Guru Nanak Dev Engineering College, Ludhiana
Civil Engineering Department
Study Scheme 2018 (with training)

Third Semester										
Category	**Course Code**	**Course Title**	**Theory/ Practical**	**Hours per week**			**Marks Distribution**			**Credits**
				L	**T**	**P**	**Int**	**Ext**	**Total**	
Professional Core courses	PCCE-101	Surveying & Geomatics	Theory	3	1	0	40	60	100	4
Professional Core courses	PCCE-102	Solid Mechanics	Theory	3	0	0	40	60	100	3
Professional Core courses	PCCE-103	Fluid Mechanics	Theory	3	0	0	40	60	100	3
Professional Core courses	PCCE-104	Disaster Preparedness & Planning	Theory	3	0	0	40	60	100	3
Engineering Science Course	ESCE-101	Basic Electronics & applications in Civil Engineering	Theory	3	0	0	40	60	100	3
Humanities and Social Sciences including Management	HSMCE-101	Civil Engineering-Introduction, Societal & Global Impact	Theory	3	0	0	40	60	100	3
Professional Core courses	LPCCE-101	Surveying & Geomatics Laboratory	Practical	0	0	2	30	20	50	1
Professional Core courses	LPCCE-102	Fluid Mechanics Laboratory	Practical	0	0	2	30	20	50	1
Professional Core courses	LPCCE-103	Solid Mechanics Laboratory	Practical	0	0	2	30	20	50	1
Training	TR-101	Training - I	Practical*	-	-	-	60	40	100	1
Mandatory course		Mentoring and Professional Development	Practical	0	0	1		-	-	0
		26		**18**	**1**	**7**	**390**	**460**	**850**	**23**

Fourth Semester							
Category	**Course**	**Course Title**	**Theory/**	**Hours**		**Marks**	**Credits**

	Code		Practical	Per Week			Distribution			
				L	T	P	Int	Ext	Total	
Professional Core courses	PCCE-105	Concrete Technology	Theory	3	0	0	40	60	100	3
Professional Core courses	PCCE-106	Material, Testing & Evaluation	Theory	4	0	0	40	60	100	4
Professional Core courses	PCCE-107	Hydrology & Water Resources Engineering	Theory	3	1	0	40	60	100	4
Professional Core courses	PCCE-108	Transportation Engineering	Theory	3	1	0	40	60	100	4
Basic Science Course	BSCE-101	Mathematics-III	Theory	3	0	0	40	60	100	3
Professional Core courses	LPCCE-104	Concrete Testing Laboratory	Practical	0	0	2	30	20	50	1
Professional Core courses	LPCCE-105	Transportation Laboratory	Practical	0	0	2	30	20	50	1
Project	PRCE-101	Seminar and Technical Report Writing	Practical	0	0	2	50	-	50	1
Mandatory Courses (Non-credit)	MCCE-101	Environment Science	Theory[#]	2	0	0	50	-	50	0
Mandatory Courses	MPD-102	Mentoring and Professional Development	Practical	0	0	1	100	-	100	1
		27		**18**	**2**	**7**	**410**	**340**	**750**	**22**

*4 weeks Industrial/Institutional training for which viva will be conducted along End semester exam of Fifth semester.
#Grade will be awarded (Satisfactory/Unsatisfactory).

Fifth Semester

Category	Course Code	Course Title	Theory/ Practical	Hours Per Week			Marks Distribution			Credits
				L	T	P	Int	Ext	Total	
Professional Core courses	PCCE-109	Engineering Geology	Theory	3	0	0	40	60	100	3
Professional Core courses	PCCE-110	Engineering Economics, Estimation and Costing	Theory	3	1	0	40	60	100	4
Professional Core courses	PCCE-111	Construction Engineering & Management	Theory	3	0	0	40	60	100	3
Professional	PCCE-112	Environmental	Theory	4	0	0	40	60	100	4

Core courses		Engineering								
Professional Core courses	PCCE-113	Structural Engineering	Theory	3	1	0	40	60	100	4
Professional Core courses	PCCE-114	Geotechnical Engineering	Theory	3	0	0	40	60	100	3
Professional Core courses	LPCCE-106	Geotechnical Laboratory	Practical	0	0	2	30	20	50	1
Professional Core courses	LPCCE-107	Environmental Engineering Laboratory	Practical	0	0	2	30	20	50	1
Professional Core courses	LPCCE-108	Structural Laboratory	Practical	0	0	2	30	20	50	1
Training	TR-102	Training - II	Practical*	-	-	-	60	40	100	1
Mandatory Course		Mentoring and Professional Development	Practical	0	0	1	-	-		0
		28		**19**	**2**	**7**	**390**	**460**	**850**	**25**

Sixth Semester

Category	**Course Code**	**Course Title**	**Theory/ Practical**	**Hours Per Week**			**Marks Distribution**			**Credits**
				L	**T**	**P**	**Int**	**Ext**	**Total**	
Professional Core courses	PCCE-115	Irrigation Engineering	Theory	3	1	0	40	60	100	4
Professional Core courses	PCCE-116	Building Construction Practice	Theory	3	0	0	40	60	100	3
Professional Elective courses	PECE-XXX	Track Specific Course – I	Theory	3	1	0	40	60	100	4
Professional Elective courses	PECE-XXX	Track Specific Course – II	Theory	3	1	0	40	60	100	4
Professional Core courses	LPCCE-109	CAD & BIM Laboratory	Practical	0	0	2	30	20	50	1
Open Elective courses	OEZZ-XXX	Open Elective – I	Theory	3	0	0	40	60	100	3
Open Elective Courses (Non-credit)	MCI-102/ MCI-103	Constitution of India/ Management –I (Organizational Behaviour)	Theory[#]	2	0	0	50	-	50	0
Project	PRCE-102	Minor Project	Practical	0	0	2	60	40	100	1
Mandatory Course	MPD-103	Mentoring and Professional Development	Practical	0	0	1	100	-	100	1

		25		**17**	**3**	**5**	**390**	**360**	**750**	**21**
*4 weeks Industrial/Institutional training for which viva will be conducted along End Semester Exam of Seventh semester. #Grade will be awarded (Satisfactory/Unsatisfactory).										

Choice – I (Industrial Training in 7th Semester)										
Seventh Semester										
Category	**Course Code**	**Course Title**	**Theory/ Practical**	**Hours Per Week**			**Marks Distribution**			**Credits**
				L	**T**	**P**	**Int**	**Ext**	**Total**	
Training	TR-103	Training - III	Practical*	-	-	-	60	40	100	1
Training	TR-104	Industrial Training	Practical	-	-	-	350	150	500	15
							410	**190**	**600**	**16**
Eighth Semester										
Category	**Course Code**	**Course Title**	**Theory/ Practical**	**Hours Per Week**			**Marks**			**Credits**
				L	**T**	**P**	**Int**	**Ext**	**Total**	
Professional Elective courses	PECE-XXX	Track Specific Course – III	Theory	3	1	0	40	60	100	4
Professional Elective courses	PECE-XXX	Track Specific Course – IV	Theory	3	1	0	40	60	100	4
Open Elective courses	OEZZ-XXX	Open Elective – II	Theory	3	0	0	40	60	100	3
Professional Elective courses	LPECE-XXX	Track Specific Course – V	Practical	0	0	2	30	20	50	1
Project	PRCE-103	Major Project	Practical	0	0	6	120	80	200	3
Mandatory Course	MPD-104	Mentoring and Professional Development	Practical	0	0	1	100	-	100	1
			21	**9**	**2**	**9**	**370**	**280**	**650**	**16**

Choice – II (Training in 8th Semester)										
Seventh Semester										
Category	**Course Code**	**Course Title**	**Theory/ Practical**	**Hours Per Week**			**Marks Distribution**			**Credits**
				L	**T**	**P**	**Int**	**Ext**	**Total**	
Professional Elective courses	PECE-XXX	Track Specific Course – III	Theory	3	1	0	40	60	100	4
Professional Elective courses	PECE-XXX	Track Specific Course – IV	Theory	3	1	0	40	60	100	4

Open Elective courses	OEZZ-XXX	Open Elective – II	Theory	3	0	0	40	60	100	3
Professional Elective courses	LPECE-XXX	Track Specific Course – V	Practical	0	0	2	30	20	50	1
Project	PRCE-103	Major Project	Practical	0	0	6	120	80	200	3
Training	TR-103	Training - III[#]	Practical	-	-	-	60	40	100	1
			21	**9**	**2**	**9**	**370**	**280**	**650**	**16**

Eighth Semester

Category	**Course Code**	**Course Title**	**Theory/ Practical**	**Hours Per Week**			**Marks**			**Credits**
				L	**T**	**P**	**Int**	**Ext**	**Total**	
Training	TR-104	Industrial Training	Practical	-			350	150	500	15
Mandatory Course	MPD-104	Mentoring and Professional Development	Practical	0	0	1	100	-	100	1
			Total				**450**	**150**	**600**	**16**

** Industrial /Institutional Training will be imparted at the end of 2nd semester in the institute or students can go to industry for four weeks.*

There will be one period per week for Mentoring and Professional Development; final evaluation of this course will be done based on the combined assessment of odd and even semester of respective year of study.

List of Electives

Geotechnical and Transportation Engineering		**Structural Engineering**		**Environmental Engineering**	
Course Code	**Course Name**	**Course Code**	**Course Name**	**Course Code**	**Course Name**
PECE-101	Foundation Engineering	PECE-131	Masonry Structures	PECE-161	Ecological Engineering
PECE-102	Geotechnical Design	PECE-132	Structural Analysis	PECE-162	Environmental Change and Sustainable Development
PECE-103	Reinforced Earth	PECE-133	Advanced Structural Analysis	PECE-163	Physico-Chemical Treatment Methods
PECE-104	Earthen Embankment	PECE-134	Design of Concrete Structures	PECE-164	Biological Treatment Processes
PECE-105	Rock Mechanics	PECE-135	Prestressed Concrete	PECE-165	Rural Water Supply and Onsite Sanitation Systems
PECE-106	Environmental Geo-technology	PECE-136	Design of Steel Structures	PECE-166	Urban Hydrology and Hydraulics
PECE-107	Ground Improvement	PECE-137	Bridge Engineering	PECE-167	Solid Waste Management
PECE-108	Pavement Materials	PECE-138	Industrial Structures	PECE-168	Analytical Methods for Environmental Monitoring
PECE-109	Pavement Design	PECE-139	Civil Engineering	PECE-169	Air Pollution Control

Geotechnical and Transportation Engineering		Structural Engineering		Environmental Engineering	
Course Code	**Course Name**	**Course Code**	**Course Name**	**Course Code**	**Course Name**
			Design-I		
PECE-110	Traffic Engineering and Management	PECE-140	Civil Engineering Design-II	PECE-170	Water Distribution and Sewerage Network Design
PECE-111	Urban Transportation Planning	PECE-141	Repairs & Rehabilitation of Structures	PECE-171	Environmental Impact Assessment and Life Cycle Analysis
PECE-112	Geometric Design of Highways	PECE-142	Sustainable Construction Methods	PECE-172	Industrial Wastewater Management and Reuse
PECE-113	Airport Planning and Design	LPECE-102	Problem Analysis Laboratory	LPECE-103	Problem Analysis Laboratory
PECE-114	Railway Engineering				
PECE-115	Highway Construction and Management				
PECE-116	Port and Harbour Engineering				
PECE-117	High Speed Rail Engineering				
PECE-118	Transportation Economics				
PECE-119	Instrumentation & Sensor Technologies for Civil Engineering Applications				
LPECE-101	Problem Analysis Laboratory				

List of Open Electives

Course Code	Open electives
OECE-101	Metro Systems and Engineering
OECE-102	Numerical Methods in Engineering
OECE-103	Project Management & Monitoring
OECE-104	Traffic Management & Road Safety
OECE-105	Environmental Impact Assessment
OECE-106	Building Information Modelling

Study Scheme 2018 (without training)

Third Semester										
Category	**Course Code**	**Course Title**	**Theory/ Practical**	**Hours per week**			**Marks Distribution**			**Credits**
				L	**T**	**P**	**Int**	**Ext**	**Total**	
Professional Core courses	PCCE-101	Surveying & Geomatics	Theory	3	1	0	40	60	100	4
Professional Core courses	PCCE-102	Solid Mechanics	Theory	3	0	0	40	60	100	3
Professional Core courses	PCCE-103	Fluid Mechanics	Theory	3	0	0	40	60	100	3
Professional Core courses	PCCE-104	Disaster Preparedness & Planning	Theory	3	0	0	40	60	100	3
Engineering Science Course	ESCE-101	Basic Electronics & applications in Civil Engineering	Theory	3	0	0	40	60	100	3
Humanities and Social Sciences including Management	HSMCE-101	Civil Engineering-Introduction, Societal & Global Impact	Theory	3	0	0	40	60	100	3
Professional Core courses	LPCCE-101	Surveying & Geomatics Laboratory	Practical	0	0	2	30	20	50	1
Professional Core courses	LPCCE-102	Fluid Mechanics Laboratory	Practical	0	0	2	30	20	50	1
Professional Core courses	LPCCE-103	Solid Mechanics Laboratory	Practical	0	0	2	30	20	50	1
Training	TR-101	Training - I	Practical*	-	-	-	60	40	100	1
Mandatory course		Mentoring and Professional Development	Practical	0	0	1		-	-	0
		26		**18**	**1**	**7**	**390**	**460**	**850**	**23**

Fourth Semester										
Category	**Course Code**	**Course Title**	**Theory/ Practical**	**Hours Per Week**			**Marks Distribution**			**Credits**
				L	**T**	**P**	**Int**	**Ext**	**Total**	

Professional Core courses	PCCE-105	Concrete Technology	Theory	3	0	0	40	60	100	3
Professional Core courses	PCCE-106	Material, Testing & Evaluation	Theory	4	0	0	40	60	100	4
Professional Core courses	PCCE-107	Hydrology & Water Resources Engineering	Theory	3	1	0	40	60	100	4
Professional Core courses	PCCE-108	Transportation Engineering	Theory	3	1	0	40	60	100	4
Basic Science Course	BSCE-101	Mathematics-III	Theory	3	0	0	40	60	100	3
Professional Core courses	LPCCE-104	Concrete Testing Laboratory	Practical	0	0	2	30	20	50	1
Professional Core courses	LPCCE-105	Transportation Laboratory	Practical	0	0	2	30	20	50	1
Project	PRCE-101	Seminar and Technical Report Writing	Practical	0	0	2	50	-	50	1
Mandatory Courses (Non-credit)	MCCE-101	Environment Science	Theory[#]	2	0	0	50	-	50	0
Mandatory Courses	MPD-102	Mentoring and Professional Development	Practical	0	0	1	100	-	100	1
		27		**18**	**2**	**7**	**410**	**340**	**750**	**22**

*4 weeks Industrial/Institutional training for which viva will be conducted along End semester exam of Fifth semester.
#Grade will be awarded (Satisfactory/Unsatisfactory).

Fifth Semester

Category	**Course Code**	**Course Title**	**Theory/ Practical**	**Hours Per Week**			**Marks Distribution**			**Credits**
				L	**T**	**P**	**Int**	**Ext**	**Total**	
Professional Core courses	PCCE-109	Engineering Geology	Theory	3	0	0	40	60	100	3
Professional Core courses	PCCE-110	Engineering Economics, Estimation and Costing	Theory	3	1	0	40	60	100	4
Professional Core courses	PCCE-111	Construction Engineering & Management	Theory	3	0	0	40	60	100	3
Professional Core courses	PCCE-112	Environmental Engineering	Theory	4	0	0	40	60	100	4
Professional	PCCE-113	Structural	Theory	3	1	0	40	60	100	4

Core courses		Engineering								
Professional Core courses	PCCE-114	Geotechnical Engineering	Theory	3	0	0	40	60	100	3
Professional Core courses	LPCCE-106	Geotechnical Laboratory	Practical	0	0	2	30	20	50	1
Professional Core courses	LPCCE-107	Environmental Engineering Laboratory	Practical	0	0	2	30	20	50	1
Professional Core courses	LPCCE-108	Structural Laboratory	Practical	0	0	2	30	20	50	1
Training	TR-102	Training - II	Practical*	-	-	-	60	40	100	1
Mandatory Course		Mentoring and Professional Development	Practical	0	0	1	-	-		0
		28		**19**	**2**	**7**	**390**	**460**	**850**	**25**

Sixth Semester

Category	**Course Code**	**Course Title**	**Theory/ Practical**	**Hours Per Week**			**Marks Distribution**			**Credits**
				L	**T**	**P**	**Int**	**Ext**	**Total**	
Professional Core courses	PCCE-115	Irrigation Engineering	Theory	3	1	0	40	60	100	4
Professional Core courses	PCCE-116	Building Construction Practice	Theory	3	0	0	40	60	100	3
Professional Elective courses	PECE-XXX	Track Specific Course – I	Theory	3	1	0	40	60	100	4
Professional Elective courses	PECE-XXX	Track Specific Course – II	Theory	3	1	0	40	60	100	4
Professional Core courses	LPCCE-109	CAD & BIM Laboratory	Practical	0	0	2	30	20	50	1
Open Elective courses	OEZZ-XXX	Open Elective – I	Theory	3	0	0	40	60	100	3
Open Elective Courses (Non-credit)	MCI-102/ MCI-103	Constitution of India/ Management –I (Organizational Behavior)	Theory[#]	2	0	0	50	-	50	0
Project	PRCE-102	Minor Project	Practical	0	0	2	60	40	100	1
Mandatory Course	MPD-103	Mentoring and Professional Development	Practical	0	0	1	100	-	100	1
		25		**17**	**3**	**5**	**390**	**360**	**750**	**21**

*4 weeks Industrial/Institutional training for which viva will be conducted along End Semester Exam of

Seventh semester.
#Grade will be awarded (Satisfactory/Unsatisfactory).

Seventh Semester

Category	Course Code	Course Title	Theory/ Practical	Hours Per Week			Marks Distribution			Credits
				L	T	P	Int	Ext	Total	
Professional Elective courses	PECE-XXX	Track Specific Course – III	Theory	3	1	0	40	60	100	4
Professional Elective courses	PECE-XXX	Track Specific Course – IV	Theory	3	1	0	40	60	100	4
Open Elective courses	OEZZ-XXX	Open Elective – II	Theory	3	0	0	40	60	100	3
Professional Elective courses	LPECE-XXX	Track Specific Course – V	Practical	0	0	2	30	20	50	1
Seminar/Project	PRCE-104	Project – I	Practical	0	0	6	120	80	200	3
Training	TR-103	Training – III	Practical*	-	-	-	60	40	100	1
Mandatory Course		Mentoring and Professional Development	Practical	0	0	1		-		0
		21		**09**	**2**	**9**	**330**	**320**	**650**	**16**

Eighth Semester

Category	Course Code	Course Title	Theory/ Practical	Hours Per Week			Marks			Credits
				L	T	P	Int	Ext	Total	
Professional Elective courses	PECE-XXX	Track Specific Course – VI	Theory	3	1	0	40	60	100	4
Professional Elective courses	PECE-XXX	Track Specific Course – VII	Theory	3	1	0	40	60	100	4
Open Elective courses	OEZZ-XXX	Open Elective – III	Theory	3	0	0	40	60	100	3
Seminar/Project	PRCE-105	Project – II	Practical	0	0	6	120	80	200	3
Seminar/Project	PRCE-106	Seminar	Practical	0	0	2	50	-	50	1
Mandatory Course	MPD-104	Mentoring and Professional Development	Practical	0	0	1	100	-	100	1
		20		**9**	**2**	**9**	**390**	**260**	**650**	**16**

** Industrial /Institutional Training will be imparted at the end of 2nd semester in the institute or students can go to industry for four weeks.*
There will be one period per week for Mentoring and Professional Development; final evaluation of this course will be done based on the combined assessment of odd and even semester of respective year of study.

List of Electives

Geotechnical and Transportation Engineering		Structural Engineering		Environmental Engineering	
Course Code	**Course Name**	**Course Code**	**Course Name**	**Course Code**	**Course Name**
PECE-101	Foundation Engineering	PECE-131	Masonry Structures	PECE-161	Ecological Engineering
PECE-102	Geotechnical Design	PECE-132	Structural Analysis	PECE-162	Environmental Change and Sustainable Development
PECE-103	Reinforced Earth	PECE-133	Advanced Structural Analysis	PECE-163	Physico-Chemical Treatment Methods
PECE-104	Earthen Embankment	PECE-134	Design of Concrete Structures	PECE-164	Biological Treatment Processes
PECE-105	Rock Mechanics	PECE-135	Pre-stressed Concrete	PECE-165	Rural Water Supply and Onsite Sanitation Systems
PECE-106	Environmental Geo-technology	PECE-136	Design of Steel Structures	PECE-166	Urban Hydrology and Hydraulics
PECE-107	Ground Improvement	PECE-137	Bridge Engineering	PECE-167	Solid Waste Management
PECE-108	Pavement Materials	PECE-138	Industrial Structures	PECE-168	Analytical Methods for Environmental Monitoring
PECE-109	Pavement Design	PECE-139	Civil Engineering Design-I	PECE-169	Air Pollution Control
PECE-110	Traffic Engineering and Management	PECE-140	Civil Engineering Design-II	PECE-170	Water Distribution and Sewerage Network Design
PECE-111	Urban Transportation Planning	PECE-141	Repairs & Rehabilitation of Structures	PECE-171	Environmental Impact Assessment and Life Cycle Analysis
PECE-112	Geometric Design of Highways	PECE-142	Sustainable Construction Methods	PECE-172	Industrial Wastewater Management and Reuse
PECE-113	Airport Planning and Design	LPECE-102	Problem Analysis Laboratory	LPECE-103	Problem Analysis Laboratory
PECE-114	Railway Engineering				
PECE-115	Highway Construction and Management				
PECE-116	Port and Harbour Engineering				
PECE-117	High Speed Rail Engineering				
PECE-118	Transportation Economics				
PECE-119	Instrumentation & Sensor				

Geotechnical and Transportation Engineering		Structural Engineering		Environmental Engineering	
Course Code	**Course Name**	**Course Code**	**Course Name**	**Course Code**	**Course Name**
	Technologies for Civil Engineering Applications				
LPECE-101	Problem Analysis Laboratory				

List of Open Electives

Course Code	Open electives
OECE-101	Metro Systems and Engineering
OECE-102	Numerical Methods in Engineering
OECE-103	Project Management & Monitoring
OECE-104	Traffic Management & Road Safety
OECE-105	Environmental Impact Assessment
OECE-106	Building Information Modelling

Subject Code: PCCE-101

Subject Name: Surveying & Geomatics

Programme: B.Tech.	**L:** 3 **T:** 1 **P:** 0
Semester: 3rd	**Teaching Hours:** 36L + 12T = 48Hours
Theory/Practical: Theory	**Credits:** 4
Internal Marks: 40	**Percentage of Numerical/Design Problems**: 50%
External Marks: 60	**Duration of End Semester Exam (ESE):** 3 hours
Total Marks: 100	**Elective Status:** Compulsory

Prerequisites: NIL

Additional Material Allowed in ESE: Non programmable scientific calculator

On Completion of the course, the student will have the ability to:

CO#	Course Outcomes
1.	Summarize the concept, various methods and techniques of surveying.
2.	Compute angles, distances and levels for a given area.
3.	Apply the concept of tachometry survey in difficult and hilly terrain.
4.	Select appropriate instruments for data collection and survey purpose.
5.	Interpret the concepts related to GIS and GPS and examine the geographical data.
6.	Analyze and retrieve the information from remotely sensed data and interpret the data for survey.

Detailed Contents:

Part – A

Introduction: **2L+0T = 2hours**

Principles, Survey stations, Survey lines- ranging, direct &indirect ranging.

Compass Surveying: **3L+2T=5hours**

Bearing and its measurement with prismatic compass, calculation of angles from bearings, Local Attraction

Levelling: **4L+2T = 6hours**

Principles of levelling, booking and reducing levels; differential levelling, reciprocal levelling, profile levelling and cross sectioning. Digital and Auto Level, Errors in levelling.

Contouring: **2L+0T=2hours**

Characteristics, methods, uses; areas and volumes.

Plane Table Surveying: **2L+0T=2hours**

Setting up the plane table and methods of plane tabling (Radiation and three-point problem only).

Theodolite Traversing: **3L+3T=6hours**

Instruments, Measurement of horizontal and vertical angle; Balancing of Traverse, Omitted Measurements.

Tachometry: **3L+1T=4hours**

Definition, determination of tachometer constants and reduced level from tachometric observations.

Triangulation and Trilateration: **2L+1T= 3hours**

Triangulation - network- Signals. Baseline - choices - extension of base lines - corrections - Trigonometric leveling.

Curves: **2L+0T= 2hours**

Elements of simple and compound curves – Method of setting out Transition curve – length of curve – Elements of transition curve.

Part – B

Modern Field Survey Systems: **6L+0T=6hours**

Principle of Electronic Distance Measurement, Modulation, Types of EDM instruments, Distomat, Total Station – Parts of a Total Station – Accessories – Advantages and Applications, Field Procedure for total station survey, Errors in Total Station Survey; Global Positioning Systems- Segments, GPS measurements, errors and biases, Surveying with GPS, LADAR (drone and vehicle based)

Photogrammetry Surveying: **3L+3T = 6hours**

Introduction, Basic concepts, flight planning; Stereoscopy, photographic mapping- mapping using paper prints, mapping using stereo plotting instruments, mosaics, map substitutes.

Remote Sensing: **4L+0T = 4hours**

Introduction – Electromagnetic Spectrum, interaction of electromagnetic radiation with the atmosphere and earth surface, remote sensing data acquisition: platforms and sensors.

Text Books:

1. Duggal, S.K., Surveying Vol I & II, Tata McGraw Hill, 2019
2. Punmia, B.C., Jain, Ashok Kumar and Jain, Arun Kumar, Surveying Vol. I & II, Laxmi Publications, 2016
3. Agor, R., A Text Book of Advanced Surveying, Khanna Publishers, 1991
4. Arora, K.R., Surveying Volume I,II& III, Standard Book House. 2019

Reference Books:

1. Bhavikatti, S.S. Surveying & Levelling Volume I & II, 2019
2. Kochher, C.L., A Text Book of Surveying Vol. I & II, Dhanpat Rai Publishing Co., 2014
3. Ramamrutham S., Plane and Geodetic Surveying, Dhanpat Rai Publishing Company, 2016
4. Chandra A.M., Plane Surveying, New Age International Publishers, 2015
5. Chandra A.M., Higher Surveying, New Age International Publishers, 2015
6. Soni, S.K, Surveying Volume I & II, Katson Books, 2016

E-Books and online learning material:

1. Fundamentals of Surveying by S.K. Roy**,**
   https://civildatas.com/download/fundamentals-of-surveying-by-roy
   Accessed on 28-09-2021.
2. Surveying-Problem Solving with Theory and Objective Type Questionsby Dr. A.M. Chandrahttps://civildatas.com/download/surveying-problem-solving-with-theory-and-objective-type-questions
   Accessed on 28-09-2021

Online Courses and Video Lectures:

1. Digital Land Surveying and Mapping by Prof. J.K. Ghosh, "https://onlinecourses.nptel.ac.in/noc21_ce08/preview"Accessed on 28-09-2021.
2. GPS Surveying by Prof.J.K. Ghosh ,"https://onlinecourses.nptel.ac.in/noc20_ce51/preview" Accessed on 28-09-2021.

Subject Code: PCCE-102

Subject Name: Solid Mechanics

Programme: B.Tech. (CE)	**L:** 3 **T:** 0 **P:** 0
Semester: 3	**Teaching Hours:** 36
Theory/Practical: Theory	**Credits:** 3
Internal Marks: 40	**Percentage of Numerical/Design/Programming Problems:** 80%
External Marks: 60	**Duration of End Semester Exam (ESE):** 3hr
Total Marks: 100	**Elective Status:** Compulsory

Prerequisites: N/A

Additional Material Allowed in ESE: [Scientific Calculator]

On completion of the course, the student will have the ability to:

CO#	Course Outcomes (CO)
1	Demonstrate the use of different concepts such as static equilibrium, free body in structural analysis
2	Analyze structural members subjected to tension, compression and torsion.
3	Apply fundamental concepts to determine stress/strain induced in loaded elements
4	Construct SFD/BMD for different type of beams under various loading conditions
5	Plot elastic curves for loaded beams with different support conditions
6	Compare the response of columns and struts with different edge conditions

Detailed Contents:

Part-A

Concept of Equilibrium: 3L = 3 hours

Loads, supports, reactions, displacements; General equilibrium equations; Equilibrium of a point and a member; Concept of free body diagram; Statical determinacy of a problem.

Shear Force and Bending Moment Diagrams: 7L = 7 hours

Introduction to the concept of shear force, bending moment and the sign convention; Shear force and bending moment diagrams for cantilever, simply supported and overhang beams subjected to point loads, uniformly distributed loads, uniformly varying loads, moments or their combination, point of contra flexure.

Displacements: 5L= 5hours

Concept of displacements, types - deflections and rotations; assumptions; sign convention; different methods to compute displacements caused by different loadings.

Bending and Shear Stresses: 5L = 5 hours

Assumptions - theory of simple bending; Derivation of bending equation; Centroid and section modulus of various cross-sectional shapes including rectangular, circular, I, channel, angle etc.; Determination of bending stresses, bending stress distribution across various beam sections; Determination of shear stress, shear stress distribution across various beam sections.

Part-B

Stresses and Strains: 8L = 8 hours

Concept of stress and strain; Type of stresses and strains; Stress-strain diagrams for ductile, brittle materials; Generalized Hooke's law; Concept of working stress and factor of safety; Lateral strain, Poisson's ratio and Volumetric strain; Elastic moduli and relationship between them; Bars of varying section, composite bars, thermal stresses; Stresses and strains in thin cylinders, spherical shells subjected to internal pressures; Normal stress, tangential stress; Rectangular block subjected to normal stress along and across two planes, combination of normal and tangential stress; Concept of principal stresses, principal strains and principal planes; use of Mohr circle in computation of stresses and strains.

Torsion of Circular Shafts: 4L = 4 hours

Derivation of torsion equation and its assumptions, application of equation to circular shafts; combined torsion and bending of circular shafts, principal stress and maximum shear stress under combined loading of torsion and bending.

Columns and Struts: 4L= 4 hours

Stability of Columns; buckling load of axially loaded columns with various end conditions; Euler's and Rankine's formula; Columns under eccentric load, lateral load.

