ACADEMIC REGULATIONS

COURSE STRUCTURE AND SYLLABUS

B.TECH.

CIVIL ENGINEERING

Effective for the B.Tech. Students admitted into first year For The academic year

2020-2021

PRAGNANAM BRAHMA

ANITS

(AUTONOMOUS)

ANIL NEERUKONDA INSTITUTE OF TECHNOLOGY & SCIENCES (AUTONOMOUS)
Approved by AICTE & Affiliated to Andhra University
SANGIVALASA-531162, BHEEMUNIPATNAM MANDAL, VISAKHAPATNAM DISTRICT

INSTITUTE VISION

- To emerge as a world class technical institution

INSTITUTE MISSION

- To impart holistic technical education by providing
- The state of the art infrastructure
- Exceptional technical and teaching expertise
- Best of human value

VISION OF THE DEPARTMENT

- To emerge as a leading Civil Engineering Department globally

MISSION OF THE DEPARTMENT

- Empower our students with contemporary and industry relevant skills in Civil Engineering using outstanding technical and teaching expertise and best of infrastructure
- Nurture holistic development of our students inculcating universal human values and life skills for serving the society as leaders of their profession

Program Educational Objectives (PEOs)

PEO1: Successfully practice Civil Engineering in construction industry, public sector and entrepreneurship, ensuring a prosperous professional career.

PEO2: Pursue higher education and Research for professional development contributing to the advancement of civil engineering through lifelong learning

PEO3: Demonstrate leadership abilities actively contributing to societal needs with a focus on sustainable development and human values.

Program Outcomes

1. **Engineering knowledge:** Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
2. **Problem analysis:** Identify, formulate, research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
3. **Design/development of solutions:** Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
4. **Conduct investigations of complex problems:** Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
5. **Modern tool usage:** Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.
6. **The engineer and society:** Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilitiesrelevant to the professional engineering practice.
7. **Environment and sustainability:** Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
8. **Ethics:** Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
9. Individual and team work: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
10. **Communication:** Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.
11. **Project management and finance:** Demonstrate knowledge and understanding of the engineering and management principles and apply these to one‘s own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.
12. **Life-long learning:** Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

Program Specific Outcomes

1. Plan and develop safe, economical and sustainable buildings and other structures based on applicable professional standards, codes and ethics.
2. Analyze and solve stability problems in soils for design of foundations and earth structures and plan and design highway, railway and other transportation systems based on applicable safety standards, codes and ethics.
3. Plan and develop irrigation and water supply systems and analyze and solve problems due to pollution of air, water and land leading to a nourished, richer and healthy society.

CIVIL ENGINEERING (4 Year B.Tech Programme) - COURSE CURRICULUM R-20

Total Credits:160

I Year Course structure

Semester - I

Course Code	Title of the course	Category	Periods						Sessionals Marks	Semester end Exam marks	Total Marks	Credits
			L	T	P	E	O	Total				
CIV111	EngineeringMathematics – I	BS	3	0	0	1	6	10	40	60	100	3
CIV112	Engineering Physics	BS	3	0	0	1	4	8	40	60	100	3
CIV113	Engineering Chemistry	BS	3	0	0	1	4	8	40	60	100	3
CIV114	Building Technology	PC	2	1	0	1	2	6	40	60	100	3
CIV115	Engineering Drawing	ES	2	0	3	1	4	10	40	60	100	3.5
CIV116	Engineering Physics Lab	BS	0	0	3	0	1	4	50	50	100	1.5
CIV117	Engineering Chemistry Lab	BS	0	0	3	0	1	4	50	50	100	1.5
CIV118	Engineering Workshop	ES	0	0	3	0	1	4	50	50	100	1.5
CIV119	Human Values and Professional Ethics(Mandatory non-credit course)	MC	3	0	0	0	1	4	50	0	50	–
Total			**16**	**1**	**12**	**5**	**24**	**58**	**400**	**450**	**850**	**20**

Semester -II											
Course Code	**Title of the course**	**Category**	**Periods**						**Sessionals Marks**	**Semester end Exam marks**	**Total Marks**	**Credits**
			L	**T**	**P**	**E**	**O**	**Total**				
CIV121	EngineeringMathematics – II	BS	3	0	0	1	6	10	40	60	100	3
CIV122	Communicative English	HSS	3	0	0	0	2	5	40	60	100	3
CIV123	Engineering Geology	BS	2	0	1	1	2	6	40	60	100	3
CIV124	Engineering Mechanics	ES	2	1	0	1	4	8	40	60	100	3
CIV125	Problem solving with C	ES	3	0	0	1	3	7	40	60	100	3
CIV126	English Language Lab	HSS	0	0	3	0	1	4	50	50	100	1.5
CIV127	Problem solving with C– lab	ES	0	0	3	0	1	4	50	50	100	1.5
CIV128	Environmental Science (Mandatory non-credit course)	MC	3	0	0	0	1	4	50	0	50	–
Total			**16**	**1**	**7**	**4**	**20**	**48**	**350**	**400**	**750**	**18**

II Year Course structure

Semester - I

Course Code	Title of the course	Category	Periods						Sessionals Marks	Semester end Exam marks	Total Marks	Credits
			L	T	P	E	O	Total				
CIV211	Engineering Mathematics - III	BS	2	1	0	1	2	6	40	60	100	3
CIV212	Building Planning & Design	SOC	2	0	2	1	2	7	50	50	100	3
CIV213	Environmental Engineering-I	PC	2	1	0	1	2	6	40	60	100	3
CIV214	Strength of Materials	ES	2	1	0	2	3	8	40	60	100	3
CIV215	Surveying & Geomatics	ES	3	1	0	1	2	7	40	60	100	4
CIV216	Surveying Field Work	SOC	0	0	3	0	1	4	50	50	100	1.5
CIV217	Strength of Materials Lab	PC	0	0	3	0	1	4	50	50	100	1.5
CIV218	Environmental Engineering Lab	PC	0	0	3	0	1	4	50	50	100	1.5
Total			**11**	**4**	**11**	**6**	**14**	**40**	**340**	**460**	**800**	**20.5**

Semester - II												
Course Code	**Title of the course**	**Category**	**Periods**						**Sessionals Marks**	**Semester end Exam marks**	**Total Marks**	**Credits**
			L	**T**	**P**	**E**	**O**	**Total**				
CIV221	Environmental Engineering-II	PC	2	1	0	2	2	7	40	60	100	3
CIV222	Fluid Mechanics-I	PC	2	1	0	2	3	8	40	60	100	3
CIV223	Concrete Technology	PC	3	0	0	1	2	6	40	60	100	3
CIV224	Geotechnical Engineering – I	PC	2	1	0	2	2	7	40	60	100	3
CIV225	Structural Analysis – I	PC	2	1	0	2	3	8	40	60	100	3
CIV226	Building Architecture with Revit	SOC	0	0	3	0	1	4	50	50	100	1.5
CIV227	Concrete Technology Lab	PC	0	0	3	0	1	4	50	50	100	1.5
CIV228	Geotechnical Engineering Lab	PC	0	0	3	0	1	4	50	50	100	1.5
CIV229	Summer Internship-I*	PR	0	0	0	0	4	4	–	–	–	–
Total			**11**	**4**	**9**	**9**	**19**	**52**	**350**	**450**	**800**	**19.5**

* Summer internship-I to be conducted after II year-II semester and evaluated in III year-I semester

III Year Course structure

Semester - I

Course Code	Title of the course	Category	Periods						Sessionals Marks	Semester end Exam marks	Total Marks	Credits
			L	T	P	E	O	Total				
CIV311	Open Elective-I#	OE	2	1	0	1	2	6	40	60	100	3
CIV312	Fluid Mechanics-II	PC	2	1	0	2	4	9	40	60	100	3
CIV313	Geotechnical Engineering – II	PC	2	1	0	2	3	8	40	60	100	4
CIV314	Reinforced Concrete Structures-I	PC	2	1	0	2	2	7	40	60	100	3
CIV315	Structural Analysis – II	PC	2	1	0	2	3	8	40	60	100	3
CIV316	Computer Applications in Civil Engineering Lab	SOC	0	0	3	0	1	4	50	50	100	1.5
CIV317	Fluid Mechanics Lab	PC	0	0	3	0	1	4	50	50	100	1.5
CIV318	Technical Seminar	PR	0	0	3	0	1	4	100	–	100	2
CIV319	Quantitative Aptitude-I & Verbal Aptitude-I	HSS	0	0	3	1	3	7	100	0	100	1.5
CIV3110	Summer Internship-I*	PR	0	0	0	0	4	4	100	–	100	1.5
Total			**10**	**5**	**12**	**10**	**24**	**61**	**600**	**400**	**1000**	**24**

