage, subsurface drainage.(IRC recommendations)</p>	02
09.	<p>Bridge Engineering</p> <p>Bridge engineering: importance, investigations, site selection, collection of data, determination of flood discharge, waterway, afflux, economic span, scour</p>	05

depth, Bridge Appurtenances, different types of bridges	
Design criteria for Bridge Foundations. IRC Code of practice for bridges	

Outcomes

On successful completion of the course, the students shall be able to understand the following

- Basic concept about highway engineering.
- Types of pavements different elements in each type.
- Materials used for highway construction
- Method of design of flexible rigid pavement.
- Construction maintenance of different type of pavement
- Different types of traffic control system
- Basic idea about the bridge engineering.

Theory Examination:-

1. Question paper will comprise of **six** questions; each carrying 20 marks.
2. The **first** question will be **compulsory** which will have the short questions having weightage of 4-5 marks covering the entire syllabus.
3. The **remaining five** questions will be based on all the modules of entire syllabus. For this, the module shall be divided proportionately and further, the weightage of the marks shall be judiciously awarded in proportion to the importance of the sub-module contents thereof.
4. The students will have to attempt **any three** questions **out** of **remaining five** questions.
5. Total **four** questions need to be attempted.

Oral Examination:

The oral examinations shall be based on the entire syllabus the report of the experiments conducted by the students including assignments and the Traffic Survey Report.

List of practical: *(At least seven to be performed)*

1. Impact test on aggregates
2. Abrasion test on aggregates
3. Crushing test on aggregates
4. Shape test on aggregates

5. Penetration test on bitumen
6. Ductility test on bitumen
7. Softening point test on bitumen
8. Viscosity test on bitumen
9. Marshall stability test
10. Subgrade CBR

Tests on Aggregate:

Aggregate grading; Sp. Gravity; Crushing; Abrasion; Impact; Soundness; Flakiness; Shape. silica

Tests on Bitumen:

Viscosity, Penetration, softening point, Flash and Fire point, Marshall Stability.

Tests on Subgrade:

Sub-grade CBR.

Site Visit:

The visits to any site involving construction of pavements is going on may be arranged to appraise the students about the various aspects of road construction including concrete pavements, etc. and the students may be asked to submit the report of such visits. This report may form the part of the term work.

Term Work:

The term-work shall comprise of the neatly written report based on the afore-mentioned experiments and the assignments. There shall be at least 10 assignments which will comprise of numerical problems and lay-out sketches, covering the entire syllabus and divided properly module wise. In addition to this, the students shall conduct any one of the traffic surveys and will prepare a detail report thereof. This report along with a report on site visit shall form a component part of the term work.

Distribution of Term Work Marks:

The marks of the term work shall be judiciously awarded for the various components depending upon the quality of the term work. The final certification and acceptance of term work warrants the satisfactory performance of the experiments, appropriate completion of the report thereof along with that of assignments and report of the traffic surveys; and the minimum passing marks to be obtained

by the student. The following weightage of marks shall be given for different components of the term work.

- Report of the Experiments : 8 Marks
- Assignments : 7 Marks
- Traffic Study and Visit Report : 5 Marks
- Attendance : 5 Marks

Further, while giving weightage of marks on the attendance, following guidelines shall be resorted to.

- 75%- 80% : 03 Marks; 81%- 90%: 04 Marks 91% onwards: 05 Marks

Recommended Books:

1. Highway Engineering: *Khanna, S.K., Justo, C. E. G. and Veeraragavan, A.*; Nem Chand and Bros., Roorkee (Revised 10th Edition, 2015).
2. Principles and Practice of Highway Engineering: *Kadiyali, L. R.*; Khanna Publishers, Delhi
3. Principles of Transportation and Highway Engineering, *Rao, G.V.*; Tata Mc-Graw Hill Publishing House Pvt. Ltd., New Delhi.
4. Principles, Practice and Design of Highway Engineering (Including Airport Engineering): *Sharma, S.K.*; S. Chand and Company Pvt. Ltd., New Delhi (3rd Revised Edition, 2013)
5. Bridge Engineering: *Victor, D. J.*; Tata Mc-Graw Hill Publishing House Pvt. Ltd., New Delhi
6. Bridge Engineering: *Bindra, S. P.*, Dhanpatrai and Sons, New Delhi

Reference Books:

1. Transportation Engineering and Planning: *Papacostas, C.S. and Prevedouros, P.D.*; Prentice Hall India Learning Pvt. Ltd., New Delhi
2. Principles of Transportation Engineering: *Chakraborty, Partha and Das, Animesh*; Prentice Hall India Learning Pvt. Ltd., New Delhi
3. Transportation Engineering: *Khisty, C.J. and Lall, Kent, B.*; Prentice Hall India Learning Pvt. Ltd., New Delhi
4. Traffic Engineering and Transport Planning: *Kadiyali, L.R.*, Khanna Publishers, Delhi
5. Relevant specifications of Bureau of Indian Standards including latest version.
6. Relevant specifications of Indian Roads Congress including latest version.

