CHARUSAT
CHAROTAR UNIVERSITY OF SCIENCE AND TECHNOLOGY

ACADEMIC REGULATIONS & SYLLABUS

Faculty of Technology & Engineering

Bachelor of Technology Programme
(Fourth Year Civil Engineering)
Effective From 2019-20

Education Campus – Changa, (ECC), hitherto a conglomerate of institutes of professional education in Engineering, Pharmacy, Computer Applications, Management, Applied Sciences, Physiotherapy and Nursing, is one of the choicest destinations by students. It has been transformed into **Charotar University of Science and Technology (CHARUSAT)** through an Act by Government of Gujarat. CHARUSAT is permitted to grant degrees under Section-22 of UGC- Govt. of India.

The journey of CHARUSAT started in the year 2000, with only 240 Students, 4 Programmes, one Institute and an investment of about Rs. 3 Crores (INR 30 million). At present there are seven different institutes falling under ambit of six different faculties. The programmes offered by these faculties range from undergraduate (UG) to Ph.D degrees including M.Phil. These faculties, in all offer 64 different programmes. A quick glimpse in as under:

Faculty	Institute	Programmes Offered
Faculty of Technology & Engineering	Charotar Institute of Technology	B. Tech M. Tech MTM Ph.D.
Faculty of Pharmacy	Ramanbhai Patel College of Pharmacy	B. Pharm M. Pharm MPM PGDCT/ PGDPT Ph.D.
Faculty of Management Studies	Indukaka Ipcowala Institute of Management	M.B.A PGDM Dual Degree BBA+MBA Ph.D.
Faculty of Computer Applications	Smt. Chandaben Mohanbhai Patel Institute of Computer Applications	M.C.A/MCAL M.Sc. (IT) Dual Degree BCA+MCA Ph. D

Faculty of Applied Sciences	P. D. Patel Institute of Applied Sciences	M.Sc. Dual Degree B.Sc. + M.Sc. Ph.D.
Faculty of Medical Sciences	Ashok and Rita Institute of Physiotherapy Manikaka Topawala Institute of Nursing Charotar Institute of Paramedical Sciences	B.PT M.PT Ph.D. B.Sc. (Nursing) M.Sc. PGDHA PGDMLT GNM Ph.D.

The development and growth of the institutes have already led to an investment of over Rs. 125 Crores (INR 1250 Million). The future outlay is planned with an estimate of Rs. 250 Crores (INR 2500 Million).

The University is characterized by state-of-the-art infrastructural facilities, innovative teaching methods and highly learned faculty members. The University Campus sprawls over 105 acres of land and is Wi-Fi enabled. It is also recognized as the Greenest Campus of Gujarat.

CHARUSAT is privileged to have 360 core faculty members, educated and trained in IITs, IIMs and leading Indian Universities, and with long exposure to industry. It is also proud of its past students who are employed in prestigious national and multinational corporations.

From one college to the level of a forward-looking University, **CHARUSAT** has the vision of entering the club of premier Universities initially in the country and then globally. High Moral Values like **Honesty, Integrity and Transparency** which has been the foundation of ECC continues to anchor the functioning of **CHARUSAT**. Banking on the world class infrastructure and highly qualified and competent faculty, the University is expected to be catapulted into top 20 Universities in the coming five years. In order to align with the global requirements, the University has collaborated with internationally reputed organizations like Pennsylvania State University – USA, University at Alabama at Birmingham – USA, Northwick Park Institute –UK, ISRO, BARC, etc.

CHARUSAT has designed curricula for all its Programmes in line with the current international practices and emerging requirements. Industrial Visits, Study Tours, Expert Lectures and Interactive IT enabled Teaching Practice form an integral part of the unique **CHARUSAT** pedagogy.

The Programmes are credit-based and have continuous evaluation as an important feature. The pedagogy is student-centered which augurs well for self-learning and motivation for enquiry and research, and contains innumerable unique features like:

- Participatory and interactive discussion-based classes.
- Sessions by visiting faculty members drawn from leading academic institutions and industry.
- Regular weekly seminars.
- Distinguished lecture series.
- Practical, field-based projects and assignments.
- Summer training in leading organizations under faculty supervision in relevant Programmes.
- Industrial tours and visits.
- Extensive use of technology for learning.
- Final Placement through campus interviews.

Exploration in the field of knowledge through research and development and comprehensive industrial linkages will be a hallmark of the University, which will mould the students for global assignments through technology-based knowledge and critical skills.

The evaluation of the student is based on grading system. A student has to pursue his/her Programme with diligence for scoring a good Cumulative Grade Point Average (CGPA) and for succeeding in the chosen profession and life.

CHARUSAT welcomes you for a Bright Future

CHAROTAR UNIVERSITY OF SCIENCE AND TECHNOLOGY
Accredited with Grade A by NAAC,
Accredited with Grade A by KCG

Faculty of Technology and Engineering

ACADEMIC REGULATIONS

Bachelor of Technology (Civil Engineering) Programme

Charotar University of Science and Technology (CHARUSAT)
CHARUSAT Campus, At Post: Changa – 388421, Taluka: Petlad, District: Anand
Phone: 02697-247500, Fax: 02697-247100, Email: info@charusat.ac.in
www.charusat.ac.in

Academic Year – 2019-20

CHARUSAT

FACULTY OF TECHNOLOGY AND ENGINEERING
ACADEMIC REGULATIONS
Bachelor of Technology Programmes

To ensure uniform system of education, duration of undergraduate and post graduate programmes, eligibility criteria for and mode of admission, credit load requirement and its distribution between course and system of examination and other related aspects, following academic rules and regulations are recommended.

- ***System of Education***

  The Semester system of education should be followed across the Charotar University of Science and Technology (CHARUSAT) both at Undergraduate and Master's levels. Each semester will be at least of 90 working days duration. Every enrolled student will be required to take a specified load of course work in the chosen subject of specialization and also complete a project/dissertation if any.

- ***Duration of Programme***

  Undergraduate programme (B. Tech.)

Minimum	8 semesters (4 academic years)
Maximum	12 semesters (6 academic years)

- ***Eligibility for Admissions***

  As enacted by Govt. of Gujarat from time to time.

- ***Mode of Admissions***

  As enacted by Govt. of Gujarat from time to time.

- ***Programme Structure and Credits***

  As per Annexure – I attached

- *Attendance*

  All activities prescribed under these regulations and enlisted by the course faculty members in their respective course outlines are compulsory for all students pursuing the courses. No exemption will be given to any student regarding attendance except on account of serious personal illness or accident or family calamity that may genuinely prevent a student from attending a particular session or a few sessions. However, such unexpected absence from classes and other activities will be required to be condoned by the Principal.

  Student's attendance in a course should be 80%.

- *Course Evaluation*

7.1 The performance of every student in each course will be evaluated as follows:

7.1.2 Internal evaluation by the course faculty member(s) based on continuous assessment, for 30% of the marks for the course; and

7.1.3 Final examination by the University through modes such as; written paper or practical test or oral test or presentation by the student or a combination of any two or more of these, is set to 70% of the marks for each the course.

7.2 Internal Evaluation

As per Annexure – I attached

7.3 University Examination

The final examination by the University for 70% of the evaluation for the course will be through written paper or practical test or oral test or presentation by the student or a combination of any two or more of these.

7.4 In order to earn the credit in a course a student has to obtain grade other than FF.

7.5 Performance at Internal & University Examination

7.5.1 Minimum performance with respect to internal marks as well as university examination will be an important consideration for passing a course.
Details of minimum percentage of marks to be obtained in the examinations (internal/external) are as follows:

Minimum marks in University Exam per course	Minimum marks Overall per course
40%	45%

7.5.2 A student failing to score 40% in the final examination will get an FF grade.

7.5.3 If a candidate obtains minimum required marks in each course but fails to obtain minimum required overall marks, he/she has to repeat the university examination till the minimum required overall marks are obtained.

- *Grading*

8.1 The total of the internal evaluation marks and final University examination marks in each course will be converted to a letter grade **on** a ten-point scale as per the following scheme:

Table: Grading Scheme (UG)

Range of Marks (%)	≥80	<80 ≥73	<73 ≥66	<66 ≥60	<60 ≥55	<55 ≥50	<50 ≥45	<45
Corresponding Letter Grade	AA	AB	BB	BC	CC	CD	DD	FF
Numerical point (Grade Point) corresponding to the letter grade	10	9	8	7	6	5	4	0

8.2 The student's performance in any semester will be assessed by the Semester Grade Point Average (SGPA). Similarly, his/her performance at the end of two or more consecutive semesters will be denoted by the Cumulative Grade Point Average (CGPA). The SGPA and CGPA are calculated as follows:

(i) SGPA = $\Sigma C_i G_i / \Sigma C_i$ where,
C_i= Number of credits of course i
G_i = Grade Point for the course i
i = 1 to n
n = number of courses in the semester

(ii) CGPA = $\Sigma C_i G_i / \Sigma C_i$ where,
C_i = Number of credits of course i
G_i = Grade Point for the course i
i = 1 to n
n = number of courses of all semesters up to which CGPA is computed

(iii) No student will be allowed to move further in next semester if CGPA is less than 3 at the end of an academic year.

(iv) A student will not be allowed to move to third year if he/she has not cleared all the courses of first year.

(v) A student will not be allowed to move to fourth year if he/she has not cleared all the courses of second year.

9. Award of Degree

9.1 Every student of the programme who fulfils the following criteria will be eligible for the award of the degree:

9.1.1 He/ She should have earned minimum required credits as prescribed in course structure; and

9.1.2 He/ She should have cleared all internal and external evaluation components in every course; and

9.1.3 He/ She should have secured a minimum **CGPA of 4.5** at the end of the programme;

9.1.4 In addition to above, the student has to complete the required formalities as per the regulatory bodies, if any.

9.2 The student who fails to satisfy minimum requirement of CGPA will be allowed to improve the grades so as to secure a minimum CGPA for award of degree. Only latest grade will be considered.

10. Award of Class

The class awarded to a student in the programme is decided by the final CGPA as per the following scheme:

Distinction	:	CGPA ≥ 7.5
First class	:	CGPA ≥ 6.0
Second Class	:	CGPA ≥ 5.0

11. Transcript

The transcript issued to the student at the time of leaving the University will contain a consolidated record of all the courses taken, credits earned, grades obtained, SGPA,CGPA, class obtained, etc.

Annexure – I

CHAROTAR UNIVERSITY OF SCIENCE & TECHNOLOGY (CHARUSAT)														
TEACHING & EXAMINATION SCHEME FOR B TECH PROGRAMME IN CIVIL ENGINEERING (CBCS)														
Level	**Course Code**	**Course Title**	**Teaching Scheme**							**Examination Scheme**				
			Contact Hours			Credit				Theory		Practical		Total
			Theory	Practical	Total	Theory	Practical	Project	Total	Internal	External	Internal	External	
Level 4	CL441	Design of Structures – I	4	2	6	4	1		5	30	70	25	25	150
	CL442	Transportation Engineering - II	4	2	6	4	1		5	30	70	25	25	150
	CL443	Environmental Engineering - II	4	2	6	4	1		5	30	70	25	25	150
	CL444	Geotechnical Engineering - II	4	2	6	4	1		5	30	70	25	25	150
	CL445	Summer Internship - II	0	3	3	0	0	3	3			75	75	150
	CL471-476	Programme Elective - III	3	2	5	3	1		4	30	70	25	25	150
					32				**27**					**900**
	CL446	Construction Project Management	3	2	5	3	1		4	30	70	25	25	150
	CL447	Water Resources Engineering - II	3	2	5	3	1		4	30	70	25	25	150
	CL448	Professional Practices	4	2	6	4	1		5	30	70	25	25	150
	CL449	Design of Structures - II	4	2	6	4	1		5	30	70	25	25	150
	CL450	Project	0	5	5	0	0	5	5			75	75	150
	CL481-487	Programme Elective - IV	3	2	5	3	1		4	30	70	25	25	150
					32				**27**					**900**

CONTENTS

B. Tech. (Civil Engineering) Programme

SYLLABI

(Semester – 7)

CHAROTAR UNIVERSITY OF SCIENCE AND TECHNOLOGY

CL441: DESIGN OF STRUCTURES – I
B TECH 7th SEMESTER (CIVIL ENGINEERING)

Credits and Hours:

Teaching Scheme	Theory	Practical	Total	Credit
Hours/Week	4	2	6	5
Marks	100	50	150	

A. Course Objectives:

The objectives of the course are:

- To make the students familiar with the fundamental design concepts of steel and reinforced cement concrete structures.
- To make the students aware with the behavior and design of R.C.C. structural elements, which will be useful in the design of various structures.
- To make the students aware with the behavior and design of Steel structural elements this will be useful in the designing of various structures.

B. Course Outline:

Sr. No	Title of Unit	Minimum number of Hours
	Concrete Element Design	
1	Design of Flexure Members	12
2	Design of Slabs	05
3	Design of Compression Members with/without Bending	05
4	Design of Footings	05
5	Design Concepts of Bunkers and Silos	03
	Steel Element Design	
6	Connections Design	10
7	Design of Tension Members	05
8	Design of Compression Members	05
9	Design of Built-up Column and Column Bases	06
10	Plastic Design of Beam	04

Total Hours (Theory): 60
Total Hours (Lab): 30
Total Hours: 90

C. **Detailed Syllabus:**

Concrete Element Design

1.	**Design of Flexure Members**	**12 Hours**	**20%**
1.1	Methods of design of concrete structures		
1.2	Limit state of collapse: Flexure, Compression, Shear		
1.3	Characteristic and design values & partial safety factors		
1.4	Limit state of serviceability: Deflection, Cracking		
1.5	Basis of design, loads & forces		
1.6	Behaviour of R.C.C. beams under loads		
1.7	Design of singly reinforced sections		
1.8	Design of doubly reinforced sections		
1.9	Design of T- sections		
2.	**Design of Compression Members with/without Bending**	**05 Hours**	**09%**
2.1	Analysis & design of axially loaded short column		
2.2	Design of axially loaded column with uni & bi-axial bending		
3.	**Design of Slabs**	**05 Hours**	**09%**
3.1	Method of slab analysis		
3.2	Design of One-way slab (simply supported)		
3.3	Design of Two-way slab (restrained, simply supported)		
4.	**Design of Footings**	**05 Hours**	**09%**
4.1	Pressure distribution under Footing		
4.2	Design of isolated footing (square & oblong)		
5.	**Design Concepts of Bunkers and Silos**	**03 Hours**	**05%**
5.1	Introduction		
5.2	Difference between Bunker & Silo		
5.3	Concepts of loading and design		

Steel Element Design

6.	**Connections Design**	**10 Hours**	**16%**
	Bolted Connections		
6.1	Bolt as connection, types of bolts, types of bolted joints		
6.2	Load transfer mechanism, failure of bolted joints		
6.3	Bearing type connections		
6.4	Tensile strength of plate		
6.5	Strength and efficiency of the joint		
6.6	Beam – Beam connection, Column – Beam connection, Unstiffened connection		
	Welded Connections		
6.7	Welding processes, welding electrodes, advantages of welding		
6.8	Types and properties of welds, types of Joints		
6.9	Effective area of welds		
6.10	Design of welds, simple joints		
6.11	Moment resistant connections		
6.12	Beam-to-column connections		
7.	**Design of Tension Members**	**05 Hours**	**09%**
7.1	Types of tension members		
7.2	Net sectional area, effective net area, types of failures		
7.3	Design strength of tension members, slenderness ratio		
7.4	Design of tension member		
8.	**Design of Compression Members**	**05 Hours**	**08%**
8.1	Effective length, slenderness ratio, types of sections		
8.2	Types of buckling		
8.3	Column formula, design strength of angle sections, I-section and more		
8.4	Design of axially loaded compression members		
9.	**Design of Built-up Column and Column Bases**	**06 Hours**	**10%**
9.1	Introduction to Built-Up columns		
9.2	Design of Lacing		
9.3	Design of Battening		

9.4 Slab based, Gusseted base foundation

10. Plastic Design of Beam **04 Hours** **05%**

10.1 Plastic Hinge Concept

10.2 Plastic-Collapse Load

10.3 Design of continuous beams and portal frame using plastic design approach.

D. Instructional Method and Pedagogy:

- At the start of course, the course delivery pattern, prerequisite of the subject will be discussed.
- Lectures will be conducted with the aid of multi-media projector, black board, OHP etc.
- Attendance is compulsory in lectures and laboratory.
- Internal exams will be conducted as per pedagogy as a part of internal evaluation.
- Assignments/Surprise tests/Quizzes/Seminar will be conducted as a part of internal theory evaluation.
- The course includes a laboratory, where students have an opportunity to build an appreciation for the concepts being taught in lectures.
- Tutorials related to course content will be carried out in the laboratory.

Term Work:

- Various types of calculative examples and theory will be provided to the students in form of tutorials for the structure design practice.

E. Students Learning Outcomes:

On the successful completion of this course:

- The students will get an idea regarding the fundamentals design concepts of any R.C.C. and Steel structural member.
- The students will be able to design all three types of R.C.C. flexure members like Singly Reinforced, Doubly Reinforced and Flanged Sections.
- The students will be able to understand the design of one-way slab and two-way slabs.

- The students will be able to design the columns with axially loaded with uni-axial and bi-axial bending.
- The students will be able to design of square and oblong isolated footing.
- The students will be able to understand the designing of connections which are really important for the stability and safety of the steel structure.
- The students will be able to design the steel structure members which are either subjected to axial loading or transverse kind of loading.

F. Recommended Study Material:

Text Books:

1. Shah, H.J., Reinforced Concrete Vol-I & II, Charotar Publishing House.
2. Shah, V.L. and Karve, S.R., Limit State Theory and Design of Reinforced Concrete, Structures Publications.
3. Punamia, B.C. and Jain, A.K., R.C.C. Designs (Reinforced Concrete Structures), Laxmi Publications (P) Ltd.
4. Duggal, S.K., Limit State Design of Steel Structures, McGraw Hill Education (P) Ltd, New Delhi.
5. Subramanian, N., Steel Structures: Design and Practice, Oxford University Press.

Reference Books:

1. Variyani and Radhaji, Manual of Limit State Design, CBS Publishers, New Delhi.
2. Pillai, S. and Menon, D., Reinforced Concrete Design, TATA McGraw-Hill.
3. Ramchandra and Gehlot V., Limit State Design of Concrete Structures, Scientific Publishers, India.

Other Materials:

1. IS: 456: Plain and Reinforced Concrete-Code of Practice
2. IS: 875 (Part 1 to 5), Code of Practice for Design Loads
3. IS: 800, General Construction in Steel- Code of Practice
4. SP 16, Design Aids for Reinforced Concrete to IS: 456
5. SP 6, Handbook for Structural Engineers

CL442: TRANSPORTATION ENGINEERING- II
B TECH 7th SEMESTER (CIVIL ENGINEERING)

Credit and Hours:

Teaching Scheme	Theory	Practical	Total	Credit
Hours/Week	4	2	6	5
Marks	100	50	150	

A Objective of the Course:

- To know about the basics and design of various components of railway engineering.
- To study about the types and functions of track, junctions and railway stations.
- To learn about the various characteristics, planning and components of bridges.
- To study about the types and components of tunnels, its alignment and safety in tunnels.
- To understand the fundamentals of planning and design of Airport structures and operations at Airport.
- To make students aware of design of runway and taxiways at Airport.
- To understand the various elements of Harbour and the operations in Harbour.
- To understand the fundamentals of planning and design of various marine structures.