Semester - II												
Course Code	**Title of the course**	**Category**	**Periods**						**Sessionals Marks**	**Semester end Exam marks**	**Total Marks**	**Credits**
			L	**T**	**P**	**E**	**O**	**Total**				
CIV321	Open Elective-II#	OE	2	1	0	1	2	6	40	60	100	3
CIV322	Professional Elective – I	PE	3	0	0	1	2	6	40	60	100	3
CIV323	Steel Structures	PC	2	1	0	2	3	8	40	60	100	3
CIV324	Reinforced Concrete Structures-II	PC	2	1	0	2	3	8	40	60	100	4
CIV325	Highway Engineering	PC	2	1	0	1	2	6	40	60	100	4
CIV326	Irrigation Engineering	PC	2	1	0	2	2	7	40	60	100	4
CIV327	Structural Analysis & Design using Staad Pro	SOC	0	0	3	0	2	5	50	50	100	1.5
CIV328	Transportation Engineering Lab	PC	0	0	3	0	1	4	50	50	100	1.5
CIV329	Quantitative Aptitude-II & Soft Skills	HSS	0	0	3	2	3	8	100	0	100	1.5
CIV3210	Summer Internship-II*	PR	0	0	0	0	4	4	–	–	–	–
Total			**13**	**5**	**9**	**11**	**24**	**62**	**440**	**460**	**900**	**25.5**

 # Open Electives can be either interdisciplinary subjects/emerging subject/MOOCs as decided by the Department.

*** Summer Intership-II** *to be conducted after III year-II semester and evaluated in IV year-I semester*

IV Year Course structure

Semester - I

Course Code	Title of the course	Category	Periods						Sessionals Marks	Semester end Exam marks	Total Marks	Credits
			L	T	P	E	O	Total				
CIV411	Open Elective-III#	OE	2	1	0	1	2	6	40	60	100	3
CIV412	Estimation & Costing	PC	2	1	0	2	3	8	40	60	100	3
CIV413	Professional Elective – II	PE	3	0	0	1	2	6	40	60	100	3
CIV414	Professional Elective – III	PE	3	0	0	1	2	6	40	60	100	3
CIV415	Professional Elective – IV	PE	2	1	0	2	3	8	40	60	100	3
CIV416	Project work-I	PR	0	0	6	0	6	12	100	–	100	2
CIV417	Summer Internship-II*	PR	0	0	0	0	4	4	100	–	100	1.5
Total			**12**	**3**	**6**	**7**	**22**	**50**	**400**	**300**	**700**	**18.5**

Semester – II												
Course Code	**Title of the course**	**Category**	**Periods**						**Sessionals Marks**	**Semester end Exam marks**	**Total Marks**	**Credits**
			L	**T**	**P**	**E**	**O**	**Total**				
CIV421	Open Elective - IV[#](MOOCs)	OE	2	1	0	1	2	6	40	60	100	3
CIV422	Professional Elective – V(MOOCs)	PE	2	1	0	1	2	6	40	60	100	3
CIV423	Project Work –II	PR	0	0	9	0	9	18	50	50	100	8
	Total		**4**	**2**	**9**	**2**	**13**	**30**	**130**	**170**	**300**	**14**

*** Summer Intership-II** *to be conducted after III year-II semester and evaluated in IV year-I semester*

 # Open Electives can be either interdisciplinary subjects/emerging subject/MOOCs as decided by the Department.

R 20 II Year
Detailed Syllabus

R 20 II Year I Sem
Detailed Syllabus

ENGINEERING MATHEMATICS – III

(Common to Civil, ECE, EEE, Mech. and Chem. Engineering)

CIV 211 **Credits : 3**

Instruction : 2 Lectures & 1 Tutorial / week Sessional Marks : 40

End Exam : 3 Hours End Exam Marks : 60

Course Outcomes:

At the end of the course, the student will be able to

1. Apply gradient, divergence & curl to scalar and vector point functions and also physically interpret their meaning
2. Apply the concepts of Vector calculus & the corresponding theorems to evaluate line, surface and flux integrals
3. Solve both first & higher order partial differential equations by different techniques and apply to two dimensional heat conduction equations, vibrations of a string etc.
4. Apply infinite Fourier series to represent discontinuous function which occurs in signal processing & electrical circuits.
5. Apply the principles of Fourier transforms to Boundary value problems.

Mapping of course outcomes with program outcomes:

		PO												PSO		
		1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO	1	3	1	1										2	1	1
	2	3	1	1										2	1	1
	3	3	1	1										2	1	1
	4	3	1	1										2	1	1
	5	3	1	1										2	1	1

UNIT-I: VECTOR DIFFERENTIATION [12 Lectures]

Scalar and vector point functions – Del applied to scalar point functions: Gradient, directionalderivative - Del applied to vector point functions - Physical interpretation of divergence and curl - Delapplied twice to point functions - Del applied to products of point functions.

TB1 - Sections: 8.4, 8.5, 8.6, 8.7, 8.8 and 8.9.

UNIT-II: VECTOR INTEGRATION [12 Lectures]

Integration of vectors – Line integral, Circulation, work done– Surface's integral, flux – Green'stheorem in the plane – Stoke's theorem – Volume integral – Gauss divergence theorems (all theorems without proofs) – Irrotational and Solenoidal fields.

TB1 - Sections: 8.10, 8.11, 8.12, 8.13, 8.14, 8.15, 8.16 and 8.18.

UNIT-III: PARTIAL DIFFERENTIAL EQUATIONS AND THEIR APPLICATIONS [12 Lectures]

Introduction – Formation of partial differential equations by eliminating arbitrary constants and functions – Solutions of a partial differential equations by direct Integration – Linear equations of the first order (Lagrange's linear equations);

Applications: Method of separation of variables – Vibrations of a stretched string: Wave equation - One dimensional heat flow equation ($\frac{\partial u}{\partial t} = C^2 \frac{\partial^2 u}{\partial x^2}$), and two-dimensional heat flow equation (i.e., Laplace equation: ($\frac{\partial^2 u}{\partial x^2} + \frac{\partial^2 u}{\partial y^2} = 0$).

TB1 - Sections: 17.1, 17.2, 17.4, 17.5, 17.8, 17.9, 17.10, 17.11, 18.2, 18.4 and 18.5.

UNIT – IV: FOURIER SERIES **[12 Lectures]**

Introduction – Euler's formulae – Conditions for a Fourier expansion – Functions having points of discontinuity – Change of interval – Even and odd functions – Half range series - Parseval's formula.

TB1 - Sections: 10.1, 10.2, 10.3, 10.4, 10.5, 10.6, 10.7 and 10.9.

UNIT – V: FOURIER TRANSFORMS **[12 Lectures]**

Introduction – Definition – Fourier integral theorem (without proof) - Fourier sine and cosine integrals – Fourier transforms – Properties of Fourier transforms – Convolution theorem - Parseval's identity for fourier transforms - Relation between Fourier and Laplace transforms - Fourier transforms of the derivatives of a function - Applications of transforms to boundary value problems.

TB1 - Sections: 22.1, 22.2, 22.3, 22.4, 22.5, 22.6, 22.7, 22.8, 22.9 and 22.11.

TEXTBOOK:

1. B. S. Grawal, "Higher Engineering Mathematics", 43rd edition, Khanna publishers, 2017.

REFERENCES

1. N P. Bali and Manish Goyal, "A text book of Engineering mathematics", Laxmi publications, latest edition.
2. Erwin Kreyszig, "*Advanced Engineering Mathematics*", 10th edition, John Wiley & Sons, 2011.
3. R. K. Jain and S. R. K. Iyengar, Advanced Engineering Mathematics, 3rd edition, Alpha Science International Ltd., 2002.
4. George B. Thomas, Maurice D. Weir and Joel Hass, Thomas Calculus, 13th edition, Pearson Publishers.

BUILDING PLANNING & DESIGN

CIV 212 **Credits : 3**

Instruction : 2 Lectures & 2 Tutorial / week Sessional Marks : 50

End Exam : 3 Hours End Exam Marks :50

Course Objectives:

1. To understand the principles of planning and bye laws of buildings.
2. To draw a plan, elevation and section of load bearing buildings.
3. To prepare detailed drawings of Foundations, Doors, Windows etc.

Course Outcomes:

At the end of course student will be able to:

1. Analyze the factors effecting the orientation and layout of houses by applying the principles of climatology.
2. Design various types of residential buildings by applying the building regulations and bye-laws.
3. Analyze the given functional requirements and apply the concepts of climatology to produce building drawings.

Mapping of course outcomes with program outcomes:

		PO												PSO		
		1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO	1	3	3		2	2								3		
	2	3	2	3					3					3		
	3	3	3			3					3			3		

SYLLABUS

UNIT - I **12 Periods**

Climatology: Elements of climate: Sun, Wind, Relative Humidity, and Temperature. Comfort conditions for house, Various types of Macro-climatic zones, Design of Houses and layouts with reference to climatic zones, Mahoney tables, Solar charts, Wind rose diagrams, Ventilation. Principles of Planning, Orientation of Buildings, Seismic Zones (IS 1893) & Wind Zones (IS 875 – Part III).