Text/Reference Books:

1. 'Elements of Strength of Materials', Timoshenko, S. and Young, D. H., DVNC, New York, USA.
2. 'Solid Mechanics', Kazmi, S. M. A., TMH, New Delhi.
3. 'Mechanics of Materials', Hibbeler, R. C., Pearson Prentice Hall.
4. 'An Introduction to the Mechanics of Solids', Crandall, S. H., N. C. Dahl, and T. J. Lardner, McGraw Hill.
5. 'Mechanics of Materials', Ferdinand P. Beer, E. RusselJhonston Jr. and John T. D. Ewolf, TMH.
6. 'Strength of Materials', James M. Gere and Barry J. Goodno, Cengage Learning India Pvt. Ltd., New Delhi.
7. 'Strength of Materials', R. Subramanian, Oxford University Press, New Delhi.

E-Books and online learning material

Online Courses and Video Lectures

Subject Code: PCCE-103

Subject Name: Fluid Mechanics

Programme: B.Tech	**L:**3 **T:**0 **P:**0
Semester: 3	**Teaching Hours:** 36
Theory/Practical: Theory	**Credits:** 3
Internal Marks:40	**Percentage of Numerical/Design/Programming Problems:**70%
External Marks:60	**Duration of End Semester Exam (ESE):**3hr
Total Marks:100	**Elective Status:** Compulsory

Pre-requisites: N/A

Additional Material Allowed in ESE: [Scientific Calculator]

On completion of the course, the student will have the ability to:

CO #	Course Outcomes (CO)
1	Distinguish between the basic terms used in fluid mechanics and its broad principles.
2	Estimate the forces induced on a plane/submerged bodies.
3	Formulate expressions using dimensionless approach and able to determine design parameters by creating replica of prototype at appropriate scale.
4	Apply the continuity, momentum and energy principles and design the pipelines used for water supply or sewage under different situation.
5	Calculate drag force exerted by fluid on the body of varying shapes and able to minimize them.
6	Design an open channel(lined/unlined) of different shapes and size optimally as per site condition.

Detailed Contents:

Part-A

Basic Concepts and Definitions ***3 hours***

Distinction between a fluid and a solid; Density, Specific weight, Specific gravity, Kinematic and dynamic viscosity; variation of viscosity with temperature, Newton law of viscosity; surface tension, capillarity, Bulk modulus of elasticity, compressibility.

Fluid Statics

6 ***hours***

Fluid Pressure: Pressure at a point, Pascal's law, Piezometer, U-Tube Manometer, U-Tube Differential Manometer, Micro-manometers. Pressure gauges, Hydrostatic pressure and force: horizontal, vertical and inclined surfaces, Buoyancy and stability of floating bodies.

Fluid Kinematics ***3 hours***

Classification of fluid flow: steady and unsteady flow; uniform and non-uniform flow; laminar and turbulent flow; rotational and irrotational flow; compressible and incompressible flow; ideal

and real fluid flow; one-, two- and three-dimensional flows; Streamline, path line, streak line and stream tube; stream function, velocity potential function. One, two-and three-dimensional continuity equations in Cartesian coordinates

Fluid Dynamics ***7 hours***

Surface and body forces; Equations of motion - Euler's equation; Bernoulli's equation– derivation, Energy Principle, Practical applications of Bernoulli's equation: venturi-meter, orifice meter and pitot tube, Momentum principle; Forces exerted by fluid flow on pipe bend; Dimensional Analysis and Dynamic Similitude -Definitions of Reynolds Number, Froude Number, Mach Number, Weber Number and Euler Number; Buckingham's π-Theorem.

Part-B

Laminar Flow & Turbulent Flow ***5 hours***

Laminar flow through: circular pipes, parallel plates. Stoke's law, Reynold's experiment, Transition from laminar to turbulent flow. Prandtl's mixing length theory, universal velocity distribution equation. Resistance to flow of fluid in smooth and rough pipes, Moody's diagram. Flow through Pipes: Loss of head through pipes, Darcy-Wiesbatch equation, minor losses, total energy equation, hydraulic gradient line, Pipes in series, equivalent pipes, pipes in parallel

Boundary Layer Analysis ***5 hours***

Assumption and concept of boundary layer theory. Boundary-layer thickness, displacement, momentum & energy thickness, laminar and turbulent boundary layers on a flat plate; Laminar sub-layer, smooth and rough boundaries. Local and average friction coefficients, Separation and Control.

Open Channel Flow ***7 hours***

Introduction, Comparison between open channel flow and pipe flow, geometrical parameters of a channel, Uniform Characteristics of uniform flow, Chezy's formula, Manning's formula. Most economical section of channel, Specific energy, Specific energy curve, critical flow, discharge curve Specific force Specific depth, and Critical depth. Channel Transitions. Theory of hydraulic jump, Elements and characteristics of hydraulic jump in a rectangular Channel, length and height of jump, location of jump, Types, applications and location of hydraulic jump, Energy dissipation and other uses.

Text-Books:

1. Fluid Mechanics and Machinery, Ojha C.S.P., Berndtsson R. and Chadramouli P.N., Oxford University Press, 2010
2. Hydraulics and Fluid Mechanics, Modi P M and Seth S M, Standard Book House, 2019
3. Theory and Applications of Fluid Mechanics, Subramanya K., Tata McGraw Hill, 2002
4. Fluid mechanics and hydraulic machine: Bansal, R.K. SI units. New Delhi, India: Laxmi

Publication 2018
5. Fluid Mechanics with Engineering Applications, R. L. Daugherty, J. B. Franzini and E.J. Finnemore, International Student Edition, McGraw Hill, 2017
6. Fluid mechanics: fundamentals and applications, Cengel, Y. A. New Delhi, India: Tata McGraw-Hill Publishing, 2006
7. Fluid mechanics and turbo machines, Das, M. M. New Delhi, India: PHI Learning, 2010

Reference Books:

E-Books and online learning material

1. https://easyengineering.net/fundamentals-of-hydraulic-engineering-systems-by-houghtalen-nw4/
2. https://easyengineering.net/schaums-outline-of-fluid-mechanics-and-hydraulics-by-jack-evett/
3. https://easyengineering.net/cengel-fluid-mechanics-fundamentals-and-applications-nw2/

Online Courses and Video Lectures

1. https://nptel.ac.in/courses/112/105/112105171/
2. https://nptel.ac.in/courses/112/104/112104118/

Subject Code: PCCE-104
Subject Name: Disaster Preparedness and Planning

Programme: B.Tech.	**L:** 3 **T: 0 P:** 0
Semester: 3	**Teaching Hours:** 36 L = 36 Hours
Theory/Practical: Theory	**Credits:** 3
Internal Marks: 40	**Percentage of Numerical/Design Problems:** 0%
External Marks: 60	**Duration of End Semester Exam (ESE):** 3hours
Total Marks: 100	**Elective Status:** Compulsory

Prerequisites: N/A
Additional Material Allowed in ESE: N/A
On Completion of the course, the student will have the ability to:

CO#	Course Outcomes
1	Identify various types of disasters, their causes, effects & mitigation measures.
2	Demonstrate various phases of disaster management cycle and analyze vulnerability and risk maps about various disasters.
3	Infer the use of emergency management system to tackle the problems.
4	Discuss the role of various agencies and organizations for effective disaster management.
5	Assess early warning system and the utilization of advanced technologies in disaster management.
6	Explain different models for sustainable disaster management and discuss the same with reference to civil engineering.

Detailed Contents:

Part A

Introduction to Disaster Management **2L = 2 Hours**

Define and describe disaster, hazard, vulnerability, risk severity, frequency and details, capacity, impact, prevention, mitigation.

Disasters **10 L = 10 Hours**

Identify and describe the types of natural and man-made disasters, hazard and vulnerability profile of India, mountain and coastal areas, Factors affecting vulnerability such as impact of development projects and environment modifications (including dams, land-use changes, urbanization etc.), Disaster impacts (environmental, physical, social, ecological, economic etc.); health, psycho-social issues; demographic aspects (gender, age, special needs), Lessons and experiences from important disasters with specific reference to civil engineering.

Disaster Mitigation and Preparedness **4L = 4 Hours**

Disaster Management Cycle-its phases; prevention, mitigation, preparedness, relief and recovery; structural and non-structural measures; Preparedness for natural disasters in urban areas.

Risk Assessment **6L = 6 Hours**

Assessment of capacity, vulnerability and risk, vulnerability and risk mapping, stages in disaster recovery and associated problems; Use of Remote Sensing Systems (RSS) and GIS in disaster Management, early warning systems.

Part-B

Post Disaster Response **8L= 8 Hours**

Emergency medical and public health services; Environmental post disaster response (water, sanitation, food safety, waste management, disease control, security, communications); reconstruction and rehabilitation; Roles and responsibilities of government, community, local

institutions, role of agencies like NDMA, SDMA and other international agencies, organizational structure, role of insurance sector, DM act and NDMA guidelines.

Integration of Public Policy **6L = 6 Hours**

Planning and design of infrastructure for disaster management, Community based approach in disaster management, methods for effective dissemination of information, ecological and sustainable development models for disaster management.

Text Book:

1. Singh, B.K., "Handbook of disaster management: Techniques & Guidelines", Rajat Publications, 2008.
2. Singh, R.B., "Natural Hazards and Disaster Management: Vulnerability and Mitigation", Rawat Publications, 2006.

Reference Books:

1. Disaster Management, Ghosh G.K., APH Publishing Corporation, 2006.
2. Disaster Risk Reduction in South Asia, Pradeep Sahni, Prentice Hall, 2004.

E-Books and online learning material:

1. IASC Guidelines on Mental Health and Psychosocial Support in Emergency Settings, 2007 | IASC (interagencystandingcommittee.org)
2. http://www.ndmindia.nic.in/
3. Microsoft Word - UN agencies and int org involved in emergency response.doc (who.int)

Subject Code: ESCE-101

Subject Name: Basic Electronics & applications in Civil Engineering

Programme: B.Tech. (CE)	**L:** 3 **T:** 0 **P:** 0
Semester: 3	**Teaching Hours:** 36
Theory/Practical: Theory	**Credits**: 3
Internal Marks: 40	**Percentage of Numerical/Design/Programming Problems**: 5-10%
External Marks: 60	**Duration of End Semester Exam (ESE):** 3hr
Total Marks: 100	**Elective Status**: Compulsory

Prerequisites: N/A

Additional Material Allowed in ESE: Non-Programmable Scientific Calculator

On completion of the course, the student will have the ability to:

CO#	Course Outcomes (CO)
1	Identify areas of application of electronics in civil engineering
2	Develop the understanding of and soft computing and importance of electronic in civil engineering
3	Providing inspiration to use the electronic products and other instruments to solve civil engineering problems
4	Use the computers / computing tools to solve civil engineering problems
5	Develop programs using basic language for solving civil engineering problems
6	Appraise the use of sensors in civil engineering applications

Detailed Contents:

Part-A

Introduction: **5 hours**

Role of Electronics in civil engineering, such as Intelligent Signaling, Intelligent Transportation, Instrumentation of bridges and buildings, and material testing.

Diodes and Applications: **6 hours**

PN junction diode, volt ampere characteristics Ideal versus Practical, Diode Equivalent Circuits, Special Diodes: Zener Diode, LED, Photo Diode; Applications of diodes in civil engineering.

Transistor Characteristics: **7 hours**

Bipolar Junction Transistor (BJT) –Construction, Operation, Common Base, Common Emitter and Common Collector Configurations, Transistor as an Amplifier in CE configuration, Operating Point, Transistor Biasing meaning, Essentials of a Transistor Biasing circuit, Voltage Divider Bias Circuits; Introduction to Field Effect Transistor (FET)

Part-B

Digital Electronics Basics: **7 hours**

Logic Gates: OR, AND, NOT, NOR, NAND, EX-OR; Pin diagram and description of ICs of logic gates, Number Systems: binary, octal and hexadecimal; Binary Operations: addition, Subtraction; BCD code and BCD additions. 7 segment LCD Display, Introduction to Data Acquisition Systems. Integrated Circuits (ICs): Meaning, advantages and disadvantages.

Transducers & Sensors: **6 hours**

Transducing Principles, Ultrasonic, Optical and Infrared Sensors,

Inductive, Capacitive and Resistive Transducers, Applications of Transducers/ Sensors for measurements of Length, Thickness, Displacement, Pressure, Temperature, Flow, Humidity, and Moisture.

Computing tools/languages: **5 hours**

Introduction and application of different languages, such as C, C+, python, VBA, spread sheets, etc. And its use in solving civil engineering problems.

Text Books:

1. V.K Mehta and Rohit Mehta, Principles of Electronics, S Chand Publishers
2. A.K. Sawhney, A course in Electrical & Electronic Instrumentation, Dhanpat Rai and Sons

Reference Books

N N Bhargava, Basic Electronics and Linear Circuits, Mc Graw Hill Education, second edition.

E-Books and online learning material

Online Courses and Video Lectures

NPTEL / other online resources

Subject Code: HSMCE-101

Subject Name: Civil Engineering- Introduction, Societal & Global Impact

Programme: B.Tech.	**L:** 3 **T:** 0 **P:** 0
Semester: 3rd	**Teaching Hours:** 36 L = 36 Hours
Theory/Practical: Theory	**Credits:** 3
Internal Marks: 40	**Percentage of Numerical/Design Problems:** 0%
External Marks: 60	**Duration of End Semester Exam (ESE):** 3 hours
Total Marks: 100	**Elective Status:** Compulsory

Prerequisites: NIL

Additional Material Allowed in ESE: NIL

On Completion of the course, the student will have the ability to:

CO#	Course Outcomes
1	Explain what constitutes Civil Engineering
2	Identify the vast interface of this field with the society at large
3	Evaluate things to do creative and innovative work for the benefit of the society
4.	Analyze things innovatively to ensure sustainability
5	Demonstrate the depth of engagement possible within civil engineering and exploration of various possibilities of a career in this field
6	Illustrate the Futuristic engineering systems

Detailed Contents:

Part – A

Civil Engineering and its historical developments; Understanding the importance of Civil Engineering in shaping and impacting the world; the ancient and modern Marvels and Wonders in the field of Civil Engineering; Scope of work involved in various branches of Civil Engineering and future vision; Recent Civil Engineering breakthroughs and innovations; Avenues for entrepreneurial working.

[8 hours]

Understanding the past to look into the future; Pre-industrial revolution days, Agricultural revolution, first and second industrial revolutions, IT revolution and how these eras helped the civil engineering to grow; Concept of sustainability and the steady erosion of the environment due to haphazard developments; Global warming, its impact and possible causes; Atmospheric pollution; Pollution Mitigation measures; Health & Safety aspects for stakeholders; Environmental Impact Analysis: Concept and procedures; Innovations and methodologies for ensuring Sustainability.

[10 hours]

Part – B

Infrastructure development and growth of the Nation; its effects on the GDP, employment, living standards of the people, etc.; Introduction and overview to Futuristic systems: Megacities, Smart Cities, Stadia; Roads, Railways, Metros, Hyper Loop, Airports, Seaports, River ways, Sea canals, Tunnels, bridges; Energy generation: Hydro, Solar, Wind, Wave, Tidal, Geothermal, Thermal energy; Telecommunication needs: towers, above-ground and underground cabling; Flood control: Dams, Canals, River interlinking; Energy efficient built-environments and LEED ratings; Awareness of various Codes & Standards governing Infrastructure development.

[18 hours]

Text Books/References:

1. Fintel, C, Handbook of Civil Engineering, CBS Publications.
2. Chen W. F. and Richard Liew J.Y., The Civil Engineering Handbook, CRC Press.
3. Žiga Turk (2014), Global Challenges and the Role of Civil Engineering, Chapter 3 in: Fischinger M. (eds) Performance-Based Seismic Engineering: Vision for an Earthquake Resilient Society. Geotechnical, Geological and Earthquake Engineering, Vol. 32. Springer, Dordrecht
4. Brito, Ciampi, Vasconcelos, Amarol, Barros (2013) Engineering impacting Social, Economical and Working Environment, 120th ASEE Annual Conference and Exposition
5. NAE Grand Challenges for Engineering (2006), Engineering for the Developing World, The Bridge, Vol 34, No.2, Summer 2004.
6. Ashley R M., Nowell R., Gersonius B., Walker L. (2011). Surface Water Management and Urban Green Infrastructure. Review of Current Knowledge. Foundation for Water Research FR/R0014
7. Barry M. (2003) Corporate social responsibility – unworkable paradox or sustainable paradigm? Proc ICE Engineering Sustainability 156. Sept Issue ES3 paper 13550. p 129-130
8. Bogle D. (2010) UK's engineering Council guidance on sustainability. Proc ICE Engineering Sustainability 163. June Issue ES2 p61-63

E-Books and online learning material

Online Courses and Video Lectures

https://www.classcentral.com/course/swayam-introduction-to-civil-engineering-profession-17658

Subject Code: LPCCE-101

Subject Name: Surveying & Geomatics Laboratory

Programme: B.Tech.	**L:** 0**T:** 0**P:** 2
Semester: 3rd	**Teaching Hours:** 24
Theory/Practical: Practical	**Credits:** 1
Internal Marks: 30	**Percentage of Numerical/Design Problems**: 100%
External Marks: 20	**Duration of End Semester Exam (ESE):** 1.5 hours
Total Marks: 50	**Elective Status:** Compulsory

Prerequisites: NIL

On Completion of the course, the student will have the ability to:

CO#	Course Outcomes
1.	Assess horizontal & vertical angles by Theodolite.
2.	Survey the area using different methods of plane tabling and compass survey and to adjust the compass traverse graphically.
3.	Compute the reduce levels using various methods of leveling.
4.	Predict the location of any point horizontally and vertically using Tachometry
5.	Setting out curves in the field.
6.	Use electronic survey instruments.

S. No.	Name of Practical
1.	Measurement of bearing and angles with compass, adjustment of traverse by graphical method.
2.	Different methods of levelling, height of instrument, rise & fall methods.
3.	Measurement of horizontal and vertical angle by theodolite.
4.	Determination of tachometric constants and determination of reduced levels by tachometric observations.
5.	Plane table survey, different methods of plotting, Three point problems.
6.	Determination of height of an inaccessible object.
7.	Setting out of circular curves in the field using different methods.
8.	Plotting of traverse using the Total Station and GPS.

Reference Material:

1. Hamilton R., Murgel G., Engineering Surveying Laboratory Manual, Kendall/Hunt Publishing Co., 2018.
2. Pant M.K., Laboratory Manual for Civil Engineering Students, S.K. Kataria and Sons, 2016.

Subject Code: LPCCE-102
Subject Name: Fluid Mechanics Laboratory

Programme: B.Tech. (CE)	L: 0 T: 0 P: 2
Semester: 3	**Teaching Hours:** 24
Theory/Practical: Practical	**Credits:** 1
Internal Marks: 30	**Percentage of Numerical/Design/Programming Problems**:100%
External Marks: 20	**Duration of End Semester Exam (ESE):** 1.5 hr
Total Marks: 50	**Elective Status:** Compulsory

Prerequisites:
On Completion of the course, the student will have the ability to:

CO#	Course Outcomes
1.	Select appropriate pressure measuring device under different conditions of flow.
2.	Determine the stability of a floating body.
3.	Apply Bernoulli's theorem in practical manner.
4.	Estimate the discharge of fluid through pipe, orifices and in open channel.
5.	Identify the major and minor losses in pipe.
6.	Estimate the various elements and energy losses in hydraulic jump.

Sr No.	Name of Practical
1	To study of pressure measuring devices as piezometer, U-tube manometer, and pressure gauges.
2	To verify Bernoulli's Theorem.
3	To determine the meta centric height of a of Floating Body under different condition.
4	To determine the coefficient of discharge of Venturi meter.
5	To determine the coefficient of discharge of Orifice Meter.
6	To determine the coefficient of friction of different diameter pipes.
7	To estimate the minor losses as energy loss in pipe bend, sudden contraction, or enlargement in pipe.
8	To determine the coefficient of discharge on rectangular and V-notches.
9	To determine the various element of a hydraulic jump.

Reference Material:

1. Fluid Mechanics and Machinery, C.S.P.Ojha, R. Berndtsson and P. N. Chadramouli, Oxford University Press, 2010
2. Hydraulics and Fluid Mechanics, P M Modi and S M Seth, Standard Book House
3. Theory and Applications of Fluid Mechanics, K. Subramanya, Tata McGraw Hill
4. Fluid Mechanics with Engineering Applications, R.L. Daugherty, J.B. Franzini and E.J. Finnemore, International Student Edition, Mc Graw Hill.

Subject Code: LPCCE-103

Subject Name: Solid Mechanics Laboratory

Programme: B.Tech. (CE)	**L:** 0 **T:** 0 **P:** 2
Semester: 3	**Teaching Hours:** 24
Theory/Practical: Practical	**Credits:** 1
Internal Marks: 30	**Percentage of Numerical/Design/Programming Problems:**100%
External Marks: 20	**Duration of End Semester Exam (ESE):** 1.5 hr
Total Marks: 50	**Elective Status:** Compulsory

Prerequisites:

On Completion of the course, the student will have the ability to:

CO#	Course Outcomes (CO)
1	Outline the importance of physical properties of steel.
2	Apply and comprehend code provisions for testing different properties of steel.
3	Develop stress-strain curve for axial compression, axial tension and shear.
4	Measure hardness and impact strength of steel.
5	Assess flexural strength of a given material.
6	Experiment with fatigue and impact strength of steel.

S. No.	Name of Practical
1.	Determination of physical properties of steel including strength and ductility.
2.	Study of tensile and compressive stress-strain behaviour of steel.
3.	Development of shear stress-strain curve for steel in torsion.
4.	Determination of hardness of a material by Rockwell and Brinell hardness testing machine.
5.	Determination of impact strength of a material by Izod and Charpy tests.
6.	Determination of bending strength of a wooden beam specimen.
7.	Determination of fatigue strength of a material.

R**eference Material**

1. Laboratory Manual of Testing Materials, William Kendrick Hall Hydraulics and Fluid Mechanics, P M Modi and S M Seth, Standard Book House

Subject Code: PCCE-105

Subject Name: Concrete Technology

Programme: B.Tech. (CE**)**	**L:** 3 **T:** 0 **P:** 0
Semester: 4	**Teaching Hours:** 36
Theory/Practical: Theory	**Credits:** 3
Internal Marks: 40	**Percentage of Numerical/Design/Programming Problems:** 50%
External Marks: 60	**Duration of End Semester Exam (ESE):** 3hr
Total Marks: 100	**Elective Status:** Compulsory

Prerequisites: N/A

Additional Material Allowed in ESE: [Scientific Calculator]

On completion of the course, the student will have the ability to:

CO#	Course Outcomes (CO)
1	Demonstrate the relevance of different properties of constituent materials on properties of concrete.
2	Examine the behavior and durability aspects of concrete under different loading and exposure conditions.
3	Outline the issues involved in production and use of concrete.
4	Design of concrete mixes as per BIS specifications.
5	Identify and use appropriate testing methods for concrete
6	Classify concrete based upon their distinct properties

Detailed Contents:

Part-A

Concrete and its ingredients: Properties of cement, aggregate, admixture, water and other additives; Related Indian Standard codes & guidelines. 5L = 5 hours

Concrete behaviour in fresh and hardened states: Workability, Elasticity, Shrinkage, Creep, Fatigue, Strength in compression, tension, shear and bond; Influence of various factors on test results; Concrete cracking and type of cracks; Permeability and durability characteristics of concrete including resistance to sulphate& acid attack, alkali-aggregate reaction, freezing and thawing; Fire resistance 10L = 10 hours

Production of concrete: Mixing, handling, placing, compaction of concrete and related issues; Quality control; Behaviour in extreme environmental conditions like hot weather, cold weather and under water conditions 5L = 5 hours

Part-B

Concrete mix design: Basic considerations, proportioning of material, effect of various parameters,

trial mixes, IS code 5L = 5 hours

Inspection and testing of concrete: Defects in concrete; Deterioration of concrete; Strength tests including compressive, split tensile, flexural, pullout etc.; Durability tests including permeability, carbonation, rapid chlorine ion penetration etc.; Destructive and Non-destructive testing of concrete; Acceptance and compliance requirements of concrete as per IS codes 5L = 5 hours

Special concretes: Types and specifications; Fibre reinforced and steel reinforced concrete; Polymer concrete; Light weight concrete, High strength concrete, Prestressed concrete, Self Compacting Concrete, Pervious Concrete, Self Healing Concrete 6L = 6 hours

Text / Reference Books

1. 'Properties of Concrete', A. M. Neville, Prentice Hall
2. 'Concrete Technology', M. S. Shetty, S.Chand& Co.
3. 'Concrete Technology', M. L. Gambhir, Tata McGraw Hill Publishers, New Delhi
4. 'Concrete Technology', A. R. Santha Kumar, Oxford University Press, New Delhi

E-Books and online learning material

Online Courses and Video Lectures

Subject Code: PCCE-106

Subject Name: Materials, Testing a& Evaluation

Programme: B.Tech. (CE**)**	**L:4 T:** 0 **P:** 0
Semester: 4	**Teaching Hours:** 48
Theory/Practical: Theory	**Credits: 4**
Internal Marks: 40	**Percentage of Numerical/Design/Programming Problems:** 50%
External Marks: 60	**Duration of End Semester Exam (ESE):** 3hr
Total Marks: 100	**Elective Status:** Compulsory

Prerequisites: N/A

Additional Material Allowed in ESE: [Scientific Calculator]

On completion of the course, the student will have the ability to:

CO#	Course Outcomes (CO)
1	Demonstrate the role of materials in civil engineering applications
2	Identify appropriate measurement instruments, equipments and devices to capture the material response under loading
3	Select and apply suitable material testing procedures/techniques
4	Plan and write technical Laboratory report
5	Interpret the observations/ test reports for selection of suitable material
6	Utilize the relevant information from the standards and guidelines

Detailed Contents:

Part-A

Material - Definition, classifications (engineering/non-engineering and structural/non-structural), types (brittle, ductile, composites and cementitious materials, etc.) and its role in engineering design & construction; desirable properties and specifications; Material microstructure (e.g. of concrete, etc) and its effect on their engineering properties. 12L = 12 hours

Strength-deformation and fracture behavior of materials; Characteristics strength of materials, determination & its reporting; Material behavior under different stress conditions; Parameters affecting the material strength; Different equipments, devices, and instruments to characterize the material response/ behavior; Current testing technology (displacement-controlled and load-controlled) and its selection for capturing the response of the material. 12L = 12 hours

Part-B

Force and strain measurements, Important instrument considerations - Fatigue, impact, toughness, crushing, abrasion, permeability and other time-dependent properties, such as shrinkage, creep; Durability considerations. 10L =10 hours

Documenting the experimental program, including the test procedures, collected data, method of interpretation and final results; Use of test data/ testing reports in the material selection for various civil engineering projects /construction 7L = 7 hours

Quality control - Sampling, Acceptance criterion, Code of practice and guidelines in this regard for Cements; Aggregates; Admixtures; Concrete (plain, reinforced and steel fibre/ glass fibre-reinforced, light-weight concrete, High Performance Concrete, permeable Concrete); Soils; Bitumen and asphaltic materials; Timbers; Glass and Plastics; Structural Steel; Aluminum; Geo-textiles; Carbon composites. 7L = 7 hours

Text/ Reference Books

1. Chudley, R., Greeno (2006), 'Building Construction Handbook' (6th ed.),R. Butterworth-Heinemann
2. Khanna, S.K., Justo, C.E.G and Veeraragavan, A, ' Highway Materials and Pavement Testing', Nem Chand & Bros,
3. Singh H. (2021), Structural Materials, Springer
4. Kyriakos Komvopoulos (2011), Mechanical Testing of Engineering Materials, Cognella
5. E.N. Dowling (1993), Mechanical Behaviour of Materials, Prentice Hall International Edition
6. Mehta, P K and Monteiro P J M (1997), Concrete: Microstructure, Properties and Materials, Tata McGraw Hill.

E-Books and online learning material

1. Related papers published in international journals

Online Courses and Video Lectures

Subject Code: PCCE-107

Subject Name: Hydrology and Water Resources Engineering

Programme: B.Tech.	**L:** 3 **T:** 1 **P:** 0
Semester: 3	**Teaching Hours:** 36 + 12 (T)= 48 Hours
Theory/Practical: Theory	**Credits:** 4
Internal Marks: 40	**Percentage of Numerical/Design Problems:** 70%
External Marks: 60	**Duration of End Semester Exam (ESE):** 3hours
Total Marks: 100	**Elective Status:** Compulsory

Prerequisites: NIL

Additional Material Allowed in ESE: Non Programmable scientific calculator

On Completion of the course, the student will have the ability to:

CO#	Course Outcomes
1.	Explain the interaction among various processes in the hydrologic cycle
2.	Determine the average annual rainfall of any area using the rain gauge data and compile interrelations of various parameters as infiltration, evapotranspiration etc
3.	Define the various components of hydrographs and calculate the estimated run off.
4.	Determine the water requirement for different crops and plan appropriate method of applying water.
5.	Develop the distribution system of canal and various components of irrigation system.
6.	Classify and plan dams according to suitability of sites available, their problems and able to determine forces exerted by fluid on dams.

Detailed Contents:

Part-A

Introduction: **2L+0T = 2hours**

Hydrologic Cycle, Water-Budget Equation, History of Hydrology, World Water Balance, Applications in Engineering, Sources of Data.

Precipitation **4L+2T = 6hours**

Forms of Precipitation, Characteristics of Precipitation in India, Measurement of Precipitation, Rain Gauge Network, Mean Precipitation over an Area, Depth Area-Duration Relationships, Maximum Intensity/Depth-Duration-Frequency Relationship, Probable Maximum Precipitation (PMP), Rainfall Data in India.

Abstractions from precipitation: **4L+1T = 5hours**

Evaporation Process, Evaporimeters, Analytical Methods of Evaporation Estimation, Reservoir Evaporation and Methods for its Reduction, Evapotranspiration, Interception, Depression Storage, Infiltration, Infiltration Capacity, Measurement of Infiltration, Modelling Infiltration Capacity,

Classification of Infiltration Capacities, Infiltration Indices.

Runoff:

9L+3T=12

Hydrograph, Factors Affecting Runoff and Runoff Hydrograph, Components of Hydrograph, Base Flow Separation, Effective Rainfall, Unit Hydrograph, S-curve hydrograph, Snyder's synthetic unit hydrograph. Surface Water Resources of India

Part-B

Water withdrawal and uses: 3L+1T = 4hours

Water for Energy Production, Water for Agriculture, Water for Hydroelectric Generation; Flood Control, Analysis of Surface Water Supply, Water Requirement of Crops-Crops and Crop Seasons in India, Cropping Pattern, Duty and Delta; Quality of Irrigation Water; Soil-Water Relationships, Root Zone Soil Water, Infiltration, Consumptive use, Irrigation Requirement, Frequency of Irrigation; Methods of Applying Water to The Fields: Surface, Sub-Surface, Sprinkler and Trickle / Drip Irrigation.