B Outline of the Course:

Sr. No	Title of Unit	Minimum number of Hours
1	Railway Engineering	17
2	Bridge Engineering	12
3	Tunnel Engineering	6
4	Airport Engineering	17
5	Harbour Engineering	8

Total hours (Theory): 60
Total hours (Lab): 30
Total Hours: 90

C Detailed Syllabus:

1	**Railway Engineering**	**17 Hours**	**28%**

1.1 **Introduction**

1.1.1 Development of railways in India

1.1.2 Permanent way and railway track components, Ideal requirement of permanent way, Capacity of railway track, Gauge, Conning of wheels

1.1.3 Rails-function and types of rails, rail sections, defects in rails, creep of rails, rail joints and welding of rails

1.1.4 Sleepers – function, types, spacing and density

1.1.5 Ballast- Function and Types of Ballast material, Sub-ballast

1.1.6 Rail fixtures and Fastenings

1.1.7 Subgrade and embankment

1.2 **Geometric design of railway track**

1.2.1. Gradients

1.2.2. Speed of the trains on curves

1.2.3. Super elevation

1.2.4. Curves

1.2.5. Radius of the curves

1.2.6. Widening on curves

1.3 **Railway Traction, Crossing, Stations, Yards, Signaling and Interlocking**

1.3.1. Railway traction and track resistance, stresses in railway track – rails, sleepers, ballast

1.3.2. Points and crossings – turnouts, switches, crossings

1.3.3. Track junctions – types and salient features

1.3.4. Railway stations - requirements, facilities, classifications, platforms, loops, sidings

1.3.5. Railway yards – types, required equipment in yards

1.3.6. Signaling and control system – Necessity, objectives, classification

1.3.7. Interlocking of signals and points, Mechanical Interlocking devices

1.4 **Railway Track**

1.4.1. Railway track - construction, drainage, maintenance

1.4.2. Recent developments in railways – high speed trains, modernization in track for high speed, Metro rails, Monorail, Maglev Rails, Tube Rails, Automation in operation and control

1.4.3. Safety in railways – accidents and remedial measures

2 Bridge Engineering **12 Hours** **20%**

2.1 **Introduction**

0.0.1 Selection of site

0.0.2 Data collection

0.0.3 Stages of investigation

0.0.4 Waterway calculations

0.0.5 Scours depth, Afflux

0.0.6 Free board, Vertical clearance and economic span.

2.2 **Classification**

2.2.1. Classification of superstructures with respect to structural behavior and material used

2.2.2. Types of substructures, flooring joints, bridge bearings, movable bridges, temporary bridges

2.3 **Construction methods**

2.3.1. Methods of erection of various types of bridges, Superstructures and Substructures

2.4 **Maintenance**

2.4.1. Testing and strengthening of bridges

2.4.2. Equipment used in bridge engineering

3 Tunnel Engineering **06 Hours** **10%**

3.1 **Introduction**

3.1.1. Necessity/Advantage of a tunnel

3.1.2. Classification of Tunnels

3.1.3. Size and shape of a tunnel

3.1.4. Alignment of a Tunnel, Portals and Shafts

3.1.5. Problems in Tunneling

3.2 **Tunneling in Hard Rock**

3.2.1. Sequence of operation

3.2.2. Faces of attack

3.2.3. Methods of tunneling in hard rock

3.3 **Tunneling in Soft Ground**

3.3.1. Types and factors affecting the choice of method to sort ground

3.3.2. Methods of tunneling in soft rocks

3.4 **Lighting, Ventilation and Dust control**

3.4.1. Tunnel Lighting

3.4.2. Ventilation of Tunnel

3.4.3. Methods of Ventilation, Dust control

3.4.4. Drainage of tunnel, Drainage system, Safety

4 Airport Engineering **17 Hours** **28%**

4.1 **Introduction to Airport Engineering**

4.1.1. History and development

4.1.2. Policy of air transport

4.1.3. Air transport authorities, air transport activities

4.1.4. Air crafts and its characteristics

4.1.5. Airport classifications as per ICAO

4.2 **Airport Planning**

4.2.1. Regional planning-concepts and advantages

4.2.2. Requirements of an ideal airport layout

4.2.3. Location and planning of airport as per ICAO and F.A.A. recommendations

4.2.4. Airport Elements -airfield, terminal area, obstructions, approach zone, zoning laws, airport capacity

4.2.5. Airport size and site selection

4.2.6. Estimation of future air traffic & development of new airport

4.3 **Run Way Design**

4.3.1. Wind rose and orientation of runway

4.3.2. Wind coverage and crosswind component

4.3.3. Factors affecting runway length

4.3.4. basic runway length and corrections to runway length

4.3.5. Runway geometrics and runway patterns (configurations)

4.3.6. Runway marking, Threshold limits, Cross section of runway

4.4 **Taxiway Design**

4.4.1. Controlling factors

4.4.2. Taxiway geometric elements, layout, exit taxiway, location and geometrics, holding apron, turnaround facility

4.4.3. Aprons -locations, size, gate positions

4.4.4. Aircraft parking configurations and parking systems

4.4.5. Hanger-site selection

4.4.6. Planning and design considerations

4.4.7. Fuel storage area, blast pads

4.4.8. Wind direction indicator

4.5 **Air Traffic Control and Visual Aids**

4.5.1. Air traffic control objectives, Control system

4.5.2. Control network-Visual aids-landing information system

4.5.3. Airport markings and lighting

5 Harbour Engineering **08 Hours** **14%**

5.1 **Harbour Planning**

5.1.1. Harbour components

5.1.2. Ship characteristics

5.1.3. Characteristics of good harbour and principles of harbour planning

5.1.4. Size of harbour, site selection criteria and layout of harbours

5.1.5. Surveys to be carried out for harbour planning

5.1.6. Natural Phenomena: Wind, waves, tides formation and currents phenomena, their generation characteristics and effects on marine structures, silting, erosion and littoral drift.

5.2 **Marine Structures**

5.2.1. General design aspects & principles

5.2.2. Breakwaters - function, types

5.2.3. Wharves, Quays, Jetties, Piers, Pier heads, Dolphin, Fenders

5.2.4. Mooring accessories – function, types, suitability, design and construction features

5.3 **Docks and Locks**

5.3.1. Tidal basin

5.3.2. Wet docks-purpose, design consideration

5.3.3. Operation of lock gates and passage

5.3.4. Repair docks - graving docks, floating docks

5.4 **Port Amenities and Navigational Aids**

5.4.1. Ferry, transfer bridges, Floating landing stages, Transit sheds, Warehouses, Cold storage, Aprons, Cargo handling equipment

5.4.2. Purpose and general description

5.4.3. Channel and entrance demarcation

5.4.4. Buoys, Beacons, Light house, Electronic communication devices.

D Instructional Method and Pedagogy:

- At the start of course, the course delivery pattern, prerequisite of the subject will be discussed.
- Lectures will be conducted with the aid of multi-media projector, black board, OHP etc.
- Attendance is compulsory in lectures and laboratory.
- Internal exams will be conducted as per pedagogy as a part of internal evaluation.
- Assignments based on course content will be given to the students at the end of each unit/topic and will be evaluated at regular interval.
- Surprise tests/Quizzes/Seminar will be conducted.
- The course includes a laboratory, where students have an opportunity to build an appreciation for the concepts being taught in lectures.

- Experiments/Tutorials related to course content will be carried out in the laboratory.

E Student Learning Outcomes:

The course content should be taught and learning imparted with the aim to develop required knowledge and skills so that the students are able to acquire following competency:

- The students will gain an experience in the implementation of Railway, Bridge, Tunnel, Airport and Harbour Engineering on engineering concepts which are applied in field of Transportation Engineering.
- The students will get a diverse knowledge of Railway, Bridge, Tunnel, Airport and Harbour engineering practices applied to real life problems.
- The students will learn to understand the theoretical and practical aspects of Railway, Bridge, Tunnel, Airport and Harbour engineering along with the design and management applications.

F Recommended Study Material:

Text Books:

1. Satish Chandra and M.M. Agrawal, Railway Engineering, Oxford University Press, New Delhi
2. S.C. Rangwala, K.S. Rangwala and P.S. Rangwala, Principles of Railway Engineering, Charotar Publishing House, Anand.
3. S.P.Bindra, Principles and Practice of Bridge Engineering, Dhanpat Rai &Sons, New Delhi
4. S.C. Saxena, Tunnel Engineering, Dhanpat Rai & Sons, New Delhi
5. Dr. S. K. Khanna, M.G.Arora and S.S. Jain, Airport Planning & Design, Nem Chand & Bros.,Roorkee
6. Airport Engineering, Charotar Publishing House Pvt. Ltd, Anand
7. R. Srinivasan and S. C. Rangwala, Harbour, Dock and Tunnel Engineering, 1995, Charotar Pub.House, Anand

Reference Books:

1. S. C. Saxena And S.P. Arora, A Text Book of Railway Engineering, Dhanpat Rai & Sons, New Delhi
2. D.J. Victor, Essential of Bridge Engineering, Oxford & IBH Pub. Co. Ltd. Mumbai
3. G.V. Rao Airport Engineering, Tata McGraw Hill Pub. Co., New Delhi
4. S. P. Bindra, A Course in Docks and Harbour Engineering, 1992, Dhanpat Rai & Sons, New Delhi
5. Alonzo Def. Quinn, Design and Construction of Ports and Marine Structure, McGraw - Hill Book Company, New York

Web Materials:

1. http://www.cphbooks.com/html/40ae.htm
2. http://as.wiley.com/WileyCDA/WileyTitle/productCd-0471527556.html
3. http://cphbooks.com/html/38re.htm
4. http://books.google.co.in/books?id=Bs_Y9RV05wwC&printsec=frontcover&dq=Railway+engineering&source=bl&ots=HnwsKu3zY&sig=nql0Xqu7zM6qB71HNuWLkNbCk0&hl=en&ei=9B_qTNflK43CvQPesNDCCA&sa=X&oi=book_result&ct=result&resnum=3&ved=0CCwQ6AEwAg#v=onepage&q&f=false

List of Tutorials

Tutorial No.	Name of Tutorials
1	Introduction, Railway Track Gauge, Alignment of Railway lines
2	Track and Track stresses, Rails, Sleeper
3	Ballast, Track fittings, Geometric design of Track
4	Resistance to Traction, Points and crossings, Railway Stations and Yards
5	Signaling and interlocking
6	Bridge –General, Classification of Bridge Construction methods, Maintenance
7	Tunnel-General, Tunneling in Hard Rock, Tunneling in Soft Ground,
8	Lighting, Ventilation , Drainage and safety
9	Layout of Airport, components of airport, authorities of airport
10	Factors affecting runway design , Wind rose diagram, Design of runway
11	Design of taxiway

12	Navigational aids of Airport
13	Components of harbor, Factors affecting the site selection
14	Different natural phenomena and wave actions, Harbour infrastructure

CL443: ENVIRONMENTAL ENGINEERING-II
B TECH 7th SEMESTER (CIVIL ENGINEERING)

Credit and Hours:

Teaching Scheme	Theory	Practical	Total	Credit
Hours/Week	4	2	6	5
Marks	100	50	150	

A Objectives of the Course:

- To understand the role of sanitation in sustainable wastewater management via pollution prevention and its relation to public health and environment.
- To analyze the relevant physical, chemical and biological processes and their mutual relationships within various sanitation components.
- To provide sufficient knowledge in fundamental theory and design of conventional wastewater treatment facilities to contribute to the development of innovative approaches to the provision of adequate and sustainable sanitation services in the country.
- To analyze and design waste management systems beginning with appropriate treatment, reclamation and resource recovery and re-use and to relate the environmental engineering practice with global contemporary issues and professional ethics.

B Outline of the Course:

Sr. No	Title of Unit	Minimum number of hours
1	Sewage: Generation, Collection and Conveyance	08
2	Sewage: Characteristics	10
3	Sewage: Primary Treatment	06
4	Sewage: Secondary Treatment	20
5	Sewage: Tertiary Treatment	03
6	House Drainage & Decentralized Sewage Treatment System	05
7	Solid Waste Management	08

Total hours (Theory): 60
Total hours (Lab): 30
Total Hours: 90

C Detailed Syllabus:

1 Sewage: Generation, Collection and Conveyance **08 Hours** **13%**

1.1 Definitions: sewage, sullage, sewerage, Conservancy and water carriage system

1.2 Introduction to material/mass balance

1.3 Sewer: Shapes and materials of sewers, Design of sewers

1.4 Systems of sewerage and their layouts, 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

1.5 Estimating domestic wastewater discharge

2 Sewage: Characteristics **10 Hours** **17%**

2.1 Sampling of sewage, Analysis of sewage

2.2 Aerobic decomposition, anaerobic decomposition

2.3 Characteristics - physical, chemical, biological

2.4 Standards for effluent disposal & receiving water body

3	**Sewage: Primary Treatment**	**06 Hours**	**10%**
3.1	Treatment processes: Objective, methods of treatment, flow sheets of STP		
3.2	Screens, Grit chamber, Primary and secondary clarifier. Design of primary treatment units.		
4	**Sewage: Secondary Treatment**	**20 Hours**	**34%**
4.1	Biological unit processes - bacterial growth and its kinetics, its applications to treatment systems, Suspended and attached growth process,		
4.2	Aerobic treatments - trickling filter, activated sludge process, rotating biological contactors (RBC), stabilization pond and aerated lagoons Anaerobic treatments - Upflow Anaerobic Sludge Blanket (UASB)		
4.3	Sludge treatment & disposal: anaerobic sludge digestion		
4.4	Self-purification of natural water bodies: Oxygen economy, Numerical on BOD, Sewage farming. Disposal of treated effluent		
5	**Sewage: Tertiary Treatment**	**03 Hours**	**05%**
5.1	Removal of residual organics		
5.2	Removal of nutrients		
5.3	Recycling and reuse of wastewater		
6	**House Drainage & Decentralized Sewage Treatment System**	**05 Hours**	**08%**
6.1	Plumbing fixtures, materials used for plumbing system, systems of plumbing, anti-siphonic and vent pipes		
6.2	Septic tanks, Soak Pits, Low Cost Sanitation		
7	**Solid Waste Management**	**08 Hours**	**13%**
7.1	Importance of solid waste management		
7.2	Quantity, composition and characteristics of domestic and municipal solid waste		
7.3	Methods of solid waste collection: Based on availability of Services & modes of Operation		
7.4	Solid waste treatment – composting, incineration.		

D Instructional Method and Pedagogy:

- At the starting of the course, delivery pattern and prerequisite of the subject will be discussed.
- Lectures will be conducted with the aid of Multi-Media projector, Black board, OHP etc.
- Attendance is compulsory in lectures and laboratory.
- Internal exams will be conducted as per pedagogy as a part of internal theory evaluation.
- Assignments based on course content will be given to the students at the end of each unit/topic and will be evaluated at regular interval.
- Surprise tests/Quizzes/Seminar will be conducted as per pedagogy as a part of internal theory evaluation.

E Student Learning Outcomes:

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

- To understand the design principles involved in treatment of municipal wastewater.
- To identify, analyze and select the appropriate physical, chemical, and biological parameters used for assessing waste characteristics.
- To apply appropriate breadth and depth of skills in identification of engineering problems designed with realistic constraints and contribute to sustaining and improving community.
- To improve written communication and design skills by preparing a preliminary design report detailing the design of a wastewater treatment plant.

F Recommended Study Material:

Text Books:

1. Garg, S.K., Environmental Engg. Vol. – I &II, Khanna Publications.
2. Environmental Engineering: Punmia, B. C., Laxmi Publications, New Delhi
3. Peavy, Rowe and Tchobanoglous, Environmental Engg. Tata McGraw Hill, New Delhi.

Reference Books

1. Wastewater Engineering Treatment, Disposal, Refuse: Metcalf and Eddy, Tata McGraw Hill Publishers, New Delhi, 1995.
2. Introduction to Environmental Engineering: P. Aarne Vesilind, PWS Publishing Company, 2000
3. Introduction to Environmental Engineering :P. Aarne Vesilind, Susan M. Morgan, Thompson /Brooks/Cole; Second Edition 2008
4. Manual on Wastewater Treatment: CPH and Env. Engg. Organization (3rd Ed.), Ministry of Urban Development, Govt. of India, New Delhi, 1991.
5. CPHEEO Manual on Sewage and Treatment
6. Sanitary Engg. and Sewage Treatment, Manual, Ministry of Works & Housing, New Delhi.
7. Dix, H.M., Environmental Pollution, Edward Arnold Publishers Ltd.
8. Chaterjee, A.K., Environmental Engg, Khanna Publishers.
9. Harrison, R.M., Pollution Control, Springer Us/rsc.
10. Water Supply and Treatment, Manual, Ministry of Works and Housing, New Delhi.

Web Materials:

1. http://www.epa.gov
2. http://www.indiaenvironmentportal.org.in
3. http://nptel.iitm.ac.in
4. http://www.filtersource.com
5. https://dgserver.dgsnd.gov.in

List of Experiments

Experiment No.	Name of Tutorial / Experiment (At least eight to be performed)
1	Determination of chlorides
2	Determination of pH of sewage
3	Determination of Total Solids, suspended solids, dissolved solids, volatile solids
4	Determination of Dissolved oxygen
5	Determination of Bio chemical Oxygen Demand of sewage sample
6	Determination of Chemical Oxygen Demand of sewage sample
7	Determination of Sulphates
8	Determination of Nitrates
9	Determination of Oil & Grease
10	Determination of Ammoniacal Nitrogen
11	To find Sludge Volume Index (SVI) of sewage sample
12	Plumbing demonstration of accessories, fittings and fixtures

CL444: GEOTECHNICAL ENGINEERING - II
B TECH 7th SEMESTER (CIVIL ENGINEERING)

Credits and Hours:

Teaching Scheme	Theory	Practical	Total	Credit
Hours/week	4	2	6	5
Marks	100	50	150	

A. Objectives of the Course:

The main objectives of the course are:

- To know about the different soil exploration techniques.
- To determine the earth pressure exerted by soil on earth retaining structure.
- To understand concept of soil stabilization.
- To be able to design shallow and deep foundations.
- To understand various techniques to enhance bearing capacity of poor soils.
- To provide the student with the specific knowledge about the stress distribution in soil due to various surface loading.