Learning outcomes: 1) Classify the climatic zones of India 2) Explain the influence of climate on planning & orientation of building 3) Identify the applications of solar charts, Mahoney tables and wind rose diagrams

UNIT – II **12 Periods**

Residential buildings: Design of Individual rooms with particulars attention to functional and furniture requirements (for internal evaluation only). Different types of Residential Buildings, Description of a Multi-Storied Building, Selection of site for residential buildings, Guidelines for planning and drawing of residential building, General Building regulations and Bye laws for Residential Buildings, Building set-back problems. Introduction to Fire Resistant Design as per NBC - 2016

Learning outcomes: 1) Identify various types of residential buildings 2) Explain the regulations and bye-laws of residential buildings 3) Identify the planning requirements of residential buildings

UNIT – III **36Periods**

Drawing Exercises in AUTO-CAD:

Exercise-1: Conventional signs of materials, symbols of sanitary & plumbing equipment used in a residential building
Exercise-2: Cavity walls, Cross-section of Masonry Foundation
Exercise-3: Panelled door and Glazed Panelled door
Exercise-4: King post and Queen post trusses
Exercise-5: Half turn and Quarter turn stair-cases
Exercise-6: Dimensioned plan, sectional elevation and section of a small house (one room & Verandah)
Exercise-7: Dimensioned plan, sectional elevation and section of a one bed roomed house with verandah
Exercise-8: Dimensioned plan, sectional elevation and section of a two-bed roomed house with verandah
Exercise-9: Dimensioned plan, sectional elevation and section of an office house
Exercise-10: Dimensioned plan, sectional elevation and section of a LIG house
Exercise-11: Dimensioned plan, sectional elevation and section of a one bed roomed RCC framed building with verandah (For internal evaluation only)
Exercise-12: Dimensioned plan, sectional elevation and section of an irregularly shaped House (Home Exercise)
Exercise-13: Elevation of Louvered door and wire-gauge door (HomeExercise)
Exercise-14: Elevation of Steel roof truss (Home Exercise)

Learning outcomes: 1) Identify the conventional signs & symbols of building materials 2) Draw the plan, section and elevation of various building components 3) Draw the section and elevation for different plans of load bearing buildings

TEXT BOOKS

1. Kumara Swamy. N and KameswaraRao. A (2013),"Building Planning and Drawing", Charotar Publishing House,Gujarat,7th edition.
2. GurucharanSingh and Jagadish Singh (2015),"Building Planning Designing and Scheduling", Standard Publishers Distributors,Delhi.

REFERENCES

1. Shah.M.G, Kale.C.M and Patki.S.Y.(2019),"Building drawing with an integrated approach to the built environment",McGraw-Hill Publishing Company Limited.
2. Trimurty.R.(2008), "Civil Engineering Drawing", Premier Publishing House.
3. Azhar Wahab(2020), "A handbook on AUTOCAD tools practice",Notion press, Chennai
4. Relevant NPTEL Courses.

ENVIRONMENTAL ENGINEERING – I

CIV 213 **Credits : 3**

Instruction : 3 Lectures & 1 Tutorial / week Sessional Marks : 40

End Exam : 3 Hours End Exam Marks : 60

Course Objectives:

1. The principal objective of the course is to develop the technical knowledge for better understanding the concepts of water supply and its characteristics and enabling them to use these technical skills in solving the problems in industries.
2. To impart the knowledge in planning, design, construction, operation and maintenance aspects of water supply systems.
3. To provide theoretical and practical exposure in the field of water treatment and supply.
4. To increase the management skills with regard to collection, treatment and distribution of sustainable water.

Course Outcomes:

By the end of the course the student will be able to

1. Analyse the water demand for a town / city using population forecasting, per capita demand and design period
2. Analyse the water quality by evaluating the properties of water and waterborne diseases.
3. Analyse the water supply sources and their yield, identify the suitability of collection and conveyance methods.
4. Design and evaluate water treatment systems, including the operations and working of different units.
5. Design the elements of public water systems, including water pumping, transportation, and distribution systems.

Mapping of course outcomes with program outcomes:

		PO												PSO		
		1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO	1	2	3													2
	2	2	3													2
	3	2	3													2
	4		2	3												3
	5		2	3												3

SYLLABUS

UNIT - I 12 Periods

Introduction: Introduction: Importance and Necessity of Protected Water Supply systems, Objectives of Protected water supply system, Flow chart of public water supply system, Role of Environmental Engineer, Agency activities.

Water Demand and Quantity studies: Estimation of water demand for a town or city, Types of water demands, Per capita Demand, Factors affecting the Per Capita Demand, Variations in the Demand, Design Period, Factors affecting the Design period,

PopulationForecasting Studies.

Learning outcomes: 1) Describe the importance and need of protected water supply 2) Articulate the factors affecting per capita demand 3) Classify the various types of demand 4) Estimate the water demand of the town

UNIT - II 12 Periods

Quality of water: Characteristics of water – Physical, Chemical and Biological. Analysis of Water – Physical, Chemical and Biological. Impurities in water, Water borne diseases. Drinking water quality standards- Relevant codes (IS 10200:2012, WHO Standards)**.**

Learning outcomes: 1) Classify various characteristics of water 2) Articulate the water borne diseases and their symptoms 3) Estimate the quality of water

UNIT - III 12 periods

Sources of Water Supply: Surface sources of water: Lakes, Rivers, Impounding Reservoirs, Capacity of storage reservoirs, Mass curve analysis. Groundwater sources of water: Types of water bearing formations, springs, Infiltration galleries and Wells, Yields from wells.

Collection and Conveyance: Factors governing the selection of the intake structure, Types of Intakes. Conveyance of Water: Gravity and Pressure conduits, Types of Pipes, Pipe Materials, Pipe joints.

Learning outcomes: 1) Categorize the different sources for water supply 2) Classify the various types of intake structures 3) Estimate the storage capacity of a reservoir and yield of wells 4) Illustrate different types of pipe materials and joints to be used

UNIT - IV 12 Periods

Treatment of Water: Layout and general outline of water treatment units –Treatment methods (Theory and Design) - Sedimentation, Sedimentation with Coagulation, Clari-flocculation,Filtration, Chlorination and other Disinfection methods, Softening of Water, De-fluorination**.**

Learning outcomes: 1) Design the general layout of the treatment plant 2) Design different types of treatment units 3) Modify the sequence of treatment processes

UNIT - V 12 Periods

Distribution System: Distribution of Water: Methods of Distribution system, Components of Distribution system, Layouts of Distribution networks, Pressures in the distribution layouts, Analysis of Distribution networks-Multi-storeyed Buildings

Pumping: Necessity of pumping in water supply - classification and brief description of types of pumps - selection of pump - calculation of head, horsepower - economical diameter of pumping main.

Learning outcomes: 1) Identify the different methods of distribution system and its component parts 2) Analyze various distribution networks 3) Design the layouts of the distribution network 4) Classify the various types pumps 5) Estimate the horsepower

and economical diameter of pumping mains

TEXTBOOKS

1. Birdie G S and Birdie J S, (2010) "Water Supply and Sanitary Engineering", Dhanpat Rai and Sons, Fifth Edition, Delhi.
2. Garg, S.K., (1977) “Environmental Engineering Vol. I “, Khanna Publishers,Thirty Fourth Edition, New Delhi.

REFERENCES

1. Modi, P.N, (2018) “Environmental Engineering Vol. I”, Standard Book House, Fifth Edition New Delhi.
2. Punmia B.C, (2005) “Environmental Engineering Vol. I”, Lakshmi Publications (P) Ltd., New Delhi.
3. Handbook on Water Supply and Drainage, (1987) SP35, B.I.S., New Delhi.
4. National Building Code of India, SP 7 (1) (2005), Bureau of Indian Standards, First Reprint, May 1992. – (Part-9 Section 1)
5. Relevant IS Codes
6. Relevant NPTEL Courses.

STRENGTH OF MATERIALS

CIV 214 **Credits : 3**

Instruction : 2 Lectures & 1 Tutorial / week Sessional Marks : 40

End Exam : 3 Hours End Exam Marks : 60

Course Objectives:

From this course students will learn the following

1. Understand the concept of Stress and Strain so as to compute different types of stresses.
2. Draw the Shear force and bending moment diagrams for determinate beams.
3. Determine the principal stresses on oblique planes

Course Outcomes:

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

1. Analyze the different types of stresses and strains in prismatic and non prismatic bodies subjected to forces acting in one or more directions.
2. Analyze and illustrate the SFD and BMD for determinate beams acted upon by different types of loads and their combinations.
3. Analyze and illustrate the bending stress and shear stress in beams having different cross sections.
4. Analyze various stresses on an oblique plane of a prismatic body subjected to forces acting in one or more directions.
5. Analyze the stresses in a body subjected to torsion, helical spring subjected to axial load and axial twist, and thin cylindrical vessels subjected to fluid pressure.

Mapping of course outcomes with program outcomes:

		PO												PSO		
		1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO	1	3	3											3	2	
	2	3	3											3		
	3	3	3											3		
	4	3	3											3	3	
	5	3	3											3		

SYLLABUS

UNIT - I 12 Periods

Simple Stresses and Strains: Elasticity and plasticity – Types of stresses and strains – Hooke's law - Generalized Hooke's Law– stress – strain diagram for mild steel and HYSD-bars Working stress – Factor of safety – Lateral strain, Poisson's ratio and volumetric strain – Elastic constants and the relationship between them – Bars of varying section – composite bars – Temperature stresses.

Learning outcomes: 1) Define stress and strain.2) Draw and explain stress strain curve for mild steel.3) Derive the relationship between elastic constants.4) Calculate temperature stresses

UNIT – II 12 Periods

Shear Force and Bending Moment in beams: Definition of beam – Types of beams – Concept of shear force and bending moment – S.F and B.M diagrams for cantilever, simply supported and overhanging beams subjected to point loads, U.D.L., uniformly varying loads, moment and combination of these loads – Point of contra flexure – Relation between S.F, B.M and rate of loading at a section of a beam.