Distribution systems: 4L+2T =

6hours

Canal Systems, Alignment of Canals, Canal Losses, Estimation of Design Discharge, Design of Channels- Rigid Boundary Channels, Alluvial Channels, Kennedy's and Lacey's Theory of Regime Channels, Canal Outlets: Non-Modular, Semi-Modular and Modular Outlets.

Water logging: 2L+0T =

2hours

Causes, Effects and Remedial Measures. Lining of Canals, Types of Lining. Drainage of Irrigated Lands: Necessity, Methods.

Dams and spillways 8L+3T

=11hours

Embankment dams: Classification, design considerations, estimation and control of seepage, slope protection. Gravity dams: forces on gravity dams, causes of failure, stress analysis, elementary and practical profile. Arch and buttress dams. Spillways: components of spillways, types of gates for spillway crests; Reservoirs- Types, capacity of reservoirs, yield of reservoir, reservoir regulation, sedimentation, economic height of dam, selection of suitable site.

Text Books:

1. K Subramanya, Engineering Hydrology, Mc-Graw Hill.
2. K N Muthreja, Applied Hydrology, Tata Mc-Graw Hill.
3. K Subramanya, Water Resources Engineering through Objective Questions, Tata McGraw Hill.

4. G L Asawa, Irrigation Engineering, Wiley Eastern
5. L W Mays, Water Resources Engineering, Wiley.
6. J. D Zimmerman, Irrigation, John Wiley & Sons
7. C S P Ojha, R Berndtsson and P Bhunya, Engineering Hydrology, Oxford.

Reference Books:

1. Rajesh Srivastava and Ashu jain , Engineering hydrology, Mc-Graw Hill.
2. C.S. Ojha, R. Berndtsson and P. Bhuya, Engineering hydrology, Oxford.
3. Bharat Singh and R.S. Varshney, Embankment dam engineering, Nem Chand &Bros

E-Books and online learning material:

1. https://www.slideshare.net/gauravhtandon1/earthen-dams?qid=545878bc-2274-40a8 bd63-1b3299a66079&v=&b=&from_search=8
2. https://slideplayer.com/slide/9263550/
3. https://sites.google.com/a/venusict.org/hydrology-and-water-resources-engineering/material

Online Courses and Video Lectures:

1. https://nptel.ac.in/courses/105/105/105105110/
2. https://www.coursera.org/learn/water-management
3. https://freevideolectures.com/course/100/water-resources-engineering

Subject Code: PCCE-108

Subject Name: Transportation Engineering

Programme: B.Tech. (CE**)**	**L:** 3 **T:** 1 **P:** 0
Semester: 4	**Teaching Hours:** 36+12T= 48
Theory/Practical: Theory	**Credits: 4**
Internal Marks: 40	**Percentage of Numerical/Design/Programming Problems:** 40%
External Marks: 60	**Duration of End Semester Exam (ESE):** 3hr
Total Marks: 100	**Elective Status:** Compulsory

Prerequisites: N/A

Additional Material Allowed in ESE: [Scientific Calculator]

On completion of the course, the student will have the ability to:

CO#	Course Outcomes (CO)
1	Appreciate the importance of different modes of transportation and characterize the road transportation.
2	Alignment and geometry of pavement as per Indian Standards according to topography.
3	**Assess the properties of highway materials in Laboratory**
4	Understand the importance of railway infrastructure planning and design.
5	Identify the functions of different component of railway track.
6	Outline the importance of Airport Infrastructure

Detailed Contents:

Part-A

Introduction: Importance of Transportation, Different Modes of Transportation, Characteristics of Road Transport. (2+0T= 2 hours)

Transportation Systems: Multi modal transportation system, Characteristics of Mass Transit systems including technical, demand operational and economic problems, fixed Track Facility, Mass Rapid Transit System-Elevated, Surface and Underground construction, Express Bus System, integrated Operating Characteristics of Terminal and Transfer facilities. (6+2T= 8 hours)

Highway Development & Planning: Principles of Highway Planning, Road Development in India, Classification of Roads, Road Patterns, Planning Surveys; Highway Construction: Right of way; Earthen/Gravel Road, Water Bound Macadam, Wet Mix Macadam, Bituminous Pavements, Cement Concrete Pavements (6+2T= 8 hours)

Railway Engineering: History of Railways, Development of Indian Railway, Organization of Indian Railway, Important Statistics of Indian Railways. Railway Gauges: Definition, Gauges on World Railways, Choice of Gauge, Uniformity of Gauge, Loading Gauge, Construction Gauge (5+2T= 7 hours)

Part-B

Railway Track: Requirements of a Good Track, Track Specifications, Detailed Cross-Section of Single/Double Track used in Indian Railways. Components of permanent way - Rails, Sleepers, Ballast, Sub-grade and Formation, Track Fixtures & Fastenings, Coning of Wheels, Tilting of Rails, Adzing of Sleepers, Rail Joints, Creep of Rails. (6+2T= 8 hours)

***Airport Engineering*:** Introduction, Air Transport Scenario in India and Stages of Development, National and International Organizations; Airport planning - Site selection, runway orientation, etc. Concept of Head Wind, Cross Wind, Wind Rose Diagram, Runway Configuration (6+2T= 8 hours)

Aircraft Parking System &Visual Aids: Main Taxiway, Exit Taxiway, Separation Clearance, Holding Aprons.: Marking and Lighting of Runway and Taxiway, Landing Direction Indicator, and Wind Direction Indicator, IFR/VFR. (5+2T=7hours)

Text Books

1. Khanna S.K., and Justo, C.E.G. "Highway Engineering", Nem Chand and Brothers, Roorkee,1998.
2. Kadiyali, L.R. "Principles and Practice of Highway Engineering", Khanna Publishers, New Delhi, 1997.
3. Flaherty, C.A.O. "Highway Engineering", Volume 2, Edward Arnold, London, 1986.
4. Sharma, S.K. "Principles, Practice & Design of Highway Engineering", S. Chand & Company Ltd., New Delhi, 1985.
5. Mannering, "Principles of Highway Engineering & Traffic Analysis", Wiley Publishers, NewDelhi.

Reference Books

E-Books and online learning material

Online Courses and Video Lectures

Subject Code: BSCE-101

Subject Name: Mathematics-III

Programme: B.Tech. (CE**)**	**L:** 3 **T:** 0 **P:** 0
Semester:4	**Teaching Hours:** 36
Theory/Practical: Theory	**Credits:** 3
Internal Marks: 40	**Percentage of Numerical/Design/Programming Problems:**100%
External Marks: 60	**Duration of End Semester Exam (ESE):** 3hr
Total Marks: 100	**Elective Status:** Compulsory

Prerequisites: N/A

Additional Material Allowed in ESE: [Scientific Calculator]

On completion of the course, the student will have the ability to:

CO#	Course Outcomes (CO)
1	Study the use / application of mathematic theory in the solution of engineering problems.
2	Identify appropriate method / functions for obtaining solution
3	Use power series method to solve differential equation and its application to Bessel's and Legendre's equations.
4	Analyze Ordinary and Partial differential equations and learn simplest means to solve them.
5	Learn and apply binary operations, Laplace, Fourier transform methods to civil engineering applications
6	Use the concepts of limit, continuity and derivative of complex variables and use analytic functions which are widely applicable to two dimensional problems in engineering.

Detailed Contents:

Part-A

***Transform Calculus* -1:** Laplace Transform, Properties of Laplace Transform, Laplace transform of periodic functions. Finding inverse Laplace transform by different methods, convolution theorem, Solving ODEs by Laplace Transform method (9 hours)

***Transform Calculus*-2:** The Fourier integral, The Fourier transform, Fourier sine and cosine transform, properties of Fourier transform, Convolution theorem, Parseval's Identities, application of Fourier transforms to solve PDE. (9 hours)

Part-B

***Logic and Partially ordered sets*:** Introduction to first order logic and first order theory. Complete partial ordering, chain, lattice, complete, distributive, modular and complemented lattices. (9 hours)

***Algebraic Structures*:** Algebraic structures with one binary operation – semigroup, monoid and group. Cosets, Lagrange's theorem, normal subgroup, homomorphic subgroup, Congruence relation and quotient structures (9 hours)

***Text* Books:**

1. Erwin Kreyszig, Advanced Engineering Mathematics, 9th Edition, John Wiley & Sons, 2006.
2. N.P. Bali and Manish Goyal, A text book of Engineering Mathematics, Laxmi Publications, Reprint, 2010.
3. B.S. Grewal, Higher Engineering Mathematics, Khanna Publishers, 35th Edition, 2000.
4. Veerarajan T., Engineering Mathematics, Tata McGraw-Hill, New Delhi, 2008.
6. K. H. Rosen, "Discrete Mathematics", MGH Publication.
7. John A. Dossey, "Discrete Mathematics", Addison Wesley Publishing Company.
8. T. Sengadir, "Discrete Mathematics", Pearson Education.
9. G. Shanker Rao, "Discrete Mathematics", New Age International Pvt. Ltd Publishers.

E-Books and online learning material

Online Courses and Video Lectures

Subject Code: LPCCE-104

Subject Name: Concrete Testing Laboratory

Programme: B.Tech. (CE)	**L:** 0 **T:** 0 **P:** 2
Semester:4	**Teaching Hours:** 24
Theory/Practical: Practical	**Credits:** 1
Internal Marks: 30	**Percentage of Numerical/Design/Programming Problems:**
External Marks: 20	**Duration of End Semester Exam (ESE):**
Total Marks: 50	**Elective Status:** Compulsory

Prerequisites:

On Completion of the course, the student will have the ability to:

CO#	Course Outcomes(CO)
1	Evaluate properties of building materials, such as cement and aggregates.
2	Perform experiments to check the acceptance criteria
3	Design concrete mixes as per BIS provisions.
4	Analyze the properties of concrete in fresh and hardened state.
5	Create a well-organized document and present the results appropriately.
6	Apply non-destructive testing (NDT) for evaluating concrete quality.

S. No.	Name of Practical
1.	Tests on cement • Fineness • Consistency • Setting time • Soundness • Specific gravity • Strength
2.	Tests on aggregates (fine and coarse) • Specific gravity • Bulk Density • Fineness Modulus • Moisture content • Water Absorption • Bulking of sand
3.	Design mix of concrete as per BIS method.
4.	Workability tests on concrete • Slump test • Compaction Factor test

	• Vee-Bee test
5.	Strength tests on concrete • Compressive strength (Cube and Cylinder) • Split Tensile strength • Flexural strength • Abrasion resistance
6.	Non-Destructive Techniques • Rebound hammer test • Ultra sonic pulse velocity test

R**eference Material**

1. 'Concrete Laboratory Manual', M. L. Gambhir, DhanpatRai& Sons, New Delhi.
2. 'Concrete Laboratory Manual', TTTI Chandigarh.

Subject Code: LPCCE-105

Subject Name: Transportation Laboratory

Programme: B.Tech. (CE)	**L:** 0 **T:** 0 **P:** 2
Semester: 4	**Teaching Hours:** 24
Theory/Practical: Practical	**Credits:** 1
Internal Marks: 30	**Percentage of Numerical/Design/Programming Problems:**
External Marks: 20	**Duration of End Semester Exam (ESE):**
Total Marks: 50	**Elective Status:** Compulsory

Prerequisites:

On Completion of the course, the student will have the ability to:

CO#	Course Outcomes(CO)
1	Characterize the pavement materials as per the Indian Standard guidelines.
2	Evaluate the strength of subgrade soil by CBR test.
3	Conduct experiments to evaluate aggregate properties.
4	Determine properties of bitumen material and mixes
5	Evaluate the pavement condition by rough meter and Benkelman beam test.
6	Create a well-organized report and present the results appropriately

S. No.	Name of Practical
1.	*Tests on Sub-grade Soil* • California Bearing Ratio Test
2.	*Tests on Road Aggregates* • Crushing Value Test • Los Angles Abrasion Value Test • Impact Value Test • Shape Test (Flakiness and Elongation Index)
3.	*Tests on Bituminous Materials and Mixes* • Penetration Test • Ductility Test • Softening Point Test • Flash & Fire Point Test • Bitumen Extraction Test
4.	*Field Tests* • Study of Roughometer/Bump Indicator • Study of Benkelman Beam Method

R**eference Material**

1. Khanna S.K., and Justo, C.E.G. “Highway Material & Pavement Testing”, Nem Chand and Brothers, Roorkee., International Student Edition, McGraw Hill.

Subject Code: PRCE-101

Subject Name: Seminar and Technical Report Writing

Programme: B.Tech. (CE)	**L:** 0 **T:** 0 **P:** 2
Semester: 4	**Teaching Hours:** 24
Theory/Practical: Practical	**Credits:** 1
Internal Marks: 50	**Percentage of Numerical/Design/Programming Problems:** nil
External Marks: nil	**Duration of End Semester Exam (ESE):**
Total Marks: 50	**Elective Status:** Compulsory

Prerequisites: NIL

On Completion of the course, the student will have the ability to:

CO#	Course Outcomes (CO)
1	Find the relevant sources for information of research area.
2	Create a well-organized document using appropriate format and grammatical structure.
3	Infer the work of others in a consistent manner.
4	Classify the ethical and professional issues.
5	Develop the effective written and oral communication.
6	Conclude the implications of research/problem to society.

Content:

This is an open-ended structured course in which the students under the overall supervision of a faculty member of his discipline must submit report as a culmination of his endeavor and investigation. The focus area of the seminar can be any topic from the civil engineering discipline.
The course will aim to evaluate student's Understanding, Broadness, Diversity, Self-Learning and Service in the area of civil engineering.
Students will prepare the individual seminar report as per the prescribed format and present it before the group of students.

Text/Reference Books:

1. David F. Beer and David McMurrey, "Guide to writing as an Engineer", John Willey. New York, 2004
2. Diane Hacker, Pocket Style Manual, Bedford Publication, New York, 2003 (ISBN 0312406843)
3. Raman Sharma, "Technical Communications", Oxford Publication, London, 2004.
4. Dale Jungk, "Applied Writing for Technicians", McGraw Hill, New York, 2004. (ISBN: 07828357-4)
5. Sharma, R. and Mohan, K. "Business Correspondence and Report Writing", TMH New Delhi 2002.

Subject Code: MCI-101
Subject Name: Environmental Science

Programme: B.Tech. (CE)	**L:** 2 **T:** 0 **P:** 0
Semester:4	**Teaching Hours:** 24
Theory/Practical: Theory	**Credits:** 0
Internal Marks: 40+10	**Percentage of Numerical/Design:** 0%
External Marks: --	**Duration of End Semester Exam (ESE): --**
Total Marks: 50	**Elective Status:** Mandatory

Prerequisites: N/A

Additional Material Allowed in ESE: NIL

On completion of the course, the student will have the ability to:

CO#	Course Outcomes (CO)
1	Identify environmental variables and interpret results.
2	Evaluate local, regional and global environmental topics related to resource use and management.
3	Interpret the results of scientific studies of environmental problems.
4	Propose solutions to environmental problems related to resource use andmanagement.
5	Infer threats to global biodiversity, their implications and potential solutions.
6	Adapt sustainability as a practice in life, society and industry.

Detailed Contents:

Part-A

Natural Resources: **3 hours**

Renewable and non-renewable resources: Natural resources and associated problems: Forest resources: Use and over-exploitation, deforestation, case studies, Timber extraction, mining, dams and their effects on forests and tribal people,

Water resources: **5 hours**

Use and over-utilization of surface and ground water, floods, drought, conflicts over water, dam's benefits and problems, Food Resources: World food problems, changes caused by agriculture and over grazing, effects of modern agriculture, fertilizers- pesticides problems, water logging, salinity, case studies, Energy Resources: Growing energy needs, renewable and non-renewable energy sources, use of alternate energy sources, case studies, Land Resources: Land as a resource, land degradation, man induces landslides, soil erosion, and desertification.

Eco Systems: **4 hours**

Concept of an ecosystem, Structure and function of an ecosystem, Producers, consumers, decomposers, Energy flow in the ecosystems, Ecological succession, Food chains, food webs and ecological pyramids, Introduction, types, characteristic features, structure and function of the following ecosystems: Forest ecosystem, Grass land ecosystem, Desert ecosystem, Aquatic ecosystems (ponds, streams, lakes, rivers, oceans, estuaries).

Part- B

Biodiversity and Conservation: **4 hours**

Introduction-Definition: genetics, species and ecosystem diversity, Biogeographically classification of India, Value of biodiversity: consumptive use, productive use, social, ethical, aesthetic and option values, Biodiversity at global, national and local level, India as a mega diversity nation, Hot-spots of biodiversity, Threats to biodiversity: habitats loss, poaching of wild

life, man wildlife conflicts, Endangered and endemic spaces of India, Conservation of biodiversity: in-situ and ex-situ conservation of biodiversity.

Environmental Pollution: **3 hours**

Definition, causes, effects and control measures of: Air pollution, Water pollution, Soil pollution, Marine pollution, Noise pollution, Thermal pollution, nuclear hazards. Causes, effects and control measures of urban and industrial wastes, Role of an individual in prevention of pollution, Pollution case studies.

Social issues and the Environment: **4 hours**

Form unsustainable to sustainable development, Water conservation, rain water harvesting, water shed management, Resettlement and rehabilitation of people; its problems and concerns, case studies, Environmental ethics: issues and possiblesolutions, Climate change, global warming, acid rain, ozone layer depletion, nuclear accidents and holocaust, case studies, Environment protection Act, Air (prevention and control of pollution) Act, Water (prevention and control of pollution) Act, Wildlife protection act, Forest conservation act

Human population and the environment: **3 hours**

Population growth and variation among nations, Population explosion- family welfare program, Environment and human health, Human rights, Value education, HIV / AIDS, Women and child welfare

Text Books:

1. Textbook of Environmental studies, Erach Bharucha, UGC
2. Fundamental concepts in Environmental Studies, D D Mishra, S Chand & Co Ltd
3. Essentials of Environment Science by Joseph.
4. Perspectives in Environmental Studies by Kaushik, A.

Reference Books:

1. Environment Biology by Agarwal, K. C., Nidi Publ. Ltd. Bikaner.
2. Principle of Environment Science by Cunninghan, W.P.
3. Elements of Environment Science & Engineering by Meenakshi.
4. Elements of Environment Engineering by Duggal.

E-Books and online learning material

: https://www.ugc.ac.in/oldpdf/modelcurriculum/env.pdf

Online Courses and Video Lectures

Subject Code: PCCE-109
Subject Name: Engineering Geology

Programme: B.Tech (Civil Engineering)	**L:** 3 **T:** 0 **P:** 0
Semester: 5	**Teaching Hours:** 36 Hours
Theory/Practical: Theory	**Credits:** 03
Internal Marks: 40	**Percentage of Numerical/Design Problems:** 0%
External Marks: 60	**Duration of End Semester Exam (ESE):** 3 hours
Total Marks: 100	**Elective Status:** Compulsory

Additional Material Allowed in ESE: NIL

On Completion of the course, the student will have the ability to:

CO	Course Outcomes
1.	Understand the geological considerations in civil engineering projects.
2.	Predict the different properties of rocks.
3.	Identify the geological problems associated with civil engineering structures and suggest remedies.
4.	Analyze geological data for civil engineering projects.
5.	Inter predict the engineering properties of rocks in laboratory and field
6.	Plan appropriate techniques for improvement the engineering properties of rocks.

Detailed Contents:

Part-A

Introduction: **6 hours**

Branches of geology useful to civil engineering, scope of geological studies in various civil engineering projects. Department dealing with this subject in India and their scope of work Mineralogy-Mineral, Origin and composition. Physical properties of minerals. Rock forming minerals, megascopic identification of common primary & secondary minerals.

Petrology: **6 hours**

Rock forming processes. Specific gravity of rocks. Ternary diagram. Igneous petrology- Volcanic Phenomenon and different materials ejected by volcanoes. Types of volcanic eruption. Concept of Hot spring and Geysers. Characteristics of different types of magma. Division of rock on the basis of depth of formation, and their characteristics. Chemical and Mineralogical Composition. Texture and its types. Various forms of rocks. Classification of Igneous rocks on the basis of Chemical composition. Detailed study of Acidic Igneous rocks like Granite. Engineering aspect to granite. Basic Igneous rocks Like Gabbro, Dolerite, Basalt. Engineering aspect to Basalt. Sedimentary petrology- mode of formation, Mineralogical Composition. Texture and its types, Structures, Gradation of Clastic rocks. Classification of sedimentary rocks and their characteristics. Detailed study of Conglomerate, Breccia, Sandstone, Mudstone and Shale, Limestone Metamorphic petrology- Agents and types of metamorphism, metamorphic grades, Mineralogical composition, structures & textures in metamorphic rocks. Important Distinguishing features of rocks as Rock cleavage, Schistosity, Foliation. Classification. Detailed study of Gneiss, Schist, Slate with engineering consideration.

Physical Geology: **4 hours**

Weathering. Erosion and Denudation. Factors affecting weathering and product of weathering. Engineering consideration. Superficial deposits and its geotechnical importance: Water fall and Gorges, River meandering, Alluvium, Glacial deposits, Laterite (engineering aspects), Desert Landform, Loess, Solifluction deposits, mudflows, Coastal deposits.

Strength Behavior of Rocks: **4 hours**

Stress and Strain in rocks. Concept of Rock Deformation & Tectonics. Dip and Strike. Outcrop and width of outcrop. Inliers and Outliers. Main types of discontinuities according to size. Fold- Types and nomenclature, Criteria for their recognition in field. Faults: Classification, recognition in field, effects on outcrops. Joints & Unconformity; Types, Stresses responsible, geotechnical importance. Importance of structural elements in engineering operations. Consequences of failure as land sliding, Earthquake and Subsidence. Strength of Igneous rock structures.

Part-B

Geological Hazards: 4 hours

Types of landslide. Prevention by surface drainage, slope reinforcement by Rock bolting and Rock anchoring, retaining wall, Lowering of water table and Subsidence. Earthquake: Magnitude and intensity of earthquake. Seismic sea waves. Revelation from Seismic Records of structure of earth. Seismic Zone in India.

Rock masses as construction material: 6 hours

Definition of Rock masses. Main features constituting rock mass. Main features that affects the quality of rock engineering and design. Basic element and structures of rock those are relevant in civil engineering areas. Main types of works connected to rocks and rock masses. Important variables influencing rock properties and behavior such as Fresh rock Influence from some minerals. Effect of alteration and weathering. Measurement of velocity of sound in rock. Classification of Rock material strength. Rock Quality Designation.

Geology of dam and reservoir site: 3 Hours

Required geological consideration for selecting dam and reservoir site. Failure of Reservoir. Favorable & unfavorable conditions in different types of rocks in presence of various structural features, precautions to be taken to counteract unsuitable conditions, significance of discontinuities on the dam site and treatment giving to such structures.

Rock Mechanics: 3 hours

Sub surface investigations in rocks and engineering characteristics or rocks masses; Structural geology of rocks. Classification of rocks, Field & laboratory tests on rocks, Stress deformation of rocks, Failure theories and shear strength of rocks, Bearing capacity of rocks.

Text Books:

1. Rock Mechanics for Engineers - B.P. Verma - Khanna Publishers New Delhi.
2. Engineering Geology - D.S.Arora – Mohindra Capital Publishers 2000.
3. Engineering Geology - Parbin Singh - 8th Edition S.K. Kataria & Sons.

Reference Books:

1. Introduction to Rock Mechanics - Richard E. Goodman – wiley.
2. Engg. Behaviour of rocks - Farmar, I.W - Kluwer Academic Publishers.
3. Rock Mechanics and Engg. - C Jaeger – Cambridge University Press.
4. Text Book of Engineering Geology – Kesavvalu - MacMillan India.
5. Geology for Geotechnical Engineers - J.C.Harvey - Cambridge University Press.

E-Books and online learning material:

The Elements of Geology by William Harmon Norton
https://www.freebookcentre.net/earth-science-books-download/The-Elements-of-Geology.html
Structural Geology by Stephen J. Martel
https://www.freebookcentre.net/earth-science-books-download/Structural-Geology-by-Stephen-J.-Martel.html
Geology Lecture Notes and Supplementary Material by Scott T. Marshall

https://www.freebookcentre.net/earth-science-books-download/Geology-Lecture-Notes-and-Supplementary-Materials.html
Physical Geology by Stephen A. Nelson
https://www.freebookcentre.net/earth-science-books-download/Physical-Geology.html

Online Courses and Video Lectures:

1. https://www.youtube.com/watch?v=aTVDiRtRook&list=PLDF5162B475DD915F
2. https://www.youtube.com/watch?v=fvoYHzAhvVM
3. https://www.youtube.com/watch?v=9K2Zu-phR4Q
4. https://www.youtube.com/watch?v=UzZFMWH-lSQ
5. https://freevideolectures.com/course/87/engineering-geology

Subject Code: PCCE-110
Subject Name: Engineering Economics, Estimation and Costing

Programme: B.Tech.	**L:** 3 **T:** 1 **P:** 0
Semester: 5	**Teaching Hours:** 36 + 12 (T)= 48 Hours
Theory/Practical: Theory	**Credits:** 4
Internal Marks: 40	**Percentage of Numerical/Design Problems:** 70%
External Marks: 60	**Duration of End Semester Exam (ESE):** 3hours
Total Marks: 100	**Elective Status:** Compulsory

Prerequisites: NIL
Additional Material Allowed in ESE: Non programmable scientific calculator
On Completion of the course, the student will have the ability to:

CO#	Course Outcomes
1.	Apply different concepts of economics in engineering projects
2.	Evaluate present worth, future worth, benefit/cost, life cycle and breakeven analyses on one of many economic alternatives.
3.	Formulate technical specifications for various works to be performed for a project and their impact on the cost of a structure.
4.	Formulate rough and detailed building estimates
5.	Quantify the cost of a structure by evaluating quantities of its constituent materials and prepare tender documents.
6.	Demonstrate the knowledge related to various rules and regulations applicable to construction industry.

Detailed Contents:

Part-A

Basic Principles and Methodology of Economics: 5+1T =6hour
Demand/Supply – elasticity – Government Policies and Application; Theory of the Firm and Market Structure; Basic Macro-economic Concepts (including GDP/GNP/NI/Disposable Income) and Identities for both closed and open economies; Aggregate demand and Supply (IS/LM); Price Indices (WPI/CPI), Interest rates, Direct and Indirect; Components of Monetary and Financial System Taxes; Monetary and Fiscal Policy Tools & their impact on the economy – Inflation and Phillips Curve.

Elements of Business/Managerial Economics: 4+2T = 6hours
Techniques, Types of Costs, Lifecycle costs, Budgets, Break even Analysis, Capital Budgeting, Application of Linear Programming. Investment Analysis – NPV, ROI, IRR, Payback Period, Depreciation, Time value of money (present and future worth of cash flows). Business Forecasting – Elementary techniques. Statements – Cash flow, Financial. Case Study Method

Introduction to Acts pertaining: 2 hours
Minimum wages, Workman's compensation, Contracts, Arbitration, Easement rights

Part-B

Introduction to the process of Estimation: 10+4T = 14hours
Use of relevant Indian Standard Specifications for the same, taking out quantities from the given requirements of the work, comparison of different alternatives, Bar bending schedules, Mass haul Diagrams, Estimating Earthwork and Foundations, Estimating Concrete and Masonry, Finishes, Interiors, MEP works; BIM and quantity take-offs; Material survey - Thumb rules for computation of materials requirement for different materials for buildings percentage breakup of the cost, cost

sensitive index, market survey of basic materials.

Specifications & Analysis of rates: 9+4T = 13hours

Types, requirements and importance, detailed specifications for buildings, roads, minor bridges and industrial structures; Rate analysis - Purpose & importance, factors affecting, task work, daily output from different equipment/ productivity, labour costs.

Tender: 6+1T =7hours

Preparation of tender documents; importance of inviting tenders; contract types, relative merits, prequalification; general and special conditions; termination of contracts, extra work and Changes, penalty and liquidated charges; Settlement of disputes; R.A. Bill & Final Bill; Payment of advance, insurance, claims, price variation, etc; Preparing Bids- Bid Price buildup: Material, Labour, Equipment costs, Risks, Direct & Indirect Overheads; Profits; Bid conditions; alternative specifications; Alternative Bids. Bid process management

Text Books:

1. Mankiw Gregory N. (2002), Principles of Economics, Thompson Asia
2. V. Mote, S. Paul, G. Gupta (2004), Managerial Economics, Tata McGraw Hill
3. UBS Publishers & Distributors, Estimating and Costing in Civil Engineering: Theory and Practice including Specification and Valuations, 2016
4. Pareek Saroj (2003), Textbook of Business Economics, Sunrise Publishers
5. M Chakravarty, Estimating, Costing Specifications & Valuation
6. B.S. Patil, Building & Engineering Contracts
7. Dutta, B.N., Estimating and Costing in Civil Engineering (Theory & Practice), UBS Publishers, 2016
8. A.K. Upadhyay, Civil Estimating and Costing, S.K. Kataria and sons,2011

Reference Books:

1. Misra, S.K. and Puri (2009), Indian Economy, Himalaya
2. Joy P K, Handbook of Construction Management, Macmillan
3. Relevant Indian Standard Specifications.
4. World Bank Approved Contract Documents.
5. FIDIC Contract Conditions.
6. Acts Related to Minimum Wages, Workmen's Compensation, Contract, and Arbitration
7. Typical PWD Rate Analysis documents.

E-Books and online learning material:

1. https://www.slideshare.net/ganeshmrgn/estimation-and-costing
2. https://www.slideshare.net/anbukkarasidhuraisam/estimating-costing-i
3. https://www.slideshare.net/dpkkrprajapati/engineering-economics

Online Courses and Video Lectures:

1. https://onlinecourses.swayam2.ac.in/nou20_cs11/preview
2. https://nptel.ac.in/courses/112/107/112107209/
3. https://www.youtube.com/watch?v=D04uxZpgp6M
4. https://onlinecourses-archive.nptel.ac.in/noc18_me35/course
5. https://www.classcentral.com/course/swayam-engineering-economic-analysis-9919

Subject Code: PCCE-111
Subject Name: Construction Engineering and Management

Programme: B.Tech. (Civil Engineering)	**L:** 3 **T: 0 P:** 0
Semester: 5	**Teaching Hours:** 36 Hours
Theory/Practical: Theory	**Credits:** 3
Internal Marks: 40	**Percentage of Numerical/Design Problems:** 20%
External Marks: 60	**Duration of End Semester Exam (ESE):** 3 Hours
Total Marks: 100	**Elective Status:** Compulsory

Additional Material Allowed in ESE: NIL

On Completion of the course, the student will have the ability to:

CO#	Course Outcomes
1.	Identify various construction methods with their respective features.
2.	Decide various resources required for a particular construction project.
3.	Use CPM and PERT techniques to identify the best course of action for the given input parameters.
4.	Explain different techniques and elements of monitoring a construction project.
5.	Draw a comprehensive checklist required for quality control at a construction project.
6.	Differentiate and explain type of civil engineering contracts including important features.