B. Outline of the Course:

Sr. No.	Title of the Unit	Minimum Number of Hours
1	Soil Exploration	08
2	Earth Pressure	10
3	Stability of Slopes	10
4	Shallow Foundation	10
5	Deep Foundation	14
6	Stress Distribution	08

Total Hours (Theory): 60

Total Hours (Lab): 30

Total Hours: 90

C. **Detailed Syllabus:**

1	**Soil Exploration**	**8 Hours**	**13%**
1.1	Introduction, Stages in sub-surface Exploration, Depth of Exploration, Location and number of pits and Borings		
1.2	Methods of boring/exploration		
1.3	Sampling of soils, types of soil samplers		
1.4	Standard penetration test, Cone penetration test: Static and Dynamic		
1.5	Field vane shear test		
1.6	Field plate load test, NDT method		
2	**Earth Pressure**	**10 Hours**	**17%**
2.1	Introduction, effects of wall movements on earth pressure, lateral earth pressure at rest		
2.2	Rankine's& Coulomb's theory for active and passive earth pressure conditions for cohesionless and cohesive backfill, Rebhann's and Culmann's graphical method		
3	**Stability of Slopes**	**10 Hours**	**17%**
3.1	Introduction, types of slope failure, factor of safety		
3.2	Slice method, friction circle method, Taylor's stability number & other methods of analysis		
3.3	Improving stability of slopes, various stability conditions in an earth dam & canals		
4	**Shallow Foundation**	**10 Hours**	**17%**
4.1	Introduction, bearing capacity of soil, types of failure in soil, allowable bearing pressure		
4.2	Terzaghi's bearing capacity theory, factors affecting bearingcapacity, depth of foundation		
4.3	Bearing capacity of foundation subjected to eccentric loads,settlement-consideration & computation, effect of water-table		
4.4	Ultimate bearing capacity of footing based on SPT and CPTvalues, IS code of practice for computing bearing capacity		

5	**Deep Foundation**	**14 Hours**	**23%**
5.1	Introduction, types of piles, method of installation and load carrying behavior, necessity of pile foundation		
5.2	Static pile load formulae, pile load test, dynamic pile formulae		
5.3	Bearing capacity of single pile subjected to vertical load in sands and clays, pile subjected to uplift load		
5.4	Negative skin friction, group action of piles in cohesionless & cohesive soil		
5.5	Settlement of group pile		
5.5	Pile Integrity Test (PIT)		
5.6	Well Foundation: Introduction		
5.7	Introduction to Ground Improvement Techniques		
6	**Stress Distribution**	**08 Hours**	**13 %**
6.1	Stress strain parameters, geostatic stresses, concentrated force - Boussinesq's equations		
6.2	Pressure distribution diagram, vertical stress distribution on horizontal plane, vertical stress distribution on vertical plane, vertical pressure distribution under uniformly loaded circular area, line load, strip load & uniformly loaded rectangular area		
6.3	Newmark's influence charts, Westergard's analysis		
6.4	Contact pressure distribution, limitation of elastic theories		

D. Instructional Method and Pedagogy:

- At the start of course, the course delivery pattern, prerequisite of the subject will be discussed.
- Lectures will be conducted with the aid of multi-media projector, black board, OHP etc.
- Attendance is compulsory in lectures and laboratory.
- Internal exams will be conducted as per pedagogy as a part of internal evaluation.
- Assignments based on course content will be given to the students at the end of each unit/topic and will be evaluated at regular interval.
- Surprise tests/Quizzes/Seminar will be conducted.

- The course includes a laboratory, where students have an opportunity to build an appreciation for the concepts being taught in lectures.
- Experiments/Tutorials related to course content will be carried out in the laboratory.

E. Students Learning Outcome:

The course content should be taught and learning imparted with the aim to develop required knowledge and skills so that they are able to acquire following competency:

- Students will be aware of various soil exploration techniques and also know the various I.S. code criteria for SPT test and results.
- Student will be able to compute the lateral earth pressure against retaining wall.
- Students will be able to analysis the slope stability using different methods.
- Students will be able to determine the bearing capacity of shallow and deep foundation in sand and clay.
- The student will have the knowledge about the various techniques depending on type of soil to improve the soil properties.
- Students will be able to determine the vertical pressure for different loading condition on surface through different methods.

F. Recommended Study Material:

Text Books:

1. Arora, K.R., Soil Mechanics & Foundation Engineering, Standard Publication, New Delhi.
2. Punamia, B.C., Soil Mechanics & Foundation Engineering, Laxmi Publication Pvt. Ltd., New Delhi.
3. Murthy, V.N.S., Soil Mechanics & Foundation Engineering; SaiKripa Technical Consultants, Bangalore.
4. Shroff A. V., Shah D. L., "Soil Mechanics & Geotechnical Engineering", Oxford-IBH, New Delhi.

Reference Books:

1. Singh Alam, Soil Engineering, Vol. – I and II, Asia Publication House.
2. Fang and Einterkorn, Foundation Engineering Handbook.
3. Peck, Thomson and Thornburn, Foundation Engineering,
4. Shamsher Prakash and Gopal Ranjan, Analysis and Design of Retaining Structures,
5. Sarita Publications.
6. Nayak, N.B., Foundation Engineering Manual.
7. Sribivasula and Vaidyanathan, Handbook of Machine Foundation, Tata McGraw HillBook Co., New Delhi.

Web Materials:

1. http://edudel.nic.in
2. http://bis.org.in/other/quake.htm
3. http://www.vastu-design.com/india_homes.htm
4. http://www.thepeninsulaneighborhood.com/ThePlan.html
5. http://www.historytution.com/indus_valley_civilization/town_planning.html
6. http://nptel.ac.in/courses/105101083/

List of Experiments

Experiment No.	Name of Experiment
1	Standard Penetration Test
2	Cone Penetrometer Test for Liquid Limit
3	Unconfined Compression Test
4	Laboratory Vane Shear Test
5	Laboratory Plate Load Test
6	Static Cone Penetration Test

CL445: SUMMER INTERNSHIP - II
B TECH 7th SEMESTER (CIVIL ENGINEERING)

Credits and Hours:

Teaching Scheme	Project	Total	Credit
Hours/week	45	90	3
Marks	150	150	

A. Objectives of the Course:

Summer internships are required to be carried out in order to help students to find and know the applications of their theoretical knowledge enhance their industrial experience, make them familiar with the industry culture and work ethics.

- The main objectives for offering the internship for the students are:
- To get perspective and experience of the field.
- To make them industry ready.
- To make them familiar with modern tools and technologies.
- To enhance technical writing skills through report writing as per the industry standards.
- To get involved in design, development and testing practices followed by the industry.
- To enhance their soft-skills, presentation skills, interpersonal skills, documentation skills and office etiquettes required to sustain in industrial environment.
- To participate in team work and preferably as part of a multi-disciplinary team.
- To understand the professional and ethical responsibilities of an engineer.
- To make them more productive, consistent and punctual.
- To make them aware about industry best practices, processes and regulations followed in industries.

B. Instructional Method and Pedagogy:

- Summer internship shall be at least of 90 hours during the summer vacation only.
- Department/Institute will help students to find an appropriate company/industry/organization for the summer internship.
- The student must fill up and get approved a Summer Internship Acceptance form by the company and provide it to the Coordinator of the department within the specified deadline.
- Students shall commence the internship after the approval of the department Coordinator. Summer internships in research centers are also allowed.
- During the entire period of internship, the student shall obey the rules and regulations of the company/industry/organization and also those of the University.
- Due to inevitable reasons, if the student is not able to attend the internship for a few days with the permission of the supervisor, the department Coordinator should be informed via e-mail and these days should be compensated later.
- The student shall submit two documents to the Coordinator for the evaluation of the summer internship:
  1. Summer Internship Report
  2. Summer Internship Assessment Form
- Upon the completion of summer internship, a hard copy of "Summer Internship Report" must be submitted to the Coordinator on the first day of the new term.
- The report must outline the experience and observations gained through practical internship, in accordance with the required content and the format described in this guideline. Each report will be evaluated by a faculty member of the department on a satisfactory/unsatisfactory basis at the beginning of the semester.
- If the evaluation of the report is unsatisfactory, it shall be returned to the student for revision and/or rewriting. If the revised report is still unsatisfactory the student shall be requested to repeat the summer internship.

C. Format of Summer Internship Report:

The report shall comply with the summer internship program principles. Title is to be centered and written in capital boldface letters. Sub-titles shall be written in small letters and boldface. The typeface shall be "Times New Roman" font with a font size of 12pt. All the margins shall be 2.5cm. The report shall be submitted in printed form and filed. A soft copy of the report shall be submitted in a CD and enclosed with the report. Each report shall be bound in a simple wire vinyl file and contain the following sections:

- Cover Page
- Page of Approval and Grading
- Abstract page: An abstract gives the essence of the report (usually less than one page). Abstract is written after the report is completed. It must contain the purpose and scope of internship, the actual work done, and conclusions arrived at.
- TABLE OF CONTENTS (with the corresponding page numbers)
- LIST OF FIGURES AND TABLES (with the corresponding page numbers)
- DESCRIPTION OF THE COMPANY: Summarize the type of work, administrative structure, number of each category of employees, etc. Provide information regarding
    1. Location and spread of the company
    2. Number of employees, engineers, technicians, administrators in the company
    3. Divisions of the company
    4. Your group and division
    5. Administrative tree (if available)
    6. Main functions of the company
    7. Customer profile and market share
- INTRODUCTION: In this section, give the purpose of the summer internship, reasons for choosing the company, and general information regarding the nature of work you carried out.
- PROBLEM STATEMENT: What is the problem you are solving, and what are the reasons and causes of this problem.
- SOLUTION: In this section, describe what you did and what you observed during the summer internship. It is very important that majority of what you write should be based on what you did and observed that truly belongs to the company/industry/organization.

- CONCLUSIONS: In the last section, summarize the summer internship activities. Present your observations, contributions and intellectual benefits. If this is your second summer internship, compare the first and second summer internships and your preferences.
- REFERENCES: List any source you have used in the document including books, articles and web sites in a consistent format.
- APPENDICES: If you have supplementary material (not appropriate for the main body of the report), you can place them here. These could be schematics, algorithms, drawings, etc. If the document is a datasheet and it can be easily accessed from the internet, then you can refer to it with the appropriate internet link and document number. In this manner you don't have to print it and waste tons of paper.

D. Learning outcomes:

After completion of the course students will able:

- To apply knowledge and skills gained in company/industry/organization to real-world problems.
- To solve engineering problems.
- To learn to work as a team.
- To work with teammates from other disciplines.
- To use experience related to professional and ethical issues in the actual work environment.
- To explain the impact of engineering solutions employed in a project, in a global, economic, environmental, and societal context.
- To find relevant sources (e.g., library, Internet, experts) and gathers information.
- To demonstrate knowledge of contemporary issues related with engineering in general.
- To use new tools and technologies.

CL471: ADVANCED STRUCTURAL ANALYSIS
B TECH 7th SEMESTER (CIVIL ENGINEERING)
PROGRAMME ELECTIVE-III

Credits and Hours:

Teaching Scheme	Theory	Tutorial / Practical	Total	Credit
Hours/week	3	2	5	4
Marks	100	50	150	

A. Objectives of the Course:

- To understand the fundamental ideas of the FEM and to know the behavior and usage of each type of elements covered.
- To learn the analysis process involved in various complex structures used in professional structural engineering.
- To provide essential knowledge of Matrix method and Finite element method which are used in development of computer programme.
- To strengthen theoretical concepts of structural analysis by most versatile methods.

B. Outline of the Course:

Sr. No.	Title of the Unit	Minimum Number of Hours
1	Introduction	02
2	Direct Stiffness Method	28
3	Finite Element Method	15

Total Hours (Theory): 45
Total Hours (Lab): 30
Total Hours: 75

C. Detailed Syllabus:

1	**Introduction**	**02 Hours**	**04 %**
1.1	Basic concepts of Analysis		
2	**Direct Stiffness Method**	**28 Hours**	**62%**
2.1	Introduction: Stiffness Method		
2.2	Overview of different stiffness & rotation-transformation matrices		
2.3	Analysis of beam, plane truss, plane frames, grid, space truss and space frame by stiffness method member approach		
2.4	Analysis of beam, plane truss and plane frame under various secondary effects like support sinking, prestraining and temperature effect		
2.5	Symmetry and Anti-symmetry		
2.6	Oblique supports and elastic supports		
3	**Finite Element Method**	**15 Hours**	**34%**
3.1	Introduction to FEM, Advantages and disadvantages of FEM		
3.2	Types of problems, stresses & equilibrium, strain-displacement relations, stress-strain relations		
3.3	Application of FEM to one dimensional (for bar & beam) & two dimensional problems using constant strain triangles		
3.4	Two dimensional iso-parametric elements: Four node quadrilateral elements, numerical integration, higher order elements		
3.5	Application of FEM to two dimensional truss element		

D. Instructional Method and Pedagogy:

At the start of course, the course delivery pattern, prerequisite of the subject will be discussed.

- Lectures will be conducted with the aid of multi-media projector, black board, OHP etc.
- Attendance is compulsory in lectures and laboratory.

- Internal exams / Unit tests will be conducted as per pedagogy as a part of internal theory evaluation.
- Assignments/Surprise tests/Quizzes/Seminar will be conducted as per pedagogy as a part of internal theory evaluation.
- The course includes a laboratory, where students have an opportunity to build an appreciation for the concepts being taught in lectures.
- Experiments/Tutorials related to course content will be carried out in the laboratory.

E. Students Learning Outcomes:

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

- To solve the structural problems using Finite element method.
- Use Direct stiffness method for the analysis of Frame structures
- To recognize the importance of structural analysis and the different tools used to determine the response of a structural system to external loads.

F. Recommended Study Material:

Text Books:

1. Weaver William and Gere James, Matrix Analysis of Framed Structures, CBS Publishers
2. Dawe, D.J., Matrix and Finite Element Displacement Analysis of Structures, Clarendon Press.
3. Menon Devdas, Advanced Structural Analysis, Narosa Publishing House
4. Desai & Ables, Introduction to the Finite Element Method, CBS
5. Bhavikatti S.S., Finite Element Analysis, New age international limited, publishers

Reference Books:

1. Krishnamoorthy C.S., Finite Element Analysis, Tata McGraw-Hill
2. Cook, R.D., Concepts & Applications of Finite Element Analysis, John Wiley & Sons
3. Wang, C.K., Intermediate Structural Analysis, Tata McGraw Hill

CL472: ADVANCED GEOTECHNICAL ENGINEERING
B TECH 7th SEMESTER (CIVIL ENGINEERING)
PROGRAMME ELECTIVE - III

Credits and Hours:

Teaching Scheme	Theory	Tutorial/Practical	Total	Credit
Hours/week	3	2	5	4
Marks	100	50	150	

A. Objectives of the Course:

The objectives of this course are:

- To gain in-depth understanding of soil mechanics to apply in day-to-day geotechnical engineering, the eventual aim of this subject is to incorporate psychological perception of learning and reasoning of engineering aspects of foundation engineering in general.
- To gain knowledge of effective learning of various aspects of soil mechanics along with bringing out the advanced theories and practical knowledge of geotechnical engineering.
- To understand the concept of soil-structure interaction.
- To understand the mechanical behavior of rock materials, rock discontinuities and rock masses.
- To attain advanced knowledge and skills in geotechnical engineering and in treatment of Expansive/Collapsible soil contaminated soil or soil leachate and the design of foundations on such a problematic soil.
- To study the engineering behavior of soil under dynamic forces and criteria for the design of foundations under such a seismic environment.

B. Outline of the Course:

Sr. No.	Title of the Unit	Minimum Number of Hours
1	Introduction	01
2	Influence of Soil Structure Interaction	04
3	Introduction to Rock Mechanics	08
4	Foundation on Expansive Soils	10
5	Foundation on Collapsible Soils	05
6	Environmental Waste Effects On Soils	07
7	Machine Foundations	10

Total Hours (Theory): 45
Total Hours (Lab): 30
Total Hours: 75

C. Detailed Syllabus:

1	**Introduction**	**01 Hour**	**02%**
1.1	Course review		
1.2	Overview of Soil Mechanics and Rock mechanics		
1.3	Overview of Foundation Engineering		
2	**Influence of Soil Structure Interaction**	**04 Hours**	**09%**
2.1	Introduction		
2.2	Concept of Soil Structure Interaction		
3	**Introduction to Rock Mechanics**	**08 Hours**	**18%**
3.1	Introduction		
3.2	Geological classification of rocks		
3.3	Index properties of rocks		
3.4	Classification of rocks for engineering purpose		
3.5	Rock strength and failure criteria		
3.6	Modes of failure of rocks		
4	**Foundation on Expansive Soils**	**10 Hours**	**22%**
4.1	Identification of expansive soils		
4.2	Parameters of expansive soils		

4.3	Causes of moisture changes		
4.4	Preventive measures for expansive soils		
4.5	Techniques for Controlling Swelling: Horizontal Moisture Barriers, Vertical Moisture Barriers, Surface and Subsurface Drainage, Prewetting, Soil Replacement Sand Cushion Techniques, CNS Layer Technique.		
4.6	Modification of Swelling Characteristics: Lime Stabilization, Mechanisms, Limitations, Lime Injection, Lime Columns, Mixing, Chemical Stabilization, Design of Foundation on Expansive soils: Drilled Pier, Belled Drilled Pier, Under-Reamed Piles.		
5	**Foundation on Collapsible Soils**	**05 Hours**	**11%**
5.1	Types of collapsible soils		
5.2	Parameters of collapsible soils		
5.3	Treatment Methods for Collapsible Soil: Induce Collapse Prior to Construction, Decrease Foundation Pressures, Solidify the Soil, Densify Collapsible Soil, Other Methods		
5.4	Design of foundation on un-wetted collapsible soil, Soil subjected to wetting.		
6	**Environmental Waste Effects on Soils**	**07 Hours**	**15%**
6.1	Man made changes in geotechnical environment - mining, embankments, pumping, reservoir, landfills and reclamation effect and control.		
6.2	Control of contamination with use of clay barriers, geosynthetics, cut-off walls, leachate collection systems.		
6.3	Stabilization - different materials and techniques in control of ground pollution and treatment		
7	**Machine Foundations**	**10 Hours**	**23%**
7.1	Introduction of Soil dynamics, basic definitions		
7.2	Types of machine foundation		
7.3	General criteria for design of machine foundation		
7.4	Vibration analysis of a machine foundation		

7.5 Examples based on topic

7.6 Indian Standard on Design and Construction of Foundation for Reciprocating Machines

7.7 Liquefaction

D. Instructional Method and Pedagogy:

At the start of course, the course delivery pattern, prerequisite of the subject will be discussed.

- Lectures will be conducted with the aid of multi-media projector, black board, OHP etc.
- Attendance is compulsory in lectures and laboratory sessions.
- Internal exams / Unit tests will be conducted as per pedagogy as a part of internal theory evaluation
- Assignments/Surprise tests/Quizzes/Seminar will be conducted as a part of internal theory evaluation.
- The course includes a laboratory, where students have an opportunity to build an appreciation for the concepts being taught in lectures.
- Experiments/Tutorials related to course content will be carried out in the laboratory.

E. Students Learning Outcomes:

On the successful completion of this course

- The students will get a diverse knowledge of geotechnical engineering practices applied to real life problems.
- Students will learn the various aspects of geotechnical engineering and be able to conduct independent work.
- The students will learn to understand the theories and practical aspects of geotechnical engineering along with the design and field applications.
- Able to understand the concept of soil structure interaction and its influence on soil behavior.

- To be able to analyze and to determine mechanical and engineering properties of rocks for engineering application, critically review rock mechanics principles and methods and their applications to engineering practices. And analyses rock slope stability and foundations on rock.
- The students will learn to design and analyze the foundations on problematic soils.
- The student will learn to assess the quality of soil and extent of soil pollution and soil degradation and suitable remediation.
- The student will learn to understand soil response when subjected to dynamic actions, fundamentals of wave propagation and seismology and the knowledge of in situ and laboratory tests for soil dynamic characterization.

F. Recommended Study Material:

Text Books:

1. Soil Mechanics & Foundation Engineering, K.R Arora, Standard Publication, New Delhi.
2. Soil Mechanics & Foundation Engineering, B.C Punamia, Laxmi Publication Pvt Ltd. New Delhi
3. Soil Mechanics & Foundation Engineering by Murthy, V.N.S, Sai Kripa Technical Consultants, Bangalore.
4. Geo-environmental Engineering: Site Remediation, Waste Containment, and Emerging Waste Management Technologies by Hari D Sharma and Krishna R Reddy, John Wiley & Sons.

Reference Books:

1. Singh Alam, Soil Engineering, Vol. I and II, Asia Publication House.
2. Basics and Soil Mechanics by Gopal Ranjan and A S R Rao, New Age International pvt ltd., New Delhi.
3. Design Aids in Soil Mechanics and Foundation Engineering by Kaniraj, McGraw Hill Education.
4. Principles of Foundation Engineering by B.M Das, Cengage, US.
5. Fang and Einterkorn, Foundation Engineering Handbook, Springer.
6. Foundation Engineering by Peck, Thomson and Thornburn, Wiley, India.

