AC – 26/2/2015, Item No. 4.60

UNIVERSITY OF MUMBAI

Bachelor of Engineering

Civil Engineering (Final Year – Sem.VII&VIII), Revised course

(REV- 2012) from Academic Year 2015 -16,

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 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 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) give freedom to affiliated Institutes to add few (PEO's) courseobjectives course outcomes to be clearly defined for each course, so that all faculty members in affiliated institutes understand the depth approach of course to be taught, which will enhance learner's learning process. It was also resolved that, maximum senior faculty from colleges 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 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 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 adopted ten points scale to grade learner's performance. Credit 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 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 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 Faculty of Technology of 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'sfor 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, course objectives 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 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

Subject 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**

Subject 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 subject '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

Subject 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**

Subject 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 & Practical** **# Oral & Sketching**

University of Mumbai

Scheme of Instructions and Examination

Third Year Engineering (Civil Engineering)

(With effect from 2014-2015)

Semester V

Subject 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**

Subject 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**

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

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

Semester VI

Subject Code	Subject Name	Teaching Scheme (Contact Hours)			Credits Assigned			
		Theory	Pract.	Tut.	Theory	Pract.	Tut.	Total
CE-C601	Geotechnical Engg. – 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 Engg. – II	4	2	--	4	1	--	5
CE-C605	Environmental Engg – I	3	2	--	3	1	--	4
CE-C606	Theory of Reinforced Prestressed Concrete	4	2	--	4	1	--	5
Total		**22**	**12**	**--**	**22**	**6**	**--**	**28**

Subject 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 Engg. – 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 Engg. – II	20	20	20	80	3	25	--	25	150
CE-C605	Environmental Engg. – I	20	20	20	80	3	25	--	--	125
CE-C606	Theory of Reinforced and Prestressed 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 andExamination

Fourth Year Engineering (Civil Engineering)

(With effect from 2015-2016)

Semester VII

Subject 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**

Subject 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

Subject 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**

Subject 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 and Oral (Internal and External)

N.B.: Guidelines for Project, i.e., Dissertation (Part-I& 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 Flood Control
4. Solid Waste Management
5. Systems Approach in Civil Engineering
6. Risk Value Management
7. Advanced Structural Analysis
8. Structural Dynamics
9. Advanced Structural Mechanics
10. Advanced Foundation Engineering
11. Ground Water Hydrology
12. Pavement Subgrade Materials
13. Air Pollution
14. Prestressed Concrete
15. Traffic Engineering Control
16. Reinforced Concrete Repairs 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 Management
5. Bridge Design Engineering
6. Environmental Impact Assessment 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 Economics
17. Advanced Repairs and Rehabilitation of Structures
18. Geosynthetics and Reinforced Structures

Semester VII

Subject Code	Subject Name	Credits
CE–C701	Limit State Method for Reinforced Concrete Structure	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	25	--	--	125

Rationale

The limit state method (LSM) is based on the statistical probability which provides the rational solution to the design problem. The philosophy lies behind LSM uses multiple safety factors format which attempts to provide adequate safety at the ultimate load as well as adequate serviceability at service load by considering all possible limit states.The ultimate load method (ULM) proportions the structural element in such a way that the elements withstand the ultimate load, which is obtained by enhancing the service load by some factor referred to as the load factor, for giving a desired margin of safety. The ULM,thus, ensures safety but disregards the serviceability aspects, whereas the LSM ensures the safety at the ultimate load and serviceability at the working load rendering the structure fit for its intended use. The subject involves the application of limit state method in the analysis and design of various elements of the civil engineering structures such as beams, column, slab and footing. The application of the concept of Ultimate Load Method in the limited extent, i.e., for the flexural members like beams also forms a part of the course.

Objectives

1. To develop the clear understanding amongst the students of the concepts of the design of reinforced concrete structure using ULM and LSM.
2. To study the various clauses of IS: 456-2000 and its significance in the RCC design.
3. To apply the concepts of ULM in the analysis and design of beams.
4. To apply the concepts of LSM in the analysis and design of beams, slabs, columns and footings.

Detailed Syllabus

Module	Sub-Modules/ Contents	Periods
I.	**Ultimate Load Method:** Brief introduction to fundamentals of ultimate strength theory: curved stress distribution, compressive stress block, simplified rectangular stress block as per Whitney's approach, ultimate moment of resistance of singly reinforced section and doubly reinforced sections.	05
II.	**Limit State Method :** Introduction to limit state method of design as per IS 456 (latest edition): concepts of probability and reliability, characteristic loads, characteristic strength, partial safety factors for loads and materials, introduction to various limit states.	04
III.	**Limit State of Collapse – Flexure:** Limit state of collapse in flexure, shear and Limit state of serviceability in deflection and cracking, design of singly and doubly reinforced rectangular and T sections for flexure, design of members in shear and bond, design of beam subjected to bending and torsion. Requirements governing reinforcement detailing.	17
IV.	**Design of Slabs:** Design of one way and two way slabs	07
V.	**Limit State of Collapse – Compression:** Limit state of collapse compression for short and slender column. Members subjected to combined axial and uni-axial as well as biaxial	08

	bending. Development of interactive curves and their use in column design.	
VI.	**Design of Foundations:** Isolated square and rectangular footings subjected to axial load and moments. Design of combined rectangular pad footings, slab beam type footing and strap footing.	11

Contribution to Outcomes

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

1. Understand the pros and cons of the ULM and LSM vis-à-vis Working Stress method (WSM), covered in Semester VI.
2. Understand the various clauses specified in IS: 456-2000 for designing structural members with the safety and economy.
3. Understand the application and effectiveness of the LSM to the considerable extent along with the application of ULM in the limited extent.

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 the entire syllabus. For this, the modules shall be divided proportionately further; and 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 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.

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 three problems and/ or questions 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 its quality. 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

Recommended Books:-

1. Design of Reinforced Concrete Structures*: Dayaratnam, P;* Oxford and IBH.
2. Limit State Design – Reinforced Concrete: *Jain A. K*, Nemchand and Bros., Rorrkee
3. Limit State Design – Reinforced Concrete: *Shah and Karve*, Structure Publications, Pune.
4. Ultimate Strength Design for Structural Concrete: *Arthur, P. D.and Ramakrishnan, V.*, Wheeler and Co. Pvt. Ltd.
5. Limit State Theory of Reinforced Concrete Design:*Huges, B. P.*, Pitman.
6. Reinforced Concrete:*Warner, R. F., Rangan, B. C.and Hall, A. S.*, Pitman.
7. Reinforced Concrete:*H.J. Shah*, Charotar Publishers, Anand.
8. Fundamentals of Reinforced Concrete: *Sinha and Roy*, S. Chand and Co. Ltd.
9. Illustrated Reinforced Concrete Design: *Dr. V. L. Shah and Dr. S. R. Karve*, Structure Publications, Pune.
10. Reinforced Concrete Design: *Wang, C. K., Salmon, C. G., and Pincheira, J. A,*

John Wiley(2007), 7th Edition.

11. Reinforced Concrete Fundamentals: *Ferguson, P. M., Breen, J. E., and Jirsa, J. O.*, John Wiley andSons (1988) 5th Edition.
12. RCC Design (WSM and LSM): *Punmia, B. C.,Jain, A. K., and Jain, Arun, K.*, Laxmi Publications.
13. Limit State Design of Reinforced Concrete (as per IS: 456-2000): *Punmia, B. C., Jain, A. K., and Jain, Arun, K.*,Laxmi Publications.
14. Design and RCC structural Elements (RCC Vol-I): *Bhavikatti, S. S.*,New Age International Publications.

Semester VII

Subject Code	Subject Name	Credits
CE-C702	Quantity Survey Estimation and Valuation	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	04	25	--	25	150

Rationale

Any structure, i.e., building, bridge, dam etc. consists of various building materials. Due to rise in the cost of materials, the structure has to be designed so that it is safe, serviceable and economical. Without proper design and estimation, it may lead to the increase in cost of construction and it further affects the economical aspect of the structure. A prior knowledge of various building materials is required for the construction and it controls the cost of the structure, save wastage of labour-hours and eventually helps in giving the correct amount required and quantity of various materials required. It also helps in scheduling of men, materials and machine to be used in the project at stages. The scope of the subject includes estimating, costing, analysis of rates, specification, valuation, tender and contracts etc.

Objectives

- To read, understand and interpret plans, sections, detailed drawings and specifications for a construction project.

- To study the various methods of detailed and approximate estimates.
- To emphasize the importance of relevant IS: 1200- 1964 codes and relevant Indian Standard specifications, taking out quantities from the given requirements of the work, and drafting specifications.
- To conduct a material and labour survey to understand the current market rates for the various materials required for construction and the different categories of labour required.
- To perform the rate analysis for various items: standard and non-standard and the use of DSR in this process.
- To study the process of tendering and its various stages, various types of contracts, its suitability and validity as per the Indian Contract Act of 1872 and draft various clauses and conditions of a contract.
- To study the arbitration process.
- To study assessment of the value of a property.

Detailed Syllabus

Module	Sub-Modules/ Contents	Periods
I.	**Estimates:** Various types, their relative importance, factors to be considered, 14 complete set of Estimate. Approximate estimates: importance, purpose, different methods. Use of CBRI Equations for the same. Methods of preparation of estimates for projects such as: i) Building R.C.C., Load bearing ii) Road iii) Cross drainage work iv) Factory shed including steel truss	18
II.	**Measurements for various items:** Use of relevant Indian Standard Specifications for the same, taking out quantities from the given requirements of the work, comparison of different alternatives, Bar bending schedules, Mass haul Diagrams	06
III.	**Material survey:** Approximate estimates of requirement of various materials for	05

	building works, percentage breakup of the cost, cost sensitive index, market survey of basic materials	
IV.	**Specifications:** Types, requirements and importance, detailing of specifications for various items	03
V.	**Rate analysis:** Purpose, importance and necessity of the same, factors affecting, task work.	06
VI.	**Tender:** Preparation of tender documents, importance of inviting tenders, contract types, relative merits, prequalification. general and special conditions, termination of contracts, extra work and items, penalty and liquidated charges, Settlement of disputes, R.A. Bill and Final Bill, Payment of advance , insurance, claims, price variation, etc.	06
VII.	**Valuation:** Different terms used the role of a valuer, purpose and necessity of the same. Capitalized Value, Years purchase,sinking fund, depreciation, types of values, Purpose of valuation. Different methods of valuation for 1. open plots. 2. open plots with existing residential and commercial structures 3. lease hold properties Use of valuation tables and formulae	08

Contribution to Outcomes

At the end of this course, the students will be able to:

- Read, understand and interpret plans, sections, detailed drawings and specifications for a construction project.
- Prepare approximate and detailed estimates based on the quantity survey of the available general and detailed drawings.
- Draft specifications, make bar bending schedules and draw mass haul diagrams.

- Haveknowledge about the current market rates for labour and material required for construction, perform rate analysis and compare with DSR.
- Draft tenders, prepare valid contract documents.
- Understand the process of arbitration.
- Understand the role of a valuer and assess the value of a property**.**

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 further, and the weightage of the marks shall be judiciously awarded in proportion to the importance of the sub-module or 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 will be based on the entire syllabus and the term work.

Term Work:

The term work shall consist of the following:

1. An approximate estimate of a multistoried building by approximate method.
2. Detailed estimate of any **four** of the following with the required material survey for the same.
   a) a single storeyed building (RCC)
   b) a bridge with minimum 2 spans
   c) a factory building
   d) a road work
   e) a cross drainage work
   f) a load bearing structure

3. Valuation report in a standard format of the Government/ Private company/Firm.
4. Assignments on rate analysis, market survey, specifications and simple estimates.
5. Detailed estimate of a minor structure.
6. Bar bending schedule.

The use of quantity survey software and the use of worksheets / databases while solving some of the afore-mentioned assignments is desirable.

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 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

Recommended Books:

1. Estimating, Costing Specifications and Valuation: *Chakraborty, M.*, Kolkata.
2. Building and Engineering Contracts: *Patil, B. S.*, University Press, Hyderabad.
3. Estimating and costing: *Datta, B. N.*, UBS Publications
4. Relevant Indian Standard Specifications, BIS Publications
5. World Bank approved contract documents

Semester VII

Subject Code	Subject Name	Credits
CE-C703	Irrigation Engineering	5

Teaching Scheme

Contact Hours			Credits Assigned			
Theory	Practicals	Tutorials	Theory	Practicals	Tutorials	Total
4	2	-	4	1	-	5

Evaluation Scheme

Theory					Termwork/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	3	25	-	25	150

Rationale

India is an agricultural country where majority of population lives in villages so agricultural industry is the backbone of Indian economy. Being a tropical country with large temporal and spatial variation of rainfall and availability only for three to four months irrigation is strongly needed in India. To satisfy this need enhancing the irrigation facilities in the country is required. This subject provides necessary knowledge about survey for investigation, hydrology for calculation of yield from rainfall, designing the storage capacity, planning design and constructions of important irrigation structures like dams, weirs, cross drainage woks and canal structures. This subject is also useful to the students with respect to facts, concepts, principles and procedures related to irrigation structures so that they can effectively plan and execute these structures.

Objectives

1. To collect the data for irrigation system.
2. To calculate the yield from catchments.

3. To calculate the capacity of Canals.
4. To calculate the storage capacity of reservoirs.
5. To find out and fix the control levels of reservoirs.
6. To decide the section of Dams, Weirs and Barrages.
7. To classify the Canals and design the Canals.
8. To classify different irrigation systems.

Detailed Syllabus

Module	Sub- Module/Content	Periods
I	**Introduction:** Definition of irrigation, water resources in India, development of irrigation in India, need of irrigation in India, Benefits of irrigation, ill effects of irrigation, irrigation systems: major, medium and minor irrigation projects, command area development,impact of irrigation on environment, national water policy.	4
II	**Water requirement of crops:** Crops and crop seasons in India, cropping pattern, duty and delta. Quality of irrigation water. Soil water relationship: soil characteristics significant from irrigation considerations, root zone soil water, infiltration, consumptive use, irrigation requirement, frequency of irrigation. Methods of applying water to the fields: surface, sub-surface, micro irrigation: sprinkler irrigation, drip irrigation.	8
III	**Hydrology:** Hydrologic cycle, Precipitation: Types of precipitations, measurement of rainfall by rain gauges, stream flow measurement, runoff, factors affecting runoff, computation of runoff, yield of the catchment runoff hydrograph, runoff computations, flood discharge and calculations, unit hydrograph, application of unit hydrograph, methods of deriving unit hydrograph, S-hydrograph.	9

IV	**Ground water and well hydraulics:** Ground water resources, occurrence of ground water, methods of ground water exploration, well irrigation. Well hydraulics: steady state flow in wells, equilibrium equations for confined and unconfined aquifer, aquifer tests, design of water wells.	7
V	**Investigation and reservoir planning** Selection of site for reservoir, zones of storage reservoir, capacity elevation and area elevation curve of reservoir site, control levels, fixation of control levels, reservoir sedimentation, methods of control of sedimentation.	4
VI	**Dams:** Introduction, classification. Gravity dams: forces acting on gravity dam, modes of failure, stability analysis. Design, galleries, joints. Keys, water seals. Earth and rock-fill dams: types, causes of failure, seepage analysis, stability analysis, design, rock-fill dams. Arch and buttress dams: types. Spillways and types of spillways, other energy dissipating devices: types.	12
VII	**Distribution systems:** Canal systems, alignment of canals, canal losses, estimation of design discharge. Bandhara Irrigation. Canal outlets: non-modular, semi-modular and modular outlets. Waterlogging: causes, effects and remedial measures. Lining of canals: economics of lining. Drainage of irrigated land: necessity, methods, Canal regulation works. Cross drainage works and its types.	8

Contribution to Outcomes

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

1. Calculate the demand of water required for agricultural land
2. Understand basic requirements of irrigation and how can they be managed
3. Apply their knowledge on ground water, well hydraulics to estimate the safe yield and ground water potential
4. Perform analysis and design of various Irrigation systems including hydraulic structures
5. Carry out design of water resources projects independently.

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 further, the weightage of the marks shall be judiciously awarded in proportion to the importance of the sub-module or 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.

Term Work:

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

Distribution of the Term Work Marks:

The marks of the term work shall be judiciously awarded depending upon its quality. The final certification and acceptance of term work warrants the satisfactory and appropriate completion of the report of the 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.

- 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. Irrigation Water Resources and Water Power Engineering: *P.N. Modi*, Standard Book House, Delhi, ISBN 978-81-87401-29-0.
2. Irrigation Engineering and Hydraulic Structures:*S. K. Ukarande*, Ane's Books Pvt. Ltd. (Abridged Edition 2015), ISBN 9789383656899
3. Irrigation and Water Power Engineering: *B.C. Punmia, Pande, B.B. Lal, A.K Jain*. Laxmi Publications Pvt, Ltd. New Delhi.
4. Irrigation Engineering and Hydraulics Structures: *S. K. Garg*, Khanna Publishers. Delhi.
5. Design of Irrigation Structures: *S. K. Sharma*, S. Chand and Co.
6. Theory and Design of Irrigation Structures: *R. S. Varshney and R, C. Gupta*, Nem Chand and Bros., Roorkee
7. Engineering for Dams, Vol. I to III: *Crager*, *Justin and Hinds*, John Wiley
8. Design of Small Dams: USBR.
9. Hydro Power Structures: *R. S. Varshney*, Nem Chand and Bros. Roorkee
10. Concrete *Dams: R. S. Varshney*, Oxford and IBH Publishing Co.

Semester VII

Subject Code	Subject Name	Credits
CE-C704	Environmental Engineering - II	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	25	--	25	150

Rationale

Every civil engineer must be acquainted with the principles of public health engineering, design of waste water collection and treatment systems; and develop rational approaches towards sustainable waste management via appropriate treatmentand reuse. The course deals with the overall features and study of treatment of sewage processes. The course lays emphasis on complete update of the knowledge of these processes related to design of treatment plant.

Objectives

- To understand and explain the role of sanitation in the urban water cycle and its relation to public health and environment.
- To develop rational approaches towards sustainable wastewater management via pollution prevention.

- To understand the relevant physical, chemical and biological processes and their mutual relationships within various sanitation components.
- Tocontribute to the development of innovative approaches to the provision of adequate and sustainable sanitation services in the country.
- To study the appropriate treatment, Reclamation and resource recovery and re-use at both centralized and decentralized levels.

Detailed Syllabus

Module	Sub-Modules/ Contents	Periods
I.	**Sewage Generation, Collection and Conveyance**	12
	Introduction : Need for sewerage system, Domestic sewage, Industrial waste and Storm Water- Quantification and design. Definitions: sewage, sullage, sewerage, Conservancy and water carriage system Systems of sewerage and their layouts : Separate, Combined and partially combined system, Merits and demerits ,Patterns of sewerage layout, Quantity of sewage, dry weather flow	
	Conveyance of sewage: Sewer: Shapes and materials of sewers, open drains, Design of sewers: SEWER SIZE, Determination of velocity of flow using empirical formulae, limiting velocities. Laying and testing of sewers Sewer joints, Sewer appurtenances, Ventilation of sewers. Construction and Maintenance of sewers. Pumping of sewage: Types, selection of pumps, Pumping station	
II.	**Primary Treatment of sewage:** Need for Analysis, Characteristics of sewage: Composition, Biochemical characteristics, aerobic decomposition, anaerobic decomposition, Sampling of sewage, Analysis of sewage. Treatment processes: Objective, methods of treatment, flow sheets showing Preliminary, Primary, Secondary and Tertiary treatment.	10

	Screens, Grit chamber, Primary and secondary clarifier. Design of primary treatment units.	
III.	**Secondary treatment methods:** Principles, Trickling filter, Activated sludge process, recirculation, hydraulic design of trickling filter and activated sludge process, Sludge volume index, Operational problems in trickling filter and activated sludge process, Aerated lagoons, Rotating Biological contractors, Stabilization Ponds, UASB . Design of secondary treatment units **Sludge treatment and disposal:** Sludge Digestion: Principles of anaerobic digestion, quantity and characterization of sludge, design of sludge digestion tanks, disposal of digested sludge, drying beds. **Sewage disposal :** Discharge of Raw and treated sewage on land and water, standards for disposal. **Self-purification of natural water bodies:** Oxygen economy, Numericals on BOD, Sewage farming. Disposal of treated effluent	16
IV.	**Reclamation and Reuse of Waste water :** Tertiary treatment for removal of residual organics, removal of nutrients, recycling and reuse of wastewater.	04
V.	**House drainage and Environmental sanitation** **Plumbing :** basic principles, Plumbing regulations, preliminary data for design, Preparation and submission of plans, Plumbing fixtures , materials used for plumbing system, systems of plumbing, antisiphonic and vent pipes. **Low cost sanitation:** Septic tanks, Imhoff tanks- Principles, Operation and suitability, Design.	06
VI.	**Environmental Pollution**: Air-Composition and properties of air, Quantification of air pollutants,Monitoring of air pollutants, Air pollution- Occupational hazards, Urban air pollution automobile pollution, Chemistry of combustion, Automobile engines, quality of	04

	fuel,operating conditions and interrelationship. Air quality standards, Control measures for Air pollution, construction and limitations, **Noise**-Basic concept, measurement and various control methods. Thermal pollution.	

Contribution to Outcomes

Having completed this course the students shall ensure the safe handling and treatment of wastewater and sewage. The students shall be able to conduct quality control tests on samples obtained from sewer water, soil, nearby rivers and groundwater. Further, the students shall be able to design the treatment facilities and assess the guidelines for disposing of waste. Lastly, they shall be able to formulate approaches to treat waste water in most effective manner.

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 further, the weightage of the marks shall be judiciously awarded in proportion to the importance of the sub-module and 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 (*At least eight to be performed)*

1. Measurement of Noise level
2. Determination of chlorides
3. Determination of pH of sewage
4. Determination of Total Solids, suspended solids, dissolved solids, volatile solids
5. Determination of Dissolved oxygen
6. Determination of Bio chemical Oxygen Demand of sewage sample
7. Determination of Chemical Oxygen Demand of sewage sample
8. To find Sludge Volume Index (SVI) of sewage sample.

9. Measurement of air quality standard by High volume sampler
10. Plumbing demonstration of accessories, fittings and fixtures.

Site Visit:

The students will visit the Sewage Treatment Plant in the nearby vicinity or in the city and prepare detailed report thereof. This report will form a part of the term work.

Oral Examination:-

Oral examination will be based on entire syllabus and the term work.

Term Work:

The term-work shall comprise of the neatly written report based on the experiments performed in the laboratory and the assignments. The assignments shall be given covering the entire syllabus in such a way that the students would attempt at least two problems and/or questions on each modules/ sub-modules and contents thereof, further. Adetailed report on the visit to sewage treatment plant will also be submitted as a part of the term work.

Distribution of the Term Work Marks:

The marks of the term work shall be judiciously awarded for the various components depending upon its quality. The final certification and acceptance of term work warrants the satisfactory performance of the experiments by the student, properly compiled report thereof along with the assignments 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.

1. Report of the Experiments: 08 Marks
2. Assignments: 08
3. Report on the visit to Sewage Treatment Plant : 04 Marks
4. 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

Demonstration of available software for design of sewage treatment plant and sewer network is to be done.

Recommended Books:

1. Environmental Engineering (Vol. II):*Garg, S. K.*, Khanna Publishers, New Delhi.
2. Water supply and Sanitary Engineering:*Hussain, S. K.*, Oxford and IBH Publication, New Delhi.
3. Plumbing Engineering,Theory and Practice: *Patil, S. M.*, Seema Publications, Mumbai.
4. Environmental Engineering: *Punmia, B. C.*, Laxmi Publications, New Delhi
5. Air pollution:*Rao, M. N.*, Tata Mc-Graw Hill Publishers, New Delhi
6. Environmental Engineering:*Peavy, H. S., Rowe D. R. and Tchobanoglous G.*; Tata-Mcgraw Hill, 1991.
7. Wastewater Engineering Treatment, Disposal, Refuse: *Metcalf and Eddy*, Tata McGraw Hill Publishers, New Delhi, 1995.
8. Water Supply and Sewerage:*Steel, E.W.*
9. Introduction to Environmental Engineering:*P. Aarne Vesilind*, PWS Publishing Company, 2000
10. Introduction to Environmental Engineering :*P. Aarne Vesilind, Susan M. Morgan*, Thompson /Brooks/Cole; Second Edition 2008
11. Manual on Wastewater Treatment: CPH and Env. Engg. Organization (3rd Ed.), Ministry of Urban Development, Govt. of India, New Delhi, 1991.
12. CPHEEO Manual on Sewage and Treatment
13. Relevant Indian Standard Specifications

Semester VII

Subject Code	Subject Name	Credits
CE-E705	Elective-I: Advanced Surveying	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	25	--	25	150

Rationale

This is an advanced course dealing in modern surveying instruments such as Total Station, Electronic Theodolite and Electronic Distance Measuring (EDM) Instruments. This subject also includes the study of GPS (Global Positioning System) for navigation and positioning including the applications of GIS (Geographic Information System). Detailed study of Photogrammetry and its geometrical considerations are taken into account. Advanced surveying also includes Remote Sensing and image interpretation techniques along with field astronomy and hydrographic surveying.

Objectives

- To study traversing using Total Station.
- To establish Waypoints/ Networks using GPS receivers.
- To demonstrate GIS software
- To Measure the Relief Displacement using Mirror Stereoscope.

Detailed Syllabus

Module	Sub-Modules/ Contents	Periods
I.	**ModernSurveyingEquipment:** Dataandequipmentneededforengineering projects. Review of traditional surveying equipment. Changingsceneinsurveyingandmapping,mapsubstitutes,useand advantage of modern surveying equipment in project. Modernsurveying electronicequipment,theirprinciples,constructionsworkinganduse-ElectronicTheodolite,E.D.M.Instruments-Distomat,Totalstation.Applicationoflasersin distanceandangularmeasurements.Introductionof electronicnavigationandpositionfixing.Differentsystemsandtheir characteristics.	09
II.	**GlobalPositioningSystem:** Introductiontonavigationandpositioning, Geodesy;geospatialreferencesystems,overviewofGPS;GPSsegments, 2Dand 3Dpositioning, GPS error sourcesandhandling, GPSapplications.	06
III.	**GeographicInformationSystem:** GeographicInformationSystem(GIS)-DefinitionofGIS,Geographicalconcepts and terminology,Componentsof GIS,Dataacquisition,Rasterandvectorformats,scannersand digitizers. AdvantagesofGPSandGISinthestoragethematicinformationextracted fromremotelysensedimages.	08
IV.	**Photogrammetry:** Definitionofphotogrammetricterms,geometryofaerial andterrestrialphotographs,aerialcameraandphoto theodolite,scalesof photographs,tiltandheightdisplacementsstereoscopicversionand stereoscopes,heightdeterminationfromparallaxmeasurements,flight planning.mansand mansubstitutesandtheiruses.	08

V.	**RemoteSensing:** Introductionand definitionofremotesensingterms,remote sensingsystem,principlesofremotesensing,InteractionofEMR, Fundamentalsofaerialphotography,platformsandorbits,sensors,data products,principlesofvisualinterpretation,principlesanduses;thermal remotesensitize, microwave remotesensing.	08
VI.	**ImageInterpretation:** Principlesofinterpretationofaerialandsatellite images,equipmentsandaidsrequiredforinterpretation,groundtruth-collectionand verification,advantagesofmultidateandmultibandimages, digitalimageprocessing;introduction,imageenhancementtechniques, digital image classification.	07
VII.	**FieldAstronomy:** Terms,coordinatesystems,hourangle,right declination,altitude,and azimuth:studyofastronomicalcharts,deter latitudeandbearingbyobservationonthesunandpolestar,time, standardtime,localtime,universaltime,equationoftime.	03
VIII.	**HydrographicSurveying:** Uses, Methodofhydrographicsurveys, mean sea-level,tidegauges,soundingequipments,locationofsoundings, the capacity of reservoir, stream gauging	03

Contribution to Outcomes

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

1. Use modern surveying instruments.
2. Use GPS receivers.
3. Demonstrate GIS software.
4. Use Mirror Stereoscope.

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 further; and 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 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.

Term Work:

The term-work shall comprise of the neatly written report based on the practical performed either in the laboratory or on the field 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 and/or questions on each modules/ sub-modules and 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 the practical performed and 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.

- Report of the Practical/ Field Studies : 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. Highersurveying:*A.M.Chandra,* NewAgeInternationalpublishers.
2. Highersurveying:*B.C.Punimia,AshokJoin,ArunK.Jain,* LaxmiPublications(P), Ltd.
3. Geographic Information System and Science: *Longley, Paul A., Michael F. Goodchild, David J. Maguuire, David W. Rhind*, John Wiley and Sons, New York (2^{nd} Ed.), 2005
4. ModelingOurWorld:TheESRIGuidetoGeodatabaseDesign:*Zeiler,M*.ESRI Press,Redlands,California, 1999.
5. GIS,SpatialAnalysis,andModeling:Maguire,*D.,M.Batty,andM.Goodchild*.2005. ESRIPress(070.212.05842005)
6. GlobalPositioningSystem:Signals,Measurements,andPerformance,*PratapMisraandPer Enge*(2^{nd} Ed.), 2006.
7. RemoteSensingPrinciplesand Interpretation*: Floyd,F.Sabins,Jr:,Freeman*andCo.,San Franscisco,1978.
8. RemoteSensingandImageInterpretation:*LillesandandKiefere*:,JohnWiley,1987.
9. A Remote Sensing Perspective: Introductory Digital Image Processing:*John,R. Jensen*, PrenticeHall.
10. ImagingRadarforResource Survey:Remote SensingApplications:*W.Travelt*,Chapman andHall.

Semester VII

Subject Code	Subject Name	Credits
CE-E705	Elective-I: Rock Mechanics	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	25	--	25	150

Rationale

There are several structures such as foundations, dams, rock slopes, tunnel, hydroelectric and energy generating plants, mines, etc. which are built directly on or in rock masses. The design of structures depends on the rock mass properties and the interaction between the rock and the structure. This demands the study of mechanics applied to rocks and engineering activity involving rocks. The course is an interdisciplinary course with applications in geology and geophysics, mining, petroleum and geotechnical engineering.

Objectives

1. To study the structural geology and classification of rock masses
2. To study the stress distribution and stress - strain behaviour of rocks
3. To study bearing capacity of rocks
4. To study the stability of rock slopes and openings in rocks

5. To study the rock bolting and grouting.

Detailed Syllabus

Module	Sub-Modules/ Contents	Periods
I.	**Structural Geology of Rocks**: Introduction	04
II.	Subsurface Investigations in Rocks and Engineering Characteristics of Rock Masses	04
III.	**Engineering Classification of Rocks and Rock Masses:** Classification of intact rocks, rock mass classifications {rock quality designation, rock structural rating, geomechanics classification (RMR)}, strength and modulus from classifications, classification based on strength and modulus, geo-engineering classification, Deere and Miller's Engineering Classification.	06
IV.	**Stress Distribution in Rocks:** Field and Laboratory Tests on Rocks	07
V.	**Strength, Modulus and Stress-Strain Responses of Rocks:** Factors influencing rock responses, strength criteria for isotropic intact rocks, modulus of isotropic intact rocks with confining pressure, uni-axial compressive strength of intact anisotropic rocks, strength due to induced anisotropy in rocks, compressive strength and modulus from SPT, stress- strain models (constitutive models, elastic stress-strain model, elasto-plastic stress-strain model, equivalent material concept), influence of intermediate principal stress.	07
VI.	**Bearing Capacity of Rocks:** Estimation of bearing capacity (foundation on intact rock, heavily fractured rock, UBC with Hoek-Brown criterion, foundation on slope), stress distribution in rocks, factor of safety, strengthening measures (concrete shear keys, bored concrete piles, tensioned cable anchors, concrete block at toe), settlement in rocks (from joint factor, for horizontal joints, from field tests).	07
VII	**Stability of Rock Slopes:**	06

	Modes of failure, rotational failure, plane failure, wedge method of analysis, buckling failure, toppling failure, improvement of slope stability and protection.	
VIII	**Opening in Rocks:** Introduction to theory of elasticity, lines and unlined tunnels, pressure tunnels and tunnels for other purposes.	06
IX	**Rock Bolting and Grouting:** Grouting in rocks, objectives, contact grouting, consolidation grouting, process of grouting, grout requirement, types of grout, stage grouting, grout curtain. Rock bolts, rock bolt types and applications, theory of rock bolting, rock anchors, modes of failure, uplift capacity.	05

Contribution to Outcomes

On successful completion of the course, the students shall develop an ability to identify, formulate and solve rock associated problems. They are further expected to acquire the knowledge about the latest trends and methodologies for understanding rock mechanics and engineering.

Theory Examination:-

1. Question paper will comprise of **six** questions; each carrying 20 marks.
2. The **first** question will be **compulsory**whichwill 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 further, and 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 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.

Term Work:

The term-work shall comprise of the neatly written report based on the assignments. The assignments shall be given covering the entire syllabus in such a way that the students would attempt at least two problems and/or questions on each modules/ sub-modules and 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. The final certification and acceptance of the term-work warrants the satisfactory and the appropriate completion of the assignments;andthe 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. Fundamentals of Rock Mechanics: *J. C. Jaegar and N. G. W. Cook*, Oxford Press.
2. Rock Mechanics and Design of Structures on Rock: *Obert, Leon and W. I. Duvall.*
3. Rock Mechanics in Engineering Practice: *K. G. Stagg and O. C. Zienkiewicz*, John Willey and Sons, New York.
4. Rock Mechanics – Vol. I and II: *Jumukis*, Trans Tech Publication, USA.

Semester VII

Subject Code	Subject Name	Credits
CE-E705	Elective-I: Applied Hydrology and Flood Control	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	25	--	25	150

Rationale

This subject deals with the various processes involved in hydrological cycle and provides in depth understanding of the theories and concepts of surface, subsurface and ground water hydrology. It also explains the application of hydrographs, unit hydrographs and further describes various techniques of estimating stream flows.

Objectives

1. To study the various processes involved in the hydrological cycle.
2. To study the Measurement of rainfall, computation of average rainfall, various water losses etc.
3. To study the hydrograph and unit hydrographs, applications of unit hydrograph concept.
4. To study various flood control methods, estimate design flood, and flood routing.

5. To study the concepts of ground water movement, steady and unsteady flow towards fully penetrating wells and well yields.

Detailed Syllabus

Module	Sub-Modules/ Contents	Periods
I.	**Introduction:** Hydrological cycle, scope of hydrology, water budget equation, sources of data.	2
II.	**Precipitation:** Measurement of precipitation, network of rain gauges and their adequacy in a catchment, methods of computing average rainfall, hyetograph and mass curve of rainfall, adjustment of missing data, station year method and double mass curve analysis, Depth-Area - Duration relationship, Intensity-Duration -Frequency relationship, Probable Maximum Precipitation.	5
III.	**Abstractions from Precipitation:** Evaporation and transpiration, evapotranspiration, interception, depression storage, infiltration and infiltration indices, determination of water losses.	3
IV.	**Stream Flow Measurement:** Measurement stream-flow by direct and indirect methods, measurement of stage and velocity, area-velocity method, stage-discharge relationships, current meter method, pitot tube method, slope-area method, rating curve method, dilution technique, electro-magnetic method, ultrasonic method.	6
V.	**Runoff:** Catchment, watershed and drainage basins, Factors affecting runoff, rainfall-runoff relationship, runoff estimation, droughts.	4
VI.	**Hydrograph Analysis:** Characteristics, base *flow* separation, unit hydrograph, S-hydrograph, complex hydrograph, synthetic hydrograph, dimensionless unit hydrograph, Instantaneous unit hydrograph.	14

VII.	**Floods:** Estimation, envelope curves, flood frequency studies, probability and stochastic methods, estimation of design flood, flood control methods, Limitations, risk-reliability and safety factor.	5
VIII.	**Flood Routing:** Reservoir routing, channel routing.	5
IX.	**Ground Water Hydrology:** Yield , transmissibility, Darcy's law, Dupuit's theory of unconfined flow, steady flow towards fully penetrating wells (confined and unconfined).Unsteady flow towards wells: Jacob's curve and other methods, use of well Function, pumping tests for aquifer characteristics, methods of recharge.	8

Contribution to Outcomes

On completion of this course, student shall have a good understanding of the:

- principles of hydrologic cycle and water budgeting
- measurement and analysis of precipitation and water losses
- rainfall-Runoff relationships, runoff estimation and stream gauging techniques
- hydrographs and unit hydrographs, application of unit hydrographs
- steady and unsteady flow towards well, aquifer characteristics and yields from wells.

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 further, and the weightage of the marks shall be judiciously awarded in proportion to the importance of the sub-module and 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.

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 and / or questions on each sub-modules and 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. 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. Engineering Hydrology: *K. Subramanya*, Tata McGraw Hill Publishing Co. Ltd. New Delhi.
2. Irrigation Engineering and Hydraulic Structures:*S. K. Ukarande*, Ane‘s Books Pvt. Ltd. (Abridged Edition 2015), ISBN 9789383656899
3. Hydrology: *H. M. Raghunath*, New Age International Publishers, New Delhi
4. Irrigation and Water Power Engineering: Dr. *B.C. Punmia* and Dr. *Pande*, *B.B.Lal*, Laxmi Publications Pvt. Ltd. New Delhi.
5. Irrigation Engineering and Hydraulics Structures: *S. K. Garg*, Khanna Publishers. Delhi
6. Irrigation Water Resources and Water Power Engineering: Dr. *P.N. Modi*, Standard BookHouse. Delhi.
7. Elementary Hydrology: *V. P. Singh*, Prentice Hall
8. Engineering Hydrology: Principles and practice*: V. M. Ponce*, Prentice Hall

Semester VII

Subject Code	Subject Name	Credits
CE-E705	Elective-I: Solid Waste Management	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	25	--	25	150

Rationale

This course will be of interest to those who wishes to understand the principles and techniques of solid waste management, including the legislative, environmental, economic and social drivers. The course also provides the opportunity to visit recycling facilities and disposal sites to better understand links between theory and practice.This subject deals with control of generation, storage and collection, transfer, processing and disposal of solid waste in a manner in which it benefits-public health economics, conservation aesthetics and other environmental considerations.

Objectives

- To understand the implications of the production, resource management and environmental impact of solid waste management.

- To understand the components of solid waste management infrastructure systems to minimize the above effects.
- To be aware of the significance of recycling, reuse and reclamation of solid wastes.
- To be familiar with relationships between inappropriate waste management practices and impacts on water, soil and sediment quality.
- To fully appreciate the current practices available and implement the systems available in solid waste management.
- To be capable of carrying out an assessment of the relationships between environmental guidelines, human activities and environmental quality of impacted soils and water.
- To study the different storage and collection method of the solid waste management.