Detailed Contents:

Part-A

Basics of Construction **2 hr**

Unique features of construction, construction projects- types and features, phases of a project, agencies involved and their methods of execution;

Construction Methods and Equipment **8 hr**

Formwork and Staging, conventional walls and slabs; conventional framed structure with blockwork walls; Modular construction methods for repetitive works; Precast concrete construction methods; Basics of Slip forming for tall structures. Equipment for Earthmoving, Dewatering; Concrete mixing, transporting & placing; Cranes, Hoists and other equipment for lifting; Equipment for transportation of materials. Equipment Productivities.

Planning and Organizing Construction Site and Resources **8 hr**

Site- site layout including enabling structures, developing site organization, documentation at site; Manpower- planning, organizing, staffing; Materials- planning, procurement, inventory control; Equipment- productivity, planning, organizing; Funds- cash flow, sources of funds; Resource Scheduling- Bar chart, line of balance technique, resource constraints and conflicts; resource aggregation, allocation, smoothening and leveling. Make-up of construction costs; Classification of costs, time- cost trade-off in construction projects, compression and decompression.

Part-B

Construction Project Planning **10 hr**

Stages of project planning- pre-tender planning, pre-construction planning, detailed construction planning, role of client and contractor. Process of development of plans and schedules- work break-down structure, assessment of work content and durations, activity lists, sequence of activities. Techniques of planning- Bar charts, Gantt Charts. CPM Network- basic terminology, types of precedence relationships, activity on link and activity on node

representation, computation of float values, critical and semi critical paths, calendaring networks. PERT- Assumptions underlying PERT analysis, determining three-time estimates, analysis, slack computations, calculation of probability of completion.

Project Monitoring, Control & Safety **5 hr**

Supervision, record keeping, periodic progress reports. Updating of plans: purpose, frequency and methods of updating. Common causes of time and cost overruns and corrective measures, Use of Building Information Modelling (BIM) in project management; Quality control: concept of quality, quality of constructed structure, use of manuals and checklists for quality control, role of inspection, basics of statistical quality control. Safety, Health and Environment on project sites: accidents; their causes, effects and preventive measures.

Contracts Management Basics **3 hr**

Importance of contracts; Types of Contracts, parties to a contract; Common contract clauses (Notice to proceed, rights and duties of various parties, notices to be given), Contract Duration and Price. Performance parameters; Delays, penalties and liquidated damages; Force Majeure, Suspension and Termination. Changes & variations, Dispute Resolution methods.

Text Books:

1. Nunnally, S.W. Construction Methods and Management, Prentice Hall, 2006
2. Jha, Kumar Neeraj., Construction Project management, Theory & Practice, Pearson Education India, 2015
3. Punmia, B.C., Khandelwal, K.K., Project Planning with PERT and CPM, Laxmi Publications, 2016.

Reference Books/Codes:

1. Peurifoy, R.L. Construction Planning, Methods and Equipment, McGraw Hill, 2011
2. Varghese, P.C., “Building Construction”, Prentice Hall India, 2007.
3. Chudley, R., Construction Technology, ELBS Publishers, 2007.
4. National Building Code, Bureau of Indian Standards, New Delhi, 2017.

Subject Code: PCCE-112
Subject Name: Environmental Engineering

Programme: B.Tech.	**L:** 4 **T:** 0 **P:** 0
Semester: 5	**Teaching Hours:** 48 hours
Theory/Practical: Theory	**Credits:** 4
Internal Marks: 40	**Percentage of Numerical/Design Problems:** 30%
External Marks: 60	**Duration of End Semester Exam(ESE):** 3hours
Total Marks: 100	**Elective Status:** Compulsory

Prerequisites: N/A
Additional Material Allowed in ESE: Scientific Calculator and graph papers
On Completion of the course, the student will have the ability to:

CO#	Course Outcomes
1.	ntify different types of water demands and select suitable source of water,
2.	alyze water and wastewater quality for a given end use and its disposal,
3.	sign an appropriate sewerage system,
4.	tline physical and chemical composition of solid wastes and to investigate the activities associated with the management of solid waste,
5.	cuss various sources of air pollution and their effects on environment, and
6.	ect the most appropriate technique for the treatment of water, wastewater, solid waste and contaminated air.

Detailed Contents:

Part-A

Water: **12 hours**

General requirement for water supply, population forecasting and water demand, sources, intake, pumping and transportation of water; Physical, chemical and bacteriological characteristics of water and their significance, Water quality criteria, Water borne diseases, Natural purification of water sources. Engineered systems for water treatment: aeration, sedimentation, softening, coagulation, filtration, adsorption, ion exchange, membrane processes and disinfection.

Wastewater: **16 hours**

Generation of domestic wastewater, sullage, storm water, Wastewater flow variations; Conveyance of wastewater- Sewers, shapes design parameters, Design of sewerage systems, wastewater pumping, sewer appurtenances. Wastewater collection from buildings; Physical, chemical and bacteriological characteristics of wastewater, Wastewater treatment, Primary, secondary and tertiary treatment of wastewater, wastewater disposal standards, aerobic and anaerobic treatment systems, suspended and attached growth systems, sludge digestion and handling, recycling of sewage – quality requirements for various purposes.

Part-B

Solid Waste: **13 hours**

Engineering principles; Sources, Composition and Properties of Municipal Solid Waste, Onsite handling, storage and processing, Collection, transfer and transport, Recovery of resources, Conversion products and energy, Disposal of solid waste including sanitary landfill. Introduction to biomedical and hazardous waste management.

Air and Noise Pollution: **07 hours**

Air Pollutants, their sources, harmful effects on environment, metrology and atmospheric diffusion of pollutants, air sampling and pollutant measurement methods, ambient air quality and emission standards, control, removal of gaseous pollutants, particulate emission control, control of automobile pollution. Noise: Basic concept, measurement and various control methods.

Text Books:

1. Peavy H.S., Rowe D.R. and Tchobanoglous G. "Environmental Engineering", 1st Edition, McGraw-Hill Education (Indian Edition), 2017.
2. Davis M.L and Cornwell D.A. "Introduction to Environmental Engineering", 5th Edition, McGraw-Hill Education, 2012.
3. Nathanson J.A. and Schneider R.A. "Basic Environmental Technology", 6th Edition, Pearson Education India, 2016.
4. Masters G.M. and Ela W.P. "Introduction to Environmental Engineering and Science" 3rd Edition, Pearson International, 2014.
5. Garg S.K. "Water Supply Engineering", 33rd Edition, Khanna Publishers, 2010.
6. Garg S.K., "Sewage Disposal and Air Pollution", 39th Edition, Khanna Publishers, 2019.

Reference Books:

1. MetCalf and Eddy, "Wastewater Engineering- Treatment and Reuse", 4th Edition, McGraw-Hill Education (Indian Edition), 2017.

E-Books and online learning material:

1 "Manual on Operation and Maintenance of Water Supply System", Central Public Health & Environmental Engineering Organisation, Ministry of Housing and Urban Affairs, Govt. of India, 2005.
http://cpheeo.gov.in/cms/manual-on-operation--and-maintenance-of-water-supply-system-2005.php

2 "Manual on Sewerage and Sewage Treatment Systems", Central Public Health & Environmental Engineering Organisation, Ministry of Housing and Urban Affairs, Govt. of India, 2013.
http://cpheeo.gov.in/cms/manual-on-sewerage-and-sewage-treatment.php

3 "Manual on Municipal Solid Waste Management", Central Public Health & Environmental Engineering Organisation, Ministry of Housing and Urban Affairs, Govt. of India, 2016.
http://cpheeo.gov.in/cms/manual-on-municipal-solid-waste-management-2016.php

Online Course and Video Lectures:

1 https://nptel.ac.in/courses/127/105/127105018/
2 https://nptel.ac.in/courses/120/108/120108005/
3 https://nptel.ac.in/courses/105/102/105102089/

Subject Code: PCCE-113
Subject Name: Structural Engineering

Programme: B.Tech. (Civil Engineering)	**L:** 3 **T:** 1 **P:** 0
Semester: 5	**Teaching Hours:** 36+12T = 48 Hours
Theory/Practical: Theory	**Credits:** 3
Internal Marks: 40	**Percentage of Numerical/Design Problems:** 70%
External Marks: 60	**Duration of End Semester Exam (ESE):** 3 Hours
Total Marks: 100	**Elective Status:** Compulsory

Prerequisites: Math-1
Additional Material Allowed in ESE: Non programmable calculator, IS 456, IS 800, IS 875
On Completion of the course, the student will have the ability to:

CO#	Course Outcomes
1.	Calculate the loads and its effects in structural members.
2.	Selection of appropriate structural type and load for a given set of constraints
3.	Analyse structural system and determination of forces and displacements
4.	Select suitable material for construction of structural system
5.	Design of different structural elements
6.	Detail different structural element as per different applicable BIS guidelines

Detailed Syllabus

Part-A

The concept of structure, what makes a structure, its need and types; First principles of planning and design process: Load, types of loads and its assessment; Concept of equilibrium - Principles of structural stability & robustness; Concept and importance of load path, its selection.

[4+1T =5 hours]

Structural analysis: Concept of redundancy and its importance - determinate and redundant structural systems; Effect of load on the structural member - displacements, simple stresses and strains, their importance and calculation for determinate problems only; Classical methods of analysis - beam, pin- and rigid-jointed frames (only portal types frames and beams having DoR up to 2, just to illustrate the concept).

[14+4T=18 hours]

Part-B

Materials - Concrete and steel, their mechanical properties; Safety and structural design criteria; Role of standards (BIS) in the design process. [4 hours]

Design of structural elements using structural steel and reinforced concrete - Slabs (one-way cases only), Beams, Axially loaded columns, Isolated footings; Checks to ensure completeness of a selected load path; Fire protection and durability aspects; Detailing, its importance.

[17+4T=21 hours]

Text/Reference Books

1. Devdas Menon, Reinforced Concrete Design. McGraw Hill, 2017
2. Devdas Menon, Structural Analysis. Narosa, 2010

3. Gambhir M L, Design of Reinforced Concrete Structures. PHI, 2008
4. Gambhir M L, Fundamental of Structural Steel Design, McGraw Hill, 2017
5. Gambhir M L, Fundamental of Structural Mechanics and Analysis, PHI, 2011
6. Nilson, A. H. Design of Concrete Structures. 13th edition. McGraw Hill, 2004
7. McCormac, J.C., Nelson, J.K. Jr., Structural Steel Design. 3rd edition. Prentice Hall, N.J., 2003.
8. Galambos, T.V., Lin, F.J., Johnston, B.G., Basic Steel Design with LRFD, Prentice Hall, 1996
9. Salmon, C.G. and Johnson, J.E., Steel Structures: Design and Behavior, 3rd Edition, Harper & Row, Publishers, New York, 1990.
10. NBC, National Building Code, BIS (2017).

Subject Code: PCCE – 114
Subject Name: Geotechnical Engineering

Programme: B.Tech.	**L:** 3 **T:** 0 **P:** 0
Semester: 5	**Teaching Hours:** 36
Theory/Practical: Theory	**Credits:** 3
Internal Marks: 40	**Percentage of Numerical/Design Problems**: 70%
External Marks: 60	**Duration of End Semester Exam (ESE):** 3hours
Total Marks: 100	**Elective Status:** Compulsory

Prerequisites: NIL

Additional Material Allowed in ESE: Non-Programmable Scientific Calculator, graph (natural scale and semi-log)

On Completion of the course, the student will have the ability to:

CO	Course Outcomes
1.	Classify different types of soils based on their origin & formation, and derive various phase relationships of the soil
2.	Determine the index properties of soil
3.	Decide the engineering characteristics of soil
4.	Evaluate shear strength and permeability parameters of different soils
5.	Compute elastic and consolidation settlements
6.	Apply the principles of compaction to field problems

Detailed Contents:

Part-A

Introduction and basic concepts **6hours**

Types of soils, their formation and deposition, Definitions: soil mechanics, soil engineering, rock mechanics, geotechnical engineering. Scope of soil engineering. Comparison and difference between soil and rock. Basic Definitions and Relationships- Soil as three-phase system in terms of weight, volume, voids ratio, and porosity. Definitions: moisture content, unit weights, degree of saturation, voids ratio, porosity, specific gravity, mass specific gravity, etc. Relationship between volume weight, voids ratio- moisture content, unit weight- percent air voids, saturation- moisture content, moisture content- specific gravity etc. Determination of various parameters such as: Moisture content by oven dry method, pycnometer, sand bath method, torsional balance method, nuclear method, alcohol method and sensors. Specific gravity by density bottle method, pycnometer method, measuring flask method. Unit weight by water displacement method, submerged weight method, core-cutter method, sand-replacement method.

Plasticity Characteristics of Soil **6hours**

Introduction to definitions of: plasticity of soil, consistency limits-liquid limit, plastic limit, shrinkage limit, plasticity, liquidity and consistency indices, flow & toughness indices, definitions of activity and sensitivity. Determination of: liquid limit, plastic limit and shrinkage limit. Use of consistency limits. Classification of Soils-Introduction of soil classification: Indian standard soil classification system. Identification: field identification

of soils, general characteristics of soil in different groups.

Permeability and seepage of Soil **6hours**

Darcy's law, validity of Darcy's law. Determination of coefficient of permeability: Laboratory method: constant-head method, falling-head method. Permeability aspects: permeability of stratified soils, factors affecting permeability of soil. Seepage Analysis-Introduction, stream and potential functions, characteristics of flow nets, graphical method to plot flow nets. Effective stress principle, nature of effective stress, effect of water table. Fluctuations of effective stress, effective stress in soils saturated by capillary action, seepage pressure, quicksand condition.

Part-B

Compaction of Soil **4hours**

Introduction, theory of compaction, laboratory determination of optimum moisture content and maximum dry density, concept of O.M.C. and zero Air Void Line. Compaction in field, compaction specifications and field control.

Consolidation of Soil **8hours**

Introduction, comparison between compaction and consolidation, initial, primary & secondary consolidation, spring analogy for primary consolidation, interpretation of consolidation test results, One – dimensional Terzaghi's theory of consolidation, final settlement of soil deposits, computation of consolidation settlement and secondary consolidation

Shear Strength **6hours**

Mohr circle and its characteristics, principal planes, relation between major and minor principal stresses, Mohr-Coulomb theory, types of shear tests: direct shear test, merits of direct shear test, triaxial compression tests, test behaviour of UU, CU and CD tests, pore-pressure measurement, computation of effective shear strength parameters: unconfined compression test, vane shear test

Text Books:

1. Arora K.R., "Soil Mech. & Foundation Engineering", Standard Publishers Distributors, 2011
2. Ranjan G. and Rao A.S., "Basic and applied Soil Mechanics", New Age International Publishers
3. Murthy V.N.S., "Soil Mech. & Foundation Engineering", CBS Publishers & Distributors

Reference Books:

1. Principles of Geotechnical Engineering, by Braja M. Das, Cengage Learning
2. Principles of Foundation Engineering, by Braja M. Das, Cengage Learning
3. Soil Mechanics by Craig R.F., Chapman & Hall
4. Fundamentals of Soil Engineering by Taylor, John Wiley & Sons
5. Geotechnical Engineering by Gulati and Datta, Tata McGraw Hill

6. Geotechnical Engineering by Principles & Practices by Donald. P. Coduto, Pearson Education.

E-Books and online learning material:

1. Soil Mechanics and Foundation by BC Punmia, Ashok K Jain, Arun K Jain
https://easyengineering.net/soil-mechanics-and-foundations-by-punmia
2. Geotechnical Engineering by C. Venkatramaiah
http://93.174.95.29/main/1DC69D69B5C9EEE6A7B8747692402614

Online Courses and Video Lectures:

1. https://nptel.ac.in/courses/105/101/105101201 Accessed on Nov. 13, 2019
2. https://nptel.ac.in/courses/105/105/105105185 Accessed on Nov. 26, 2018
3. https://nptel.ac.in/courses/105/105/105105168 Accessed on Dec. 21, 2017

Subject Code: LPCCE106
Subject Name: Geotechnical Laboratory

Programme: B.Tech.	**L: 0 T: 0 P:** 2
Semester: 5	**Teaching Hours:** 24 Hours
Theory/Practical: Theory	**Credits:** 1
Internal Marks: 30	**Percentage of Numerical/Design Problems:** 100%
External Marks: 20	**Duration of End Semester Exam (ESE):** 1.5hours
Total Marks: 50	**Elective Status:** Compulsory

Prerequisites: Basics of Soil Mechanics
Additional Material Allowed in ESE: NIL
On Completion of the course, the student will have the ability to:

CO#	Course Outcomes
1.	Comprehend the procedure for classifying coarse grained and fine-grained soils
2.	Evaluate the index properties of soil
3.	Determine the engineering properties of soil
4.	Interpret the results of compaction test for relative compaction in the field
5.	Apply modern engineering tools effectively and efficiently for geotechnical engineering analysis.
6.	Conduct experiments, analyze and interpret results for geotechnical engineering design

Detailed Contents:

1. Determination of in-situ density by core cutter method and Sand replacement method.
2. Determination of moisture content in soil sample using oven drying method.
3. Determination of Liquid Limit & Plastic Limit.
4. Determination of specific gravity of soil solids by pyconometer method.
5. Grain size analysis of sand and determination of uniformity coefficient (Cu) and coefficient of curvature (Cc).
6. Compaction test of soil.
7. Unconfined Compression Test for fine grained soil.
8. Direct Shear Test
9. Determination of Relative Density of soil.
10. Determination of permeability by Constant Head Method.
11. Demonstration of miscellaneous equipments such as Augers, Samplers, Rapid Moisture meter, Proctor's needle
12. Preparing a consolidated report of index properties and strength properties of soil

Text Books:

1. Soil Testing Engineering, Manual by Shamsher Prakash and P.K. Jain, Nem Chand & Brothers
2. A Laboratory Manual on Soil Mechanics: Testing and Interpretation by Ravi Kumar Sharma, I.K. International Publishing House Pvt. Ltd.

Reference Books:

1. Soil Mechanics and Foundation Engg.- Punmia B.C. (2005), 16th Edition Laxmi Publications Co. , New Delhi.
2. BIS Codes of Practice: IS 2720 (Part 2, 3, 4, 5, 7, 10, 13, 14, 17) – Methods of test for soils
3. Soil Testing for Engineers- Lambe T.W., Wiley Eastern Ltd., New Delhi

4. Manual of Soil Laboratory Testing- Head K.H., (1986)- Vol. I, II, III, Princeton Press, London.

E-Books and online learning material:

1. http://home.iitk.ac.in/~madhav/geolab.html

Online Courses and Video Lectures:

1. https://nptel.ac.in/courses/105/101/105101160/

www.nitttrchd.ac.in/sitenew1/nctel/civil.php

Subject Code: LPCCE-107
Subject Name: Environmental Engineering Laboratory

Programme: B.Tech.	**L:** 0 **T:** 0 **P:** 2
Semester: 5	**Teaching Hours:** 24 Hours
Theory/Practical: Practical	**Credits:** 1
Internal Marks: 30	**Percentage of Numerical/Design Problems:** --
External Marks: 20	**Duration of End Semester Exam (ESE):** Viva-voce
Total Marks: 50	**Elective Status:** Compulsory

Prerequisites: Nil

On Completion of the course, the student will have the ability to:

CO#	Course Outcomes
1.	Conduct experiments as per standard methods of sampling and analysis.
2.	Demonstrate the expertise to characterize water and wastewater samples.
3.	Understand the importance of laboratory analysis as a controlling factor in the treatment of water and wastewater.
4.	Record the experimental observations and interpret the analysis results.
5.	Use the analysis results for making informed decision about the potability of water and disposal of wastewater.
6.	Recognize the working of air pollution monitoring equipment and noise meter.

S. No.	Name of Practical
1.	Determination of pH value of a water/wastewater sample.
2.	Determination of Turbidity of a water sample.
3.	Determination of Hardness- total, calcium and magnesium hardness of a water sample.
4.	Determination of solids- total, dissolved, suspended, settleable solids of a water/wastewater sample.
5.	Determination of acidity and alkalinity of a water sample
6.	Determination of chlorides and sulphates in a water sample.
7.	Determination of Dissolved Oxygen (DO) and Biochemical Oxygen Demand (BOD) of a wastewater sample.
8.	Determination of Chemical Oxygen Demand (COD) of a wastewater sample.
9.	Determination of bacteriological quality of a water/wastewater sample.
10.	Determination of nutrients in wastewater (TKN, TN and TP).
11.	Demonstration of air pollution monitoring equipment.
12.	Demonstration of noise level meter.

Text/Reference Books:

1. Standard Methods for the Examination of Water and Waste Water, American Public Health Association, American Water Works Association, 2017.
2. Sawyer C.N., McCarty P.L. and Parkin G.F., Chemistry for Environmental Engineering and Science, 5th Edition, McGraw Hill, 2003.
3. Manuals of analytical equipment.

Subject Code: LPCCE-108
Subject Name: Structural Laboratory

Programme: B.Tech.	**L:** 0 **T:** 0 **P:** 2
Semester: 5	**Teaching Hours:** 24 Hours
Theory/Practical: Practical	**Credits:** 01
Internal Marks: 30	**Percentage of Numerical/Design Problems: -**
External Marks: 20	**Duration of End Semester Exam(ESE):** 1.5 Hours
Total Marks: 50	**Elective Status:** Compulsory

Prerequisites: NIL
Additional Material Allowed in ESE: NIL
On Completion of the course, the student will have the ability to:

CO#	Course Outcomes
1.	Verify theoretical formulas by conducting experiments.
2.	Predict the behavior of statically determinate beams and trusses.
3.	Depict the behavior of two hinged arch and three hinged arch structures.
4.	Demonstrate the influence lines for statically determinate and indeterminate beams.
5.	Observe and compute deflections of simply supported beams, curved beams and frames using classical methods.
6.	Outline the deflected shapes of columns and struts with different end conditions.

Detailed Contents:

1. Deflection of a simply supported beam and verification of Clark-Maxwell's theorem.
2. To determine the Flexural Rigidity of a given beam.
3. To verify the Moment- area theorem for slope and deflection of a given beam.
4. Deflection of a fixed beam and influence line for reactions.
5. Deflection studies for a continuous beam and influence line for reactions.
6. Study of behaviour of columns and struts with different end conditions.
7. Experiment on three-hinged arch.
8. Experiment on two-hinged arch.
9. Deflection of a statically determinate pin jointed truss.
10. Forces in members of redundant frames.
11. Experiment on curved beams.
12. Unsymmetrical bending of a cantilever beam.

Text Books:
Laboratory Manual on Structural Mechanics by Dr. Harvinder Singh; New Academic Publishing Comp. Ltd
E-Books and online learning material:
1. Structural Analysis Lab by Lakshman Singh
http://www.dbit.ac.in/ce/syllabus/structural-analysis-lab.pdf
Online Courses and Video Lectures:
https://lecturenotes.in/practicals/36000-lab-manual-for-structural-analysis2-sa2-by-prashant-kumar?reading=true

Subject Code: PRCE-102
Subject Name: Minor Project

Programme: B.Tech. (Civil Engineering)	**L: 0 T: 0 P:** 2
Semester: 6	**Teaching Hours:** 24 Hours
Theory/Practical: Practical	**Credits:** 1
Internal Marks: 60	**Percentage of Numerical/Design Problems:** 90%
External Marks: 40	**Duration of End Semester Exam (ESE):**
Total Marks: 100	**Course Category:** Core

Additional Material Allowed in ESE: Relevant IRC codes

On Completion of the course, the student will have the ability to:

CO#	Course Outcomes
1.	Formulate detailed estimate of a building.
2.	Compute quantity of materials required for civil engineering works as per specifications.
3.	Analyze rates for items not covered in CSR.
4.	Create a well-organized document using appropriate format and grammatical structure.
5.	Infer the work of others in a consistent manner.
6.	Classify the ethical and professional issues.

Detailed Contents:

This is a structured open-ended course in which the students under the overall supervision of a faculty member of his discipline will perform a detailed cost estimate of a project and submit report as a culmination of his endeavor and investigation. The focus area of the work can be any project of civil engineering such as Building, Highway, Industrial Project, Bridges, Canal, Dam etc.

Subject Code: PCCE-115
Subject Name: Irrigation Engineering

Programme: B.Tech.	**L**: 3 **T**: 1 **P**: 0
Semester: 6	**Teaching Hours**: 36L +12T = 48hours
Theory/Practical: Theory	**Credits**: 4
Internal Marks: 40	**Percentage of Numerical/Design/Programming Problems**: 70%
External Marks: 60	**Duration of End Semester Exam (ESE):** 3hours
Total Marks: 100	**Elective Status**: Compulsory

Prerequisites: Hydrology & Water Resources Engineering (PCCE-107)
Additional Material Allowed in ESE: Non Programmable Scientific Calculator, Khosla's Curve, Blench Curves, Montague's Curve, H_L/y_c curves
On completion of the course, the student will have the ability to:

CO#	Course Outcomes (CO)
1	Explain the functioning and design consideration of various components of Diversion Head Work.
2	Analyze the various parameters of hydraulic structures for seepage and uplift pressure.
3	Utilize the concept and principles of silt control devices.
4	Design water distribution systems, regulators, canal falls, outlets, cross drainage works, weirs and barrages of irrigation network.
5	Choose the best possible canal fall, outlet and cross drainage works according to real time situation.
6	Identify appropriate energy dissipation devices suitable for hydraulic structures as per site condition.

Detailed Contents:

Part-A

Head Works: **5L+0T = 5hours**
Types of head works, Functions and investigations of a diversion head work: component of a diversion head work and their design considerations, silt control devices.

Theories of Seepage: **4L+2T = 6hours**
Seepage force and exit gradient, assumptions and salient features of Bligh's Creep theory, Limitations of Bligh's Creep theory, salient features of Lane's weighted Creep theory and Khosla's theory, Comparison of Bligh's Creep theory and Khosla's theory, Determination of uplift pressures and floor thickness.

Design of Weirs: **5L+3T = 8hours**
Weirs versus barrage, types of weirs, main components of weir, causes of failure of weir and design considerations with respect to surface flow, hydraulic jump and seepage flow. Design of barrage or weir.

Energy Dissipation Devices: **3L+1T = 4hours**
Use of hydraulic jump in energy dissipation, Types of energy dissipators and their hydraulic design.

Part-B

Canal Regulators: **4L+1T = 5hours**
Offtake alignment, cross-regulators – their functions and design, Distributory head regulators-their functions and design, canal escape.

Canal Falls: **5L+2T = 7hours**

Necessity and location, types of falls and their description, selection of type of falls, Design of Sarda type, straight glacis and Inglis or baffle wall falls.

Cross-Drainage works: **6L+2T = 8hours**

Definitions, choice of type, Hydraulic design consideration, Aqueducts their types and design, siphon aqueducts – their types and design considerations, super passages, canal siphons and level crossing.

Canal Out-lets: **4L+1T = 5hours**

Essential requirements, classifications, criteria for outlet behaviours: flexibility, proportionality, sensitivity, sensitiveness, etc. Details and design of non-modular, semi-modular and modular outlets.

Text Books:

1. S. K Garg, "Irrigation Engineering & Hydraulic Structure", Khanna Publishers, 24th Edition, 2012
2. K. R. Arora, "Irrigation Waterpower and Water Resources Engineering", Standard Publishers Distributors, 3rd Edition, 2010
3. B. C. Punmia, B.B.L. Pande, Ashok K.R. Jain, Arun K.R. Jain, "Irrigation & Water Power Engineering", 16th Edition, Laxmi Publications (P) Ltd., New Delhi, 2009
4. P.N. Modi, "Irrigation Water Resources and Water Power Engineering", Standard Book House, 9th Edition, 2014
5. R.K. Sharma and T.K. Sharma, "Irrigation Engineering", S. Chand Publishers, 2007
6. S. R. Sahasrabudhe, "Irrigation Engineering and Hydraulic Structures", Katson Publishing House, 2007

Reference Books:

1. Houk Ivan E., "Irrigation Engineering Volume – I & II", John Wiley; 2nd Printing Stated L.C. 51-12519 Edition (January 1, 1962)
2. G.L.Asawa, "Irrigation and Water Resources Engineering", New Age International Publishers, 2005.
3. Varshney R.S., "Concrete dams", 2nd Edition, Oxford and IBH Pub.Co.in, New Delhi, 1982.
4. Varshney R.S., S. C. Gupta & R.L. Gupta, "Theory and Design of Hydraulic structures", 2nd Edition, Nemchand and Brothers, 1992.
5. Satyanarayana Murthy C, "Water Resources Engineering", 1st Edition, New Age International Pvt. Ltd. Publishers, 1997.
6. Relevant IS codes.