7. Foundation Engineering Manual by Nayak, N.B., Dhanpat Rai Publications,New Delhi.
8. Handbook of Machine Foundation by Sribivasula and Vaidyanathan, Tata McGraw Hill Book Co., New Delhi.
9. Geo-Environmental Engineering – Principles and Applications by Lakshmi N. Reddy, Hilary. I. Inyang, Makcel Dekker Ink, 2000
10. Geotechnical and Geo-environmental Engineering Handbook by R. Kerry Rowe, Springer, US.
11. Geotechnical Practice for Waste Disposal by D.E .Daniel, Chapman & Hall, London.

List of Tutorials

Tutorial No.	Name of Tutorial
1	Influence of Soil Structure Interaction
2	Introduction to Rock Mechanics
3	Foundation on Expansive Soils
4	Foundation on Collapsible Soils
5	Environmental Waste Effects On Soils
6	Machine Foundations

CL473: ENVIRONMENTAL POLLUTION & CONTROL
B TECH 7th SEMESTER (CIVIL ENGINEERING)
PROGRAMME ELECTIVE - III

Credits and Hours:

Teaching Scheme	Theory	Practical/Tutorial	Total	Credit
Hours/week	3	2	5	4
Marks	100	50	150	

A. Objective of the Course:

The objectives of the course are:

- To give the students an overview of the various environmental concerns that is being faced nowadays.
- To provide details of different types of pollution prevalent around the world.
- To enable the students in analyzing global pollution issues as well as that of India.

B. Outline of the course:

Sr. No.	Title of the unit	Minimum number of hours
1.	Overview of the Course	02
2.	Water Pollution	06
3.	Industrial Wastewater Management	12
4.	Hazardous Waste Management	12
5.	Air Pollution Control	10
6.	Environmental Policies for Pollution Prevention	03

Total Hours (Theory): 45
Total Hours (Lab): 30
Total Hours: 75

C. **Detailed Syllabus:**

1.	**Overview of the Course:**	**02 Hours**	**04%**
1.1	Concept of pollution prevention and cleaner production, environmental management hierarchy		
1.2	Industrialization and sustainable development		
2.	**Water Pollution:**	**06 Hours**	**13%**
2.1	Classification of freshwater pollutants, Heat pollution and its effects, process of self-cleaning, Dissolved oxygen profile, Eutrophication and its impact		
2.2	Sampling methods: Purpose of sampling, different types of samples, collection methods and various instruments used for it		
2.3	Marine water pollution: Types, sources and consequences		
3.	**Industrial Wastewater Management:**	**12 Hours**	**27%**
3.1	Effects of industrial wastes on sewerage system and receiving water bodies		
3.2	Industrial waste survey: Process flow charts, condition of waste stream		
3.3	Pre-treatment of industrial wastewater: Volume reduction, strength reduction, neutralization, equalization and proportion, removal of organic and inorganic dissolved solids		
3.4	Wastewater treatment in specific industries: Distillery, sugar, pulp and paper, cement, textile, dairy, fertilizer, pesticides, pharmaceutical, etc.		
4.	**Hazardous Waste Management:**	**12 Hours**	**27%**
4.1	Introduction, sources, classification, regulations for hazardous waste management, hazardous waste characterization, designated hazardous wastes		
4.2	Waste minimization and resource recovery: Approaches, development of a waste tracking system		
4.3	Transportation of hazardous waste: Requirements, regulations, containers, bulk and non-bulk transport, emergency response		

4.4	Physico-chemical, chemical and biological treatment of hazardous waste		
4.5	Sanitary landfill: Design approach, leachate and gaseous collection system, facility siting and process selection for treatment, storage, disposal facility (TSDF)		
4.6	Recent developments in solid wastes reuse and disposal: Power generation, blending with construction materials and Best Management Practices		
4.7	Biomedical waste management: Sources, treatment and disposal		
5.	**Air Pollution Control:**	**10 Hours**	**22%**
5.1	Meteorology: Composition and structure of the atmosphere, wind circulation, solar radiation, lapse rates, atmospheric stability conditions, wind velocity profile, Maximum Mixing Depth (MMD), temperature inversions, windrose diagram		
5.2	Monitoring of particulate matter and gaseous pollutants: Respirable, non-respirable and nano - particulate matter, CO, CO2, Hydrocarbons (HC), SOX and NOX, photochemical oxidants		
5.3	Pollutants dispersion models: Description and application of point, line and areal sources		
5.4	Air pollution control equipment for particulate matter & gaseous pollutants: Gravity settling chambers, centrifugal collectors, wet collectors, fabric filters, electrostatic precipitator (ESP), adsorption, absorption, scrubbers, condensation and combustion		
6.	**Environmental Policies for Pollution Prevention:**	**03 Hours**	**07%**
6.1	Introduction to environmental legislations		
6.2	Environmental auditing: Financial and managerial opportunities		

D. Instructional Method and Pedagogy:

- At the start of course, the course delivery pattern, prerequisite of the subject will be discussed.
- Lectures will be conducted with the aid of multi-media projector, black board, OHP etc.
- Attendance is compulsory in lectures and laboratory.
- Internal exams will be conducted as per pedagogy as a part of internal theory evaluation.
- Assignments based on course content will be given to the students at the end of each unit/topic and will be evaluated at regular interval.
- Surprise tests/Quizzes/Seminar will be conducted.
- The course includes a laboratory, where students have an opportunity to build an appreciation for the concepts being taught in lectures.
- Experiments/Tutorials related to course content will be carried out in the laboratory.

E. Student Learning Outcomes:

At the end of the course the students will be able to

- Discover correctly the knowledge related to environmental pollution
- Understand the theories and practical aspects of pollution control along with the design and management applications.
- Propose ideas to control environmental pollution with respects to professionalism and ethics.

F. Recommended Study Material:

Text Books:

1. Mahajan, S.P., Pollution Control in Process Industries, Tata McGraw Hill Publishing Company Ltd., New Delhi.
2. Washington, D.C., Eckenfelder, Industrial Water Pollution Control, McGraw hill Company, New Delhi, American Chemical Society, USA, 2000.
3. Rao, C.S., Environmental Pollution Control Engineering, Wiley Eastern Ltd., New Age International Ltd.
4. Rao, M.N. and Rao, H.V.N., Air Pollution, Tata McGraw-Hill

Reference Books:

1. Wark, K., Warner, C.F. and Davis, W.T., Air Pollution - Its Origin and Control, Harper & Row Publishers, New York, 1998.
2. Perkins, H.C., Air Pollution, McGraw Hill, 1974.
3. Stern, A.C., Air Pollution, Vol. - I, II, III.
4. Nemerow, N.N., Liquid Waste of Industry Theories, Practices and Treatment. Addison Willey, New York, 1971.
5. Ross, R.D., Industrial Waste Disposal, Reinhold Environmental Series – New York, 1978.
6. Tchobanoglous, G., Theissen, H. and Eliassen, R., Solid Waste Engineering - Principles and Management Issues, McGraw Hill, New York, 1991.

Web Materials:

1. http://www.epa.gov
2. http://www.indiaenvironmentportal.org.in
3. http://nptel.ac.in

List of Experiments

Experiment No.	Name of Experiment
1	Introduction to Sampling in water and wastewater analysis
2	Determination of BOD/COD ratio
3	Monitoring of Noise
4	Determination of PM10 and PM2.5 in ambient air
5	Determination of gaseous pollutants in ambient air
6	Determination of various parameters in solid waste
7	Treatability studies of industrial wastewater

CL474: ADVANCED HIGHWAY & TRAFFIC ENGINEERING
B TECH 7th SEMESTER (CIVIL ENGINEERING)
PROGRAMME ELECTIVE -III

Credits and Hours:

Teaching Scheme	Theory	Practical/ Tutorial	Total	Credit
Hours/week	3	2	5	4
Marks	100	50	150	

A. Objectives of the Course:

- To develop an understanding about the various paving material behavior and its characteristics.
- To develop an understanding about the various types of pavement distress and failure.
- To learn about the various rehabilitation and maintenance strategies of pavement.
- To make students aware of environmental impact assessment and road safety audits
- To understand the fundamentals of planning and design of intersections & parking
- To understand the fundamentals of traffic characteristics and flowing theories of traffic.
- To study about the types of equipment used in road construction and the new methodology of highway construction.

B. Outline of the Course:

Sr. No.	Title of the Unit	Minimum Number of Hours
1	Pavement Materials Characterization	13
2	Pavement Evaluation, Rehabilitation & Maintenance	10
3	Road Safety & Environmental Impact Assessment	5
4	Design of Intersections and Parking Analysis	5
5	Traffic Flow Theory	7
6	Road Making Machinery & Modern Highway System	5

Total Hours (Theory): 45
Total Hours (Lab): 30
Total Hours: 75

C. Detailed Syllabus:

1 Pavement Materials Characterization **13 Hours** **28 %**

1.1 Bituminous Materials: conventional and modified binders, production, types and grade , physical and chemical properties and uses

Modified bitumen: Crumb Rubber Modified bitumen, Natural rubber modified bitumen, polymer modified bitumen

Introduction to emulsified bitumen and its characterization; Long term and short term ageing and its effect on bitumen performance

1.2 Bituminous Mix design ,Desirable properties of bituminous mixes, Modified Marshall's specifications, Introduction to super pave mix design procedure

1.3 Requirements of paving concrete, design of mixes – IRC, absolute volume, , Vibrated Concrete mix design, design of DLC and SFRC mixes

1.4 Composites, Plastics and Geo-synthetics: Plastics and polymerization process, properties, durability and chemical composition, Reinforced Polymer Composites, Geo-synthetics, Dry Powdered Polymers- Enzymes.

1.5	Reclaimed/Recycled Waste Products: Reclaimed Materials – waste products in civil engineering applications, effect of waste products on materials, structure and properties, self-healing and smart materials		
2	**Pavement Evaluation, Rehabilitation & Maintenance**	**10 Hours**	**23 %**
2.1	Pavement Evaluation : Methods of Pavement Evaluation, Visual Rating Pavement Serviceability Index(PSI), Roughness Measurements: Importance of smooth riding surface, measurement of road roughness, Towed Fifth Wheel Bump Integrator, Skid Resistance: Measurement, Importance, governing, Factors Pavement Deterioration Research		
2.2	Pavement failures: Types of pavement distress: its symptoms, remedies and causes, Techniques for functional and structural evaluation of pavements.		
2.3	Overlay Design and Construction : Need, Types, Overlay design methods for flexible pavements by conventional design method, Benkelman beam method, Falling Weight Deflection Method, I.R.C. Guidelines &Asphalt Institute Method. Overlay Design Methods for Rigid Pavements, Flexible overlays over rigid slabs		
2.4	Recycling of flexible and rigid pavements,		
3	**Road Safety & Environmental Impact Assessment**	**5 Hours**	**11 %**
3.1	Introduction, Collision & condition diagram, Causes of accidents, Accident studies & records, Analysis of accident studies, Road Safety Improvement Strategies.		
3.2	Road Safety Audit Process, Black Spot, Black Route, Area Identification		
3.3	Transport related different types of pollution& their sources, Effects of Weather Conditions, Vehicular emission parameters, Pollution standards, Measurement and analysis of vehicular emission, Mitigative Measures.		

3.4	Urban and non-urban traffic noise sources, Noise level factors, Effects of traffic noise, Propagation and measurement of traffic noise, Prediction and control measures, Noise studies, Noise standards.		
3.5	EIA requirements of highway projects, EIA procedures, guidelines, EIA practices in India.		
4	**Design of Intersection and Parking Analysis**	**5 Hours**	**11 %**
4.1	Principles of design, channelization, roundabouts, staggered intersections Design of rotary intersection.		
4.2	Introduction to Parking Studies ,Types of parking facilities, Modes of parking , Parking studies and analysis, Evaluation of parking parameters, Ill effects of parking		
5	**Traffic Flow Theory**	**7 Hours**	**16 %**
5.1	Uninterrupted traffic Flow Theory : Fundamentals of Traffic flow theory, Uninterrupted Traffic flow including Macroscopic and Microscopic Traffic flow models		
5.2	Interrupted traffic Flow Theory : Fundamentals of Interrupted Traffic Flow, Shockwave Analysis, Car following theory, Queuing Theory, Vehicle arrival: Gap and Gap acceptance		
6	**Road Making Machinery & Modern Highway System**	**5 Hours**	**11%**
6.1	Role of Labour vs. machinery in road construction, Earth work machinery, volume changes, clearing and grubbing, Tractors, Tractor Dozers, scrapers, Graders.		
6.2	Rock excavation machinery, Transporting Equipment, Compaction Equipment , Production of aggregates		
6.3	Bituminous concrete road equipment, Cement Concrete road making Equipment, Equipment Usage charges		
6.4	Automated Highway System , ITS		
6.5	Green Highway, Smart Highway, Electric Highway & Solar Highway		

D. Instructional Method and Pedagogy:

- At the start of course, the course delivery pattern, prerequisite of the subject will be discussed.
- Lectures will be conducted with the aid of multi-media projector, black board, OHP etc.
- Attendance is compulsory in lectures and laboratory.
- Internal exams will be conducted as per pedagogy as a part of internal evaluation.
- Assignments based on course content will be given to the students at the end of each unit/topic and will be evaluated at regular interval.
- Surprise tests/Quizzes/Seminar will be conducted.
- The course includes a laboratory, where students have an opportunity to build an appreciation for the concepts being taught in lectures.
- Experiments/Tutorials related to course content will be carried out in the laboratory.

E. Students Learning Outcomes:

The course content should be taught and learning imparted with the aim to develop required knowledge and skills so that they are able to acquire following competency:

- The student will develop an understanding of the basic concepts of different paving material and their characteristics.
- The student will be able to identify the distress in pavement and will be able to decide the evaluation and maintenance strategies for the pavement.
- The student will able to understand about the road safety audit process and EIA.
- The student will able to design the parking facilities and at grade intersection.
- The student will capable to understand the traffic flow behavior on the basis of flow theories.
- The student will learn about the modern equipment and highway system.

F. Recommended Study Material:

Text Books:

1. Dr. L. R. Kadiyali and Dr. N. B. lal, Principles & practices of Highway Engineering, Khanna Publication Delhi
2. Dr. L. R. Kadiyali, Traffic Engineering & Transport Planning, Khanna Publication Delhi.
3. S. K Khanna & C. E.G Justo, Highway Engineering, Nem Chand & Bros, Roorkee.
4. Elvik, R., and Vaa, T., The Handbook of Road Safety Measures, Elsevier, 2004.
5. Chakroborty & Das, Principles of Transportation Engineering, PHI Learning pvt ltd. Delhi

Reference Books:

1. Khisty C.J., Transportation Engineering - An Introduction, Prentice Hall, India, 2002.
2. Papacostas C.S., Prevedouros, "Transportation Engineering and Planning", 3rd Edition,Prentice Hall of India, New Delhi, 2002
3. Drew, D.R., "Traffic Flow Theory and Control", McGraw Hill, NewYork,1968
4. Larry W Canter, "Environmental Impact Assessment", McGraw Hill Publishers, 1996.
5. Ogden, K. W., Safer Roads: A Guide to Road Safety Engineering. Avebury Technical, 1996.
6. Road Safety manuals by various organizations in India and other developed countries.

IRC Codes:

1. IRC SP: 049, " Guidelines for the use of dry lean concrete as sub-base in rigid pavement"
2. Manual of Ministry of Road Transport & Highway (MoRTH)
3. IRC 58: Guidelines for the Design of Plain Jointed Rigid Pavements
4. IRC 37: Guidelines for the Design of Flexible pavements
5. IRC 81: Guidelines for strengthing of flexible Road Pavement using Benkleman Beam Deflection Technique.

List of Experiments

Experiment No.	Name of Experiment
1	Design of Bituminous Mix & Marshal Stability Test
2	CBR test on paving materials
3	Benkelman Beam Deflection test
4	Parking studies
5	Physical inventory using total station survey equipment.
6	Environmental impact – Noise studies and vehicular emission measurement

CL475: COMPUTATIONAL METHODS IN WATER RESOURCES ENGINEERING
B TECH 7th SEMESTER (CIVIL ENGINEERING)
PROGRAMME ELECTIVE - III

Credits and Hours:

Teaching Scheme	Theory	Practical/Tutorial	Total	Credit
Hours/week	3	2	5	4
Marks	100	50	150	

A. Objective of the Course:

The objectives of the course are:

- To provide an opportunity to students to work as a part of interdisciplinary team.
- To develop ability among students to synthesize data and technical concepts for application in hydrology and water resources engineering.
- To provide, students with a sound foundation in the mathematical, scientific and engineering fundamentals necessary to formulate, analyze, solve engineering problems and to prepare them for their career.

B. Outline of the course:

Sr. No.	Title of the unit	Minimum number of hours
1.	Overview of the Course	03
2.	Probabilistic analysis	06
3.	Regression Analysis	08
4.	Ordinary Differential Equations	10
5.	Partial Differential Equations	10
6.	Infinite Series	08

Total Hours (Theory):45
Total Hours (Lab): 30
Total Hours: 75

C. **Detailed Syllabus:**

1.	**Overview of the Course:**	**03 Hours**	**07%**
1.1	Need for computational and statistical methods, overview of the applications in civil Engineering in general and Water Resources Engineering in particular.		
1.2	Review of numerical techniques for finding roots of non-linear equations		
2.	**Probabilistic analysis:**	**06 Hours**	**13%**
2.1	Review of basic concepts of probability and probability distributions		
2.2	Probabilistic analysis and treatment of hydro-meteorological and water quality data		
2.3	Flood frequency analysis		
3.	**Regression Analysis:**	**08 Hours**	**18%**
3.1	Simple linear and multiple linear regression, evaluation of regression, confidence limits		
3.2	Applications – rainfall-runoff analysis, rating curves, water quality modelling		
4.	**Ordinary Differential Equations:**	**10 Hours**	**22%**
4.1	Nature of problems, boundary and initial equations		
4.2	Euler's method, modified Euler's method, Predictor-Corrector method, Runge-Kutta method, Boundary value problems		
4.3	Applications for reservoir routing, gradually varied flow problems, pipe networks.		
5.	**Partial differential equations:**	**10 Hours**	**22%**
5.1	Classification and nature of problems, Concepts of finite difference method, Solution of parabolic equations, pollutant transport, Solutions of elliptical equation, Laplace equation and Poisson equation.		
5.2	Flow through porous media, Solution of hyperbolic equation		
5.3	Unsteady flow through open channels, propagation of waves		
5.4	Concept of finite volume method		

6. Infinite Series: **08 Hours** **18%**

6.1 Basics of Finite Element Method, FEM vs FDM, Element shapes, shape functions, development of shape functions for linear elements

6.2 Formulation of FEM for stress analysis problems

6.3 Flow through porous media, Galerkin's method and Variational method

D. Instructional Method and Pedagogy:

- At the start of course, the course delivery pattern, prerequisite of the subject will be discussed.
- Lectures will be conducted with the aid of multi-media projector, black board, OHP etc.
- Attendance is compulsory in lectures and laboratory.
- Internal exams will be conducted as per pedagogy as a part of internal theory evaluation
- Assignments based on course content will be given to the students at the end of each unit/topic and will be evaluated at regular interval.
- Surprise tests/Quizzes/Seminar will be conducted.
- The course includes a laboratory, where students have an opportunity to build an appreciation for the concepts being taught in lectures.
- Experiments/Tutorials related to course content will be carried out in the laboratory.

