SCHEME & SYLLABUS
OF

UNDERGRADUATE DEGREECOURSES
IN
CIVILENGINEERING

2020-2021
(B.Tech. I Yr admitted 2019-20 and B.Tech.LEETadmitted 2020-21)

DEPARTMENT OF CIVIL ENGINEERING

J C BOSE UNIVERSITY OF SCIENCE AND TECHNOLOGY, YMCA
FARIDABAD

J C BOSE UNIVERSITY OF SCIENCE AND TECHNOLOGY, YMCA

VISION

YMCA University of Science and Technology aspires to be a nationally and internationally acclaimed leader in technical and higher education in all spheres which transforms the life of students through integration of teaching, research and character building.

MISSION

- To contribute to the development of science and technology by synthesizing teaching, research and creativeactivities.
- To provide an enviable research environment and state-of-the-art technological exposure to itsscholars.
- To develop human potential to its fullest extent and make them emerge as world class leaders in their professions and enthuse them towards their socialresponsibilities.

Program Educational Objectives (PEO'S)

PEO-1:

A fundamental knowledge of the basic and engineering sciences and develop mathematical and analytical skills required for civil engineering.

PEO-2:

Graduates to be equipped with practical skills and experimental practices related to core and applied areas of civil engineering to expand their knowledge horizon beyond books. This will prepare the students to take-up career in industries or to pursue higher studies in civil and interdisciplinary programs.

PEO-3:

Graduates will have improved team building, team working and leadership skills with high regard for ethical values and socialresponsibilities.

PEO- 4:

Civil Graduates will explore and create innovations in various aspects of engineering.

PROGRAMME OUTCOMES (PO'S) B.TECH. CIVIL ENGINERING

Engineering Graduates will be able to:

1) Engineeringknowledge:Applyknowledgeofmathematics,science,engineeringfundamentals,andcivil

engineering to the solution of engineering problems.

2) Problem analysis: Identify, formulate, review literature and analyze civil engineering problems to design, conduct experiments, analyze data and interpretdata.

3) Design /development of solutions: Design solution for civil engineering problems and design system component of processes that meet the desired needs with appropriate consideration for the public health and safety, and the cultural, societal and the environmentalconsiderations.

4).Conduct investigations of complex problems: Use research based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions in civil engineering.

5) Modern tool usage: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to civil engineering activities with an understanding of the limitations.

6) The engineer and society: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to civil engineering practice.

7) Environment and sustainability: Understand the impact of the civil engineering solutions in societal and environmental contexts, and demonstrate the knowledge and need for sustainabledevelopment.

8) Ethics: Apply ethical principles and commit to professional ethics and responsibilities and norms of the civil engineeringpractice.

9) Individual and team work: Function affectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings in civilengineering.

10) Communication: Communicate effectively on complex engineering activities with the engineering committee and with society at large, such as, being able to comprehend and write affective reports and design documentation, make effective presentations in civilengineering.

11) Project Management and finance: Demonstrate knowledge & understanding of the civil engineering principles and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments in civilengineering.

12) Life- long learning: Recognize the need for, and the preparation and ability to engage in independent research and lifelong learning in the broadest contest of technological changes in civilengineering.

PROGRAM SPECIFIC OUTCOMES (PSOs):

1) To apply practical skills, knowledge of engineering fundamentals and civil engineering, to industries andinstitutions.

2) To explore, create and develop innovations in various aspects of engineering. The student will be ready to take-up career or to pursue higher studies with high regard to ethical values and social responsibilities.

GRADING SCHEME

Marks %	Grade	Grade	Category
90-100	O	10	Outstanding
80≤marks<90	A+	9	Excellent
70≤marks< 80	A	8	Very good
60≤marks< 70	B+	7	Good
50≤marks< 60	B	6	Above Average
45≤marks< 50	C	5	
40≤marks< 45	P	4	Pass
<40	F	0	Fail
	Ab	0	Absent

Percentage calculation= CGPA * 9.5

Course code and definition:

Course code	Definitions
L	Lecture
T	Tutorial
P	Practical
BSC	Basic Science Courses
ESC	Engineering Science Courses
HSMC	Humanities and Social Sciences including Management courses
PCC	Professional core courses
PEC	Professional Elective courses
OEC	Open Elective courses
LC	Laboratory course
MC	Mandatory courses
PROJ	Project

Undergraduate Degree Courses in Engineering & Technology
CIVIL ENGINEERING

(As per guidelines of All India Council for Technical Education Model curriculum)

1. General, Course structure & Theme &Semester-wise creditdistribution

Definition of Credit:

1 Hr. Lecture (L) per week	1 credit
1 Hr. Tutorial (T) per week	1 credit
1 Hr. Practical (P)perweek 2 Hours Practical (Lab) perweek	0.5 credits 1 credit

Credits –172 for a student to be eligible to get Under Graduate degree in Engineering.