Detailed Syllabus

Module	Sub-Modules/Contents	Periods
1.	**Introducing Municipal Solid Waste Management** Overview: problems and issues of solid waste management - Need for solid waste management-Functional elements such as waste generation, storage, collection, transfer and transport, processing, recovery and disposal in the management of solid waste.	05
2.	**Generation and Characteristics of Waste** Sources, Types, composition, quantity, sampling and characteristics of waste, factors affecting generation of solid wastes.	04
3.	**Waste Collection, Storage and Transport** Collection and storage of municipal solid waste; Methods of collection - House to House collection - Type of vehicles-Manpower requirement-collection routes; on site storage methods-materials used for containers-Reduction of solid waste at source-on site segregation of solid waste-Recycling and Reuse Need for transfer and transport; transfer station-selection of location, operation and maintenance; transportation Methods-manual, Mechanical methods with or without compaction, economy in transportation of waste optimization of transportation routes.	10

4.	**Waste Processing Techniques** Processing techniques-biological and chemical conversion technologies – composting and its methods, vermicomposting, mechanical composting, In vessel composting, incineration, pyrolysis, gasification.	07
5.	**Disposal of Solid Waste** Segregation, reduction at source, recovery and recycle; dumping of solid waste-sanitary waste- sanitary landfills-site selection-design and operation of sanitary landfill-secure landfills-landfill bioreactors-leachate and landfill gas management-landfill closure and environmental monitoring-landfill remediation; Municipal solid waste in Indian conditions, legal aspects of solid waste disposal.	12
6.	**Industrial Solid Waste** Waste products during manufacturing and packing, operation of pollution control facilities, generation, minimization at source, recycling, disposal.	04
7.	**Hazardous Waste** Definition, sources, hazardous characteristics, management, Treatment and disposal, mutagenesis, carcinogenesis, Toxicity testing.	04
8.	**Biomedical Waste** Definition, sources, classification, collection, segregation, treatment and disposal.	04
9.	**Electronic Waste** Waste characteristics, generation, collection, transport and disposal.	02

Contribution to outcomes

On completion of this course, the students shall be able to understand the various methods of disposal of solid waste. They shall have the better understanding of the nature and characteristics of solid waste and regulatory requirements regarding solid waste management and further they shall have an ability to plan waste minimization. Besides, they shall be prepared to contribute practical solutions to environmental problems in our society.

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 further, and the weightage of the marks shall be judiciously awarded in proportion to the importance of the sub-module and 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 will be based on the entire syllabus and the term work.

Site Visit:

Each student shall visit any site involving industrial/hazardous/municipal solid waste comprising source, characterization, transportation, recycles, treatment and disposal. The detailed report prepared on such visit will also form a part of 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 two problems and/ or questions on each modules/ sub-modules and contents thereof further. A detailed report prepared on the site visit as mentioned in the afore-mentioned section will also be submitted along with the assignments.

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 completion of the assignments 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.

1. Tutorial and Assignments: 16Marks
2. Report on the site visit : 04 Marks
3. 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

Demonstration of available software for design of sewage treatment plant and sewer network is to be done.

Recommended Books:-

1. Integrated Solid Waste Management: *Techobanglous, Thisen, and Vigil*, McGraw Hill International.
2. Hazardous Waste Management: *Lagrega, Buckingham, and Evans*, McGraw Hill International.
3. Solid Waste Management in Developing Countries: *Bhide, A. D.*, Nagpur publications.
4. Environmental Pollution Control Engineering: *Rao, C. S.*, Wiley Eastern, Manual of solid waste of management, CPHEEO.
5. E-Waste: Implications, Regulations, and Management in India and Current Global Best Practices, *Rakesh Johri*, The Energy and Resources Institute.
6. Biomedical Waste Management in India: *Jugal Kishore and Ingle, G. K.*, Century Publications.

Semester VII

Subject Code	Subject Name	Credits
CE-E705	Elective-I: System Approach in Civil Engineering	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	25	--	25	150

Rationale

Use of advanced analytical techniques to improve decision making is the need of the hour in Civil Engineering, considering the present scenario. Systems approach is also known as operations research, management science or industrial engineering. People with skills in systems approach hold jobs in decision support, business analytics, marketing analysis and logistics planning in civil engineering projects.This course is indeed required by the civil engineering professionals, as it makes sense to make the best use of available resources. Today's global markets and instant communications mean that customers expect high-quality products and services when they need them, where they need them. The organizations, whether public or private, need to provide these products and services as effectively and efficiently as possible. This requires careful planning and analysis – the hallmarks of good systems approach. This is usually based on process modelling, analysis of options or business analytics.This course helps a civil engineer to arrive at proper scheduling, facility planning, forecasting, managing and marketing their projects

Objectives

1. To develop the skill for problem formulation amongst the students so as to enable them understand various components for formulating a problem
2. To develop decision making, especially, under uncertain scenario, risks, etc.
3. To enable thestudents formulate LPP, NLP, distribution queuing models, assignment and transportation models, games theory, replacement models and other such optimization techniques and should be able to analyze them.

Detailed Syllabus

Module	Sub- Modules/Contents	Periods
I	**Concept of Systems Approach:** 1.1 System, boundaries of system, goals and objectives, optimality, 1.2 Mathematical models, objective function and constraints, 1.3 Problem solving mechanism, types of problems, modeling/problem formulation, 1.4 Sub-optimization, solution techniques, 1.5 Sensitivity Analysis	07
II	**Decision Theory:** 2.1 Classification of decision situations, decision tables and decision tree, 2.2 criteria for decision making under certain, uncertain and risk conditions, 2.3 Utility theory	07
III	**Time Series Analysis::** 3.1 Variations in time series, 3.2 Trend analysis: method of moving averages 3.3 Method of least squares	06

IV	**Linear Programming:** 5.1 Formulation of Linear optimization models, Civil engineering applications. 5.2 Simplex method, special cases in simplex method, 5.3 Method of Big M, Two phase method, duality, sensitivity analysis General nature of problem, formulation of problems 5.4 Graphical nature and formulation of problem, method of solution, 5.5 Sensitivity analysis	08
V	**Non-Linear Programming:** 4.1: Single variable unconstrained optimization –Local and Global optima, Uni-modal Function 4.2 Sequential Search Techniques: Dichotomous, Fibonacci, Golden Section methods.	05
VI	**Distribution Models:** 6.1 Transportation problems and its variants 6.2 Assignment problems and its variants 6.3 Games Theory	07
VII	**Queuing, Sequencing and Replacement Models:** 7.1 Queuing Theory, queue discipline, Simulation 7.2 Sequencing model – n jobs through 2, 3 and M machines 7.3 Replacement Models	06
VIII	**Dynamic Programming:** 8.1 Multi stage decision processes, Principle of optimality, Recursive equation, Application of D.P. 8.2 Decision theory	06

Contribution to Outcomes

On successful completion of the course, the students shall be able to solve various civil engineering problems by formulating them into linear and non-linear programmes. Further, they are expected to be able to analyze and take appropriate decisions by applying transportation, assignment, sequencing making, replacement models to the specific problems. They are also expected to apply dynamic programming, games theoryand other such optimization approaches to civil engineering 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 further, and 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 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.

Term Work:

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

Reference Books:

1. Operations Research : *Hamdy A.Taha*
2. Engineering Optimization—Theory and Practice:*Rao.S. S.*, Wiley.
3. Engineering Optimization—Methods and Applications: *Ravindran Philip*s,Wiley
4. Operations Research:*Sharma, J. K.*
5. Quantitative Techniques in Management:*Vohra, N. D.*
6. Principles of Construction Management:*Pilcher, R.*
7. Operations Management: *Buffa, E. S.*
8. Principles of Operations Management: *Wangner, H. M.*
9. Principles of Operation Research: *Wagner*, Prentice Hall.
10. Operation Research:*Hira* and *Gupta*, S.Chand
11. Operations Research: Principles and Practice: *RavindravPhilip* and *Solberg*,Wiley,India

Semester VII

Subject Code	Subject Name	Credits
CE-E705	Elective-I: Risk and Value Management	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	25	--	25	150

Rationale

Many risks and uncertainties are associated with civil engineering projects. As these projects are directly applicable and beneficial to the society, oneneeds to carry out all such projects with great care by applying risk management in practices. At the same time, one needs to maintain the value right from the conception stage of the project. This course is indeed required by the civil engineering professionals as it makes sense to identify the risks involved and manage risks through the management system. This course helpsthecivil engineer to get acquainted with value engineering approach, function analysis, etc.

Objectives

1. To understand the types of risks involved in civil engineering/ construction projects.
2. To enable the students develop the skills of managing the risks.
3. To prepare value engineering job plan.

4. To make the students understand the basic concept of function analysisfor achieving the value.
5. To impart to the students the knowledge of the life cycle costing of the civil engineering/ construction projects.

Detailed Syllabus

Module	Sub- Modules/Contents	Periods
I.	**Risks** Definition, Types of risks; Uncertainties in projects.	03
II.	**Risks associated with construction** Risks related to resources- Time, Money, Technology, Manpower etc.; Risks related to agencies- Client, Contractor etc.; Decision making in construction.	05
III.	**Risk Management Systems:** Risk identification, sources of risks.; Classification of risks, Impact and consequences of risks; Risk qualification and risk analysis; Risk response, retention, reduction, transfer and avoidance	07
IV.	**Value Engineering:** Definition: Value, Value Engineering, Value Analysis; Value Management; Habits, attitudes and roadblocks and their relation to value Engineering.	07
V.	**Value Engineering Job Plan:** Definition: Value Engineering Job Plan, Various versions of plan; Phases involved in Job Plan.	04
VI.	**Function Analysis:** Function and its role in achieving value; Function in terms of its cost and worth; Graphical functional analysis; Function analysis system technique.	06
VII.	**Creative Thinking:** Definition: Creative Thinking; Creative People and their characteristics; Creative Processes, Creative sessions etc.	06

VIII.	**Life Cycle Costing :** Definition, Purpose and implications; Economic Principles for L.C.C.; Types of life cycle costs.	05
IX.	**Energy :** Energy resources and consumption; Energy embodiment of construction materials; Factors affecting energy consumption; Impact of maintenance on energy saving.	07
X.	Integrated approach to value and risk management**.**	02

Contribution to Outcomes

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

1. Identify the risks associated with the projects and apply risk management systems.
2. Understand the value approach clearly and apply the measures for achieving the value.
3. Prepare value engineering job plan.
4. Know about the creative thinking, creative people which will be very much helpful for them in future.
5. Understand the effective consumption of valuable energy.

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 further, and 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 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.

Term Work:

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

Distribution of TermWork Marks:

The marks of term-work shall be judiciously awarded depending upon the quality of the term work. 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. Value Engineering: L.W. Zimmerman, *Hart, G.D.* (CBS publishers and distributors.)
2. Value andRisk Management: *Dallas, M.F.* (Blackwell publishing.)
3. Risk Management andConstruction: *Flagnan, R.*and*Norman, G.*(Blackwell Scientific)
4. Value Engineering in the Construction Industry – *Dell'lsola, A.J.*(Construction publication company)

Semester VII

Subject Code	Subject Name	Credits
CE – C 705	Advanced Structural Analysis	6

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	03	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 indeterminate. There are various advanced method to analyze these structure. The methods of analysis which are given in the syllabus are amenable to computer software.

Objectives

- To analyze the statically indeterminate portal frame.
- To study the various methods for evaluating rotation and displacement parameters in complete frame.
- To analyze the symmetrical frame with symmetrical and anti-symmetrical loading.
- To understand the concept of analysis of non-prismatic frame and beam.
- To understand the concept of influence lines with respect to statically indeterminate beams.

- To understand the concept of plastic analysis with respect to the simple portal frame.
- To understand thoroughly the stiffness matrix method of analysis which is the basis of all computerbasedsoftware methods used in practice.

Detailed Syllabus

Module		Sub – Modules / Contents	Periods
I.	**1. Introduction to stiffness Method in Matrix Form** :		15
	1.1	Basic concepts of stiffness coefficients, member stiffness matrix for beam, member stiffness matrix for plane truss, member stiffness matrix for rigid jointed plane frame, member stiffness matrix for plane grid and of space frame.	
	1.2	Properties of stiffness matrix, co-ordinate transformation matrix, stiffness matrix in local and global co-ordinate axes system, assemblage of structural stiffness matrix and application of boundary conditions.	
	1.3	Joint loads, Equivalent joint loads, method of solution for displacements and computation of internal forces in members	
	1.4	Application of stiffness method to beams, pin jointed trusses, rigid jointed plane frames and simple plane grid structures.	
II.	**2. Conventional Form of stiffness Method, Modified Moment Distribution Method, Kani's Method :**		10
	2.1	Symmetrical structure, Symmetric and anti-symmetric loads, Modification of stiffness and carryover factors for symmetric and anti-symmetric loads both for sway and non-sway cases for frames with different support conditions. Application to frames involving side sways	
	2.2	Fundamental equation of Kani's method, frames with side sway and without sway.	
III.	**3. Flexibility Method in Matrix Form** :		04
	3.1	Review of concepts of flexibility coefficients, Flexibility member matrix for beam, member flexibility matrix for plane truss, member flexibility matrix for rigid jointed plane frame, member	

		flexibility matrix for plane grid and of space frame.	
	3.2	Selection of primary structure, concepts of flexibility matrix, compatibility equation, solution for redundant forces, computational of internal forces, and joint displacement. Application to pin jointed trusses and rigid jointed plane frames for different loading including the effect of settlement of support, temperature changes and elastic supports	
IV.	**4. Conventional Form of Flexibility Method :**		10
	4.1	Elastic Center Method and its application to rectangular box, rigid jointed portal frames and fixed arches.	
	4.2	Column Analogy Method and its application to analysis of non-prismatic beams, simple rectangular frames, determination of stiffness coefficients and carry over factors for non-prismatic beam members	
V.	**5. Influence Line Diagrams for Indeterminate Structures**		05
	Muller Breslau's Principle for drawing influence line diagrams for statically indeterminate structures. Influence Lines Diagrams for propped cantilevers, fixed beams and continuous beams.		
VI.	**6. Approximate Method for Analysis of Building Frames :**		05
	6.1	Approximate method for gravity loads: Substitute frame method and equivalent frames.	
	6.2	Approximate method for lateral loads: Portal and cantilever method.	
VII.	**7. Plastic Analysis of Steel Structures :**		03
	Application to single bay single storey rectangular frames		

Contribution to Outcomes

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

- Understand the stiffness matrix method and to analyze various types of structures using this method.
- Understand the conventional and approximate methods of analysis.

- Understand the methodology involved in commercially available computer software for analysis which are based on stiffness matrix method
- Obtain the response of the indeterminate beams under the action of moving loads.
- Evaluate the displacement/ deflection in frames under the action of loads

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 further, and 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 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 andthe term work.

Term Work:

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

Recommended Books:

1. Basic Structural Analysis: *Reddy C. S.*,Tata McGraw hill.
2. Analysis of Framed Structures : *Gere and Weaver*, East-West Press
3. Analytical Methods in Structural Analysis: *S. A. Raz* , New Age Int Publishers
4. Modern Method in Structural Analysis: *Dr. B. N. Thadani and Dr. J. P. Desai*, Weinall Book Corporation.
5. Structural Analysis: *L. S. Negi and R. S. Jangid*, Tata McGraw hill.
6. Structural Analysis Vol. I and Vol. II: *Pandit and Gupta*, Tata McGraw Hill.
7. Fundamentals of Structural Mechanics and Analysis: *Gambhir, M.L.*, Prentice Hall India (PHI) Learning Pvt. Ltd.
8. Structural Analysis Vol.II: *Vaidyanathan, R. and Perumal*, P., Laxmi Publications
9. Fundamentals of Structural Analysis: Roy, Sujit Kumar and Chakrabarty, Subrata, S. Chand and Co. Ltd., New Delhi
10. Structural Analysis: *T.S. Thandavamoorthy*, Oxford Higher Education

Reference Books:

1. Matrix Method in Structural Analysis: *Livesley R. K. Pergamon Press*, London.
2. Elementary Structural Analysis: *Wilber*, McGraw Hill, New York.
3. Plastic Method of Structural Analysis: *B. G. Neal*, Chapman and Hall, London.
4. Intermediate Structural Analysis : *Wang C. K.*, Tata McGraw hill
5. Matrix Method of Structural Analysis: *Dr. A. S. Meghre, S. K. Deshmukh*, Charotar Publishing House.
6. Structures: *Schodek, D.L. and Bechthold, Martin*, Prestice Hall India Learning Pvt. Ltd.
7. Matrix Analysis of Structures: *P. K. Singh*, Cengage Learning.

Semester VII

Subject Code	Subject Name	Credits
CE-E705	Elective-I: Advanced Structural Mechanics	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	25	--	25	150

Rationale

There are different types of structures subjected to various types of loading/ forces such as axial, shear, bending and torsion. This course equips the students to analyze the behavior of structural members under different types of loading. This course also aimed at imparting certain theoretical foundation and physical understanding to solve structural mechanics problems mostly involving beams and thin-walled structures under different loading conditions.

Objectives

1. To understand the concept of the shear centre and evaluation of the shear centre for symmetrical and non-symmetrical thin walled sections.
2. To understand the concept and behavior of beams resting on elastic foundation.
3. To study the behavior of beams curved in plan.

4. To understand the concept of different theories of failure with respect to materials.
5. To study the behavior of deep beams using different theories available for the analysis of different sections.
6. To introduce the concept of torsion theories for solid section.

Detailed Syllabus

Modules	Sub-Modules/ Contents	Periods
I.	Shear Centre for symmetrical and non-symmetrical (about both axes) thin walled open sections.	07
II.	Bending of beams with large initial curvature loaded in their plane of curvature. Application to analysis of hooks, circular closed rings, chain links with straight length and semi-circular ends.	08
III.	Beams on elastic foundation: Analysis of beams of infinite length subjected to concentrated force/moment and semi-infinite length subjected to concentrated load/moment at one end. Semi-infinite beam hinged at one end (origin) and subjected to UDL throughout.	08
IV.	Beams curved in plan: Analysis of beams loaded perpendicular to their own plane, simply supported, fixed and continuous beams.	07
V.	Theories of Failure: Maximum principal stress theory, Maximum principal strain theory, Maximum shear stress theory, maximum total strain energy theory.	08
VI.	Analysis of deep beams: Determination of deflection. Determination of shear correction factor for various sections rectangular solid and hollow section and circular solid and hollow section and I-section	06
VII.	Torsion in non-circular solid section rectangle, triangular and hexagon section.	08

Contribution to Outcomes

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

1. Understand the concept of shear centre for thin walled open sections.

2. Study the behavior of beam resting on elastic foundation with various loading conditions.
3. Analyze the beam curvedin plan for different support conditions.
4. Understand the concept of different theories of failure in different sections.
5. Determine deflection, shear correction factor for different sections like solid and hollow sections.
6. Understand the concept of torsion in non-circular solid section.

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 further, and 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 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 syllabusand the term work.

Term Work:

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

Recommended Books:-

1. Mechanics of Materials: *Popov, E.P.* Prentice Hall of India Pvt. Ltd.
2. Mechanics of Materials: *James Gere, M.*,Thomson Brooks.
3. Mechanics of Materials: *Beer, F.P., E. Russell Jhonston and John T. DeWolf*, TMH, New Delhi.
4. Advanced Mechanics of Materials: *Arthur P. Boresi and Omar M. Sidebottom*, Wiley and Sons.
5. Advanced Mechanics of Materials: *Arthur P. Boresi and Richard Schmidt*, John Wiley and sons.
6. Strength of Material Part I and Part II: *Timoshenko*, McGraw Hill, New York.
7. Mechanics of Solids: *Shames, I* and *Pitarresi,J. M.*, Preentice Hall, New Delhi.
8. Beams on Elastic Foundation: *Heteny M.*
9. Strength of Materials: *Subramanian*, Oxford University Press.

Semester VII

Subject Code	Subject Name	Credits
CE-E705	Elective-I: Structural Dynamics	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	25	--	25	150

Rationale

The civil engineering structures are mostly designed for only static gravitational loads. However, in actual practice the structures may be subjected to dynamic loads due to wind, vibrations, impacts, explosion, shocks and earthquake forces apart from the static loads. This subject involves the basic understanding of the analysis of structures subjected to such type of loading.

Objectives

- To expose the students to understand the basic theory of structural dynamics, structural behavior under vibratory load and the effect of damping.
- To study the difference between static load and different types of dynamic loads.
- To study the free vibration analysis of SDOF systems, concept of damping and dynamic analysis of SDOF system subjected to different dynamic loads.

- To study the dynamic degrees of freedom andcalculation of the frequencies and mode shapes for lumped mass for discrete MDOF systems,
- To study the modal analysis of MDOF systems and analysis of systems with distributed mass for continuous system.
- To study the random vibrations, probabilistic theory, random process and related parameters.
- To study the stochastic response analysis of linear SDOF systems.

Detailed Syllabus

Module	**Sub-Modules/Contents**	**Period**
I	**Introduction:** Introduction to structural dynamics, definition of basic problem in dynamics, static v/s dynamic loads, different types of dynamic load	02
II	**Single Degree of Freedom (SDOF) Systems:** Undamped vibration of SDOF system, natural frequency and period of vibration, damping in structures, viscous damping and coulomb damping, effect of damping on frequency of vibration and amplitude of vibration, Logarithmic decrement. Forced vibration, response to harmonic forces, periodic loading, dynamic load factors, response of structure subjected to general dynamic load, Duhamel's integral, numerical evaluation of dynamics response of SDOF systems subjected to different types of dynamic loads. Introduction to frequency domain analysis, response of structure in frequency domain subjected to general periodic and non-periodic / impulsive forces of short duration, use of complex frequency response function. Use of Fourier Series for periodic forces, introduction to vibration isolation. Distributed mass system idealized as SDOF system, use of Rayleigh's method, response of SDOF system subjected to ground motion.	16

III	**Generalized Single-Degree of Freedom System:** Generalized properties, assemblages of rigid bodies, systems with distributed mass and elasticity, expressions for generalized system properties.	04
IV	**Lumped Mass Multi Degree of Freedom (MDOF) system:** Coupled and uncoupled systems, direct determination of frequencies of vibration and mode shapes, orthogonality principle, vibration of MDOF systems with initial conditions, approximate methods of determination of natural frequencies of vibration and mode shapes-vector iteration methods, energy methods and use of Lagrange's method in writing equations of motions. Decoupling of equations of motion, modal equation of motion, concept of modal mass and modal stiffness, forced vibration of MDOF system, modal analysis, and application to multi storey rigid frames subjected to lateral dynamic loads.	10
V	**Structure with Distributed Mass System:** Use of partial differential equation, free vibration analysis of single span beams with various boundary conditions, determination of frequencies of vibration and mode shapes, forced vibration of single span beams subjected to the action of specified dynamic loads.	05
VI	**Random Vibrations:** Probability theory: Single random variable, important averages of single random variable, two random variables, important averages of two variables, principal axis of joint probability density function, Rayleigh's probability density function. Random processes, stationary and ergodic processes, autocorrelation function, power spectral density function, relationship between power spectral and autocorrelation functions, power spectral density and autocorrelation functions for derivatives of processes, superposition of stationary processes, stationary Gaussian processes, stationary white noise, probability distribution for maxima and extreme values	09

VII	**Stochastic Response of Linear SDOF Systems:** Transfer functions, relationship between input and output autocorrelation functions, relationship between input and output power spectral density functions, response characteristics for narrowband systems	06

Contribution to Outcomes

The students are expected to understand the difference between static and dynamic loads and analysis. They are expected to evaluate the response of SDOF and MDOF systems to different types of dynamic loads including ground motions. They are also expected to understand the basics of random vibrations and the application of this concept to analyze Linear SDOF systems.

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 further, and 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 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.

List of experiments: *(At least five to be performed)*

1. To find the time period of compound pendulum
2. To study instrumentations in structural dynamics

3. To find natural frequency of SDOF system
4. To find natural frequency of two DOF system
5. To find natural frequency of three DOF system
6. To observe liquefaction of soil
7. To observe phenomenon of vibration absorption

Term Work:

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

Distribution of Term Work Marks:

The marks of term-work shall be judiciously awarded for various components 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.

- Report of the Practical: 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:-

- Structural Dynamics-An Introduction to Computer Methods: *Craig R.R.*, John Wiley and Sons.
- Dynamics of Structures: *Anil K. Chopra*, Prentice Hall India Pvt. Ltd.
- Dynamics of Structures: *Cloguh*and*Penzein*, Tata Mc-Graw Hill Pvt. Ltd.
- Structural Dynamics:*John M. Biggs*, Tata Mc-Graw Hill.

Semester VII

Subject Code	Subject Name	Credits
CE-E705	Elective-I: Advanced Foundation Engineering	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	25	--	25	150

Rationale

In order to find the solution to field problems and design issues in wide range of geotechnical structures such as slopes, retaining walls, foundations etc., a detailed study on the theories and analysis methods is required. This course develops the capability and requisite skills of a student to problem solving in geotechnical application areas and with eemphasis on indepth study exposes the student to dwell on further new developments.

Objectives

- To study site investigation techniques and characterization of the soil
- To understand the one and three dimensional consolidation process and their practical applications
- To study stress paths and failure criteria
- To learn the different vertical stress theories

- To study the bearing capacity and settlement of shallow foundations
- To study the load carrying capacity of pile foundations
- To study different ground improvement methods

Detailed Syllabus

Module	Sub-modules/ Contents	Periods
I.	**Site exploration and characterization** Purpose and scope, influence of soil conditions and type of foundations on exploratory programme, project assessment, phasing of site exploration. Open excavation and boring methods of exploration, types of samplers and their design features. Subsurface soundings- static, dynamic and geophysical methods. Planning of subsurface investigations, type and sequence of operations, lateral extent and depth of exploration, interpretation of field and laboratory data.	06
II.	**Consolidation** Terzaghi's one dimensional consolidation- derivation of equation (solution in detail need not be covered) Estimation of C_c and c_v from laboratory tests, estimation of preconsolidation pressure by various methods, field consolidation curves, prediction of field settlement, practical applications. Quasi-preconsolidation and secondary consolidation. Concept of three dimensional consolidation in cylindrical coordinates, theory of sand drain and prefabricated vertical drains.	10
III.	**Stress and strain behaviour of soil** Triaxial test – drained and undrained behaviour of sands and clays. Stress path, ideal, plastic and real soil behaviour, shear strength of sands and clays, failure criteria in soils- Mohr-Coulomb's criteria, modified cam clay model.	06
IV.	**Estimation of stresses** i. Boussinesq's theory, vertical stress due to concentrated load,	05

	horizontal and shear stress due to concentrated load, isobar diagram, vertical stress distribution on horizontal plane, influence diagram, vertical stress distribution on vertical plane. ii. Vertical stress due to line load, vertical stress under strip load, maximum shear stress at points of under strip loads, vertical stress under a circular area, vertical stress under a corner of a rectangular area, Newmark's influence charts. iii. Westergard's theory.	
V.	**Bearing capacity and settlement of shallow foundation** Modes of failure, failure criteria- Terzahi concept, Vesic concept, IS code recommendations. Assumptions in estimation of ultimate loads, effect of shape, embedment of footing, eccentricity in loading, choice factor of safety. Compressibility (including critical rigidity index), settlement of foundations on sand- Schmertmann method. Evaluation of bearing capacity using plate load test and standard penetration test, Housel method.	12
VI.	**Pile foundations** Estimation of single pile capacity by static and dynamic methods, group capacity in sand and clay deposits, separation of skin friction and end bearing capacity. Settlement of single and group of piles.	07
VII	**Ground improvement** Improvement of deep cohesionless soils. Improvement in cohesive soils. Improvement of soil using additives such as fibres, chemicals, sustainable waste materials Concept of using geosynthetics, soil nailing to stabilize slopes and embankments Instrumentation- pore pressure gauges and settlement gauges and their applications.	06

Contribution to Outcomes

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

1. Ability to identify, formulate and solve geotechnical engineering problems
2. Ability to design a suitable foundation system from economic and safe aspects
3. Awareness of the latest trends and instrumentation in ground improvement methods
4. Ability to relate easily to allied subjects such soil dynamics; advanced engineering geology, rock mechanics etc.

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 further, and 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 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:

Oral examination will be based on entire syllabus and the term work.

List of Experiments:

It is recommended to perform the following laboratory tests.

1. Unconsolidated Undrained, Consolidated Undrained and Consolidated Drained triaxial tests.
2. Direct box shear test on c-ϕ soils.

Site / Field Visits:

The students shall be taken to visit the sites where pile driving/SPT/CPT/plate load tests are carried being out. They will prepare a detailed report thereof which will be submitted along with the term work.

Term work:

The term-work shall comprise of the neatly written report based on the experiments performed in the laboratory and the assignments. The assignments shall be given covering the entire syllabus in such a way that the students would attempt at least three problems and/ or questions on each modules/ sub-modules or contents thereof further. A project report covering the selection of soil parameters and design of shallow / pile foundations and ground improvements using stone columns and sand drains shall also form a 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 its quality. The final certification and acceptance of term work warrants the satisfactory performance of the experiments by the student, properly compiled report thereof along with the assignments 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	:	05 Marks
Assignments	:	10 Marks
Report of Site Visit/ Field 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. Soil Mechanics and Foundation Engineering: *V. N. S. Murthy*, Saitech Publications
2. Soil Mechanics and Foundation Engineering: *K. R. Arora*, Standard Publishers and

Distributors, New Delhi.

3. Geotechnical Engineering: *C. Venkatramaiah*, New Age International.
4. Soil mechanics in Engineering Practice: *K. Terzaghi* and *R. B. Peck*, Wiley international edition.
5. Foundation Engineering Hand Book: *Winterkorn* and *Fang*, Galgotia publications.
6. Foundation Design Manual: *N. V. Nayak*, DhanpatRai publications (P) Ltd.
7. Principles of Foundation Engineering: *Braja M. Das*, PWS publishing.
8. Relevant Indian Standard Specifications and Codes, BIS Publications, New Delhi.

Semester VII

Subject Code	Subject Name	Credits
CE-E705	Elective-I: Ground Water Hydrology	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	25	--	25	150

Rationale

This subject deals with the basic principles of ground water flow and application of ground water engineering. It discusses theground water availability, ground water flow, storage and yield of well. It also provides basic knowledge on ground water pollution, ground water management and ground water modeling.

Objectives

- To understand the sources of ground water, aquifers, water occurrence and movement in different types of rocks.
- To understand the ground water potential theory, movement of ground water, evaluation of aquifer parameter.
- To study yield of well, the various types of wells, construction, maintenance, etc.

- To study the quality of ground water analysis and ground water pollution, recharge of ground water, etc.
- To study the ground water management and ground water modelling.

Detailed Syllabus

Module	Sub-Modules / Contents	Periods
I.	**Introduction:** Ground water utilization and historical background, ground water in hydrologic cycle, ground water budget, ground water level fluctuations and environmental influence, literature/ data/ internet resources.	2
II.	**Occurrence and Movement of Ground Water:** • Origin and age of ground water, rock properties affecting groundwater, groundwater column, zones of aeration and saturation, aquifers and their characteristics/classification, groundwater basins and springs. • Darcy's Law, permeability and its determination, Dupuit assumptions, heterogeneity and anisotropy. • Ground water flow rates and flow directions, general flow equations through porous media	6
III.	**Advanced Well Hydraulics:** • Steady /unsteady, uniform / radial flow to a well in a confined/ unconfined /leaky aquifer, well flow near aquifer boundaries/ for special conditions. • Partially penetrating/horizontal wells and multiple well systems, well completion/ development/ protection/ rehabilitation/ testing for yield	12

IV.	**Pollution and Quality Analysis of Ground Water:** • Municipal /industrial /agricultural /miscellaneous sources and causes of pollution, attenuation/underground distribution / potential evaluation of pollution. • Physical /chemical /biological analysis of groundwater quality, criteria and measures of ground water quality, ground water salinity and samples, graphical representations of ground water quality.	6
V.	**Surface/ Sub-Surface Investigation of Ground Water:** • Geological /geophysical exploration/ remote sensing / electric resistivity /seismic refraction based methods for surface investigation of groundwater, test drilling and ground water level measurement. • Sub-surface ground water investigation through geophysical / resistivity /spontaneous potential/radiation / temperature / caliper / fluid conductivity.	6
VI.	**Artificial Ground Water Recharge:** • Concept and methods of artificial ground water recharge, recharge mounds and induced recharge, wastewater recharge for reuse, water spreading.	5
VII.	**Saline Water Intrusion in Aquifers:** • Ghyben-Herzberg relation between fresh and saline waters, shape and structure of the fresh and saline water interface. • Upcoming of saline water, fresh-saline water relations on oceanic islands, seawater intrusion in Karst terrains, saline water intrusion control	5

VIII	**Modeling and Management of Ground Water:** • Ground water modeling through porous media/analog / electric analog / digital computer models. • Ground water basin management concept, hydrologic equilibrium equation, conjunctive use of surface and ground water, ground water basin investigations, data collection and field work, dynamic equilibrium in natural aquifers. • Management potential and safe yield of aquifers, stream-aquifer interaction.	10

Contribution to Outcomes

On successful completion of this course, the studentsare expected to have a good understanding of:

- Porous medium properties that control ground water flow
- Ground water flow equations to confined and unconfined aquifers
- Pump test for determining the aquifer properties, yield of well, etc.
- Quality analysis of ground water, fresh-saline water relationsand ground water pollution.
- Various surface and sub-surface investigations, conjunctive use of surface and ground water, ground water management, etc.

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 further, and 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 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.

Term Work:

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

Recommended Books:

1. Numerical Modeling of Coastal Aquifers: *S .K. Ukarande* and*A. K.Rastogi* ISBN-978-3-639-17552-3"
2. Numerical Groundwater Hydrology: *A.K Rastogi*, Penram International Publication, Mumbai-ISBN-798187972272
3. Groundwater Hydrology: *D. K. Todd* , John Wiley and sons
4. Hydrogeology: *Karanth K. R.,* TataMc-Graw Hill Publishing Company.
5. Groundwater*: Freeze*, *R.A.* and *Cherry*, J.A Prentice Hall, New Jersey

Semester VII

Subject Code	Subject Name	Credits
CE-E705	Elective-I: Pavement Subgrade and Materials	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	25	--	25	150

Rationale

Highway and airways mode of transportation contributes to the economical, industrial, social and cultural development of any country. For the design and construction of highway and airfield, it is imperative to know the properties of the materials such as soil, aggregates and bitumen used in the construction of pavements. The various tests are required to be conducted to evaluate the properties of these materials for the scientific design of the pavements and economic utilization of the different materials. The course also deals with the soil survey, stresses in soil and various ways and means of improving the soil and implementing techniques of improvement. The course also deals with the various surface and sub-surface drainage.

Objectives

1. To give the students hands on experience on various material properties and testing procedures of pavement materials as per IRC standards.
2. To study the significance of the soil subgrade along with its functions.
3. To study the soil classification for highway engineering purpose as per different classification system.
4. To understand the concept of stresses in soil.
5. To enable the student to identify the basic deficiencies of various soil deposits and to arrive upon the various ways and means of improving the soil and implementing the techniques of improvement.
6. To understand the various system of drainage system.

Detailed Syllabus

Module	Sub-Modules/ Contents	Periods
I.	**Subgrade:** Functions, Importance of subgrade soil properties on pavement performance, subgrade soil classification for highway engineering purpose soils as per PRA system, revised PRA system, Bur mister system, Compaction system.	10
II.	Grading requirements for aggregate, selection of bases and sub-base material (including stabilized materials), selection of different grade of bitumen, types of bituminous surfaces, skid qualities, bituminous mix design, Marshall Stability test, design aspect of paving concrete. Experimental characteristics of road aggregate.	08
III.	**Soil Survey:** Soil Survey Procedure for Highway and Ground Water Investigation. Identification and Significance of soil Characteristics, effect of water in soil Swelling/shrinkage, cohesion, plasticity in soil. Soil Moisture movement- ground water, gravitational water, held water, soil suction.	08
VI.	**Stress in soil:** Theories of elastic and plastic behavior of soils, Methods of	10

	reducingsettlement, estimation of rate of settlement due to consolidation in foundation of road embankment. Static and cyclic triaxial test on subgrade soils, resilient deformation, resilient strain, resilient modulus. CBR test, effect of lateral confinement on CBR and E value of Subgrade soil. Static and cyclic plate load test, estimation of modulus of subgrade reaction, correction for late size, correction for worst moisture content.	
V.	**Ground Improvement Technique:** Different method of soil stabilization, use of geo-textile, geogrid and fibres in highway subgrade. Vertical sand drain: design criteria, construction and uses	08
VI	**Storm water Drainage:** General principles subsoil Drainage. Frost action soil: Frost susceptible soils, depth of frost penetration, and loss of strength during frost melting. Compaction of soils, field and laboratory method of soil compaction, equipment's used in field compaction. Design of surface and subsurface drainage system, pumping system, water body, holding ponds	08

Contribution to Outcomes

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

- Understand the soil classification in accordance with various soil classify the system and evaluate the ability of the soil as a subgrade material.
- Understand the requirements and desirable properties of the various materials to be used in the construction of pavements.
- Understand the characterization of different paving materials along with the tests to be conducted on these materials.
- Know the various ground improvement methods.
- Know the different methods of drainage in highways and design the drainage systems.

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 further, and 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 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.

Term Work:

The term-work shall comprise of the neatly written report comprising of the assignments. The assignments shall be given covering the entire syllabus in such a way that the students would attempt at least two problems/ two questions on each modules/ sub-modules and 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 which will comprise of the report on assignments. The final certification and acceptance of term-work warrants the satisfactory and the appropriate completion of the termwork; 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. Principles of Pavement Design, Second Edition, 1975: *Yoder, E.J.* , John Wiley and Sons, Inc., New York.
2. Concrete Roads: *HMSO*, Road Research Laboratory, London.
3. Highway Engineering: *Khanna, S.K., Justo, C,E.G. and Veeraragavan, A.*, Nem Chand and Brothers, Roorkee (10th Revised Edition, 2014)
4. Principles and Practices of Highway Engineering; *Dr. L. R. Kadiyali and Dr. N. B. Lal*, Khana Publishers, New Delhi.
5. Highway Engineering, *Sharma, S.K.*, S. Chand Technical Publishers, New Delhi (3rd Revised Edition, 2013).
6. Principles of Transportation and Highway Engineering: *Rao, G.V.* , Tata Mc-Graw Hill Publications, New Delhi

Semester VII

Subject Code	Subject Name	Credits
CE-E705	Elective-I: Air Pollution	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	25	--	25	150

Rationale

Air pollution is the introduction of particulates, biological molecules, or other harmful materials into the Earth's atmosphere, possibly causing disease, death to humans, damage to other living organisms such as food crops, or the natural or built environment. The atmosphere is a complex natural gaseous system that is essential to support life on planet Earth. Stratospheric ozone depletion due to air pollution has been recognized as a threat to human health as well as to the Earth's ecosystems. This course makes the students acquainted with the classification, sources and effects of air pollution, various methods; and equipment available for controlling it.

Objectives

- To have the knowledge of mathematics, science and engineering to identify and to solve the problem of air pollution.

- To lay emphasis on the principles underlying the understanding of ambient air pollution, its sources and its effects.
- To give an exposure to the students of the air pollution problem in India.
- To have an introduction to sources of air pollution, basic meteorological processes and technology for air pollution control; and odor control.
- To understand the health problems, risk assessment and global atmospheric changes due to air pollution.
- To understand the reasons for environment degradation due to air pollution.