Learning outcomes: 1) Define shear force and bending moment2) Draw shear force and bending moments diagrams for cantilever, simply supported and overhanging beams3) Derive relation between S.F, B.M and rate of loading

UNIT - III 12 Periods

Bending Stresses: Theory of simple bending – Assumptions – Derivation of bending equations, Neutral axis – Determination of bending stresses – section modulus of rectangular and circular sections (Solid and Hollow), I-T- Angle sections.

Shear Stresses: Derivation of formula – Shear stress distribution across various beam sections like rectangular, circular, triangular, I- T- Angle sections.

Learning outcomes: 1) Explain pure bending and derive the bending equation.2) Determine bending stresses for different sections.3) Derive shear stress equation4) Plot the shear stress distribution diagram

UNIT – IV 10 Periods

Principal Stresses and Planes: Introduction – Principal planes and Principal Stresses – Method of determining stresses on an inclined section – Mohr's circle of stresses

Introduction to theories of failure: (i) Principal Stress theory, (ii) Principal Strain theory, (iii) Maximum Shear Stress theory and (iv) Maximum strain energy theory.

Learning outcomes: 1) Explain principal stresses and planes.2) Determine the major, minor principal stresses and shear stress on oblique planes3) Determine principal stresses on oblique planes by using graphical methods4) Explain theories of failures.

UNIT - V 12 Periods

Torsion of Circular Shafts: Theory of pure torsion – Derivation of Torsional Rigidity equation – Assumptions made in the theory of pure torsion – Torsional moment of resistance – Polar section modulus – Power transmitted by shafts; Springs: Introduction – Types of springs – deflection of closed and open coiled helical springs under axial load.

Thin Cylinders: Thin cylindrical shells – Derivation of formula for stresses and their corresponding strains.

Learning outcomes: 1) Explain theory of pure torsion 2) Derive the torsion equation 3) Analyze springs subjected to axial load. 4) Derive equations for longitudinal and circumferential stresses in thin cylinders andstudy the effect of these stresses on cylinders

TEXT BOOKS

1. R.K.Bansal (2018), "Strength of Materials", Laxmi Publications, Sixth edition, India.
2. Beer Johnston (2017) "Mechanics of Materials", McGraw Hill Education, Seventh Edition, India.

REFERENCES

1. Timoshenko (2003), “Elements of Strength of Materials”, East-West, Fifth edition, India.
2. P.N. Singh and P.K. Jha (2021) “Elementary Mechanics of Solids”, New Age International Private Limited, Second edition , New Delhi, India.
3. Egor P. Popov (2015) “Engineeering Mechanics of Solids”, Pearson Education India, Second edition, India.
4. S.Ramamrutham (2020)” Strength of materials”, Dhanpat Rai Publishing Company(P)Ltd, 20th edition, New Delhi, India.
5. Relevant NPTEL Courses.

SURVEYING & GEOMATICS

CIV 215 **Credits : 4**

Instruction : 3 Lectures & 1 Tutorial / week Sessional Marks : 40

End Exam : 3 Hours End Exam Marks : 60

Course Objectives:

The objective if the course is to prepare student

1. To measure the height and distance by theodolite and Dumpy level.
2. To measure the angles and distances by using Theodolite and Compass.
3. To measure areas by total station.

Course Outcomes:

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

1. Demonstrate an ability to use Chain and Prismatic compass for calculating distances, areas and determine Angles & Bearings
2. Determine Reduced levels and distances of different stations using various methods of differential and trigonometric levelling and Prepare Contour Maps
3. Determine horizontal and vertical angles between points and calculate areas and volumes.
4. Apply surveying skills in aligning highways and railway curves and Execute necessary experimental skills to determine heights and distances of inaccessible objects and solve different surveying problems using tachometric relations.
5. Apply modern survey equipment (Total Station) to measure angles and distances, and learn the basics of GIS and GPS.

Mapping of course outcomes with program outcomes:

		PO												PSO		
		1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO	1	3												2	3	2
	2	3												2	3	2
	3	2	3											3	3	3
	4	2	3											2	3	2
	5	2	3											2	3	2

SYLLABUS

Unit-I **12 Periods**

Chain Surveying: Classification of surveying-Principles of Surveying. -Linear measurements. Instrumentation for chaining – Errors due to incorrect chain-Chaining on uneven and sloping ground-Errors in chaining - Tape corrections – Problems.

Compass Surveying: Definitions of Bearing. True bearing, True meridian, Magnetic Meridian, Magnetic bearing – Arbitrary Meridian, R.B. & B.B of lines – Designation of bearings, Conversion of bearings from one system to the other Related problems – Calculation of angles for bearings, Calculation of bearing for angles, Related problems – Theory of Magnetic compass (i.e. Prismatic compass), Temporary adjustments of compass-Magnetic Declination – Local Attraction-Related Problems

Learning Outcomes: 1) **Understand** the principles of surveying 2) **Handle** Chain

effectively for its necessary purposes 3) **Compute** Areas of give layout: 4) **Handle**Prismatic Compass effectively for its necessary purposes 5) **Compute** Angles and Bearing for the given open or closed traverse 6) **Estimate** Corrections considering problems like Magnetic Declination and/or Local Attraction

Unit-II **12 Periods**

Levelling: Definitions of terms-Methods of levelling - Uses and adjustments of dumpy level-Temporary adjustments of dumpy level levelling staves - Differential levelling, - Reciprocal levelling. Precise levelling - Definition of BS, IS, FS, HI, TP-Booking and reduction of levels, H.I. methods-Rise and fall method-Checks-Related problems

Trigonometric levelling: Elevation of the tower - Base of the object accessible and inaccessible – Reduced level of the elevated points – instrument axis at different levels.

Contouring: Definitions- Contour Interval and horizontal equivalent - Characteristics of contours-methods of locating contours-Direct and indirect methods-Interpolation of contours-Contour Gradient

Learning outcomes: 1**) Estimate** the distances, Reduced levels and height of both accessible and inaccessible objects. 2) **Use** Contour Maps in determining necessary data. **3) Handle** leveling instruments effectively for its necessary purposes. 4) **Compute** Reduced Levels of various stations using different methods.

Unit-III **12 Periods**

Theodolite Survey: Theodolite Component Parts, Classification, – Temporary Adjustments, Measurement of horizontal angle – Method of repetition, Method of reiteration – Uses of theodolites – Permanent adjustments of a theodolite. Open and closed traverse – Closing errors, Balancing the error – Bowditch method – Transit method.

Areas and Volumes: General Methods of Determining Areas, Area By Co-ordinates, calculation of volume by The Prismoidal Formula ,The Trapezoidal Formula.

Learning outcomes: 1) **Determine** the included angles of a closed traverse. 2) **Analyze** the closing errors of a closed traverse, 3) **Calculate** the Areas by various methods, 4) **Calculate** the volume by various methods

Unit-IV **12 Periods**

Curves: Types of Curves - Simple curves – Elements of simple curves – Methods of setting simple curves – Rankine's method – Two theodolite method – Obstacles in curve setting – Compound curves – Elements of compound curves– Transition curves – Ideal shape - length of transition curve - Setting out methods- Introduction to reverse curves.

Tacheometry: Instruments - Principle of tacheometry – Methods of Tacheometry - Stadia methods – Fixed hair method – Movable hair method – Tangential method.

Learning outcomes:1) **Calculate**Reduced levels and height of both accessible and inaccessible objects.2) **Devise** formulas for finding out various elements of simple, compound, reverse and transition curves. 3) **Establish** relations between various elements of the curves. 4) **Calculate** the Tacheometric Constants. 5) **Devise** formulas for finding out distances,

Unit-V **8 Periods**

Advanced Surveying Instruments: Electronic Theodolite, Introduction to geodetic surveying, EDM Instruments, Total station and global positioning system- Introduction to Geographic Information System (GIS). Introduction to Drone surveying.

Learning outcomes: 1) **List** the essential features of an Electronic Theodolite. 2) **Differentiate** the advantages of electronic theodolite over other theodolites. 3) **Analyze** the advantages of total station over theodolites and EDM Instruments. 4) **Infer** the functionality of GPS, GIS and Drone surveying.

TEXT BOOKS

1. Arora K R (2016), "Surveying Vol. I, II &III ", Standard Book House Publications Pvt. Ltd., New Delhi, 16th Edition.
2. Punmia B C (2016), "Surveying Vol. I, II & III", Lakshmi Publications, New Delhi, 17th Edition.

REFERENCES

1. Agor R, "A Text Book of Surveying and Levelling", Khanna Publishers, New Delhi, 12th Edition.
2. Kanetkar T.P and Kulkarni. S.V. (1988), "Surveying and Levelling Vol. I & Vol. II", Pune Vidyarthi GrihaPrakashan, Pune.
3. Kochhar C.L. (2013), " A Text book of Surveying", Dhanpatrai Publishing Company Pvt Ltd., New Delhi, 11th Edition.
4. Duggal S.K. (2017), "Surveying Vol. 1 and 2", McGraw Hill Education, 4th Edition.
5. Burrough P.A. (1986), "Principles of GIS for land resource assessment", Clarendon Press, Oxford.
6. Relevant NPTEL Courses.