E. Student Learning Outcomes:

At the end of the course the students will be able to

- Apply numerical methods for solution of differential equations in Water Resources and Environmental Engineering
- Apply finite difference schemes for solution of hydraulic and hydrologic models
- Formulate finite element model for solution of flow through porous media
- Perform statistical analysis of water resources systems

F. Recommended Study Material:

Text Books:

1. Hoffman, J.D., (2011), **"**Numerical Methods for Engineers and Scientists**",** CRC Press, Special Indian Edition
2. Numerical Methods by Chapra and Canale.
3. Schilling, R.J., and S.L. Harris, (2007), "Applied Numerical Methods for Engineering**",** CENGAGE Learning, India Edition

Reference Books:

1. Kotteguda, N.T. and Renzo Resso, (1998), "Statistics, Probability and Reliability for Civil and Environmental Engineers**"**, McGraw Hill Companies Inc., New York
2. Neural Network Fundamentals with Graphs, Algorithms, Applications-Bose N.K. & Liang P. McGraw Hill N.Y.
3. Computational Fluid Dynamics by Anderson.
4. Abbot, M.A. and Vervey (1996), "Computational Hydraulics", Elsevier Publications

List of Tutorials

Tutorial No.	Name of Tutorial
1	Probabilistic analysis and treatment of hydro-meteorological and water quality data
3	Flood frequency analysis
4	Rainfall-runoff analysis, rating curves, water quality modelling
5	Euler's method, modified Euler's method, Predictor-Corrector method, Runge-Kutta method, Boundary value problems
6	Applications for reservoir routing, gradually varied flow problems, pipe networks.
7	Flow through porous media, Solution of hyperbolic equation
8	Unsteady flow through open channels, propagation of waves
9	Applications of infinite series

CL476 GIS & REMOTE SENSING APPLICATIONS IN CIVIL ENGINEERING
B TECH 7th SEMESTER (CIVIL ENGINEERING)
PROGRAMME ELECTIVE - III

Credits and Hours:

Teaching Scheme	Theory	Practical / Tutorial	Total	Credit
Hours/week	3	2	5	4
Marks	100	50	150	

A. Objective of the Course:

- To develop understanding about remote sensing system, Global Navigation Satellite System (GNSS) and GIS.
- To enable students to carryout analysis of remotely sensed data and extract information from it.
- To make students conversant with data collection using GNSS systems and Differential GPS.
- To enable students to prepare thematic maps and carryout analysis using GIS technique.
- To enable students to learn different applications of remote sensing system, and GIS.
- To apply the knowledge, techniques, skills, and applicable tools of the discipline to engineering and surveying activities.

B. Outline of the Course:

Sr. No.	Title of the Unit	Minimum Number of Hours
1	Introduction to Remote Sensing	**03**
2	Remote sensors and platforms	**07**
3	Satellite data Analysis	**05**
4	Digital Image processing	**07**
5	Introduction to Geographic Information System (GIS)	**05**
6	GIS data processing	**06**

7	Introduction to navigational systems	06
8	Integration of GIS and Remote Sensing, Applications in Civil Engineering	06

Total Hours (Theory): 45
Total Hours (Lab): 30
Total Hours: 75

C. Detailed Syllabus:

1	**Introduction to Remote Sensing**	**03 Hours**	**7 %**
1.1	History and development of remote sensing		
1.2	Electromagnetic radiation and its interaction with matter		
1.3	Atmospheric effects and corrections		
2	**Remote sensors and platforms**	**07 Hours**	**16 %**
2.1	Overview of Remote sensors		
2.2	Remote sensing satellite platforms and orbits		
2.3	Optical sensor systems		
2.4	Microwave sensor systems		
2.5	Indian Satellite Program		
2.6	Recent trends in Remote Sensing techniques: Microwave remote sensing, Lasers and radars, Hyper spectral remote sensing		
3	**Satellite data Analysis**	**05 Hours**	**11 %**
3.1	Methods of acquisition of digital images from conventional and space-borne scanners		
3.2	Satellite data products		
3.3	Visual image interpretation		
3.4	Image Processing Systems		
4	**Digital Image processing**	**07 Hours**	**16%**
4.1	Digital Image, Media for digital data recording, Storage, Data formats		
4.2	Distortions in Space-borne Digital images and Restoration		
4.3	Matching and Registration of satellite images		
4.4	Image enhancement through Point Operations : Neighborhood Operations on Satellite Images,		

4.5	Image Transforms : Fourier, Wavelet, Hough, color and PCT Arithmetic Operations,		
4.6	Digital Image Analysis Through Supervised and Unsupervised Classification,		
4.7	Post-classification Analysis: statistical accuracy estimation.		
4.8	Image processing softwares.		
5	**Introduction to Geographic Information System (GIS)**	**05 Hours**	**11 %**
5.1	Introduction to GIS, Concept of GIS and Functions and advantages		
5.2	Spatial data concepts, map reference systems		
5.3	Spatial data - sources, models, structures, Data quality		
5.4	Analysis and interpolation		
6	**GIS data processing**	**06 Hours**	**13 %**
6.1	Spatial data model, Geospatial analysis		
6.2	Attribute management and metadata concept		
6.3	GIS Data sources, Organizing data for analysis		
6.4	Linking spatial and attribute data		
6.5	Spatial decision support systems,		
6.6	GIS Softwares		
7	**Introduction to navigational systems**	**06 Hours**	**13 %**
7.1	Overview of GPS and GNSS		
7.2	Current navigational system, components, Functioning and Uses		
8	**Integration of GIS and Remote Sensing and their Applications in Civil Engineering**	**06 Hours**	**13 %**
	Case studies in the following areas:		
8.1	Environmental engineering		
8.2	Water Resources		
8.3	Intelligent Transport Systems		
8.4	Land-use – Land cover – Urban planning		
8.5	Disaster Management		

D. Instructional Method and Pedagogy:

- At the start of course, the course delivery pattern, prerequisite of the subject will be discussed.
- Lectures will be conducted with the aid of multi-media projector, black board, videos, etc.
- Internal Exams/Assignments/Surprise tests/Quizzes/Seminar/Project, etc., will be conducted as a part of internal theory evaluation.
- The course includes a laboratory, where students have an opportunity to build an appreciation for the concepts being taught in lectures.
- Experiments/Tutorials/Term work related to course content will be carried out in the laboratory.

E. Students Learning Outcomes:

On the successful completion of this course

- Ability to develop Orthographic and Contour maps using aerial photographs and Remote Sensing Images
- Ability to develop maps using data set from Total Station, GIS, GPS and Scanners
- Ability to create GIS application referencing spatial features with Attribute data

F. Recommended Study Material:

Text Books:

1. B. Bhatta, Remote Sensing and GIS, 2nd Edition, Oxford University Press, New Delhi
2. George Joseph, Fundamentals of Remote Sensing, Universities Press, India, 2005
3. A.M. Chandra and S.K. Ghosh, Remote Sensing and Geographical Information System, Narosa Publishing House, New Delhi.

Reference Books:

1. Gopi, Advanced Surveying: Total Station, GIS and Remote Sensing, Pearson Education India, 2006, (ISBN 8131743012, 9788131743010)
2. J.R. Jensen, Introductory Digital Image Processing, Prentice-Hall, New Jersey
3. J.R. Jensen, Remote Sensing of Environment: An Earth Perspective, Pearson Education, Delhi, 2004

4. P.A. Burrough and R.A. McDonnell, Principles of Geographical Information Systems, 2nd ed. Oxford, England, Oxford University Press.
5. T.M. Lillesand, R.W. Kiefer and J.W. Chipman, Remote Sensing and Image Interpretation, 5th edition, John Wiley and Sons, India
6. Kali Charan Sahoo, Textbook of Remote Sensing and Geographical Information System, Atlantic Publishers.

List of Experiments

Experiment No.	Name of Tutorial / Experiment
1	Visual Image Interpretation: Photographic Products
2	Digital Interpretation of True Color Composite and False Color Composite
3	Image Registration and Geo-referencing
4	Image Enhancement
5	Image Transformation
6	Multiband Image Operations
7	Supervised Image Classification
8	Unsupervised Image Classification
9	Accuracy Assessment of image classification
10	Introduction to GIS, Spatial Data Generation
11	Linking of Spatial and Attribute Data
12	Linking of Spatial and Attribute Data
13	Integration of GIS and RS, civil engineering application

B. Tech. (Civil Engineering) Programme

SYLLABI

(Semester – 8)

CHAROTAR UNIVERSITY OF SCIENCE AND TECHNOLOGY

CL446: CONSTRUCTION PROJECT MANAGEMENT
B. TECH 8th SEMESTER (CIVIL ENGINEERING)

Credits and Hours:

Teaching Scheme	Theory	Practical	Total	Credit
Hours/week	3	2	5	4
Marks	100	50	150	

A. Objectives of the Course:

- To understand the work scenario of construction industry and to establish significance and objectives of construction project management.
- To impart knowledge about various functions and principles of construction management.
- To make students capable of identifying alternative methods for course of action and to select best course of action through feasibility analysis of construction project.
- To learn different planning tools applicable to construction like bar charts, Gantt charts and linked bar charts as well as network techniques like CPM and PERT in both AOA and AON. Demonstrating the same using examples.
- To analyze the cost time analysis to arrive at optimum cost time schedule with applications relevant to construction industry and also updating and rescheduling.
- To understand management of a quality construction project from start to completion while maintaining budget and schedule.
- To make students acquainted with tendering procedure and various constructions contract systems.

B. Outline of the Course:

Sr. No.	Title of the Unit	Minimum Number of Hours
1	Introduction to Construction Project Management	07
2	Project Feasibility Study	03
3	Management Techniques	05
4	Project Management Through Networks	05
5	Critical Path Method	10

6	Program Evaluation and Review Technique (PERT)	05
7	Resource Allocation and Resource Scheduling	05
8	Contracts and Tender	05

Total Hours (Theory): 45

Total Hours (Lab): 30

Total Hours: 75

C. Detailed Syllabus:

1	**Introduction to Construction Project Management**	**07 Hours**	**16%**
1.1	Introduction to Construction Management		
1.2	Necessity, objectives of construction management		
1.3	Unique features of Construction Project		
1.4	Stages in construction project management, Factors affecting various stages of construction management		
1.5	Construction Resources		
1.6	Function of Construction Management		
1.7	Causes of failures construction projects and its relevance with construction management		
2	**Project Feasibility Study**	**03 Hours**	**7%**
2.1	Need of Project Feasibility Study		
2.2	Technical Analysis		
2.3	Financial Analysis		
2.4	Economic Analysis		
2.5	Ecological Analysis		
3	**Management Techniques**	**05 Hours**	**11%**
3.1	Work Breakdown structure for various projects		
3.2	Gantt or Bar chart		
3.3	Mile stone Chart		
3.4	Line of Balance technique		
4	**Project Management Through Networks**	**05 Hours**	**11%**
4.1	Definition and Objective of network techniques		
4.2	Types of network		
4.3	Elements of network like activity, dummy and event		

4.4	Interrelationship of Events, Interrelationship of Activity		
4.5	Network Rules and Fulkerson's rule for Numbering Events		
4.6	Advantages of Network techniques over conventional techniques		
5	**Critical Path Method**	**10 Hours**	**22%**
5.1	Introduction		
5.2	Activity Time estimate-EST, LST, EFT, LFT		
5.3	Event time estimate- T_E, T_L		
5.4	Critical activities, Critical path and Floats		
5.5	Cost optimization by crashing a Network		
5.6	Updating of CPM Network		
6	**Program Evaluation and Review Technique (PERT)**	**05 Hours**	**11%**
6.1	PERT Network : Introduction , Difference between PERT and CPM		
6.2	Expected time, frequency distribution, mean, variance and standard deviation		
6.3	PERT Network Analysis		
7	**Resource Allocation and Resource Scheduling**	**05 Hours**	**11%**
7.1	Introduction		
7.2	Resource smoothing		
7.3	Resource leveling		
8	**Contracts and Tender**	**05 Hours**	**11%**
8.1	Contract- definition , Essentials of contract		
8.2	Types of contract & Suitability for construction projects		
8.3	Tender – definition, Tender Notice and Tender submission		
8.4	Opening of tender, Scrutiny of tender, Acceptance of tender		
8.5	Rejection of Tender		

D. Instructional Method and Pedagogy:

- At the start of course, the course delivery pattern, prerequisite of the subject will be discussed.
- Lectures will be conducted with the aid of multi-media projector, black board, OHP etc.
- Attendance is compulsory in lectures and laboratory.

- Internal exams will be conducted as per pedagogy as a part of internal theory evaluation.
- Assignments based on course content will be given to the students at the end of each unit/topic and will be evaluated at regular interval.
- Surprise tests/Quizzes/Seminar will be conducted as per pedagogy as a part of internal theory evaluation.
- The course includes tutorial, where students have an opportunity to build an appreciation for the concepts being taught in lectures.

E. Learning Outcomes:

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

- Explain various functions of construction management.
- Identify alternative methods of course of action and select best course of action through feasibility analysis of construction project.
- Apply basic principles of management and its applications in construction industry.
- Utilize Bar Charts, draw and analyze network diagrams using PERT and CPM techniques in construction industry applications.
- Estimate project durations which involve probability distribution curves.
- Manage resources through cost time trade off, updating, rescheduling and compressing with applications in construction industry.
- Understand the tendering procedure and various construction contract systems.

F. Recommended Study Material:

Text Books:

1. Chitkara, K. K., Construction Project Management Planning, Scheduling and Controlling, Tata McGraw Hill, New Delhi.
2. Jha, K.N., Construction Project Management, Pearson Publications.
3. Seetharaman, S., Construction Engineering & Management, Umesh Publications, 2007.
4. Peurifoy, L., Schexnayder, C.J. and Shapira, A., Construction Planning, Equipment and Methods, McGraw Hill, New Delhi, 8th Edition, 2010.

5. Punamia, B.C. and Khandelwal, K.K., Project Planning and Control with PERT and CPM, Laxmi Publications, New Delhi, 2004.
6. Kotadia, A.S., Construction Management and Equipments, Mahajan Publishing House.

Reference Books:

1. Sharma, M.R., Fundamnetals of Construction Planning and Management, S.K. Kataria & Son, New delhi, 2012.
2. Srinath, L.S., PERT & CPM Principles and Applications, Tata McGraw Hill, New Delhi.
3. Gahlot, P.S. and Dhir, B.M., Construction Planning & Management, New Age International (P) Ltd., New Delhi.
4. Sharma, S.C., Construction Equipment &Managemetn, Khanna Publications, New Delhi, 1988.
5. Sengupta and Guha, Construction Management and Planning, Tata McGraw Hill, New Delhi.

Web Materials:

1. http://www.umsl.edu/~sauterv/analysis/488_f02_papers/ProjMgmt.html
2. https://www.mpug.com/articles/pmp-prep-resource-leveling-and-resource-smoothing/
3. http://www.em-ea.org/guide%20books/book-1/1.7%20project%20management.pdf
4. http://teacher.buet.ac.bd/shakil_kashem/network%20technique-1.pdf
5. http://www.math.upatras.gr/~tsantas/DownLoadFiles/Hillier&Lieberman_7th-edition_Chapter10.pdf
6. https://www.youtube.com/watch?v=vUMGvpsb8dc
7. https://www.youtube.com/watch?v=4oDLMs11Exs
8. https://www.youtube.com/watch?v=nlki7GhssPo
9. https://www.izenbridge.com/blog/underlining-the-differences-between-resource-leveling-and-resource-smoothing/

CL447: WATER RESOURCES ENGINEERING - II
B. TECH 8th SEMESTER (CIVIL ENGINEERING)

Credits and Hours:

Teaching Scheme	Theory	Practical/Tutorial	Total	Credit
Hours/week	3	2	5	4
Marks	100	50	150	

A. Objective of the Course

- This course covers the advanced topics of Water Resources Engineering. The principles and application of the core branch of Civil Engineering is covered. The objectives of the course are to:
- To take up the basic concepts of various hydraulic structures.
- To introduce students the basic concepts of large scale water resources management as well as irrigation and drainage systems their design, planning and management.
- To develop analytical skills relevant to the areas mentioned above, particularly the design of irrigation and drainage projects.

B. Outline of the course:

Sr. No.	Title of the unit	Minimum number of hours
1.	Dams	14
2.	Reservoir	09
3.	Diversion Head Works	06
4.	Spillways & Energy Dissipators	04
5.	Canal Irrigation System	08
6.	Cross Drainage Works & Outlets	02
7.	Canal Regulation Works	02

Total Hours (Theory): 45
Total Hours (Lab): 30
Total Hours: 75

C. **Detailed Syllabus:**

1	**Dams**	**14 Hours**	**32%**
1.1	Definition, classification, factors affecting selection of type of dam		
1.2	Selection & investigation of site for a dam		
1.3	Earth dams: Types, foundation requirements, causes of failure, design criteria, suitable preliminary sections, seepage line determination & analysis, stability analysis - side slope, foundation, checking of stability, seepage control measures		
1.4	Rockfill dams: Foundation requirements, typical sections, design consideration for a rockfill dam		
1.5	Gravity dam: Definition, forces acting on dams, load combination for design, modes of failure & criteria for structural stability, stability analysis, elementary & practical profile, design of gravity dam, openings in dams		
2	**Reservoir**	**09 Hours**	**20%**
2.1	Definition, types, site selection factors		
2.2	Capacity-elevation and area elevation curves of a reservoir site, derivation & examples based on topic		
2.3	Storage zones		
2.4	Reservoir capacity: Catchment yield and reservoir yield, determination of dependable catchment yield of reservoir, fixing the reservoir capacity for the computed value of the dependable yield of the reservoir catchment, relation between the inflow, outflow and storage data for a reservoir, fixing the reservoir capacity from the annual inflow and outflow data, mass curve and demand curve		
2.5	Reservoir losses		
2.6	Reservoir sedimentation and control		
2.7	Reservoir clearance		

3	**Diversion Head Works**	**06 Hours**	**13%**
3.1	Classification of head works		
3.2	Types & components of diversion head works		
3.3	Location & typical layout of diversion headworks		
3.4	Difference between dam, weir and barrage		
3.5	Types of weirs with merits and demerits		
3.6	Criteria for designing weir and barrage		
3.7	Theories of subsurface flow: Bligh's creep theory, Lane's weighted creep theory, theory of seepage flow (critical gradient), Khosla's theory		
4	**Spillways & Energy Dissipators**	**04 Hours**	**9%**
4.1	Spillways: Definition, location, essential requirements, components, classification		
4.2	Energy Dissipators: Formation & types of hydraulic jump; Jump Height Curve (JHC), Tail Water Rating Curve (TWRC) and alternatives of JHC & TWRC, types of energy dissipators		
5	**Canal Irrigation System**	**08 Hours**	**18%**
5.1	Classification of canals, alignment		
5.2	Distribution system		
5.3	Cross section and longitudinal sections of canals		
5.4	Design of unlined canal in alluvial & non-alluvial soils		
5.5	Design of channel using Kennedy's Garrat's diagram & Lacey's regime diagram		
5.6	Canal lining & design		
6	**Cross Drainage Works & Outlets**	**02 Hours**	**4%**
6.1	Cross Drainage Works: Definition, types, selection criteria		
6.2	Outlets: Definition, requirements, types		
7	**Canal Regulation Works**	**02 Hours**	**4%**
7.1	Falls: Definition, necessity, location, types		
7.2	HR & CR: Definition, functions		
7.3	Escapes: Definition, necessity, types		

D. Instructional Method and Pedagogy:

- At the starting of the course, delivery pattern, prerequisite of the subject will be discussed.
- Lectures will be conducted with the aid of Multi-Media projector, Black Board, OHP etc.
- Attendance is compulsory in lectures and laboratory.
- Internal exams/Unit tests/Surprise tests/Quizzes/Seminar/Assignments etc. will be conducted as a part of continuous internal theory evaluation.
- The course includes a laboratory, where students will get opportunities to build appreciation for the concepts being taught in lectures.
- Experiments/Tutorials related to course content will be carried out in the laboratory.
- In the lectures and laboratory discipline and behavior will be observed strictly.
- Industrial visits will be organized for students to explore industrial facilities. Students are required to prepare a report on industrial visit and submit as a part of the assignment.