Detailed Syllabus

Module	Sub-Modules/ Contents	Periods
I.	Composition of dry ambient air Properties of air. Function of air, Definition of pollution. Classification of air pollutants. Units for Qualification of air pollution,History of air pollution, Global and national scope of the problem- general, urban, rural, specific.	06
II.	Sources of air pollution natural and man-made Major pollutants from different sources in Greater Bombay area (or any metropolis of Maharashtra), Emission factors.	05
III.	Effects of air and noise pollution on human health, plants ,animals, properties and visibility, indoor air pollution and personal exposure to air pollution , simple numerical problems based on COH, CoHb	05
IV.	Meteorological aspects of air pollution Large scale wind circulation geotropic wind, gradient wind, cyclone, anticyclone, planetary boundary layer. Lapse rate, stability conditions, wind velocity profile, maximum mixing depth, topographic effects.	06
V.	Plum patterns, plum dispersion, Gaussian model for predicting concentration, downwind from a single source, diffusion coefficients, Turner’s stability categories and graphs for dispersion estimates. Maximum ground level concentration, inversion effects, distance touching ground modification of Gaussian model to predict particulate dispersion, plume rise, modified Holland equation for small source. ASME equation for large source, Brigg’s equation for buoyant plum	09

	rise, Brigg's equation for momentum plum rise.	
VI.	Methods and instruments for sampling and analysis of air for stack and ambient air monitoring.	05
VII.	Government of India: air pollution laws. Indian standards- emission and air quality standards.	04
VIII.	Control Devices Principles, operations and types, simple hoods and ducts. Settling chambers, cyclones, electrostatic precipitators (ESP), Filters,scrubbers, absorption towers and incinerators. Collection efficiencies for laminar and turbulent flows for settling chambers, particle cut size for cyclone, ESP Concept of frictional and overall efficiencies. Design criteria for filters, scrubbers, absorption towers and incinerators.	12

Contribution to Outcomes

On completion of this course, the students are expected to understand the classification, sources, effects, various methods and equipment available for controlling air pollution. They are expected to have a better understanding of the nature and characteristics of air pollution and regulatory requirements regarding air pollution and further, they shall have an ability to plan air pollution control.

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 further, and 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 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.

Term Work:

The term work shall comprise of the neatly written report based on 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 sub-modules and 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. 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

Recommended Books:

1. Air Pollution: *Henry Capeskins*, McGraw Hill publication.
2. Air Pollution: Part A- Analysis and Part B-Prevention and Control: *Ledbetter, J. O.*, Make Dekker Inc., New York.
3. Air Pollution: *Wark* and *Warner, Harper* and *Row*, New York.
4. Air Pollution Control Guidebook for Management: Edited by *Rossano, A.T.*, Environ Science Service Division. ERA Inc., USA
5. Air Pollution Control Theory: *Martin Crawford*, McGraw Hill publication.

6. Government of India's Publication of laws related to air pollution, Maharashtra Pollution Control Board's (MPCB) Publication of standards. IndianStandards relevant to Air Pollution Monitoring, Definitions, Standards.
7. Air Pollution: *Rao. M. N. and Rao, H. V. N.,* Tata McGraw Hill Publication, New Delhi.
8. Air Pollution Vol.1: *Tripathi, A. K.,* (editor) Ashish Publication House, New Delhi.
9. Air Pollution (Bio-pollutants in air): *Srivastava, A.K.*, Ashish Publication House, New Delhi.
10. Environmental Engineers Handbook Vol. II, Air pollution: *Liptak, B. G.*, (ed) Chilton Book Co .USA.
11. Air Pollution Handbook: *Magill, P. L.*et al., McGraw Hill publication.
12. Industrial Air Pollution Handbook: *Parker, A.*, Tata McGraw Hills Publication.

Semester VII

Subject Code	Subject Name	Credits
CE-E705	Elective-I: Prestressed 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	25	--	25	150

Rationale

Pre-stressed concrete combines high strength steel and high strength concrete in an active manner. Today, pre-stressed concrete is being used in the construction of wide range of structures. It helps an engineer to achieve a much economical section for carrying heavy loads over larger span lengths. Thus, the use pre-stressed concrete has become a standard practice for long span bridges. Building codes have been developed for the design and detailing of pre-stressed concrete. This course involves the study of various types of pre-stressing techniques in detail.

Objectives

1. To bring the students to such a level so as to enable them to take the appropriate decision in respect of choice of prestressed section over R. C. C. as a civil engineer.

2. To make the student to be aware of such a highly mechanized technology in civil engineering construction.
3. To imbibe the culture of entrepreneurship in pre-cast and pre-stressed industry in mass housing, railway sleepers, electric transmission poles, etc.
4. To understand the basic design considerations in pre- stressed concrete structures in relation to its applications.
5. To employ and develop new techniques in rehabilitation of distressed structures like buildings, bridges and infrastructures.

Detailed Syllabus

Module	Sub-Modules/ Contents	Periods
I.	**Introduction to Prestressed Concrete:** Basic concept and general principles, materials used and their properties, methods, techniques and systems of prestressing.	03
II.	**Analysis of Prestressed concrete sections:** Loading stages and computation of section properties, critical section under working load for pre tensioned and post tensioned members, stress method, load balancing method and internal resisting couple method, kern points, choice and efficiency of sections, cable profiles.	08
III.	**Loss of Prestress:** Loss of stresses doe to elastic deformation of concrete, creep in concrete, creep in steel, shrinkage in concrete, relaxation in steel, anchorage slip and friction.	06
IV.	**Deflections of Prestressed Concrete Members:** Short time and long time deflection, deflection of uncracked sections, Uni-linear and bi-linear methods for cracked sections.	05
V.	**Design of Prestressed Concrete Sections for Flexure in Working Stress and Limit State Method:** General philosophy of design, permissible stresses in concrete and steel,suitability of section, safe cable zone, design of simply supported pretension and post tension slabs and beams using limit state method	10
VI.	**Design for shear:**	06

	Calculation of principle tension under working load, permissible principle tension, shear strength calculation under limit state of collapse for both sections cracked and uncracked in flexure.	
VII.	**End zone stresses in prestressed concrete members:** Pretension transfer bond, transmission length, end block of post-tensioned members.	06
VIII.	Introduction to application of prestressing to continuous beams and slabs, linear transformation and concordancy of cables.	08

Contribution to Outcomes

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

1. To understand the concept of pre-stressing, behavior of the pre-stressed structures vis-à-vis that of the RCC structure.
2. To take the decision with respect to the choice of pre-stressed section over RCC.
3. To understand the application of these techniques in civil engineering construction, especially in mass housing, railway sleepers, transmission of poles, bridges, etc.
4. To analyze the various pre-stressed components of the structures and design the same.

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 further, and 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 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.

Site Visit/ Field Visit:

The students shall visit the site where the construction of pre-cast and pre-stressed concrete is going on. The students shall prepare the detailed report thereof and submit as a part of the term work.

Term Work:

The term work shall consist of the assignments. The assignments shall be given covering the entire syllabus in such a way that the students would attempt at least three problems/ questions on each modules/ sub-modules sub-modules and contents thereof further. The report of the field visit/ site visit shall also form a part of the term work.

Distribution of Term Work Marks:

The marks of term-work shall be judiciously awarded depending upon its quality. The final certification and acceptance of the term-work warrants the satisfactory and the appropriate completion of the assignments, properly compiled report of the field/ site visit; 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 Field Visit/ 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. Prestressed Concrete*: N. Krishna Raju*, McGraw Hill, New York.
2. Prestressed Concrete: *N. Rajgopalan*, Narosa Publishing House.
3. Fundamentals of Prestressed Concrete: *Sinha, N.C.*and *S.K. Roy*, S.C. Chand and Company.

4. Prestressed Concrete Structures: *Dayaratnam, P.*, Oxford andIBH
5. Design of Prestressed Concrete Structures: *T.Y.Lin* and*N.H. Burns*, John Willey, New York.
6. Design of Prestressed Concrete: *Nilson Arthur*, McGraw Hill Book Company.
7. Prestressed Concrete Vol—I*: IY.Guyon*, Contractors Record, London.
8. Prestressed Concrete*: S. Ramamurtham*, Dhanpat RaiandSon's
9. Relevant latest IS codes.

Semester VII

Subject Code	Subject Name	Credits
CE-E705	Elective-I: Traffic Engineering and Control	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	25	--	25	150

Rationale

The complete knowledge of traffic engineering for urban and rural roads is essential for civil engineers, especially who are dealing with thetransportation problems in day-to-day activities. This subject imparts the skills required in controlling the traffic on the busy roads. The complete concepts learning here may include planning, Design and implementation of traffic signals, islands, intersections, markings on the roads, network flow problems related with all the important aspects for complete control of traffic on all the important and busy roads.

Objectives

1. To understand all the traffic characteristics.
2. To understand all the traffic surveys conducted for complete analysis of busy roads, which requires for effective traffic management.

3. To understand, to plan and design all the important elements on the roads like signals, junctions, islands for effective traffic engineering.
4. To understand the various network flow problems, whichincludes the traffic management skills.

Detailed Syllabus

Module	Sub- Modules/Contents	Periods
I	**Traffic Engineering and Control** : Various traffic surveys and traffic studies: Speed, journey time and delay survey and studies, vehicle volume count classification and occupancy	10
II	**Origin-Destination surveys andParking survey:** Origin-Destination Studies: Purpose, various methods of conducting O-D studies with pros and cons of each method, interpretation of the analysis results of O-D studies, utility Parking Survey: Purpose, different types of parking surveys, methods of conducting parking surveys and interpretation of the results.	04
III	**Statistical Methods for Traffic Engineering and their Applications:** Distributions, sampling theory and significance testing, regression and correlation.	05
IV	**Intersection Design:** Principles, various available alternatives, rotary design, mini round about, traffic signals: types of traffic signals, advantages, determination of optimal cycle time and signal setting for an intersection with fixed time signals, coordination of signals, types area traffic control, delay at signalized intersection.	07
V	**Accidents and Road Safety:** Accident cause, recording system, analysis and preventive measures, accident cost, alternative methodologies for calculation.	04
VI	**Traffic Management:** Various measures and their scope, relative merits and demerits.	03

VII	**Highway Capacity:** Passenger's car units, level of service, factor affecting capacity and level of service, influence of mixed traffic, capacity and level of service analysis.	03
VIII	**Highway Lighting:** Need for street lighting, important definitions, law of illumination, discernment by artificial lighting, mounting height, spacing, lantern arrangements, types of lamps, lighting of some important highway structures.	04
IX	**Traffic Signs and Markings:** General principle of traffic signing, types of traffic signs, design of signs, location and maintenance of signs, different types of road marking, marking design, marking maintenance, introduction to intelligent transportation systems.	04
X	**Theory of Traffic Flow:** Scope, definitions and basic relationship, review of flow density speed studies, hydrodynamic analogies, application of hydrodynamic analogy, Lighthill and Whitams theory, car-following theory and its application to traffic engineering, probabilistic description of traffic flow, an introduction to queuing theory as applied to traffic flow problems for study state conditions, fundamentals of traffic stimulation modeling.	05
XI	**Network Flow Problems and Entropy in Transportation:** Wardope principles of equilibrium, graph theoretic approach, network flows, minimum path trees, primal level solutions, introduction to entropy in transportation	03

Contribution to Outcomes

After completion of the course work, the student are expected to understand the complete knowledge of traffic surveys, traffic characteristics and management skills related with various problems on busy roads. The students shall be in a commanding position to plan, design and implement the traffic signals, islands, markings, network flow characteristics required in the transportation planning. The student is expected to get full knowledge related to all the modern techniques, various important methods for effective management of control of traffic on all the important and busy urban roads.

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 further, and 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 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.

Term Work:

The term work shall comprise of the neatly written report based on assignments. The assignments shall be given covering the entire syllabus in such a way that the students would attempt at least four problems / questions on each sub-modules and contents thereof further. Apart from this, the students shall conduct at least three traffic surveys and shall prepare a detailed report of the analysis of these surveys. This report shall also form a part of the term work.

Distribution of the Term Work Marks:

The marks of term work shall be judiciously awarded for various components depending upon its quality. 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 : 12 Marks
- Report of the Traffic Surveys: 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. Traffic Engineering and Transportation Planning: *Kadiyali L. R.*, Khanna Publishers, Delhi.
2. Principles of Traffic Engineering: *Pingnataro, G. J.*, McGraw-Hill
3. Traffic System Analysis for Engineering and Planners: *Wohl* and *Martin*, Mc-Graw Hill
4. Principles of Transportation Engineering: *Partha Chakroborty*, *Animesh Das*, Prentice Hall (India).
5. Traffic Flow Theory and Control: *Drew, D. R.*, Mc-GrawHill, New York
6. Highway Capacity Manual, Transportation Research Board, National Research Council, Washington D.C.
7. Transportation Engineering and Planning: *Papacostas, C. S.*, *Prevedouros, P. D.*, PHI Learning Pvt. Ltd.
8. Principles, Practice and Design of Highway Engineering: Dr. *Sharma, S. K.*
9. Transportation Engineering: *C. Jotin Khisty* and *B. Kent Lall*, PHI Learning Pvt. Ltd.

Semester VII

Subject Code	Subject Name	Credits
CE-E705	Elective-I: Reinforced Concrete Repairs and Maintenance	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	25	--	25	150

Rationale

For an existing building to be in a good condition, so that it can continue to perform the intended functions, maintenance of the building plays a key role. Adequate maintenance improves aesthetic and functional values.Moreover; it facilitates extending the building life and ensures the safety of dwellers. Usually, the structures do perform well for about 50 years after the construction and thereafter, the deterioration begins. Insufficient maintenance and lack of repairs may lead to the limited life span of the structure. However, the regular maintenance and timely identification of deteriorated building elements for proper remedial measures may result in to the extension of life span of the structure up to 100 years also. Most of the modern structures built in India are becoming old as they have reached about 50 years of their age and are in the dire need of the repair and maintenance. Hence, there is a huge employment potential in conformity with the field of repair and maintenance. This course, therefore, finds its place in the curriculum such that the pupils can acquire the competency in this area. The course deals with the building maintenance, special materials, concrete repair chemicals, strengthening of RCC members by underpinning, plate bonding, shoring, RC jacketing, etc. Technical knowhow and skills developed through this course may be helpful to preserve the historical buildings. Therefore, it is vital and imperative to get acquainted with the course for civil engineers.

Objectives

- To get familiar with the causes of distress of concrete structures, seepage and leakage in concrete structures and the effect on steel corrosion.
- To study the condition survey, evaluation and assessment of damage through the visual inspection and various Non-Destructive Testing methods.
- To acquire the knowledge in connection with the special repair materials and crack repair methodologies to be applied in the field.
- To study the concrete protective materials, thermal protection coatings, etc.
- To implement the steel corrosion protection methods in the field.
- To know the various ways to maintain the reinforcedconcrete structures.

Detailed Syllabus

Module	Sub-Modules/Contents		Periods
I	**Introduction**		08
	1.1	Causes of deterioration of concrete structures, effects of climate, moisture, temperature, chemical, wear, erosion and loading on serviceability and durability	
	1.2	Design and construction errors	
	1.3	Causes of seepage and leakage in concrete structures	
	1.4	Formation of cracks including those due to corrosion	
II	**Condition Survey, Evaluation and Damage Assessment**		12
	2.1	Diagnostic methods and analysis.	
	2.2	Destructive, semi-destructive and non-destructive methods: core test, carbonation test, chloride test, petrography, corrosion analysis, cover meter test, rebound hammer test, ultrasonic pulse velocity	

		test, and crack measurement techniques.	
	2.3	Concrete endoscopy and thermal imaging	
	2.4	Pull-off test and pull-out test	
III	**Materials and Repair Methodologies**		10
	3.1	Repair analysis and design	
	3.2	Repair materials and their desired properties	
	3.3	Methodologies for crack and patch repair: polymer modified mortar, polymer modified concrete, polymer concrete	
	3.4	Injection grouting, shortcreting, joints and sealants, rebar corrosion crack repair	
IV	**Protection of Concrete Structures**		08
	4.1	Protective materials and their properties for moisture barrier systems.	
	4.2	Above grade and below grade water-proofing of concrete structures.	
	4.3	Systems like integral, crystalline, coatings, membranes, etc.	
	4.4	Thermal protection coatings.	
V	**Rebar Corrosion Protection**		08
	5.1	Methods of corrosion protection, corrosion inhibitors	
	5.2	Corrosion resistant steels, cathodic protection	
	5.3	Pre-packed zinc sacrificial anode, Snap-on zinc mesh anode CP system	
VI	**Maintenance of Concrete Structures**		06
	6.1	Facets of maintenance	
	6.2	Planned preventive maintenance	
	6.3	Maintenance cycles	
	6.4	Statutory legislation and obligation	

Contribution to Outcomes

On successful completion of the course, the students shall are expected to:

- Assess the structural health of the buildings and infrastructural works.
- Inspect and evaluate the damaged structures.

- Implement the techniques for repairing the concrete structures.
- Employ the methods of steel protection in the field.
- Maintain the concrete structures in the working and safe condition.
- Be able to take the decision of dismantling the structure, if it is deteriorated beyond the repairing.

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 further, and the weightage of the marks shall be judiciously awarded in proportion to the importance of the sub-module and 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 will be based on entire syllabus and the term work.

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

1. Rapid chloride penetration test
2. Carbonation test by spraying phenolphthalein
3. Non -destructive testing of concrete structures by Rebound hammer, UPV meter etc.
4. Corrosion analyzer by half-cell potential meter
5. Tests on polymer modified mortar/concrete and coating for adhesion by Pull-off test method
6. Outdoor exposure test to measure weathering of coating
7. Test for flexibility of coating by applying on a tin sheet
8. Test for effectiveness by measuring temperature difference of a thermal protection coating and concrete substrate on terrace
9. Test for effectiveness by measuring water absorption of coating applied on a card board

Condition Survey:

The students will carry out the condition survey of any damaged structures by visual observations, crack management and will prepare a detailed report thereof. This report will form a part of the term work.

Term Work:

The term-work shall comprise of the neatly written report based on the experiments/ practicalperformed and the assignments along with the detailed report on the condition survey.

Distribution of Term Work Marks:

The marks of the term work shall be judiciously awarded for the various components depending upon its quality. The final certification and acceptance of the term work warrants the satisfactory performance of the experiments/ practical by the student, properly compiled report thereof along with the assignments and the report on condition survey; and the minimum passing marks to be obtained by the student. The assignments shall be given covering the entire syllabus in such a way that the students would attempt at least two problems/ questions on each sub-modules and contents thereof further.

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

1. Report of the Experiments: 08 Marks
2. Assignments: 08 Marks
3. Report on the Condition Survey : 04 Marks
4. 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. Concrete Repair and Maintenance: *Peter H.Emmons* and *Gajanan M. Sabnis*, Galgotia Publication.

2. Repairs and Rehabilitation-Compilation from Indian Concrete Journal-ACC Publication.
3. Guide to Concrete Repair and Protection, HB84-2006, A joint publication of Australia Concrete Repair Association, CSIRO and Standards Australia.
4. CPWD hand book on Repairs and Rehabilitation of RCC buildings published by DG(Works), CPWD, Government of India (Nirman Bhawan), http://www.cpwd.gov.in/handbook.pdf
5. Guide to Concrete Repair, *Glenn Smoak*, US Department of the Interior Bureau of Reclamation, Technical Service Center, http://books.google.co.in
6. Management of Deteriorating Concrete Structures: *George Somerville*, Taylor and Francis Publication
7. Concrete Building Pathology: *Susan Macdonald*, Blackwell Publishing.
8. Testing of Concrete in Structures: *John H. Bungey*, *Stephen G. MillardandMichael G. Grantham*, Taylor and Francis Publication.
9. Durability of concrete and Cement Composites: *Page, C.L.*and*Page, M.M.*, Woodhead Publishers

Semester VII

Subject Code	Subject Name	Credits
CE-E705	Elective-I: Advanced Computational Techniques	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	25	--	25	150

Rationale

With the dramatic increase in data generation and due to rapid technological developments, in fields including civil engineering the field of statistics has undergone a major change, as new and novel techniques of statistical modeling and advanced computational techniques are continually required. This subject includes the basic understanding of concepts like hypothesis testing, regression and correlation, linear programming and introduction of genetic algorithm

Objectives

- To introduce different methods of statistics.
- To enhance the knowledge of probability theory and application in construction industry.
- To discuss about different methods of data collections and its analysis.
- To discuss the importance of Hypothesis testing and its application in civil engineering.

• To discuss application of ANOVA.

• To explain the application of linear programming problem and transportation problem in construction industry.

Detailed Syllabus

Module	Sub-Modules/ Contents	Periods
I.	**Review of Basic Statistics and Probability:** Probability Distributions, Theoretical: binomial, poisson, normal, exponential, hypergeometric, uniform	07
II.	**Sampling and Sampling Distributions** Probability and non-probability samples, sampling and non-sampling errors Sample size, sampling distributions: t, F and ƛ^{2}distributions.	05
III.	**Hypothesis Testing** Type I and II error, testing of mean, proportion, tests for equality of mean and variances of two populations, confidence interval, ƛ^{2} test for goodness of fit, ANOVA (one way classification),Non parametric tests: sign test, U test	08
IV.	**Correlation and Regression** Karl Pearson's and Rank Correlation coefficient, simple linear regression least squares method	06
V.	**Management Decision Making** System approach, decision making under uncertainty and risk: decision tables and decision tree.	08
VI.	**Linear Programming** Graphical solution, simplex method, dual, sensitivity analysis, transportation and assignment problems	10
VII.	**Introduction to Genetic Algorithms**	08

Contribution to Outcomes

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

- Learnt different methods of statistics and its applications, different methods of data collection and presentation.
- Learnt about probability theory, application of Binomial distribution, Poisson distribution in civil engineering projects.
- An understanding of implementing the concept of linear programming problem and the transportation problem in getting the optimum solution for civil engineering problem.
- Understood the concept of hypothesis, significance level, type – I and type – II error in hypothesis.

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 further, and 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 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.

Term Work:

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

Distribution of the 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

Recommended Books:-

1. Quantitative Techniques for Managerial Decisions: *Shrivastava, Shenoy and Sharma*, Wiley.
2. Research Methodology: *Kothari, C. R.*, Wiley Eastern
3. Methods in Social Research: *Goode, W. J.and Hatt, P. K.*, McGraw Hill
4. Handbook of Genetic Algorithms (1991): *Davis,L. D. and Melanie Mitchell*, Van Nostrand Reinham.
5. An Introduction to Genetic Algorithms (1998): *Melanie Mitchell*, Van Nostrand Reinham

Semester VII

Subject Code	Subject Name	Credits
CE-P706	Project – Part I	02

Teaching Scheme

Contact Hours	Credits Assigned
01 Hr Per Project Group	02

Evaluation Scheme

Term Work/ Oral		Total
TW	OR	
50	25	75

The Project shall be based on thrust areas in Civil Engineering (Construction Engineering and Management; Structural Engineering, Geotechnical Engineering including Geology, Transportation Engineering, Hydraulics Engineering, Environmental Engineering, Remote Sensing, etc.) or interface problem of any of the diversified fields of the Civil Engineering Branch.

For this purpose, the students shall form a group of minimum two students and maximum four students. Further, each faculty shall be permitted to guide maximum four groups.

Guidelines for Project- Part I:

- Student should carry out the preliminary literature survey and subsequently, identify the problem in broad terms for the project and finalize/ settle it in consultation with Guide/ Supervisor.
- Pursuant to this, the student shall refer multiple literatures pertaining to the theme of the problem and understand the problem and define the problem in the precise terms.
- Student should attempt solution to the problem by analytical/simulation/experimental methods. The solution shall be validated with proper justification. The students shall compile the report in standard format.

- The work to be pursued as a part of the project shall be divided broadly in two parts, namely- Project Stage- I and Project Stage- II.
- The topic of the project should be such that it is a value addition for the existing knowledge in the field and has some worthwhile outcomes.

Guidelines for Assessment of Project Stage- I

- Project Stage- I should be assessed based on following points
  1. Quality of Literature survey and Novelty in the problem
  2. Clarity of Problem definition and Feasibility of problem solution
  3. Relevance to the field
  4. Clarity of objective and scope
  5. Methodology for carrying out the work defined as a Problem Statement (Formulation in respect of the analytical studies/ Experimental Work / Combination thereof depending upon the nature of the work involved)/ Data Collection, etc.
- Project Stage I should be assessed through a presentation by a panel of internal examiners appointed by the Head of the Department.

Semester VIII

Subject Code	Subject Name	Credits
CE-C801	Design and Drawing of Reinforced Concrete 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 1	Test 2	Average						
20	20	20	80	04	25	--	25	150

Rationale

Different civil engineering structures such as residential and industrial buildings resting on different types of foundation depending upon the sub-soil conditions and constraints at the site if any. The water tanks and retaining walls are to be planned and designed by the civil engineers. This subject helps the students to enable them to design these systems by resorting to the available concept of the RCC.

Objectives

1. To understand the complete analysis and design of residential and industrial buildings using relevant IS codes.
2. To understand the complete analysis and design of different types of retaining walls.

3. To understand the complete analysis and design of different types of water tanks using relevant IS codes by working stress method.
4. To develop the students well versed with concepts of civil engineering techniques and ability to use it in practice.

Detailed Syllabus

Module	Sub- Modules/ Contents	Periods
I.	**Design of Foundations:** Design of simple raft subjected to symmetrical loading using limit state method.	09
II.	**Design of Staircases:** Design of dog legged andopen well type staircase using limit state method.	08
III.	**Comprehensive Design of the Building:** Complete design of residential, commercial or Industrial building includingstaircase and foundations using limit state method; Introduction to ductile design and detailing ofstructures.	12
IV.	**Design of Retaining Walls:** Design of cantilever andcounter fort type retaining wall using limit state method.	09
V.	**Design of Water Tanks:** Circular and rectangular, at ground level, underground and overhead water tank both by IS coefficient and - approximate methods, includingsupporting structure for overhead water tanks using working stress method.	14

Note: Relevant and latest IS codes of practice shall be followed for all the topics.

Contribution to Outcomes

On successful completion of the course:

1. The student shall be able to independently or as a member of the team design the structures using structural analysis and design knowledge for safety, serviceability and economy.
2. The student shall be able to design different types of water tank, retaining wall by limit state method.
3. The student shall be able to design a residential and industrial buildings by relevant IS code.

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 further, and 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 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 accompanied by sketching will be based on entire syllabus and the term work.

Term Work:

The term work shall consist of a neatly written Design Report including detailed drawings on the following topics:

1. Design report of (G+3) industrial or residential building using relevant IS codes.
2. Design report of counter fort retaining wall.

3. Design report of rectangular or circular underground water tank or overhead water tank using relevant IS codes by working stress method.

Design report and at least four A-1 (Full imperial) size drawings sheets for above three projects shall be submitted as term work. All drawing work is to be done in pencil only. Design of building project will be done using design aids and anyone of available softwaressuch as STAAD-Pro and ETABS, etc.

Distribution of Term Work Marks:

The marks of term-work shall be judiciously awarded depending upon its quality. The final certification and acceptance of the term-work warrants the satisfactory and the appropriate completion of the assignments, properly compiled design report; 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.

1. Design report: 20 Marks
2. 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. Limit State Theory for Reinforced Concrete Design: *Huges B. P.*, Pitman
2. Limit State Design - Reinforced Concrete: *Jain A. K.*, New Chand, India
3. Reinforced Concrete: *Warener R. F., Rangan B.C.* and *Hall A. S.*
4. Illustrated Design of G+3 Building: *Shah and Karve*, Structures Publishers.
5. Reinforced Concrete: *S. N. Sinha*, TMH, New Delhi
6. Reinforced Concrete: *H. J. Shah*, Charotar Publisher
7. Relevant I.S. codes and Design Aids, BIS Publications.
8. Reinforced Concrete Fundamentals: *Ferguson P.M.*, *Breen J.E.*, and *Jirsa J.O.*, 5th Edition,John Wiley and Sons, 1988.
9. Illustrated Reinforced Concrete Design: *Dr. V.L. Shah* and *Dr. S.R. Karve*, Structures Publishers.

10. Earthquake Resistant Design of Structures- *S.K.Duggal*, Oxford University Press, New Delhi
11. Earthquake Resistant Design of Structures –*PankajAgrawaland Manish Shrikhande*, PHI Learning Pvt. Ltd.

Semester VIII

Subject Code	Subject Name	Credits
CE-C802	Construction Engineering	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	25	--	25	150

Rationale

Proper planning, selection, procurement, installation, operation, maintenance and equipment replacement policy plays an important role in the equipment management for a successful completion of project. With the growing use of machinery it has become necessary for construction engineer to be thoroughly familiar with the working application and upkeep of the wide range of modern equipment. Since the modern construction projects require a huge amount of capital, one has to adopt latest technology, modern equipment and modern management techniques to achieve economy, quality and quick result. The course covers the full range of principal construction equipment, latest technology and other allied aspects of the construction.

Objectives

- To study the different types of standard / special equipment used in the construction industry.

- To learn the different sources of equipment, economic life and depreciation cost of equipment.
- To determine owning and operating costs, evaluate maintenance and repair costs.
- To study the various equipment related to earthmoving, drilling and blasting, pile driving, pumping, stone crushing, air compressors, equipment for moving materials etc.
- To understand the complex processes involved in the construction of tunnels.
- To learn various soil stabilization techniques such as sand drains and stone columns, use of geotextiles and chemicals, diaphragm wall, rock anchors, foundation grouting, etc.
- To understand the concept of mass concreting, vacuum concreting and modern slip forms.

Detailed Syllabus

Module	Sub-Modules/ Contents	Periods
I	**Construction equipment:** **1.1** Standard types of equipment, special equipment, cost of owning and operating equipment, depreciation costs, investment and operating costs, economic life, sources of construction equipment, factors affecting selection of construction equipment, balancing of equipment.	05
	1.2 Study of equipments with reference to available types and their capacities, operations and factors affecting their performance:	
	1.2.1 Earthmoving equipment: tractors and attachments, dozers and rippers, scrapers, shovels, draglines, trenching machines, clamshell, hoes, trucks and wagons, dumpers, dozers, trenching machines, rollers and compactors	05
	1.2.2 Drilling and blasting equipment: bits, jackhammers, drifters, drills, blasting material, firing charge, safety fuse, electric blasting caps, drilling patterns, transporting and handling of explosives	05
	1.2.4 Pile driving equipment: types, pile driving hammers: single acting anddouble acting, differential acting hammers, hydraulic and	05

	diesel hammers, vibratory pile drivers	
	1.2.5 Pumpingequipment:reciprocating, diaphragm andcentrifugalpumps,wellpoint system	02
	1.2.6 Stone crushing equipment: jaw, gyratory and cone crushers, hammer mills, roll crushers, rod and ball crushers, aggregate screens and screening plants, portable plants	04
	1.2.7 Air compressor	02
	1.2.8 Equipment for moving materials: builder's hoists, forklifts, cranes, belt-conveyors, cableways, ropeways	02
II	**Tunneling:** Selection of alignment, methods of tunneling in soft soils and in hard rock,sequence of operations for drilling and blasting method, mechanical moles, boomers, tunnel boring machines, mucking, ventilation of tunnels, dust control, types of tunnel supports, sequence of lining operation, lining with pneumatic placers and by pumpcretemethodsize, sampling distributions: t, F and ƛ ²distributions.	10
III	**Soil stabilization techniques:** sand drains, stone columns use ofgeotextilesand chemicals, diaphragm wall, rock anchors,foundation grouting	05
IV	**Concrete:** massconcreting, vacuumconcrete, forms for concrete construction: slip forms, collapsible forms, forms for cantilevers	05
V	**Different types of cladding:** fixing and maintenance arrangements	02

Contribution to Outcomes

At the end of this course, the students will be able:

- To know the different types of standard / special equipment used in the construction industry and select the appropriate equipment.
- To determine the optimal use of the equipment, owning, operating and maintenance and repair costs of the equipment.
- To decide judiciously whether the equipment should be purchased or hired, repaired or sold.

- To select the alignment for tunnels, various methods of tunneling in soft soils as well as in hard rock, sequence of operations to be followed along with the various tunneling machines.
- To decide the ground improvement and soil stabilization methods such as sand drains and stone columns, use of geo-synthetics and chemicals based on the suitability of the site conditions.
- To suggest mass concreting, vacuum concreting and modern slip forms techniques.

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 further, and the weightage of the marks shall be judiciously awarded in proportion to the importance of the sub-module and contents thereof.
4. The students will have to attempt any **three** questions out of remaining five questions. 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 based on assignments. The assignments shall be given covering the entire syllabus in such a way that the students would attempt at least four problems and/or questions on each modules or sub-modules and 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 the acceptance of the term-work warrant 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. Construction Equipment and Planning: *Purifoy, R. L., and Ledbetter*, McGraw Hill
2. USBR, Earth Manual
3. USBR, Concrete Manual
4. Handbook of Heavy Construction: *O'Brien, Havers and Stubb*, McGraw Hill
5. Foundation Analysis and Design: *Bowels, J. E.*, Mc Graw Hill Publications
6. Construction Engineering and Management: *Seetharaman, S., Umesh,* S Chand Publications, New Delhi
7. Concrete Technology: *Shetty, M. S.*, Khanna Publishers
8. Construction Equipment and its Management: *Sharma, S. C.*, Khanna Publishers

Semester VIII

Subject Code	Subject Name	Credits
CE-C803	Construction Management	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	25	-	25	150

Rationale

This course is intended to teach students the management skills to be applied during all the stages of any civil engineering project. The professional construction engineering practice will be rendered meaningless if the service is not offered with a scientific approach and managerial practices. This course deals with the techniques to be applied for scheduling projects, optimizing time-cost and other resources in construction, monitoring and ensuring quality and safety aspects in projects.

Objectives

- To understand the basic principles and functions of construction management.
- To learn scheduling techniques such as CPM and PERT.
- To gain the knowledge of time-cost optimization and effective utilization of resources on construction sites.

- To understand allocating the resources and project monitoring.
- To know about safety and quality aspect of construction works.

Detail Syllabus

Module	Sub- Modules/Contents	Periods
I	**Introduction to Construction Management:** 1.1 Concept of Management, Principles of management, contribution by eminent personalities towards growth of management thoughts. 1.2 Significance of construction, management, objectives and functions of construction management 1.3 Resources required for construction.	04
II	**Construction Projects:** 2.1 Unique features of construction industry. 2.2 Construction projects- classification, characteristics life cycle concept of project etc. 2.3 Roles and responsibilities of various agencies associated with a Construction project. 2.4 Pre-requisites of commencing construction work sanctions, approvals to be sought, and feasibility studies. 2.5 Site layout, organizing and mobilizing the site	05
III	**Construction Project Planning and Scheduling:** 3.1Stages of planning in the view of owner/Department as well as contractor. 3.2 W.B.S, Bar Charts. 3.3Network-Terminology, Network Rules, Fulkerson's rule, skip numbering, Precedence network etc. 3.4 C.P.M - Activity and event with their types, activity times, event times, critical path, forward pass, backward pass, float and its types. 3.5 P.E.R.T- Assumption underlying PERT analysis time estimates, slack and its types, probability of completing the project etc.	14

IV	**Resources Management and Allocation :** 4.1 Material Management- Importance, objectives, functions of material management, inventory control, A-B-C analysis, E.O.Q etc. 4.2 Human Resource Management- Manpower planning, recruitment, Selection training, performance evaluation of worker etc. 4.3 Financial Management- accounting and Accounting principles, source of finance, cash flows associated with project, time value of money, economic appraisal criterias for project. 4.4 Resources Allocation Methods- Resource leveling resource smoothening. 4.5 Introduction to project Management MS Project and PRIMAVERA	12
V	**Project Monitoring and Cost Control :** 5.1 Supervision, record keeping, Periodic progress reports etc. 5.2 Updating- Purpose of frequency of updating method of updating a network etc. 5.3 Time cost optimization in construction projects compression and decompression of network etc. 5.4 Common causes of time over run and cost overrun and Corrective measures.	05
VI	**Safety and Health on Construction Sites** 6.1 Common causes of accidents on construction sites, costs of accident, precautionary measures to avoid accidents, 6.2 Occupational health hazards in construction industry. 6.3 Safety and Health Campaign. 6.4 O.S.H.A	04
VII	**Quality Control :** 7.1 Concept of Quality, quality control check list in quality control etc. 7.2 Role of inspection in quality control, 7.3 Quality manual, Quality assurance statistical quality control 7.4 ISO 14000	04
VIII	**Construction Labors and Legislation :** 8.1 Need for legislation 8.2 Acts applicable to Indian construction labours such as payment of wages act, min wages act, workmen’s compensation act, factories act etc.	04

Contribution to Outcomes

On successful completion of the course:

- The students will be able to understand and apply the knowledge of management functions like planning, scheduling, executing and controlling to construction projects.
- The students will be able to demonstrate their capability for preparing the project networks to work out best possible time for completing the project.
- The students will be able to understand and exercise the time- cost relationship in practices.
- The students will be able to implement the safety as well as quality aspects during the execution of civil engineering project.
- The course will inculcate the managerial skills among the students which will be helpful for them in future during actual execution of projects.

Theory examination:

1. The question paper will comprise of **six** questions, each carrying 20 marks.
2. The **first** question will be **compulsory** and will have 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 the syllabus. For this, the modules shall be divided equally and further, and the weightage of the marks shall be judiciously awarded in proportion to the importance of the sub-modules and contents thereof.
4. The student will have to attempt **any three** questions out of remaining five questions. Total **four** questions need to be solved.

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 assignments. The assignments shall be given covering the entire syllabus in such a way that the students would attempt at least four problems and/ or questions on each modules/ sub-modules and contents thereof, further. In addition to this, the students will carry out the mini project based on the application of softwareslike MSP/ PRIMAVERA. This project will form a part of the term work.

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 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

Recommended books:

1. Construction Engineering and Management: *Seetaraman, S.*
2. Construction Planning andManagement – *Dr. Shrivastava, U. K.*
3. Professional Construction Management: *Barrie, D.S.*and *Paulson, B. C.*, McGraw Hill
4. Construction Project Management: *Chitkara, K. K.*, Tata McGraw Hill
5. Handbook of Construction Management: *Joy, P. K.*, Macmillan, India
6. Critical Path Methods in Construction Practice: *Antill, J. M. and Woodhead, R. W.*, Wiley
7. Construction Hazard and Safety Handbook: *King and Hudson*,Butterworths

Semester VIII

Subject Code	Subject Name	Credits
CE-E804	Elective – II: Advanced Construction Engineering	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	25	--	25	150

Rationale

Engineering constructions have grown to become highly sophisticated and organized in nature and involves safety concerns, quality measures and use of modern equipment and materials. This course provides an extensive overview of materials and equipment used in construction industry and methods used to construct facilities with these materials. The construction of large engineering projects including major activities such as excavation, concreting, steel fabrication and erection are also discussed in this course. This course also incorporates the process and theory of pre-fabrication and steel construction are also explained in detail.