SURVEYING FIELD WORK

CIV 216 **Credits : 1.5**

Instruction : 3 Practicals / week Sessional Marks : 50

End Exam : 3 Hours End Exam Marks : 50

Prerequisites:

Surveying & Geomatics

Course Objectives:

1. To know how to conduct the experiments by using different survey instruments.
2. To improve practical knowledge.

Course Outcomes:

At the end of this course student will be able to:

1. Determine Horizontal angles using Repetition and Reiteration methods
2. Estimate Vertical angles and Reduced Levels of different points
3. Idetify the height of the objects when base is accessible and when base is inaccessible and determine tacheometric constants.
4. Analyse setting up of curves using Rankine's method and two Theodolite Method
5. Demonstrate computation of area and height of objects using Total Station.

Mapping of course outcomes with program outcomes:

		PO												PSO		
		1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO	1	3	3		3					3	3			3	3	3
	2	3	3		3					3	3			3	3	3
	3	3	3		3					3	3			3	3	3
	4	3	3		3					3	3			3	3	3
	5	3	3		3					3	3			3	3	3

LIST OF EXPERIMENTS

1. Survey of an area by chain surveying (closed traverse) & plotting
2. Surveying past obstacles using chain and prismatic compass
3. Distance between Inaccessible points using prismatic compass
4. Surveying of a given area by prismatic compass (closed Traverse) and plotting after adjustment
5. Fly Levelling (HI method/Raise and Fall Method)
6. Longitudinal and cross-sectional levelling and plotting
7. Trigonometric levelling- Height and distance problem
8. Distance and elevation computations by tacheometric surveying
9. Determination of area of ground by Total Station
10. Determination of Gradient of line between two inaccessible points using total station
11. Traversing using total station
12. Curve setting using total station.

REFERENCES

1. Punmia B C (2016), “Surveying Vol. I &II”, Lakshmi Publications, New Delhi, 17th Edition.
2. Relevant NPTEL Courses

STRENGTH OF MATERIALS LABORATORY

CIV 217 **Credits : 1.5**

Instruction : 3 Practicals / week Sessional Marks : 50

End Exam : 3 Hours End Exam Marks : 50

Course Objectives:

From this course students will learn the following

1. The stress – strain characteristics of mild steel bar.
2. Determining modulus of elasticity, modulus of rigidity of different materials.
3. Determine the properties such as hardness, compressive strength, shear strength, impact strength of different materials.

Course Outcomes:

At the end of this course student will be able to

1. Investigate the different materials by analyzing mechanical properties through the application of various test methods along with team, comprehend and write an effective report as an individual.
2. Interpret test results by analyzing failure mechanisms and apply this knowledge to material selection and engineering design processes.

Mapping of course outcomes with program outcomes:

		PO												PSO		
		1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO	1	3	3		3					3	3			3		
	2	3	3		3					3	3			3		

LIST OF EXPERIMENTS

1. Tension test on Mild Steel / HYSD bars.
2. Compression test on wood (parallel to grains and perpendicular to grains)
3. Test on close coiled helical spring for the determination of rigidity modulus and spring constant
4. Hardness tests - Brinell’s & Rockwell’s.
5. Impact tests – Charpy and Izod
6. Torsion test.
7. Bending test.: Load deflection test for the determination of young’s modulus on a simply supported and cantilever beam for wood and steel.

REFERENCES

1. P.N. Singh and P.K. Jha (2021) “Elementary Mechanics of Solids”, New Age International Private Limited, Second edition, New Delhi, India.
2. Relevant NPTEL Courses.

ENVIRONMENTAL ENGINEERING LAB

CIV 218 **Credits : 1.5**

Instruction : 3 Practicals / week Sessional Marks : 50

End Exam : 3 Hours End Exam Marks : 50

Prerequisites:

Environmental Engineering-I, Engineering Chemistry

Course Objectives:

To enable the students to determine the various water quality parameters value in a given water sample.

Course outcomes:

By the end of the course, student will be able to:

1. Investigate the water samples for various characteristics
2. Interpret the obtained results with IS 10500:2012 and write effective report.

Mapping of course outcomes with program outcomes:

		PO												PSO		
		1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO	1	2	3		3					3	3					3
	2	2	3		3					3	3					3

LIST OF EXPERIMENTS

1. Determination of pH and Electrical Conductivity of water
2. Determination of turbidity in water and Optimum coagulant dose.
3. Estimation of total solids, organic solids and inorganic solids and settleable solids by Imhoff Cone.
4. Estimation of Total Hardness–Calcium & Magnesium.
5. Estimation of Acidity in water
6. Estimation of Alkalinity in water
7. Determination of Available and Residual Chlorine content in water
8. Determination of Dissolved Oxygen and Biological Oxygen Demand by Winkler's Method.
9. Determination of Biological Oxygen Demand by Winkler's Method.
10. Estimation of chloride content in water
11. Estimation of fluoride content in water.
12. Determination of C.O.D. (Demo)

REFERENCES

1. Garg S. K. (2001), "Environmental Engineering Vol. I", KhannaPublications, , 5th Edition, New Delhi.

2. Sawyer, C.N., McCarty, P.L., and Parkin, G.F. (2000), "Chemistry for Environmental Engineering", Tata McGraw-Hill Publishing Company Limited, 4th Edition, New Delhi,
3. BIS 10500- 1991, Indian Standard Drinking Water – Specification (Second Revision).
4. BIS 3025 (Part 44): Method of Sampling and Test (Physical and Chemical) forWater and Wastewater, Part 44: Biochemical Oxygen Demand (BOD) (First Revision)
5. Relevant NPTEL Courses
6. Guidelines for Drinking-water Quality, (2008), WHO Standards (3rd Edition)

R 20 II Year II Sem
Detailed Syllabus

ENVIRONMENTAL ENGINEERING – II

CIV 221 **Credits : 3**

Instruction : 2 Lectures & 1 Tutorial / week Sessional Marks : 40

End Exam : 3 Hours End Exam Marks : 60

Course Objectives:

The objective of the course is to enable the student to

1. Identify the wastewater generation sites and make them understand the Principles of Estimation and characterization of wastewater generated in a community
2. Understand various Unit operations and Unit Processes and their functions in wastewater treatment
3. Design the components of wastewater treatment system
4. Learn the necessity of treatment and safe disposal of sewage and sludge generated out of community

Course Outcomes:

By the end of the course, student will be able to:

1. Identify suitable sewer materials and appurtenances for designing and laying sewers.
2. Analyse the characteristics of wastewater and hydraulic design of sewers and storm drains
3. Design the components of primary treatment of wastewater
4. Design the biological treatment components of wastewater treatment
5. Design the components of septic tank and Imhoff tanks and analyse appropriate management and disposal methods of sludge.

Mapping of course outcomes with program outcomes:

		PO												PSO		
		1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO	1	3														2
	2	2	3													2
	3	2	2	3												3
	4	2	2	3												3
	5	2	2	3												3

SYLLABUS

UNIT – I 12 Periods

Introduction to sanitation: Definition of terms – Sources of wastewater - Systems of sanitation – relative merits & demerits – collection and conveyance of waste water – sewerage – classification of sewerage systems- Estimation of sewage flow and storm water drainage – fluctuations

Learning Outcomes: 1) Understand the Terminology involved in wastewater treatment 2) Identify sources of wastewater and systems of sanitation 3) Analyze the sewerage system required for particular area 4) Estimate the quantity of sewage and storm water generated

UNIT – II 12 Periods

Sewage appurtenances: Appurtenances: Manhole, Drop manhole, Inverted siphon, Storm water inlets and catch basins – materials for sewers- Layout of sewers.

Hydraulics of sewers and storm drains: Hydraulic Design of Sewers and storm Drains

Learning Outcomes: 1) Understand the importance of Providing Sewage appurtenances for maintenance works 2) Design the Sewer pipe and storm water drain for the wastewater generated

UNIT – III 12 Periods

Sewage Characteristics: Sample collection - Sewage characteristics: Physical, Chemical and Biological Characteristics and their testing –BOD-first stage BOD exertion-COD-Relative Stability and Population Equivalent-Decomposition of Sewage- Cycles of Decay

Primary Treatment - Preliminary treatment – Screens - grit chambers – Skimming tanks - sedimentation – design of primary and pretreatment units.

Learning Outcomes: 1) Identify the Procedure of Sample collection 2) Examine the wastewater for Physical, chemical and Biological characteristics 3) Understand different cycles of organic matter decay 4) Understand the importance of Primary treatment 5) Design the primary treatment units

UNIT – IV 12 Periods

Secondary treatment: Aerobic and anaerobic treatment process-comparison.

Suspended growth process: Activated Sludge Process, principles, designs, and operational problems, modifications of Activated Sludge Processes, miscellaneous methods, Oxidation ponds, Oxidation ditches, Aerated Lagoons.

Attached Growth Process: Trickling Filters-mechanism of impurities removal-classification–filter problems-design and operation- recirculation, RBC’s

Learning Outcomes: 1) Identify different processes of secondary treatment of wastewater 2) Design the Secondary treatment systems 3) Determine the flow of treatment required based on the quality report of wastewater

UNIT – V 12 Periods

Anaerobic Processes: Septic Tanks and Imhoff tanks -Principles and Design

Bio-solids (Sludge) management: Characteristics- thickening – digestion, drying and sludge disposal

Disposal of sewage: methods of disposal – disposal into water bodies- Oxygen Sag Curve-disposal on land

Learning Outcomes: 1) Understand the importance of Sludge volume reduction and treatment 2) Identify the methods of Sewage and sludge disposal 3) Analyze the critical point of pollution in the river based on deoxygenation and reoxygenation curves

TEXT BOOKS

1. Garg, S.K. (2020), "Environmental Engineering (Vol.II): Sewage disposal and Air Pollution Engineering", Khanna Publishers, Delhi 40th Edition.
2. Modi, P.N. (2020), "Sewage Treatment Disposal and Waste Water Engineering" Standard Book House, Delhi, 17th Edition.