E. Student Learning Outcomes:

On the completion of the course one should be able to:

- Concepts of different hydraulic structures.
- Be able to plan and design irrigation projects.
- Design channels and other irrigation structures required for irrigation, drainage, soil etc.
- Conservation, flood control and other water-management projects.

F. Recommended Study Material:

Text Books:

1. Mahajan, S.P., Pollution Control in Process Industries, Tata McGraw Hill Publishing Company Ltd., New Delhi.
2. Washington, D.C., Eckenfelder, Industrial Water Pollution Control, McGraw hill Company, New Delhi, American Chemical Society, USA, 2000.

3. Rao, C.S., Environmental Pollution Control Engineering, Wiley Eastern Ltd., New Age International Ltd.
4. Rao, M.N. and Rao, H.V.N., Air Pollution, Tata McGraw-Hill

Reference Books:

1. Wark, K., Warner, C.F. and Davis, W.T., Air Pollution - Its Origin and Control, Harper & Row Publishers, New York, 1998.
2. Perkins, H.C., Air Pollution, McGraw Hill, 1974.
3. Stern, A.C., Air Pollution, Vol. - I, II, III.
4. Nemerow, N.N., Liquid Waste of Industry Theories, Practices and Treatment. Addison Willey, New York, 1971.
5. Ross, R.D., Industrial Waste Disposal, Reinhold Environmental Series – New York, 1978.
6. Tchobanoglous, G., Theissen, H. and Eliassen, R., Solid Waste Engineering - Principles and Management Issues,McGraw Hill, New York, 1991.

Web Materials:

1. http://www.epa.gov
2. http://www.indiaenvironmentportal.org.in
3. http://nptel.ac.in

List of Experiments

Experiment No.	Name of Experiment
1	Introduction to Sampling in water and wastewater analysis
2	Determination of BOD/COD ratio
3	Monitoring of Noise
4	Determination of PM10 and PM2.5 in ambient air
5	Determination of gaseous pollutants in ambient air
6	Determination of various parameters in solid waste
7	Treatability studies of industrial wastewater

CL448: PROFESSIONAL PRACTICES
B. TECH 8th SEMESTER (CIVIL ENGINEERING)

Credits and Hours:

Teaching Scheme	Theory	Practical/Tutorial	Total	Credit
Hours / Week	4	2	6	5
Marks	100	50	150	

A. Objectives of the Course:

The objectives of this course are

- To learn to prepare estimates of the civil engineering works and specification of construction items.
- To introduce the basic learning requirements for the civil engineer project manager and to make the appreciation for the qualitative nature of the construction project management.
- To gain in depth knowledge of professional practice as well the quantity analysis of construction works, like, buildings, Canal, Road & culverts, etc.

B. Outline of the Course:

Sr. No.	Title of the Unit	Minimum Number of Hours
1.	Estimation	**05**
2.	Rules & Method of Measurement	**04**
3.	Detailed Quantity Estimation	**30**
4.	Specification	**04**
5.	Rate Analysis	**07**
6.	Valuation	**10**

Total Hours (Theory): 60
Total Hours (Lab): 30
Total Hours: 90

C. **Detailed Syllabus:**

1.	**Estimation**	**05 Hours**	**8%**
1.1	General		
1.2	Purpose of estimates		
1.3	Types of estimates		
1.4	Approximate estimate, general principle of approximate estimate, Construction cost index, approximate method of costing for buildings, water supply and sanitary works.		
1.5	Detail estimate, data required for detail estimate, preparation of detail estimate, Standard measurement form, Abstract of measurement. Factors to be consider during preparation of a detailed estimate.		
1.6	Procedure of estimate		
1.7	Quantity estimate, Revised estimate, Supplementary estimate, complete estimate and Annual maintenance or repair estimate Data required for sanction of project, Administrative approval, expenditure sanction, Technical Sanction		
2	**Rules and Methods of Measurement**	**04 Hours**	**6%**
2.1	General rules which are applicable during the calculation of quantity for different associated items		
2.2	Principles in selecting units of measurement for items, various units and standard modes of measurement for different item of work and materials as per IS:1200 revised		
2.3	Deduction criteria for various item of works		
3.	**Detailed Quantity Estimation**	**30Hours**	**50%**
3.1	Building Estimate: General items of work for building estimate and their units of measurements, long wall short wall and centre line methods. • Estimation of quantity of load bearing structure. • Quantity analysis of R.C.C. component: footing, column, lintel, chajja, beam, slab, with schedule of bar bending, material estimate.		

- Quantity analysis of steel roof truss
- Abstract preparation

3.2 Estimate of retaining wall,

3.3 Estimate of a septic tank and soak pit including sanitary and water supply installations

3.4 Road work: Estimation of earthwork for roads. Estimates of Metalled road, Estimate of village road culvert

3.5 Irrigation work: Estimation of earthwork for canal. Quantity of lining work for canal. Estimate of aqueduct.

4 Specifications **04 Hours** **7%**

4.1 Definition

4.2 Objective, importance, use, types of specification

4.3 General and special specification

4.4 Specification for material and workmanship

4.5 Design and principles of specification

4.6 Sources of information

4.7 Typical specification of various item of works

5 Rate Analysis **07 Hours** **12%**

5.1 Rate analysis and requirement of the rate analysis

5.2 Factors affecting rate analysis

5.3 Method of preparation of rate analysis of work

5.4 Quantity of materials per unit rate of work

5.5 Estimating Labor

5.6 Cost of equipment or tools and plants

5.7 Overhead expenses

5.8 Contractor Profit

5.9 Task of work

5.10 Load of trucks

5.11 Rate analysis of all typical items of works for building construction

6 Valuation **10 Hours 17%**

6.1 Valuation, value, price and cost, purpose and principle of valuation

6.2 Different form of value

6.3 Mortgage and lease

6.4 Freehold and Leasehold property

6.5 Sinking Fund, depreciation, types of depreciation

6.6 Year of purchase

6.7 Outgoings

6.8 Methods of Valuation

6.9 Rent Fixation

D. Instructional Method and Pedagogy:

- At the start of course, the course delivery pattern, prerequisite of the subject will be discussed.
- Lectures will be conducted with the aid of multi-media projector, black board, OHP etc.
- Attendance is compulsory in lectures and laboratory.
- A presentation topic will be given to the student and consider as a part of internal theory evaluation.
- Internal exams will be conducted as per pedagogy as a part of internal evaluation.
- Assignments/Surprise tests/Quizzes/Seminar/Group project will be conducted as a part of internal theory evaluation.
- The course includes a laboratory, where students have an opportunity to build an appreciation for the concepts being taught in lectures.
- Tutorials related to course content will be carried out in the laboratory.

E. Students Learning Outcomes:

On the successful completion of this course

- The students will get a diverse knowledge of estimating, costing and professional practice, which will be use full in tackling real life problems.
- The students will be able to understand the procedure to carry out the estimation and steps to prepare reports of the construction works.

- The students will learn the purpose and importance of valuation.

F. Recommended Study Material:

Text Books:

1. Dutta, B.N., Estimating & Costing in Civil Engineering Theory and Practice, UBS Publishers & Distributors Limited, New Delhi, 1997.
2. Chakraborti, M., Estimating, Costing, Specification and Valuation on Civil Engineering, M. Chakraborty Publication, 2007.
3. Roshan Namavati, Theory & Practice Of Valuation, (Land & Buildings) for Architects, Engineers, Surveyors, Advocates, & Income Tax Practitioners, Universal Book Corp

Reference Books:

1. Patil, B.S., Civil Engineering Contracts, Vol. – I, Orient Longman Publication, 1998.
2. Rangwala, S.C., Elements of Estimating and Costing, Professional practice, Charotar Publishing House, Anand.
3. Aggarwal, A., Upadhyay, A.K., Civil Estimating, Costing &Valuation, S.K Kataria & Sons, New Delhi.
4. Chandola, S.P. and Vazirani, Estimating and Costing, Khanna Publication.

Web Materials:

1. http://nptel.iitm.ac.in/courses/Webcourse-contents/IIT%20Guwahati/cpm/index.html

CL449: DESIGN OF STRUCTURES-II
B. TECH 8th SEMESTER (CIVIL ENGINEERING)

Credits and Hours:

Teaching Scheme	Theory	Practical/Tutorial	Total	Credit
Hours/week	4	2	6	5
Marks	100	50	150	

A. Objective of the Course:

- To make student familiar with the fundamental design concepts of steel and reinforced cement concrete structures.
- To familiarize students about the theory and application of analysis and design of Multi-storey Building.
- To develop students with an understanding of the behavior and design of reinforced concrete members and systems of Multi-storey Building.
- To impart concepts of design of reinforced concrete structures such as staircase, retaining walls, Intze tank and combined footing.
- To familiarize the students with the knowledge of reinforcement detailing of structural members and scheduling.
- To introduce the student theory and application of steel structures such as plate girder, gantry girder, roof truss.
- To design the structural element such as plate girder and gantry girder for excessive moving load by selecting steel member.
- To equip the student with the analysis and design of roof truss considering effect of wind.

B. Outline of the Course:

Sr. No.	Title of the Unit	Minimum Number of Hours
1	Analysis & Design of Multi-storied Building	16
2	Design of Retaining Wall	10
3	Design of Intze Tank	06

4	Design of Steel Beam	05
5	Design of Plate Girder	07
6	Design of Gantry Girder	08
7	Analysis & Design of Roof Truss	08

Total Hours (Theory): 60
Total Hours (Lab): 30
Total Hours: 90

C. Detailed Syllabus:

1	**Analysis & Design of Multi-storied Building**	**16 Hours**	**27%**
1.1	Framed Buildings		
1.2	Loads, Distribution of Loads, Combination of Loads		
1.3	Structural Layout of Building		
1.4	Gravity Loads Analysis		
1.5	Typical Floor Design		
1.5.1	Design of Slab		
1.5.2	Design of Beams		
1.5.3	Analysis and Design of Column		
1.5.4	Design of Combined Footing		
1.6	Classifications of Stairs		
1.6.1	Design Requirements of Stairs		
1.6.2	Design of Dog-legged Stair		
1.7	Detailing of Members		
2	**Design of Retaining Wall**	**10 Hours**	**17%**
2.1	Types of Retaining Wall		
2.2	Active & Passive Earth Pressure		
2.3	Design of Cantilever Retaining Wall		
2.4	Design of Counter fort Retaining Wall		
3	**Design of Intze Tank**	**06 Hours**	**10%**
3.1	Introduction		
3.2	Analysis and Design		
3.3	Reinforcement in Cylindrical Wall		
3.4	Wind Forces on Container and Staging		

3.5	Checking of Column Design for Wind Loads		
4	**Design of Steel Beam**	**05 Hours**	**08%**
4.1	Beam Type, Section Classification, Lateral Stability, Effective Length		
4.2	Design of Laterally Supported Beams in Bending		
4.3	Design of Laterally Un-Supported Beams		
4.4	Shear Behaviour		
4.5	Web Buckling and Web Crippling		
5	**Design of Plate Girder**	**07 Hours**	**12%**
5.1	Introduction		
5.2	Components of Plate Girder		
5.3	Buckling of Plate Elements		
5.4	Buckling of Web Plate		
5.5	Requirements of Plate Girder Components		
5.6	Design of Plate Girder		
6	**Design of Gantry Girder**	**08 Hours**	**13%**
6.1	Introduction		
6.2	Loads on Gantry Girder		
6.3	Maximum Load Effects		
6.4	Selection of Gantry Girder		
6.5	Design of Gantry Girder		
7	**Analysis & Design of Roof Truss**	**08 Hours**	**13%**
7.1	Selection of the Type of Truss, Spacing of Truss		
7.2	Panel Layout of Truss		
7.3	Loads on the Roof Truss, Load Combinations		
7.4	Analysis of Roof Truss, Deflection of Truss		
7.5	Selection of Sections, Connections		
7.6	End Bearings, Bracing of Truss		
7.7	Design of Roof Truss		

D. Instructional Method and Pedagogy:

- At the start of course, the course delivery pattern, prerequisite of the subject will be discussed.
- Lectures will be conducted with the aid of multi-media projector, black board, videos, etc.
- Internal Exams/Assignments/Surprise tests/Quizzes/Seminar/Project, etc., will be conducted as a part of internal theory evaluation.
- The course includes a laboratory, where students have an opportunity to build an appreciation for the concepts being taught in lectures.
- Experiments/Tutorials/Term work related to course content will be carried out in the laboratory.

E. Students Learning Outcomes:

On the successful completion of this course

- The student will be able to recognize the design philosophy of steel and reinforced cement concrete structures.
- The student will be able to apply methods and computer software to analyze Multi-storey Building.
- The students can identify the typical failure modes of staircase, retaining walls and combined footing with detailing.
- The students will be able to understand the behavior of tanks under forces and application of design with detailing.
- The student will develop the understanding of structural drawings for practical execution of structures.
- Students will be able to give economical design of girder considering the effects of bending and shear with proper connections.
- Students will be able to understand the force transfer mechanism of roof truss and economical design of members.

F. Recommended Study Material:

Text Books:

1. Shah, H. J., Reinforced Concrete Vol-I & II, Charotar Publishing House.
2. Varghese, P. C., Limit State Design of Reinforced Concrete, Prentice – Hall of India.
3. S Unnikrishna Pillai & Devdas Menon, Reinforced Concrete Design, Second Edition, Tata McGraw Hill
4. Punamia, B. C., & Jain, A.K., R.C.C. Designs (Reinforced Concrete Sturctures), Laxmi Publications (P) Ltd.
5. Duggal, S.K., Limit State Design of Steel Structures, McGraw Hill Education (P) Ltd, New Delhi
6. Subramanian, N., Steel Structures: Design and Practice, Oxford University Press.

Reference Books:

1. Shah, V.L., & Karve, S.R., Limit State Theory and Design of Reinforced Concrete, Structures Publications.
2. Ramchandra & Gehlot V., Limit State Design of Concrete Structures, Scientific Publishers, India.
3. Sinha, S.N., Handbook of Reinforced Concrete Design, Tata McGraw Hill Publishing Company Limited
4. S.S. Bhavikatti, Design Of Steel Structures (By Limit State Method As Per IS: 800), I. K. International Pvt Ltd,.
5. V L Shah,Veena Gore, Limit State Design of Steel Structures, Structures publications.

IS Specifications:

1. IS: 456, Plain and Reinforced Concrete-Code of Practice
2. IS: 875 (Part 1 to 5), Code of Practice for Design Loads
3. IS: 800, General Construction in Steel- Code of Practice
4. SP 16, Design Aids for Reinforced Concrete to IS: 456
5. SP 34, Handbook on Concrete Reinforcement and Detailing
6. SP 6, Handbook for Structural Engineers

Term Work:

1. Analysis & Design of Multi-storied Building along with Detailing of Structural Elements in Drawing Sheet
2. Design of Cantilever and Counterfort Retaining Wall
3. Design of Intze Tank
4. Design of Steel Beam
5. Design of Plate Girder
6. Design of Gantry Girder
7. Design of Roof Truss
8. Drawing Sheets of Multi-storied Building, Cantilever and Counterfort Retaining Wall, Intze Tank, Roof Truss

CL450: PROJECT
B. TECH 8th SEMESTER (CIVIL ENGINEERING)

Credit and Hours:

Teaching Scheme	Project	Total	Credit
Hours/Week	30	150	5
Marks	150	150	

A. Objective of the Course:

- To enhance their industrial experience, make them familiar with the industry culture and work ethics.
- To make students conversant about formulation and evaluation of Infrastructure projects.
- To make students understand the applications of civil engineering related theoretical concepts in field.
- To enhance their soft-skills, presentation skills, interpersonal skills, documentation skills and office etiquettes required to sustain in industrial environment.
- To understand the professional and ethical responsibilities of an engineer.
- To participate in team work and preferably to work as part of a multi-disciplinary team.

B. Outline of the Course:

Sr. No	Title of Unit	Percentage weightage %
1.	Selection of the Project Topic	**05**
2.	Progress of Project	**20**
3.	Report Writing	**50**
4.	Presentation	**25**

C. **Detailed Syllabus:**

1.	**Selection of the Project Topic**	**05%**
1.1	Type of Project will be assigned to a student / group of students based on their inclination / willingness / interest	
2.	**Progress of Project**	**20%**
2.1	Students should need to report to respective project mentor at every week regarding the progress of the respective project	
3.	**Report Writing**	**50%**
3.1	The students are required to prepare a report including the Preamble, Objectives, Scope, Study Area Selection, Activities learned during project, Design or any task to be asked to performed by mentor, Conclusions, Recommendations and Annexure of the concerned project	
4.	**Presentation**	**25%**
4.1	At the end of the semester presentation will be prepared by student/group of students to evaluate the project.	

D. **Methods and Pedagogy:**

- Type of Project will be assigned to a student / group of students based on their inclination/willingness/interest.
- The project may include a site visit as per the project type, where group of students can avail an opportunity to build an appreciation for the concepts to be utilized in understanding the actual scenario.
- Work progress of the project will be assessed and evaluated based on the guidelines mentioned in section C at the end of the semester. It carries a weightage of 75 Marks as a part of internal evaluation.
- At the end of the semester, students have to submit the final project report. The project report should consist of at least 40-50 pages and at the most 70 pages.
- At the end of semester, a presentation of the project is required to be done in group or individually on scheduled date for at least 15 minutes.
- At the end of the semester, the projects will be evaluated as per the guidelines mentioned in section C in consultation with subject experts. It carries a weightage of 75 Marks as a part of University Evaluation.

E. Learning Outcomes:

After completion of the course students will able:

- To apply knowledge and skills learned in company/industry/organization to real-world problems.
- To solve engineering problems.
- To function as a team.
- To work with teammates from other disciplines.
- To use experience related to professional and ethical issues in the work environment.
- To explain the impact of engineering solutions, developed in a project, in a global, economic, environmental, and societal context.
- To find relevant sources (e.g., library, Internet, experts) and gather information.
- To demonstrate knowledge of contemporary issues related with engineering in general.
- To use new tools and technologies.

F. Recommended Study Material:

- Project related study is to be carried out by each student/group of students.
- Reference Books/Text Books
- e – Books
- e – Journals
- IS-Codes

CL481: DESIGN OF STRUCTURES USING INTERNATIONAL CODES
B. TECH 8th SEMESTER (CIVIL ENGINEERING)
PROGRAMME ELECTIVE - IV

Credits and Hours:

Teaching Scheme	Theory	Practical / Tutorial	Total	Credit
Hours/week	3	2	5	4
Marks	100	50	150	

A. Objectives of the Course:

The main objectives of the course are:

- To provide an understanding of the design concept of concrete structures by Euro code.
- To make the students aware of the basics of ACI Code and Euro Code.