Objectives

- To understand the characteristics and complexities involved in large engineering projects.

- To study the excavation methods in various types of soils including selection of equipment, safety measures and drainage.
- To study the pre-fabrication process involved in various construction techniques.
- To gain knowledge regarding selection of appropriate equipment and techniques in construction for large and heavy engineering projects.

Detailed Syllabus

Module	Sub-Modules/ Contents	Periods
I.	Large and heavy engineering projects: Characteristics and complexities, methods statement for major activities like excavation, concreting, steel fabrication and erection for projects like earthen dams, hydropower projects, nuclear power plant, refineries and other industrial projects etc.	06
II.	Excavation for heavy engineering projects: Excavation in various types of soils, selection of equipment, safety measures in excavation, drainage in excavation	06
III.	Concrete construction for heavy engineering projects: Selection of equipment for batching, mixing, transporting, placing andcompacting for various types of jobs, safety measures during concreting, Special concretes and mortars: preplaced aggregate concrete, roller compacted concrete, grouting	06
IV.	Prefabricated construction: Planning for pre-casting, selection of equipment for fabrication, transport and erection, quality measures, safety measures during erection	06
V.	Steel construction: Planning for field operations, selection of equipment and erection tools, tools and methods of welding, tools and methods of cutting and joining, bridge erection, quality measures, safety measures during fabrication and erection	06
VI.	Specific issues related to planning, site layouts, equipment selection and pre-project activities for large size construction projects like	06

	earthen dams, concrete dams, thermal power stations, nuclear power stations, light houses, airports and ports, bridges	
VII.	Information related to special equipment and their applications to Off-shore construction, underground utility construction	06
VIII.	New materials and equipment for construction	05
IX.	Case studies of heavy construction projects	05

Contribution to Outcomes

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

- Understand the importance of quality and safety measures involved during fabrication process and erection of steel structures.
- Select new materials and equipment appropriate for the respective construction procedure.
- Undertake procedure related to large engineering projects including excavation, concreting, steel fabrication and erection.
- Gain knowledge in the field of special equipment used for off-shore construction.

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 further, and 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 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.

Term work:

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

Distribution of Term Work Marks:

The marks of the term-work shall be judiciously awarded depending upon its quality. 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

Recommended Books:

1. Handbook of Heavy Construction: *Stubbs*, McGraw Hill Publications, New York
2. Construction Equipments: *Jagdish Lal*.
3. Erection of Steel Structures: *Thomas baron*
4. Journals of Civil Engineering and Construction Engineering of Various Publishers.

Semester -VIII

Subject Code	Subject Name	Credits
CE-E804	Elective-II: Advanced Engineering Geology	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	25	--	25	150

Rationale

This subject gives the information about Deccan Trap Basalts. It is most useful in Civil Engineering field with regard to the construction point of view of dams, tunnels and bridges. It also helps in understanding the formation of various types of soil and factors that affect the characteristics of soil.It also gives the ideas about indirect geological investigation with regard to foundation point of view.

Objectives

1. To study the various methods of geological investigation in engineering field.
2. To study the types of basalt and various factors affecting strength and water tightness of basalt.
3. To study the significance of the features such as gas cavities, joints, dykes, fractures, etc. in civil engineering projects.

4. To study physical properties of the basalt such as compressive strength, water absorption, etc. and weathering effects on the rock masses and suitable treatment for such rock masses from foundation point of view of dam.
5. To study the foundation levels/ cut off levels for dam, application of grouting with height of dams; and foundation treatment for fractures having different rocks.
6. To study the different types of tunnels passing through different types of basalt.
7. To study the difficulties intruded by volcanic breccia, tuff, intertrapean beds, etc.
8. To study the protective measures such as guniting, rock bolting, shotcreting, steel fibre shotcreting.
9. To study the bridge foundation.
10. To study the different types of soil and influence of climate in the deccan trap areas.
11. To study the use of compact and amygdaloidal basalt as a construction material.

Detailed Syllabus

Module	Sub-Modules/ Contents	Periods
I.	**Introduction:** Importance of geological studies in engineering investigations, precautions to avoid misleading conclusions likely to be drawn while interpreting drilling data with particular reference to RQD, case histories illustrating economics made possible by proper geological studies.	04
II.	**Engineering Geology of Deccan trap basalts:** Factors affecting strength and water tightness, stability of cuts and ability to stand without support, significance of features like gas cavities, jointing, weathering, hydrothermal alteration, volcanic breccia, techylytes, dykes, fractures, field structures of flows, stratigraphic sequence of flows etc. and their significance in civil engineering projects.	07
III.	**Dams:** Strength and water tightness of Deccan trap rocks from foundation point of view, physical properties such as compressive strength, water absorption etc. of basalts, effect of weathering and hydrothermal	11

	alteration on engineering properties of rocks, deterioration of rock masses on exposure to atmosphere and suitable treatment for such rocks. Investigations for determining the foundation treatment for adverse geological features, determination of foundation levels/cutoff levels for dams, groutability of rocks, correction of adverse feature by grouting, purpose of consolidated and curtain grouting, determining depth and zones of grouting, relation of zones of grouting with height of dams, foundation treatment for fractures having different manifestations, jointed rocks, techylytes and dykes. Erosion of tail channel as a factor in selecting site for spillway causes of rapid erosion from side spillways, geological conditions leading to erosion. Case histories.	
IV.	**Tunneling:** Methodologies of investigations for different types of tunnels for different purposes, location spacing ,angles and depths of drill holes for different types of tunnels, difference in behavior of basalts because of jointing as exemplified by compact basalts and amygdaloidal basalts. Difficulties introduced by techylytes, volcanic bracias, tuffs, intertrappean beds, fractures, dykes, hydrothermal alteration, flow contacts unfavorable field characters. Computing structural discontinuities in rock masses, RQD, joint frequency index. RMR values, Q system, standup time. Selection and provision of protective measures such as guniting, rock bolting, shotcreting, steel supports depending on geological conditions. Suitability of TBM for tunneling. Case histories.	09
V.	**Bridges:** Investigations for bridge foundations, computing SBC for bridge foundation based on nature and structure of rock, foundation settlements. Case histories.	05

VI.	**Geology of soil formation:** Residual and transported soils. Rock weathering conditions favorable for decomposition and disintegration, influence of climate on residual and transported soils in the Deccan trap area. Nature of alluvium of Deccan trap rivers and its engineering character. Effect of deposition of calcium carbonate, Scarcity of sand in the rivers in Deccan trap area.	06
VII.	**Geophysical Investigations:** Seismic and electrical resistivity methods of explorations.	05
VIII.	**Construction Material:** Deccan trap basalts as construction Material. Use of compact basalt and amygdaloidal basalt as Rubble for masonry metal for concrete making.	05

Contribution to Outcomes

On completion of the course, the student shall be able to:

1. Understand various methods of direct and indirect geological investigation which are important in civil engineering field.
2. Recognize various types of basalt and significance of geological structures of basalts like gas cavities, joints, etc.
3. Understand the treatment of rocks show secondary geological structures like joints, fractures, etc.
4. Understand foundation level/ cut off level of dam.
5. Recommend suitable basalt for tunneling and understand difficulties intruded by volcanic breccia, tuff and intertrapean beds.
6. Apply preventive measures for dam and tunnels.
7. Understand the bridge foundation.
8. Understand the formation of soil and use of basalts.

Theory Examination:-

1. Question paper will comprise of **six** questions; each carrying 20 marks.

2. The **first** question will be **compulsory**whichwill 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 further, and 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 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.

List of Practical:

- Logging of drill core, preparation of logs and interpreting drilling data, calculation of RQD and joint frequency index.
- Preparing geological cross section from drill hole data and using them for designing of civil engineering structures.
- Use of electrical resistivity method for determining depth of bed rock.
- Study of geological aspects of an engineering projects and writing a report based on studies carried out during visits to civil engineering projects.

Term Work:

The term-work shall comprise of the neatly written report of the practicals and assignments. The assignments shall be given covering the entire syllabus in such a way that the students would attempt at least two problems and/or questions on each modules/ sub-modules and 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 and the assignments. The final certification and the acceptance of the term-work warrant the satisfactory and the appropriate completion of the assignments;and further 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: 12 Marks
- Practical: 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. PWD handbook, Engineering Geology, Government of Maharashtra.
2. Textbook of Engineering Geology, *R. B. Gupte*, PVG Prakashan.
3. Geology of India, *D. H. Wadia.*
4. Geology of India and Burma, *M. S. Krishnan*.
5. Textbook of Engineering geology, *N., Chenna, Kesavulu.*
6. Geology for Civil Engineering*: A. C. McLean, C. D. Gribble, George Aleen and Unwin* London.
7. Textbook of Engineering Geology*: P. K. Mukerjee*, Asia.

Semester VIII

Subject Code	Subject Name	Credits
CE-E804	Elective-II: Geographical Information System	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	25	--	25	150

Rationale

GIS is a core subject which provides power of mapping to civil engineers. GIS lets us visualize, question, analyze and interpret date to understand relationships, patterns and trends. In this subject, the students get acquainted with the detailed study of GIS. Data models of spatial and non-spatial information are also explained. An overview on digitizing, editing and structuring of map data is also provided for error detection, correction and appropriate topology creation. Digital Elevation Models (DEM) and their needs are also incorporated along with the applications of Remote Sensing and GIS.

Objectives

- To Install GIS software and getting familiar with its user interface.
- To digitize, edit and structure map data.
- To represent spatial data model.
- To view data.
- To label the features.

- To use geo-processing tools.
- To enable data conversion.
- To import and export data.
- To apply the techniques of remote sensing and GIS for forest resource Management, Agriculture and Soil Management, Water Resource Management and Disaster Management.

Detailed Syllabus

Module	Contents	Periods
I.	IntroductiontoGIS:Definition,sourcesofdata,typesofdata,conceptof spaceandtimeinGIS,spatialinformationtheory,historyofGIS,elements ofGIS,objectivesofGIS,hardwareandsoftwarerequirementsofGIS, applicationofGIS	09
II.	Datamodelsofspatialinformation:Layersandcoverage,conceptualmodel s ofspatialinformation,representationofspatialdatamodelsincomputer: rasterandvectormodels,comparativeoverviewbetweenrasterandvector models	11
III.	Datamodelsofnon-spatialinformation:Databasemanagementsystems, hierarchical structure, networkstructure,relationalstructure	07
IV.	Digitizing,EditingandStructuringofmapdata:Digitizing: manual,semi-automaticandautomatic,editing:errordetectionandcorrection,tolerances , topologycreation.attributemap generation	10
V.	DigitalElevationModel:NeedofDEM,VariousstructuresofDEM:line, TIN, grid.	08
VI.	ApplicationofRemotesensingandGIS:Forestresourcemanagement, agricultureandsoilmanagement,waterresourcemanagement,landuseand landsuitability.disaster management	07

Contribution to Outcomes

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

- Install and Use GIS software.

- Project the Maps and view data to interpret the results.
- Create Spatial data models.
- Use Geo-processing tool.
- Convert the data.
- Import and Export data.
- Layout a Map using GIS software.

Theory examination:

1. The question paper will comprise of **six** questions; each carrying 20 marks.
2. The **first** question will be **compulsory** and will have question/s on the theoretical portion covering the entire syllabus.
3. The remaining five questions will be based on all the modules of the entire syllabus. For this, the modules shall be divided equally and further, the weightage of the marks shall be judiciously awarded in proportion to the importance of the sub-module and contents thereof.
4. The students will have to attempt **anythree** 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.

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

1. InstallationofGISsoftware and gettingFamiliarizedwithGISmenuandTools
2. MapProjections and Map Digitization.
3. Geo-Referencing.
4. CreatingVectordata and CreatingRasterdata/ data layers.
5. Creatingattribute table.
6. Measurements: length and area.
7. Dataviewing basedonSingleSymbol, Graduated Symbol.
8. DataviewingonContinuouscolor and unique value.
9. Labelingthefeatures.
10. Selection tool and Geo-processingtool(Buffer,Clip,intersectanddifference).
11. Coordinatecapture- tosavein notepad.
12. Joininglayersbasedoncommonfield.

13. Dataconversion (raster to vector), polygon to polyline.
14. Convertpolygontopolyline.
15. AddGraphic overlay to a vector layer.
16. Importandexportdata and MapLayout.

Term work:

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

Distribution of Term Work Marks:

The marks of the term-work shall be judiciously awarded for the various components depending upon its quality. The final certification and the acceptance of the term-work warrant the satisfactory and the appropriate completion of the assignments;and further, 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: 10 Marks
- Practicals: 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. GeographicInformationSystemsandScience (2nd Ed.):*Longley,PaulA., MichaelF.Goodchild,DavidJ.Maguire,DavidW.Rhind*,JohnWileyandSons,New York, 2005.
2. ModelingOurWorld:TheESRIGuideto GeodatabaseDesign:*Zeiler,M.*, ESRIPress, Redlands,California, 1999.
3. GIS,SpatialAnalysisandModeling:*Maguire,D.*,*M.Batty*,and*M. Goodchild*, ESRI Press, 2005.

4. Introduction to GeographicInformationSystems:*Kang-TsungChang*,TataMc GrawHill.
5. AdvancedSurveying(TotalStation,GISandRemoteSensing) (1st Ed.): *SatheeshGopi*,*R.Sathikumar*,*N. Madhu*,2007.

Semester VIII

Subject Code	Subject Name	Credits
CE-E804	Elective II- Water Resources Engineering and Management	5

Teaching Scheme

Contact Hours			Credits Assigned			
Theory	Practicals	Tutorials	Theory	Practicals	Tutorials	Total
4	2	-	4	1	-	5

Evaluation Scheme

Theory					Termwork/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	3	25	-	25	150

Rationale

The knowledge of this subject is essential to understand facts, concepts of water resources project planning, environmental impact assessment, flood estimation and control measures. This course will provide the students the knowledge of planning, design, and operation of water resources systems using mathematical optimization methods and models. The student will learn to apply basic economic analysis (engineering economic and microeconomic analysis) and operations research techniques (linear, nonlinear and dynamic programming, and combinatorial optimization) to various surface water resource allocation problems.

Objectives

1. To know about objectives of Water resources project planning, investigations and data requirement.
2. To understand Water resources system design, development, assessment and environment impact assessment.
3. To evaluate Engineering economy in flood control projects.

4. To Model watershed hydrology using different techniques.
5. To understand requirements of multipurpose project developmental issues like hydro-electric power development, inland water transportation and watershed management.

Detailed Syllabus

Module	Sub -Modules/Contents	Periods
I	**Water resources project planning** Investigations in project planning, planning data requirement and collection, levels or planning and objectives, project formulation and evaluation, multipurpose project planning, Drawbacks in planning, system approach in water resources planning.	9
II	**Water resources development and environment** Objects of water resources development. water resources system design, Water resources assessment, augmentation of water resources, Economics of water resources development, Integrated and conjunctive use of water development, Irrigation and water management, Constraints in irrigation development, National water policy, Environmental planning, Environmental impact assessment, measurement of ElA, status of EIA in India.	13
III	**Engineering economy in flood control projects** Flood estimation and flood control measures, flood forecasting and warning, effect of urbanization on runoff, peak flow methods in urban area, Flood routing through reservoirs and channels, discounting formulae, discounting methods, economies of flood control, estimating flood damages, estimating flood control benefits, reservoir sedimentation and control.	10

IV	**Modelling watershed hydrology** Hydrologic processes, rainfall-runoff measurement and analysis, Hydrographs and IUH, Mathematical models in hydrology, Nash and clark model, Generalised watershed simulation models, GIS tool in watershed management, probability and stochastic models, frequency analysis, Regression and correlation, optimisation techniques for water resources projects by linear programming, non-linear programming and dynamic programming, mathematical models for large scale multipurpose projects, different case studies.	13
V	**Multipurpose developmental issues** Hydro-electric power development and power sector, inland water transportation, micro-level planning, watershed management. Rainwater harvesting, cloud seeding, cost-benefit considerations in water resources planning, River basin management.	7

Contribution to outcomes

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

1. Know about Investigations required in water resources project planning, formulation and its evaluation.
2. Assess economics of water resources development, Integrated and conjunctive use of water development and water management.
3. Estimate flood, its control measures, flood forecasting techniques, warning system and its benefits.
4. Model watershed hydrology by different techniques along with applications of optimization techniques for water resources projects.
5. Understand cost-benefit considerations in water resources project planning.

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 the entire syllabus. For this, the modules shall be divided proportionately further; and 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 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.

Term work:-

The term-work shall comprise of the neatly written assignments. The assignments shall be given covering the entire syllabus in such a way that the students would attempt at least four problems and/or questions on each modules/ sub-modules and 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 and the assignments. The final certification and the acceptance of the term-work warrant the satisfactory and the appropriate completion of the assignments;and further, 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. Water Resources Engineering: *Ralph A Wurbs*, *Weseley P. James*, Prentice Hall. India
2. Economics of Water Resources Planning: *James,L. D.*, *Leo,R. R.*, Mc GrawHill
3. Elements of Water Resources Engineering: *K N Duggal and P Soni*, New Age International Publishers
4. Environmental Impact Assessment: *Larry W. Canter*, Mc Graw Hill, 1997
5. Introduction to Hydrology: *Warren Viessman, Jr.* and *Gary L. Lewis*, Pearson Education, 2007.
6. Hydrology- Principles, Analysis Design*: H.M. Raghunath*, New Age International Publishers

Semester VIII

Subject Code	Subject Name	Credits
CE-E804	Elective-II: Bridge Design and Engineering	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	25	--	25	150

Rationale

In transportation system roads and railways routes are require to be constructed in difficult terrains, where requirement of bridges are essential to connect the inaccessible routes. In this subject, students will be well acquainted with the types of bridges and their selection based on the specific needs. The civil engineering profession is much concerned with design of different types of structures, in which design of bridge structure is very important. This subject deals with analysis and design of different types of bridges for IRC loads along with substructure (foundation, Pier, abutments) with various constructions methods.

Objectives

The course aims at:

1. Selection of suitable type of bridge according to the site condition.
2. IRC loadings, load distribution and railway loading.

3. Design of bridge superstructure and substructures.
4. Different types of bridge foundations.
5. Erection of bridge super structure.

Detailed Syllabus

Module	Sub- Modules/ Contents	Periods
I.	**Introduction:** Types of Bridges, Selection of suitable type of bridge, aesthetics, economic span.	08
II.	**Design Loads and their Distribution:** IRC loads, analysis of deck slab and IRC loads, Load distribution among longitudinal beams of a bridge, railway loading.	11
III.	**Design of Superstructure:** Design of balanced cantilever concrete bridge, design of prestressed concrete bridge, design of lattice girder railway bridge, introduction to design of RC Arch bridges and box bridges.	16
IV.	**Design of Substructure:** Different types of foundations, their choice and methods of construction, design of well foundation, design of piers and abutments, various types of bearings and their suitability.	14
V.	**Construction Methods :** Erection of bridge superstructure, cantilever construction.	03

Contribution to Outcomes

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

1. Select the suitable type of bridge according to the site condition.
2. Understand IRC loads, distribution of these loads among longitudinal beams of a bridge.
3. Design of balanced cantilever concrete bridge, prestressed concrete bridge, lattice girder Railway Bridge, RC Arch bridges and box bridges.

4. Design different types of foundations, piers and abutments, their methods of construction,
5. Understand various types of bearings and their suitability, erection of bridge superstructure.

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 further, and 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 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.

Term work:

The termwork shall comprise of the neatly written assignments. The assignments shall be given covering the entire syllabus in such a way that the students would attempt at least four problems and/or questions on each modules/ sub-modules and 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. The final certification and the acceptance of the term-work warrants the satisfactory and the appropriate completion of the assignments;and further, 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 Bridges: *Raju N. K.*, Oxford and IDH.
2. Bridge Engineering: *Ponnuswamy S.*, Tata Mc Graw Hill.
3. Concrete Bridge Practice: *Raina V. K.*, Tata Mc Graw Hill.
4. Essentials of Bridge Engineering: *Victor D.J*, Oxford and IDH.
5. Design of Bridge Superstructures: *T.R. Jagdeesh* and*M.A. Jayaram*, Prentice Hall India Private Ltd., New Delhi.

Semester VIII

Subject Code	Subject Name	Credits
CE-E804	Elective-II: Environmental Impact and Assessment and Audit	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	25	--	25	150

Rationale

Environmental impact assessment is the formal process used to predict the environmental consequences (positive or negative) of a plan, policy, program, or project prior to the decision to move forward with the proposed action. An impact assessment may propose measures to adjust impacts to acceptable levels or to investigate new technological solutions. This subject covers the study of environmental assessment process,environmental auditing and provisions of various environmental acts of India.

Objectives

1. To use of EIA for various projects
2. To monitor and mitigation of Impacts
3. To perform EIA for various projects

4. To perform Environmental Auditing process

5. To learn laws related to EIA and auditing in India

Detailed Syllabus

Module	Sub-Modules/ Contents	Periods
I.	Environmental impact assessment What is it, Environmental attitudes, Brief history of EIA, Significance of EIA, Role of EIA in planning and decision making process, objectives of EIA.	07
II.	Environmental assessment process Assessment methodology , Socioeconomic impact assessment, Air quality impact analysis, Noise impact analysis, Energy impact analysis, Water quality impact analysis, Vegetation and wild life impact analysis, Cumulative impact assessment, Ecological impact assessment, Risk assessment.	14
III.	Environmental Impact Assessment Basic concept behind EIS, Stages in EIS production: Screening, scoping, prediction, evaluation, reducing impact, monitoring, conclusions, typical EIS outline,	07
IV.	Rapid EIA	06
V.	Environmental Auditing Definition, aims and objectives, audit principles, incentives to undertake audit, partial environmental audits, stages of implementing environmental audits, scope of audit	06
VI.	ProvisionsofvariousenvironmentalactsofIndia	06
VII.	CaseStudies	06

Contribution to Outcomes

The students shall be able to:

1. Evaluate the need to EIA

2. Carry out an EIA for a project

3. Understand the laws and where they can be applied in Indian Context

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 further, and 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 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 assignments.

Term work:

The term-work shall comprise of the neatly written assignments. The assignments shall be given covering the entire syllabus in such a way that the students would attempt at least four problems and/or questions on each modules/ sub-modules and 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 and the assignments. The final certification and the acceptance of the term-work warrant the satisfactory and the appropriate completion of the assignments;and further, minimumpassing 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. Corporate Environmental Management: Welford R, University Press
2. Environmental Assessment: *Jain R K*, Mc-Graw Hill
3. Environmental Impact Assessment: *Harry W Conter*, Mc-Graw Hill
4. Environmental Impact Assessment – Handbook: *John G Rau* and *D C Wooren*, Mc-GrawHill.

Semester VIII

Subject Code	Subject Name	Credits
CE-E804	Elective-II: Appraisal and Implementation of Infrastructure Project	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	25	--	25	150

Rationale

This course is intended to make students aware of appraisal criteria needed for Civil engineering project. Through this course, student must learn about feasibility studies, Project report preparation etc. to decide the viability of the project.The professional construction engineering practice will be rendered meaningless if student do not grasp the knowledge of financial analysis. This course shall be helpful to students in studying all the economic aspects of Infrastructure projects.

Objectives

- To understand the basic study as well as feasibility studies of Infrastructure projects.
- To learn various appraisals for deciding the worthwhileness of the projects.

- To make students acquainted with the important tools like break even analysis, S.W.O.T analysis.
- To know about economic analysis of the projects.

Detailed Syllabus

Module	Sub- Modules/Contents	Periods
I.	**Construction Projects and Report Preparation:** 1.1 Infrastructure projects and its classification. 1.2 Project Formulation and phases involved in it. 1.3 Feasibility studies, SWOT analysis. 1.4 Preparation of Project report	09
II.	**Projects Appraisal:** 2.1 Project Development Cycle 2.2 What is appraisal? Need of appraisal etc. 2.3 Steps of appraisal.	06
III.	**Market Appraisal:** 3.1 Demand analysis, forecasting demand etc. 3.2 Sources of information, Market Survey 3.3 Uncertainties in demand forecasting	06
IV.	**Technical Appraisal** 4.1 Technical Viability 4.2 Location, Land, Building etc. 4.3 Size of plant, Technology, Machinery, raw materials etc. 4.4 Energy requirements, Water supply, effluent disposal etc.	05
V.	**Managerial Appraisal :** 5.1 Assessment of entrepreneurs, Organizational structure 5.2 Managerial requirements of project. 5.3 Chief Executive, Board of Directors etc.	07
VI.	**Financial Analysis and Economic appraisal:** 6.1Cost of project, Profitability, Break Even Analysis etc. 6.2 Economic appraisal: Urgency, Payback period, Avg. Rate of return,	12

	Net Present Value, Internal rate of return, Benefit cost ratio, Cost of Capital etc.	
VII.	**Project Implementation :** 7.1 Agencies involved in Implementation. 7.2 Methods of implementation like Built, operate and Transfer its Variants like B.O.O, B.O.OT, B.L.T etc.	04
VIII.	**Project Financing:** 8.1 Types and Sources of finance (Local, National and International) 8.2 Project financing Issues.	03

Contribution to Outcomes

On successful completion of the course, it is expected that:

- The students shall be able to understand about the infrastructure projects and implementation methods.
- The students shall be able to know how to prepare project report and detailings about theproject.
- The students shall be able to understand and apply various appraisal criteria's for deciding the worthwhileness of the project.
- The course shall inculcate the managerial skills and knowledge of financial aspects among the students which will be helpful for them in future during the implementation of projects.

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 further, and 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 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 will 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 and/or questions on each modules/ sub-modules and 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 and the assignments. The final certification and the acceptance of the term-work warrant the satisfactory and the appropriate completion of the assignments;and further, 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. Project Preparation, Appraisal, Budgeting, and Implementation: *Prasanna Chandra*, Tata McGraw Hill.

Semester VIII

Subject Code	Subject Name	Credits
CE-E804	Elective-II: Disaster Management	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	25	--	25	150

Rationale

Disasters, natural or man-made result in untold misery on the human beings and adverse effects on the ecology. Thus our ability to manage and mitigate disaster assumes paramount importance. Disaster management is understood as the managerial function charged with creating the framework, within which communities reduce vulnerability to hazards and cope with disasters.The function of disaster managers is to evaluate risk and exposure, create response plans and ensure response capacity after an event. The response capacity to disaster becomes complete when the community, with specific reference to youth is involved in the entire disaster management cycle.Youth constitute a vibrant, constructive force of a nation and more so in India, where it is emerging as a leading nation in the percentage of population in the age group of 13-35. This course is intended to teach students the management skills to be applied during such disasters.

Objectives

- To increase the knowledge and understanding of the disaster phenomenon, its different contextual aspects, impacts and public health consequences.
- To increase the knowledge and understanding of the International Strategy for Disaster Reduction (UN-ISDR) and to increase skills and abilities for implementing the Disaster Risk Reduction (DRR) Strategy.
- To ensure skills and abilities to analyze potential effects of disasters and of the strategies and methods to deliver public health response to avert these effects.
- To ensure skills and ability to design, implement and evaluate research on disasters.

Detailed Syllabus

Module	Sub - Modules/Contents	Periods
I.	**Introduction to Disasters** 1.1 Definitions and terminologies — hazard, risk, accident, disaster vulnerability 1.2 Natures and extent of disasters, natural calamities such as earthquake, floods, drought volcanoes, forest, coasts hazards, landslides etc. Manmade disasters such as chemical and industrial hazards, nuclear hazards, fire hazards etc. 1.3 Disaster Management – Financing relief, expenditure, legal aspects, rescue operations. Casual management, risk management, disaster management. 1.4 Significance of disaster management and role of civil engineers in it	15
II.	**Emergency Management Program:** 2.1 Administrative setup and organization. 2.2 Hazard analysis, training of personnel, information management, emergency facilities and equipment necessary public awareness creation 2.3 Preparation and execution of the emergency management program	12

III.	**Disaster Relief Teams:** 3.1 Various organizations registered with Government and NGO's working for disaster relief- 3.2 Challenges faced by organizations. 3.3 Methods of assessment of impact of disasters such as photogrammetric methods, media survey, ground data collection	12
IV.	**Resources Management and Allocation :** 4.1 International adopted practices for disaster mitigation. 4.2 Rules and regulations, Monitoring aspects of disaster mitigations programs. 4.3 International Strategy for Disaster Reduction (UN-ISDR) 4.4 Disaster Risk Reduction (DRR) Strategy.	13

Contribution to Outcomes

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

1. Demonstrate knowledge and understanding of the role of Public Health in disaster situations, including both a broad command of the field and a deeper knowledge of specific areas, together with insight into current research and development work and to demonstrate deeper methodological knowledge related to their chosen study track:
2. Integrate knowledge and to analyse, evaluate and manage the different public health aspects of disaster events at a local and global levels, even when limited information is available.
3. Describe, analyze and evaluate the environmental, social, cultural, economic, legal and organizational aspects influencing vulnerabilities and capacities to face disasters.
4. Work theoretically and practically in the processes of disaster management (disaster risk reduction, response, and recovery) and relate their interconnections, particularly in the field of the Public Health aspects of the disasters.
5. Manage the Public Health aspects of the disasters.
6. Obtain, analyze, and communicate information on risks, relief needs and lessons learned from earlier disasters in order to formulate strategies for mitigation in future scenarios with the ability to clearly present and discuss their conclusions and the knowledge and arguments behind them.

7. Design and perform research on the different aspects of the emergencies and disaster events while demonstrating insight into the potential and limitations of science, its role in society and people's responsibility for how it is used.
8. Analyze and evaluate research work on the field of emergencies and disaster while demonstrating insight into the potential and limitations of science, its role in society and people's responsibility for how it is used.

Theory examination:

1. Question paper will comprise of **six** questions; each carrying 20 marks.
2. The **first** question will be **compulsory**whichwill 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 the entire syllabus. For this, the modules shall be divided proportionately further; and 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 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.

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 and/or questions on each modules/ sub-modules and contents thereof, further.

Distribution of Term Work Marks:

The marks of the term-work shall be judiciously awarded depending upon its quality. The final certification and the acceptance of the term-work warrant 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. Manual Natural Disaster Management in India, *Gupta, M. C.*, NIDM, New Delhi
2. Encyclopedia of Disaster Management, Vol. I, II and III, *Goyal, S. L.*, Deep and Deep, New Delhi
3. Disaster Management Act 2005, Govt. of India
4. Publications of NDMA on Various Templates and Guidelines for Disaster Management

Reference Books:

1. An Introduction to Disaster Management –Natural Disasters and Man Made Hazards, *S.Vaidyanathan*, Ikon Books
2. Construction Engineering and Management – *Seetharaman*.
3. NICMAR Publications
4. Different sites on internet on Disaster Management
5. Project Management – *K Nagarajan* – New Age International Ltd.
6. Disaster Management Handbook by *Jack Pinkowski* – CRC Press (Taylor and Francis group)
7. RedR Handbook for Disaster Management

Semester VIII

Subject Code	Subject Name	Credits
CE-E804	Elective-II: Pavement Design and Construction	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	25	--	25	150

Rationale

The pavements are classified according to mode of transportation (highway and airways) and structural behaviour (flexible and rigid). The design of any pavement warrants the proper analysis thereof. The course deals with the various methods of the analyses and design of pavements. The evaluation of the pavements on routine basis and subsequent maintenance is essential to avoid the distresses in pavements. The course also covers the various distresses likely to take place in the pavements and various methods of evaluating the existing pavements. The distressed pavement needs either strengthening or rehabilitation depending upon the distresses the pavement has undergone. For the proper working and maintenance of the pavement, the concept of pavement management system has emerged. The course also covers these aspects. It also gives major thrust on the low volume roads and construction of concrete roads.

Objectives

1. To introduce the different types of pavements depending upon the mode of transportation using it and further, depending upon the structural behavior.
2. To understand the concept of consideration of wheel loads, axle loads, wheel-axle configuration and allied aspects as a pre-requisite in the analysis and design of the pavement.
3. To study the various types of structural responses (stresses and deformations) inducing the pavements due to wheel load and other climatic variations.
4. To study the various methods of analysis and design of the pavements and its sub-sequent applications to the various types of pavements.
5. To study the different types of distresses in pavement, evaluation of the existing pavements using different methods and rehabilitation of the distressed pavements.
6. To study the construction of the concrete roads and low volume roads.
7. To study the quality control and quality assurance in the road construction and introduce pavement management system.

Detailed Syllabus

Module	Sub-Modules/ Contents	Periods
I.	Pavement structure and functional attributes, factor affecting pavement design, types of wheel loads for highways and airports, development of design method for highway and airport pavements.	05
II.	Stresses in flexible pavements, 1-layer, 2-layer, 3-layers theories, EWLF,ESWL Stresses in Rigid pavement: load and temperature stresses, combined stresses.	10
III.	Flexible Pavement Design Airport pavement: Corps of Engineer's method, FAA method CDOT method, Asphalt institute method. Highway Pavement: Empirical methods using no soil strength criteria, empirical method based on soil strength criteria: CBR method as specified by IRC, Road note 29 methods, AASHTO method,	08

	Asphalt institute method. Fatigue and rutting as a failure criterion.	
IV.	Rigid Pavement Design: Airport pavements: PCA methods, corps of Engineer's method, FAA method. Joints and reinforcement requirement. Highway pavement: Current British procedure, IRC method.	06
V.	Evaluation and strengthening: flexible and rigid pavement distresses, condition and evaluation surveys, present serviceability index, roughness measurement, Benkaleman beam deflections, design of overlays, skid resistance and measurement.	07
VI.	Concrete road construction: Mix design, concrete strength, size of aggregates, gradation, and workability, preparation of base form work, placing of reinforcement, compaction, and finishing, curing, joints.	03
VII.	Low Cost Roads (Rural Areas) Classification of low cost roads, construction of low cost roads, stabilization of subgrade, base and its advantages, construction of granular base courses, macadam surface, macadam bases, low cost materials and methods used for highway construction, suitability of different types of roads under different situation. Soils.	03
VIII	Road making machinery Role of labour versus machinery, in road construction, earth work machinery, rock excavation machinery, aggregate transportation and watering equipment, wet mix WMM Plant, Asphalt plant, (computerized), drum mix, Continuous batch mix, compaction equipment, bituminous equipment, storage, heating and spraying equipment, hot mix plants, cold mix plants, paver, finisher, concrete road making machinery, equipment usage rates, factors affecting usage rate	05
IX	Quality control (QC) and Quality assurance (QA) during construction of various pavements, importance, process control and end product control, statistical methods in quality control, control charts, frequency of testing etc.	03
X	Introduction to pavement management systems.	02

Contribution to Outcomes

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

- Understand the structural actions involved in the pavement due to different types of load acting thereon and the various methods of analysis of pavements.
- Understand the applications of the analysis in the design of pavements using different methods of pavement design.
- Know the different types of distresses occurring in the existing pavements and carry out the structural and functional evaluation of the pavements.
- Apply the knowledge of evaluation in pre-empting the failure and to arrive upon the methodology of the rehabilitation of pavements.
- Understand the various aspects of the construction of concrete roads and low volume roads.
- Understand the pavement management system and quality control and assurance criteria and subsequently, its application in the highway construction.

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 further, and 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 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.

Term work:

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

Distribution of Term Work Marks:

The marks of the term-work shall be judiciously awarded depending upon its quality of the term work. The final certification and the acceptance of the term-work warrant the satisfactory and the appropriate completion of the assignments;and further, 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. Principles and Practice of Highway Engineering: *L.R.Kadiyali*, Khanna publications.
2. Highway Engineering: *Khanna S.K. and Justo* C.E.G. Nem Chand (Revised 10th Edition, 2014)
3. Principles, Practice and Design of Highway Engineering (Including Airport Pavements): *Sharma, S.K.*, S. Chand Technical Publications (3rd Revised Edition, 2013)
4. Pavement Analysis and Design: *Yang H. Huang*, Prentice Hall, New Jersey, 1993
5. Pavement Design: *Yoder* and *Witzech*, McGraw-Hill, 1982.
6. The Design and Performance of Road Pavements: *Croney, David et al*, McGraw Hill.

Semester VIII

Subject Code	Subject Name	Credits
CE-E804	Elective-II: Advanced Design 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 1	Test 2	Average						
20	20	20	80	03	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 of steel.These structures are designed by working stress method and limit state method. The design method of different component that are given in the syllabus are based on limit state method and working state method.

Objectives

1. To understand the analysis and design concept of round tubular structures
2. To understand the design concept of different type of steel water tank
3. To understand the design concept of lattice tower and steel chimney
4. To understand the design concept of gantry girder

5. To develop clear understanding of theconcepts and practical knowledge of modern Civil Engineering techniques for design of steel structures.
6. Use of various relevant IS codes for designing steel structures.

Detailed Syllabus

Module	Sub – Modules / Contents	Periods
I	**Introduction to Steel Structure** Introduction to type of steel, mechanical properties of Structural steel, advantages of steel as structural material, design philosophies of Working Stress Method (WSM) and Limit state method	03
II	**Moment Resistant Beam End Connections :** Design of moment resistant bolted and welded beam end connections by limit state method	05
III	**Round Tubular Structural Members :** Properties of steel tubes, design of tension member and compression members, design of welded connections, design of flexural members, analysis and design of tubular trusses including purlins and supports	06
IV	**Elevated Steel Tanks and Stacks :** Loads acting on tanks including wind and earthquake, design of circular tanks with hemispherical and conical bottom, supporting ring beam, staging for circular tanks including design of columns and foundation, design of rectangular steel tanks including design of staging, columns and foundation.	14
V	**Gantry Girder :** Loads acting on gantry girder, Analysis of gantry girder, design of gantry girder by limit state method.	07
VI	**Lattice Tower :** Different configuration of lattice towers, loads acting on lattice towers, Analysis of lattice tower, design of lattice tower including welded or riveted connections for members by limit state method.	09

VII	**Steel Chimney :** Forces acting on chimney, design of self-supporting welded and bolted chimney and components including design of foundation.	08

Contribution to Outcomes

On completion of this course, the students shall be able to understand the analysis and design of gantry girder by limit state method. They shall be able to analysis and design steel chimney, lattice tower, tubular truss and water tank.The students are expected to be able to independently design steel structures using relevant IS codes.

Theory Examination:-

1. Question paper will comprise of **six** question; each carrying 20 marks.
2. The **first** question will be compulsory and will have short question havingweightage of 4-5 marks covering the entire syllabus.
3. The remaining **five** questions will be based on all the modules of the entire syllabus. For this, the modules 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. 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.

Term Work:

The term-work shall comprise of the neatly written assignments. The assignments shall be given covering the entire syllabus in such a way that the students would attempt at least three problems and/or questions on each modules/ sub-modules and contents thereof, further. In addition to this, the term work shall consist of a design report and detailed drawings on three projects as indicated below:

1. Roofing system including details of supports using tubular section
2. Design of elevated circular tank with conical bottom or rectangular steel tank.

3. Design of lattice tower or steel chimney.

The drawing will be drawn in pencil only on minimum of A-1 (imperial) size drawing sheets.