REFERENCES

1. Metcalf & Eddy (2017), "Wastewater Engineering: Treatment and Reuse" Tata McGraw-Hill, New Delhi, 4th Edition.
2. Raju, B.S.N. (2000), "Water supply and Waste Water Engineering" McGraw-Hill Education, New Delhi.
3. Peavy H.S., Rowe D.R., and Tchobanoglous G, (2017), "EnvironmentalEngineering" McGraw-Hill international edition, New York, 7th Edition.
4. BIS 3025 (Part 44): Method of Sampling and Test (Physical and Chemical) for Water and Wastewater, Part 44: Biochemical Oxygen Demand (BOD) (First Revision)
5. Relevant NPTEL Courses.

FLUID MECHANICS – I

CIV 222 **Credits : 3**

Instruction : 2 Lectures & 1 Tutorial / week Sessional Marks : 40

End Exam : 3 Hours End Exam Marks : 60

Course Objectives:

The objective of the course is to enable the student

1. To classify the properties of fluids and fluid statics
2. To derive the equation of conservation of mass and its application
3. To solve kinematic problems such as finding particle paths and stream lines
4. To use important concepts of continuity equation, Bernoulli's equation and turbulence, and apply the same to problems
5. To analyze laminar and turbulent flows
6. To compare the various flow measuring devices

Course Outcomes:

By the end of the semester, the student will be able to:

1. Examine the physical properties of fluids and Apply the understanding of pressure measurement to analyze the forces exerted on different gates.
2. Apply the principles of buoyancy and flotation to analyze the forces acting on submerged bodies in static fluids, while also examining different flow types.
3. Apply conservation principles of mass momentum and energy on fluids through system and control volume approaches.
4. Apply the impulse momentum principle to calculate the forces on bends, nozzles, plates, and vanes exerted by the fluid, and analyze laminar flow characteristics.
5. Analyze steady laminar and turbulent flows in pipes, solve series and parallel pipe networks, including two and three reservoir problems.

Mapping of course outcomes with program outcomes:

		PO												PSO		
		1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO	1	3	3													2
	2	3	3													2
	3	3	3													2
	4	3	3													2
	5	3	3													2

SYLLABUS

UNIT – I 10 Periods

Introduction: Dimensions and units – Physical properties of fluids - specific gravity, viscosity, surface tension, vapour pressure and their influences on fluid motion, pressure at a point, Pascal's law, Hydrostatic law -atmospheric, gauge and vacuum pressures-measurement of pressure. Pressure gauges, Manometers: Differential and Micro Manometers.

Learning outcomes: 1) Define Pascal's law, physical properties of fluid 2) Determine

pressure at point and differential pressure heads using Manometers

UNIT – II 12 Periods

Hydrostatics: Hydrostatic forces on submerged plane, Horizontal, Vertical, inclined surfaces– Centre of pressure

Buoyancy and Floatation: Archimedes Principle- Buoyancy & Floatation - Stability of Floating Bodies- Centre of Buoyancy - Metacentric Height and its Determination

Learning outcomes: 1) Define Buoyancy and Flotation principles 2) Determine the center of pressure for Horizontal, vertical and inclined surfaces 3) Determine the Centre of Buoyancy and Metacentric height for submerged and floating bodies

UNIT – III 14 Periods

Fluid Kinematics: Description of fluid flow, Stream line, path line and streak line and stream tube. Classification of flows: Steady, unsteady, uniform, non-uniform, laminar, turbulent, rotational and irrotational flows – Equation of continuity for one, two, three dimensional flows – stream and velocity potential functions, flow net analysis.

Fluid Dynamics: Surface and body forces – Euler's and Bernoulli's equations for flow along a stream line - Momentum equation and its application – forces on pipe bend

Learning outcomes: 1) Classify the type of flow 2) Calculate forces on pipe bend using Impulse Momentum equation 3) Derive Euler's and Bernoulli's Equation for along a stream line

UNIT – IV 14 Periods

Laminar Flow: Reynold's experiment – Characteristics of Laminar & Turbulent flows, Shear and velocity distributions, Laws of Fluid friction, Hagen-Poiseuille Formula, Flow between parallel plates, Flow through long tubes, hydrodynamically smooth and rough flows.

Turbulent Flow: Closed Conduit Flow: Darcy-Weisbach equation, Minor losses – pipes in series – pipes in parallel – Total energy line and hydraulic gradient line.

Learning outcomes: 1) Derive Hagen-Poiseuille Equation and Darcy-Weisbach equation 2) Calculate different losses in pipes when pipes are in series and parallel 3) Draw Total Energy and Hydraulic gradient lines

12 Periods

UNIT - V

Measurement of Flow: Pitot tube, Venturi meter and Orifice meter – classification of orifices, small orifice and large orifice, flow over rectangular, triangular, trapezoidal and stepped notches - –Broad crested weirs

Learning outcomes: 1) Classify orifices, small orifices and large orifice 2) Calculate flow through notches and weirs

TEXT BOOKS

1. Modi P.N. & Seth S.M. (2017), "Hydraulics & Fluid Mechanics including Hydraulics Machines", Standard Book House, New Delhi, 22nd Edition.

2. Jain A.K. (1998), “Fluid Mechanics including Hydraulic Machines”, Khanna Publishers, New Delhi, 12th Edition.

REFERENCES

1. Kumar K.L. (2016), “Engineering Fluid Mechanics”, S. Chand & Company Publishers, New Delhi, 8th Revised Edition.
2. Bansal R.K. (2018), “A Textbook of Fluid Mechanics and Hydraulic Machines”, Laxmi Publications, New Delhi., 10th Edition.
3. Frank. M. White (2011), “Fluid Mechanics (In SI Units)”, Tata McGraw Hill Education, 7th Edition.
4. Schaum’s Outline Series (2011), “Fluid Mechanics and Hydraulics”, McGraw Hill Education, 3rd Edition.
5. Relevant NPTEL Courses.

CONCRETE TECHNOLOGY

CIV 223 **Credits : 3**

Instruction : 2 Lectures & 1 Tutorial / week Sessional Marks : 40

End Exam : 3 Hours End Exam Marks : 60

Course Objectives:

1. Learn about the properties, uses and tests on various ingredients required for making concrete.
2. Study the behavior of concrete in fresh and hardened state.
3. Understand the applications of special concrete and learn concrete mix design

Course Outcomes:

At the end of course student will be able to:

1. Analyze the suitability of cement for construction by evaluating the characteristics.
2. Analyze the aggregates used in concrete based on their characteristics and relative suitability.
3. Analyze the role of admixtures on properties of concrete and identify the suitable test to determine workability with justification.
4. Analyze the characteristics of hardened concrete based on different tests.
5. Design the concrete mix as per Indian Standards and outline the role of special concretes.

Mapping of course outcomes with program outcomes:

		PO												PSO		
		1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO	1	2	3											3		
	2	2	3											3		
	3	2	3											3		
	4	2	3											3		
	5	2	2	3										3		

SYLLABUS

UNIT – I 12 Periods

Cement: Composition of ordinary Portland cement- oxide composition and compound composition- their functions in cement. Manufacture of ordinary Portland cement by wet process and dry process. Types of cement - OPC & blended (only fly ash & slag) and their uses. Tests on cement (IS 4031) – field tests – laboratory tests.

Tests on cement with industrial admixtures (IS 1727) (For Internal Evaluation only)

Learning Outcomes: 1) Explain the composition and manufacture of OPC. 2) State different types of cements and their Purposes 3) Conduct tests on cement

UNIT - II 12 Periods

Aggregate: Classification of aggregate *(as per IS 383)* based on origin, shape, size, unit weight: Manufactured sand (M – Sand)– characteristics of aggregates – strength, particle shape and texture, specific gravity, bulk density, voids, porosity and absorption of

aggregates – Moisture content of aggregate – bulking of fine aggregate. Tests on aggregates.

Learning outcomes: 1) Classify various types of aggregates. 2) Determine the properties of aggregates. 3) Conduct tests on aggregates

UNIT - III 12 Periods

Fresh Concrete: Manufacture of concrete – Batching, Mixing, Transportation, Placing, Vibrating, Finishing, Curing – Workability – Factors affecting workability – segregation and bleeding – Tests available for measurement of workability

Admixtures: Admixtures – functions of admixtures – General purpose admixtures such as Retarding admixture, accelerating admixtures, Air Entraining admixtures, Water reducing admixture

Learning Outcomes: 1) Explain the steps involved in the manufacture of concrete.2) Explain workability and Conduct tests on workability. 3) select Suitable admixtures for Various usage of Concrete

UNIT - IV 12 Periods

Hardened Concrete: Strength of concrete – water-cement ratio – gel-space ratio – gain of strength with age – effect of maximum size of aggregate on strength – compressive strength – flexural strength – tensile strength of concrete – bond strength – factors affecting the strength of concrete. Introduction to creep and shrinkage of concrete– Tests on hardened concrete *(as per IS 516)*

Learning Outcomes: 1) Factors affecting on strength of Concrete 2) Illustrate the procedure for tests on Concrete.3) Explain the Concept of creep and shrinkage. 4) conducts Tests on Concrete

UNIT - V 12 Periods

Special Concretes: Introduction to special concretes – lightweight concrete – no fines concrete – fibre reinforced concrete – self compacting concrete

Concrete Mix Design: Concrete mix design – BIS 10262 Method of mix design

Tests on Special Concretes – Introduction to High Performance Concrete (ACI 211) (For Internal Evaluation only)

Learning outcomes: 1) state the purpose of special concrete 2) Design concrete mix for the required grade

TEXT BOOKS

1. Shetty, M. S. and Jain, A K (2019), "Concrete Technology Theory and Practice", S Chand Publishers, 8th Edition, New Delhi
2. Neville, A M (2012), "Properties of Concrete", Prentice Hall Publishers, 5th Edition, United States

REFERENCES

1. Gambhir, M. L. (2017), "Concrete Technology Theory and Practice", Mc Graw Hill Education, 5th Edition.
2. Gupta B L, & Amit Gupta (2014), "Concrete Technology", Standard Publishers Distributors. New Delhi.