B. Outline of the Course:

Sr. No.	Title of the Unit	Minimum Number of Hours
1.	Overview of ACI 318	15
2.	Euro code 2 – Design of concrete Structures	30

Total Hours (Theory): 45
Total Hours (Lab): 30
Total Hours: 75

C. Detailed Syllabus:

1	**Overview of ACI 318**	**15 Hours**	**33%**
1.1	Standards for tests and materials		
1.2	Construction Requirements: Durability, Concrete quality, mixing and placing, Formwork, Embedded pipes and construction joints Details of Reinforcement		
1.3	General Requirements : Analysis and design- general considerations, Strength and serviceability requirements, Flexural and axial loads, Shear and Torsion		
1.4	Structural Systems or Elements: two way Slab systems, Walls, Footings, Composite concrete flexural members		
1.5	Informatives: Appendix C (Alternative load and strength reduction factor), Appendix E (Steel reinforcement information)		
2	**Euro code 2 – Design of Concrete Structures**	**30 Hours**	**67%**
2.1	Scope of Euro code 2		
2.2	Materials : Concrete, Reinforcing steel, Design compressive and tensile strengths, Ductility characteristics		
2.3	Durability and cover to reinforcement: Requirements for durability, Methods of verifications, Minimum cover		
2.4	Ultimate Limit States (ULS): Bending with or without axial force, Shear, Members not requiring design shear reinforcement, Members requiring design shear reinforcement, Shear between web and flanges of T-sections, Shear at the interface between concrete cast at different times, Shear and transverse bending, Torsion, Design procedure		
2.5	Serviceability Limit States (SLS): Stresses, Crack control, General considerations, Minimum reinforcement areas, Control of cracking without direct calculation, Calculation of crack widths, Deflection control, General considerations, Cases where calculations may be omitted.		

2.6 Detailing of members and particular rules: General, Beams, Shear reinforcement, Columns, Transverse reinforcement, Deep beams, Foundations,

2.7 Informatives: Annexure A (Modification of partial factors for materials), Annexure B (Creep and shrinkage strain), Annexure C (Properties of reinforcement suitable for use with this Euro code), Annexure E (Indicative strength classes for durability), Annexure F (Tension reinforcement expressions for in-plane stress conditions), Annexure J (Detailing rules for particular situations)

D. Instructional Method and Pedagogy:

At the start of course, the course delivery pattern, prerequisite of the subject will be discussed.

- Lectures will be conducted with the aid of multi-media projector, black board, OHP etc.
- Attendance is compulsory in lectures and laboratory.
- Internal exams will be conducted as per pedagogy as a part of internal theory evaluation.
- Assignments based on course content will be given to the students at the end of each unit/topic and will be evaluated at regular interval.
- Surprise tests/Quizzes/Seminar will be conducted as per pedagogy as a part of internal theory evaluation.
- The course includes a laboratory, where students have an opportunity to build an appreciation for the concepts being taught in lectures.
- Experiments/Tutorials related to course content will be carried out in the laboratory.

E. Students Learning Outcomes:

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

- To understand and design reinforced concrete structures by using the concepts of Euro code.

- To understand and design reinforced concrete structures by using the concepts of ACI code.
- To deal with design procedures with different fundamentals.

F. Recommended Study Material:

Reference Books:

1. Prab Bhatt, T.J. MacGinley, & Ban Seng Choo, Reinforced Concrete Design to Eurocodes: Design Theory and Examples, Fourth Edition, CRC Press, United States
2. W.M.C. McKenzie, Design of Structural Elements, Palgrave Macmillan
3. W.H. Mosley, Reinforced Concrete Design: to Eurocode 2, Palgrave Macmillan

Web Materials:

1. http://www.phd.eng.br/wp-content/uploads/2015/12/en.1992.2.2005.pdf
2. http://www.eurocodes.fi/1992/paasivu1992/sahkoinen1992/1110_WS_EC2.pdf
3. http://publications.lib.chalmers.se/records/fulltext/188834/188834.pdf
4. https://archive.org/stream/gov.law.aci.318.1995/aci.318.1995#page/n11/mode/2up

CL482: FIELD APPLICATIONS OF GEOTECHNICAL ENGINEERING
B. TECH 8th SEMESTER (CIVIL ENGINEERING)
PROGRAMME ELECTIVE - IV

Credits and Hours:

Teaching Scheme	Theory	Tutorial/ Practical	Total	Credit
Hours/week	3	2	5	4
Marks	100	50	150	

A. Objective of the Course:

The main objectives of the course are

- To make students aware about Reinforced Soil Structures.
- To explain how properties of soil can be modified as per requirement.
- To explain design of foundation for marine structures.
- To explain the role of geosynthetics for improvement of various properties of structures.
- To explain the use of remote sensing in geotechnical engineering.

B. Outline of the Course:

Sr. No.	Title of the Unit	Minimum Number of Hours
1	Reinforced Soil Structures	10
2	Ground Improvement Techniques	12
3	Foundation of Marine Structures	09
4	Geosynthetics in Civil Engineering	06
5	Remote Sensing Applications in Geotechnical Engineering	08

Total Hours (Theory): 45
Total Hours (Lab): 30
Total Hours: 75

C. **Detailed Syllabus:**

1	**Reinforced Soil Structures**	**10 Hours**	**22%**
1.1	Concept of soil reinforcement		
1.2	Reinforcing materials and their properties		
1.3	Design of soil reinforcement for stability		
1.4	Durability of reinforcement materials		
1.5	Applications of Reinforced earth structures		
2	**Ground Improvement Techniques**	**12 Hours**	**27%**
2.1	Principles of ground improvement		
2.2	Properties of compacted soil, Compaction control tests.		
2.3	Mechanical Stabilization: Principle of mechanical modification, Dynamic Stabilization, Vibro-floatation, Pre-compression and Compaction piles.		
2.4	Hydraulic modification, Dewatering systems, Preloading and vertical drains, Sand Drain, Electro-kinetic dewatering		
2.5	Chemical modification, Modification by admixtures		
2.6	Bearing capacity & Slope stability improvement		
3	**Foundation of Marine Structures**	**09 Hours**	**20%**
3.1	Origin, Nature and distribution of marine soils and their engineering properties		
3.2	Sampling and sample disturbance, In-situ testing of marine soil		
3.3	Offshore platforms		
3.4	Shallow foundations on marine soil		
3.5	Deep foundations on marine soil		
4	**Geosynthetics in Civil Engineering**	**06 Hours**	**13%**
4.1	Introduction: An overview on the development and applications various geosynthetics, geotextiles, geogrids, geonets, geomembranes and geo-composites.		
4.2	Designing with geotextiles: Geotextile properties and test methods, functions, designing for separation, reinforcement, stabilization, filtration, drainage.		
4.3	Different test on geosynthetics		

5	**Remote Sensing Applications in Geotechnical Engineering**	**08 Hours**	**18%**

5.1 Definitions and introduction to remote sensing

5.2 Components of remote sensing system,

5.3 Active and passive remote sensing, electromagnetic radiations and their interactions with the earth features and atmosphere. Spectral windows and spectral signatures and their significance in remote sensing

5.4 Radiometric quantities used in the collection of spectral signatures

5.5 Remote sensing satellite orbits, image acquisition process

5.6 Various remote sensing platforms like ground based, air borne and satellite based. Passive and active remote sensors

D. Instructional Method and Pedagogy:

- At the start of course, the course delivery pattern, prerequisite of the subject will be discussed.
- Lectures will be conducted with the aid of multi-media projector, black board, OHP etc.
- Attendance is compulsory in lectures and laboratory.
- Internal exams / Unit tests will be conducted as per pedagogy as a part of internal theory evaluation.
- Assignment/Surprise tests/Quizzes/Seminar will be conducted which carries 5 Marks as a part of internal theory evaluation.
- The course includes a tutorial class where students have an opportunity to build an appreciation for the concepts being taught in lectures.
- Tutorials related to course content will be carried out in the laboratory.

E. Students Learning Outcomes:

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

- Design reinforced soil structures.
- Improve various properties of soil in economical way.
- Identify important aspects of foundation design for marine structures.

- Identify which types of geosynthetics are required for given engineering problems.
- Apply remote sensing outputs in geotechnical problems.

F. Recommended Study Material:

Text Books:

1. Koerner, R.M., Designing with Geosynthetics, (Third Edition), Prentice Hell, 1997.
2. Reinforced Soil and Geo-textiles- J. N. Mandal, proceedings FIGC- 1988, Oxford and IBH publishing company private Ltd., New Delhi.
3. Remote Sensing and image interpretation by Lilles and T.M. and Kiefer R.W. John Wiley and Sons. New York.
4. H. G. Poulos, Marine Geotechniques, Unwin Hyman, London.
5. Swamisaran, Analysis and Design of Substructures, Oxford & IBH Publishing company Private Ltd., Delhi.
6. Dr. Purushothama Raj, Ground Improvement Techniques, Laxmi Publications, New Delhi.

Reference Books:

1. Jewell, R.A., Soil Reinforcement with Geotextile, CIRIA, London, 1996.
2. Remote Sensing in Civil Engineering, by Kennie, T.J.M. and Matthews M.C. Surrey University Press, Glasgow. Taylor,
3. Hausmann, M.R., Engineering Principles of Ground Modification, McGraw Hill, 1990.
4. Jones, C.J.F.P., Earth Reinforcement and Soil Structures, Butterworth Publications, 1996.

Web Materials:

1. http://edudel.nic.in
2. http://bis.org.in/other/quake.htm
3. http://www.thepeninsulaneighborhood.com/ThePlan.html
4. http://www.historytution.com/indus_valley_civilization/town_planning.html

List of Tutorials

Tutorial No.	Name of Tutorial
1	Reinforced Soil Structures
2	Ground Improvement Techniques
3	Foundation of Marine Structures
4	Geosynthetics in Civil Engineering
5	Remote Sensing Applications in Geotechnical Engineering

CL483: STRUCTURAL DYNAMICS & EARTHQUAKE ENGINEERING
B. TECH 8th SEMESTER (CIVIL ENGINEERING)
PROGRAM ELECTIVE- IV

Credits and Hours:

Teaching Scheme	Theory	Practical/ Tutorial	Total	Credit
Hours/week	3	2	5	4
Marks	100	50	150	

A. Objectives of the Course:

- To gain knowledge of the nature and effect of earthquakes
- To learn about fundamental structural dynamics, seismology, structural earthquake response.
- To gather knowledge about earthquake mechanics, earthquake-induced effects, hazard and risk assessment and earthquake resistant design, as well as emergency response.

B. Outline of the Course:

Sr. No.	Title of the Unit	Minimum Number of Hours
1	Theory of vibrations	15
2	Earthquake Basics & Design Philosophy	08
3	Lateral Load Analysis of Building	10
4	Ductile Detailing	06
5	Special Topics	06

Total Hours (Theory): 45
Total Hours (Lab): 30
Total Hours: 75

C. **Detailed Syllabus:**

1	**Theory of vibrations**	**15 Hours**	**34%**
1.1	Introduction, Difference between Static and Dynamic load, Basic Terminologies		
1.2	Simplified single degree of freedom system, mathematical modeling of buildings, natural frequency, resonance v/s increased response		
1.3	Responses of buildings to different types of vibrations like free and forced, damped and un-damped		
1.4	Response to multi degree (maximum three) of freedom systems, mode shapes		
2	**Earthquake Basics & Design Philosophy**	**08 Hours**	**18%**
2.1	Introduction of Earthquake, Definitions of basic terms		
2.2	Causes of earthquake and their characteristics, Seismographs, Seismic Zoning practices in India, Seismic Codes		
2.3	Earthquake parameters, Characterization of ground motion		
2.4	Earthquake Intensity & Magnitude, Recording Instruments		
2.5	Philosophy of earthquake resistant design, earthquake proof v/s earthquake resistant design		
2.6	Four virtues of earthquake resistant (strength, stiffness, ductility and configuration), Seismic structural		
2.7	Damages caused during past earthquakes (worldwide)		
3	**Lateral Load Analysis of Building**	**10 Hours**	**22%**
3.1	Lateral analysis of the building systems, Lateral load distribution,		
3.2	Torsionally coupled and un-coupled systems		
3.3	Design Lateral Loads for RC Building Concept of Response Spectra, Design Response Spectrum		
3.4	Equivalent lateral load concept, Rigid floor diaphragm, Codal Provisions		

4	**Ductile Detailing**	**06 Hours**	**13%**
4.1	Concept of ductile detailing, IS 13920 provisions for RC frame.		
5	**Special Topics**	**06 Hours**	**13%**
5.1	Introduction of different control systems: Passive control: base isolation and active control: bracing system, TMD and some latest invention		
5.2	Soil liquefaction, causes and its remedial measure		
5.3	Introduction to Disaster Management: Types of Disaster, Phases of disaster management, Disaster rescue, psychology and plan of rescue operations		

D. Instructional Method and Pedagogy:

- At the start of course, the course delivery pattern, prerequisite of the subject will be discussed.
- Lectures will be conducted with the aid of multi-media projector, black board, OHP etc.
- Attendance is compulsory in lectures and laboratory.
- Internal exams will be conducted as per pedagogy as a part of internal theory evaluation.
- Assignments based on course content will be given to the students at the end of each unit/topic and will be evaluated at regular interval.
- Surprise tests/Quizzes/Seminar will be conducted.
- The course includes a laboratory, where students have an opportunity to build an appreciation for the concepts being taught in lectures.
- Experiments/Tutorials related to course content will be carried out in the laboratory.

E. Students Learning Outcomes:

On the successful completion of this course

- The students will be able to understand causes, types and measurement of an earthquake.
- The students will be able to develop response spectrum for earthquake ground motion and estimate lateral load on the structures as per codal stipulations.

- The students will be able to analyze and design various lateral load resisting systems.
- The students will be able to appraise concept of ductility and related codal specification for earthquake resistant design.
- The students will be understand basic earthquake mechanisms, tectonics, types of ground motion, and propagation of ground motion and interpret earthquake ground motion data.

F. Recommended Study Material:

Text Books:

1. Chopra, A.K., Dynamics of Structures, Prentice Hall, N.J.
2. Mario Paz, Structural Dynamics, McGraw-Hill
3. Manish Shrikhande & PankajAgrawal; Earthquake resistant design of structures, PHI Publication, New Delhi
4. Duggal, S.K., Earthquake resistance design of structures; Oxford University Press, New Delhi.

Reference Books:

1. Park & Pauly, Behavior of RC Structure
2. Clough & Penzin, Dynamics of structures, McGraw-Hill.
3. IITK-GSDMA EQ27 – V-3.0, Design Example of a Six Storey Building
4. Murthy, C.V.R., Earthquake Tips, NICEE

Web Materials:

1. http://en.wikipedia.org/wiki/Earthquake_engineering
2. http://www.curee.org
3. http://www.earthquakeengineering.com/
4. http://www.nicee.org/

Other Materials:

1. IS: 875, Code of Practice for Design Loads
2. IS: 1893 (Part-I), Criteria for Earthquake Resistant Design
3. IS: 4327, Earthquake Resisting Design & Construction Building

2. IS: 13920, Ductile Detailing of RC Structures
3. IS: 13827, Earthquake Resistance of Earthen Buildings
4. IS: 13828, Earthquake Resistance Low Strength Masonry Buildings

CL484: TRANSPORT PROJECT PLANNING & EVALUATION
B. TECH 8th SEMESTER (CIVIL ENGINEERING)
PROGRAMME ELECTIVE - IV

Credits and Hours:

Teaching Scheme	Theory	Practical/ Tutorial	Total	Credit
Hours/week	3	2	5	4
Marks	100	50	150	

A. Objectives of the Course:

- To cover the major areas of Transportation Planning, Management and Economics at introductory level to provide the student with basic rational and a set of design concept.
- To introduce the issues of transportation planning and transportation policy.
- To impart knowledge in the rudiments and advancements in Transportation planning and Travel Demand Forecasting.
- To introduce travel survey methods for understanding travel behavior.
- To identify the role of various modes of Mass Transportation like Bus and Rail and its Planning and Management.
- Help in formulation and evaluation of Transportation Engineering projects using software's.

B. Outline of the Course:

Sr. No.	Title of the Unit	Minimum Number of Hours
1	Introduction	02
2	Travel Survey and Traffic Impact Assessment	04
3	Transportation Planning Process and Modeling	15
4	Public to Transportation Systems	07
5	Transportation System Management	04
6	Travel Demand, Elastic Model and Demand Management	04

7	Project Formulation and Evaluation Techniques	06
8	Introduction Transportation Engineering Softwares	03

Total Hours (Theory): 45
Total Hours (Lab): 30
Total Hours: 75

C. Detailed Syllabus:

1	**Introduction**	**02 Hours**	**4%**
1.1	Introduction to planning		
1.2	Levels of planning, Objectives & goals of planning		
1.3	Road Infrastructure planning and evaluation of projects		
1.4	Planning Morphology		
2	**Travel Survey and Traffic Impact Assessment**	**04 Hours**	**9%**
2.1	Travel Survey: Travel Survey Process		
2.2	Travel Survey: Data Processing and Interpretation, Future Methodologies		
2.3	Traffic Impact Assessment: Content of TIA		
2.4	Traffic Impact Assessment: TIA and Transportation Planning		
3	**Transportation Planning Process and Modeling**	**15 Hours**	**33%**
3.1	Conventional and Four Stage Modeling Process		
3.2	Trip Generation Models		
3.3	Trip Distribution Models and Calibration		
3.4	Trip Assignment Models		
3.5	Mode Choice and Modal Split Models.		
4	**Public Transportation Systems**	**07 Hours**	**16%**
4.1	Introduction to public transportation systems		
4.2	Transit Classification and Right of way		
4.3	Transit System Performance: Transit Capacity, Frequency and Headway, Quality of Service		
4.4	Bus Rapid Transit: System, Technology and Operation		
4.5	Rail Rapid Transit: System, Technology and Operation		
4.6	Multi-modal Transportation System		
5	**Transportation System Management**	**04 Hours**	**9%**

5.1	Introduction to TSM		
5.2	Need, scope and Strategies for TSM		
5.3	TSM planning & classification		
6	**Travel Demand, Elastic Model and Demand Management**	**04 Hours**	**9%**
6.1	Demand Management		
6.2	Elastic Model: Types of elasticity, Sensitivity & elasticity		
6.3	Sensitivity of travel demand, Factors affecting Elasticity		
6.4	Demand Model- Kraft Demand Model		
6.5	Traffic Management Measures		
6.6	Advantages and Disadvantages		
7	**Project Formulation and Evaluation Techniques**	**06 Hours**	**14%**
7.1	Surveys and Investigations- Traffic Surveys, Conventional Ground Survey, Drainage Study, Soil Investigation, Pavement Design Investigation		
7.2	Design Drawing, Estimate and Project Report- Design, Drawing, Estimate, Earthwork Quantities, Project Reports, Stages in project preparation		
7.3	Transport Pricing- Methods of road pricing, Transport costs, Elasticity of demand, Average cost and Marginal cost pricing, Pricing Policy, Congestion Pricing, Public and Private Transport Pricing		
8	**Introduction to Transportation Engineering Softwares**	**03 Hours**	**6%**
8.1	Introduction		
8.2	Mx Road, TransCAD		
8.3	IIT Pave, VISSIM, VISUM		
8.4	HDM4		

D. Instructional Method and Pedagogy:

- At the start of course, the course delivery pattern, prerequisite of the subject will be discussed.
- Lectures will be conducted with the aid of multi-media projector, black board, OHP etc.
- Attendance is compulsory in lectures and laboratory.
- Internal exams will be conducted as per pedagogy as a part of internal theory evaluation.
- Assignments based on course content will be given to the students at the end of each unit/topic and will be evaluated at regular interval.
- Surprise tests/Quizzes/Seminar will be conducted.
- The course includes a laboratory, where students have an opportunity to build an appreciation for the concepts being taught in lectures.
- Experiments/Tutorials related to course content will be carried out in the laboratory.