Distribution of Term Work Marks:

The marks of the term-work shall be judiciously awarded for various components depending upon its quality. The final certification and the acceptance of the term-work warrant 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 : 10 Marks
- Design Report: 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 Design of Steel Structures: Punamia, *A. K. Jain and Arun Kumar Jain*, Laxmi Publication

3 Design of Steel Structures: *Dayaratnam*, Wheeler Publication, New Delhi.

4 Design of steel structures: *Krishnamachar, B.S.*and*Ajitha Sinha D.*

Reference Books:

1. Design of Steel Structures: *Mac. Ginely T.*
2. Design of Steel Structures: *Kazimi, S. M.* and *Jindal, R. S.*, Prentice Hall of India.
3. Design of Steel Structures: *Breslar, Lin* and *Scalzi*, John Willey, New York.
4. Design of Steel Structures: *Arya* and *Ajmani,* New chand and Bros.
5. Relevant IS codes, BIS Publication, New Delhi
6. Steel structures, Controlling behavior through design: *Englekirk, R.,* Wiley

7. LRFD Steel Design : *William T. Segui*, PWS Publishing
8. Design of Steel Structures: *Edwin H. Gaylord*, *Charles N. Gaylord* and *James*, Stallmeyer, McGraw-Hill
7. Design of Steel Structures, Vol I and II: *Ramchandran*, Standard Book House, New Delhi.
8. Design of Steel Structures: *Dayaratnam*, Wheeler Publication, New Delhi
9. Design of Steel Structures: *Breslar*, *Lin* and *Scalzi*, John Willey, New York.
10. Structural Steel Work: *Reynolds, T. J., Kent L.E. and Lazenby, D.W.*, English University Press.
11. Comprehensive Design of Steel Structures: *Punmia*, *A.K. Jain* and *Arun Kumar Jain*, Laxmi Publications Pvt. Ltd.
12. Design of Steel Structures: *Sayal, I. C.*and *Salinder Singh*, Standard Publishers and Distributors.

Semester VIII

Subject Code	Subject Name	Credits
CE-E804	Elective-II: Earthquake Engineering	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	25	--	25	150

Rationale

Earthquake engineering is the science of the performance of buildings and structures when subjected to seismic loading. It also assists analyzing the interaction between civil infrastructure and the ground, including the consequences of earthquakes on structures. One of the most important aims of earthquake engineering is the proper design and construction of buildings in accordance with building codes, so as to minimize damage due to earthquakes. It is the earthquake engineer who ensures proper design of buildings so they will resist damage due to earthquakes, but at the same time not be unnecessarily expensive.

Objectives

- To study the importance of the earthquake engineering
- To study the different types of dynamic loads, concept of damping, and analysis of SDOF system subjected to different types of dynamic loads.

- To calculate frequency and mode shapes for the MDOF system, analysis of MDOF system subjected to different types of dynamic loads.
- To study the causes of earthquake, types of earthquakes, seismic waves, structure of earth, and measurement of earthquake magnitude and intensity.
- To study the concept of Response Spectrum, ground motion parameters, characteristics of response spectrum, and various methods to construct response spectrum.
- To analyze the structure subjected to ground motion as per codal provisions of IS:1893-2002 and calculation of earthquake loads/forces. Importance of ductility in earthquake resistant design of structure and codal provision of IS: 13920.
- To perform the basic experiments in structural dynamics on SDOF and MDOF system.

Detailed Syllabus

Module	Sub-Modules/ Contents	Periods
I.	**Introduction:** Definitions of basic problems in dynamics, static v/s dynamic loads, different types of dynamic loads, undamped vibration of SDOF system, natural frequency and periods of vibration, damping in structure. Response to periodic loads, response to general dynamic load, response of structure subject to round motion, use of Fourier series for periodic forces.	12
II.	**MDOF systems:** Direct determination of frequencies and mode shapes, orthogonality principle, approximate methods for determination of frequencies and mode shapes. Forced vibration of MDOF system, modal analysis, applications to multistoried rigid frames subject to lateral dynamic loads including ground motion.	08

III.	**Seismological Background:** Seismicity of a region, earthquake faults and waves, structure of earth, plate tectonics, elastic-rebound theory of earthquake, intensity and magnitude of earthquake, measurement of ground motion, seismogram, earthquake frequency , local site effects, seismotectonics and Seismicity of India.	06
IV.	**Characterization of Ground Motion:** Earthquake response spectra, factors influencing response spectra, design response spectra for elastic systems, peak ground acceleration, response spectrum shapes, deformation, pseudo-velocity, pseudo-acceleration response spectra. Peak structural response from the response spectrum, response spectrum characteristics, construction site specific response spectra.	08
V.	**Deterministic Earthquake Response:** Types of earthquake excitation, lumped SDOF elastic systems. translational excitation, lumped MDOF elastic systems, translational excitation, time history analysis, multistoried buildings with symmetric plans, multi storied buildings with un symmetric plans, torsional response of symmetric plan building, distributed - parameter elastic systems, translational excitation, combining maximum modal responses using mean square response of a sin le mode, SRSS and CQC combination of modal responses.	06
VI.	**I. S. Code Method of Seismic Analysis:** Seismic co-efficient method and its limitation, response spectrum method, IS 1893-2002 provisions for seismic analysis of buildings and water towers, seismic evaluation and retrofitting, types of structural system used in building to resist earthquake loads.	06
VII	Review of damages during past earthquakes and remedial measures, seismic design considerations, allowable ductility demand, ductility capacity, reinforcement detailing for members and joints as per IS 13920.	06

Contribution to Outcomes

- The students are expected to understand the difference between static and dynamic analysis, types of dynamic loads, concept of damping.
- The students are expected to evaluate the response of the structures subjected to different types of dynamic loads.
- The students are expected to understand earthquake phenomenon, concept of response spectrum, application of structural dynamics in the evaluation of structural response to Earthquake excitation and their codal provisions.
- The students are expected to carry out Seismic analysis of structure.

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 further, and 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 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.

Term work:-

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

Distribution of Term Work Marks:

The marks of the term-work shall be judiciously awarded depending upon its quality. The final certification and the acceptance of the term-work warrant the satisfactory and the appropriate completion of the assignments;and further, 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:-

- Structural Dynamics-An Introduction to Computer Methods: *Roy R. Craig*.
- Dynamics of Structures: *Anil K. Chopra*, Prentice Hall, India.
- Dynamics of Structures: *Cloguh* and *Penzien*, Tata McGraw Hill
- Structural Dynamics: *John M, Biggs*, Tata McGraw Hill
- Fundamentals of Earthquake Engineering: *N. M. Newmarks* and *E. Rosenblueth*, Prentice Hall.
- Earthquake Design Practice for Building: *D. Key*, *Thomas Telford*, London, 1988.
- Earthquake Engineering: *R. L. Wiegel*, 2nd Edition, Prentice Hall, London, 1989.
- Design of Multistoried Buildings for Earthquake Ground Motions: *J. A. Blume*, Portland Cement Association, Chicago, 1961.
- Proceedings on World Conference on Earthquake Engineering: 1956-2000.
- Earthquake Resistant Design of Structures: *Pankaj Agarwal, Manish Shrikhande*, Prentice Hall, India, 2006.
- I. S. codes No. 1893, 4326, 13920. (All latest codes)

Semester VIII

Subject Code	Subject Name	Credits
CE-E804	Elective-II: Soil Dynamics	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	25	--	25	150

Rationale

In basic geotechnical engineering course generally various static loads are considered in the theories and analysis of soil. But practically many geotechnical applications require the knowledge of the behaviour and properties/response of soil as a material which is subjected to various types of dynamic or cyclic time-dependent loadings. Some of the structures which are subjected to dynamic loadings are machine foundations, shallow and deep foundations, retaining structures, slopes, sub grade soil below railway, pavement, runway etc. This course provides the fundamental theoretical and computational aspects of dynamics for some important geotechnical problems and structures.

Objectives

- To study fundamental concepts of vibrations, degrees of freedom and damping systems.

- To study phenomena like liquefaction and their effects.
- Tostudy principals of machine foundation design and dynamic earth pressure theories on retaining wall.
- To learn test methods of evaluating dynamic properties of soil.

Detailed Syllabus

Module	Sub- Modules/Contents	Periods
I.	Vibration of elementary system, degree of freedom, analysis of system with one degree of freedom, spring-mass system, harmonic vibration, uniform circular motion natural frequency, free and forced vibrations with and without damping, type of damping	10
II.	Wave propagation in elastic rods, in an elastic infinite medium and in semi elastic half space, wave generated by surface footing.	05
III.	Liquefaction of soils, criterion and factors affecting liquefaction of soil, laboratory and field studies on liquefaction, liquefaction studies in oscillatory simple shear, evaluation of liquefaction potentials, liquefaction of clay.	10
IV.	Principles of machine foundation design, criteria for satisfactory machine foundation, degree of freedom of a block foundation analysis of vertical and sliding vibration of a machine foundation, mass of soil participating in vibration.	06
V.	Vibration isolation and screening methods, improvement of distressed machine foundation.	07
VI.	Field and laboratory tests for evaluation of dynamic properties of soil under vertical vibration coefficient of elastic uniform shear, spring constant damping modulus of elasticity typical values of soils.	07
VII.	Basics of dynamic earth pressure on retaining walls: conventional gravity type, reinforced soils, distribution of pressure, point of application of the resultant, simple examples.	07

Contribution to outcomes

On successful completion of the course, the students are expected to:

- Acquire the knowledge of concepts, principles and applications of soil under dynamic loading.
- Develop an ability to design with reference to code provisions and solve the practical soil problems subjected to vibrations.
- Provide an impetus to new developments in related dynamic topics.

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 further, and 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 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.

Laboratory Test

It is recommended to conduct block foundation tests.

Oral Examination:-

The oral examination will be based on the entire syllabus.

Term Work:

Each student shall prepare a project report covering the selection of design parameters, design analysis including drawing on any aspect of soil dynamics included in the syllabus. The project report referred above along with the assignments will form a part of the term work.The assignments shall be given covering the entire syllabus in such a way that the students would attempt at least four problems and/or questions on each modules/ sub-modules and contents thereof, further. The report on the block vibration tests, if conducted, shall also form a part of the term work.

Distribution of Term Work Marks:

The marks of the term-work shall be judiciously awarded for various components of the term work depending upon its quality. The final certification and the acceptance of the term-work warrant the satisfactory and the appropriate completion of the assignments, proper compilation of the project report and that of experiments/ practical, if conducted;and further, 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. Soil Dynamics: *Shamsher Prakash*, McGraw-Hill book company
2. Principles of Soil Dynamics: *Braja, M. Das*, PWS-Kent Publishing Company
3. Dynamics of Bases and Foundations: *Barkan, D. D.*, McGraw- Hill Book company
4. Relevant IS codes

Semester VIII

Subject Code	Subject Name	Credits
CE-E804	Elective-II: Building Services	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	25	--	25	150

Rationale

The building services are based on engineering principles that are applied to the construction of buildings and the built environment. In many respects, building services are responsible for the artificial environment in which we live and work and associated with that the environmental condition of our planet. Building service systems are complex and typically are a major source of cost and potential coordination problems in building construction. Fundamental knowledge of how mechanical, electrical, plumbing and other systems work and interact is fundamental to the construction professional. This course provide an introduction to building service systems which includes Study the design, interfaces, and specifications of various building services in building construction.

Objectives

- To introduce students to concepts of building services and its applications.

- To understand design concept of various machinery like lift, escalators, vibrators, concrete mixers etc. and utility services in building like plumbing system, electrical system, fire safety installation etc.
- To introduce concept of green building which includes various energy efficient building services?

Detailed Syllabus

Module	**Sub- Modules/Contents**	**Periods**
I.	**Machineries:**	06
	1.1 Lifts and Escalators - Special features required for physically handicapped and elderly - conveyors - Vibrators - Concrete mixers - DC/AC motors - Generators - Laboratory services - Gas , Water, air and electricity - Hot water boilers- pumps	
II.	**Plumbing Systems in Building:**	09
	2.1 Plumbing Services:- Water Distribution system - Material for service pipes - Service connection - Size of service pipe - Water meter - valves storage tanks **2.2 Drainage system :-** Pipe and traps - system of plumbing - House drainage plans - septic tanks- soak pit	
III.	**Electrical systems and Illumination Design in Buildings:**	12
	3.1 Electrical systems in buildings: Basics of electricity - Single / Three phase supply - Protective devices in electrical installations - Earthing for safety -Types of Earthing - ISI specifications - Types of wires, wiring systems and their choice - Planning electrical wiring for building - Main and distribution boards - Transformers and switch gears - Layout of substations **3.2 Principles of Illumination Design:** Visual task - Factors affecting visual task - Modern theory of light and colour - Synthesis of Light - Additive and Subtractive synthesis of colour - Luminous flux - candela - solid angle illumination - utilization factor - Depreciation factor - MSCP - MHCP - Lans of illumination - Classification of lighting - Artificial lights sources - spectral energy distribution - Luminous efficiency -	

	Colour temperature - Colour rendering. **3.3 Design of Modern lighting:** Lighting for stores, offices, school, hospitals and house lighting. Elementary idea of special features required and minimum level of illumination required for physically handicapped and elderly in building types.	
IV.	**Refrigeration Principles and Applications:**	09
	4.1 Thermodynamics - Heat - temperature, measurement transfer - change of state - sensible heat - Latent heat of fusion, evaporation, sublimation - saturation temperature - super heated vapour - sub cooled liquid - pressure temperature relationship for liquid **4.2 Refrigerants and air conditioners** - Vapour compression cycle - compressor - Evaporators- Refrigerants control devices - Electric motors - starters - Air handling units- cooling towers - Window type and packed air conditioners - chilled water plant - Fan coil systems - water piping - cooling load - Air conditioning systems for different types of building - Protection against fire to be caused by A.C. systems.	
V.	**Fire Safety Services**	06
	5.1 Fire Safety Installation: Causes of fire in building - safety regulation - NBC - Planning considerations in building like non-combustible materials, construction, staircases and lift lobbies, fire escapes and A.C. system. Special features required for physically handicapped and elderly in building types - Heat and smoke detectors - Fire alarm system, snorkel Ladder - Fire Lighting pump and water storage - Dry and wet riser - Automatic sprinklers	
VI.	**Rain Water Harvesting**	06
	6.1Rain Water Harvesting Water Audit of India, Concept of rain water harvesting, Methodologies for Percolation / recharge bore pit, Percolation / recharge bore well, Percolation/ recharge well cum bore pit, Harvesting rooftop rainwater, Harvesting driveway runoff. National water harvesters network (NWHN) and some case studies.	
VII.	**Green Building**	04
	7.1. Introduction to Green Building: Need for a green building, planning and design of green buildings, obstacles,	

	materials used in green building technology, rating system (According to LEED- INDIA)	

Contribution to Outcomes

On successful completion of the course, it is expected to enable the students to:

- Understand the importance and installation of utility services.
- Understand drawbacks if all service lines are not installed properly or used faulty material.
- Choose appropriate systems and integrate the same in to the building construction projects.

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 further, and 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 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 assignments.

Term work:

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

Distribution of Term Work Marks:

The marks of the term-work shall be judiciously awarded depending upon its quality. The final certification and the acceptance of the term-work warrant the satisfactory and the appropriate completion of the assignments;and further, 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. Heat Pumps and Electric Heating: *E. R. Ambrose*, John and Wiley and Sons, Inc., New York, 1968.
2. Handbook for Building Engineers in Metric Systems, NBC, New Delhi, 1968.
3. Philips Lighting in Architectural Design, McGraw-Hill, New York, 1964.
4. The Lighting of Buildings: *R. G. Hopkinson and J. D. Kay*, Faber and Faber, London, 1969.
5. Air-conditioning and Refrigeration: *William H. Severns* and *Julian R. Fellows*, John Wiley and Sons, London, 1988.
6. Air-conditioning and Energy Conservation: *A.F.C. Sherratt*, The Architectural Press, London, 1980.
7. National Building Code.
8. Building Construction: *Dr. B. C. Punmia, Ashol K Jain*, A.K Jain
9. Construction Engineering and Management: *S. Seetharaman*, Umesh Publicatins, Delhi.
10. Water supply and Sanitory Installations: *A. C. Panchdhari*, New Age International Publication, Delhi
11. Fire Safety in Building: *V. K. Jain*, New Age International Publication, Delhi

12. Green Remodeling: *David Johnston*.
13. Green Building , Project Planning and Cost Estimation: *R. S. Means*
14. LEED – INDIA (Abridged Reference guide for Core and Shell, Version 1.0).

Semester VIII

Subject Code	Subject Name	Credits
CE-804	Elective II- Design of Hydraulic Structures	05

Teaching Scheme

Contact Hours			Credits Assigned			
Theory	Practicals	Tutorials	Theory	Practicals	Tutorials	Total
4	2	-	4	1	-	5

Evaluation Scheme

Theory					Termwork/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	3	25	-	25	150

Rationale

This subject provides necessary knowledge about planning, design and constructions of important hydraulic structures like dams, reservoirs, weirs, cross drainage woks and canal structures. It also provides basic knowledge to design various regulation structures like spillways, energy dissipation works, canal structuresand canal regulation works. This subject is also useful to gain the knowledge with respect to facts, concepts, principles and procedures related to hydraulic structures so that students can effectively plan and execute various types of hydraulic structures.

Objectives

1. To study planning of reservoir and selection criteria for gravity dam.
2. To study various types of dams including planning and design.
3. To study the design of earth and rock fill dams.
4. To study spillways and energy dissipaters and flood control works.

5. To study design details of surplus weir, barrages, canal drop, canal regulator, cross drainage works.

Detailed Syllabus

Module	Sub Modules/Contents	Periods
I.	**Reservoir Planning and Management:** Reservoir – types, storage capacity of reservoir, storage zones, designing reservoir capacity, flow duration curves, mass curves of inflow and outflow, reservoir losses, reservoir sedimentation, silt control, selection of type of dam, selection of site of dam, preliminary and final investigations of dam sites.	4
II.	**Gravity Dams:** Definition, typical cross section, forces acting on gravity dam, modes of failure and structural stability analysis, profile of dam- elementary and practical profile, low and high gravity dam, design consideration and fixing of section of dam, methods of design, construction of galleries in dams, types of joints, temperature control in concrete dams, foundation treatment..	12
III.	**Arch and Buttress Dams:** Definition and types of arch dams, forces acting on arch darn, design of arch dams, types of buttress dams.	4
IV.	**Earth and Rock Fill Dams:** Types of earth dams, method of construction, causes and failures of earth dams, design criteria, selecting suitable preliminary section, seepage line for different conditions and its location, seepage control through embankment and through foundations, Swedish circle method with pore pressure, details of construction and maintenance, types of rock fill dams, stability analysis, advantages.	10

V	**Spillways and Flood Control Works:** Introduction, location of spillway, design consideration of main spillway, controlled and uncontrolled spillway, types of spillways, design principles of ogee spillway. Chute spillway. Siphon spillway and shaft spillway, energy dissipation below overflow and other types of spillways, design of bucket type energy dissipater and stilling basin, flood mitigation reservoirs. Crest gates, types, advantages, design of radial gate, outlet works through dams, intake structures.	12
VI	**Miscellaneous Topics:** Design of small bridges and culverts, data collection, high flood discharge, linear waterway calculation, scour depth, causeways and culverts, principles of hydraulic design of causeways and culverts, design details of surplus weir, flush escape, direct sluice, canal drops, canal regulators, diversion head works: component parts, functions, weirs and barrages, Blighs Creep theory, Lanes weighed theory. Cross drainage (CD) works: Types of CD works	10

Contribution to outcomes

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

1. Select the site for dam with preliminary and final investigations, fix storage capacity, analyze reservoir losses, and estimate sedimentation in reservoirs.
2. Analyze forces acting on gravity dam its failure and carry out stability analysis of gravity dams.
3. Understand forces on an arch and buttress dams and its design.
4. Understand details of construction and maintenance of earth fill and rock fill dams including stability analysis criteria.
5. Understand design principles of spillways, energy dissipation works and flood control works.
6. Design small bridges and culverts and its principles of hydraulic 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 the entire syllabus. For this, the modules shall be divided proportionately further; and 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 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.

Term Work:

The term-work shall comprise of the neatly written assignments. The assignments shall be given covering the entire syllabus in such a way that the students would attempt at least four problems and/or questionson each modules/ sub-modules and 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 and the assignments. The final certification and the acceptance of the term-work warrant the satisfactory and the appropriate completion of the assignments;and further, 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. Irrigation Engineering and Hydraulic Structures:*S. K. Ukarande*, Ane's Books Pvt. Ltd. (Abridged Edition 2015), ISBN 9789383656899.
2. Irrigation and Water Power Engineering: *B.C. Punmia, Pande B.B. Lal, A.K Jain*. Laxmi Publications Pvt, Ltd. New Delhi
3. Irrigation Water Resources and Water Power Engineering: *P.N. Modi*, Standard Book House, Delhi, ISBN 978-81-87401-29-0.
4. Irrigation Engineering and Hydraulics Structures: *S. K. Garg*, Khanna Publishers. Delhi.
5. Design of Irrigation Structures: *S. K. Sharma*, S. Chand and Co.
6. Theory and Design of Irrigation Structures: *R. S. Varshney and R. C. Gupta*, Nem Chand
7. Engineering for Dams, Vol. I to III: *Crager*, *Justin* and *Hinds*, John Wiley
8. Design of Small Dams: USBR
9. Hydro Power Structures: *R. S. Varshney*, Nem Chand and Bross, Roorkee
10. ConcreteDams: *R. S. Varshney*, Oxford and IBH Publishing Co.

Semester VIII

Subject Code	Subject Name	Credits
CE-E804	Elective-II: Industrial Waste Treatment	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	25	--	25	150

Rationale

This subject deals with sampling, manufacturing process and treatment of different industrial waste. Industrial waste waters are generally much more polluted than the domestic or even commercial wastewaters. Such industrial wastewaters cannot always be treated easily by the normal methods of treating domestic wastewaters, and certain specially designed methods. In order to achieve this aim, it is generally always necessary, and advantageous to isolate and remove the troubling pollutants from the wastewaters, before subjecting them to usual treatment processes. Thus Wastewater treatment is closely related to the standards and/or expectations set for the effluent quality. Wastewater treatment processes are designed to achieve improvements in the quality of the wastewater.

Objectives

- To study different characteristics of liquid waste generated from different industries.

- To study the effect of disposal of liquid waste into natural water course, municipal sewer and on land
- To study general treatment of industrial wastes like neutralization, equalization and segregation.
- To study the conventional aerobic and anaerobic biological treatment methods

Detailed Syllabus

Module	Sub- Modules/Contents	Periods
I.	General: Liquid wastes from industries – their volumes and characteristics, Effect of disposal into natural water courses, Municipal sewers and on land, River standards and effluent standards.	04
II.	Sampling and analysis of industrial wastes, Treatability study, good housekeeping, bioassay test, population equivalence.	04
III.	Stream sanitation: Effects of industrial wastes on self-purification of streams and fish life, Statement and significance of the parameters of Streeter and Phelp's equation and BOD equations, Deoxygenating and reaeration , Oxygen sag and numericals based on this.	08
IV.	General treatment of industrial wastes: Neutralization, equalization, segregation. Modification of conventional aerobic and anaerobic biological treatment methods. Dewatering and disposal of sludges – floatation, vacuum filtration, centrifugation, filter press and membrane filters.	08
V.	Detailed consideration of wastes produced from following industries: Manufacturing processes normally followed , Volume and effects of raw and treated effluent on streams, sewers, characteristics of effluents and land Treatment methods, reuse-recovery 1)Textiles: cotton 2)Pulp and paper:- Sulphate process 3)Electroplating 4)Dairy 5)Sugar-sugarcane	18

	6)Distilleries 7) Tanneries 8) Refineries	
VI.	Provision of various acts pertaining to industrial wastes / effluents, introduction to environmental impact assessment and environmental audit.	06
VII.	Common Effluent Treatment Plants (CETPs): Location, Need, Design, Operation and Maintenance Problems and Economical aspects.	04

Contribution to outcomes

On completion of this course, the students shall have an ability to understand the industrial waste sources, effects and its treatment. The students shall understand the various methods of disposal of industrial waste. They shall further have an understanding of the nature and characteristics of industrial waste and regulatory requirements regarding industrial waste treatment and lastly, they will have an ability to plan industrial waste minimization.

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 the entire syllabus. For this, the modules shall be divided proportionately further; and 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 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.

Site Visit/ Field Visit:

The students will visit any industrial/hazardous/municipal solid waste comprising source, characterization, transportation, recycles, treatment and disposal.

Term Work:

The term-work shall comprise of the neatly written assignments. The assignments shall be given covering the entire syllabus in such a way that the students would attempt at least four problems and/or questions on each modules/ sub-modules and contents thereof, further. In addition to the assignments, each student shall prepare a report on visit to the site mentioned in the preceding section.

Distribution of Term Work Marks:

The marks of the term work shall be judiciously awarded for the various components depending upon its quality. The final certification and acceptance of term work warrants the satisfactory completion of the assignments,proper compilation of the report on the site visit; andfurther, minimum passing marks to be obtained by the student.

The following weightage of marks shall be given for different components of the term work:

1. Tutorial and Assignments: 16 Marks
2. Report on the site visit : 04 Marks
3. 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. Waste Water Treatment: *Rao* and *Datta*, Oxford and IBH Publishing Co.
2. Environmental Pollution and Control in Chemical Process Industries: *Bhatia, S. C.*, Khanna Publication.
3. Industrial Water Pollution Control: *Eckenfelder Jr, W. W.*, Mc Graw Hill.

4. Industrial Water Pollution Management: *Gurnham, E. F*., John Wiley.
5. Biological Waste Treatment: *Eckenfelder* and *Connor*, Pergamon Press.
6. Theories and Practices of Industrial Waste Treatment: *Addisoon Wesley*.
7. Pollution Control in Process Industries: Mahajan, S. P., Tata McGraw Hill.
8. Industrial Waste: *Rudolfs, W.(Ed)*, L E C Publishers Inc.
9. The Treatment of Industrial Wastes: *Besselievre, E. D*., Mcgraw Hill.
10. Industrial Waste Disposal: *Ross, R. D. (Ed)*, Reinhld Bok Croporation.

Semester VIII

Subject Code	Subject Name	Credits
CE-E804	Elective-II: Transportation Planning and Economics	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	25	--	25	150

Rationale

This subject will impart complete knowledge of Transport Planning, Management of Transportation techniques and concepts, which will give the complete perspective with respect to Transportation Modeling, advanced/soft computing techniques for expert systems related with transportation. The students will study in detail with respect to Economic Evaluation of all Civil Engineering Projects, especially related with Transportation projects. Knowledge also gained in this subject related with the important concepts for Mass Rapid Transit systems for urban transportation.

Objectives

1. To study all the land-use transport models used in the transportation planning.
2. To understand the travel-forecasting principles and techniques in planning.

3. To study and understand all the important economic evaluation techniques related with Tansportation/Highway projects.
4. To gain the complete knowledge of mass rapid transit systems used in urban transportation.

Detailed Syllabus

Module	Sub-Modules/ Contents	Periods
I.	Transportation Planning and management: General Travel Forecasting Principles and techniques, Generalized demand, price and capacity relationship applied to travel forecasting, Practical problems of forecasting travel. Introduction to the process of urban transport planning. Travel demand forecasting: Trip generation analysis, trip classification, multiple regression analysis, category analysis, trip distribution analysis: introduction, methods of trip distribution, uniform and average factor method, Fratar method, Furness method, the gravity model and its calibration, Intervening and competing opportunities model, linear programming approach to trip distribution. Modal split analysis: introduction, Modal split analysis: Probit analysis, Logit analysis and Discriminant analysis, modal split models with behavioral basis. Traffic Assignment: purpose of traffic assignment, traffic flow characteristics, Assignment techniques: All or nothing assignment, Multiple route assignment, Capacity restraint assignment, Diversion curves. Rout building algorithms. Land-use transport models: Introduction, selection of Land-use transport models, The Lowry model, Grain – Lowry model, Applications of Lowry model. Introduction to advanced/soft computational techniques for transportation planning like Expert Systems, Neural Networks, Fuzzy Logic, Genetic Algorithm, Simulated Annealing, Hybrid systems etc.	24

II.	Transport Economics: Economic evaluation of highway schemes, need for economic evaluation, cost and benefits of transportation projects, basic principles of economic evaluation, Net present value method, benefit/cost ratio method, internal rate of return method. Vehicle operating costs, Value of travel time saving, Accident costs and road pricing.	09
III.	Public Transportation Introduction to various mass transportation systems, Classification of mass transit modes: Street transit or surface transit, Semi rapid transit, Rapid transit or mass rapid transit System, Special transit systems: magnetic levitation, monorails, water borne transport, Automated Guided Transit, Detailed capacity assessment of some selected technologies: Conventional bus on bus bays, Light rail transit, Rail Rapid Transit, Regional rail Transit or Suburban Railway, Suitability of Transit Systems for different travel demand for Indian Cities, Suitability of Transit Systems for Indian Cities of Different Population sizes and forms, Influence of other factors in selection of Mass Transit Systems, Transit System Operations: Introduction, Route Development, Stop location and stopping policy, Schedule development, Capacity of transit systems. Future of Public transportation.	19

Contribution to Outcomes

On successful completion of the course work, students will get complete knowledge and will clearly understand all the concepts for Urban Transportation Planning, which may include Multiple Regression Analysis etc. They are expected to gain all the knowledge necessary regarding Methods available for Economic Evaluation like Benefit/Cost ratio, Rate of Return, Net Present Value method etc. They shall be able to understand and plan the Transit Systems with respect to Mass Transportation for Urban areas, which ultimately relieve the congestion problems faced by citizens in all the busy cities.

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 further, and 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 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.

Term work:

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

Distribution of Term Work Marks:

The marks of the term-work shall be judiciously awarded depending upon its quality. The final certification and the acceptance of the term-work warrant 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. Traffic Engineering and Transport Planning: *L.R. Kadiyali*, Khanna publishers Delhi.
2. Principles of Traffic Engineering: *G.J. Pingnataro*, Mc Graw-Hill, 1970.
3. Traffic System Analysis for Engineering and Planners: *Wohl* and *Martin*, Mc Graw Hill, 1983.
4. Introduction to Urban Transport Systems, Planning: *B.G. Hutchinson*, McGraw-Hill, 1970.
5. Economics of Transportation: Fair and Williams, *Harper*and *Brothers*, Publishers, New York.
6. Economic Analysis for Highway: *Winfrey*, *Robley*, International Textbook Co., Pennsylvania, USA, 1969.
7. Public Transportation Planning Operation and Management: *Gray* and *Hoel*, Prentice Hall Publication.
8. Principles of Transportation Engineering: *Partha Chakroborty* and *Animesh Das*, Prentice Hall (India).

Semester VIII

Subject Code	Subject Name	Credits
CE-E804	Elective-II: Advanced Repairs and Rehabilitation of 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 1	Test 2	Average						
20	20	20	80	03	25	--	25	150

Rationale

The success of the repair and rehabilitation project depends on the specific plans designed for it. It is vital to evaluate the condition of the concrete in the structure and relating the condition of the concrete to the underplaying causes. Further, it is important to select an appropriate repair material and method for any deficiency found, while using selected materials and methods to repair or rehabilitate the structure. It is also important for civil engineers to focus on the maintenance of structures and prepare investigation reports for repair and rehabilitation of structures. The buildings and infrastructural works are subjected to the severe environmental conditions. This badly damages the concrete, making repair and rehabilitation imperative. So, there are enormous employment opportunities in the field of Repair and Rehabilitation in India. This course has, therefore, relevance in the curriculum so that the students can be made competent in this area. The course deals with the structural strengthening, specialized repairs, use of composite materials, seismic retrofitting and maintenance of structures post-repair. The repair and rehabilitation of heritage structures is as important as any other building. The course caters for the rehabilitation of heritage structures. The knowledge acquired by the students through this course would help them to master the required skills in the domain of repair andrehabilitation.

Objectives

- To study the need for strengthening of structures.
- To be familiar with the various methods of strengthening of columns, beams, walls, footings, slabs, etc.
- To get acquainted with the specialized repairs for the buildings and infrastructural works.
- To know the process of retrofitting of the structures using composite materials.
- To acquire the technical knowhow in the area of seismic retrofitting.
- To get introduced to the concept of repairing and maintaining the heritage structures.

Detailed Syllabus

Module	Sub-Modules/ Contents	Periods
I.	**Introduction:** Need for strengthening due to various reasons such as ageing, natural calamities, increase of load, change of function and design, construction errors	05
II.	**Structural Strengthening:** Strengthening and retrofitting of columns, beams, walls, footings and slabs, piers of concrete structures by jacketing, external post-tensioning, replacing or adding reinforcement, plate bonding, textile reinforced concrete	11
III.	**Specialized Repairs:** Electro chemical repair using re-alkalization and chloride extraction techniques, Specialized repairs for chemical disruption, fire, marine exposure etc, Repair of damaged structures of water retaining structures, hydraulic structures, Pavements and Runways, Tunnels,	11

	Bridges, Piers and Flyovers, Parking Garages, Underwater repair, Masonary Repair, Repair and Restoration of Heritage Structures	
IV.	**Retrofitting by Composite Materials:** Fiber reinforced concrete, Ultra-high performance fibre reinforced concrete (UHPFRC), Fiber reinforced composites, Carbon fibre reinforced polymer (CFRP), Fibre wrapping (Carbon, Aramide, Glass)	10
V.	**Seismic Retrofitting:** Seismic strengthening of existing RC structures, Use of FRP for retrofitting of damaged structures	08
VI.	**Post-Repair Maintenance of Structures:** Protection and Maintenance schedule against environmental distress to all those structures	04
VII.	Special care in repair and rehabilitation of heritage structures	03

Contribution to Outcomes

The students should acquire desired learning outcomes in cognitive, psychomotor and affective domain and thereby demonstrate the following outcomes:

- Assess the structural health and take a decision whether it needs the strengthening or not.
- Implement the various methods for strengthening columns, beams, slabs, footing, etc. in the field.
- Have a thorough understanding of the special repair materials and techniques.
- Retrofit the damaged structures using composite materials like UHPFRC, CFRP, etc.
- Understand the importance of the seismic retrofitting and employ the methods for the affected structures.
- Carry out the repair of the structures of heritage importance and maintain the same.

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 the entire syllabus. For this, the modules shall be divided proportionately further; and 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 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.

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 and/or questionson each modules/ sub-modules and 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 and the assignments. The final certification and the acceptance of the term-work warrant 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. Concrete Repair and Maintenance: *Peter H .Emmons* and *Gajanan M. Sabnis*, Galgotia Publication.
2. Repairs and Rehabilitation-Compilation from Indian Concrete Journal-ACC Publication.
3. Guide to Concrete Repair and Protection, HB84-2006, A joint publication of Australia Concrete Repair Association, CSIRO and Standards Australia.
4. CPWD hand book on Repairs and Rehabilitation of RCC buildings published by DG (Works), CPWD, Government of India (Nirman Bhawan), http://www.cpwd.gov.in/handbook.pdf
5. Guide to Concrete Repair, *Glenn Smoak*, US Department of the Interior Bureau of Reclamation, Technical Service Center, http://books.google.co.in
6. Management of Deteriorating Concrete Structures: *George Somerville*, Taylor and Francis Publication
7. Concrete Building Pathology: *Susan Macdonald*, Blackwell Publishing.
8. Testing of Concrete in Structures*: John H. Bungey, Stephen G. Millard and Michael G. Grantham*, Taylor and Francis Publication.
9. Durability of concrete and cement composites: *C.L.Page* and *M.M. Page*,Wood Head Publishing.
10. Concrete Repair, Rehabilitation and Retrofitting: *M. Alexander, H. D. Beushausen, F. Dehn* and *P. Moyo*, Taylor and Francis Publication.
11. Concrete Repair Manual, Volume I and II, Published jointly by ACI, BRE, Concrete Society, ICRI

Semester VIII

Subject Code	Subject Name	Credits
CE-E804	Elective II: Geo-synthetics and Reinforced Structures	5

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	25	--	25	150

Rationale

The course introduces the students to the different types of geosynthetics, their manufacturing technique, testing methods and their applications in different types of civil engineering projects. Detailed design techniques and construction methods will also be covered in the course.

Objectives

To study the:

- types of geosynthetics.
- manufacturing techniques.
- physical, mechanical and hydraulic properties.
- reinforced soil retaining walls and slopes.
- foundations on reinforced soil.
- drainage and filtration applications of geosynthetics.

- pavements with geosynthetics.
- scope for use of geosynthetics in landfills.