3. Santha Kumar, A R (2006), “Concrete Technology”, Oxford University Press, 2nd Edition.
4. Relevant IS Codes
5. Relevant NPTEL Courses.

GEOTECHNICAL ENGINEERING – I

CIV 224 **Credits : 3**

Instruction : 2 Lectures & 1 Tutorial / week Sessional Marks : 40

End Exam : 3 Hours End Exam Marks : 60

Prerequisites:

Engineering Mechanics, Engineering Geology.

Course Objectives:

The objective of the course is to impart the basic knowledge and skills related to the

1. Physical and plasticity characteristics of soil and various soil classification systems.
2. Stresses in soils due to self-weight, water and foundations
3. Compaction of soils
4. Consolidation of saturated soils

Course outcomes:

By the end of the course, the student will be able to:

1. Apply principles of soil mechanics to estimate the physical properties of soil.
2. Analyse the physical and plasticity characteristics of the given soil sample to classify the soil as per Indian Standard Classification system.
3. Apply the principles of soil mechanics to estimate the geostatic stresses in a soil mass and its permeability.
4. Analyse the stresses in soil and pore water and examine the potential for quick conditions. Also Apply the relevant theories to calculate the stresses in soil mass due to foundation loads.
5. Analyse the given compaction test data and estimate the OMC and MDD of the soil. Also analyse the stresses and soil conditions in a soil mass to estimate the magnitude and duration of settlements.

Mapping of course outcomes with program outcomes:

		PO												PSO		
		1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
CO	**1**	3													2	
	2	3	2												3	
	3	3													2	
	4	3	2												3	
	5	2	3												3	

SYLLABUS

UNIT - I 12 Periods

Physical Properties of Soil: Three phase system - phase diagram - physical properties- Functional Relationships between physical properties-determination of water content, specific gravity, In-situ density, Relative density**.**

Learning Outcomes: 1) Define physical properties of soil and derive their interrelationships 2) Explain methods for determination of physical properties 3) Solve civil engineering problems involving physical properties

UNIT - II 12 Periods

Plasticity Characteristics of soil: Atterberg's limits and their determination-liquid limit, plastic limit, shrinkage limit - Index properties-Activity-Free swell index.

Soil Classification: Soil classification-need and criteria for soil classification-IS Particle size classification-Classification tests-grain size analysis -hydrometer analysis- grain size distribution curve - Unified Soil

Classification- Indian Standard Soil classification- Coarse grained soils- Fine grained soils-Plasticity chart

Learning Outcomes: 1) Define Consistency limits and explain methods for their determination 2) Define index properties of clayey soil and bring out their significance 3) Draw the grain size distribution curve and analyse the gradation of soil 4) Classify the given soil based on I.S. Soil Classification system

UNIT - III 12 Periods

Effective stress: Stresses due to self-weight-total, neutral and effective stresses – Pressure diagrams under different soil conditions.

Permeability: Permeability-Darcy's law-Limitations of Darcy's law-laboratory tests for determination of permeability- Constant head method, Variable head method- Factors effecting permeability.

Learning Outcomes: 1) Determine the total stress, neutral and effective stresses for the given soil conditions 2) Draw the pressure distribution diagrams for the given soil and water conditions 3) Determine the permeability of soil using constant or variable head method.

UNIT - IV 12 Periods

Seepage Analysis: Types of soil water -Average permeability of stratified soils. Seepage pressure-critical hydraulic gradient -quick sand condition.

Stresses in soil due to Foundation loads: Boussinesq theory- Concentrated load-Strip footing- circular footing- Rectangular footing-Newmark's influence chart - Pressure bulb-Significant depth-Westergaard'stheory - 2:1 distribution method

Learning Outcomes: 1) Determine critical hydraulic gradient and its effect on quick sand condition 2) Determine the stress in soil under the footing(s) using Boussinesq's or Westergaard'stheory 3) Determine the stress in soil under the footing(s) using 2:1 distribution method or Newmark's influence chart

UNIT - V 12 Periods

Compaction: Principle of compaction, OMC and MDD, Lab tests-IS light weight and heavy weight compaction tests, Factors effecting compaction - zero air void line-Effect of compaction on engineering properties of soils - Field compaction control – Proctor's Needle.

Consolidation: Definition and significance-mechanism-Terzaghi's soil-spring analogy -lab consolidation test – e-log p curve-Coefficient of compressibility-coefficient of volume change-compression index-determination of consolidation settlement – Terzaghi's theory of 1D consolidation- Time-settlement calculations. Determination of coefficient of consolidation-time fitting methods – Pre-consolidation pressure-normally consolidated and over consolidated clays- secondary consolidation.

Learning Outcomes: 1) Determine the OMC and MDD from I.S. Light weight and Heavy weight compaction tests and Draw the zero air-void line 4) Explain the procedure for Field compaction control. 2) Explain the procedure for Field compaction control. 3) Explain the mechanism of consolidation using Terzaghi's soil-spring analogy and identify types of consolidation 4) Determine the magnitude of consolidation settlement from consolidation test data 5) Determine the duration of consolidation settlement using Terzaghi's theory of consolidation

TEXTBOOKS

1. Narasinga Rao, B.N.D.(2015), Soil Mechanics and Foundation Engineering, Wiley Publishers, New Delhi
2. Arora, K.R. (2008), "Soil Mechanics and Foundation Engineering", Standard Publishers, Delhi.

REFERENCES

1. Murthy, V.N.S. (2009), "A text book of Soil Mechanics and Foundation Engineering", UBS Publishers Distributors Ltd., New Delhi.
2. Braja M. Das, (2005), "Fundamentals of Geotechnical Engineering", Thomson Asia Pvt. Ltd.,

Singapore.
3. Craig, R.F. (2014), “Soil Mechanics”, McGraw hill, New Delhi
4. Gopal Ranjan and Rao, A.S.R. (2007), “Basic and Applied Soil Mechanics”, New age International (P) Ltd, New Delhi.
5. Shashi K Gulhati and Manoj Dutta (2005), Geotechnical Engineering, Tata McGraw Hill, New Delhi
6. Relevant NPTEL Courses.

STRUCTURAL ANALYSIS – I

CIV 225 **Credits : 3**

Instruction : 2 Lectures & 1 Tutorial / week Sessional Marks : 40

End Exam : 3 Hours End Exam Marks : 60

Course Objectives:

1. Apply suitable methods for calculating deflections in statically determinate beams and trusses.
2. Apply suitable methods for analyzing statically indeterminate beams.
3. Analyze beams under moving loads.

Course Outcomes:

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

1. Analyze various combined bending & Direct Stresses & Apply Various theories of column buckling
2. Compare & Solve deflections for statically determinate beams & Trusses using various methods
3. Solve Statically Determinate Trusses by Applying the concept of Energy theories
4. Solve deflection of beams using Clapeyron's theorem
5. Compare & Solve deflections for statically Indeterminate beams using various methods

Mapping of course outcomes with program outcomes:

		PO												PSO		
		1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO	1	3	2											2		
	2	2	3											3		
	3	2	3											3		
	4	2	3											3		
	5	2	3											3		

SYLLABUS

UNIT – I 10 Periods

Combined bending and direct stresses: Resultant stress on a rectangular section subjected to eccentric load along one axis and along both the axes – kern (Core) of a section.

Columns and Struts: Euler' theory – end conditions. Rankine – Gordon formula – other empirical formulae – Eccentrically loaded columns – Perry's formula, Secant formula.

Learning outcomes: 1) Calculate the corner stresses for a rectangular section subjected to uniaxial and bi-axial loading. 2) Derive the expression for Kern of a section. 3) Apply Euler's & Rankine's theory for long columns. 4) Find the stresses in Eccentrically loaded column

UNIT – II 14 Periods

Deflections of beams: (a) Double integration method (b) Macaulay's method (c) Moment area method (d) Conjugate beam method, Relation between curvature, rotation and deflection.

Learning Outcomes: 1) Calculate the deflection of statically determinate beams by using Double integration method, Macaulay's method, Moment area method and Conjugate beam method.

UNIT - III 14 Periods

Strain Energy: Expression for strain energy due to (i) Axial load, (ii) Shear force, (iii) Bending Moment and (iv) Torsion;

Deflections of Statically Determinate Beams and Plane Trusses (Limited to 9 members only): (a) Unit load method (b) Castigliano's theorem – I.