E. Students Learning Outcomes:

The course contents should be taught with the aim to develop required knowledge and skills so that they are able to acquire following competency:

- The students would be able to understand and evaluate current scenarios of traffic management and improve it.
- Basic understanding of transportation planning its theoretical backgrounds and applications.
- The students would also be able to correlate economy and growth of transportation sector along with basic knowledge to quantify the benefits from well-developed transportation facilities.
- Students would be aware of the Principles and Planning of Transportation Infrastructure.
- Skill for collecting data about travel behavior and analyzing the data for use in transport planning.
- The students would have knowledge on planning of various transit systems like bus and rail, their scheduling and management strategies.

- Students would be equipped with the economic principles in dealing with transport supply and demand.
- The students would gain knowledge on various Transportation software tools and their application in solving transportation problems on a real time basis.

F. Recommended Study Material:

Text Books:

1. Khanna, S.K. & Justo, C.E.G., Highway Engineering, NemChand & Bros, Roorkee (U.A).
2. Kadiyali, L.R., Traffic Engineering & Transport Planning, Khanna Publishers, New Delhi.
3. Kadiyali, L.R. & Lal, N.B., Principles & Practices of Highway Engineering, Khanna Publishers, New Delhi.
4. Jotin Khisty, S.C. and Kent Lall, B., Transportation Engineering – An Introduction, Pearson Prentice-Hall, NJ
5. Salter, R J., Highway Traffic Analysis and Design, ELBS

Reference Books:

1. Sharma, S.K., Principles, Practice and Design of Highway Engineering, S. Chand & Co., New Delhi.
2. Hutchinson, B.G., Principles of Urban Transport Systems Planning, Scripta, McGraw-Hill, NewYork, 1974.
3. Hutchison, B.G., Introduction to Transportation Engineering, & Planning, McGraw Hill Book Co.
4. John W. Dickey, Metropolitan Transportation Planning, Tata McGraw Hill Pub. Co.
5. Vukan R. Vuchic, Urban Public Transportation System & Technology, Prentice Hall, Inc.
6. Papacostas C.S., Prevedouros, "Transportation Engineering and Planning, 3rd Edition, Prentice Hall of India, New Delhi, 2002
7. Rajaraman, V., Computer Oriented Numerical Methods, Prentice – Hall of India, 1995

8. Chapra S.C., and Canale R.P., Numerical Methods for Engineers, McGraw – Hill, 2004
9. Michael J.Bruton , "An Introduction to Transportation Planning", Hutchinson,1985
10. Michael D.Meyer and Eric J.Miller , "Urban Transportation Planning – A Decision Oriented Approach", McGraw Hill Book Company, New York,1984
11. F.D.Hobbs, "Traffic Planning and Design", Poargam on Oress
12. John W.Dickey, "Metropolitan Transportation Planning" – Tata McGraw Hill Publishing Company Limited, New Delhi, 1980.
13. Paul H.Wright, "Transportation Engineering – Planning and Design", John Wiley and Sons, New York, 1989.

List of Tutorials

Tutorial No.	Name of Tutorial
1	Introduction
2	Travel Survey and Traffic Impact Assessment
3	Transportation Planning Process and Modeling
4	Public Transportation Systems
5	Transportation System Management
6	Travel Demand, Elastic Model and Demand Management
7	Project Formulation and Evaluation Techniques
8	Introduction to Transportation Engineering Softwares

CL485: WATERSHED MANAGEMENT
B. TECH 8th SEMESTER (CIVIL ENGINEERING)
PROGRAMME ELECTIVE - IV

Credits and Hours:

Teaching Scheme	Theory	Practical/Tutorial	Total	Credit
Hours/week	3	2	5	4
Marks	100	50	150	

A. Objective of the Course:

This course covers the fundamental topics of Watershed Management, their principles as well as applications in the field of civil engineering. The objectives of the course are

- To introduce the fundamental principles and concepts of watershed management.
- To comprehend different approaches towards storm water management, rainwater harvesting, flood and drought management.
- To understand soil erosion, watershed modelling, and water quality problems.
- To learn concept of integrated watershed management.
- To understand the concepts of development and planning of watershed.

B. Outline of the course:

Sr. No.	Title of the unit	Min. no. of hours
1.	Introduction and basic concepts	**04**
2.	Watershed modelling	**07**
3.	Soil Erosion Modelling	**05**
4.	Management of Water Quality	**06**
5.	Storm Water and Flood and Drought Management	**06**
6.	Integrated Watershed Management	**07**
7.	Urban Storm-water Management	**05**
8.	Use of modern techniques in watershed management	**05**

Total Hours (Theory): 45
Total Hours (Lab): 30
Total Hours: 75

C. **Detailed Syllabus:**

1	**Introduction and basic concepts**	**04 Hours**	**09%**
1.1	What is Watershed, Watershed management, historical look at watershed management		
1.2	Basic hydrology, occurrence and movement of water		
1.3	Human interventions to manage water flow or quality		
2	**Watershed modeling**	**07 Hours**	**16%**
2.1	Standard modeling approaches and classifications		
2.2	System concept for watershed modeling		
2.3	Modeling of rainfall-runoff process, subsurface flows and groundwater flow		
3	**Soil Erosion Modeling**	**05 Hours**	**11%**
3.1	Soil Erosion, Soil water Relationship		
3.2	Types and causes of soil erosion, Estimation of soil erosion		
3.3	Different methods to control soil erosion		
4	**Management of Water Quality**	**06 Hours**	**13%**
4.1	Water quality and pollution, types and sources of pollution		
4.2	Water quality modeling		
4.3	Environmental guidelines for water quality		
5	**Storm Water and Flood and Drought Management**	**06 Hours**	**13%**
5.1	Storm water management, design of drainage system,		
5.2	Estimation of design flood and design droughts in a watershed		
5.3	Flood routing through channels and reservoir, flood control and reservoir operation		
5.4	Drought assessment and classification, drought analysis techniques		
5.5	Drought mitigation planning		
6	**Integrated Watershed Management**	**07 Hours**	**16%**
6.1	Introduction to integrated approach, conjunctive use of water resources		
6.2	Rainwater harvesting, Different methods of water harvesting		

6.3	Proposed water harvesting in India through interlinking of rivers		
7	**Urban Stormwater Management**	**05 Hours**	**11%**
7.1	Issues pertaining to watershed management in urban environments		
7.2	Methods to control pollution from urban stormwater		
7.3	Measures to control urban stormwater pollution		
8	**Use of modern techniques in watershed management**	**05 Hours**	**11%**
8.1	Applications of Geographical Information System(GIS) and Remote Sensing(RS) in Watershed Management		
8.2	Role of RS and GIS in in Watershed Management and Decision Support System		

D. Instructional Method and Pedagogy:

- At the starting of the course, delivery pattern, prerequisite of the subject will be discussed.
- Lectures will be conducted with the aid of Multi-Media projector, Black Board, OHP etc.
- Attendance is compulsory in lectures and laboratory.
- Internal exams/Unit tests/Surprise tests/Quizzes/Seminar/Assignments etc. will be conducted as a part of continuous internal theory evaluation.
- The course includes a laboratory, where students will get opportunities to build appreciation for the concepts being taught in lectures.
- Experiments/Tutorials related to course content will be carried out in the laboratory.
- In the lectures and laboratory discipline and behaviour will be observed strictly.
- Minimum one watershed visit and two virtual visits will be organized for students to explore application of conceptual learning. Students are required to prepare a report on site visit and submit as a part of the laboratory work.

E. Student Learning Outcomes:

On the completion of the course one should be able to:

- Understand the fundamental principles and concepts of watershed management.

- Apply various approaches towards storm water management, rainwater harvesting, and flood and drought management.
- Apprehend soil erosion, watershed modelling, and water quality problems.
- Attest the concept of integrated watershed management.
- Corroborate for development and planning of watershed.

F. Recommended Study Material:

Text Books:

1. Watershed Management by J.V.S. Murthy New Age Publishers
2. Watershed Management by Madan Mohan Das, PHI Publication

Reference Books:

1. Watershed management: Guidelines for Indian Conditions by E.M. Tideman, Omega Scientific Publishers.
2. Hydrology and Soil Conservation Engineering by Ghanshyam Das, Prentice Hall India.
3. Watershed Planning & Management by Dr. Rajvir Singh, Yash Publishing House.
4. Watersheds - Processes, Assessment and Management by Pau A. Debarry, John Wiley & Sons.

Web Materials:

1. http://www.epa.gov
2. http://www.indiaenvironmentportal.org.in
3. http://nptel.ac.in

List of Experiments

Experiment No.	Name of Experiment
1	Introduction to Sampling in water and wastewater analysis
2	Determination of BOD/COD ratio
3	Monitoring of Noise
4	Determination of PM10 and PM2.5 in ambient air
5	Determination of gaseous pollutants in ambient air
6	Determination of various parameters in solid waste
7	Treatability studies of industrial wastewater

CL486: INFRASTRUCTURE MANAGEMENT
B. TECH 8th SEMESTER (CIVIL ENGINEERING)
PROGRAMME ELECTIVE - IV

Credits and Hours:

Teaching Scheme	Theory	Practical/Tutorial	Total	Credit
Hours/week	3	2	5	4
Marks	100	50	150	

A. Objectives of the Course:

- To understand the current infrastructure scenario.
- To understand the concepts of urbanization and requirements of urban infrastructure.
- To learn about rural infrastructure and improvements required in it.
- To teach in detail about infrastructure privatization and financial models of infrastructure.
- To study about risks involved in infrastructure, risk management strategies and infrastructure maintenance.

B. Outline of the Course:

Sr. No.	Title of the Unit	Minimum Number of Hours
1	Introduction and Infrastructure scenario	**04**
2	Urban Infrastructure	**10**
3	Rural Infrastructure	**09**
4	Private Involvement in Infrastructure	**05**
5	Infrastructure Economics and Finance	**08**
6	Infrastructure Risk Management	**05**
7	Infrastructure Maintenance	**04**

Total Hours (Theory): 45
Total Hours (Lab): 30
Total Hours: 75

C. **Detailed Syllabus:**

1	Introduction and Infrastructure scenario	**04 Hours**	**09%**
1.1	Types of Infrastructure		
1.2	Role of Infrastructure		
1.3	Need and scenario of infrastructure		
1.4	Infrastructure crisis		
2	Urban Infrastructure	**10 Hours**	**22%**
2.1	Concept of urbanization and economic development		
2.2	Scenario of municipal infrastructure		
2.3	**Models of urban governance**		
2.4	Municipal finances		
2.5	Major municipal reforms		
2.6	Legislations pertaining to urban infrastructure		
3	Rural Infrastructure	**09 Hours**	**20%**
3.1	Overview		
3.2	Concept of rural infrastructure planning		
3.3	State of rural infrastructure		
3.4	Growth		
3.5	Rural characteristics		
3.6	Strategies to improve infrastructure in rural areas		
4	Private Involvement in Infrastructure	**05 Hours**	**11%**
4.1	Overview		
4.2	Benefits		
4.3	Problems and challenges of infrastructure privatization		
5	Infrastructure Economics and Finance	**08 Hours**	**18%**
5.1	Principles of finance		
5.2	Infrastructure economics		
5.3	Developing financial models for infrastructure		
5.4	Introduction to project finance		
6	Infrastructure Risk Management	**05 Hours**	11%
6.1	Risks in infrastructure		
6.2	Quantitative risk analysis		

6.3 Qualitative risk management

6.4 Risk management strategies

7	Infrastructure Maintenance	**04 Hours**	**9%**

7.1 Introduction to Infrastructure maintenance

7.2 Need and requirement for Infrastructure maintenance

7.3 Preventive techniques for maintenance

D. Instructional Method and Pedagogy:

- At the start of course, the course delivery pattern, prerequisite of the subject will be discussed.
- Lectures will be conducted with the aid of multi-media projector, black board, OHP etc.
- Internal Exams/Assignments/Surprise tests/Quizzes/Seminar/Project, etc., will be conducted as a part of internal theory evaluation.
- The course includes a various task related to various infrastructure projects including group project/group seminar, where students have an opportunity to build an appreciation for the concepts being taught in lectures.
- Tutorials/Term work related to course content will be carried out in the laboratory.

E. Students Learning Outcomes:

On the successful completion of this course

- Students will be able to understand concepts of infrastructure, infrastructure economics, policies and regulation.
- Students will be able to identify and analyze issues related to infrastructure projects.
- Students will be able to recommend appropriate infrastructure management plan.

F. Recommended Study Material:

Text Books:

1. J. Parkin and D. Sharma, Infrastructure planning, Thomas Telford
2. P. Chandra, Projects: Planning, analysis, selection, financing, implementation, and review, Tata McGraw-Hill

3. S. Goodman and M. Hastak, Infrastructure planning handbook: Planning, engineering, and economics, McGraw-Hill

Reference Books:

1. Ronald W Hudson, "Infrastructure Management: integrating design, Construction, maintenance, rehabilitation and renovation", MGH, 1st Edition, 1997
2. L. Squire and H. G.van der Tak, Economic analysis of projects, John Hopkins University Press, London, 1975.
3. J. D. Finnerty, Project financing - Asset-based financial engineering, John Wiley & Sons, New York, 1996.

Web Materials:

1. Ministry of Urban Development: http://moud.gov.in/
2. Indian Infrastructure Finance Company Limited: http://www.iifcl.co.in/
3. Ministry of Shipping: http://shipping.nic.in/index.php
4. Indian Ports Association: http://www.ipa.nic.in/abou.htm
5. National Maritime Foundation: http://www.maritimeindia.org
6. India Maritime 2015: http://www.indiamaritime.in
7. http://nptel.ac.in/courses/105106115/

Term Work

Term work will be based on above syllabus with seminar/group project to be incorporated.

CL487: ADVANCED CONSTRUCTION TECHNOLOGY
B. TECH 8th SEMESTER (CIVIL ENGINEERING)
PROGRAMME ELECTIVE - IV

Credits and Hours:

Teaching Scheme	Theory	Practical/Tutorial	Total	Credit
Hours/week	3	2	5	4
Marks	100	50	150	

A. Objectives of the Course:

The main objectives of the course are

- To understand operations of important construction equipment and to understand various techniques and methods employed in different sectors of construction industry.
- To make the students familiar with the operations, systems and techniques used in concrete and other heavy constructions.
- To develop an advanced knowledge of the latest developments in the field of cement concrete.
- To study and understand the pre-stressed and precast concrete construction system, methods, application and uses.
- To develop knowledge of how the material and technology selection influence the sustainable building design and construction.

B. Outline of the Course:

Sr. No.	Title of the Unit	Minimum Number of Hours
1	Substructure Construction	**15**
2	Superstructure Construction	**08**
3	Concreting Process & Equipments	**06**
4	Advanced Concrete Technology	**08**
5	Sustainable Construction Technologies	**08**

Total Hours (Theory): 45
Total Hours (Lab): 30
Total Hours: 75

C. Detailed Syllabus:

1 Substructure Construction **15 Hours** **33%**

1.1 Box jacking, Pipe jacking
1.2 Under water construction of diaphragm walls and basement
1.3 Tunnelling techniques
1.4 Piling techniques and load testing, Battered piles
1.5 Driving well and Caissons,
1.6 Cofferdams: types, design considerations, construction sequence, sinking of cofferdam
1.7 Cable anchoring and grouting
1.8 Sheet piles: laying operations for built up offshore system
1.9 Shoring for deep cutting

2 Superstructure Construction **08 Hours** **18%**

2.1 Techniques of construction for continuous concreting operation in tall buildings
2.2 Large span structures – segmental bridge construction techniques
2.3 In-situ pre-stressing in high rise structures
2.4 Post tensioning techniques

3 Concreting Process & Equipments **06 Hours** **14%**

3.1	Aggregate crushers, feeders and screens, aggregate handling equipments		
3.2	Concrete batching, mixing and pumping equipments		
3.3	Ready mix concrete equipment		
3.4	Tools and plants for hot weather concreting		
3.5	Underwater concreting		
4	**Advanced Concrete Technology**	**08 Hours**	**18%**
4.1	Properties and applications of High strength and high performance concrete		
4.2	Reactive powder concrete		
4.3	Lightweight, heavyweight, and mass concrete		
4.4	Fibre reinforced concrete		
4.5	Self-compacting concrete, Self-healing concrete		
4.6	Polymer Concrete, Epoxy resins and screeds		
5	**Sustainable Construction Technologies**	**08 Hours**	**17%**
5.1	Necessity and importance		
5.2	Criteria for defining as sustainable materials		
5.3	Recycled building products from industrial, agricultural and urban waste stream materials		
5.4	Recent developments in sustainable building materials and technologies		
5.5	Smart buildings		

D. Instructional Method and Pedagogy:

- At the start of course, the course delivery pattern, prerequisite of the subject will be discussed.
- Lectures will be conducted with the aid of multi-media projector, black board, OHP etc.
- Attendance is compulsory in lectures and laboratory.
- Internal exams will be conducted as per pedagogy as a part of internal theory evaluation.
- Assignments based on course content will be given to the students at the end of each unit/topic and will be evaluated at regular interval.

- Surprise tests/Quizzes/Seminar will be conducted as per pedagogy as a part of internal theory evaluation.
- The course includes tutorial, where students have an opportunity to build an appreciation for the concepts being taught in lectures.

E. Learning Outcomes:

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

- Understand operational details of important equipment, techniques and methods employed in substructure construction.
- Understand the operations, systems and techniques and other heavy constructions works like bridge construction, pre-stressing and post-tensioning.
- Know and understand about different equipments, techniques and methods of producing and placing of concrete.
- Have in-depth knowledge of different types of advanced concrete and its application.
- Understand about different materials and methods used for sustainable building construction.

F. Recommended Study Material:

Text Books:

1. Energy Conservation Building Code, Bureau of Energy Efficiency, New Delhi, 2007.
2. J.R Waters, 'Energy Conversation in Building: A Guide to part of the building regulations', Black well publishing, 2003.
3. Peurifoy R. L., C. J. Schexnayder, A. Shapira and R. Schmitt, 'Construction planning, equipment, and methods', 8th ed., McGraw Hill, New York, 2010.
4. Jerry Irvine, 'Advanced Construction Techniques', CA Rocketr, 1984.
5. Shetty M.S., 'Concrete Technology', S.Chand and Company Ltd. Delhi, 2003.
6. Ben C. Gerwick, Construction of Pre-stressed Concrete, Wiley-Interscience; 2 edition, 1997.

Reference Books:

1. Ross Spiegel and Dru Meadows, 'Green Building Materials: A guide to Product Selection and Specification', John Wiley & Sons, 2012
2. Roy Chudley and Roger Greeno, 'Construction Technology', Prentice Hall, 2005.
3. Sankar, S.K. and Saraswati, S., 'Construction Technology', Oxford University Press, New Delhi
4. Gambhir, M. L., 'Concrete Technology', McGraw Hill Education, 2006.
5. Krishnaraju, N., 'Advanced Concrete Technology', CBS Publishers.
6. Krishna Raju N, Prestressed Concrete, Tata McGraw Hill Publishing, 2006.
7. Tyagi, A.K. (Ed). Handbook on Energy Audits and Management Tata Energy Research Institute, 2000.

Web Materials:

1. http://www.pipejacking.org/about_pipe_jacking
2. http://www.jackedstructures.com/home.html
3. https://www.youtube.com/watch?v=wUlQyiHfex0
4. http://www.deepexcavation.com/en/Diaphragm+wall+construction+methods
5. http://www.pilingcontractors.com.au/processes/diaphragm-walls
6. http://nptel.ac.in/courses/105104034/1
7. https://www.deepexcavation.com/en/shoring-engineering
8. Https://www.researchgate.net/publication/281174992_a_short_study_on_launching_techniques
9. http://www.post-tensioning.org/Uploads/Conference/2012%20Convention/Segmental%20Bridge%20Constructin%20Techniques.pdf
10. https://www.concretenetwork.com/post-tension/basics.html
11. http://www.teriin.org/