E-Books and online learning material

1. Irrigation and Water Power Engineering by B.C.Punmia, B.B.L. Pande, Ashok K.R. Jain, Arun K.R. Jain
   https://easyengineering.net/irrigation-and-water-power-engineering-by-punmia/
2. Irrigation Engineering by R. N. Reddy
   https://easyengineering.net/irrigation-engineering-book-pdf-by/

Online Courses and Video Lectures

1. https://nptel.ac.in/courses/105/105/105105110/

Subject Code: PCCE – 116
Subject Name: Building Construction Practice

Programme: B. Tech.	**L:** 3 **T:** 0 **P:** 0
Semester: 6	**Teaching Hours:** 36
Theory/Practical: Theory	**Credits:** 4
Internal Marks: 40	**Percentage of Numerical/Design Problems**: 20%
External Marks: 60	**Duration of End Semester Exam(ESE):** 3 hours
Total Marks: 100	**Elective Status:** Compulsory

Prerequisites: NIL
Additional Material Allowed in ESE: Nil
On Completion of the course, the student will have the ability to:

CO#	Course Outcomes
1.	Apply know-how to execute different types of construction using masonry and concrete
2.	Plan and freeze specifications in light of BIS guidelines
3.	Decide appropriate type of equipment needed to execute the construction activity
4.	Select appropriate type of construction method and formwork
5.	Construct various structural and non-structural building components
6.	Execute different construction activities related to substructure and superstructure

Detailed Contents

Section-A

Construction Practice: Load Bearing Structure, Framed Structure and High rise Building Technology, Load transfer mechanism in different types, Environmental impact of materials – responsible sourcing, Specifications, Details and sequence of activities, Construction co-ordination, Site Clearance, Marking, Earthwork, masonry – stone masonry – Bond in masonry – laying brick and concrete hollow block masonry, flooring, damp proof courses, construction joints – movement and expansion joints, precast pavements, Building foundations, basements, temporary shed, centering and shuttering – slip forms – scaffoldings – de-shuttering forms, Fabrication and erection of steel trusses, Related BIS guidelines

[12 hrs]

Construction equipment: Selection of equipment for earth work, earth moving operations, types of earthwork equipment -tractors, motor graders, scrapers, front end waders, earth movers, Equipment for foundation and pile driving, Equipment for compaction, batching, mixing and concreting, Equipment for material handling and erection of structures, Types of cranes, Equipment for dredging, trenching, tunneling

[6 hrs]

Section-B

Sub-structure construction: Techniques of Box jacking and Pipe Jacking, Under water construction of diaphragm walls and basement, Tunneling techniques, Piling techniques, Well and caisson – sinking coffer dam, Cable anchoring and grouting, Driving diaphragm walls, sheet piles, Shoring for deep cutting – well points, Dewatering and stand by Plant equipment for underground open excavation

[9 hrs]

Super structure construction: Launching girders, bridge decks, off-shore platforms, Special forms for shells, Techniques for heavy decks, In-situ pre-stressing in high rise structures, Material handling – erecting light weight components on tall structures, Support structure for heavy Equipment and

conveyors, Erection of articulated structures

[9 hrs]

Text Books:

1. Building Materials and Construction by GC Sahu and Jaygopal Jena, McGraw-Hill Education Publisher.
2. Fundamentals of Building Construction Materials and Methods by Edward Allen and Joseph Iano, Wiley Publisher
3. Construction Practice by Brian Cooke, Wiley Publisher.
4. Building Construction: Principles, Materials, And Systems by Madan L Mehta Ph.d., Walter Scarborough, Diane Armpries, Pearson Publisher
5. Building Construction by Varghese, P.C., , Prentice Hall India
6. National Building Code, Bureau of Indian Standards, New Delhi

Subject Code: PECE-101
Subject Name: Foundation Engineering

Programme: B.Tech. (Civil Engineering)	**L:** 3 **T: 1 P:** 0
Semester: 5	**Teaching Hours:** 36 L +12T =48 Hours
Theory/Practical: Theory	**Credits:** 4
Internal Marks: 40	**Percentage of Numerical/Design Problems:** 60%
External Marks: 60	**Duration of End Semester Exam (ESE):** 3 Hours
Total Marks: 100	**Course Category:** Elective

Prerequisites: PCCE-114 Geotechnical Engineering

Additional Material Allowed in ESE: NIL

On Completion of the course, the student will have the ability to:

CO	Course Outcomes
1.	Evaluate relative merits and demerits of various soil investigation techniques to understand the characteristics of subsoil for the design of foundations.
2.	Analyze the settlement of substructures for cohesive and non-cohesive soils.
3.	Predict the soil failure by understanding its criteria.
4.	Apply the knowledge of soil bearing capacity for the design of shallow foundation.
5.	Demonstrate the knowledge of earth pressure for the lateral stability of retaining wall and well foundations.
6.	Apply the knowledge of soil bearing capacity for the design of deep foundation

Detailed Contents:

Part-A

Soil Investigation: **6+2T = 8hours**

Object of soil investigation for new and existing structures. Depth of exploration for different structures, Spacing of bore Holes. Methods of soil exploration and relative merits and demerits, Types of soil sample. Design features of sampler affecting sample disturbance, Essential features and application of the following types of samples-Open Drive samples, Stationery piston sampler,. Rotary sampler, Geophysical exploration by seismic and resistivity methods, Bore hole log for S.P.T

Earth Pressure **6+2T = 8hours**

Earth Pressure Terms and symbols used for a retaining wall. Movement of all and the lateral earth pressure. Earth pressure at rest, Rankine states of plastic equilibrium, K_a and K_p for horizontal backfills. Rankine's theory both for active and passive earth pressure for Cohesionless backfill with surcharge and fully submerged case. Cohesive backfill condition, Coulomb's method for cohesion less backfill, Merits and demerits of Ranking and Coulomb's theories, Culmann's graphical construction (without surcharge load)

Shallow Foundation **9+3T = 12hours**

Type of shallow foundations, Depth and factors affecting it, Definition of ultimate bearing capacity, safe bearing capacity and allowable bearing capacity. Rankine's analysis and

Terzaghi's analysis, types of failures, Factors affecting bearing capacity, Skemptons Equation, B.I.S recommendations for shape, depth and inclination factors. Plate Load test and standard penetration Test Bosussinesq equation for a point load, uniformly loaded circular and rectangular area, pressure distribution diagrams, Newmarks chart and its construction, 2:1 method of load distribution, Comparison of Bosussinesq and Westerguard analysis for a point load, Causes of settlement of structures, Comparison of immediate and consolidation settlement, calculation of settlement by plate load Test and Static Cone penetration test data, Allowable settlement of various structures according to I.S. Code, Situation most suitable for provision of rafts, Proportioning of rafts, Methods of designing raft, Floating foundation

Part-B

Pile Foundations **9+3T = 12hours**

Necessity and uses of piles, Classification of piles, Merits and demerits of different types based on composition, Types of pile driving hammers & their comparison, Effect of pile driving on adjacent ground, Use of Engineering News Formula and Hiley's Formula for determination of allowable load, Limitations of pile driving formulae, Cyclic Pile Load Test, Separation of skin friction and point resistance using cyclic pile load test, Determination of point resistance and frictional resistance of a single pile by Static formulas Piles in Clay, Safe load on a Friction and point Bearing pile, Pile in sand, Spacing of piles in a group, Factors affecting capacity of a pile group, Efficiency of pile group by converse – Labare formula and feeds formula, Bearing capacity of a pile group in clay by block failure and individual action approach, Calculation of settlement of friction pile group in clay, Related Numerical problems, Settlement of pile groups in sand, Negative skin friction, Related numerical problem

Caissons and Wells **6+2T = 8hours**

Major areas of use of caissons, advantages and disadvantages of open box and pneumatic caissons, Essential part of a pneumatic caisson, Components of a well foundation, Calculation of allowable bearing pressure. Conditions for stability of a well, Forces acting on a well foundation, Computation of scour depth

Text Books:

1. Soil Mech. & Foundation Engg, by K.R. Arora, Standard Publishers Distributors
2. Soil Mech. & Foundation Engg., by V.N.S. Murthy
3. Principle of Foundation Engineering by B.M.Das, CL Engineering

Reference Books/Codes:

1. Geotechnical Engineering, by P. Purshotama Raj
2. Basic and applied Soil Mechanics by Gopal Ranjan and A.S.R.Rao, New Age International
3. Soil Mech. & Foundations by Muni Budhu Wiley, John Wiley & Sons
4. Geotechnical Engineering by Gulhati and Datta, Tata McGraw - Hill Education
5. Foundation Engineering by Varghese P.C, PHI Learning.
6. Soil mechanics and Foundation Engineering by B.P.Verma, Khanna Publication.
7. Foundation Analysis and Design by Bowles J.E, Tata McGraw - Hill Education

E-Books and online learning material:

1. https://books.google.co.in/books/about/FOUNDATION_ENGINEERING.html?id=3_VSLiXA7w0C Accessed on 20-09-2021
2. https://bookauthority.org/books/best-geotechnical-engineering-ebooks Accessed on 20-09-2021

Online Courses and Video Lectures:

1. https://nptel.ac.in/courses/105/105/105105176 Accessed on 20-09-2021
2. https://www.youtube.com/watch?v=T4UaqZk8Y44 Accessed on 20-09-2021
3. https://freevideolectures.com/course/2674/foundation-engineering Accessed on 20-09-2021
4. https://www.classcentral.com/course/swayam-geotechnical-engineering-ii-foundation-engineering-12922 Accessed on 20-09-2021

Subject Code: PECE-112
Subject Name: Geometric Design of Highways

Programme: B.Tech. (Civil Engineering)	**L:** 3 **T: 0 P:** 0
Semester: 5	**Teaching Hours:** 36 Hours
Theory/Practical: Theory	**Credits:** 3
Internal Marks: 40	**Percentage of Numerical/Design Problems:** 20%
External Marks: 60	**Duration of End Semester Exam (ESE):** 3 Hours
Total Marks: 100	**Course Category:** Elective

Additional Material Allowed in ESE: Relevant IRC codes

On Completion of the course, the student will have the ability to:

CO#	Course Outcomes
1.	Develop an understanding of overall Traffic pattern and its behaviour.
2.	Develop un understanding and design of various sight distances and other design elements
3.	Design the components of horizontal and vertical alignment of different classes of highways.
4.	Design the cross-sectional elements of different classes of highways.
5.	Appreciate the various types of intersections and suggest the required measures.
6.	Plan the required facilities for pedestrians, bicycles, buses and parking.

Detailed Contents:

Part-A

INTRODUCTION **2 hrs**

Classification of rural highways and urban roads. Objectives and requirements of highway geometric design. Design Control and Criteria

DESIGN ELEMENTS: **12 hrs**

Sight distances - types, analysis, factors affecting, measurements, Horizontal alignment - design considerations, stability at curves, super-elevation, widening, transition curves; curvature at intersections, vertical alignment - grades, ramps, design of summit and valley curves, combination of vertical and horizontal alignment including design of hair pin bends, IRC standards and guidelines for design. problems.

CROSS SECTION ELEMENTS **8hrs**

Right of way and width considerations, roadway, shoulders, kerbs traffic barriers, medians, frontage roads; Facilities for pedestrians, bicycles, buses and trucks, Pavement surface characteristics - types, cross slope, skid resistance, unevenness.

Part-B

GEOMETRIC DESIGN OF INTERSECTIONS **8 hrs**

Types of Intersections; Design Principles for Intersections; Design of At-grade Intersections – Channelization, Objectives; Traffic Islands and Design standards; Rotary Intersection – Concept, Advantages and Disadvantages; Grade separated Interchanges – Types, warrants and Design standards.

MISCELLANEOUS ELEMENTS **6 hrs**

Requirements of Pedestrians; Pedestrian facilities on Urban Roads; Cycle Tracks – Guidelines and Design standards; Bus bays –Types and Guide lines; Design of On-street and Off street Parking facilities – Guidelines for lay out Design, Traffic Signs and Markings.

Text Books:

1. Khanna S.K. and Justo, C.E.G.`Highway Engineering', Nem Chand and Bros.,2000.
2. Principles and Practice of Highway Engineering, L.R.Kadiyali and N.B.Lal, Khanna, 2007.
3. AASHO, "A Policy on Geometric Design of Highways and Streets', American Association of State Highway and Transportation Officials, Washington D.C.
4. C. Jotin Khistya and B. Kent Lall, "Transportation Engineering", by Prentice Hall of India Private Limited

Reference Books/Codes:

1. DSIR, `Roads in Urban Areas', HMSO, London.
2. Jack E Leish and Associates, `Planning and Design Guide: At-Grade Intersections'. Illinios.
3. Relevant IRC Codes & Publications

Subject Code: PECE-132
Subject Name: Structural Analysis

Programme: B.Tech. (Civil Engineering)	**L:** 3 **T:** 1 **P:** 0
Semester: -	**Teaching Hours:** 48 Hours
Theory/Practical: Theory	**Credits:** 04
Internal Marks: 40	**Percentage of Numerical/Design Problems:** 70%
External Marks: 60	**Duration of End Semester Exam (ESE):** 3 Hours
Total Marks: 100	**Elective Status:** Program Elective

Prerequisites: Mathematics-1 and Structural Engineering
Additional Material Allowed in ESE: Non programmable calculator
On Completion of the course, the student will have the ability to:

CO	Course Outcomes
1.	Recognize the concept of structural systems, loads, supports and displacements
2.	Develop and use the concept of influence line diagram for calculating maximum values of different structural quantities in a statically determinate structure, like BM, SF and displacement.
3.	Analyze different types of statically determinate structures including cables, beams, arches, frames and trusses.
4.	Assess the effect of rolling loads, support displacements and temperatures on response of statically determinate structures.
5.	Compute reactive forces in the beams, pin-jointed and rigid jointed frames using conventional methods of analysis.
6.	Analyze different types of statically indeterminate structures including beams, frames and trusses.

Detailed Syllabus

Part-A

Analysis of Determinate Structures:

- Force Method: Statically determinate structures (method of joints: method of sections for trusses)
- Displacement Method: Statically determinate structures (Unit load method; Energy method)

[8+2T=10 hours]

Moving Loads and Influence Line Diagrams: Concept of influence line diagram, rolling loads; Bending moment and shear force diagrams due to single and multiple concentrated rolling loads, uniformly distributed moving loads; Equivalent UDL; Muller Breslau principle; Influence lines for beams, girders with floor beams and frames; calculation of the maximum and absolute maximum shear force and bending moment; Concept of envelopes; Influence line for displacements; Influence line for bar force in trusses.

[8 + 2T =10hours]

Part-B

Analysis of indeterminate structures:

- Force methods: Statically indeterminate structures (method of consistent deformations and theorem of least work).
- Displacement Methods: Kinematically indeterminate structures (slope-deflection method and moment distribution method). [18 +6T=24 hours]

Influence Line Diagrams: Concept and application in the analysis of statically indeterminate structures; Influence line for bar forces in the statically indeterminate trusses, beams and frames.

[3+1T=4 hours]

Text/Reference Books

1. Intermediate structural analysis - C K. Wang. McGraw Hill
2. Indeterminate structural analysis - J. Sterling Kinney Addison-Wesley Educational Publishers
3. Basic structural analysis - C. S. Reddy Tata McGraw-Hill
4. Devdas Menon, Structural Analysis, Narosa, 2010
5. Gambhir M L, Fundamental of Structural Mechanics and Analysis, PHI, 2011

Subject Code: PECE – 134
Subject Name: Design of Concrete Structures

Programme: B.Tech.	**L:** 3 **T:** 1 **P:** 0
Semester: -	**Teaching Hours:** 36 + 12 (T)= 48 Hours
Theory/Practical: Theory	**Credits:** 4
Internal Marks: 40	**Percentage of Numerical/Design Problems**: 90%
External Marks: 60	**Duration of End Semester Exam (ESE):** 3 hours
Total Marks: 100	**Elective Status:** Elective

Prerequisites: NIL
Additional Material Allowed in ESE: Scientific Calculator, IS 456-2000, IS 3370-2009, SP16
On Completion of the course, the student will have the ability to:

CO#	Course Outcomes
1.	Compare the fundamental concepts of different design philosophies available for RC elements
2.	Execute the solution using a logic and structured approach based on limit state method and IS code provisions for various RC elements, such as slabs and stairs.
3.	Design various substructure components like foundations, retaining walls
4.	Design various superstructure components like columns, continuous beams
5.	Apply the concepts of structure design to special structural elements like water retaining structures
6.	Employ the code of practice for design of reinforced concrete structural members and elementary structural systems.

Detailed Contents:

Part-A

Design Philosophies **2+0T = 2 hours**
Working Stress Method, Limit State Method

Slabs **4+1T = 5hours**
Design of Two way Slabs

Design of Continuous beams **3+1T = 4hours**
Design for Bending, Shear, Bond, Anchorage, Development Length and Torsion

Stairs **3+1T = 4hours**
Design of staircase – laterally supported and longitudinally supported

Part-B

Compression Members **6+2T = 8hours**
Design of Short Compression Members under Axial Load with uniaxial and biaxial Bending, Design of Slender Columns

Foundations **6+3T = 9hours**
Combined Footing (Rectangular, Trapezoidal, Strap), Raft Footing

Retaining walls **7+2T = 9hours**
Design of Cantilever type retaining wall, Counter-fort type retaining wall

Liquid retaining structures **5+2T = 7hours**
Design of circular and rectangular water tanks resting on ground

All design and analysis should be based on Limit State Methods.

Text Books:
1. Reinforced Concrete Design; Pillai & Menon; Tata McGraw-Hill Education

2. Limit state Design of Reinforced Concrete; Varghese P C; Prentice-Hall of India Pvt. Ltd

3. Reinforced Cement Concrete, Mallick and Rangasamy; Oxford-IBH

Reference Books:

1. IS 456-2000: Indian Standard. Plain and Reinforced concrete -Code of practice
2. IS 3370-2009: Code of practice for concrete structures for storage of liquids
3. SP 16: Design Aids
4. SP 24: Explanatory hand book
5. SP 34: Detailing of Reinforcement

Subject Code: PECE – 163

Subject Name: Physico-Chemical Treatment Methods

Programme: B.Tech.	**L:** 3 **T:** 1 **P:** 0
Semester:	**Teaching Hours: 36+12T =**48
Theory/Practical: Theory	**Credits:** 4
Internal Marks: 40	**Percentage of Numerical/Design Problems**: 50%
External Marks: 60	**Duration of End Semester Exam (ESE):** 3 hours
Total Marks: 100	**Elective Status:** Elective

Prerequisites: NIL

Additional Material Allowed in ESE: Nil

On Completion of the course, the student will have the ability to:

CO	Course Outcomes
1.	Identify the sampling and analysis techniques required for the monitoring of water treatment plants and for the characterization of the water.
2.	Outline the water quality guidelines, criteria and standards.
3.	Evaluate various physical and chemical treatment options for treatment of water and wastewater.
4.	Explain the mechanism behind the treatment processes and their advantages and disadvantages.
5.	Exhibit greater flexibility and originality in the definition and innovative solution of water pollution problems.
6.	Conclude the fundamental principles and the similarities or differences among many of the engineered systems for water treatment.

Detailed Contents:

Part-A

Water – Quality, Standards and Criteria:
Physical, chemical and biological water quality parameters; Water quality guidelines, criteria and standards; Wastewater Effluent standards (6+3T=9 Hours)

Purification of water-
Natural treatment processes- Physical, chemical and biological processes. Water treatment technologies-overview, Primary, Secondary and tertiary treatment-Unit operations & unit processes (7+2T=9 Hours)

Screening & Grit removal: Screens; grit chambers (3+0T=3 Hours)

Settling Tanks, Coagulation and Flocculation:
Theory of settling; Types of settling; Settling Tanks; Coagulation-flocculation; Flash mixing tanks and flocculation tanks; Tube settlers and plate settlers. (6+3T=9 Hours)

Part-B

Aeration: Diffused, surface and gas transfer processes.

Filtration Systems: Filtration theory and filter hydraulics; Slow sand filters; Rapid gravity filters; Pressure filters; Multimedia filters. (7+2T=9 Hours)

Disinfection: Chlorination; Ozonation; UV radiation (3+0T=3 Hours)

Other Water Treatment Technologies: Ion-exchange process; Adsorption process- Adsorption equilibria-adsorption isotherms; membrane processes (nano-filtration, ultra-filtration and reverse osmosis).
(4+2T=6 Hours)

Text Books:

1. Metcalf and Eddy, "Wastewater Engineering – Treatment and Reuse", Tata McGraw Hill.
2. Syed R. Qasim, Edward Motley, Guang Zhu, "Water Works Engineering"- Planning, Design and Operation, PHI
3. Weber W.J., "Physico-chemical Processes for Water Quality Control", John-Wiley
4. Howard S. Peavy, Donald R. Rowe & George Tchobanoglous, "Environmental Engg.", McGraw Hill
5. Viessman Jr, Hammer J. M, Perez, E.M, and Chadik, P. A, Water Supply and Pollution Control, PHI Learning
6. Hammer, M.J. and Hammer, M.J. Jr., "Water and Wastewater Technology", PHI Learning

Subject Code: PECE – 167
Subject Name: Solid Waste Management

Programme: B.Tech.	**L:** 3 **T:** 1 **P:** 0
Semester: -	**Teaching Hours:** 36+12T=48
Theory/Practical: Theory	**Credits:** 4
Internal Marks: 40	**Percentage of Numerical/Design Problems**: 30%
External Marks: 60	**Duration of End Semester Exam (ESE):** 3 hours
Total Marks: 100	**Elective Status:** Elective

Prerequisites: NIL
Additional Material Allowed in ESE: Nil
On Completion of the course, the student will have the ability to:

CO#	Course Outcomes
1.	Examine physical and chemical composition of wastes and to analyze activities associated with the management of solid waste.
2.	Employ method to recover materials, conserve products, and to generate energy from solid and wastes.
3.	Design and locate waste containment systems as per regulatory standards and to appreciate the increasing importance of waste and resource management in achieving environmental sustainability.
4.	Define and explain important concepts in the field of solid waste management and suggest suitable technical solutions for treatment of municipal and industrial waste.
5.	Imply the role legislation and policy drivers play in stakeholders' response to the waste.
6.	Apply the basic scientific principles for solving practical waste management challenges including landfill operations

Detailed Contents:

Part-A

Introduction: Definition of solid wastes, Nuisance potential and extent of solid waste problems, Objectives and scope of integrated solid waste management. (6+2T=8 Hours)

Characterization and Quantification: Types, composition, characteristics and quantities of wastes, Methods of quantification and characterization of wastes. (6+2T=8 Hours)

Collection, Storage and Transportation of Wastes: Types of collection systems and their components, Concept of waste segregation at source and recycling and reuse of wastes; Household, street and community level collection bins and storage containers. (6+2T=8 Hours)

Part-B

Solid Waste Processing and Treatment: Waste processing – processing technologies – biological and chemical conversion technologies – Composting - thermal conversion technologies - energy recovery (6+2T=8 Hours)

Sanitary Landfills: Design, development, operation and closure of landfills, Management of leachate and landfill gases, environmental monitoring of landfill sites. (6+2T=8 Hours)

Legal Requirements: Municipal solid waste rules; Hazardous waste rules; Biomedical waste rules; E-waste rules; Rules related to recycled plastics, used batteries, flyash, etc. (6+2T=8 Hours)

Text Books:

1. Pichtel, J., Waste Management Practices – Municipal, Hazardous and Industrial, CRC Press.
2. Vesilind, P.A., Solid Waste Engineering, Thomson Learning Inc.
3. Tchobanoglous, G., Vigil, S.A. and Theisen, H., Integrated Solid Waste Management: Engineering Principles and Management Issues, McGraw Hill
4. Howard S. Peavy, Donald R. Rowe & George Tchobanoglous, “Environmental Engg.”, McGraw Hill
5. CPHEEO, Manual on Municipal Solid waste management, Central Public Health and Environmental Engineering Organization, Government of India

Subject Code: OECE-101
Subject Name: Metro Systems and Engineering

Programme: B.Tech. (Civil Engineering)	**L:** 3 **T: 0 P:** 0
Semester: 6	**Teaching Hours:** 36 Hours
Theory/Practical: Theory	**Credits:** 3
Internal Marks: 40	**Percentage of Numerical/Design Problems:** 30%
External Marks: 60	**Duration of End Semester Exam (ESE):** 3 Hours
Total Marks: 100	**Course Category:** Open Elective

Additional Material Allowed in ESE: NIL

On Completion of the course, the student will have the ability to:

CO#	Course Outcomes
1.	Understand overview of metro systems.
2.	Analyse vehicle dynamics and structure; tunnel ventilation systems; electrical systems.
3.	Apply electronic signalling systems and automatic fare collection.
4.	Understand the basics of construction planning & management.
5.	Evaluate the construction quality & safety systems.

Detailed Contents:

Part-A

Introduction to Metro systems **5 hours**

Overview of Metro Systems; Need for Metros; Routing studies; Basic Planning and Financials.

Planning and Development **8 hours**

Overview and construction methods for: Elevated and underground Stations; Viaduct spans and bridges; Underground tunnels; Depots; Commercial and Service buildings. Initial Surveys & Investigations;

Traffic Management Systems **8 hours**

Basics of Construction Planning & Management, Construction Quality & Safety Systems. Traffic integration, multimodal transfers and pedestrian facilities; Environmental and social safeguards; Track systems-permanent way. Facilities Management Module

PART B

Signalling Systems **5 hours**

Introduction to Signalling systems; Automatic fare collection; Operation Control Centre (OCC and BCC); SCADA and other control systems; Platform Screen Doors.

Electrical Systems **5 hours**

OHE, Traction Power; Substations- TSS and ASS; Power SCADA; Standby and Back-up systems; Green buildings, Carbon credits and clear air mechanics.

Mechanical Systems **5 hours**

Ventilation systems; Air conditioning for stations and buildings; Fire control systems; Lifts and Escalators

Text Books:

1. "Electric Traction for Railway Trains: A Book for Students, Electrical and Mechanical Engineers, Superintendents of Motive Power and Others" Edward Parris BurchPalala Press 2018.
2. "Metropolitan Railways: Rapid Transit in America (Railroads Past and Present)",Middleton, Indiana University Press 2013.
3. "World Metro Systems", Garbutt, Capital Transport Publishing; 2nd Revised edition 1997.

Subject Code: OECE-102

Subject Name: Numerical Methods in Engineering

Programme: B.Tech. (Civil Engineering)	**L:** 3 **T: 0 P:** 0
Semester: 6	**Teaching Hours:** 40 Hours
Theory/Practical: Theory	**Credits:** 3
Internal Marks: 40	**Percentage of Numerical/Design Problems:** 70%
External Marks: 60	**Duration of End Semester Exam (ESE):** 3 Hours
Total Marks: 100	**Course Category:** Open Elective

Additional Material Allowed in ESE: NIL

On Completion of the course, the student will have the ability to:

CO#	Course Outcomes
1.	Demonstrate the concept of approximations and errors in the implementation and development of numerical methods.
2.	Select an appropriate solution to an engineering problem dealing with the roots of equations by numerical methods.
3.	Execute the solution of problems involving linear algebraic equations and appreciate the application of these problems in field of engineering.
4.	Apply the techniques to fit curve to data and be capable of choosing the preferred method for any particular problem.
5.	Evaluate the solution of the problems through the numerical integration and differentiation and solve ordinary and partial differential equations and eigen value problems through various techniques.
6.	Able to use newmarks method for civil engineering problems.

Detailed Contents:

Part-A

Equation **8 hr**

Roots of algebraic transcendental equation, Solution of linear simultaneous equations by different methods using Elimination, Iteration, Inversion, Gauss-Jordan and Method, Homogeneous and Eigen Value problem, Non-linear equations, Interpolation

Finite Difference Technique **8 hr**

Initial and Boundary value problems of ordinary and partial differential equations, Solution of Various types of plates and other civil engineering related problems

New Marks Methods **6 hr**

Solution of determinate and indeterminate structures using New-marks Procedure (Beam)

Part-B

Statistical Methods **6 hr**

Method of correlation and Regression analysis for fitting a polynomial equation by least square

Initial Value problem **6 hr**

Galerkin's method of least square, Initial Value problem by collocation points, Runge-kutta Method

Solution **6 hr**

Implicit and explicit solution, solution for nonlinear problems and convergence criteria

Text Books:

1. James B. Numerical Mathematical Analysis. Scarborough Oxford and IBH Publishing, 2005.
2. Sastry S.S. Introductory Methods of Numerical Analysis, PHI Learning, 2012.
3. Jia X. and Liu S. Introduction to Computer Programming and Numerical Methods.Kendall/Hunt Publishing Co., 2007.
4. Dixit J.B. Numerical Methods. USP (Laxmi publication), 2011.

Reference Books/Codes:

1. Grewal B. S. Numerical Methods in Engineering and Science, (with programming in C and C++). Khanna Publishers, 2012.
2. Gerald F.C. and Wheatley P.O. Applied Numerical Analysis. Pearson Education Inc., 2008.

Subject Code: OECE-103
Subject Name: Project Management & Monitoring

Programme: B.Tech. (Civil Engineering)	**L:** 3 **T: 0 P:** 0
Semester: 6	**Teaching Hours:** 40 Hours
Theory/Practical: Theory	**Credits:** 3
Internal Marks: 40	**Percentage of Numerical/Design Problems:** 30%
External Marks: 60	**Duration of End Semester Exam (ESE):** 3 Hours
Total Marks: 100	**Course Category:** Open Elective

Additional Material Allowed in ESE: NIL

On Completion of the course, the student will have the ability to:

CO#	Course Outcomes
1.	Understand the need of project planning and device a plan to define the work to be performed in construction project.
2.	Utilize various tools and techniques of project management and develop more realistic schedule by identifying the central problem and analyze the alternatives.
3.	Analyze time estimates of different activities and events in a network for better controlling of project by identifying critical path.
4.	Determine minimum total cost and minimum project time by conducting a crash program.
5.	Develop understanding about techniques of updating, allocation of resources and rescheduling a project.
6.	Apply computer skills to project management and evaluation.

Detailed Contents:

Part-A

Introduction **6 hr**

Need for project planning & management, time, activity & event, bar-chart, Milestone chart, uses & draw backs

PERT **12 hr**

Construction of PERT network, time estimates, network analysis, forward pass &backward pass, slack, critical path, data reduction, suitability of PERT for research project, numerical problems.

Part-B

CPM **12 hr**

Definitions, network construction, critical path, fundamental rules, determination of project schedule, activity time estimates, float types, their significance, numerical problems.

Cost Analysis and Contract **12 hr**

Type of costs, cost time relationships, cost slopes, conducting a crash programme, determining the minimum total cost of project, numerical problems, updating a project, when to update, time grid diagram, resource scheduling, planning of different components of engineering projects. Introduction of relevant open-source software(s).

Text Books:

1. Srinath L.S.PERT and CPM - Principles and Applications. East West Press, 2001.
2. Jha K.N. Construction Project Management: Theory and Practices. 2nd edition, Pearson Education India, 2015.
3. Verma M. Construction Equipment & Planning and Application. Metropolitan Book Co, 1975.
4. Shrivastava U.K. Construction Planning and Management. Galgotia Publications Pvt. Ltd., 2000.

Reference Books/Codes:

1. Punmia B.C. and Khandelwal K.K. Project Planning and Control with PERT and CPM. 4th edition, Laxmi Publications Private Limited, 2016.
2. Wiest J.D. & levy F.K. Management Guide to PERT & CPM. Prentice Hall, 1970.