Semester VI

Course Code	Subject Name	Credits
CE-C605	Environmental Engineering – I	04

Teaching Scheme

Contact Hours			Credits Assigned			
Theory	Practical	Tutorial	Theory	Practical	Tutorials	Total
03	02	--	03	01	--	04

Evaluating scheme

Theory			Term Work/ Practical/Oral			Total		
Internal Assessment			End Sem Exam	Duration of End sem exam	TW	PR	OR	
Test 1	Test 2	Average						
20	20	20	80	03 Hrs.	25	--	-	125

Rationale

Environmental engineering is important for all human endeavors not simply about construction within the environment. This subject lays emphasis on the practical application of knowledge, while at the same time recognizing the importance of theoretical knowledge in developing the intellectual capacity of the engineer. Knowledge of this subject is useful for planning, designing, execution monitoring water supply sanitary schemes for the towns/cities.

Objectives

- To prepare students who can accomplish planning, design construction of water systems related infrastructural facilities.
- To give a practical orientation to students to be able to contribute practical solutions to environmental problems in our society.

- To inculcate the students with sound theoretical knowledge in engineering sciences as well as in research consultancy skills.
- To impart positive responsive vocational attitudes, initiative creative thinking in their mission as engineers.

Detailed Syllabus

Module	Sub Modules/Contents	Periods
1	Water	
1.1	Man's environment; Importance of environmental sanitation Water supply systems: need for planned water supply schemes, Sources of water, components of water supply system determination of their design capacities, Quantity of water, Water demand, Population forecasting methods with numerical. Types of Intake structures.	05
1.2	Distribution systems: Requirements of good distribution systems. Lay out of distribution networks, advantage disadvantages, Methods of distribution. Design of distribution networks (Hardy cross method)	06
1.3	Quality of water: wholesomeness palatability, physical, chemical, Biological standards. Treatment of water; impurities in water- processes for their removal- typical flow sheets. Sedimentation : Theory of sedimentation, Types, factors affecting efficiency, design of sedimentation tank, tube settlers Coagulation flocculation ; mechanisms, common coagulations, rapid mixing flocculating devices, G GT values, Jar test, coagulant aids – Polyelectrolyte etc. Filtration: classification, slow and rapid s filters, dual media filters, s, gravel under drainage system, mode of action, cleaning, limitations, operational difficulties, performance, basic design consideration, pressure filters: construction operation. Water softening: lime soda base exchange methods, Principle reactions, design considerations, sludge disposal. Miscellaneous Treatments : removal of Iron Manganese, taste, odour, colour,	30

	<p>principles methods, de-fluoridation, reverse osmosis</p> <p>Disinfection : chlorination, chemistry of chlorination, kinetics of disinfection, chlorine demand, free combined chlorine, break point chlorination, super chlorination, dechlorination, chlorine residual, uses of iodine, ozone, ultra violet rays chlorine dioxide as disinfectants, well water disinfection</p>	
2	<p>Municipal solid waste management</p> <p>Solid waste : Sources, Types , composition, Physical biological properties of solid wastes, sources types of hazardous infectious wastes in municipal solid wastes</p> <p>Solid waste generation collection, storage, hling , transportation, processing</p> <p>Treatment disposal methods</p> <p>Material separation recycle, physic- chemical biologicalstabilization solidification thermal methods, l disposal, site remediation, leachate its control.</p> <p>Hazardous wastes: Effects of hazardous waste on environment its disposal</p>	04
3	<p>Building water supply:</p> <p>Introduction, per capita supply, service connections from main, storage of water supply systems in a building, sizing of pipes, water meters</p> <p>Fixtures andfittings: Introduction, classification of fixtures, special accessories, fittings. Pipe material, Joints, Valves.</p> <p>Design of pipes, primary & secondary branches, Laying of pipes ,testing of maintenance of pipes.</p>	03

Theory Examination:-

1. Question paper will comprise of **six** questions; each carrying 20 marks.
2. The **first** question will be **compulsory** which will have the short questions having weightage of 4-5 marks covering the entire syllabus.
3. The **remaining five** questions will be based on all the modules of entire syllabus. For this, the module shall be divided proportionately and further, the weightage of the marks shall be judiciously awarded in proportion to the importance of the sub-module contents thereof.
4. The students will have to attempt **any three** questions **out** of **remaining five** questions.