Detailed Syllabus

Module	Sub - Modules/Contents	Periods
I.	**Introduction:** 1. Definition of geosynthetics. The terminology includes natural fibre materials such as coir, jute and hemp. 2. Historical background of geosynthetics. 3. Basic functions of geosynthetics and relevance to the environment. 4. Different types of geosynthetics (nonwoven and woven geotextiles, geogrids, geonets etc) and their exclusive functions and applications. 5. Pros and cons of geosynthetics in various functions and applications.	03
II.	**Polymers and Resins:** 1. Polymersfor geotextiles- Basis of polymers and resins, classification and types, brief manufacturing (PP/PE/PET (Polyester)/PA (Nylon) etc.), property comparison (physical, mechanical and weatherability etc.) and applications, influence of UV rays and stabilization. a. Environmental implications of use of these materials, recyclability and life cycle analysis. 2. Geosynthetic types and their manufacturing techniques: i. Geosynthetic types: Geotextiles, geogrids (knitted, woven, extruded), geonets, geomembranes, geosynthetics clay liners, geopipe, geofoam, geocomposites and geocells. ii. Filter type, yarn types and mechanical properties:Manmade and natural (jute/coir), monofilament, multifilament, staple fiber yarn, flat tape yarn and fibrillated tape yarn, stress-strain curves and linear density of yarns. iii. Geotextile types and their mechanical and functional properties: woven fabrics, nonwoven fabrics- staple fibre, spun bonded, thermal bonded; knitted and braided fabrics, functional properties	05

	of different fabrics.	
III.	**Testing Methods for Geosynthetics:** 1. Distinction between codes and standards, and guidelines. 2. The concept of quality assurance and quality control in geosynthetics. 3. Various international bodies that have come up with testing codes, standards and guidelines (BIS, ASTM, ISO, etc.). What is followed in India and why? 4. A brief on testing techniques(index and performance tests) for each of the following parameters and their application based significances: **a.**Basic physical properties including (but not limited to): i. Constituents of the material ii. Unit weight iii. Thickness, etc. iv. Apparent Opening Size **b.** Mechanical properties including i.Various strength characteristics, including significance of peak strengths, residual strengths as applicable ii. Elongations at break for tensile strengths iii. Tension module iv. Fatigue resistance v. Seam strengths vi. Puncture resistance vii. Tear resistance viii. Wetting and drying stability ix. Burst strength **c.**Connection tests for reinforced soil walls (RSW) **d.**Direct shear box i. Modified direct shear box ii. ASTM type **e.**Pull-out tests for RSW **f.**In-soil strength test	06

	g. Hydraulic properties i.Permittivity ii.Transmissivity **h.**Tests related to various reduction factors in design i. Installation damage ii. Durability from environmental considerations (chemical and biological) iii. Durability from exposure to UV considerations iv. Creep, including the conventional concept of time-temperature superposition and the Stepped Isothermal Method (SIM)	
IV.	**Reinforced Soil Retaining Walls and Slopes:** 1. Elements of a reinforced soil wall and function of each element, selection of each element, limit state approach, design principles, external and internal stability, codal provisions, FHWA and BS 8006, construction of RS walls, causes of failures, numerical example 2. Reinforced soil slopes, differences in design, modes of failure, example of a reinforced slope (desirable to use a software for design calculations).	13
V.	**Applications in Foundations:** Foundations on reinforced granular soils: reinforcement, failure mode (Binquet and Lee's approach), forces in reinforcement ties.	05
VI.	**Drainage and Filtration Applications of Geosynthetics** 1. Different filtration requirements, flow in plane of geosynthetics, flow cross plane of geosynthetics, apparent opening size, filter criteria, filtration in different types of soils and criteria for selection of geotextiles, estimation of flow of water in retaining walls, pavements, etc., and criteria selection of geosynthetics. 2. Erosion control, coastal protection, river bank protection, various methods for control.	04
VII.	**Geosynthetics in Pavements:** 1. Geosynthetics in unpaved roads – Giroud and Noiray approach	07

	(1981). 2. Geosynthetics in paved roads – Milligan, Houlbsy and others approach (1989-90). 3. Examples on unpaved and paved roads. 4. Reflective cracking applications. 5. Use in flexible pavements layers.	
VIII.	**Geosynthetics in Environmental Engineering and Landfills:** 1. Type of landfills, their functions and related environmental issues a. Municipal garbage landfills b. Construction debris fills c. Industrial landfills d. Ash ponds, slag dumps, etc. e. Ore tailings, such as copper, zinc, aluminum ores f. Specialty waste landfills including for toxic and bio-hazardous sold materials g. River and harbor dredging fills h. Radioactive waste dumps 2. The physical and chemical characteristics of solids, liquids (leachates) and gases generated by such landfills over time including toxicity, pH etc. 3. Identify the various components of landfills and the scope for use of geosynthetics and geocomposites for each of such functions.These could include but not be limited to: a. Slope stabilization including use of reinforced soil b. Providing an impervious blanket and its protection, containment systems c. Filtration d. Separation of various layers e. Erosion protection f. Reinforcement of above geosynthetics systems g. Chemical reaction of material of geosynthetics with the solid, liquid and gaseous products of the land fill, deterioration of various systems with time.	05

	4. Leachate collection systems 5. Design engineering of various systems	

Contribution to outcomes

This course will enable the students to recognize the major geosynthetics applications and their significance. They will be able to recognize the fundamental mechanism and principles in practical applications. They develop the knowledge of problem solving, analysis and 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 the entire syllabus. For this, the modules shall be divided proportionately further; and 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 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.

Term work:-

The term-work shall comprise of the neatly written assignments. The assignments shall be given covering the entire syllabus in such a way that the students would attempt at least four problems and/or questions on each modules/ sub-modules and contents thereof, further. Following guidelines shall be resorted to while giving the assignments to the students.

Assignments:

- Pictures/sketches of various types of geosynthetics.

- Illustrate the practical applications of geosynthetics highlighting each of the basic functions.
- Essays on select testing procedures along with hand drawn sketches, highlighting the significance of such tests.
- Provide a case study and analysis and design of the entire landfill.

Tutorials:

- Physically show and explain the various documents of BIS, ASTM, ISO, etc.
- Take up simple design problems for various systems of landfills.
- Software modules- Geoslope, etc.

Distribution of Term Work Marks:

The marks of the term-work shall be judiciously awarded for the various components depending upon its quality. The final certification and the acceptance of the term-work warrant the satisfactory and the appropriate completion of the assignments; and further, 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 (All latest edition):

1. Engineering Principles of Ground Modifications: *Manfred R. Hausmann*, Mcgraw Hill International.
2. Engineering with Geosynthetics, *Venkatappa Rao G.* and *SuryanarayanaRaju,* GVS, Tata McGraw Hill Publishing Co. Ltd.
3. Designing with Geosynthetics, *Koerner, R. M.*, Prentice Hall, NJ.

4. Designing in Geosynthetics, *Ingold*.

References:

1. ASTM and Indian Standards on Geotextiles.
2. BS and FHWA Codes.
3. ASCE Journals.
4. Handbook on "Geosynthetics Case Studies of ITTA Members"- ITTA, Mumbai.
5. Handbook of Geotextiles- BTRA.

Semester VIII

Subject Code	Subject Name	Credits
CE-P805	Project – Part II	04

Teaching Scheme

Contact Hours	Credits Assigned
02 Hr Per Project Group	04

Evaluation Scheme

Term Work/ Oral		Total
TW	OR	
50	50	100

After completion of the work at the end of Semester VIII, the student shall compile the report in a standard format and written in the systematic manner and chapter wise.

The student shall adhere to the following scheme of chapterization while compiling the final report in general. The Guide/ Supervisor shall ensure the student has written the Dissertation Report in appropriate language (grammatically correct).

1. **Introduction:** The student shall give the introduction to the theme of the subject chosen as a Project/ Dissertation, give further current state of art related to the theme (i.e., brief review of literature), broad problem definition and scope of the work. The student shall also state at the end of this chapter the scheme of chapterization included in his/ her Dissertation.
2. **Theoretical Aspects/ Review of Literature:** The student is expected to highlight the various theoretical aspects pertaining to the topic chosen, literature (updated) available related to the various aspects of the topic chosen citing the research work carried out by the earlier researchers and summarize the findings of the literature. The student may state the precise the problem definition. If felt necessary, these two

aspects, i.e., theoretical aspects and review of literature can be compiled as separate chapters.

3. **Formulation/ Methodology/ Experimental Work:** In this chapter, the student is expected to explain the methodology for pursuing their work. In case of analytical work, students may give the formulation along with validation for assessment of accuracy of the numerical procedure being used/ proposed by them. In respect of experimental work, the students may outline the experimental set up/ procedure. In case of the work in which either approach is involved, the students may appropriately provide the methodology to cover either approach. This chapter may be supported by the Data Collection if the work involves the Collection of the Data and its subsequent processing.
4. **Analysis/ Results and Discussion:** The studentsare expected to present the results emerging from the analytical/ theoretical/ experimental study/ studies being pursued by them. The results shall be discussed properly. The results may be compared with the results published by the earlier researchers if the work being pursued by the students warrants the same. The students may indicate the broad conclusions/ inferences at the end.
5. **Summary and Conclusions:** Based on the results discussed in the previous chapter, the students shall give in the systematic manner the conclusions/ inferences emerged from the study and summarize it properly. The students shall indicate the scope of the future work which can be extended by any other students in the future. The students may point out the limitation/s left out in the work pursued by them while carrying out the work contained in the Dissertation.
6. **References:** The students shall at the end give the list of the references in the appropriate manner. This part should not be treated as a Chapter. For referencing style, student may refer any standard journal of national and international repute.
7. **Publication/s:** The student shall give the list of the technical/ research papers published/ accepted for publication in the referred journal/ conference proceedings. This part should not be treated as a Chapter.

Project Stage- II should be assessed based on following points:

- Quality of Literature survey and Novelty in the problem
- Clarity of Problem definition and Feasibility of problem solution

- Relevance to the specialization or current Research / Industrial trends
- Clarity of objective and scope
- Methodology for carrying out the work defined as a Problem Statement (Formulation in respect of the analytical studies/ Experimental Work / Combination thereof depending upon the nature of the work involved)
- Quality of work attempted
- Presentation of the results along with the validation of results or part thereof.
- Quality of Written Report and Oral Presentation
- Publication of the technical/ research paper by the student in a conference of National/ International repute. Publication of paper in a referred/ peer reviewed journal is highly preferred.

Project Stage- II shall be assessed through a presentation jointly by the Internal Examiner (Guide/ Supervisor) and External Examiner appointed by the University of Mumbai

AC 7/6/2014, Item No. 4.25

UNIVERSITY OF MUMBAI

Bachelor of Engineering

Civil Engineering

Third Year (Sem. V & VI)

Revised Syllabus (REV- 2012) w.e.f. A. Y. 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 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 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) give freedom to affiliated Institutes to add few (PEO's) course objectives course outcomes to be clearly defined for each course, so that all faculty members in affiliated institutes understand the depth approach of course to be taught, which will enhance learner's learning process. It was also resolved that, maximum senior faculty from colleges 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 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 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 adopted ten points scale to grade learner's performance. Credit 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 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 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 Faculty of Technology of 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, course objectives 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 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

Subject Code	Subject Name	Teaching Scheme (Contact Hours)			Credits Assigned			
		Theory	Pract.	Tut.	Theory	Pract.	Tut.	Total
CEC301	Applied Mathematics III *	4	--	--	4	--	--	4
CEC302	Surveying – I	3	2	--	3	1	--	4
CEC303	Strength of Materials	4	2	--	4	1	--	5
CEC304	Building Materials Construction	3	2	--	3	1	--	4
CEC305	Engineering Geology	3	2	--	3	1	--	4
CEC306	Fluid Mechanics – I	3	2	--	3	1		4
CEC307	Database Information Retrieval System*	--	4‡	--	--	2	--	2
Total		**20**	**14**	**--**	**20**	**7**	**--**	**27**

Subject 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.						
CEC301	Applied Mathematics III *	20	20	20	80	3	--	--	--	100
CEC302	Surveying – I	20	20	20	80	3	25	--	25	150
CEC303	Strength of Materials	20	20	20	80	3	25	--	25	150
CEC304	Building Materials Construction	20	20	20	80	3	25	--	25	150
CEC305	Engineering Geology	20	20	20	80	3	25	--	25	150
CEC306	Fluid Mechanics – I	20	20	20	80	3	25	--	--	125
CEC307	Database Information Retrieval System*	--	--	--	--	--	25	25**		50
Total		**120**	**120**	**120**	**480**	**--**	**150**	**25**	**100**	**875**

‡ For the subject '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.

** For the subject 'Database Information and Retrieval System', the there will be an oral examination in conjunction with the practicals.

Semester IV

Subject Code	Subject Name	Teaching Scheme (Contact Hours)			Credits Assigned			
		Theory	Pract.	Tut.	Theory	Pract.	Tut.	Total
CEC401	Applied Mathematics – IV	4	--	--	4	--	--	4
CEC402	Surveying – II	3	3	--	3	1.5	--	4.5
CEC403	Structural Analysis – I	5	2		5	1	--	6
CEC404	Building Design and Drawing – I	2	3	--	2	1.5	--	3.5
CEC405	Concrete Technology	3	2	--	3	1	--	4
CEC406	Fluid Mechanics – II	3	2	--	3	1	--	4
Total		20	12	--	20	6	7	26

Subject 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.						
CEC401	Applied Mathematics – IV	20	20	20	80	3	--	--	--	100
CEC402	Surveying – II	20	20	20	80	3	25	--	25*	150
CEC403	Structural Analysis – I	20	20	20	80	3	25	--	25	150
CEC404	Building Design and Drawing – I	20	20	20	80	4	25	--	25#	150
CEC405	Concrete Technology	20	20	20	80	3	25	--	25	150
CEC406	Fluid Mechanics – II	20	20	20	80	3	25	--	25	150
Total		120	120	120	480	--	125	--	125	850

***Oral & Practical** **# Oral & Sketching**

University of Mumbai

Scheme of Instructions and Examination

Third Year Engineering (Civil Engineering)

(With effect from 2014-2015)

Semester V

Subject Code	Subject Name	Teaching Scheme (Contact Hours)			Credits Assigned			
		Theory	Pract.	Tut.	Theory	Pract.	Tut.	Total
CEC501	Structural Analysis – II	4	2	--	4	1		5
CEC502	Geotechnical Engg.– I	4	2	--	4	1	--	5
CEC503	Building Design and Drawing – II	1	4*	--	1	2	--	3
CEC504	Applied Hydraulics – I	4	2		4	1	--	5
CEC505	Transportation Engg. – I	4	2	--	4	1	--	5
CEC506	Business and Communication Ethics	-	2+2†	-	-	2		2
Total		**17**	**16**	**--**	**17**	**8**		**25**

Subject 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.						
CEC501	Structural Analysis – II	20	20	20	80	3	25	--	25	150
CEC502	Geotechnical Engg. – I	20	20	20	80	3	25	--	25	150
CEC503	Building Design and Drawing – II	20	20	20	80	4	25	--	25[#]	150
CEC504	Applied Hydraulics – I	20	20	20	80	3	25	--	--	125
CEC505	Transportation Engg. – I	20	20	20	80	3	25	--	--	125
CEC506	Business and Communication Ethics	--	--	--	--	-	50	--		50
Total		**100**	**100**	**100**	**400**	**-**	**150**	**-**	**100**	**750**

[#] **Oral Sketching** **Oral Presentation

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

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

Semester VI

Subject Code	Subject Name	Teaching Scheme (Contact Hours)			Credits Assigned			
		Theory	Pract.	Tut.	Theory	Pract.	Tut.	Total
CEC601	Geotechnical Engg. – II	4	2	--	4	1	--	5
CEC602	Design and Drawing of Steel Structures	4	2	--	4	1	--	5
CEC603	Applied Hydraulics – II	3	2	--	3	1	--	4
CEC604	Transportation Engg. – II	4	2	--	4	1	--	5
CEC605	Environmental Engg – I	3	2	--	3	1	--	4
CEC606	Theory of Reinforced Prestressed Concrete	4	2	--	4	1	--	5
Total		**22**	**12**	**--**	**22**	**6**	**--**	**28**

Subject 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.						
CEC601	Geotechnical Engg. – II	20	20	20	80	3	25	--	25	150
CEC602	Design and Drawing of Steel Structures	20	20	20	80	4	25	--	25@	150
CEC603	Applied Hydraulics – II	20	20	20	80	3	25	--	25	150
CEC604	Transportation Engg. – II	20	20	20	80	3	25	--	25	150
CEC605	Environmental Engg. – I	20	20	20	80	3	25	--	--	150
CEC606	Theory of Reinforced and Prestressed Concrete	20	20	20	80	3	25	--	25	150
Total		**120**	**120**	**120**	**480**		**150**		**125**	**875**

@Oral & Sketching

Semester V

Subject Code	Subject Name	Credits
CEC501	Structural Analysis –II	5

Teaching Scheme

Contact Hours			Credits Assigned			
Theory	Practical	Tutorial	Theory	Practical	Tutorial	Total
04	02	-	4	1	-	5

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 and kinematic indeterminacy (degrees of freedom) of the structures such as beams & rigid 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 to evaluate the response of such structures in the form of bending moment, shear force, axial force etc.
- To study the analyses of two hinged arches.

Detail Syllabus

Module	Sub Modules/Contents	Periods
1.	**General** Types of structures occurring in practice, their classification. Stable and unstable structures, statically and kinematical determinacy indeterminacy of structure. Symmetric structures, symmetrical & anti-symmetrical loads, distinction between linear and non-linear behaviors of material and geometric non-linearity.	**06**
2.	**Deflection of statically determinate structures** Review of general theorems based on virtual work energy methods, introduction to the concept of complimentary energy, absolute & relative deflection caused by loads, temperature changes settlement of supports, application to beams, pin jointed frames, rigid jointed frames.	**06**
3.	**Analysis of indeterminate structures by flexibility method** 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	**14**

	propped cantilevers, fixed beams, continuous beam, simple pin jointed frames including effect of lack of fit for members, simple rigid jointed frames, two hinged parabolic arches.	
4.	**Analysis of indeterminate structures by stiffness method**	**14**
	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 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 and 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 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** 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. 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 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 term-work shall be judiciously awarded depending upon the quality of the term work including that of the report on experiments assignments. The final certification acceptance of term-work warrants the satisfactory the appropriate completion of the assignments 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 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.
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*, ElBS 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 & Wilbur*, McGraw Hill.
17. Structural Analysis: *Laursen H.I*, McGraw Hill Publishing Co.
18. Structural Theorem and Their application: *B.G. Neal*, Pergaman Press.
19. Fundamentals of Structural Analysis: *K.M. Leet*, C.M. Uang 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	5

Teaching Scheme

Contact Hours			Credits Assigned			
Theory	Practical	Tutorial	Theory	Practical	Tutorial	Total
04	02	-	4	1	-	5

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 rock. The geotechnical analysis depends on the basic of 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.

Detail Syllabus

Module	Sub Modules/Contents	Periods
1.	**Introduction**	**01**
	i. Definitions: Rock, Soil - origin & formation, Soil mechanics, Rock mechanics, Soil engineering, Geotechnical engineering. ii. Scope of soil engineering- Importance of field exploration & 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**
	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**
	i. Mechanical analysis: dry sieve analysis combined sieve sedimentation analysis; Stokes'law theory of sedimentation; introduction to hydrometer method of analysis, relation between	

	percentage finer hydrometer reading, Limitation of sedimentation analysis, Particle size distribution curve its uses. ii. Relative density 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. iv. Clay mineralogy:- gravitational surface forces, primary valence bond, hydrogen bond, secondary valance bonds, basic structural units of clay minerals, difference in kaolinite, montmorillonite illite minerals, adsorbed water, soil structure. v. Sensitivity, thixotropy activity of soils.	
4.	**Classification of soils**	**03**
	i. Necessity of soil classification, Indian Stard particle size classification, Indian stard soil classification system, boundary classifications ii. General characteristics of soils of different groups.	
5.	**Permeability of soils**	**06**
	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. ii. Hydraulic head hydraulic gradient, Darcy's law, validity of Darcy's law. iii. General laminar flow, Laminar flow through soil, Factors affecting permeability of soil. iv. Determination of coefficient of permeability of soil:- Laboratory methods: constant head variable head; Field methods: pumping out pumping in tests; Indirect methods: Consolidation test data. v. Permeability of stratified soil.	
6.	**Seepage analysis**	**05**
	i. Two dimensional flow- Laplace equation, analytical solution: stream potential functions, graphical representation: flow net, characteristics of flow net, uses of flow nets.	

	ii. Other solution methods for Laplace equation- numerical methods. iii. Soil migration 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 & 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 transmissivity of geotextiles v. Filter design criteria for graded soil geotextile filters.	
7.	**Effective stress principle**	**03**
	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**
	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**
	i. Compressibility & 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. Terzhaghi's theory of consolidation- assumptions, coefficient of vertical consolidation, distribution of hydrostatic excess pore water pressure with depth & 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**
	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. ii. Mohr-Coulomb theory- shear strength parameters; Mohr-Coulomb failure criterion- relation between major minor principle stresses, total & effective stress analysis. iii. Different types of shear tests drainage conditions; Direct shear test, Triaxial compression test (UU, CU CD), Unconfined compression test, Vane shear test; comparison between direct & triaxial tests, interpretation of test results of direct shear & triaxial shear tests- stress-strain curves Mohr failure envelopes iv. Determination of shear strength of soil with geosynthetics- pull out test: ASTM procedure for finding shear strength of soil-geosynthtic system.	
11.	**Soil exploration**	**05**
	Introduction, methods of investigation, methods of boring, soil samplers & sampling, number & disposition of trial pits & 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 compaction characteristics interpret field compaction result with respect to compaction specification.

- To evaluate consolidation properties of soils apply those properties to settlement problems frequently encountered in civil engineering.
- To apply engineering science principles, using shear strength compressibility parameters, to analyze the response of soil under external loading.
- To obtain soil properties required for many design applications
- To design 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** 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 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 the term work consisting of the report of experiments performed in the laboratory 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 s 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: stard 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 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 assignments. The final certification acceptance of term-work warrants the satisfactory the appropriate completion of the assignments 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*, Stard Publishers Distributors, New Delhi.
4. Soil Mechanics & Foundation Engineering: *B.C. Punimia*, Laxmi Publications
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*, Printice Hall, New Jersey.
8. Soil Mechanics: *R. F. Craig*, Chapman & Hall.
9. Soil Mechanics: *T. W. Lambe R. V. Whitman*, John Wiley & Sons.
10. Theoretical Soil Mechanics: *K. Terzaghi*, John Wiley & Sons.
11. Designing with geosynthetics: *R. M. Koerner*, Prentice Hall, New Jersey.
12. An introduction to soil reinforcement geosynthetics: *G. L. SivakumarBabu*, 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 Geo-synthetic Friction by Direct Shear Method

Semester V

Course Code	Subject Name	Credits
CE503	Building Design & Drawing – II	3

Teaching Scheme

Contact Hours			Credits Assigned			
Theory	Practical	Tutorial	Theory	Practical	Tutorial	Total
1	4#	--	1	2	--	3

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 & drawing of Public Buildings, which includes Offices like Bank, Post-Office, Commercial Complexes, 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 Framed type with respect to Plan, Elevation, Section, Foundation Plan, Roof Plan, Site plan for the same. The subject also involves drawings of One-Point & Two-Point Perspectives for public buildings which will represent the real impression of building when we see them from a long distance, may be seeing by sitting 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 sections at various levels using latest software techniques like Auto CAD, with reference to drafting of various types of public buildings. Over all, by the end of semester, the civil engineering students will have the complete knowledge with reference to Planning, Designing, drawing concepts of all 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 Drawing of all types of public buildings.
3. To understand all the concepts involved in drawing the different Perspective drawings for public buildings, workshops.
4. To prepare various types of drawings for the public building structures planned designed, satisfying the functional market requirements.
5. To study & apply the provisions made in the relevant Indian Specifications pertaining to the practice for public buildings, the society needs for over all development.

Detail Syllabus

Module	Sub-Module/Contents	Periods
1.	Planning & 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 Depots	**10**
2.	Perspective Drawing : One Point Perspective & 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 Building Organization	**01**
7.	Use of Computers in Building Planning & Designing	**03**
8.	Introduction to Green Buildings, understanding 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.

Theory Examination:

1. The question paper will comprise of **six** questions, each carrying 20 marks.
2. Question No.1 will be **compulsory,** 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 term work.

Contents of the Practicals /Site Visit:

1. Planning 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 of that building take the measurements of that building 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. Site visit report 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 acceptance of term work warrants the satisfactory performance of drawing work by the student, appropriate completion of the report on the said drawing sheets, 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*, Stardard 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 John Callender

Semester V

Course Code	Subject Name	Credits
CEC504	Applied Hydraulics – I	5

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 knowledge of this subject is essential to understand facts, concepts and design parameters of dynamics of fluid flow, application of momentum equation in lawn sprinklers and pipe bends, dimensional analysis and impact of jets. Further it helps to understand the design aspects, components, function, and uses of centrifugal pump, reciprocating pumps and turbines.

Course Objectives

- To study hydraulic machines like centrifugal pumps, reciprocating pumps and turbines.
- 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.

Detail 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 bon 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 sprinklers. They will be able to study the dimensional analysis model laws, 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** 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 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 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 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 acceptance of term work warrants the satisfactory performance of drawing work by the student, appropriate completion of the report on the said drawing sheets 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. Fluid Mechanics Hydraulics: *Dr. S. K. Ukarande*, Ane's Books Pvt. Ltd. (Revised Edition 2012), ISBN 97893 81162538.
2. Hydraulic Fluid Mechanics: *Dr. P. M. Modi & Dr. S. M. Seth*, Stard Book House, Delhi.
3. Theory Application of Fluid Mechanics: *K. Subramanya*, Tata Mc-Graw Hill publishing Company, New Delhi.
4. Fluid Mechanics Fluid Pressure Engineering: *Dr. D. S. Kumar*, S. K. Kataria 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	5

Teaching Scheme

Contact Hours			Credits Assigned			
Theory	Practical	Tutorials	Theory	Practical	Tutorials	Total
4	-	2	4	-	1	5

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	03 Hrs	25	-	-	125

Rationale

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

Detail Syllabus

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

	measures for high speed track.	
03	**Airport Engineering** i Aircraft component parts its function, aircraft characteristics their influence on airport planning. ii Airport planning: topographical 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 & 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.	**Water Transportation** Introduction of water transportation system, harbors docks, port facilities.	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 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.

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. There shall be theory questions as well.

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 assignments. The final certification acceptance of term-work warrants the satisfactory the appropriate completion of the assignments 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

Text Books:

1. A Course of Railway Engineering: *Saxena, S. C. and Arora, S. P.*; Dhanpat Rai Sons, New Delhi.
2. Airport Planning Design: *Khanna, S.K., Arora, M.G. and Jain, J.J.; Nemchand 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 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
CEC506	Business and Communication Ethics	2

Teaching Scheme

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

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						
-	-	-	-	-	50	-		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.

Detail 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, 12th Ed.
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 (2nd Ed.)
9. Management Communication: *Bell, Smith*; Wiley India Edition (3rd Ed.)
10. 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.

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 including that of the report on experiments assignments. The final certification acceptance of term-work warrants the satisfactory the appropriate completion of the assignments 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 V

Course Code	Subject Name	Credits
CE-C601	Geotechnical Engineering – II	5

Teaching Scheme

Contact Hours			Credits Assigned			
Theory	Practical	Tutorial	Theory	Practical	Tutorial	Total
04	02	-	4	2	-	6

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

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

Detail Syllabus

Module	Sub Modules/Contents	Periods
1.	**Stability of Slopes** 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.	**Lateral earth pressure theories** 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'slateral earth pressure theory: active and passiveearth 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:** 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** 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 Terzhaghi'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**

5.	**Axially Loaded Pile Foundations:** 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: a) Static methods, b) Dynamicmethods, c) In-situ Penetration Test (SCPT) and d) Pile load test as per IS: 2911. iii. Pile Groups : a) Ultimate Capacity b) Settlement of pile group in cohesion-less and cohesive soils as per IS 2911.	**07**
6.	**Underground Conduits:** 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).	**02**
7.	**Open Cuts:** 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.	**02**
8.	**Reinforced Soils:** 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: a) Mechanically stabilized retaining wall: Stability analysis of mechanically	**05**

	stabilized (metallic strip and geotextile) retaining wall. b) Geotextile as roadway reinforcement: concept of load distribution in pavement with and without geotextile. c) Geotextile reinforced embankment: Embankment on soft foundation and potential embankmentfailure modes.	

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** 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 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 including assignments.

List of Practicals: *(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 acceptance of term work warrants the satisfactory performance of drawing work by the student, appropriate completion of the report on the said drawing sheets 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 geosynthetics: *G. L. SivakumarBabu*; 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
CEC602	Design and Drawing of Steel Structure	5

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	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 structure are made of steel .These structure are designed either by working stress method or limit state method. The design methods of different components given in the syllabus are base on limit state method. Here in this course, Limit State methods are studied in detail

Objectives

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

Detail Syllabus

Module	Sub – Modules / Contents	Periods
I	**Introduction to Steel Structure**	02
	Introduction to type of steel, mechanical properties of Structural steel, advantages of steel as structural material, design philosophies of Working Stress Method (WSM)	
II	**Introduction to Limit State Method**	03
	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 width to thickness ratio.	
III	**Simple Connection Bolted & Welded**	05
	Introduction to bolted welded connection by working stress method and limit state method, Type of bolts, advantage of bolts & welds, simple connection for bolted and welded connection.	
IV	**Tension Members**	04
	Design of tension members with welded and 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 sections and block shear.	
V	**Compression Members as Struts**	04
	Design of compression members as struts with welded /bolted end connection using single angle sections & double angle section by Limit State Method. Effective length of compression members, buckling class of various cross sections, limiting values of effective slenderness ratio.	
VI	**Compression Members as Column**	06
	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 cross sections, limiting values of effective slenderness ratio,	
VII	**Column Bases**	**03**
	Design of slab bases & 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 and 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. 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 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 acceptance of term work warrants the satisfactory performance of drawing work by the student, appropriate completion of the report on the said drawing sheets 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*, Stuctures Publication, Pune.
3. Limit State Design of Steel Structures: S.K. *Duggal*, Tata Mc-Graw Hill India Publishing House
4. Design of Steel Structures: K.S. Sairam, Pearson

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: *Arya and Ajmani*, Nem Chand and Bros., Roorkee
9. Structural Design in Steel: *Sarwar Alam Raz;* New Age International Publsihers
10. Relevant Indian Specifications, Bureau of Indian Specifications, New Delhi.

Semester VI

Course Code	Subject Name	Credits
CEC603	Applied Hydraulics – II	4

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 knowledge of this subject is essential to understand facts, concepts of and design aspects of airplanes, submarines, ships, bridges as well as channels in alluvial and non alluvial soils. This subject provides necessary knowledge about concept of boundary layer theory, study of drag and lift in case of flow around submerged bodies, design of open channel and understanding of surface profiles.

Objectives

- To compute slope of a channel
- To calculate rate of flow in a channel
- To compute wetted perimeter and hydraulic radius of open channel flow
- To identify normal depth in an open channel
- To compute critical depth of a an open channel

- To study the design of open channel and understanding the concept of surface profile with hydraulic jump.
- To study the Kennedys and Lacey's silt theory to design irrigation channels.

Detail Syllabus

Module	Sub – Modules / Contents	Periods
1.	**Boundary layer theory:** Development of boundary layer over flat curved surfaces, laminar and 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 and control.	**5**
2.	**Flow around submerged bodies:** 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 aerofoil.	**5**
3.	**Flow through open channel:** Definition, types of channels, Types of flows in channels, Prismatic non-prismatic channels, Uniform flow: steady flow and unsteady flow, laminar and turbulent flow, subcritical flow, supercritical flow, Chezy's formula, Manning's formula, hydraulically efficient channel cross-section (most economical section), Velocity distribution in open channels, and pressure distribution in open channels. Applications of Bernoulli's equation to open channel flow. Non uniform flow: Specific energy and specific energy curve, discharge curve, Dimensionless specific energy discharge curve, applications of specific energy. Momentum principle, application to open channel flow, specific force. Hydraulic jump and standing wave, small waves surges in open channels. Gradually varied flow, equation for gradually varied flow, back water curve and afflux, surface profiles. Control section, location of hydraulic jump.	**17**

4.	**Fluvial Hydraulics:** Kennedy's theory, Kennedy's methods of channel designs, silt supporting capacity according to Kennedy's theory. Drawbacks in Kennedy's theory Lacey's regime theory, Lacey's theory applied to channel design. Comparison of Kennedys and Lacey's theory, defects in Lacey's theory. Introduction to sediment transport in channels.	**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 it's 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 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: *(Any Six)*

1. Determine Chezy,s roughness factor
2. Determination of gradually varied flow
3. Study of hydraulic jump and its characteristics.
4. Calibration of venturiflume
5. Calibration of standing wave flume
6. Determination of mean velocity of flow in open channel.
7. Study of wind tunnel
8. Calibration of broad crested weir
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 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 acceptance of term work warrants the satisfactory performance of drawing work by the student, appropriate completion of the report on the said drawing sheets 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. Fluid Mechanics Hydraulics: *Dr. S. K. Ukarande*; Ane's Books Pvt. Ltd. (Revised Edition 2012), ISBN 97893 81162538.
2. Hydraulics and Fluid Mechanics: *P. M. Modi S. M. Seth*;Stard Book House, Delhi.

3. Theory and Application of Fluid Mechanics: *K. Subramanya*; Tata McGraw Hill India Publishing Company, New Delhi.
4. Fluid Mechanics and Fluid Pressure 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	5

Teaching Scheme

Contact Hours			Credits Assigned			
Theory	Practical	Tutorials	Theory	Practical	Tutorials	Total
4	2	-	4	1	-	5

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 cultural development of any country. The adequacy of transportation system of a country indicates its economic social development. Three basic modes of transportation include land, water and air. The land mode further includes highways 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.

Detail Syllabus

Module	Sub Modules/Contents	Periods
01	**Highway Planning** i Classification of roads, brief history of road developments in India, present status of roads in India ii Highway alignment, basic requirement of ideal alignment, factors governing highway alignment iii Highway location survey, map study, reconnaissance, topographic surveys, highway alignment in hilly area, drawing report preparation	03
02	**Geometric design of highway** i Terrain classification, vehicular characteristics, highway cross section elements, salient dimensions, clearances, width of carriage way, shoulders, medians, width of road way, right of way, camber its profile.(IRC Standards) ii Design speed, sight distance, perception time, break reaction time, analysis of safe sight distance, analysis of overtaking sight distance, intersection sight distance iii Horizontal curves: design of super elevation, its provisions, minimum radius of horizontal curves, widening of pavement, transition curves. iv Gradients: different types, maximum, minimum, ruling exceptional, grade	09

	compensation in curves, vertical curves: design factors, comfort sight distance. Summit curve, valley curve. v Introduction of geometric design software.	
03	**Pavement materials:** i Subgrade materials: desirable properties, modulus of elasticity, modulus of subgrade reaction, classification of subgrade soils, importance of CBR. ii Subbase material: desirable properties, different tests on aggregate, requirement of aggregate for different types of pavements. iii Bituminous materials: types of bituminous material, test on bituminous material, desirable properties, grade of bitumen	04
04	**Pavement Design:** 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, 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. iii Stress in Rigid Pavements, critical load position, stress due to load, stress due to temperature variation, combine loading temperature stress.; Design of rigid pavements (IRC: 58- 1988; IRC: SP- 62-2004) iv Introduction to pavement design software, relationship between numbers of cumulative axle, strain value elastic modulus of materials.	09
05	**Highway Construction** 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 MORTH specifications) ii. Constructions of stabilized roads: different method of soil stabilization, use of geo-textile geogrid in highway subgrade.	04
06	**Highway Maintenance Rehabilitation** i. Pavement failure: flexible pavement failure, rigid pavement failure, maintenance of different types of pavements. ii. Evaluation of pavements: structural evaluation of pavements, functional	05

	evaluation of pavement, 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)	
07	**Traffic Engineering and Control** i. Traffic study and surveys: speed studies, presentation of data, journey time delay studies, use of various methods, merits demerits ii. Vehicular volume count: types, various available methods, planning of traffic count. iii. O- D survey, need uses, various available methods iv. Parking survey, need types, traffic sign marking, signals, miscellaneous traffic control aids, traffic regulations, traffic signals. v. Intersection types: at grade separation, factors influencing design. vi. Introduction to traffic design related software's.	**07**
08	**Highway drainage** Necessity, surface drainage, subsurface drainage.(IRC recommendations)	**02**
09.	**Bridge Engineering** Bridge engineering: importance, investigations, site selection, collection of data, determination of flood discharge, waterway, afflux, economic span, scour depth, Bearing Design criteria for Bridge Foundations. IRC Code of practice for bridges	**05**

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 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 & Fire point, Marshall Stability.

Tests on Subgrade:

Sub-grade CBR.

Term Work:

The term-work shall comprise of the neatly written report based on the afore-mentioned experiments and the assignments. Their shall be at least 10 assignments which will comprise of numerical problems and lay-out sketches, covering the entire syllabus 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 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 acceptance of term work warrants the satisfactory performance of drawing work by the student, appropriate completion of the report on the said drawing sheets 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 : 8 Marks
- Traffic Study Report : 4 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. Highway Engineering: *Khanna, S.K. and Justo, C. E. G.*; Nem Chand and Bros., Roorkee,
2. Principles and Practice of Highway Engineering: *Kadiyali, L. R.*; Khanna Publsihers, Delhi
3. Principles of Transportation and Highway Engineering, *Rao, G.V.;* Tata McGraw 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
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: C.S. Papacostas and P.D. Prevedouros; Prentice Hall India Learning Pvt. Ltd., New Delhi
2. Principles of Transportation Engineering: Chakrabory, 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
6. Relevant specifications of Indian Roads Congress

Semester VI

Course Code	Subject Name	Credits
CEC605	Environmental Engineering – I	4

Teaching Scheme

Contact Hours			Credits Assigned			
Theory	Practical	Tutorial	Theory	Practical	Tutorials	Total
04	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

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 so that they can give 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.

Detail 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 sand filters, dual media filters, 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.	**30**

	Miscellaneous Treatments : removal of Iron, Manganese, taste, odour, colour, principles methods, de-fluoridation, reverse osmosis **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	
2	**Municipal solid waste management** **Solid waste :** Sources, Types , composition, Physical biological properties of solid wastes, sources types of hazardous infectious wastes in municipal solid wastes Solid waste generation collection, storage, handling , transportation, processing Treatment disposal methods Material separation recycle, physic- chemical biological stabilization solidification thermal methods, of disposal, site remediation, leachate & its control. **Hazardous wastes:** Effects of hazardous waste on environment & its disposal	**04**
3	**Building water supply:** Introduction, per capita supply, service connections from main, storage of water supply systems in a building, sizing of pipes, water meters Fixtures and fittings: Introduction, classification of fixtures, special accessories, fittings. Pipe material, Joints, Valves. Design of pipes, primary & secondary branches, Laying of pipes, testing and maintenance of pipes.	**03**

Outcomes

On completion of this course, the students will have an ability to understand the water quality criteria and standards and further, to design the water treatment plant and water distribution system. The students will understand the various methods of disposal of solid waste. They will have an understanding of the nature and characteristic of solid waste and regulatory requirements regarding solid waste management and further, they will have an ability to plan waste minimization. Besides, they will be prepared to contribute practical solutions to environmental problems in our society.

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 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 report of the visit to the Sewage Treatment Plant.

List of Practicals: *(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

Term work:-

The termwork 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 acceptance of 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 the visit to Sewage Treatment Plant : 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
CEC606	Theory of Reinforced and Prestressed 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	--	--	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 prestressing of R.C structures and its applications in the analysis of R.C. structures.

Detail 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, L-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 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 term-work shall be judiciously awarded depending upon the quality of the term work including that of the report on experiments assignments. The final certification acceptance of term-work warrants the satisfactory the appropriate completion of the assignments 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 Concre 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

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UNIVERSITY OF MUMBAI

Revised Syllabus

Program- Bachelor of Engineering

Course- Civil Engineering

(Second Year – Sem. III & IV)

Under

FACULTY OF TECHNOLOGY

(As per Credit Based Semester and Grading System from 2013-14)

From Dean's Desk:

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 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) and course objectives and course outcomes to be clearly defined for each course, so that all 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 Faculty of Technology, and developed curriculum accordingly. In addition to outcome based education, semester based credit and grading system is also introduced to ensure quality of engineering education.

Semester based Credit and 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 and Faculty of Technology has devised a transparent credit assignment policy and adopted ten points scale to grade learner's performance.Credit assignment for courses is based on 15 weeks teaching learning process, however content of courses is to be taught in 12-13 weeks and remaining 3-2 weeks to be utilized for revision, guest lectures, coverage of content beyond syllabus etc.

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 and 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 and reflects the fact that in achieving recognition, the institution or program of study is committed and 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 and knowledge that a student will have at the time of graduation from the program. In line with this Faculty of Technology of 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 and 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 and Multinational Organisations and to excel in Postgraduate studies
4. To encourage and motivate Learner's for self-learning
5. To inculcate professional and ethical attitude, good leadership qualities and 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, 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 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

Subject 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 and 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 and Information Retrieval System*	--	4‡	--	--	2	--	2
Total		**20**	**15**	--	**20**	7	--	**27**

Subject 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 and 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 and Information Retrieval System*	--	--	--	--	--	25	25		50
Total		**120**	**120**	**120**	**480**	--	**150**	**25**	**100**	**875**

‡ For the subject 'Database and 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; and accordingly, provision may be made in the Time Table. * Course common for Civil Mechanical, Automobile & Production Engineering.