Subject Code: OECE-104
Subject Name: Traffic Management & Road Safety

Programme: B.Tech. (Civil Engineering)	**L:** 3 **T: 0 P:** 0
Semester: 6	**Teaching Hours:** 40 Hours
Theory/Practical: Theory	**Credits:** 3
Internal Marks: 40	**Percentage of Numerical/Design Problems:** 20%
External Marks: 60	**Duration of End Semester Exam (ESE):** 3 Hours
Total Marks: 100	**Course Category:** Open Elective

Additional Material Allowed in ESE: NIL

On completion of the course, the student will have the ability to:

CO#	Course Outcomes
1.	Understand the traffic flow parameters and measures related to traffic control and management.
2.	Analyze the feasibility of different control devices for traffic management.
3.	Create the solution of the problem related to traffic congestion and safety.
4.	Outline the causes of road accidents and procedure to assess the road safety audit.
5.	Apply the methods to identify the black spots and propose the solutions to improve road safety.
6.	Assess the need of modernization in traffic management and road safety.

Detailed Contents:

Part - A

Fundamentals of Traffic Management **7 hr**

Principles of Traffic management; Highway capacity and Level of service; Mixed Traffic flow: PCU concept and its limitations; Traffic stream parameters: Interrupted and Uninterrupted flow

Traffic Regulation and Control devices **8 hr**

Road Signs and markings; Channelization; At-grade and Grade separated intersections; Traffic Rotary; Design principles of traffic signals

Traffic Management techniques **5 hr**

Regulatory measures for Traffic management; Travel Demand Management; Role of ITS in traffic management

Part - B

Road accidents **6 hr**

Causes of road accidents: Vehicle design factors & Driver characteristics influencing road safety, Road condition, Parking and its influence on traffic safety

Road safety measures **9 hr**

Accident data collection methods; Representation of accident data: Collision and condition diagram; Methods to Identify and Prioritize Black spots; Road safety: 3‘E’ measures

Road safety audits **5 hr**

Key elements in Road safety audit; Road safety audit procedure and investigations; Role of ITS in-Road safety

Text Books:

1. Fred L. Mannering, Scott S. Washburn. Principles of Highway Engineering and Traffic Analysis.7th Edition, Wiley, 2019.
2. Kadiyali L.R. Traffic Engineering & Transport Planning. Khanna Publications, 2013.
3. Khisty C.J. and Lall B.K. Transportation Engineering – An Introduction. 3rd Edition, Pearson, 2017.
4. Khanna S.K., Justo C.E.G and Veeraragavan A. Highway Engineering. Revised 10th Edition, Nem Chand & Bros, 2017.

Reference Books/Codes:

1. IPC SO 088-2010 Manual on Road Safety Audit, Indian Road Congress, New Delhi, 2010.

2. Highway Capacity Manual: A Guide for Multimodal Mobility Analysis. 6th Edition, TRB, Washington, DC: The National Academies Press, 2016.

3. Garber N.J and Hoel L.A. “Principles of Traffic and Highway Engineering” Fifth edition, Cengage Learning India Pvt. Ltd, 2013.

Subject Code: PECE-103
Subject Name: Reinforced Earth

Programme: B.Tech. (Civil Engineering)	**L:** 3 **T:** 1 **P:** 0
Semester: 6/7/8	**Teaching Hours:** 36L + 12T = 48 Hours
Theory/Practical: Theory	**Credits:** 4
Internal Marks: 40	**Percentage of Numerical/Design Problems:** 40%
External Marks: 60	**Duration of End Semester Exam (ESE):** 3 Hours
Total Marks: 100	**Course Category:** Program Elective

Pre-requisites: Soil Mechanics, Foundation Engineering
Additional Material Allowed in ESE: Non-programmable Scientific Calculator
On Completion of the course, the student will have the ability to:

CO	Course Outcomes
1.	Experiment with the principle of reinforced earth and different types of reinforcement techniques.
2.	Design the reinforced earth structures.
3.	Compare the soil nailing with reinforced soil and design aspects.
4.	Identify the different geosynthetics products for different construction projects.
5.	Outline the concept of fibre reinforced soil.
6.	Assess the suitability of reinforced earth for different projects.

Detailed Contents:

Part-A

Basic components of reinforced soil **4 + 2T = 6 hours**

Introduction, General, basic mechanism of reinforced earth, Soil or fill-material, reinforcement bars, Metallic strips, Metallic grids, Facing Elements, concrete panel facing etc.

Reinforced Earth Constructions **4 + 2T = 6 hours**

Introduction, Historical background, Principles of reinforced earth, Effect of reinforcement of soil, Mechanism of reinforced earth, Anchors, Tiebacks, Economic advantage of reinforced earth structure over similar structures

Design of Reinforced Earth Structure **9 + 3T = 12 hours**

Introduction, Internal and overall stability, Design of Reinforced - slopes, foundation, retaining walls and embankments

Part-B

Soil Nailing Techniques **3 + 1T = 4 hours**

Introduction, Advantages & limitations of soil nailing techniques, comparison of soil nailing with reinforced soil, methods of soil nailing - construction sequence components of system, design aspects

Geosynthetics **3 + 1T = 4 hours**

Introduction and overview, Historical developments, Recent developments, Classification based on materials, Geosynthetics – geotextiles, geogrids, geomembranes, geocomposites, geonets and other products, geomats, geomeshes, geowebs etc.

Fibre Reinforced Soil **6 + 2T = 8 hours**

General, soil stabilization, reinforced soil, soil nailing, texsol, ply soil, comparison of ply soil with reinforced soil and soil nailing, types of fibers – synthetic fibers, natural fibers, plant roots, direction of placements

Application of reinforced earth **7 + 1T = 8 hours**

Introduction, General, Reinforcement, Drainage, Filtration, Separation, Jacketing, Erosion control and Slope protection, Advantages & limitations, Applications of soil nailing techniques

Textbooks:

1. Robert M. Koerner, *Designing with Geosynthetics*, Prentice Hall – 1989
2. G.V Rao & GVS Suryanarayana Raju, *Engineering with Geosynthetics*, Tata Mc Graw Hill Publishing Co. New Delhi
3. Korener, *Construction & Geotechnical Methods in Foundation Engineering*, McGraw Hill
4. Shukla, S.K. and Yin, J.H. Fundamental of Geosynthetic Engineering, Taylor & Francis
5. Swamisaran, Reinforced Soil and its Engineering Application, New Age Publication
6. Gulati, S.K. and Datta, M., Geotechnical Engineering, TMH

Online Course:

https://nptel.ac.in/courses/105/106/105106052/ Accessed on 31-01-2013

Subject Code: PECE-104

Subject Name: Earthen Embankment

Programme: B.Tech.	**L:** 3 **T:** 1 **P:** 0
Semester: 7^{th} / 8^{th}	**Teaching Hours:** 36L + 12T = 48Hours
Theory/Practical: Theory	**Credits:** 4
Internal Marks: 40	**Percentage of Numerical/Design Problems**: 60%
External Marks: 60	**Duration of End Semester Exam (ESE):** 3 hours
Total Marks: 100	**Elective Status:** Elective

Prerequisites: NIL

Additional Material Allowed in ESE: Non-programmable scientific calculator

On Completion of the course, the student will have the ability to:

CO	Course Outcomes
1.	Identify the type and extent of the sub surface investigation required for a particular dam site.
2.	Describe the type of soil test required and its utility, to support the foundation.
3.	Assess the most appropriate method and types of material to be used for the construction.
4.	Illustrate the behavior of natural and engineered soil / rock slopes under various weather and engineering conditions.
5.	Explain the factors that may affect the stability of slopes.
6.	Select an appropriate slope stability analysis method subject to geometry of slope, material properties, and uncertainty of observations.

Detailed Contents:

Part – A

Investigation of dam's sites: **5+1T = 6hours**

General, extent of investigation, Preliminary and Final investigation, Geological investigation, Sub - surface investigation, Drilling and Sampling

Soil test & other utility: **9+3T = 12hours**

General various soil test for coarse, Sand and gravels, Clay, Silts & fine sands, Tests of foundation material shear consideration and settlement tests O.M.C. consideration

Construction material and Methods: **4+2T = 6hours**

General consideration for the construction of materials, suitability of different materials for various components earth dams. Soil unsuitable for dam construction by roll, Hydraulic- fill & semi hydraulic fill methods

Part – B

Earth and Rock Fill Dams: **6+2T = 8hours**

General features, Selection of site; Merits and demerits of the earth and rock fill dams, Classification of earth dams, Causes of failure, Safe design criteria. Instrumentation in earth dams: Pore pressure measurements, Settlement gauges, Inclinometers, Stress measurements, Seismic measurements.

Failures, Damages and Protection of Earth Dams: **6+2T = 8hours**

Nature and importance of failure, piping through embankment and foundations, methods of seepage control through embankments and foundations. Design Criteria for filters, Treatment of upstream and downstream of slopes, Drainage control, and Filter design.

Slope Stability Analysis: **6+2T = 8hours**

Types of Failure: Failure surfaces – Planar surfaces, Circular surfaces, Non-circular surfaces, Total stress analysis versus effective Stress analysis, Use of Bishop's pore pressure parameters, Short term and Long term stability in slopes. Taylor Charts.

Text Books:

1. Sherard, Woodward, Gizienski and Clevenger. Earth and Earth-Rock Dams. John Wiley &. Sons. 1963
2. Sowers, G. F. and Salley, H. I. – Earth and Rockfill Dams, Willams, R.C., and Willace, T.S. 1965.
3. Abramson, L. W., Lee, T. S. and Sharma, S. – Slope Stability and Stabilization methods – John Wiley & sons, 2002.
4. Bromhead, E. N. - The Stability of Slopes, Blackie academic and professional, London, 1992.
5. Christian Kutzner, Earth & Rockfill Dams – Principles of Design and Construction, Published Oxford and IBH, 1997.
6. Ortiago, J. A. R. and Sayao, A. S. F. J. – Handbook of Slope Stabilization, 2004.

Reference Books:

1. Bharat Singh and Sharma H. D. – Earth and Rockfill Dams, Sarita Prakashan,1999
2. Bharat singh, R.S. Varshney - Embankment Dam Engineering, Nem Chand & Bros, 2004
3. Burr Bassell - Earth Dams, A study, Wentworth Press, 2019
4. J. Paul Guyer - An Introduction to Embankment Design for Earth Fill Dams (Dams and Hydroelectric Power Plants), The Clubhouse Press, California, 2017

E-Books and online learning material:

1. Earth Dams, A study by Burr Bassell
   https://www.ebooksread.com/authors-eng/burr-bassell/earth-dams-a-study-hci.shtml
2. Design of Earth Dams by A.L. Goldin, L. N. Rasskazov, R.B. Zeidler
   https://www.taylorfrancis.com/books/mono/10.1201/9781315141022/design-earth-dams-goldin-rasskazov-zeidler
3. Earthen Dam Drainage and Failure
   http://ecoursesonline.iasri.res.in/mod/page/view.php?id=2192
4. Seepage Analysis
   http://ecoursesonline.iasri.res.in/mod/page/view.php?id=2193
5. Phreatic line in earth dam
   http://ecoursesonline.iasri.res.in/mod/page/view.php?id=2194

Online Courses and Video Lectures:

1. https://nptel.ac.in/courses/105/105/105105168/
2. https://nptel.ac.in/courses/105/105/105105185/
3. https://nptel.ac.in/courses/105/106/105106144/

Subject Code: PECE-106
Subject Name: Environmental Geo-technology

Programme: B.Tech. (Civil Engineering)	**L:** 3 **T: 1 P:** 0
Semester:6th/7th/8th	**Teaching Hours:** 36L+12T
Theory/Practical: Theory	**Credits:** 4
Internal Marks: 40	**Percentage of Numerical/Design Problems:** 30%
External Marks: 60	**Duration of End Semester Exam (ESE):** 3 Hours
Total Marks: 100	**Course Category:** Program Elective

Prerequisites- NIL

Additional Material Allowed in ESE: NIL

On Completion of the course, the student will have the ability to:

CO	Course Outcomes
1.	Understanding soil environment interaction, composition, soil structure and its behaviour.
2.	Applying site investigation techniques for characteristics of contaminated site.
3.	Analysing contaminant transport mechanisms in soils.
4.	Illustrate site investigation techniques for characterization of contaminated site.
5.	Explain the principles of soil treatment techniques
6.	Evaluating contaminants transport mechanism in soil.

Detailed Contents:

PART -A

Introduction 2+1T = 4 hours

Sources & Impact of Contamination and Soil-Waste Interaction.

Soil as a multiphase system 3+1T=6 hours

Soil-environment interaction; Properties of water in relation to the porous media; Water cycle with special reference to soil medium.

Soil mineralogy 4+2T= 8 hours

Significance of mineralogy in determining soil Behaviour, Mineralogical characterization, soil chemical Interactions, Determination of soil composition, X-ray diffraction.

PART -B

Mechanisms of soil-water interaction 10+2T=12 hours

Diffuse double layer models; Force of attraction and repulsion; Soil-water-contaminant interaction; Theories of ion exchange; Influence of organic and inorganic chemical interaction.

Concepts of waste containment 10+3T=12 hours

Sources, production and classification of wastes, Environmental laws and regulations, physico-chemical properties of soil, contaminant transport, contaminated site remediation.

Soil characterization techniques 7+3T=9 hours

Electrical and thermal properties; contaminant analysis, Stabilization of contaminated soils and risk assessment approaches.

Text Books:

1. Mitchell J.K and Soga K., Fundamentals of Soil Behavior, John Wiley and Sons Inc.
2. Fang H-Y., Introduction to Environmental Geotechnology, CRC Press
3. Daniel D.E, Geotechnical Practice for Waste Disposal, Chapman and Hall
4. Rowe R.K., Quigley R.M. and Booker J.R., Clayey Barrier Systems for Waste Disposal Facilities, CRC Press
5. Rowe R.K, Geotechnical and Geoenvironmental Engineering Handbook, Kluwer Academic Publishers
6. Reddi L.N. and Inyang H.F, Geoenvironmental Engineering - Principles and Applications, Marcel Dekker Inc.
7. Sharma H.D. and Lewis S.P, Waste Containment Systems, Waste Stabilization and Landfills: Design and Evaluation, John Wiley & Sons Inc.

E-Books and online learning material:

1. https://www.icevirtuallibrary.com/doi/full/10.1680/eg.41875.001
2. Environmental Geotechnology - Proceedings of EGRWSE 2018 | Arvind Kumar Agnihotri | Springer
3. Contaminated land | Environmental Geotechnics (icevirtuallibrary.com)
4. Waste disposal by landfill | Environmental Geotechnics (icevirtuallibrary.com)
5. 105102160.pdf - Google Drive

Online Lectures and Video Lectures:

1. NPTEL :: Civil Engineering - NOC:Geoenvironmental Engineering (Environmental Geotechnology): Landfills, Slurry Ponds & Contaminated Sites
2. NPTEL :: Civil Engineering - NOC:Geoenvironmental Engineering (Environmental Geotechnology): Landfills, Slurry Ponds & Contaminated Sites
3. NPTEL :: Civil Engineering - NOC:Geoenvironmental Engineering (Environmental Geotechnology): Landfills, Slurry Ponds & Contaminated Sites
4. NPTEL :: Civil Engineering - NOC:Geoenvironmental Engineering (Environmental Geotechnology): Landfills, Slurry Ponds & Contaminated Sites

Subject Code: PECE-107

Subject Name: Ground Improvement Techniques

Programme: B.Tech.	**L:** 3 **T:** 1 **P:** 0
Semester: 7^{th} / 8^{th}	**Teaching Hours:** 36L + 12T = 48Hours
Theory/Practical: Theory	**Credits:** 4
Internal Marks: 40	**Percentage of Numerical/Design Problems**:
External Marks: 60	**Duration of End Semester Exam (ESE):** 3
Total Marks: 100	**Elective Status:** Elective

Prerequisites: NIL

Additional Material Allowed in ESE: Non-programmable scientific calculator

On Completion of the course, the student will have the ability to:

CO	Course Outcomes
1.	Evaluate the existing characteristics of the soil to be improved.
2.	Explain the mechanism of ground improvement.
3.	Select a suitable type of ground improvement technique considering the existing soil.
4.	Design of various ground improvement techniques.
5.	Monitor the efficiency of ground improvement methods.
6.	Apply the selected ground improvement methods at site.

Detailed Contents:

Part – A

Introduction: **3+1T = 4hours**

Need for Ground Improvement, Different types of problematic soils, Emerging trends in ground Improvement.

Soil Improvement without the addition of materials: **8+3T= 11hours**

Dynamic compaction equipment used - application to granular soils - cohesive soils, depth of improvement, environmental considerations, compaction using vibratory probes, vibro techniques vibro equipment, vibro compaction and replacement process, control of verification of vibro techniques, vibro systems and liquefaction, soil improvement by thermal treatment, preloading techniques, surface compaction.

Introduction to soil improvement with the addition of materials: **8+3T = 11hours**

Stabilization of soft clay or silt with lime, bearing capacity of lime treated soils, settlement of lime treated soils, improvement in slope stability, chemical grouting, commonly used chemicals, grouting systems, grouting operations and applications, introduction to compaction grouting, application and limitations, jet grouting, jet grouting process, geometry and properties of treated soils, applications, sand - stone columns.

Part – B

Soil improvement using reinforcing elements: **11+3T = 14hours**

Introduction to reinforced earth, load transfer mechanism and strength development, anchored earth nailing reticulated micro piles, soil dowels, soil anchors, reinforced earth retaining walls, behaviors of soils on reinforcing with geotextiles, effect on strength, bearing capacity, compaction and permeability, design aspects, slopes, clay embankments, retaining walls, pavements.

Case studies: **6+2T = 8hours**

Case studies of ground improvement techniques projects.

Text Books:

1. P. Purushothama Raj "*Ground Improvement* Techniques" Laxmi Publications; New Delhi, 2016
2. Dr. B.C. Chattopadhyay and J. Maity, Ground Control and Improvement Techniques, Peedot, Howrah, 2011
3. S. K. Gulhati and M. Datta, "Geotechnical Engineering", Tata McGraw Hill, 2005
4. M. R. Hausmann, "Engineering Principles of Ground Modification", McGraw-Hill 1990

Reference Books:

1. R. M. Korner, Design with Geosynthetics, Prentice Hall, New Jersy, 3rd Edition 2002
2. Jewell R.A., Text Book on Soil Reinforcement with Geotextiles, CIRIA Special Publication, Thomas Telford,1996
3. Moseley, Text Book on Ground Improvement, Blackie Academic Professional, Chapman & Hall, 1993
4. Bureau of Indian Standards, Selection of ground improvement techniques for foundation in weak soils? guidelines, Bureau of Indian Standards, New Delhi, 1992
5. G. V. Rao and G. V. S. Rao, Text Book on Engineering with Geotextiles, Tata McGraw Hill 1990

E-Books and online learning material:

1. Dr. P Purshotama Das **,** https://books.google.co.in/books?id=cDGIhh7ttMcC&printsec=copyright&redir_esc=y#v=onepage&q&f=false **,** Accessed on 20-09-2021.
2. Ground Improvement Techniques for Soil Stabilization, https://theconstructor.org/geotechnical/ground-improvement-techniques-soil-stabilization/1836/ , Accessed on 20-09-2021

Online Courses and Video Lectures:

1. Ground Improvement by G.L. Sivakumar Babu, https://nptel.ac.in/courses/105/108/105108075/, Accessed on 20-09-2021.
2. Ground Engineering, " https://www.normet.com/process/ground-engineer-ing/?gclid=CjwKCAjw4qCKBhAVEiwAkTYsPFNuew2xpSFajSPAnsB4fxiYtXpnXGlGgOme2lIXSuSLryewSbyjqRoCAoAQAvD_BwE#07506f98 ", Accessed on 20-09-2021.

Subject Code: PCCE-109
Subject Name: Pavement Design

Programme: B.Tech. (Civil Engineering)	**L:** 3 **T:** 1 **P:** 0
Semester: 6/7/8	**Teaching Hours:** 36(L)+12(T) **=48** Hours
Theory/Practical: Theory	**Credits:** 3
Internal Marks: 40	**Percentage of Numerical/Design Problems:** 90%
External Marks: 60	**Duration of End Semester Exam (ESE):** 3 Hours
Total Marks: 100	**Course Category:** Elective

Additional Material Allowed in ESE: Relevant IRC codes

On Completion of the course, the student will have the ability to:

CO#	Course Outcomes
1.	Identify the different types of pavement and factors affecting their design
2.	Design the flexible pavement using different methods and as per latest Indian Standard.
3.	Design the bitumen mix for surface and binder course as per Indian Standard.
4.	Design the rigid pavement using different methods and as per latest Indian Standard.
5.	Evaluate the pros and cons of various other low-cost pavements proposed by IRC.
6.	Design an overlay by evaluating the existing strength of pavement.

Detailed Course Content:

Part-A

Introduction- Types of pavement structure. Functions of pavement components, Factors affecting pavement design, Design wheel load, and Strength characteristics of pavement materials. Comparison of flexible and rigid pavements **2(L)**

Design of Flexible Pavements- General design considerations, Methods for design of flexible pavements – Burmister two layer theory, Group Index Method, Triaxial Test Method, C-R value Method, McLeod's Method, Indian Roads Congress Method **8(L)**

Design of Bituminous Mixes- Mix Design Approaches, Marshall Method of Bituminous Mix Design. 6**(L)**

Part-B

Design of Rigid Pavement: – General design considerations, Westergard's Analysis, Methods for design of rigid pavements - Brief of PCA method and AASHTO Method, Indian Roads Congress Method, Types and design of Joints in cement concrete pavements. **11(L)**

Modern Design Concepts- Reinforced Concrete Pavement, Bituminous Pavement with Cemented Base, Interlocking /Concrete Block Pavement, Ultrathin White Topping, Perpetual Pavement, Pavement Overlays. Design. **9(L)**

Reference/Text Books:

1. S K Khanna, C E G Justo, and A Veeraragavan, Highway Engineering, Nem Chand & Brothers

2. L.R.Kadiyali and Dr.N.B.Lal, Principles and Practices of Highway Engineering, Khanna publishers
3. Yang H. Huang , Pavement Analysis and Design, University of Kentucky.
4. Saxena,S. C., "Highway and Traffic Engineering", CBS Publishers & Distributors.
5. Yang H. Huang , Pavement Analysis and Design, University of Kentucky

Reference Books:

1. Yoder & wit zorac , Principles of pavement design, John Wiley & Sons.
2. Subha Rao, Principles of Pavement Design.
3. R Srinivasa Kumar, Pavement Design, University Press.
4. Relevant recent IRC codes

Subject Code: PECE-110
Subject Name: Traffic Engineering and Management

Programme: B.Tech. (Civil Engineering)	**L:** 3 **T:** 1 **P:** 0
Semester: 6/7/8	**Teaching Hours:** 36(L)+12(T) = 48
Theory/Practical: Theory	**Credits:** 3
Internal Marks: 40	**Percentage of Numerical/Design Problems:** 20%
External Marks: 60	**Duration of End Semester Exam (ESE):** 3 Hours
Total Marks: 100	**Course Category:** Elective

Additional Material Allowed in ESE: Relevant IRC codes

On Completion of the course, the student will have the ability to:

CO	Course Outcomes
1.	Assess the appropriate technique to forecast traffic volume for design of roads.
2.	Determine the capacity of Highways under real field condition.
3.	Analyse the accident data and find out its causes
4.	Manage the traffic flow to avoid congestion and accident.
5.	Develop the traffic flow models to study characteristics of traffic
6.	Simulate traffic models using appropriate techniques.

Detailed Contents:

Part-A

Traffic Forecast: **6(L)+2(T)**

General travel forecasting principles, different methods of traffic forecast - Mechanical and analytical methods, Demo and relationships, methods for future projection; Design Hourly Volume for Varying Demand Conditions, Determination of PCU under mixed traffic conditions, Price-volume relationships, demand functions. Determination of design hourly volume; critical hour

Capacity studies: **6(L)+2(T)**

Concept; Highway Capacity: Factors affecting capacity, level of service, Capacity of different highway facilities including unsignalized and signalised intersections. Problems in Mixed Traffic flow; Case studies

Accident Analysis: **5(L)+3(T)**

Analysis of individual accidents and statistical data; Methods of representing accident rate; Factors in traffic accidents; influence of roadway and traffic conditions on traffic safety; accident coefficients; Driver strains due to roadway and traffic conditions

Part-B

Traffic Flow Theory: **8(L)+3(T)**

Fundamental flow relationship and their applications, Traffic flow theories and applications; Shock waves; Queuing theory and applications; Probabilistic Aspects of Traffic Flow: Vehicle arrivals, distribution models, gaps and headway distribution models; gap acceptance merging parameters.

Simulation: **5(L)+2(T)**

Fundamental principle, application of simulation techniques in traffic engineering formulation of simulation models, Case studies.

Traffic Management: **6(L)+2(T)**

Area Traffic Management System – Traffic System Management (TSM) with IRC standards - Traffic Regulatory Measures-Travel Demand Management (TDM) – Direct and indirect methods

-Congestion and parking pricing – All segregation methods- Coordination among different agencies – Intelligent Transport System for traffic management, enforcement, and education.

Text Books:

1. Kadiyali. L.R. “Traffic Engineering and Transport Planning”, Khanna Publishers, Delhi, 2013
2. Indian Roads Congress (IRC) Specifications: Guidelines and Special Publications on Traffic Planning and Management.
3. Salter. R.I and Hounsell N.B, “Highway Traffic Analysis and design”, Macmillan Press Ltd. 1996.

Reference Books/Codes:

1. Fred L. Mannering, Scott S. Washburn and Walter P. Kilareski, Principles of Highway Engineering and Traffic Analysis, Wiley India Pvt. Ltd., New Delhi, 2011
2. Garber and Hoel, “Principles of Traffic and Highway Engineering”, CENGAGE Learning, New Delhi, 2010
3. SP:43-1994, IRC Specification, “Guidelines on Low-cost Traffic Management Techniques” for Urban Areas, 1994
4. John E Tyworth, “Traffic Management Planning, Operations and control”, Addison Wesly Publishing Company, 1996
5. Hobbs. F.D. “Traffic Planning and Engineering”, University of Brimingham, Peragamon Press Ltd, 2005
6. Taylor MAP and Young W, “Traffic Analysis – New Technology and New Solutions”, Hargreen Publishing Company, 1998.

Subject Code: LPECE-101
Subject Name: Problem Analysis Laboratory

Programme: B.Tech. (Civil Engineering)	**L:** 0 **T:** 0 **P:**2
Semester: 7/8	**Teaching Hours:** 24 (P)
Theory/Practical: Theory	**Credits:** 1
Internal Marks: 30	**Percentage of Numerical/Design Problems:** -
External Marks: 20	**Duration of End Semester Exam (ESE):** -
Total Marks: 50	**Course Category:** Compulsory Track Specific

Additional Material Allowed in ESE: NIL

On Completion of the course, the student will have the ability to:

CO#	Course Outcomes
1.	Determine the various factors effecting slope stability as size and placement of reinforcement.
2.	Find out bearing capacity of spread footing on virgin and reinforced soil.
3.	Find out bearing capacity of pile in various kind of homogenous and layered soil.
4.	Design the sheet pile under various conditions of soil.
5.	Interpret the settlement expected to occur along time due to consolidation.
6.	Find the strength of soil using field test.

Course Content:

1. To find out slope stability of an earthen reinforced slope by Conventional and FEM methods through available software
2. To find out bearing capacity of a spread footing under centric and eccentric loading using available software and validation the result using analytical approach.
3. To find out pile bearing capacity under vertical and lateral load using software and validation the result using analytical approach.
4. To analyse the earth pressure on a sheet pile using software.
5. To develop and analyse a model of Geotechnical problem related with Consolidation through a FEM based Software.
6. To determine the In-situ CBR using small size dynamic Penetrometer.
7. To determine the bearing capacity of soil by Standard Penetration Test.

Subject Code: PECE-135
Subject Name: Prestressed Concrete

Programme: B.Tech.	**L:** 3 **T:** 1 **P:** 0
Semester:	**Teaching Hours:** 48 Hours
Theory/Practical: Theory	**Credits:** 4
Internal Marks: 40	**Percentage of Numerical/Design Problems:** 80%
External Marks: 60	**Duration of End Semester Exam (ESE):** 3 Hours
Total Marks: 100	**Course Category:** Elective

Additional Material Allowed in ESE: IS 1343

On Completion of the course, the student will have the ability to:

CO#	Course Outcomes
1.	Apply concepts & methods for pre-stressing systems for different sections.
2.	Compute stresses in beams due to transverse loads and prestressing.
3.	Determine the prestress losses in beams.
4.	Design the pre-tensioned and post-tensioned concrete beams & slabs.
5.	Evaluate the effect of different cable profiles on load carrying capacity of beams.
6.	Apply various provisions prescribed by IS 1343 to the design of prestressed concrete members.

Detailed Contents:

Part-A

Introduction, Basic Concepts, History of development of materials and prestressing, different methods of prestressing, Advantages and Limitations, IS provisions related to materials properties & prestressing. **6L+2T= 8 hours**

Analysis of member for prestress and bending stresses at various stages; Pressure Line; Stress, strength and Load Balancing concepts; Losses in pre-stress; short term and long-term deflections

11L+3T= 14hours

Part-B

Limit state design criteria, Types of flexural failure – strain compatibility method – IS: 1343 code procedure – design for Limit state of shear and torsion design of pre and post tensioned flexural members; design of post tensioned one way and two-way slabs. **12L+3T= 15 hours**

Cable profile, selection and proportioning; Transfer of prestress in pretensioned and posttensioned members, stress distribution at end anchorages, anchorages and end block design.

8L+3T= 11 hours

Text/Reference Books:

1. N. Krishna Raju, Prestressed concrete, Tata McGraw Hill
2. T.Y. Lin, Ned H. Burns, Design of Prestressed Concrete Structures, John Wiley & Sons.
3. P. Dayaratnam, Prestressed Concrete, Oxford & IBH
4. R. Rajagopalan, Prestressed Concrete.
5. IS 1343 2012 Code of Practice for Prestressed Concrete

Subject Code: PECE-136
Subject Name: Design of Steel Structures

Programme: B.Tech.	**L:** 3 **T:** 1 **P:** 0
Semester: 7/8	**Teaching Hours:** 36 + 12 (T)= 48 Hours
Theory/Practical: Theory	**Credits:** 4
Internal Marks: 40	**Percentage of Numerical/Design Problems:** 80%
External Marks: 60	**Duration of End Semester Exam (ESE):** 3hours
Total Marks: 100	**Elective Status:** Compulsory

Additional Material Allowed in ESE: IS 800: 2007, Steel Table/SP: 6 (1), Scientific Calculator (Non-programmable)

On Completion of the course, the student will have the ability to:

CO#	Course Outcomes
1.	Apply knowledge about various properties of steel sections to decide their appropriate use for a given design problem
2.	Design bolted and welded connections for different type of given loads
3.	Design tension and compression members including column bases for given loading
4.	Design flexural members including build up sections for given loading
5.	Assess design loads for a given roof truss and design its various components viz. rafter, web members, purlins etc.
6.	Interpret steel structural drawings

Detailed Contents:

Part-A

Introduction to structural steel: **2L+0T = 2 hours**

Structural steel and specifications, steel sections and properties, efficiency of cross-section, advantages of steel construction, design specifications as per IS 800, strength and stiffness considerations.