5. Total **four** questions need to be attempted.

List of Practical :*(Any eight experiments are to be performed)*

1. Determination of Alkalinity in water
2. Determination of Hardness in water
3. Determination of pH in water
4. Determination of Turbidity in water
5. Determination of Optimum dose of coagulant by using Jar Test Apparatus
6. Determination of Residual chlorine in water
7. Solid Waste : Determination of pH
8. Solid Waste :Determination of moisture content
9. Most probable Number
10. Determination of chlorides in water

Site Visit:

The students shall be taken to the sewage treatment plant to appraise them about the various units in such plants and various operations involved therein. The students shall prepare the detail report of such visits and it will form a part of the term work.

Term Work:

The term work shall include the reports on experiments performed in the laboratory and the brief report on the visit to sewage treatment plant.

Distribution of Term Work Marks:

The marks of the term work shall be judiciously awarded for the various components depending upon the quality of the term work. The final certification and acceptance of the term work warrants the satisfactory performance of the experiments by the student, properly compiled report thereof and the report on the site visit; and the minimum passing marks to be obtained by the student. The following weightage of marks shall be given for different components of the term work.

- Report of the Experiments: 12 Marks
- Report on site visit : 08 Marks
- Attendance : 05 Marks

Further, while giving weightage of marks on the attendance, following guidelines shall be resorted to.

- 75%- 80% : 03 Marks; 81%- 90%: 04 Marks 91% onwards: 05 Marks

Recommended Books:-

1. Water Supply and Sanitary Engineering: *S. K. Hussain*, Oxford & IBH Publication, New Delhi.
2. Manual on Water Supply Treatment (Latest Ed.): Ministry of & Housing. New Delhi
3. Plumbing Engineering Theory and Practice: *S.M. Patil*, Seema Publications, Mumbai
4. Water Supply and Sewage: *E.W.Steel*, Mc-Graw Hill Publications, New York.
5. Water Supply and Sewage: *T.J.McGhee*, McGraw Hill Publications, New York
6. CPHEEO Manual on Water Supply and Treatment
7. Water Supply Engineering- *P.N.Modi*
8. Water Supply Engineering: *S.K. Garg*, Khanna Publishers, Delhi
9. Introduction to Environmental Engineering: *Vesilind*, PWS Publishing Company.
10. Water supply and pollution control: *J.W. Clark, W. Veisman and M.J. Hammer*, International Textbook Company.
11. Relevant Indian standard specifications.
12. Integrated Solid Waste Management: *Tchobanoglous Theissen Vigil*, Mc-Graw Hill Publications, New York.
13. Solid Waste Management in Developing Countries: *A.B. Bhide and B.B. Sundaresan*.
14. Manual on Municipal Solid Waste Management: Ministry of Urban Development, New Delhi.
15. Environmental Pollution: *Gilbert Masters*
16. Basic Environmental Engineering: *Nathanson J.A.*; Prentice Hall of India Publications

Semester VI

Course Code	Subject Name	Credits
CE-C606	Theory of Reinforced and Pre-stressed Concrete	05

Teaching Scheme

Contact Hours			Credits Assigned			
Theory	Practical	Tutorial	Theory	Practical	Tutorials	Total
04	02	--	04	01	--	05

Evaluation Scheme

Theory				Term Work/ Practical/Oral			Total	
Internal Assessment			End Sem Exam	Duration of End sem exam	TW	PR	OR	
Test 1	Test 2	Average						
20	20	20	80	03 Hrs.	25	--	25	150

Rationale

Working stress Method (WSM) makes use of the concept of modular ratio based on the higher factor of safety in evaluating the stresses in two different materials of the RCC, i.e., steel and the concrete. The new concept of pre-stressed concrete has also assumed significance in the field of concrete technology. The pre-stressed is the high strength concrete in which permanent internal stresses are deliberately introduced to counteract to the desired degree, the stresses caused in the member in service usually by high tensile steel wire or tension steel, embedded pre-tensioned prior application of the external load. The subject involves the application of either method in the analysis and design of the various elements of the civil engineering structures such as beams, slabs, columns and footing. The application of the concept of pre-stressed concrete also forms part of the subjects.