Semester IV

Subject 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**	--	**26**

Subject 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 & Practical** **# Oral & Sketching**

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

Semester III

Subject Code	Subject Name	Credits
CE-C 301	Applied Mathematics-III	4

Teaching Scheme

Contact Hours			Credits Assigned			
Theory	Practical	Tutorial	Theory	Practical	Tutorials	Total
04	-	--	04	-	--	04

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.	--	-	-	100

Rationale

The study of mathematics is necessary to develop in the students the skills essential for studying new technical developments. This subject introduces some applications of engineering, through which the students can understand the link of mathematics with engineering principles. The course deals with the topics such as Laplace Transform, Complex Variables, Fourier Series and Partial Differential Equations.

Objectives

- To provide students with a sound foundation in the mathematical fundamentals necessary to formulate, solve and analyze engineering problems.
- The make the students understand the basic principles of Laplace Transform, Fourier series, Complex Variables.

Detailed Syllabus

Module	Sub-Modules/ Contents		Periods
I.	**1. Laplace Transform**		**5**
	1.1	Function of bounded variation, Laplace Transform of standard functions such as 1, t^n, e^{at}, $\sin at$, $\cos at$, $\sinh at$, $\cosh at$	

	1.2	Linearity property of Laplace Transform, First Shifting property, Second Shifting property, Change of Scale property of L.T., $L\{t^n f(t)\}, L\left\{\frac{f(t)}{t}\right\}, L\left\{\int_0^t f(u)du\right\}, L\left\{\frac{d^n f(t)}{dt^n}\right\}$ (without proof) Heaviside Unitstep function, Direct Delta function, Periodic functions and their Laplace Transform	
II.	**2. Inverse Laplace Transform**		**5**
	2.1	Inverse Laplace Transform: Linearity property, use of theorems to find inverse Laplace Transform, Partial fractions method and convolution theorem (without proof).	
	2.2	Applications to solve initial and boundary value problems involving ordinary differential equations with one dependent variable.	
III.	**Complex variables**		**10**
	3.1	Functions of complex variable, Analytic function, necessary and sufficient conditions for $f(z)$ to be analytic (without proof), Cauchy-Riemann equations inpolar coordinates.	
	3.2	Milne- Thomson method to determine analytic function $f(z)$ when it's real or imaginary or its combination is given. Harmonic function, orthogonal trajectories.	
	3.3	Mapping: Conformal mapping, linear, bilinear mapping, cross ratio, fixed points and standard transformations such as Rotation and magnification, inversion and reflection, translation.	
IV.	**4. Complex Integration**		**10**
	4.1	Line integral of a function of a complex variable, Cauchy's theorem for analytic function, Cauchy's Goursat theorem (without proof), properties of line integral, Cauchy's integral formula and deductions.	
	4.2	Singularities and poles:	
	4.3	Taylor's and Laurent's series development (without proof)	
	4.4	Residue at isolated singularity and its evaluation.	
	4.5	Residue theorem, application to evaluate real integral of type $\int_0^{2\pi} f(\cos\theta, \sin\theta)\, d\theta$, & $\int_{-\infty}^{\infty} f(x)\, dx$	
V.	**5. Fourier Series**		**10**
	5.1	Orthogonal and orthonormal functions, Expressions of a function in a series of orthogonal functions, Dirichlet's conditions, Fourier series of periodic	

		function with period 2π & $2l$.	
	5.2	Dirichlet's theorem(only statement), even and odd functions, Half range sine and cosine series, Parsvel's identities (without proof)	
	5.3	Complex form of Fourier series.	
VI.	**6. Partial Differential Equations**		**12**
	6.1	Numerical Solution of Partial differential equations using Bender Schmidt Explicit Method, Implicit method (Crank- Nicolson method) Successive over relaxation method.	
	6.2	Partial differential equations governing transverse vibrations of elastic string its solution using Fourier series.	
	6.3	Heat equation, steady-state configuration for heat flow.	
	6.4	Two and Three dimensional Laplace equations.	

Contribution to Outcomes

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

- Demonstrate the ability of using Laplace Transform and Fourier Series in solving the Ordinary Differential Equations and Partial Differential Equations.
- Identify the analytic function, harmonic function, orthogonal trajectories and to apply bilinear transformations and conformal mappings.
- Identify the applicability of theorems and evaluate the contour integrals.

Theory examination:

1. The question paper will comprise of **six** questions; each carrying 20 marks.
2. The **first** question will be **compulsory** and will have 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 the entire syllabus. For this, the modules 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. The students will have to attempt **any three** questions out of remaining five questions.
5. Total **four** questions need to be solved.

Term Work:

The term work shall comprise of the assignments (minimum eight numbers) solved by the students during the tutorial class.

Distribution of the Term Work Marks:

The marks of the term work shall be judiciously awarded depending upon the quality of the term work. The final certification and acceptance of the term work ensures the satisfactory performance during tutorials.

Recommended Books:

1. Elements of Applied Mathematics: *P N Wartikar and J N Wartikar*; Pune Vidyarthi Griha Prakashan.
2. Higher Engineering Mathematics: *Dr B. S. Grewal*; Khanna Publications.
3. Advanced Engineering Mathematics: *E Kreyszing*, Wiley Eastern Limited.

Reference Books:

1. Complex Variables: *Churchill*, Tata Mc-Graw Hill Publications
2. Numerical Methods: *Kandasamy*
3. Integral Transforms and their Engineering Applications, Dr B. B. Singh, Synergy Knowledgeware, Mumbai

Semester III

Subject Code	Subject Name	Credits
CE- C 302	Surveying -I	4

Teaching Scheme

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

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

Surveying is a core subject for civil engineers. It is the first step towards all civil engineering projects. A good surveyor is an asset to the company, organization or establishment. All the civil engineering projects such as buildings, transportation systems including roads, bridges, railways, airports along with dams and water/ sewage treatment plants start with surveying as the basic operations. Hence, the knowledge of surveying is very essential to all the civil engineering professionals. In this subject, the students get acquainted with the basic methods and equipments that are used in surveying and it helps them to produce plans and sections. It is also useful in setting out civil engineering structures on construction sites.

Objectives

Students will be able to:

- Apply principles of surveying and levelling for civil engineering works
- Use the appropriate methods of surveying.
- Perform various projects using different instruments skillfully.
- Take linear and angular measurements.
- Record the data in field book.
- Draw the plans and sections.
- Compute areas and volumes.

Detailed Syllabus

Module	Sub-Modules/ Contents		Periods
1.	**Introduction**		**05**
	1.1	Definition, principles, object, uses and necessity of surveying. Various types of surveying– based on methods and instruments, classifications-Plane surveying and geodetic surveying, Scales, Plain and diagonal scale, use of various types of verniers and micrometers in survey instruments.	
	1.2	Chain surveying, study of ranging, Instruments required for linear measurements and setting out right angles.	
2.	**Levelling**		**10**
	2.1	Definitions, technical terms, principle of levelling, different types of levels such as dumpy, tilting, wye level, auto level and laser level, temporary and permanent adjustments of level	
	2.2	Levelling staff – Different types, classification of levelling, reduction of levels. Precise level and levelling staff, and field procedure for precise levelling. Difficulties in levelling work, corrections and precautions in levelling work, problems, corrections due to curvature and refraction.	
3.	**Contouring**		**03**
	3.1	Contouring: definitions, contour interval, equivalent, uses and characteristics of contour lines, direct and indirect methods of contouring. Grade contour: definition and use.	
	3.2	Computation of volume by trapezoidal and prismoidal formula, volume from spot levels, volume from contour plans.	
4.	**Traversing**		**13**
	4.1	Compass survey: Bearings: Definition, different types and designations, compass- prismatic and surveyor's, declination, local attraction, plotting of compass survey by different methods.	
	4.2	Theodolite traverse: Various parts and axis of transit, technical terms, temporary and permanent adjustments of a transit, horizontal and vertical angles, methods of repetition and reiteration.	
	4.3	Different methods of running a theodolite traverse, Gales traverse table,	

		balancing of traverse by Bow- Ditch's, transit and modified transit rules	
	4.4	Problems on one plane and two plane methods, omitted measurements, Precautions in using transit, errors in theodolite traversing; Use of theodolite for various works such as prolongation of a straight line, setting out an angle, bearing measurements.	
5.	**Areas**		**04**
	5.1	Area of a irregular figure by trapezoidal rule, average ordinate rule, Simpson's 1/3 rule, various coordinate methods.	
	5.2	Planimeter: types including digital planimeter, area of zero circle, use of planimeter.	
6.	**Plane Table Surveying**		**04**
	6.1	Definition, uses and advantages , temporary adjustments	
	6.2	Different methods of plane table surveying	
	6.3	Errors in plane table surveying	
	6.4	Use of telescopic alidade	

Contribution to Outcomes

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

- Take linear and angular measurements
- Record the various measurements in the field book
- Find the areas of irregular figures.
- Prepare the plans and sections required for civil engineering projects.

The successful completion of the course shall equip the students to undertake the course Surveying-II.

Theory examination:

1. The question paper will comprise of **six** questions; each carrying 20 marks.
2. The **first** question will be **compulsory** and will have 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 the entire syllabus. For this, the modules 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. The students will have to attempt **any three** questions out of remaining five questions.
5. Total **four** questions need to be solved.

Oral Examination:

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

List of Practicals:

1. Chaining Ranging and offsetting.
2. Measuring Bearing of survey lines using Prismatic compass.
3. Measuring bearing of survey lines using Surveyor's compass.
4. Measurement of horizontal angle by Repetition Method.
5. Measurement of horizontal angle by Reiteration Method.
6. Measurement of vertical Angle using theodolite.
7. Determination of R.L of points using Auto level and Dumpy level.
8. Determination of areas of irregular figures by planimeter.
9. Plane table surveying by various methods.

Term work: It shall consist of the following:

1. Field book submission on afore-mentioned practicals conducted on and off the field.
2. Drawing sheets of a three day projects on compass / theodolite traversing and plane table surveying.
3. The assignments shall comprise of the minimum 20 problems covering the entire syllabus divided properly module wise.

Distribution of the Term Work Marks:

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

Recommended Books:

1. Surveying and Levelling: Vol-I and II: *Kanetkar and Kulkarni*, Pune Vidyarthi Griha, Pune.
2. Surveying and Levelling: *N N Basak*, Tata McGraw Hill, New Delhi.
3. Surveying*: R. Agor*, Khanna Publishers.
4. Surveying: Vol-I: *Dr K.R. Arora*, Standard Book House.
5. Surveying and Levelling (2nd Edition): *R. Subramanian*; Oxford Higher Education.
6. Surveying and levelling (Vol.-I): *Dr. B.C. Punmia,* Laxmi Publications.
7. Surveying and Levelling (Vol.-I):*S. K.Duggal,* Tata Mc-Graw Hill

Semester III

Subject Code	Subject Name	Credits
CE-C 303	Strength of Materials	4

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

There are different types of structures made up of different materials such as concrete, steel, metals and timber. They are subjected to various types of loading/ forces such as axial, shear, bending and torsion. This subject equips the students to analyze the internal behavior of material of the structural members under different types of loading. The knowledge gained in this subject is helpful to study other subjects like Structural Analysis and Structural Design.

Objectives

- To study the engineering properties of the materials and solids and analyze the same to evaluate the stress –strain behaviour.
- To analyze the internal forces for the statistically determinate and compound beams having internal hinges with different types of loading.
- To understand the concept and behaviour of flexural members (beams) in flexure and shear, solid circular shaft for tension, thin shells for internal stresses.
- To introduce the concept of strain energy for axial, flexure, shear and torsion.
- To study the behaviour of axially loaded columns using different theories available for the analysis with various end conditions.

Detailed Syllabus

Module	Sub-Modules/ Contents		Periods
I.	**1. Shear Force and Bending Moment in Beams**		**07**
	1.1	Axial force, shear force and bending moment diagrams for statically determinate beams including beams with internal hinges for different types of loading.	
	1.2	Relationship between rate of loading, shear force and bending moment.	
II.	**2. Stresses and Strains**		**07**
	2.1	Stresses, Strains, Modulus of elasticity (E), Modulus of rigidity (G), Bulk Modulus (K), Yield Stresses, Ultimate Stress, Factor of safety, shear stress, Poisson's ratio.	
	2.2	Relationship between E, G and K, bars of varying sections, deformation due to self weight, composite sections, temperature stress.	
III.	**3. Theory of Simple Bending**		**06**
	Flexure formula for straight beam, moment of inertia, transfer theorem, polar moment of inertia, simple problems involving application of flexure formula, section modulus, moment of resistance, flitched beams.		
	4. Strain Energy		**03**
	Strain energy due to axial force, stresses in axial member and simple beams under impact loading.		
IV.	**5. Shear Stresses in Beams**		**06**
	Distribution of shear stress across plane sections commonly used for structural purposes, shear connectors.		
	6. Theory of Simple Torsion		**06**
	Torsion in circular shafts-solid & hallow, stresses in shaft when transmitting power, closed coil helical spring under axial load		
V.	**7. Direct and Bending Stresses**		**06**
	Application to member's subjected to eccentric loads, core of section, problems on chimneys, retaining walls etc involving lateral loads.		
	8. Struts		**03**
	Struts subjected to axial loading, concept of buckling, Euler's formula for struts with different support conditions, limitation, Euler's and Rankine's design formulae.		

VI	**9. Principal Planes and Stresses**		05
	9.1	General equation for transformation of stress, principal planes and principal stresses, maximum shear stress, stress determination using Mohr's circle,	
	9.2	Principal stresses in shafts subjected to combined torsion, bending & axial thrust, and concept of equivalent torsional and bending moment.	
	10. Thin Cylindrical and Spherical Shells		
	Cylindrical and spherical shells under internal pressure.		**03**

Contribution to Outcomes

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

- Understand and determine the engineering properties for metals and non metals.
- Understand the concepts of shear force, bending moment, axial force for statically determinate beams and compound beams having internal hinges; and subsequently, its application to draw the shear force, bending moment and axial force diagrams.
- Analyze the flexural members for its structural behaviour under the effect of flexure (bending), shear and torsion either independently or in combination thereof.
- Study the behaviour of the structural member under the action of axial load, bending and twisting moment.
- Study the deformation behaviour of axially loaded columns having different end conditions and further, evaluate the strength of such columns.

The successful completion of the course will equip the students for undertaking the courses dealing with the analysis and design of determinate and indeterminate structures.

Theory examination:

1. The question paper will comprise of **six** questions; each carrying 20 marks.
2. The **first** question will be **compulsory** and will have 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 the entire syllabus. For this, the modules 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. The students will have to attempt **any three** questions out of remaining five questions.
5. Total **four** questions need to be solved.

Oral Examination:

The oral examination shall be based on the entire syllabus and the report of the experiments/ practicals conducted by the students including assignments.

List of Practicals:

1. Tension test on mild steel bars (stress-strain behaviour ,Young's modulus determination)
2. Tests on Tor Steel (Tension, bend and re-bend)
3. Transverse Test on cast iron.
4. Shear Test on mild steel, cast iron, and brass.
5. Torsion Test on mild steel and cast iron bar.
6. Brinell Hardness test (any three metal specimen)
7. Rockwell Hardness test on mild steel.
8. Izod / Charpy impact test (any three metal specimen)

Term Work:

The term work shall comprise of the neatly written report based on the above mentioned experiments and assignments. The assignments shall comprise of the minimum 20 problems covering the entire syllabus divided properly module wise.

Distribution of the Term Work Marks:

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

Recommended Books:

1. Strength of Materials: *S. Ramamrutham*, Dhanpatrai Publishers.
2. Strength of Materials: *R.K. Rajput*, S. Chand Publications.
3. Mechanics of Materials: Vol-I: *S.B. Junnarkar and H.J. Shah*, Charotar Publications.
4. Strength of Materials: *Subramanian*, Oxford University Press
5. Strength of Materials: *S.S. Rattan*, Tata Mc-Graw Hill, New Delhi
6. Strength of Materials (Mechanics of Materials): *R.S. Lehri and A.S. Lehri*, S.K.Kataria Publishers, New Delhi
7. Strength of Materials: *Dr. V.L.Shah*, Structures Publications, Pune

Reference Books:

8. Mechanics of Materials: *James, M. and Barry J.*; Cengage Learning.
9. Mechanics of Materials: *Andrew Pytel and Jaan Kiusalaas*, Cengage Learning.
10. Mechanics of Materials: *Timoshenko and Gere*, Tata McGraw Hill, New Delhi.
11. Mechanics of Materials: *James M. Gere*, Books/Cole.
12. Strength of Materials: *G.H. Ryder*, Mc-Millan.
13. Mechanics of Materials: *E.P. Popov*, Prentice Hall India (PHI) Pvt. Ltd.
14. Mechanics of Materials: *Pytel and Singer*, Mc-Graw Hill, New Delhi.
15. Strength of Materials: *William A. Nash and Nillanjan Mallick*, Mc-Graw Hill Book Co .(Schaum's Outline Series)
16. Mechanics of Materials: *Beer and Johnson*, Tata Mc-Graw Hill New Delhi.

Semester III

Subject Code	Subject Name	Credits
CE-C 304	Building Materials and Construction	4

Teaching Scheme

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

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

Materials are essential elements, constituent parts (or) substances which are used to raise a building, but materials could not be turned into structures without a method of construction. This subject provides necessary knowledge about properties and uses of different types of building materials. This subject is intended for gaining useful knowledge with respect to facts, concepts, principles and procedures related to building construction system so that student can effectively plan and execute building construction work.

Objectives

- To study the manufacturing process, properties, and use of different types of building materials like cement, lime, mortar, concrete, stone, brick, timber, including materials such as paints and varnishes used for treatment of the surfaces so as to achieve good knowledge about the building materials.
- To enable the students to identify various components of building (foundation, masonry, roof and floor, staircase etc.), their functions and methods of construction so as to achieve good knowledge about building construction.

Detailed Syllabus

Module	Sub-Modules/ Contents		Periods
I.	**Foundations** Different types of structures such as load bearing structures, framed structures and composite structures, Introduction to different types of foundations: Stepped foundations, column footing, combined footing, under-reamed pile foundations.		**7**
	Construction Materials: Classification and Properties		
	1.1	Classification of materials, building materials symbols and requirements of building materials and products: functional, aesthetical and economical.	
	1.2	Study of properties of materials-physical, mechanical, chemical, biological and other like durability, reliability, compatibility and economic characteristics.	
II.	**Raw Materials, Manufacturing Process and Properties of Basic Construction Materials.**		**6**
	2.1	Rocks (Stone) - quarrying, milling and surface finishing, preservative treatments.	
	2.2	Structural clay products- bricks, roofing tiles, ceramic tiles, raw materials and manufacturing process.	
	2.3	Concrete blocks, flooring tiles, paver blocks-raw materials and manufacturing process.	
	2.4	Binder material: lime, cement: physical properties and manufacturing process, plaster of Paris- properties and uses.	
	2.5	Mortar - ingredients, preparation and uses.	
III.	**Masonry Construction and Masonry Finishes**		**6**
	3.1	Classification and bonding of stone, brick and concrete blocks	
	3.2	Masonry finishes-pointing, plastering and painting	
	3.3	**Paints and Varnishes**	
		Types, constituents and uses.	
IV.	**4.1**	**Formwork**	**6**
		Materials used, design considerations, shuttering, centering and staging, scaffolding.	
	4.2	**Floor and Roofs**	
		Type of floors, floor finishes and suitability. Type of roofs, wooden and steel trusses and roof covering	

V.	**5.1**	**Glass**	**7**
		Types and uses. Introduction to glass fibre reinforced plastic.	
	5.2	**Timber**	
		Varieties, defects in timber, preservative treatments and wood composites.	
	5.3	**Metal and Alloys**	
		Ferrous and non ferrous metals and alloys, aluminum, tin, zinc, nickel - types and uses and anti-corrosive treatment.	
VI.	**Building Services, Air conditioning and Ventilation, Acoustics and Sound Insulation, Damp-proofing and Water proofing.**		**7**
	6.1	Air conditioning: systems of heating, air conditioning, ventilation, construction requirements.	
	6.2	Acoustics and sound insulation: Characteristics of sound, reflection and absorption coefficient, acoustical defects, design and material.	
	6.3	Damp-proofing and water proofing: materials and methods	

Contribution to Outcomes

On completion of the course, the students will be:

- Able to identify the various building materials with symbols.
- Able to identify the properties of building materials.
- Made acquainted with the manufacturing process of basic construction materials.
- Made acquainted with the masonry construction and finishes
- Aware of building services, acoustics, DPC, etc.

Theory examination:

1. The question paper will comprise of **six** questions; each carrying 20 marks.
2. The **first** question will be **compulsory** and will have 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 the entire syllabus. For this, the modules 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. The students will have to attempt **any three** questions out of remaining five questions.
5. Total **four** questions need to be solved.

Oral Examination:

The oral examination shall be based on the entire syllabus and term work comprising of the report of the experiments/ practicals conducted by the students and a detail report of the industrial/ site visit.

List of Experiments/ Practicals: (Minimum **seven** to be performed)

1. Water absorption and compressive strength test of bricks.
2. Water absorption and transverse load test on tiles.
3. Moisture content and flexural strength test on timber.
4. Compression test on timber (Parallel/ perpendicular to the grains).
5. Physical properties of cement: Fineness, consistency, setting time, Soundness, Compressive strength.
6. Compression test on Paver blocks.
7. Water absorption, density and compression test on masonry blocks.
8. Abrasion test on tiles.

Site Visit/ Industrial Visit:

The students shall visit the brick, paver blocks, concrete block, cement, glass and plastic manufacturing industrial plants. They shall study various aspects of the plant along with various operations. The visit to any site where construction is going on may be arranged and the students may be made aware of the various construction activities. They shall prepare a report of the visit which shall include all above points. The same shall be evaluated by the concerned teacher.

Term Work:

The term work shall consist of:

- Report of minimum **07** experiments.
- Assignments, including at least **20** sketches on A2 size drawing sheets covering entire syllabus.
- Industrial visit report to at least **any one** of the above mentioned industrial plants.

Although minimum numbers of experiments and industrial visits are prescribed, the students shall be encouraged to perform more number of experiments and site/ industrial visits.

Distribution of the Term Work Marks:

The marks of the term work shall be judiciously awarded for the various components of the term work and depending upon the quality of the term work including industrial/ site visit report. The final certification and acceptance of term work warrants the satisfactory performance of laboratory work by the student, appropriate completion of the assignments.

Recommended Books:

1. Building Construction: *S. P. Bindra and S. P. Arora*, Dhanpat Rai and Sons, Delhi.
2. Building Drawing: *M. G. Shah, C. M. Kale and S. Y. Palki*, Tata Mc-Graw Hill, Delhi.
3. Services in Building Complex: *V. K. Jain*, Khanna Publishers.
4. Materials of Construction: *D. N. Ghose*, Tata McGraw Hill, Delhi.
5. Architectural Materials science: *D. Anapetor*, Mir Publishers.
6. Introduction to Engineering Materials: *B. K. Agrawal*, Tata McGraw Hill New Delhi.
7. Engineering Materials: S.*R. Rangwala,* Charotar Publications.
8. Engineering Materials: *P. Surendra Singh*, Vani Education Books New Delhi.
9. Building Construction: *Rangwala*, Charotar Publications, Anand (Gujrat).
10. Building Materials (Products, Properties and Systems): *M.L.Gambhir and Neha Jamwal*, Mc-Graw Hill Publications.
11. Specifications for different materials, BIS Publications, New Delhi

Semester III

Subject Code	Subject Name	Credits
CE-C 305	Engineering Geology	4

Teaching Scheme

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

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

The study of Geology helps to understand about geological formations, classifications and morphology of rocks, physical properties of minerals and the importance of the study of Geology for civil engineers with regard to founding the structures like dams, bridges, buildings etc. It also gives the ideas about geological formations in causing earthquake and landslides.

Objectives

- Study of importance of geological studies in various civil engineering projects and Interior of the earth.
- Study of physical geology including geological action of river, wind, glacier, volcano earthquake and weathering.
- Study of minerals and rocks with classification, structure, texture and origin.
- Study of structural geology including geological structure like fold, fault, joint, etc.
- Study of geological history of peninsular India with economic minerals and building stones of India.
- Study of methods of surface and subsurface investigation and their importance.
- Study of types, lithology structural conditions, advantages, difficulties, significance of geological structures during the construction of dam and tunnel.

- Study of ground water zones, factors controlling water bearing capacity of rocks, geological work of ground water and springs
- Study of types, causes, preventive measures for landslides.
- Study of building stones with geological and engineering properties.

Detailed Syllabus

Module		Sub-Modules/Contents	Periods
I	**1.**	**Introduction**	**01**
	1.1	Branches of geology useful to civil engineering, Importance of geological studies in various civil engineering Projects.	
	1.2	Internal structure of the Earth and use of seismic waves in understanding the interior of the earth	
	2.	**General and Physical Geology**	**08**
	2.1	Agents modifying the earth's surface, study of weathering and its significance in engineering properties of rocks like strength, water tightness and durability etc.	
	2.2	Brief study of geological action of river, wind, glacier, ground water and the related land forms created by them.	
	2.3	Volcano- Central type and fissure type, products of volcano, volcanic land forms.	
	2.4	Earthquake - Earthquake waves, construction and working of seismograph, Earthquake zones of India, elastic rebound theory Preventive measures for structures constructed in Earthquake prone areas.	
II	**3.**	**Mineralogy**	**01**
		Identification of minerals with the help of physical properties, rock forming minerals, megascopic identification of primary and secondary minerals, study of common ore minerals	
	4.	**Petrology** Study of igneous, sedimentary and metamorphic rocks, distinguishing properties among these three rocks to identify them in fields.	**06**
	4.1	Igneous Petrology - Mode of formation, Texture and structure, Classifications, study of common occurring igneous rocks.	

	4.2	Sedimentary Petrology - Mode of formation , Textures, characteristics of shallow water deposits like lamination, bedding, current bedding etc., residual deposits, chemically formed and organically deposits, classification and study of commonly occurring sedimentary rocks.	
	4.3	Metamorphic Petrology - Mode of formation, agents and types of metamorphism, metamorphic minerals, rock cleavage, structures and textures of metamorphic rocks, classification and study of commonly occurring metamorphic rocks.	
III	**5. Structural Geology**		**03**
	Structural elements of rocks, dip, strike, outcrop patterns unconformities, outliers and inlier, study of joints. Faults and folds, importance of structural elements in engineering operations.		
	6. Stratigraphy and Indian Geology		**02**
	General principles of Stratiagraphy, geological time scale, Physiographic divisions of India and their characteristics. Stratiagraphy of Maharashtra		
IV	**7. Geological Investigation**		**04**
	7.1	Preliminary Geological Investigation and their importance to achieve safety and economy of the projects supporting dams and tunnel projects ,methods of surface and subsurface investigations, excavations-Trial pit, trenches etc.	
	7.2	Core Drilling - Geological logging, Inclined Drill holes. Electrical Resistivity method, Seismic method and their applications.	
	7.3	Use of Aerial photographs, Satellite imageries in civil engineering projects.	
	8. Geology of dam and reservoir site:		**04**
	8.1	Strengths, stability, water tightness over the foundation rocks and its physical characters against geological structures at dam sites, favorable and unfavorable conditions for locating dam sites.	
	8.2	Precautions over the unfavorable geological structures like faults , dykes , joints, unfavorable dips on dam sites and giving treatments, structural and erosional valleys.	
V	**9. Tunneling**		**03**
	Importance of geological considerations while choosing tunnel sites and alignments of the tunnel, safe and unsafe geological and structural conditions, Difficulties during tunneling and methods to overcome the difficulties.		
	10. Ground water		**03**

	10.1	Sources, zones, water table, unconfined and Perched water tables. Factors controlling water bearing capacity of rocks, Pervious and Impervious rocks, Cone of depression and its use in Civil engineering. Geological work of groundwater, Artesian well.	
	10.2	Springs seepage sites and geological structures. Different types of rocks as source of ground water	
VI	**11. Recharge of ground water**		**03**
	Methods of artificial recharge of ground water, geology of percolation tank.		
	12. Land slides		
	Types, causes and preventive measures for landslides, Landslides in Deccan region.		
	13. Building stones		**01**
	Requirements of good building stones and its geological factors, controlling properties, consideration of common rocks as building stones, study of different building stones from various formations of Indian Peninsula,		

Contribution to Outcomes

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

- Understand the interior structure of the earth and seismological evidences.
- Identify various landforms which are created by geological agents like wind, river, glaciers, volcanoes and earthquake.
- Recognize various types of minerals with physical properties, rocks with their textures, structures and origin. Also use of common building stones.
- Understand geological structure like folds, faults, joints, unconformity etc. knowledge of which is very essential in the design and construction of dams, tunnels etc.
- Understand surface and subsurface strata, the sources and zones of ground water.
- Apply the preventive measures for landslide and earthquake prone areas.
- Take a self decision to make his report over the site with the Geological ingredients and information, up to the need of project aim.

Theory examination:

1. The question paper will comprise of **six** questions; each carrying 20 marks.
2. The **first** question will be **compulsory** and will have 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 the entire syllabus. For this, the modules 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. The students will have to attempt **any three** questions out of remaining five questions.
5. Total **fou**r questions need to be attempted.

Oral Examination:

Oral examination will be based on the entire syllabus and a neatly written report for the practicals along with a report of the site visit.

List of Practicals:

1. Study of physical properties of the minerals.
2. Identification of minerals- Quartz and its varieties, Orthoclase, Plagioclase, Muscovite, Biotite, Hornblende, Asbestos, Augite, Olivin, Tourmaline, Garnet, Actinolite, Calcite, Dolomite, Gypsum, Beryl, Bauxite, Graphite, Galena, Pyrite. Hematite, Magnetite, Chromite, Corundum, Talc, Fluorite, Kyanite.
3. Identification of rocks: *Igneous rocks*- Granite and its varieties, Syenite, Diorite, Gabbro, Pegmatite. Porphyry, Dolerite, Rhyolite, Pumice, Trachyte, Basalt and its varieties, Volcanic Breccia, Volcanic tuffs. *Sedimentwy Rocks*- Conglomerate, Breccia, Sandstone and its varieties, Shales,Limestones, Laterites. *Metamorphic Rocks*- Mica Schists, Hornblende Schists, Slate, Phyllite, Granite Gneiss , Augen gneiss, Marbles and Quartzite.
4. Study of Geological maps (At least 5).
5. Study of core samples, RQD, Core logging.
6. At least two engineering problems based on field data collected during site investigation.

Term Work:

The term work shall consist of the:

- Report of the practical conducted in terms of the study of the physical properties of the minerals, identification of minerals and rocks.
- Report of the Geological maps
- Report of the two problems based on field data.
- At least *eight* assignments covering entire syllabus

Site Visit:

There shall be a visit to get the geological information according to the various contents mentioned in the syllabus. The students shall prepare a detail report thereof along with the summarized findings. The report will form a part of the term work.

Distribution of the Term Work Marks:

The marks of the term work shall be judiciously awarded for the various components of the term work and depending upon the quality of the term work. The final certification and acceptance of term work ensures the satisfactory performance of laboratory work.

Recommended Books:

1. Text book of Engineering Geology: *Dr. R. B. Gupte*, Pune Vidyarthi Griha Prakashan, Pune.
2. Text book of Engineering Geology: *P. K. Mukerjee*, Asia.
3. Text book of Engineering and General Geology: *Parbin Singh*, Carson Publication.
4. Text book of Engineering Geology: *N. Chenna, Kesavulu*, Mc-Millan.
5. Principles of Engineering Geology: *K. M. Banger*.

Reference Books:

1. Principles of Physical Geology: Arthur Homes, Thomas Nelson Publications, London.
2. Principles of Geomorphology: *William D. Thornbury*, John Wiley Publications, New York.
3. Geology for Civil Engineering: A. *C. McLean, C.D. Gribble, George Allen & Unwin* London.
4. Engineering Geology: A Prrthsarathy, V. Panchapakesan, R Nagarajan, Wiley India 2013.

Semester III

Subject Code	Subject Name	Credits
CE-C 306	Fluid Mechanics-I	4

Teaching Scheme

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

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 concept of fluid mechanics in civil engineering is essential to understand the processes and science of fluids. The course deals with the basic concepts and principles in hydrostatics, hydro kinematics and hydrodynamics with their applications in fluid flow problems.

Objectives

Students are introduced to:

- Properties of fluid and basic concepts applicable to fluid mechanics.
- Pascal's law, hydrostatic law and determination of Hydrostatic pressure and centre of pressure.
- Principle of buoyancy and its application
- Liquids in relative equilibrium.
- The concept of ideal fluid and fluid mechanics.
- Various flow measuring devices and their applications in the field.

Detailed Syllabus

Module	Sub-Modules/Contents	Periods
I.	**1. Properties of fluids**	03
	Mass density, weight density, specific gravity, specific volume, viscosity,	

	compressibility and elasticity, surface tension, capillarity, vapour pressure, types of fluids, basic concepts applicable to fluid mechanics.		
	2. Fluid Statics		**09**
	2.1	Pascal's law, hydrostatic law, pressure variation in fluids at rest. Absolute, atmospheric, gauge pressure, measurement of pressures.	
	2.2	Hydrostatic force on surface, total pressure and centre of pressure, total pressure on horizontal plane surface, vertical plane surface, Inclined plane surface, centre of pressure for vertical plane surface and for inclined plane surface, practical applications of total pressure and centre of pressure on dams, gates, and tanks.	
	2.3	Buoyancy and flotation, Archimedes principle, Metacentre, metacentric height, Stability of floating and submerged bodies, determination of metacentric height, metacentric height for floating bodies containing liquid, Time period of Transverse oscillations of floating bodies.	
II	**3. Liquids in Relative equilibrium**		**03**
	Fluid mass subjected to uniform linear acceleration, liquid containers subjected to constant horizontal acceleration and vertical acceleration, fluid containers subjected to constant rotation with axis vertical and horizontal.		
	4. Fluid Kinematics		**05**
	Types of fluid flow, description of flow pattern, Lagrangian methods, Eulerian method, continuity equation, velocity and acceleration of fluid particles, velocity potential and stream function, streamline, streak line, path line, equipotential lines and flow net, uses of flow net, rotational and irrotational motions, circulation and vorticity.		
III.	**5. Fluid dynamics**		**08**
	Control volume and control surface, Forces acting on fluid in motion, Navier-Stokes Equation, Euler's Equation of motion , Integration of Euler's equations of motion, Bernoulli's Theorem and its derivation , Bernoulli's equation for compressible fluid and real fluid, applications of Bernoulli's Equation - Venturimeter, Orifice meter, nozzle meter, pitot tube		
IV.	**Orifices and Mouthpieces**		**05**
	6.1	Classification of orifices, flow through orifices, determination of hydraulic coefficients, flow through large rectangular orifice, flow through fully submerged and partially submerged orifice, time of emptying a tank through an orifice at its bottom	

	6.2 Classification of Mouthpieces, Flow through external cylindrical mouthpiece, convergent-divergent mouthpiece, Borda's mouthpieces.		
V.	**7. Notches and Weirs**		**04**
	Classification of notches and weirs, discharge over a rectangular, triangular, trapezoidal notch/weir, velocity of approach, stepped notch, Cipolleti weir, broad crested weir, ogee weir, discharge over a submerged weir, ventilation of weirs.		
VI.	**8. Introduction to Ideal fluid flow**		**02**
	8.1	Uniform flow, source and Sink, free vortex flow, superimposed flow, doublet,	
	8.2	Flow past a half body, flow past a Rankine oval body and flow past a cylinder.	

Contribution to Outcomes

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

- Understand basic properties of fluids and basic definitions.
- Study of pressure measuring devices.
- Study of pressure on the surface in the contact of fluids and its applications.
- Understand the concepts of buoyancy and flotation and its applications.
- Understand the fundamentals of kinematics.
- Apply Bernoulli's principle to fluid flow problems.
- Measure velocity and rate of flow using various devices.
- Concept of ideal fluid flow.

Theory examination:

1. The question paper will comprise of **six** questions; each carrying 20 marks.
2. The **first** question will be **compulsory** and will have 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 the entire syllabus. For this, the modules 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. 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 (Any six):

1. Determination of metacentric height.

2. Verification of Bernoulli's theorem.
3. Determination of coefficient of discharge through Venturimeter.
4. Determination of coefficient of discharge through Orificemeter.
5. Determination of coefficient of discharge through Nozzlemeter.
6. Determination of coefficient of discharge through Notches (Rectangular and Triangular notch).
7. Determination of coefficient of discharge over weirs (Broad Crested weir and Ogee weir).
8. Determination of hydraulic coefficients of orifice.
9. Determination of coefficient of discharge through mouthpiece.

Term Work:

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

Distribution of the Term Work Marks:

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

Recommended Books:

1. Hydraulics and Fluid mechanics: *Dr P.M. Modi and Dr. S.M. Seth*, Standard Book House, Delhi
2. Theory and Application of Fluid Mechanics: *K. Subramanya,* Tata McGraw hill publishing company, New Delhi.
3. Fluid Mechanics: *Dr. A.K Jain,* Khanna Publishers.
4. Fluid Mechanics and Hydraulics: *Dr. S.K. Ukarande,* Ane's Books Pvt. Ltd. (Revised Edition 2012), ISBN 97893 8116 2538
5. Fluid Mechanics and fluid pressure engineering: *Dr. D.S. Kumar, F.K. Kataria* and *sons*
6. Fluid Mechanics: *R.K. Bansal* Laxmi Publications (P) Ltd.

Reference Books:

1. Fluid Mechanics: *Frank M. White*, Tata Mc-Graw Hill International Edition.
2. Fluid Mechanics: *Streeter White Bedford*, Tata Mc-Graw International Edition.

3. Fluid Mechanics with Engineering Applications: *R.L. Daugherty, J.B. Franzini, E.J. Finnemore*, Tata Mc-Graw Hill, New Delhi.
4. Hydraulics: *James F. Cruise, Vijay P.Singh and Mohsen M. Sherif,* CENGAGE Learning India (Pvt.) Ltd.
5. Introduction to Fluid Mechanics: *Edward J. Shaughnessy,Jr, Ira M. Katz, James P. Schaffer*. Oxford Higher Education.

Semester III

Subject Code	Subject Name	Credits
CE- C 307	Database and Information Retrieval System	2

Teaching Scheme

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

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						
-	-	-	-	-	25	25#		

Rationale

The students of Civil Engineering are often required to deal with the huge amount of data. The students are expected to be aware of the management of the data and its retrieval whenever need arises. This course concerns with the management of information and how to model it in the structured manner. The use of database management, as an application tool to manipulate the information which has been modelled earlier, will provide the students a further step in order to apply an application of information technology in solving the problems of diverse spectrums of the field of Civil Engineering.