Steel Connections: **9L+3T = 12 hours**

Riveted & bolted connections – comparison between the two, type of failures, efficiency of a joint, design of bolted connection for axial and eccentric loading, stresses in bolts. Welded connections – types of welded joints, design of welded connection for axial and eccentric loading. Simple, semi-rigid and rigid connections.

Tension Members: **3L+1T = 4 hours**

Types of tension members, design strength, net area for different sections, design of tension members, lug angles.

Part-B

Compression Members: **8L+3T = 11 hours**

Effective length, slenderness ratio, allowable stresses, design of axially loaded members, built up columns, laced and battened columns.

Column Bases: **4L+1T= 5 hours**

Introduction, design of slab base, gusseted base, grillage foundation.

Flexural Members: **5L+2T = 7 hours**

Design criteria, permissible stresses, design of laterally supported and unsupported beams, web buckling, web crippling, encased beams.

Roof truss: **5L+2T =7 hours**

Design loads, combination of loads, design of members (including purlins) and joints.

Text/Reference Books:

1. N. Subramanian, Design of Steel Structures, Oxford University Press (2008)
2. S. K. Duggal, Limit State Design of Steel structures, McGraw Hill (2009)
3. Ram Chandra, Design of Steel Structures Vol I, Standard Book House (2016)
4. DunhamC.W., Planning of Industrial Structures, John Wiley and Sons (2001)
5. GaryW., Steel Designer's Manual, Prentice Hall (2008)
6. Salmon C. G., Johnson J. E. and Malhas F. A.,Steel Structures: Design and Behavior, Pearson (2009)

Subject Code: PECE-137
Subject Name: Bridge Engineering

Programme: B.Tech.	**L:** 3 **T:** 1 **P:** 0
Semester: 6/7/8	**Teaching Hours:** 40 + 14 (T)= 54 Hours
Theory/Practical: Theory	**Credits:** 3
Internal Marks: 40	**Percentage of Numerical/Design Problems:** 30%
External Marks: 60	**Duration of End Semester Exam (ESE):** 3hours
Total Marks: 100	**Elective Status:** Elective

Prerequisites: PCCE-113 Structural Engineering
Additional Material Allowed in ESE: Non-programmable Scientific calculator, IRC: 6-2017
On Completion of the course, the student will have the ability to:

CO#	Course Outcomes
1.	Apply knowledge of the basics of bridge classification, choice of bridge type, investigations for the bridges.
2.	Identify, loadings on the bridge, IRC loadings, and load combinations.
3.	Use the techniques of the load distribution on a specific bridge system.
4.	Analyze Steel and RCC bridge deck system
5.	Design Steel and RCC bridge deck system
6.	Conceptualize the design of bridge substructures and foundations

Detailed Contents:

Part-A

Introduction: **4+1T = 5hours**
Definition and components of a bridge, Classification of bridges, Choice of abridge type. Need for investigation, Selection of bridge site, Determination of design discharge for River Bridge, Linear waterway, Economical span, Vertical clearance, scour depth, Afflux, Traffic projection.

Standard Specifications for Road Bridges: **8+4T = 14hours**
IRC Bridge Codes, Width of carriageway, Clearances, Dead load, I.R.C. standard live loads, Impact effect, Wind load, Longitudinal forces, Centrifugal forces, Horizontal forces due to water current, Buoyancy effect, Earth pressure, Deformation stresses, Erection stresses, Temperature effects, and Seismic force

Reinforced Concrete Bridges: **10+3T = 13hours**
Types of RCC bridges; Design of Culverts, T-beam girder bridges, pre-stressed concrete bridges.

Part-B

Steel Bridges: **5+1T = 6hours**
Types of Steel bridges; Design of Plate girder bridges, Truss bridges

Sub-structure and Foundation: **9+2T = 10hours**
Piers and abutments, materials for piers and abutments, Types of foundations; Shallow, Pile, and Well foundations

Bearings, Joints & Appurtenances: **3+1T = 6hours**
Importance of Bearings, Different types of bearings- Expansion Bearings, Fixed Bearings, Elastomeric Bearings, Expansion joints, Wearing Course, Approach Slab, Footpath, Handrails.

Construction and Maintenance of Bridges **3+1T =4hours**
Methods of construction of concrete and steel bridges. Formwork and false work for concrete bridges, Causes of Bridge failures, Inspection, and maintenance

Text/Reference Books:

1. Johnson, Victor, "Essentials of Bridge Engineering", Oxford University Press, 1980.
2. Khadilkar, C. H., "A Text book of Bridge Construction", Allied Publishers, 1980.
3. Rangwala, S. C., "Bridge Engineering", Charotar Publishing House Pvt. Ltd., 2008.
4. Raina, V. K., "Concrete Bridges Handbook", Shroff Publishers and Distributors, 2007.
5. Ponnuswamy, S. "Bridge Engineering", McGraw Hill Education, 2008.
6. IRC: 6-2017, Standard Specifications and Code of Practice for Road Bridges, IRC, N. Delhi.

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Subject Code: PECE-138
Subject Name: Industrial Structures

Programme: B.Tech.	**L:** 3 **T:** 1 **P:** 0
Semester: 6/7/8	**Teaching Hours:** 36 + 12 (T)= 48 Hours
Theory/Practical: Theory	**Credits:** 3
Internal Marks: 40	**Percentage of Numerical/Design Problems:** 70%
External Marks: 60	**Duration of End Semester Exam (ESE):** 3hours
Total Marks: 100	**Elective Status:** Elective

Prerequisites: Math-1 and Structural Engineering
Additional Material Allowed in ESE: Non-programmable calculator
On Completion of the course, the student will have the ability to:

CO#	Course Outcomes
1.	Explain the concept of structural systems, loads, supports and displacements of building frames.
2.	Solve plastic design of structural elements.
3.	Analyze the loads & stresses of gantry girder.
4.	Design structures using light gauge material.
5.	Design steel chimneys, storage structures and industrial building.
6.	Design of pressed steel water tank.

Detailed Syllabus

Part-A

Industrial steel building frames: Types of frames, bracing, crane girders and columns, workshop sheds, trussed bents [L: 11 hours & T: 3 hours]

Chimneys; Loads and stresses in chimney shaft, Earthquake and wind effect, Stresses due to temperature difference, combined effect of loads and temperature, temperature, design of base plate, design of foundation bolts, design of foundation.

Rectangular bunkers with slopping bottom, rectangular bunkers with high side walls; Steel stacks; introduction, force acting on a steel stack, design consideration, design example of stacks [L:15 hours & T: 5 hours]

Part-B

Water Tanks: Design of rectangular riveted steel water tank – Tee covers – Plates – Stays – Longitudinal and transverse beams –Design of staging – Base plates – Foundation and anchor bolts [L: 5 hours& T: 2 hours]

Design of pressed steel water tank: Design of stays – Joints – Design of hemispherical bottom water tank – side plates – Bottom plates – joints – Ring girder –Design of staging and foundation. [L: 5 hours& T: 2 hours]

Text/Reference Books

1. Industrial Buildings: A Design Manual (Design Manuals), Jürgen Adam , Katharina Hausmann, Frank Jüttner, Birkhauser; Illustrated edition (1 October 2004).
2. Limit State Design of Steel Structures, Duggal S K, Tata McGraw-Hill Education, 2019.
3. Design of Steel Structures: Limit State, Subramanian N, Oxford University Press, 2018.
4. Steel Structures: Design and Practice: Theory and Practice, Punmia B. C., Jain Ashok Kr., Jain Arun Kr., 2nd Ed., Lakshmi Publishers, 2010.
5. Design of Steel Structures, L S. Negi, February 16, 1997.
6. Design of Steel Structures, Ram Chandra, 12th Ed., Standard Publishers

Links:
1. https://nptel.ac.in/courses/105/105/105105162/
2. https://nptel.ac.in/courses/105/106/105106112/
3. https://nptel.ac.in/courses/105/106/105106113/
4. https://onlinecourses.nptel.ac.in/noc21_ce40/preview
5. https://www.iare.ac.in/sites/default/files/lecture_notes/lec%20notes%20ASD.pdf

Subject Code: PECE-141
Subject Name: Repair and Rehabilitation of Structures

Programme: B.Tech.	**L:** 3 **T:** 1 **P:** 0
Semester: 7/8	**Teaching Hours:** 36 + 12 (T)= 48 Hours
Theory/Practical: Theory	**Credits:** 4
Internal Marks: 40	**Percentage of Numerical/Design Problems:** 0%
External Marks: 60	**Duration of End Semester Exam (ESE):** 3 hours
Total Marks: 100	**Elective Status:** Compulsory

Prerequisites: Concrete Technology
Additional Material Allowed in ESE: Nil
On Completion of the course, the student will have the ability to:

CO#	Course Outcomes
1.	Explain concrete deterioration types and causes
2.	Estimate investigation methods and tools to evaluate distressed structures
3.	Assess the requirement of repair and retrofitting in structures
4.	Compare and identify appropriate material and technique for repair work
5.	Decide retrofitting technique corresponding to the given need
6.	Make inference from design codes with respect to repair and strengthening of structures

Detailed Contents:

Part-A

Concrete deterioration: 10+3T = 13 hours
Strength, permeability and cracking; Types and causes of distress in concrete structures; Effects due to climate, temperature, chemicals and corrosion; Embedded metal corrosion, corrosion mechanisms, stages of corrosion damage; Deterioration of cementitious systems – carbonation, chloride attack, alkali-silica reaction, freeze thaw attack, sulphate attack, acid attack, effect of fire and high temperatures and seawater attack, cracking, weathering, biological processes.
Investigation and Evaluation of Distressed Structures: 8+3T = 11 hours
Need and importance of repair, rehabilitation and retrofitting; Evaluation methods for condition assessment; Procedure for inspection and evaluating a damaged structure; Preliminary investigation, detailed investigation – sampling and material testing, concrete assessment using non-destructive tests and other methods

Part-B

Materials & Technologies for repair: 9+3T = 12 hours
Special concretes and mortar, concrete chemicals, special elements for bonding of old and new concrete, accelerated strength gain, expansive cement, polymer concrete, sulphur infiltrated concrete, ferro cement, fibre reinforced concrete, bacterial concrete, rust eliminators and polymers coating for rebars during repair, gunite and shotcrete, epoxy injection, crack stabilization, shoring and underpinning;
Strengthening of Structures: 9+3T = 12 hours
Flexural and shear strengthening; strengthening using laminates, prestressing, bracing, jacketing and stiffening of structures; maintenance of retrofitting; Design codes for retrofitting of structures;
Text Books:

1. Varghese. P.C, Maintenance Repair and Rehabilitation & Minor works of building, Prentice Hall India Pvt Ltd (2014)
2. Dodge Woodson. R, Concrete Structures: Protection, Repair and Rehabilitation, Butterworth-Heinemann (2009)

Reference Books:

1. Denison Campbell-Allen & Harold Roper, Concrete Structures: Materials, Maintenance and Repair, Longman UK (1991)

2. Gahlot S & Sharma P S, Building Repair and Maintenance Management, CBS Publishers & Distributors Pvt. Ltd., New Delhi (2006)
3. Handbook on repair and rehabilitation of RCC buildings, CPWD (2002)
4. IS 13935 - 2009, Seismic evaluation, repair and strengthening of masonry buildings - Guidelines
5. IS 15988: 2013, Seismic evaluation and strengthening of existing reinforced concrete buildings – Guidelines
6. ACI 562-16, Code Requirements for Assessment, Repair and Rehabilitation of Existing Concrete Structures (2016)

Online Courses and Video Lectures:
https://nptel.ac.in/courses/105/106/105106202/#

Subject Code: PECE-142
Subject Name: Sustainable Construction Methods

Programme: B.Tech.	**L:** 3 **T:** 1 **P**: 0
Semester: 7th / 8th	**Teaching Hours:** (36 Hours and T: 12 Hours)
Theory/Practical: Theory	**Credits:** 04
Internal Marks: 40	**Percentage of Numerical/Design Problems:** Nil
External Marks: 60	**Duration of End Semester Exam (ESE)**: 3 Hours
Total Marks: 100	**Elective Status**: Elective

Prerequisites: Building Construction Practice
Additional Material Allowed in ESE: Non-programmable Scientific calculator
On Completion of the course, the student will have the ability to:

CO#	Course Outcomes
1.	Identify various sustainable construction methods with their respective features.
2.	Develop a framework for analyzing sustainable construction technologies and economic viability.
3.	Explain the modular construction methods.
4.	Utilize various tools and techniques of project management to reduce the negative environmental impacts of construction activity.
5.	Examine the current LEED for New Construction rating system.
6.	Analyze the case study of highly successful recent green construction projects

Detailed Syllabus

Part-A

Sustainable Construction Methods. Types of foundations and construction methods; Basics of Formwork and Staging; Common building construction methods (conventional walls and slabs; conventional framed structure with blockwork walls). [L:9 hours & T: 3 hours]
Modular construction methods for repetitive works; Precast concrete construction methods; Basics of Slip forming for tall structures; Basic construction methods for steel structures; Basics of construction methods for Bridges. [L: 13 hours & T:5 hours]

Part-B

Identification of cutting-edge sustainable construction materials, technologies, and project management strategies for use in the construction industry and evaluation of their potential to reduce the negative environmental impacts of construction activity. [L: 7 hours & T:2 hours]

Examination of the current LEED for New Construction rating system, and case study analysis of highly successful recent "green construction projects" through student team assignments and presentations. Preparation for the LEED Green Associate professional licensing exam.
[L: 7 hours & T:2 hours]

Text/Reference Books

1. Sandy Halliday. Sustainable Construction. 2nd edition, Routledge, 2019.
2. Vivian Tam, Khoa Le. Sustainable Construction Technologies. 1st Edition, Butterworth-Heinemann, 2019.
3. Jha K.N. Construction Project Management: Theory and Practices. 2nd edition, Pearson Education India, 2015.
4. Verma M. Construction Equipment & Planning and Application. Metropolitan Book Co, 1975.
5. Nunnally, S.W. Construction Methods and Management, Prentice Hall, 2006.
6. Chudley, R., Greeno , 'Building Construction Handbook' (6th ed.),R. Butterworth-Heinemann, 2006.

Links:
1. https://nptel.ac.in/courses/105/102/105102195/
2. https://nptel.ac.in/courses/124/106/124106157/
3. https://www.udemy.com/course/intro-green-buildings/
4. https://www.classcentral.com/course/renewable-energy-entrepreneurship-8744

Subject Code: LPECE-102
Subject Name: Problem Analysis Laboratory

Programme: B.Tech.	**L:** 0 **T:** 0 **P**: 2
Semester: 7^{th} / 8^{th}	**Teaching Hours:** 24
Theory/Practical: Theory	**Credits:** 01
Internal Marks: 30	**Percentage of Numerical/Design Problems:** Nil
External Marks: 20	**Duration of End Semester Exam (ESE)**:
Total Marks: 50	**Elective Status**: Compulsory Track Specific

Prerequisites:
Additional Material Allowed in ESE:
On Completion of the course, the student will have the ability to:

CO#	Course Outcomes
1.	Analyse various causes of defects (cracks and deflection) in structural members.
2.	Explain the mechanism of corrosion of RC components.
3.	Identify the role of structural health monitoring and carry out NDT.
4.	Identify the types and causes of settlement of structures.
5.	Select a suitable type of remedial measure / treatment strategy after careful analysis of the problem.
6.	Perform the non-linear analysis of RC structural components using software.

Course Content:

1. To identify cracks in different buildings, followed by analysis to identify their possible reasons and to find appropriate treatment strategies.
2. Corrosion of RC components, its identification, background causes and remedial measures based on analysis.
3. Deflection of structural members, problem identification and treatment strategies.
4. Settlement of a structure, its causes, and measures to control it.
5. Structural Health monitoring, problem identification and NDT to quantify the problem.
6. Analysis of RC structural components using non-linear analysis software.

Subject Code: PECE-162
Subject Name: Environmental Change and Sustainable Development

Programme: B.Tech.	**L:** 3 **T:** 1 **P:** 0
Semester: 6 & 7/8	**Teaching Hours:** 36 + 12 (T)= 48 Hours
Theory/Practical: Theory	**Credits:** 3
Internal Marks: 40	**Percentage of Numerical/Design Problems:** 0%
External Marks: 60	**Duration of End Semester Exam(ESE):** 3 hours
Total Marks: 100	**Elective Status:** Professional Elective Course

Prerequisites: Environmental Science.
Additional Material Allowed in ESE: NIL
On Completion of the course, the student will have the ability to:

CO#	Course Outcomes
1.	Find clean technologies for sustainable development.
2.	Classify factors influencing the global climate systems.
3.	Develop strategies for climate change adaptation and mitigation measures.
4.	Evaluate and model the predicted climate change.
5.	Outline the impacts of climate change on global, regional and local scales.
6.	Discuss the climate system and anthropogenic effects.

Detailed Contents:

Part-A

Earth's Climate System: **6+2 = 8 hours**
Introduction-Climate in the spotlight - The Earth's Climate Machine – Climate Classification - Global Wind Systems - Green House Gases and Global Warming – Carbon Cycle.

Observed Changes and Its Causes: **6+2 = 8 hours**
Observation of Climate Change – Changes in patterns of temperature, precipitation and sea level rise – Observed effects of Climate Changes –Drivers of Climate Change – Evidences of Changes in Climate and Environment – on a Global Scale and in India – climate change modeling.

Impacts of Climate Change: **7+2 = 9 hours**
Impacts of climate change on various sectors – Agriculture, Forestry and Ecosystem – Water Resources – Human Health – Industry, Settlement and Society – Methods and Scenarios – Projected Impacts for Different Regions– Uncertainties in the Projected Impacts of Climate Change – Risk of Irreversible Changes.

PART-B

Climate Change Adaptation and Mitigation Measures: **7+3 = 10 hours**
Adaptation Strategies in various sectors – Water –Agriculture – Human Health – Tourism – Transport – Energy.

Sustainable Development and Environmental Movements: **10+3 = 13 hours**
Sustainable Development Principles -Indicators of Sustainability, Sustainable Development Goals (SDGs)- Implementation and monitoring- 2030 agenda for Sustainable Development.

Text Books / Reference Books:

1. **Naomi Klein, "**This Changes Everything: Capitalism Vs The Climate", Simon & Schuster 2014
2. Anil Markandya , Climate Change and Sustainable Development: Prospects for Developing Countries, Routledge, 2002
3. Heal, G. M., Interpreting Sustainability, in Sustainability: Dynamics and Uncertainty, Kluwer Academic Publication, 2012
4. Jepma, C.J., and Munasinghe, M., Climate Change Policy – Facts, Issues and Analysis, Cambridge University Press, 1998
5. Munasinghe, M., Sustainable Energy Development: Issues and Policy in Energy, Environment and Economy: Asian Perspective, Kleindorfor P. R. et. al (ed.), Edward Elgar, 2016

6. Dash Sushil Kumar, "Climate Change – An Indian Perspective", Cambridge University Press India Pvt. Ltd., 2007.
7. Bill Gates, "How to Avoid a Climate Disaster: The Solutions We Have and the Breakthroughs We Need ", Alfred A. Knopf, 2021.
8. Nathaniel Rich, "Losing Earth: A Recent History", The New York Times Magazine, 2019.
9. Michael E. Mann, "The New Climate War: The Fight to Take Back Our Planet", Public Affairs, 2021.

E-Books and online learning material:

1. www.un.org/sustainabledevelopment
2. **The Science and Politics of Global Climate Change** by Andrew E. Dessler, Edward A. Parson, Cambridge University Press (2006)
   https://www.ebooks.com/en-us/book/243908/the-science-and-politics-of-global-climate-change/andrew-e-dessler/
3. Climate Change in Prehistory: The End of the Reign of Chaos by William James Burroughs, Cambridge University Press (2005)
   https://www.ebooks.com/en-us/book/228764/climate-change-in-prehistory/william-james-burroughs/

Online Courses and Video Lectures:

1. https://www.coursera.org/learn/global-sustainable-development
2. https://www.coursera.org/learn/climate-change-mitigation
3. https://www.coursera.org/learn/act-on-climate
4. https://www.coursera.org/specializations/our-responses-climate-change
5. https://www.coursera.org/learn/what-is-climate-change
6. https://www.coursera.org/learn/globalenergyandclimatepolicy
7. https://www.coursera.org/learn/how-do-we-manage-climate-change

Subject Code: PECE-165
Subject Name: Rural Water Supply and Onsite Sanitation Systems

Programme: B.Tech.	**L:** 3 **T:** 1 **P:** 0
Semester: 6 & 7/8	**Teaching Hours:** 36 + 12 (T)= 48 Hours
Theory/Practical: Theory	**Credits:** 3
Internal Marks: 40	**Percentage of Numerical/Design Problems:** 20%
External Marks: 60	**Duration of End Semester Exam(ESE):** 3hours
Total Marks: 100	**Elective Status:** Professional Elective Course

Prerequisites: Fluid Mechanics & Environmental Engineering.
Additional Material Allowed in ESE: Calculator
On Completion of the course, the student will have the ability to:

CO#	Course Outcomes
1.	Outline the rural sanitation and the management of grey and storm water.
2.	Assess different types of waste water treatment systems.
3.	Identify various techniques and problems in rural water supply.
4.	Examine the quality and maintenance of rural water supply.
5.	Design low cost water treatment system for rural areas.
6.	Illustrate safe disposal of solid waste and different methods of solid waste management.

Detailed Contents:

Part-A

Rural Water Supply: **10+3 = 13 hours**

Issues of rural water supply –Various techniques for rural water supply- merits National rural drinking water program- rural water quality monitoring and surveillance- operation and maintenance of rural water supplies.

Low Cost Water Treatment: **6+3 = 09 hours**

Introduction – Epidemiological aspects of water quality- methods for low-cost water treatment - Specific contaminant removal systems.

PART-B

Rural Sanitation: **12+4 = 16 hours**

Introduction to rural sanitation- Community and sanitary latrines - Planning of wastewater collection system in rural areas- Ecological sanitation approach – Greywater and stormwater management- Compact and simple wastewater treatment systems in rural areas- catch basins constructed wetlands- roughing filters- stabilization ponds - septic tanks – anaerobic baffled reactors soak pits- low cost excreta disposal systems- Village ponds as sustainable wastewater treatment system Wastewater disposal.

Solid Waste Management: **8+2 = 10 hours**

Disposal of Solid Wastes- Composting- land filling- incineration- Biogas plants - Other specific issues and problems encountered in rural sanitation.

Text Books / Reference Books:

1. Eulers, V.M., and Steel, E.W., Municipal and Rural Sanitation, 6th Ed., McGraw Hill Book Company, 1965.
2. Wright, F.B., Rural Water Supply and Sanitation, E. Robert Krieger Publishing Company, Huntington, New York, 1977.
3. Juuti, P., Tapio S. K., and Vuorinen H., Environmental History of Water: Global Views on Community Water Supply and Sanitation, IWA Publishing (Intl Water Assoc), 2007.
4. Winbald, U., and Simpson-Hebert, M., Ecological Sanitation, SEI, Stockholm, Sweden, 2004.
5. Kadlec R.H. and Wallace S.D., Treatment Wetlands, CRC Press, Boca Raton, 2009.
6. Wastewater Engineering – Treatment and Reuse, Metcalf and Eddy, Tata McGraw Hill, 2020.
7. Singh, K., Rural development: principles, policies and management. SAGE Publications India, 2009.
8. Shukla, J. P. (Ed.), Technologies for sustainable rural development: having potential of socio-economic upliftment (TSRD–2014) (Vol. 1), 2014.

9. R. Chambers, Rural Development: Putting the last first, Routlege-Taylor and Francis group, 1983.
10. McCalla, A. F., & Ayres, W. S. (1997). Rural development: From vision to action. The World Bank.
11. Allied Publishers.Campbell, M. J., & Campbell, M. J. (Eds.). (1990). New technology and rural development: the social impact. Psychology Press.

E-Books and online learning material:

1. Wastewater Recycle, Reuse, and Reclamation by Saravanamuthu (Vigi) Vigneswaran, EOLSS publications catalogue, (2009) https://www.eolss.net/ebooklib/water-sciences-engineering-technology-resources.aspx
2. Water Storage, Transportation and Distribution by Yutaka Takahasi, EOLSS publications catalogue, (2009) https://www.eolss.net/ebooklib/water-sciences-engineering-technology-resources.aspx
3. Water-Related Education, Training and Technology Transfer by Andre van der Beken, EOLSS publications catalogue, (2009) https://www.eolss.net/ebooklib/water-sciences-engineering-technology-resources.aspx

Online Courses and Video Lectures:

1. https://www.cseindia.org/toilet-technoogies-and-faecal-sludge-and-water-management-in-rural-areas-10615#:~:text=Global%20Online%20Training%20Course%20Toilet%20Technoogies%20and%20Faecal%20Sludge%20and%20Water%20Management%20in%20Rural%20Areas
2. https://nptel.ac.in/courses/105/105/105105201/#
3. https://www.classcentral.com/course/water-1364#:~:text=Science%20%20Environmental%20Science-,Water%20Supply%20and%20Sanitation%20Policy%20in%20Developing%20Countries%20Part%201,Help,-8%20reviews
4. https://www.rural-water-supply.net/
5. https://www.mcgill.ca/osas

Subject Code: PECE-164
Subject Name: Biological Treatment Processes

Programme: B.Tech.	**L:** 3 **T:** 1 **P:** 0
Semester: 6 & 7/8	**Teaching Hours:** 36 + 12 (T)= 48 Hours
Theory/Practical: Theory	**Credits:** 3
Internal Marks: 40	**Percentage of Numerical/Design Problems:** 30%
External Marks: 60	**Duration of End Semester Exam(ESE):** 3hours
Total Marks: 100	**Elective Status:** Professional Elective Course

Prerequisites: Environmental Engineering.
Additional Material Allowed in ESE: Calculator
On Completion of the course, the student will have the ability to:

CO#	Course Outcomes
1.	Identify the complex issues in biological wastewater treatment systems.
2.	Analyze process kinetics for wastewater treatment.
3.	Illustrate the efficient disposal methods of treated wastewater.
4.	Analyze and design the biological processes in wastewater treatment.
5.	Explain the need of safe disposal of sludge wasted.
6.	Develop low cost biological treatment methods for rural areas.

Detailed Contents:

Part-A

Unit I: **11+4 = 15 hours**

Wastewater Characteristics and Effluent Standards: Physical, Chemical and Biological Parameters of Water Pollution, Solids (volatile and non-volatile solids, suspended, dissolved and colloidal solids), Biodegradable and Non-Biodegradable organic matter (DO, COD, BOD and BOD kinetics), Nutrients (TKN, total nitrogen, and total and ortho-phosphorus), Sulfides, Phenols, Cyanides, Heavy Metals, Effluent Standards.

Process Kinetics: Fundamentals of Process Kinetics, Zero order, First order, Second order Reactions, Enzyme reactions – Bio reactors- Types-Classification – Design principles.

Unit II: **7+2 = 09 hours**

Attached Growth Processes: Trickling Filters (Standard Rate, High Rate), Practices, Features and Design, Operational Difficulties and Remedial Measures, Rotating Biological Contactors. SAF, FAB and MBBR Technologies.

PART-B

Unit III: **10+3 = 13 hours**

Suspended Growth Processes: Activated Sludge Process, Modifications including SBR and Design Equations, Process Design Criteria, Oxygen and Nutrient Requirements. Waste stabilization Ponds and Lagoons: Aerobic Pond, Facultative Pond, Anaerobic Ponds, Polishing Ponds, Aerated Lagoons. Constructed Wetlands and Duckweed Ponds.

Unit IV: **8+3 = 11 hours**

Anaerobic Processes: Process Fundamentals, Standard, High Rate and Hybrid Reactors, Upflow Anaerobic Sludge Blanket Reactors, Design and Operation. Sludge Treatment and Disposal, Sludge Thickening, Sludge Digestion & disposal.

Text Books / Reference Books:

1. Metcalf, Eddy, Tchobanoglous, G., Burton, F.L., Stensel, H.D., "Wastewater Engineering – Treatment, Disposal and Reuse", 4th ed., Tata McGraw Hill (2002).
2. Howard S. Peavy, Donald R. Rowe & George Tchobanoglous, "Environmental Engg." International Edition, McGraw Hill (2013).
3. Eckenfelder W.W. Jr., "Industrial Water Pollution Control", 3rd ed., McGraw Hill (2003).
4. Arceivala, S. J. and Asolekar, S. R., "Wastewater Treatment for Pollution Control", 3rd ed., McGraw-Hill Education (India) Pvt. Ltd., New Delhi (2006).
5. Karia G. L. and Christian R. A., "Wastewater Treatment: Concepts and Design Approach", 2nd ed. PHI (2013).