Learning Outcomes: 1) Derive expression for strain energy stored in a body due to (i) Axial load, (ii) Shear force, (iii) Bending Moment and (iv) Torque. 2) Calculate the deflection of statically determinate beams by using Unit load method & Castigliano's theorem – I. 3) Calculate the deflection of statically determinate trusses by using Unit load method & Castigliano's theorem – I

UNIT - IV 10 Periods

Fixed beams: Analysis of Fixed beams subjected to single and multiple point loads, UDL, UVL, couple, and combination of loads. Effect of sinking and rotation of supports.

Continuous beams: Analysis for shear force and bending moment - Clapeyron's theorem of three moments- effect of sinking of supports.

Learning Outcomes: 1) Derive expressions for fixed end moments subjected to different types of loadings. 2) Analyze the fixed beams. 3) Analyze continuous beams by using three moment theorem method

UNIT - V 12 Periods

Slope deflection method: Introduction, Assumption, Sign Conventions, Derivation of slope deflection equation, applications of slope deflection equation to statically indeterminate beams

Moment Distribution Method: Introduction, Sign conventions, Carryover Factor, Distribution Factor, Application of moment distribution method to statically indeterminate beams

Learning Outcomes: 1) Analyze continuous beams by using slope deflection method. 2) Define stiffness, distribution factor and carry over factor. 3) Analyze continuous beams by using moment distribution method

TEXT BOOKS

1. Vazirani V.N., M.M Ratwani and S.K Duggal (1999), "Analysis of Structures – Vol-I & II", Khanna Publishers, 17th Edition.
2. C.S. Reddy (2017) "Basic Structural Analysis", McGraw Hill Education, 3rd Edition
3. Ramamrutham, S Narayanan (2020), "Strength of Materials", Dhanpat Rai & Sons, 20th Edition.

REFERENCES

1. R. Subramanian (2016)," Strength of Materials", Oxford University Press; 3rd Edition.

2. C.K.Wang (2017), “Intermediate Structural Analysis” , McGraw Hill International 1st Edition.
3. Devdas Menon (2017) “Structural Analysis”, Alpha Science International Ltd, 2nd Edition.
4. Thandavamoorthy (2011), “Structural analysis”, Oxford University Press.
5. S.S.Bhavakatti (2010), “Structural analysis Vol I & II”, Vikas Publishing House Pvt Ltd, 4th Edition
6. D S Prakash Rao (1996), “Structural Analysis A Unified Approach”, Universities Press.
7. Relevant NPTEL Courses.

BUILDING ARCHITECTURE WITH REVIT

CIV 226 **Credits : 1.5**

Instruction : 3 Practicals / week Sessional Marks : 50

End Exam : 3 Hours End Exam Marks : 50

Prerequisites:

Building Planning & Design

Course Objective:

The objective of this course is

Visualization for designing displaced building design views; enhancement of performance for visualization; capturing of drawing ideas in a photorealistic state with system-based/ cloud-based rendering.

Course Outcomes:

At the end of this course the student will be able to;

1. Develop higher-quality, more accurate architectural designs; use tools specifically built to support Building Information Modeling workflows.
2. Capture the concepts and maintain the central idea through design and documentation development.

Mapping of course outcomes with program outcomes:

		PO												PSO		
		1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO	1	3		3		3					1		2	2		
	2	3		3		3					1		2	2		

SYLLABUS

LIST OF EXPERIMENTS

Exercise – 1:
Design/Draw a specific type of wall with given parameters/details.

Exercise – 2:
Design/Draw a single, double and triple room(s) with specific type of walls given parameters/details.

Exercise – 3:
Design/Draw a plan/building of a structure with given specifications/parameters/details.

Exercise – 4:
Design/Assign Doors and Windows for the plan/building developed, with specific given parameters/details.

Exercise – 5:
Design/Create Roof and Floor for the building developed, with specific given parameters/details.

Exercise – 6:
Design/Create/Insert Components/Models/Families to detail the building developed, with specific given parameters/details.

Exercise – 7:
Design/Draw Staircase and Railing to a multi-levelled building with given specifications/parameters/details.

Exercise – 8:
Create Tags, Colour Legends and Schedules for a fully developed building with given specifications/parameters/details.
Create photorealistic rendered views for the fully developed project/building (interior views and exterior views).

Exercise – 9:
Develop a residential building with suitable or given elevational, functional and structural detailing/parameters.
Create/Scale layouts/sheets to print the fully developed residential project/building.

Exercise – 10:
Develop a multi-storey building (min. 4 floors above G.L.) with suitable or given elevational, functional and structural detailing/parameters.
Create/Scale layouts/sheets to print the fully developed multi-storey project/building.

REFERENCES

1. www.academy.autodesk.com
2. Relevant MOOCs.

CONCRETE TECHNOLOGY LAB

CIV 227 **Credits : 1.5**

Instruction : 3 Practicals / week Sessional Marks : 50

End Exam : 3 Hours End Exam Marks : 50

Course Objectives:

1. To apply the basic knowledge of civil engineering in selecting appropriate cement, fine and coarse aggregates in making concrete.
2. To be able to make concrete of required strength.

Course Outcomes:

At the end of this course student will be able to

1. Analyse the properties of cement, concrete and its ingredients
2. Utilize these principles to judge the suitability of various ingredients of concrete in construction

Mapping of course outcomes with program outcomes:

		PO												PSO		
		1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO	1	3	3		3		3		2	3	3			3		
	2	3	3		3		3		2	3	3			3		

LIST OF EXPERIMENTS

1. Specific gravity of cement and unit weight of cement
2. Fineness (By Sieving) & Consistency of cement
3. Initial and final setting time of cement.
4. Compressive strength of cement.
5. Specific gravity and unit weight of coarse aggregate.
6. Specific gravity and unit weight of fine aggregate.
7. Sieve analysis of coarse and fine aggregates
8. Bulking of sand.
9. Workability of fresh concrete by: Slump Cone, Compaction factor, Flow Table, Vee-Bee Consistometer Methods
10. Compressive Strength of concrete (Demonstration)
11. Split tensile strength of concrete (Demonstration)
12. Modulus of rupture of concrete (Demonstration)
13. Soundness of cement using Lee-Chatlier apparatus (Demonstration)

REFERENCES

1. Shetty, M. S. & Jain, A K (2019), "Concrete Technology Theory and Practice", S Chand Publishers, 8th Edition.
2. Neville, A M (2012), "Properties of Concrete", Prentice Hall Publishers, 5th Edition.
3. Relevant IS Codes.
4. Relevant NPTEL Courses.

GEOTECHNICAL ENGINEERING LAB

CIV 228 **Credits : 1.5**

Instruction : 3 Practicals / week Sessional Marks : 50

End Exam : 3 Hours End Exam Marks : 50

Course Objectives:

The objective of the course is

1. To impart the skills related to the physical and plasticity characteristics of soil.
2. To impart the skills related to the permeability and compaction and consolidation characteristics of soil.
3. To impart the skills related to the Strength and Swelling characteristics of soil.
4. To introduce SPT and DCPT

Course outcomes:

By the end of the course, student will be able to:

1. Conduct tests on physical and plasticity characteristics of soil, analyze and interpret the data, comprehend and write reports
2. Conduct tests on permeability and compaction characteristics of soil, analyze and interpret the data, comprehend and write reports
3. Conduct tests on strength characteristics of soil, analyze and interpret the data, comprehend and write reports

Mapping of course outcomes with program outcomes:

		PO												PSO		
		1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO	1	2	3		3					3	3				2	
	2	2	3		3					3	3				3	
	3	2	3		3					3	3				3	

LIST OF EXPERIMENTS

1. Determination of specific gravity of soils by density bottle method
2. Determination of Grain size distribution - Sieve analysis
3. Determination of Liquid limit by Casagrande's method
4. Determination of Liquid limit by Uppal's Method
5. Determination of Plastic limit
6. Determination of Free swell Index
7. Determination of in-situ density by core cutter method.
8. Determination of Permeability by Constant head method
9. Determination of Permeability by Variable head method
10. Determination of OMC and MDD by I.S. Light Compaction
11. Determination of shear parameters using Direct shear test
12. Determination of Unconfined compression strength for fine grained soils
13. Determination of coefficient of consolidation

Demonstration Experiments (Subject to availability)

1. Hydrometer analysis
2. Determination of Shrinkage limit of soil
3. Determination of in-situ density by sand replacement method.
4. Relative density – Sand
5. Triaxial Compression Test
6. Vane shear test
7. Swell pressure test

REFERENCES

1. Narasinga Rao, B.N.D. (2015), "Soil Mechanics and Foundation Engineering", Wiley Publishers.
2. Arora, K.R. (2008), "Soil Mechanics and Foundation Engineering", Standard Publishers, Delhi – 110 006.
3. Punmia, B.C. (1995), "Soil Mechanics and Foundation Engineering", Laxmi Publications Pvt. Ltd.,New Delhi.
4. SP 36: Part 1: 1987 Compendium of Indian standards on soil engineering, Part 1: Laboratorytesting ofsoils for civil engineering purposes, Bureau of Indian Standards, New Delhi
5. SP 36: Part 2 : 1988 Compendium of Indian standards on soil engineering, Part 2: Field testing of soils for civil engineering purposes, Bureau of Indian Standards, New Delhi