Objectives

The course aims at:

- Learning and practicing the data modeling using the entity-relationship and developing database designs.
- Understanding the use of Structured Query Language (SQL) and learn SQL syntax.
- Applying Graphical User Interface techniques for retrieve the information from database
- Understanding the needs of database processing and learn techniques for controlling the consequences of concurrent data access.

Detailed Syllabus

Module	Sub- Modules/ Contents
I.	**Introduction Database Concepts**
	What is a database? , Characteristics of databases, Example of database, File system V/s Database system, What is DBMS?, Users of Database system, Advantage of using an enterprise database, Concerns when using an enterprise database, Data Independence, DBMS system architecture, Database Administrator,
II.	**Entity–Relationship Data Model**
	Introduction, Benefits of Data Modeling, Types of Models, Phases of Database Modeling, The Entity-Relationship (ER) Model, Generalization, Specialization and Aggregation, Extended Entity-Relationship (EER) Model.
III.	**Relational Model and Algebra**
	Introduction , Mapping the ER and EER Model to the Relational Model , Data Manipulation , Data Integrity ,Advantages of the Relational Model, Relational Algebra , Relational Algebra Queries, Relational Calculus.
IV.	**Structured Query Language (SQL)**
	Overview of SQL, Data Definition Commands, Set operations, aggregate function, null values, Data Manipulation commands, Data Control commands, Views-Using Virtual Tables in SQL, Nested and complex queries.
V.	**Introduction to Transactions Management and Concurrency**
	Transaction concept, Transaction states, ACID properties, Implementation of atomicity and durability, Concurrent Executions, Serializability, Recoverability, Concurrency Control: Lock-based , Timestamp-based , Validation-based protocols, Deadlock handling, Recovery System: Failure Classification, Storage structure, Recovery and atomicity, Log based recovery, Shadow paging.
VI.	**Graphical User Interface**
	Murphy 's Law of G U I Design, Features of G U I, Icons and graphics, Identifying visual cues, clear communication, color selection, GUI standard, planning GUI Design Work. **Visual programming :** ***Sharing Data and Code*:** Working with Projects, Introduction to Basic language, Using inbuilt controls and ActiveX controls, creating and using classes, Introduction to Collections, Using and creating ActiveX Components, dynamic data exchange, object linking and embedding.

	Creating visual software entities: Working with text, graphics, working with files, file management, serial communication, and multimedia control interfaces.

*Out of 4 (Four) clock hours designated for this course under the head of Practicals, 2 (Two) clock hours out of these 4 (Four), may be utilized as the Theory and accordingly, the provision may be made in the time-table of the respective Colleges/ Institutes.

# Indicates the Practical Examination in conjunction with the Oral.

Contribution to Outcomes

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

- Describe data models and schemas in DBMS
- Understand the features of database management systems and relational database.
- Use SQL- the standard language of relational databases.
- Understand the functional dependencies and design of the database.
- Understand the graphical user Interface design.

Term Work:

The each student shall be assigned minimum two *case studies* to perform on the following experiments:

(1) Problem Definition and draw ER /EER diagram
(2) Design Relational Model
(3) Perform DDL operation
(4) Perform DML and DCL operations
(5) Design Forms using Visual programming
(6) Retrieve the information through GUI.

Guidelines for Conducting Practical Examination:

(1) Practical examination duration shall be of 2 (Two) hours and questions shall be based on the list of afore-mentioned experiments mentioned under the head of Term Work.
(2) Evaluation of practical examination shall be done by external examiner based on the printout of students' work
(3) Practical examination: 40 marks, oral examination based on practical examination: 10 marks
(4) Students' work along with evaluation report to be preserved till the next examination

Recommended Books:

1. Database System Concepts: *Korth, Slberchatz, Sudarshan*, 6th Edition, McGraw – Hill.

2. Database Management Systems: *G. K. Gupta*, McGraw – Hill.
3. GUI Design for dummies: IDG books.
4. Visual Basic 2005, How to program (3RD Edition): *Deitel & Deitel*, Pearson Education.
5. SQL and PL/SQL for Oracle 10g: *Dr. P.S. Deshpande*, Dreamtech Press.
6. Introduction to Database Management: *Mark L. Gillenson, Paulraj Ponniah*, Weley
7. Oracle for Professional: *Sharaman Shah*, SPD.
8. Database Management Systems: *Raghu Ramkrishnan and Johannes Gehrke*, TMH

Semester IV

Subject Code	Subject Name	Credits
CE-C 401	Applied Mathematics-IV	4

Teaching Scheme

Contact Hours			Credits Assigned			
Theory	Practical	Tutorial	Theory	Practical	Tutorials	Total
04	-	--	04	-	--	04

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.	--	--	--	100

Rationale

The study of mathematics is necessary to inculcate amongst the students the skills necessary for studying new technical developments. This subject introduces some applications of engineering through which the students can understand the link of mathematics with engineering principles. It creates sufficient background necessary to understand and use mathematical techniques for application in modern engineering. The course deals with matrices, vector calculus, non-linear programming, probability distributions and sampling theory along with correlation and regression.

Objectives

1. To inculcate an ability to relate engineering problems to mathematical context
2. To provide a solid foundation in mathematical fundamentals required to solve engineering problem
3. To impart the basic principles of matrix algebra, vector analyses, statistics and probability

Detailed Syllabus

Module	Sub-Modules/ Contents	Periods
I.	**Matrices**	**09**

	1.1	Characteristic polynomial, characteristic equation, characteristic roots and characteristic vectors of a square matrix, properties of characteristic roots and vectors of different types of matrices such as orthogonal matrix, Hermitian matrix, Skew-Hermitian matrix.	
	1.2	Diagonalisable Matrix, Cayley Hamilton theorem (without proof) Functions of a square matrix, Minimal polynomial and Derogatory matrix.	
II	**Vector calculus**		**10**
	2.1	Scalar and vector point functions, Gradient, Divergence and curl, Solenoidal and Irrotational Vector Field	
	2.2	Line integrals, Surface integrals, Volume integrals. Green's theorem(without proof) for plane regions and properties of line integrals, Stokes theorem(without proof), Gauss divergence theorem (without proof) related identities and deductions.(No verification problems on Stoke's Theorem and Gauss Divergence Theorem)	
III.	**Non Linear Programming**		**05**
	3.1	Unconstrained optimization, problems with equality constraints Lagranges Multiplier method (two constraints)	
	3.2	Problem with inequality constraints Kuhn-Tucker conditions (two constraints)	
IV.	**Probability Distributions and Sampling Theory**		**11**
	4.1	Discrete and Continuous random variables, Probability mass and density function, Probability distribution for random variables, Expected value, Variance	
	4.2	Probability Distributions: Binomial, Poisson and Normal Distributions.	
V.	**Sampling Theory**		**12**
	5.3	Sampling distribution. Test of Hypothesis. Level of significance, critical region. One tailed and two tailed tests. Interval Estimation of population parameters. Large and small samples	
	5.4	Test of significance for Large samples: Test for significance of the difference between sample mean and population means, Test for significance of the difference between the means of two samples	
	5.5	Student's t-distribution and its properties. Test of significance of Small samples Test for significance of the difference between sample mean and population means, Test for significance of the difference between the means of two Samples, paired t-test	

	5.6	Analysis of Variance(F-Test): One way classification,Two-way classification	
	5.7	Chi-square distribution and its properties, Test of the Goodness of fit,Association and Attributes	
VI	**Correlation and Regression**		**05**
	6.1	Correlation, Co-variance, Karl Pearson Coefficient of Correlation and Spearman's Rank Correlation Coefficient (non-repeated and repeated ranks) (No theoretical questions)	
	6.2	Regression Coefficients and lines of regression (No theoretical questions)	

Contribution to Outcomes

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

- Use matrix algebra with its specific rules to solve the system of linear equations.
- Understand and apply the concept of probability distribution and sampling theory to engineering problems.
- Apply principles of vector differential and integral calculus to the analysis of engineering problems.
- Identify, formulate and solve engineering problems.

Theory examination:

1. The question paper will comprise of **six** questions; each carrying 20 marks.
2. The **first** question will be **compulsory** and will have 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 the entire syllabus. For this, the modules 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. The students will have to attempt **any three** questions out of remaining five questions.
5. Total **four** questions need to be attempted.

Term Work:

The term work shall comprise of the assignments (minimum eight numbers) solved by the students during the tutorial class.

Distribution of the Term Work Marks:

The marks of the term work shall be judiciously awarded depending upon the quality of the term work. The final certification and acceptance of the term work ensures the satisfactory performance during tutorials.

Recommended Books:

1. Fundamentals of Mathematical Statistics: *S C Gupta and V K Kapoor*, S. Chand and Co.
2. Higher Engineering Mathematics: *Dr B. S. Grewal*, Khanna Publication, New Delhi.
3. Elements of Applied Mathematics: *P. N. Wartikar and J. N. Wartikar*, Pune Vidyarthi Griha Prakashan, Pune.
4. Advanced Engineering Mathematics: E Kreyszing, Wiley Eastern Limited.

Reference Books:

1. Operations Research: D.S.Hira and P.K.Gupta,S. Chand & Co.
2. Vector Analysis: Murray R. Spiegel, Shaum Series
3. Probability and Statistics : T. VeeraRajan,TataMc-Graw Hill Publications
4. Matrices: A.R.Vashistha, Krishna Prakashan, Meerut

Semester IV

Subject Code	**Subject Name**	**Credits**
CE –C 402	Surveying-II	4.5

Teaching Scheme

Contact Hours			Credits Assigned			
Theory	Practical	Tutorial	Theory	Practical	Tutorials	Total
03	03	-	03	1.5	-	4.5

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

This is an advanced course which intended to teach students modern surveying instruments with their principles and uses in surveying along with curves and setting out of different civil engineering works. Students are exposed to the concept of G.P.S., G.I.S. and remote sensing techniques. To make the students acquainted with the field problems, survey camp is arranged to execute the Road project, Block contouring project and Tachometric project at ideal locations.

Objectives

- Set out the curve by linear and angular methods with proper office and field work.
- Study modern surveying instruments.
- Set out civil engineering works, e.g., Sewer line, culvert, bridges, buildings etc.
- Execute road project, block contouring project and tacheometric project.
- Plot the 'L' section and 'C' section.
- Plot the contour plans.

Detailed Syllabus

Module	Sub-Modules/ Contents		Periods
I.	**Tacheometric surveying**		**08**
	1.1	Principle, purpose, uses, advantages and suitability of tacheometry, different methods of tacheometry, stadia formula, Stadia diagram and tables. Subtense bar method.	
	1.2	Application in plane table and curve setting.	
	1.3	Radial Contouring.	
II.	**Curves-Horizontal**		**10**
	2.1	Definitions of different terms, necessity of curves and types of curves.	
	2.2	Simple circular curves and compound curves, office and field work, linear methods of setting out curves, Angular methods of setting out curves, two theodolites and Rankine deflection angle method.	
	2.3	Reverse and transition curves, their properties and advantages, design of transition curves, shift, spiral angle. Composite curves office and field level. Setting out of curves by angular method, composite curves problems.	
	2.4	Difficulties in setting out curves and solution for the same.	
III.	**Curves- Vertical**		**03**
	3.1	Definitions, necessity, geometry and types.	
	3.2	Tangent correction and chord gradient methods.	
	3.3	Sight distance on a vertical curve	
IV.	**Setting out works**		**05**
	4.1	General horizontal and vertical control, setting out of foundation plan for load bearing and framed structure, batter board, slope and grade stakes, setting out with theodolite.	
	4.2	Setting out a foundation plans for building, sewer line, culvert, and use of laser for works; Setting out center line for tunnel, transfer of levels for underground works.	
	4.3	Project/route survey for bridge, dam and canal.; Checking verticality of high rise structures.	
V.	**Modern Surveying Instruments**		**05**

	5.1	Electronics in surveying, various types of electronic distance measurements, principles used, Application in surveying, corrections for field observations.	
	5.2	Electronic digital theodolite – types and application. Digital planimeter, digital level Total station –various applications in surveying	
	5.3	Use of computer in surveying for reduction of levels, plotting of contour plans, L-section and C-section using various softwares	
VI.	**Modern Methods of Surveying**		**08**
	6.1	Global Positioning System (GPS): Basic principles, GPS segments, receivers, computations of coordinates. Applications in surveying	
	6.2	Remote Sensing: Definition, basic concepts, electromagnetic radiation and spectrum, energy source and its characteristics, image acquisition and image interpretation. Application of remote sensing.	
	6.3	Global Information System (GIS): Geographical concepts and terminology, advantages, basic components of GIS, data types, GIS analysis, Applications of GIS.	

Contribution to Outcomes

On completion of the course, the students will be able to determine the distance in the field using tachometry and other modern survey instruments, using the same for preparation of drawings such as contour plans, 'L' section and 'C' section. Students apply this knowledge to use the modern surveying instruments in the field effectively for setting out civil engineering works such as culverts, tunnels, bridges, curves etc. accurately. The students will be updated with the knowledge of G.P.S., G.I.S. and remote sensing techniques.

Theory examination:

1. The question paper will comprise of **six** questions; each carrying 20 marks.
2. The **first** question will be **compulsory** and will have 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 the entire syllabus. For this, the modules 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. The students will have to attempt **any three** questions out of remaining five questions.
5. Total **four** questions need to be attempted.

Oral/ Practical Examination: Oral examination in conjunction with the Practical Examination will be conducted based on entire syllabus and term work.

List of Practicals:

1. To find the constants of a tachometer and to verify filed distances.
2. Height and distance problems in tachometric surveying.
3. To set out circular curve by linear methods.
4. To set out circular curve by angular methods.
5. Use of theodolite for one plane and two plane methods.
6. Study of modern surveying instruments.
7. Determination of horizontal and vertical distances using total stations.
8. Setting out a simple foundation plan in the field

Term Work:

- It shall consists of three A-1 size drawing sheets comprising of longitudinal section and cross sections, block contouring and tachometric surveying based on minimum three days survey camp at locations fulfilling the ideal site conditions, plotting of a contour plan on computer using suitable software.
- The assignments shall comprise of the minimum 20 problems covering the entire syllabus divided properly module wise.

Distribution of the Term Work Marks:

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

Recommended Books:

1. Surveying and Levelling: Vol-I and Vol.-II, *Kanetkar and Kulkarni*, Pune Vidyarthi Griha, Pune.
2. Surveying and Levelling: *N. N. Basak,* Tata McGraw Hill New Delhi.
3. Surveying: *R. Agor*, Khanna Publishers.
4. Surveying: Vol-I: *Dr K.R. Arora*, Standard Book House.
5. Surveying and Levelling (2^{nd} Edition): *R. Subramanian*, Oxford Higher Education.
6. Surveying and levelling (Vol.-II & III): *Dr. B.C. Punmia,* Laxmi Publications.
7. Higher Surveying: *Dr. A. M.Chandra*, *New* Age International Publishers.

Semester IV

Subject Code	Subject Name	Credits
CE –C 403	Structural Analysis-I	6

Teaching Scheme

Contact Hours			Credits Assigned			
Theory	Practical	Tutorial	Theory	Practical	Tutorials	Total
05	02	-	05	01	-	06

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. Most of the structures which are analyzed for finding its structural response which would form the basis for its structural design are indeterminate structure. Notwithstanding, the structural analysis of any civil engineering structural systems idealizing the same as the statically determinate one shall be the foundation of the analysis of the indeterminate structures. The knowledge gained in the subjects such as engineering mechanics and strength of materials in the preceding semesters where students have been exposed to the principles of engineering mechanics and subsequently, its application on the materials and solids to study its behaviour under the action of loads and further to evaluate its strength properties, is extended in this subject for the analysis of various structural systems such as beams, frames, arches and suspension bridges.

Objectives

- To analyze the statically determinate simple portal frame (both- rigid jointed and having an internal hinges).
- To study the methods and evaluating rotation and displacement parameters in respect of beams and frames using various methods.
- To analyze the three hinged arches; and cables, suspension bridges and three hinged stiffening girder.

- To study the buckling behavior of the axially and transversely loaded beam-columns and its analyses.
- To understand the concept and behavior of the beam and trusses under rolling loads and subsequently, to obtain the absolute maximum bending moment.
- To understand the concept of unsymmetrical bending and shear centre and its application in solving the problems of structural mechanics.

Detailed Syllabus

Module	Sub- Modules/ Contents	Periods
I	**1. Axial force, shear force and bending moment**	7
	Axial force, shear force and bending moment diagrams for statically determinate frames with and without internal hinges.	
	2. General theorems and its application to simple structures	3
	Theorems related to elastic structures, types of strain energy in elastic structures, complementary energy, principle of virtual work, Betti's and Maxwell's reciprocal theorems, Castigliano's first theorem, principle of superposition. Application of Energy Approach to evaluate deflection in simple structures such as simple beams, portal frame, bent and arch type structures, etc.	
II	**3. Deflection of Statically Determinate Structures Using Geometrical Methods**	09
	Deflection of cantilever, simply supported and overhanging beams for different types of loadings using-Integration Approach including Double Integration method and Macaulay's Method, Geometrical Methods including Moment area method and Conjugate beam method.	
III	**4. Deflection of Statically Determinate Structures Using Methods Based on Energy Principle**	10
	4.1 Application of Unit Load Method (Virtual Work Method/ Dummy Load Method) for finding out slope and deflection in beams. Application of Strain Energy Concept and Castigliano's Theorem for finding out deflection in such structures.	
	4.2 Application of Unit Load Method (Virtual Work Method) for finding out deflection of rigid jointed frames. Application of Strain Energy Concept and Castigliano's Theorem for finding out deflection in such frames.	
	4.3 Application of Unit Load Method (Virtual Work Method/ Dummy Load Method) for finding out deflection in pin jointed frames (trusses). Application of Strain Energy Concept and Castigliano's Theorem for finding out	

	deflection in trusses.	
IV	**5. Rolling Load and Influence Lines for Statically Determinate Structures**	**14**
	Influence lines for cantilever, simply supported, overhanging beams and pin jointed truss including warren truss, criteria for maximum shear force and bending moment, absolute maximum shear force and bending moment under moving loads (UDL and Series of point loads) for simply supported girder.	
V	**6. Elastic Arches**	**6**
	Determination of normal thrust, radial shear and bending moment for parabolic and circular (semi/segmental) three hinged arches, Influence lines for normal thrust, radial shear and bending moment for three hinged parabolic arch.	
	7. Cables, Suspension bridges and Three Hinged Stiffening Girder	**6**
	Simple suspension cable, different geometries of cables, minimum and maximum tension in the cable supported at same/different levels, anchor cable, suspension cable with three hinged stiffening girder.	
VI	**8. Struts**	**4**
	Struts subjected to eccentric loads, Secant formula, Perry's formula, struts with initial curvature, laterally loaded strut (beam-column)	
	9. Unsymmetrical bending	**4**
	Product of inertia, principal moment of inertia, flexural stresses due to bending in two planes for symmetrical sections, bending of unsymmetrical sections.	
	10. Shear Centre	**4**
	Shear centre for thin walled sections such as channel, tee, angle section and I-section.	

Contribution to Outcomes

On completion of this course, the students will be able to understand the behaviour of various statically determinate structures including compound structures having an internal hinges for various loadings. They will be able to analyze these structures to find out the internal forces such as axial force, shear force, bending moment, twisting moments, etc. The students shall be able to evaluate the displacements / deflections in beams and frames under the action of loads. They will be able to obtain the response of the beams under the action of moving loads. They will be able to analyze the structures such as arches and suspension bridges and study the behaviour of eccentrically loaded columns. The students shall demonstrate the ability to extend the knowledge gained in this subject in the subjects *Structural Analysis-II* and elective subjects such as *Advanced Structural Analysis* and *Advanced Structural Mechanics* in the higher years of their UG programme where they will be dealing with the indeterminate structures. The knowledge gained in this subject shall also be useful for application in the structural design in later years.

Theory examination:

1. The question paper will comprise of **six** questions; each carrying 20 marks.
2. The **first** question will be **compulsory** and will have 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 the entire syllabus. For this, the modules 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. 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 based on 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 sub-modules and contents thereof further.

Distribution of the Term Work Marks:

The marks of the term work shall be judiciously awarded depending upon the quality of the term work. The final certification and acceptance of term work warrants the satisfactory and appropriate completion of the assignments.

Recommended Books:

1. Basic Structural Analysis: *C.S. Reddy*, Tata McGraw Hill New Delhi.
2. Mechanics of Structures: Vol-I: *S. B. Junnarkar and H.J. Shah*, Charotar Publishers, Anand.
3. Analysis of Structures: Vol. I and II, *Vazirani and Ratwani*
4. Strength of Materials*: S. Ramamrutham,* Dhanpatrai and Publishers, Delhi
5. Theory of Structures: *S. Ramamrutham,* Dhanpatrai and Sons, Delhi
6. Strength of Materials*: Rajput*, S. Chand Publications, Delhi
7. Structural Analysis: *Bhavikatti*, Vikas publisher house Pvt, ltd.
8. Structural Analysis: *Devdas Menon*, Narosa Publishing House.

9. Basic Structural Analysis: K*.U. Muthu, Azmi Ibrahim, M. Vijyanand, Maganti Janadharnand. I.K.* International Publishing House Pvt. Ltd.
10. Comprehensive Structural Analysis: Vol-I and II by *Vaidyanathan R. and Perumal R.* Laxmi Publications.
11. Elementary Structural Analysis: *Jindal*
12. Structural Analysis: *L.S. Negi and R.S. Jangid,* Tata Mc-Graw Hill India
13. Fundamentals of Structural Analysis: *Sujit Kumar Roy and Subrota Chakrabarty*, S. Chand Publications.
14. Structural Analysis: *T.S. Thandavamoorthy*, Oxford University Press.
15. Structural Analysis: *Manmohan Das, Bharghab Mohan* Pentice Hall International.

Reference Books:

16. Structural Analysis: *Hibbler*, Pentice Hall International.
17. Structural Analysis: *Chajes*, ElBS London.
18. Theory of Structures: *Timoshenko and Young*, Tata McGraw Hill New Delhi.
19. Structural Analysis: *Kassimali*, TWS Publications.
20. Element of Structural Analysis: *Norries and Wilbur*, McGraw Hill.
21. Structural Analysis: *Laursen H.I,* McGraw Hill Publishing Co.
22. Structural theorem and their application: *B.G. Neal*, Pergaman Press.
23. Fundamentals of Structural Analysis: *K.M. Leet*, C.M. Uang and A.M. Gilbert, Tata McGraw Hill New Delhi.
24. Elementary theory of Structures: *Hseih*, Prentice Hall.
25. Fundamentals of Structural Analysis: Harry H. W. and Louis F. G., Wiley India

Semester IV

Subject Code	Subject Name	Credits
CE –C 404	Building Design and Drawing-I	3.5

Teaching Scheme

Contact Hours			Credits Assigned			
Theory	Practical	Tutorial	Theory	Practical	Tutorials	Total
02	03	-	02	1.5	-	3.5

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	04 Hrs.	25	-	25#	150

Rationale

The complete knowledge of planning, designing and drawing of any civil engineering structure including residential buildings such as bungalows, apartments, pent house, row house, etc. in rural as well as urban areas is essential for civil engineering students. These structures include load bearing and framed structures. The students ought to know the theory and principles of planning, various building bye-laws, local development and control rules. The subject involves preparation and interpretation of different types of drawings such as line plan, working drawings, submission drawings including various components (plan, elevation, section, foundation details) thereof along with allied details such as technical specifications, construction notes, layout for service lines. The interpretation of civil engineering drawings including building drawing is also important while working in the field. This subject imparts the knowledge of the concept and all the aspect including the various bye-laws and rules related with the functional planning, design and drawing of residential buildings.

Objectives

1. To understand the concept, aspects, principles of planning; and designing of building structures.
2. To understand the various extant building bye-laws framed by the various authorities, development and control rules satisfying orientation, zoning and functional requirements for different types of building structures.

3. To study the provisions made in the relevant Indian Specifications pertaining to the practice for architectural drawings.
4. To understand the various components of different types of civil engineering structures and drawings along with allied contents thereof and further, interpretation thereof.
5. To prepare various types of drawings for the building structures planned and designed satisfying the functional and market requirements.

Detailed Syllabus

Module	Sub-Modules/Contents		Periods
I.	Classification of structure i) Load bearing structure ii) Framed structure iii) Composite structure		**02**
II.	Study of different types of staircases for residential buildings. Study of working drawing of components of G+1 buildings: i) Stepped wall footing and isolated RCC column footing, ii) Framed and paneled doors and flush doors, iii) Casement window, half paneled and half-glazed window, iv) Dog legged staircase.		**04**
III.	**(1)**	Classification of buildings according to NBC-2005.	**07**
	(2)	Principles of civil engineering planning and aspect diagram.	
	(3)	Study of building bylaws as per NBC-2005 and local D.C rules.	
	(4)	Study of IS 962- Code of practice for architectural drawings.	
	(5)	Study of sun path diagram, Circulation diagrams and sun shading devices.	
	(6)	Orientation of buildings, setting out of foundation of simple residential building.	
IV.	Functional planning and design of residential building as per type of structure, owner's requirements, principles of planning, local byelaws and D C rules. Calculation of setback distances, carpet area, built-up area/floor area and Floor Space Index (FSI).		**08**
	Preparation of line plan for residential structures of all types such as bungalows, row houses, duplex, apartment houses etc., Development of floor plan, elevations, sections, schedule of openings and construction notes/specifications for the given line plan of residential buildings such as for: i) Individual building/Apartments/Row House/Penthouse/Duplex house.		

	ii) Two storied building. Drawing of furniture details of one/two rooms of the building planned.	
V.	Method of preparing working drawings for residential structures such as bungalows and/or apartment houses as per building bylaws, principles of planning, code of practice for architectural drawings -IS 962, and related causes of local D.C rules.	**03**
VI.	For a given line diagram, preparation of water supply, sanitary and electrical layouts.	**02**

Contribution to Outcomes

On successful completion of the course work, the students shall be able to understand the principles of planning and designing the residential buildings. The students shall get acquainted with the various extant bye-laws and development and control rules of the local authorities besides the provisions made in the relevant Indian specifications meant for practice for architectural drawings. They will demonstrate the ability to plan the buildings according to the requirements, design the various components involved therein by keeping all the principles of planning and following the extant bye-laws and rules of the local authorities. They will further demonstrate the ability of preparing different types drawings showing all the details therein.

Theory examination:

1. The question paper will comprise of **six** questions; each carrying 20 marks.
2. The **first** question will be **compulsory** and will have question/s on the theoretical portion covering the entire syllabus.
3. The remaining five questions will be based on all the modules of the entire syllabus. For this, the modules 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. These five questions shall be on planning, designing and drawing of residential buildings/ structures (framed/ load bearing) like ground floor plan, first floor plan, elevations, sections, site plan, foundation plan, details of foundations, roof plan/ terrace plan; planning, designing and drawing of staircase; drawing of constructional details of doors and windows used for residential buildings.
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:

There shall be Oral Examination in conjunction with the Sketching Examination. The oral examination shall be based on the entire syllabus and term work.

List of Practicals/Site Visit:

1. Planning and drawings of different residential buildings.
2. Report writing on the buildings that is planned and drawn by the students.

Term Work:

The term work shall consist of report on planning and design of two residential buildings (one designed as load bearing structure with pitched roof, single storied structure and the other shall be designed as RCC framed structure having ground plus one upper floor).

A-1 size drawing sheets (maximum two), drawn independently for the afore-mentioned structures, showing details drawn to scale as per standard practice, site plan, floor plan, elevation , sections, door and window schedule and construction notes.

One A-1 size drawing sheet drawn for one of the two structures designed as mentioned above, showing following details drawn to scale as per standard practice: roof plan and its section, foundation plan and its section, stair and its section, typical door and window details including section; and any other specific details.

Distribution of the Term Work Marks:

The marks of the term work shall be judiciously awarded for the various components of the term work and 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 drawing work.

Recommended Books:

1. National Building Code: NBC- 2005, BIS, New Delhi.
2. IS 962- Code of practice for architectural drawings: BIS, New Delhi.
3. Building Drawing: *M.G Shah, C. M. Kale, S.Y Patki*, Tata McGraw Hill, Delhi.
4. Civil Engineering Drawing: *M. Chakraborty*, Monojit Chakraborty publication Kolkata.
5. Building drawing and detailing: *B T S Prabhu, K.V Paul and C. Vijayan*. SPADES Publication Calicut.
6. Planning and designing buildings: *Y.S Sane*, Modern Publication House Pune.
7. Building Planning: *Gurucharan Singh*, Standard Publishers & distributors, New Delhi.

Semester IV

Subject Code	Subject Name	Credits
CE –C 405	Concrete Technology	4

Teaching Scheme

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

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

Basic concept of concrete technology is essential for civil engineering students to execute the civil engineering projects as per the standard laid down time to time. The concrete technology is the backbone of infrastructure of civil engineering field. The students must know various concreting operations and testing operations during and after construction. It is expected to know the properties of materials, especially concrete and to maintain quality in construction projects. The civil engineering students ought to know the selection of materials, its mix proportioning, mixing, placing, compacting, curing and finishing.

Objectives

- To study the properties of fresh and hardened concrete.
- To study the properties such as workability, durability and porosity.
- To acquaint the practical knowledge by experimental processes of various materials required for concrete
- To implement the knowledge of high strength and high performance concrete used in various civil engineering structures.
- To understand the concept and optimization of mix design for different environmental conditions.

Detailed Syllabus

Module		Sub-Modules/Contents	Periods
I.	**1. Ingradients of concrete**		**06**
	1.1	**Cement**	
		Physical properties of cement as per IS Codes, types of cements and their uses.	
	1.2	**Aggregates**	
		Properties of coarse and fine aggregates and their influence on properties of concrete, properties of crushed aggregates.	
II.	**2. Concrete**		**08**
	2.1	Grades of concrete, Manufacturing of concrete, importance of w/c ratio.	
	2.2	Properties of fresh concrete- workability and factors affecting it, consistency, cohesiveness, bleeding, segregation.	
	2.3	Properties of hardened concrete- Compressive, Tensile and Flexural strength, Modulus of Elasticity, Shrinkage and Creep.	
	2.4	Durability- Factors affecting durability, Relation between durability and permeability, laboratory tests on durability such as Permeability test, Rapid chloride penetration test.	
	2.5	Concreting in extreme weather conditions, under-water concreting.	
III.	**Concrete mix design**		**05**
	Mix design for compressive strength by I.S. method, Mix design for flexural strength, Method of determining compressive strength of accelerated-cured concrete test specimens as per IS:9013-2004		
IV.	**High performance and High strength concrete**		**06**
	Constituents of high performance and high strength concrete, various tests and their applications.		
	Admixtures		
	Plasticizers, Super-plasticizers, Retarders, Accelerators, Mineral admixtures and other admixtures, test on admixtures, chemistry and compatibility with concrete.		
V.	**Special concretes**		**08**
	Light weight concrete, High density concrete, No fines concrete, Fiber reinforced concrete, Polymer concrete-types, Ferrocement, Shotcrete, Self compacting concrete, Reactive powder concrete, Bendable concrete, Bacterial concrete, Roller compacted concrete, Translucent concrete.		

	Ready mix concrete	
	Advantages of RMC, components of RMC plant, distribution and transport, handling and placing, mix design of RMC.	
VII	**Non-Destructive testing of concrete**	**07**
	Hammer test, ultrasonic pulse velocity test, load test, carbonation test, ½ cell potentiometer test, core test and relevant provisions of I.S. codes.	
	Repairs and rehabilitation of concrete structures	
	Distress in concrete structures, causes and prevention, damage assessment procedure, crack repair techniques , concept of retrofitting	

Contribution to Outcomes

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

- Identify the properties of ingredients of concrete
- Know the properties of wet concrete, hardened concrete, high strength and high performance concrete
- Design the concrete mix for various grades
- Get acquainted with the various types of special concrete
- Perform various test on concrete
- Execute concreting in extreme weathers and under water

Theory examination:

1. The question paper will comprise of **six** questions; each carrying 20 marks.
2. The **first** question will be **compulsory** and will have 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 the entire syllabus. For this, the modules 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. 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 on the entire syllabus and the report of the experiments conducted by the students including assignments.

List of Practicals *(Any Eight to be performed)*:

1. Effect of w/c ratio on workability (slump cone, compaction factor, V-B test, flow table)
2. Effect of w/c ratio on strength of concrete,
3. Mix design in laboratory.
4. Modulus of rupture of concrete.
5. Study of admixtures and their effect on workability and strength of concrete
6. Secant modulus of elasticity of concrete and indirect tensile test on concrete
7. Permeability test on concrete.
8. Rapid chloride penetration test
9. Tests on polymer modified concrete/mortar.
10. Tests on fiber-reinforced concrete.
11. Non destructive testing of concrete- some applications (hammer, ultrasonic)

Industrial/ Site Visit:

At least one visit shall be arranged to the plant or industry such as RMC plant, cement manufacturing industry, stone quarry. A visit may also be arranged to the site involving repairs and rehabilitation of concrete structures. The students shall prepare detail report of the visit and this report shall 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 (at least eight) and ten assignments covering the entire syllabus divided properly module wise.

Distribution of the Term Work Marks:

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

Recommended Books:

1. Concrete Technology: *A. R. Shanthakumar*, Oxford University Press.
2. Concrete Technology Theory and Practice: *Shetty M.S.*, S. Chand.
3. Properties of concrete: *Neville*, Isaac Pitman, London.
4. Relevant I.S. codes: Bureau of Indian standard.
5. Special Publication of ACI on Polymer concrete and FRC.
6. Proceedings of International Conferences on Polymer Concrete and FRC.

7. Concrete Technology: *Gambhir M.L.*, Tata McGraw Hill, New Delhi.
8. Concrete Technology: *Neville A.M. & Brooks*. J. J., ELBS-Longman.
9. Chemistry of Cement and Concrete: *F.M. Lue*, Edward Arnold, 3rd Edition, 1970.
10. Concrete Technology: *D.F. Orchardi*, Wiley, 1962.
11. Tentative Guidelines for cement concrete mix design for pavements (IRC: 44-1976): Indian Road Congress, New Delhi.
12. Repairs and Rehabilitation – Compilation from Indian congress Journal: ACC Pub.
13. Method making, curing and determining compressive strength of accelerated-cured concrete test specimens as per IS: 9013-2004.
14. Concrete mix proportioning-guidelines (IS 10262:2009).

Semester IV

Subject Code	Subject Name	Credits
CE-C 406	Fluid Mechanics-II	4

Teaching Scheme

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

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

The course introduces the fluid flow science, problems and their applications in varied conditions. The study dealt with the characteristics of fluid flow in pipes namely compressible, laminar and turbulent with their applications in detail.

Objectives

1. To understand the pipe flow problem, losses incurred transmission of power through pipe and nozzle.
2. To study and analyze the pipe network which will help to design water supply schemes.
3. To study compressible, laminar, turbulent flows and its significance.
4. To understand the importance and use of Moody's diagram.

Detailed Syllabus

Module	Sub- Modules/ Contents		Periods
I.	**1. Flow Through Pipes**		**10**
	1.1	Loss of head through pipes, Darcy-Weisbach equation, minor and major losses.	
	1.2	Hydraulic gradient line and energy gradient line, pipes in series, equivalent pipes, pipes in parallel, flow through laterals, flow through branched pipes,	

		three reservoir problem, siphon.	
II.	**2. Flow Through Nozzles**		**05**
	Power transmitted through nozzle, condition for maximum power transmitted, diameter of nozzle for maximum transmission of power.		
III.	**3. Pipe Network and Water Hammer**		**04**
	Hardy cross method, water hammer in pipes-Gradual closure and instantaneous closure of valve, control measures.		
IV.	**4. Compressible Flow**		**04**
	4.1	Basic equation of flow (elementary study), velocity of sound or pressure wave in a fluid, Mach number, propagation of pressure waves, area-velocity relationship,	
	4.2	Stagnation properties and compressible fluid through discharge measuring devices.	
V.	**5. Laminar Flow**		**07**
	5.1	Reynolds experiment, critical velocity, laminar flow through circular pipes, annulus, and flow between two parallel plates: stationary and moving.	
	5.2	Flow through porous media, kinetic energy correction factor, and momentum correction factor. Dash pot mechanism.	
VI.	**6. Turbulent Flow Through Pipes**		**09**
	6.1	Causes of turbulence, shear stress in turbulent flow, Prandtl's mixing length theory,	
	6.2	Hydro dynamically smooth and rough pipes, velocity distribution in smooth and rough pipes, Karman-Prandtl velocity distribution equation.	
	6.3	Resistance to flow in smooth and rough pipes, resistance equation and Moody's diagram.	

Contribution to Outcomes

On successful completion of the course, the students will demonstrate the ability to:

- Solve problems of pipe flow, to understand the concept of water hammer.
- Enable to solve pipe network problems by Hardy cross method.
- Study of compressible flow and their applications; and solve the problems based on compressible fluid flow.

- Study the concept of laminar and turbulent flow and their applications; and further, solve the problems based on laminar and turbulent flows.

Theory examination:

1. The question paper will comprise of **six** questions; each carrying 20 marks.
2. The **first** question will be **compulsory** and will have 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 the entire syllabus. For this, the modules 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. 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 on the entire syllabus and the report of the experiments conducted by the students including assignments.

List of Practicals (Any six experiments to be performed):

1. Reynold's Experiment
2. Determination of viscosity of fluid
3. Friction loss through pipes
4. Minor losses through pipes
5. Laminar flow through pipes
6. Velocity distribution in circular pipes
7. Turbulent flow through pipe
8. Water Hammer phenomenon

Term Work:

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

Distribution of the Term Work Marks:

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

Recommended Books:

1. Hydraulics and Fluid mechanics: *Dr P.M. Modi and Dr. S.M. Seth*, Standard book House, Delhi
2. Theory and Application of Fluid Mechanics: *K. Subramanya,* Tata McGraw hill publishing company, New Delhi.
3. Fluid Mechanics: *Dr. A.K Jain,* Khanna Publishers.
4. Fluid Mechanics and fluid pressure engineering: *Dr. D.S. Kumar, F.K. Kataria* and *sons*
5. Fluid Mechanics and Hydraulics: *Dr. S. K. Ukarande*, Ane Books Pvt. Ltd. (Revised Edition, 2012), ISBN 97893 8116 2538
6. Fluid Mechanics: *R.K. Bansal* Laxmi Publications (P) Ltd.
7. Fluid Mechanics and Machinery: *C.S.P. Ojha, R. Berndtsson and P.N. Chandramouli*. Oxford Higher Education.

Reference Books:

1. Fluid Mechanics: *Frank M. White,* Tata Mc-Graw-Hill International edition.
2. Fluid Mechanics: *Streeter White Bed ford*, Tata McGraw International edition.
3. Fluid Mechanics with engineering applications: *R.L. Daugherty,J.B. Franzini,E.J., Finnemore*,Tata McGraw Hill New Delhi.
4. Hydraulics: *James F. Cruise, Vijay P. Singh and Mohsen M. Sherif* , CENGAGE Learning India Pvt. Ltd., Delhi.