6. Manual on Sewerage and Sewage Treatment- Central Public Health and Environmental Engg. Organisation, Ministry of Urban Development, Govt. of India (2013).
7. Davide Dionisi, "Biological Wastewater Treatment Processes: Mass and Heat Balances", CRC press, 2017
8. R. Ramalho , "Introduction to Wastewater Treatment Processes: 2nd Edition" Elsevier,1983
9. Udo Wiesmann, In Su Choi, Eva-Maria Dombrowski "Fundamentals of Biological Wastewater Treatment", Wiley-VCH Verlag GmbH & Co. KGaA, 2006

E-Books and online learning material:

1. Biological Wastewater Treatment Processes: Mass and Heat Balances by Davide Dionisi, CRC press, 2017
   https://www.routledgehandbooks.com/doi/10.1201/9781315163345#:~:text=Publication%20dates-,Biological%20Wastewater%20Treatment%20Processes,-Mass%20and%20Heat
2. Fundamentals of Biological Wastewater Treatment by Udo Wiesmann, In Su Choi, Eva-Maria Dombrowski, Wiley-VCH Verlag GmbH & Co. KGaA, 2006
   https://onlinelibrary.wiley.com/doi/book/10.1002/9783527609604#:~:text=Fundamentals%20of%20Biological%20Wastewater%20Treatment
3. Biological Treatment Processes by Lawrence K. Wang, Norman C. Pereira, Yung-Tse Hung, Humana Press, 2009
   https://link.springer.com/book/10.1007/978-1-60327-156-1#:~:text=Biological%20Treatment%20Processes

Online Courses and Video Lectures:

1. https://iwa-network.org/learn/online-course-on-biological-wastewater-treatment-principles-modelling-and-design-2-2/#:~:text=Online%20Course%20on,IHE%20Delft
2. https://nptel.ac.in/courses/105/105/105105178/#
3. https://www.un-ihe.org/online-course-biological-wastewater-treatment-principles-modelling-and-design#:~:text=Online%20Course%20on%20Biological%20Wastewater%20Treatment%3A%20Principles%2C%20Modelling%20and%20Design
4. https://www.iwapublishing.com/books/biological-wastewater-treatment-online-course-principles-modeling-and-design#:~:text=Biological%20Wastewater%20Treatment%20Online%20Course%3A%20Principles%2C%20Modeling%20and%20Design
5. https://ocw.mit.edu/courses/civil-and-environmental-engineering/1-85-water-and-wastewater-treatment-engineering-spring-2006/#:~:text=Wastewater%20Treatment%20Engineering-,Water%20and%20Wastewater%20Treatment%20Engineering,-COURSE%20HOME

Subject Code: PECE-166
Subject Name: Urban Hydrology and Hydraulics

Programme: B.Tech.	**L:** 3 **T:** 1 **P:** 0
Semester: 6 & 7/8	**Teaching Hours:** 36 + 12 (T)= 48 Hours
Theory/Practical: Theory	**Credits:** 3
Internal Marks: 40	**Percentage of Numerical/Design Problems:** 40%
External Marks: 60	**Duration of End Semester Exam(ESE):** 3 hours
Total Marks: 100	**Elective Status:** Professional Elective Course

Prerequisites: Hydrology and Water Resources Engg.
Additional Material Allowed in ESE: Calculator
On Completion of the course, the student will have the ability to:

CO#	Course Outcomes
1.	Build understanding of hydrological aspects of water resources.
2.	Develop competence to propose effective convergence and design features of water supply projects.
3.	Outline the principles of engineered systems for aeration in wastewater treatment.
4.	Recommend principles of need based activities such as pumps, mixers related to water.
5.	Illustrate the application of pipe flow and open channel flow in water distribution networks and sewers.
6.	Formulate the effective use of surface and ground water sources.

Detailed Contents:

Part-A

Introduction: **4+1 = 5 hours**
Hydrological cycle: functions, thermodynamic characteristics, human disturbance; Urban water cycle: Characteristics, Conventional and towards a new paradigm.

Surface water hydrology: **7+3 = 10 hours**
Rainfall: measurement, analysis, IDF curves, Probabilistic methods, Design rainfall, design return period and design storm duration and depth; Runoff volume and peak estimation: Time of concentration, runoff coefficient, soil conservation service method, rational method, time area method, unit hydrograph method; Rainfall-runoff process simulation; Storm water management model (SWMM).

Open-Channel flow in urban watersheds: **6+2 = 8 hours**
Open-Channel Hydraulics: States of Open-Channel flow, open-channel flow equations, steady gradually varied flow, Normal flow; Overland Flow: Kinematic-wave model, overland flow on impervious surfaces and pervious surfaces; Channel Flow: Muskingum method, Muskingum-Cunge method.

PART-B

Stormwater Drainage Structures: **7+3 = 10 hours**
Drainage of street pavements: Design considerations, flow in gutters, pavement drainage inlets; Storm sewer systems: Hydraulics, design discharge, sizing of storm sewers, hydraulic grade line, design considerations for hilly terrain; Culverts: Inlet and outlet control flow, sizing.

Stormwater pumping: **6+2 = 8 hours**
Planning of pump station: Location, pump sump, storage reservoir; Design of pumping station: Type of pump stations, choice of pump type, wet pit, design capacity of storage tank, pump characteristics curve, pump main, net positive suction head; Stormwater storage ponds: Detention ponds, site selection, design, pond routing.

Stormwater Management Practices: **5+2 = 7 hours**
Sand filters, Wetlands, Filter Strips, Water Sensitive Urban Design, Low Impact Development Design, Decentralized systems of urban stormwater drainage.

Text Books / Reference Books:

1. Chow V.T., Maidment D.R. and Mays L.W., Applied Hydrology, Tata McGraw Hill, 2016.

2. Wang X.C. and Fu G., Water-Wise Cities and Sustainable Water Systems: Concepts, Technologies, and Applications, IWA Publishing, 2021.
3. Ojha, Berndtsson, Bhunya, Engineering Hydrology, Oxford, 2018.
4. Chwen J. and Guo Y., "Urban Hydrology and Hydraulic Design", Water Resources Publication, 2006.
5. Akan A. O. and Houghtalen R. J., Urban Hydrology, Hydraulics, and Stormwater Quality: Engineering Applications and Computer Modeling, Wiley India Pvt. Ltd., 2013
6. Gribbin J. E, "Introduction To Hydraulics And Hydrology: With Applications For Stormwater Management", Cengage Learning, 2014.
7. Manual on Stormwater Drainage Systems, Vol.-1, CPHEEO, Ministry of Housing and Urban Affairs, Govt. of India, 2019.

E-Books and online learning material:

1. Hydrology by Mohan Das Madan, PHI, 2009
   https://www.amazon.com/Hydrology-Madan-Mohan-Saikia-Mimi-ebook/dp/B00K7YGHTM?tag=uuid10-20
2. **Hydrology: Principles and Processes**
   By M. Robinson, R. C. Ward, 2017
   https://www.amazon.com/dp/B074L5WDR2?tag=uuid10-20

Online Courses and Video Lectures:

1. https://nptel.ac.in/courses/105/101/105101002/#
2. https://www.coursera.org/lecture/fe-exam/hydrology-97ORE?utm_source=link&utm_medium=page_share&utm_content=vlp&utm_campaign=top_button
3. https://iwa-network.org/learn/online-course-on-urban-drainage-and-sewerage-2/
4. https://iwa-network.org/learn/urban-hydrology-and-hydraulics/
5. https://grainger.illinois.edu/academics/online/demos-cee

Subject Code: PECE-161
Subject Name: Ecological Engineering

Programme: B.Tech.	**L:** 3 **T:** 1 **P:** 0
Semester: 6 & 7/8	**Teaching Hours:** 36 + 12 (T)= 48 Hours
Theory/Practical: Theory	**Credits:** 3
Internal Marks: 40	**Percentage of Numerical/Design Problems:** 0%
External Marks: 60	**Duration of End Semester Exam(ESE):** 3 hours
Total Marks: 100	**Elective Status:** Professional Elective Course

Prerequisites: Environmental Science.
Additional Material Allowed in ESE: Nil
On Completion of the course, the student will have the ability to:

CO#	Course Outcomes
1.	Recall the students with the basics of ecological systems.
2.	Distinguish between the major ecosystems of the world.
3.	Demonstrate the application of ecological modelling for ecosystem development.
4.	Build the ability for applying eco-technology in the ecological models.
5.	Explain the eco-sanitation systems.
6.	Discover the energy in the ecological system.

Detailed Contents:

Part-A

Concept of Ecosystem: **6+2 = 08 hours**
Structure, functions and Nutrient energy flow. Concepts pertaining to energy in ecological system: Food chain, Food web, Detritus food chain Tropical levels, ecological pyramids, Eco-modeling. Landscape Ecology: Definition, Ecological units, and classification. Millennium Ecosystem Assessment and Millennium Developmental goals.

Major Ecosystems of the world: **7+2 = 09 hours**
Terrestrial ecosystem, Northern Coniferous forest, temperate deciduous forest, Grassland, Desert, Tropical Rain forest. Aquatic ecosystem, marine, fresh water & estuarine Biogeochemical Cycles: Sulphur, Carbon & Hydrogen, oxygen, Nitrogen & Hydrological Cycle. Principles pertaining to limiting Factor: Limits to population growth, limiting factor, carrying capacity etc.

Energy policy and environmental issues: **7+2 = 09 hours**
Energy needs, energy Options; Thermal (Coal, lignite, oil &natural gas) Hydro electric, Nuclear, comparative merits. Renewable energy sources-solar, wind, wave, tide, geothermal, OTEC. Siting criteria and problems associated with it. Energy from animal waste, municipal garbage etc.

PART-B

Energy audit: **4+2 = 06 hours**
Energy Conservation. A few case studies- example from TPS (Coal fired, lignite, liquid fuel, gas fired-combined cycle, hydroelectric power plants, nuclear reactor and wind energy). Study of Bio Gas Plant and Solar Collector Units.

Ecosystem Development **7+2 = 09 hours**
Strategy of ecosystem development, concept of the climax, evolution of the biosphere, microevolution compared with macroevolution, artificial selection and genetic engineering, ecosystem development to human ecology.

Low cost ecology based treatment systems **5+2 = 07 hours**
Soil infiltration systems- Wetlands and ponds- Source Separation systems- Aqua cultural systems- Agro ecosystems- Detritus based Treatment for solid wastes – marine systems- Case studies.

Text Books / Reference Books:

1. Ecological Engineering: Principles and Practice, Kangas, P.C and Kangas, P., Lewis Publishers, New York. 2003
2. Ecological Engineering for Wastewater Treatment, Etnier, C. and Guterstam, B., Lewis Publishers, New York. 1996
3. Basic Ecology, E .P. Odum, H.S Publication. 1983

4. Energy and Ecological Modelling, W.J Mitch, R. W. Bosserman and Klopatek JN, Elsevier Publication. 1981
5. Marty D. Matlock and Robert A. Morgan, “Ecological Engineering Design: Restoring and Conserving Ecosystem Services”, Wiley, 2010.
6. M.N.V. Prasad, “Handbook of Ecological and Ecosystem Engineering”, Wiley, 2021.
7. Sven Erik Jørgensen, “Introduction to Systems Ecology”, CRC Press, 2012

E-Books and online learning material:

1. Ecological Engineering for Pest Management: Advances in Habitat Manipulation for Arthropods by Gurr G. M., Wratten S .D. and Altieri M. A.
   https://g.co/kgs/YSbC6j
2. Ecological Engineering by Jeffery Clarke, 2016.
   https://g.co/kgs/KRXcqZ
3. Ecological Modelling and Engineering of Lakes and Wetlands by Jorgensen S. E. https://www.elsevier.com/books/ecological-modelling-and-engineering-of-lakes-and-wetlands/jorgensen/978-0-444-63249-4

Online Courses and Video Lectures:

1. https://onlinecourses.nptel.ac.in/noc21_ge16/preview
2. https://ocw.mit.edu/courses/civil-and-environmental-engineering/
3. https://www.coursera.org/browse/physical-science-and-engineering/environmental-science-and-sustainability
4. https://www.buytestseries.com/OnlineCourses/GATE-CE-Environmental-Engineering-Crash-Course-Online-Video-Lectures
5. https://freevideolectures.com/course/4136/nptel-introduction-environmental-engineering-science-fundamental-sustainability-concepts

Subject Code: PECE-170

Subject Name: Water Distribution and Sewerage Network Design

Programme: B.Tech.	**L:** 3 **T:** 1 **P:** 0
Semester: 6 & 7/8	**Teaching Hours:** 36 + 12 (T)= 48 Hours
Theory/Practical: Theory	**Credits:** 3
Internal Marks: 40	**Percentage of Numerical/Design Problems:** 60 %
External Marks: 60	**Duration of End Semester Exam(ESE):** 3hours
Total Marks: 100	**Elective Status:** Professional Elective Course

Prerequisites: Environmental Engineering (General Course)

Additional Material Allowed in ESE: Graphs.

On Completion of the course, the student will have the ability to:

CO#	Course Outcomes
1.	Illustrate water demand and analyze water quality,
2.	Design conventional water treatment systems
4.	Identify and make appropriate decisions for removal of dissolved solids
3.	Analyze and design water distribution systems
5.	Select appropriate method of wastewater conveyance depending upon type of wastewater
6.	Assess methods employed for water reuse, wastewater reclamation and storm water control

Detailed Contents:

Part-A

General Hydraulics: 8+2 = 10 hours

Fluid properties; fluid flow, continuity principle, energy principle and momentum principle; frictional head loss in free and pressure flow, minor heads losses, Carrying Capacity, Flow measurement.

Water transmission and distribution: 10+4 = 14 hours

Need for transport of water and wastewater, Planning of Water System, Selection of pipe materials, Water transmission main design, gravity and pumping main; Selection of Pumps and its characteristics and economics, Specials, Jointing, laying and maintenance, water hammer analysis; water distribution pipe networks design, analysis and optimization, appurtenances, corrosion prevention, minimization of water losses, leak detection storage reservoirs.

PART-B

Wastewater Collection and Conveyance: 10+4 = 14 hours

Planning factors, Design of sanitary sewer; partial flow in sewers, economics of sewer design, Wastewater pumps and pumping stations- sewer appurtenances, material, construction, inspection and maintenance of sewers, Design of sewer outfalls-mixing conditions, conveyance of corrosive wastewaters.

Stormwater Drainage 8+2 = 10 hours

Necessity, combined and separate system, Estimation of storm water runoff, Formulation of rainfall intensity duration and frequency relationships, Rational methods.

Text Books / Reference Books:

1. Metcalf, Eddy, Tchobanoglous, G., Burton, F.L., Stensel, H.D., "Wastewater Engineering–Treatment, Disposal and Reuse", 4th ed., Tata McGraw Hill (2002).
2. Howard S. Peavy, Donald R. Rowe & George Tchobanoglous, "Environmental Engg." International Edition, McGraw Hill (2013).
3. Eckenfelder W.W. Jr., "Industrial Water Pollution Control", 3rd ed., McGraw Hill (2003).
4. Arceivala, S. J. and Asolekar, S. R., "Wastewater Treatment for Pollution Control", 3rd ed., McGraw-Hill Education (India) Pvt. Ltd., New Delhi (2006).
5. Chanson H., Butterworth-Heinemann, "Environmental Hydraulics of Open Channel Flows", 2nd ed., Oxford, UK: Elsevier (2004).
6. Chow, V.T., Maidment, D.R. and Mays, L.W., "Applied Hydrology", McGraw Hill Inc. (2010).

7. “Manual on Water supply and Treatment”, CPHEEO, Ministry of Urban Development, Government of India, New Delhi (1999).
8. “Manual on Sewerage and Sewage Treatment”, CPHEEO, Ministry of Urban Development, Government of India, New Delhi (1993).
9. Manual on Stormwater Drainage Systems, Vol.-1, CPHEEO, Ministry of Housing and Urban Affairs, Govt. of India, 2019.

Subject Code: PCCE-168
Subject Name: Analytical Methods for Environmental Monitoring

Programme: B.Tech.	**L:** 3 **T:** 1 **P:** 0
Semester: 7/8	**Teaching Hours:** 36 + 12 (T) = 48 Hours
Theory/Practical: Theory	**Credits:** 4
Internal Marks: 40	**Percentage of Numerical/Design Problems:** 20%
External Marks: 60	**Duration of End Semester Exam(ESE):** 3hours
Total Marks: 100	**Elective Status:** Elective

Prerequisites: N/A
Additional Material Allowed in ESE: Scientific Calculator
On Completion of the course, the student will have the ability to:

CO#	Course Outcomes
1.	Apply the principles of volumetric and instrumental analytical methods in environmental monitoring,
2.	Analyze statistical methods for evaluating and interpreting data of environmental interest,
3.	Identify various analytical methods depending upon the requirement and usage,
4.	Interpret the applications of different chromatographic methods,
5.	Analyze various electrochemical methods, and
6.	Summarize various material characterization techniques and its principles.

Detailed Contents:

Part-A

Classification of Instrumental Methods: 12+4 = 16 hours

Performance Characteristics of Instruments (Static and Dynamic), Errors and Uncertainties in Performance Parameters, Noise Reduction, Sensitivity and Detection Limit, Errors, Types, Expression of Errors, Precision and Accuracy, Calibration of Instrumental Methods, Spectrophotometry, Electromagnetic Radiation, Atomic Absorption and Emission Spectrometry, Ultraviolet-Visible Spectrophotometry

Principle and Instrumentation: 8+2 = 10 hours

Atomic Absorption Spectroscopy, Flame Photometer, Fluorimetry, Nephelometry and Turbidimetry, Chromatography and Classification, Column Efficiency and Resolution, Quantitative Determination.

Part-B

Applications of Instrumental Methods: 7+3 = 10 hours

Column Chromatography, Thin Layer Chromatography, Principle and Application of Ion chromatography, Application Gas Chromatography (GC), Principle and Application of High Precision Liquid Chromatography (HPLC), Ion Chromatography, Mass Spectroscopy, Gas Chromatography Mass Spectroscopy (GCMS)

Electro Chemical Methods: 9+3 = 12 hours

Electrochemical Cell - Reference Electrodes, Cyclic Voltammetry, Polarograph, Oscilloscope Polarography, Ion Selective Electrodes, Conductometry, Electrolytic Conductivity, Specific Equivalent and Molar Conductance, Working Principles of pH, EC, TDS Meters, Material Characterization Techniques, SEM, TEM, XRD, FTIR, Thermal Analysis, Working Principles and Applications.

Text Books:

1. D. A. Skoog, D.M. West and T.A. Nieman, "Principles of Instrumental Analysis", 5th Ed. Thomson Asion (P) Ltd. Singapore, 2004.
2. Willard, Merritt, Dean and Settle, "Instrumental Methods of Analysis", Wadsworth Pub. Co., USA, 1989.
3. H. H. Willard, L. L. Merit, J. A. Dean and F. A. Settle, "Instrumental Methods of Analysis", 7th Ed. CBP Publishers and Distributors, New Delhi, 1988.

Reference Books:

1. Chemistry for Environmental Engineering and Science - Sawyer C.N., McCarty P.L. and Parkin, G.F. - Tata McGraw Hill, New Delhi 2017

E-Books and online learning material:

1. Modern Environmental Analysis Techniques for Pollutants
   https://www.sciencedirect.com/book/9780128169346/modern-environmental-analysis-techniques-for-pollutants

Online Courses and Video Lectures:

1. https://nptel.ac.in/courses/103/106/103106162/#

Subject Code: PECE-169
Subject Name: Air Pollution and Control

Programme: B.Tech.	**L:** 3 **T: 1 P:** 0
Semester: 7/8	**Teaching Hours:** 36 + 12 (T) = 48 Hours
Theory/Practical: Theory	**Credits:** 3
Internal Marks: 40	**Percentage of Numerical/Design Problems:** 30%
External Marks: 60	**Duration of End Semester Exam(ESE):** 3hours
Total Marks: 100	**Elective Status:** Compulsory

Prerequisites: Environmental Science and Engineering Chemistry

Additional Material Allowed in ESE: Calculator

On Completion of the course, the student will have the ability to:

CO#	Course Outcomes
1.	Define the various sources of air pollution and their effects on human health and environment,
2.	Develop the energy balance and plume behaviour for different atmospheric stability conditions,
3.	Determine the sampling techniques for air quality monitoring,
4.	Analyze the indoor and outdoor air quality.
5.	Interpret various techniques used to control particulate matter and gaseous pollutants
6.	Explain the implementation of physicochemical and biological air pollution control technologies.

Detailed Contents:

PART- A

Introduction: **3+1= 4 hours**

Sources and classification of pollutants and their effect on human health, vegetation and property, Reactions of pollutants and their effects, smoke, smog and ozone layer disturbance, Greenhouse effect.

Dynamics of atmosphere: **12+4= 16 hours**

Energy balance of atmosphere, Meteorological aspects, Wind and wind roses, Environmental and adiabatic lapse rates, Derivations of DALR, WALR and ELR, Atmospheric stability, Factors influencing stability, Temperature inversions, Mixing height.

PART- B

Air Sampling and Modelling: **9+3= 12 hours**

Transport, transformation and deposition of air contaminants, Air sampling (Ambient and stack sampling) & pollution measurement methods, Ambient air quality and emission standards, Modelling- Gaussian model and equation, Air quality index, Indoor air quality.

Air Pollution Control Systems: **12+4= 16 hours**

Settling chambers, cyclone separation, Wet collectors, fabric filters, electrostatic precipitators, Removal of gaseous pollutants by adsorption, absorption, reaction and other methods, Bio-scrubbers, bio-filters.

Text Books:

1. Howard S. Peavy, Donald R. Rowe & George Tchobanoglous, “Environmental Engg.”, International Edition, McGraw Hill (2013).
2. Perkins, H.C., “Air Pollution”, McGraw-Hill (2004).

3. Khare M, “Air Pollution - Monitoring; Modelling; Health and Control”, In TechPublishers (2012).
4. Rao M.N. and Rao H.V.N., “Air Pollution”, Tata McGraw Hill (2006).
5. Griffin R D, “Principles of Air Quality Management”, 2nd Edition, CRC Press, Boca Raton, USA (2007).

Reference Books:

1. Vallero, D.A. Environmental Contaminants Assessment and Control. Academic Press, Elsevier, 2004.
2. T.J. Lyons and W.D. Scott .Principles of air-pollution meteorology, CBS Publishers, 2001
3. Wadden, R.A., Scheff, P.A., Indoor Air Pollution: Characterization, Prediction, Control. Wiley, New York, 1983
4. Vallero D., Fundamentals of Air Pollution, 4th edition, Academic Press, 2007

E-Books and online learning material:

1. Environmental Air Pollution NPTEL (Web Course) (https://nptel.ac.in/courses/105/102/105102089/)

Online Courses and Video Lectures:

1. Fundamentals of Environmental Pollution and Control – NPTEL (Video Lectures) (https://nptel.ac.in/courses/123/105/123105001/)

Subject Code: PECE-171

Subject Name: Environmental Impact Assessment & Life Cycle Analysis

Programme: B.Tech.	**L:** 3 **T:** 1 **P:** 0
Semester: 7/8	**Teaching Hours:** 36 + 12T = 48Hours
Theory/Practical: Theory	**Credits:** 3
Internal Marks: 40	**Percentage of Numerical/Design Problems:** Nil
External Marks: 60	**Duration of End Semester Exam(ESE):** 3hours
Total Marks: 100	**Elective Status:** Compulsory

Prerequisites: Environmental Science

Additional Material Allowed in ESE: NIL

On Completion of the course, the student will have the ability to:

CO#	Course Outcomes
1.	Summarize the importance of environmental impact assessment in various engineering projects.
2.	Identify various key issues in the impact assessment of various projects.
3.	Classify mitigation measures to avoid environmental impacts.
4.	Develop methodology to prepare EIA reports.
5.	Outline life cycle inventory analysis of products.
6.	Identify the issues and propose a solution in the lifecycle analysis from raw material to disposal/reuse stage.

Detailed Contents:

Part-A

Introduction: **4+2= 6 hours**

The Need for EIA, The EIA Cycle and Procedures, Screening, Scoping, Baseline Data, Impact Prediction, Assessment of Alternatives, Delineation of Mitigation Measure and EIA Report, Public Hearing, Decision Making, Monitoring the Clearance Conditions, Components of EIA, Roles in the EIA Process.

Indian Policies for EIA: **6+2= 8 hours**

Indian Policies Requiring EIA, Government of India Ministry of Environment and Forest Notification (2000), List of projects requiring Environmental clearance.

Key Impacts: **8+2=10 hours**

Key Elements of an Initial Project Description and Scoping, Project Location(s), Risks to Environment and Human Health, Socio-Economic Impacts, Ecological Impacts, Global Environmental Issues.

Part-B

Methods for EIA: **9+3=12 hours**

Criteria for the selection of EIA methodology, impact identification, impact measurement, impact interpretation & Evaluation, Methods - Adhoc methods, Checklists methods, Matrices methods, Networks methods, Overlays methods, Environmental index using factor analysis, Cost/benefit analysis, Predictive or Simulation methods

Introduction to Life Cycle Assessment: **4+2=6 hours**

Life Cycle Assessment concepts, A brief history of Life-cycle Inventory analysis, overview of methodology, three components, identifying and setting boundaries for life-cycle stages, issues that apply to all stages, Applications of inventory analysis.

Issues Applicable to specific life cycle stages: **4+2=6 hours**

Introduction, Raw Material acquisition stage, Manufacturing stage, Use/Reuse/Maintenance stage, Recycle/Waste Management stage.

Text Books:

1. Mareddy, A. R., " Environmental Impact Assessment - Theory and Practice", Butterworth-Heinemann (2017).
2. Wathern.P., "Environmental Impact Assessment - Theory and Practice", Routledge Publishers, London (2004).
3. Canter R. L., "Environmental Impact Assessment", Tata McGraw-Hill (1981).
4. Ciambrone D.F., "Environmental Life Cycle Analysis", CRC Press (1997).

Reference Books:

1. Sadler, B. and McCabe M., "Environmental Impact Assessment: Training ResourceManual", UNEP (2002).
2. Anjaneyulu, Y. and Manikam, V, "Environmental Impact Assessment Methodologies", B S Publications (2007).
3. Ralph E Horne, Tim Grant, Verghese K, "Life Cycle Assessment: Principles, Practiceand Prospects", CSIRO Publishers (2009).
4. Michael Z., HauschildRalph K.,Rosenbaum, Stig Irving Olsen, " Life Cycle Assessment Theory and Practice", Springer (2018).

E-Books and online learning material:

1. EIA manual, Ministry of Environment and Forests, Government of India (http://environmentclearance.nic.in/writereaddata/Form-1A/HomeLinks/ommodel2.html) (http://environmentclearance.nic.in/writereaddata/Form-1A/HomeLinks/ommodel3.html) Accessed on 20 September, 2021
2. Environmental Management by Prof. T.V. Ramachandra, IISc Bangalore (https://nptel.ac.in/courses/120/108/120108004/) Accessed on 20 September, 2021

Subject Code: PECE-172

Subject Name: Industrial Wastewater Management and Reuse

Programme: B.Tech.	**L:** 3 **T:** 1 **P:** 0
Semester: 7/8	**Teaching Hours:** 36 + 12T= 48 Hours
Theory/Practical: Theory	**Credits:** 3
Internal Marks: 40	**Percentage of Numerical/Design Problems:** Nil
External Marks: 60	**Duration of End Semester Exam(ESE):** 3hours
Total Marks: 100	**Elective Status:** Compulsory

Prerequisites: Environmental Engineering

Additional Material Allowed in ESE: NIL

On Completion of the course, the student will have the ability to:

CO#	Course Outcomes
1.	Analyze the characteristics of industrial wastewaters,
2.	Summarize the processes involved and waste generated in the various industries,
3.	Demonstrate the effects of disposal of industrial wastes,
4.	Recommend waste minimising techniques to industries,
5.	Identify treatment options for handling industrial wastewater, and
6.	Recommend the effective reuse of treated industrial wastewater.

Detailed Contents:

Part-A

Sources of Pollution: **3+1= 4 hours**

Physical, Chemical, Organic & Biological properties of Industrial Wastes, Difference between industrial & municipal wastewaters, Effects of industrial effluents on sewers and Natural water Bodies.

Pre & Primary Treatment: **6+2= 8 hours**

Equalization, Proportioning, Neutralization, Oil separation by Floating, Waste Reduction, Volume Reduction, Strength Reduction.

Waste Treatment Methods: **9+3= 12 hours**

Nitrification and De-nitrification, Phosphorous removal, Heavy metal removal, Membrane Separation processes, Air stripping and Absorption processes, Disposal of treated Wastewater.

Part-B

Industrial wastewater Characterisation: **8+2= 10 hours**

Characteristics and Composition of wastewater and Manufacturing Processes of Industries like Sugar, Characteristics and Composition of Industries like Food processing Industries, Steel, and Petroleum Refineries.

Industrial Characterisation: **8+2= 10 hours**

Characteristics and Composition of Industries like Textiles, Tanneries, Atomic Energy Plants and other Mineral Processing Industries, Joint Treatment of Raw Industries wastewater and Domestic Sewage,

Common Effluent Treatment Plants (CETP): **3+1= 4 hours**

Location, Operation and Maintenance Problems, Economical aspects.

Text Books:

1. Eckenfelder W.W. Jr., “Industrial Water Pollution Control”, 3rd ed., McGraw Hill(2003).
2. Patwardhan, “Industrial Waste water Treatment”, Prentice Hall of India, New Delhi (2008).
3. Nemerrow N.L., “Theories and practices of Industrial Waste Engineering”,Addison-Wesley Publishing Company (1955).

4. C.G. Gurnham, “Principles of Industrial Waste Engineering”, Public Health Service Publications (1955).
5. Nemerow, N.L.Industrial water pollution: Origin, characteristics and treatment, R.E. Kreiger Pub. Co., 1987.

Reference Books:

1. Metcalf, Eddy, Tchobanoglous, G., Burton, F.L., Stensel, H.D., “Wastewater Engineering Treatment, Disposal and Reuse”, 4th ed., Tata McGraw Hill (2002).
2. M.N. Rao and Dutta, “Waste Water Treatment”, 3rd Edition, Oxford and IBH Publishers (2018).
3. Mark J. Hammer, Mark J. Hammer, Jr., “Water & Wastewater Technology”, Prentice Hall of India (2008).
4. Pain,A.K. and Hazra, S. Industrial Ecology: concepts and practices, ICFAI University Press, 2008.
5. Shen, T.T.Industrial pollution prevention, Springer, 1999.
6. Freeman, H. Industrial pollution prevention handbook, McGraw Hill, 1994.

E-Books and online learning material:

1. Wastewater Management by NPTEL, IIT Kharagpur (Web Course) (https://nptel.ac.in/courses/105/105/105105048/) Accessed on 20 September 2021

Subject Code: LPECE-103
Subject Name: Problem Analysis Laboratory

Programme: B.Tech.	**L:** 0 **T:** 0 **P:** 2
Semester: 7/8	**Teaching Hours:** 24
Theory/Practical: Practical	**Credits:** 1
Internal Marks: 30	**Percentage of Numerical/Design Problems:** 100%
External Marks: 20	**Duration of End Semester Exam (ESE):**
Total Marks: 50	**Elective Status:** Compulsory Track Specific

Prerequisites: N/A
Additional Material Allowed in ESE: N/A
On Completion of the course, the student will have the ability to:

CO#	Course Outcomes
1.	Summarize the role of software in environmental engineering,
2.	Formulate solution for common and complex engineering problems using software,
3.	Analyze the various factor effecting the selection of different elements for designing a model in software
4.	Determine pressure and velocity of water or wastewater at various points at different time intervals
5.	Identify the water loss in project
6.	Design a hydraulic model using software

Detailed Contents:

Hands-on practice on standard software in environmental science & engineering field and use them in solving various environmental problems, the different software(s) are:

- EPAnet
- WaterGEMS
- SewerGEMS
- StormCAD
- Civil Storm

Text Books:

1. Manual of concerned software.