Objectives

- To study the elastic theory philosophy in respect of R.C. structures and its applications to various elements such as beam, column, slab and footings.
- To study the concept of pre-stressing of R.C structures and its applications in the analysis of R.C. structures.

Detailed Syllabus

Module	Sub Modules/Contents	Periods
1.	Concept of reinforced concrete, Working Stress Method (WSM) of design for reinforced concrete, permissible stresses as per IS-456-2000; stress- strain curve of concrete steel, characteristics of concrete steel reinforcement.	04
2.	Analysis design of singly reinforced doubly reinforced rectangular, Tee, Ell-beams for flexure by WSM, balanced, under reinforced over reinforced sections.	06
3.	Design for shear bond by WSM.	04
4.	Analysis Design of rectangular circular columns subjected to axial bending by WSM.	06
5.	Design of one way two way slab by WSM	06
6.	Design of axially loaded isolated sloped pad footings	05
7.	Prestressed Concrete: Basic principles of prestressed concrete, materials used their properties, methods systems of prestressing, losses in prestress, analysis of various types of sections subjected to prestress external loads.	09
8.	General design principles: Concepts of centre of compression, kern of a section, efficiency of the section, pressure line safe cable zone, principal tension in prestressed concrete members.	04
9.	Simple design of prestressed concrete I beams (excluding end block design)	04

Outcomes

The students shall use the lectures to study the analysis design of various elements of the reinforced concrete structures such as beam, slab, column, footings using the concept of working stress method. The student shall apply the knowledge gained in the subjects such as engineering mechanics, strength of materials structural analysis in analyzing the structural components further implement it for the designing these elements. Further, the student shall use the tutorials to solve more practice problems.

Theory Examination:

1. Question paper will comprise of **six** questions; each carrying 20 marks.
2. **The first question will be compulsory** which will have the short questions having weightage of 4-5 marks covering the entire syllabus.
3. The **remaining five** questions will be based on all the modules of entire syllabus. For this, the module shall be divided proportionately and further, the weightage of the marks shall be judiciously awarded in proportion to the importance of the sub-module contents thereof.
4. The students will have to attempt **any three** questions **out** of **remaining five** questions.
5. **Total four** questions need to be attempted.

Oral Examination:

The oral examination shall be based upon the entire syllabus and the term work consisting of the assignments.

Term Work:

The term-work shall comprise of the neatly written report of the assignments. The assignments shall be given covering the entire syllabus in such a way that the students would attempt at least four problems on each modules/ sub-modules contents thereof further.

Distribution of Term-work Marks:

The marks of the term-work shall be judiciously awarded depending upon the quality of the term work including that of the report on assignments. The final certification and acceptance of term-work warrants the satisfactory and appropriate completion of the assignments; and the minimum passing

marks to be obtained by the students. The following weightage of marks shall be given for different components of the term work.

- Assignments : 20 Marks
- Attendance : 05 Marks

Further, while giving weightage of marks on the attendance, following guidelines shall be resorted to.

- 75%- 80% : 03 Marks; 81%- 90%: 04 Marks 91% onwards: 05 Marks

Recommended Books:

1. Design of Reinforced Concrete Structures: *By Dayaratnam P.*; Oxford & IBH.
2. Design of Reinforced Concrete Structures: *S. Ramamrutham*
3. Design of Concrete Structures (Vol.I): *Ramchandra*
4. R.C.C. Designs: *B.C. Punimia, Ashok Kumar Jain and Arun Kumar Jain*; Laxmi Publications
5. Fundamentals of Reinforced Concrete: *Sinha and Roy*; S. Chand and Co., New Delhi.
6. Reinforced Concrete: *Warnerr. R. F. Rangan B.C. & Hall A. S.*, Pitman.
7. Reinforced Concrete (Vol. I): *H.J.Shah*;Charotar Publishers.
8. Reinforced Concrete: *Syal and Goel*; Wheeler Publishers
9. Design of Prestressed Concrete Structures: *Lin T.Y. and Ned Burns*; John Wiley.
10. Prestressed Concrete: *Krishna Raju*, Tata Mc-Graw Hill Publishing House, New Delhi
11. Prestressed Concrete: *Evans R. H. and Bennett E.W.*, Chapman and Hall.
12. Prestressed Concrete: *N. Rajgopalan*, Narosa Publishers
13. Relevant IS Codes: BIS Publications, New Delhi
14. Reinforced Concrete Design: *Pillai, S.U. and Menon, Devdas*, Tata Mc-Graw Hill Publishing House, New Delhi