Structure of Undergraduate Engineering program:

No.	Category	Breakup of Credits
1	Humanities and Social Sciences including Management courses	10
2	Basic Science Courses	22
3	Engineering Science courses including workshop, drawing, basics of electrical/mechanical/computer etc.	28
4	Professional core courses	59
5	Professional Elective courses relevant to chosen Specialization/branch.	18
6	Open subjects – Electives from other technical and /or emerging subjects	3
7	Project work, seminar and internship in industry or appropriate work place/ academic and research institutions in India/abroad	20
8	Mandatory Courses [Environmental Sciences, IndianConstitution]	(non-credit)
	Total	**160+12***

* 03 credit each year through MOOC in First and Second Year.

* 03 credit each year of open elective through MOOC in 3rd and 4th Year.

Refer implementation of Credit Transfer/Mobility Policy of online courses,17th meeting of Academic Council (11.6.2019) for details, regarding MOOC credits. Minimum credit to be earned is 12 (**03 each year)**through MOOC for all B.Tech. students in this scheme.

HUMANITIES & SOCIAL SCIENCES INCLUDING MANAGEMENT

Sl. N	Code No.	Subject	Semester	Credits
1.	HSMC101	English	II	3
2.	HSMC251R	Basics of Civil Engineering	III	4
3.	HSMC01	Humanities-I (Effective Technical Communication)	III	3
			Total Credits:	**10**

BASIC SCIENCE COURSES

Sl. No	Code No.	Subject	Semester	Credits
1.	BSC101	Physics (Mechanics & Mechanics of Solids)	I	5.5
2.	BSC103	Mathematics –I (Calculus, Multivariable Calculus and Linear Algebra)	I	4
3.	BSC 102	Chemistry-I	II	5.5
4.	BSC 104	Mathematics –II (Differential Equations)	II	4
5.	BSC 01	Biology	III	3
			Total Credits:	**22**

ENGINEERING SCIENCE COURSES

Sl. No	Code No.	Subject	Semester	Credits
1.	ESC101	Basic Electrical Engineering	I	5
2.	ESC102	Programming for Problem Solving	II	5
3.	ESC104	Workshop Manufacturing Practices	II	3
4.	ESC105	Engineering Graphics & Design	I	3
5.	ESC201	Basic Electronics	III	3
6.	ESC203	Computer-aided Civil Engineering Drawing	III	2
7.	ESC205	Engineering Mechanics	III	4
8.	ESC209	Mechanical Engineering	IV	3
			Total Credits:	**28**

PROFESSIONAL CORE COURSES/FUNDAMENTAL ENGINEERING PRINCIPLES & TOOLS

Sl. No	Code No.	Subject	Semester	Credits
1	PCC-CE202R	Geology for Engineers	IV	3
2.	PCC-CE203R	Disaster Preparedness &Management	IV	3
3.	PCC-CE204R	Basics of Fluid Mechanics	IV	4
4.	PCC-CE205R	Basics of Solid Mechanics	IV	4
5.	PCC-CE206R	Surveying & Engineering Geomatics	IV	4
6.	PCC-CV207R	Building Materials and Testing	III	4
7.	PCC-CE301R	Basics of Mechanics of Materials	V	4
8.	PCC-CE302	Hydraulic Engineering	VI	4
9.	PCC-CE303R	Structural Engineering and Design	V	4
10.	PCC-CE304	Geotechnical Engineering	V	4
11.	PCC-CE305	Hydrology & Water Resources Engineering	VI	3
12.	PCC-CE306R	Environmental Engineering and Management	V	4
13.	PCC-CE307R	Transportation Engineering Concepts	V	4
14	PCC-CE300	Design of Reinforced Concrete Structures	VI	3
15.	PCC-CE308	Construction Engineering & Management	VII	3
16.	PCC-CE309	Engineering Economics, Estimation &Costing	VII	4
			Total Credits:	**59**

PROFESSIONAL ELECTIVE COURSES

Sl. No	Code No.	Subject	Semester	Credits
1.	PEC-CV401	Elective-I	V	3
2.	PEC-CV402	Elective-II	VI	3
3.	PEC-CV403	Elective-III	VI	3
4.	PEC-CV404	Elective-IV	VI	3
5.	PEC-CV405	Elective V	VII	3
6.	PEC-CV406	Elective-VI	VII	3
			Total Credits:	**18**

OPEN ELECTIVE COURSES

Sl. No	Code No.	Subject	Semester	Credits/Lecture
1.	Civil OEC-1	Open Elective-I through MOOC	VI	3
2.	Civil OEC-2	Open Elective-IIthrough MOOC	VII	3
3.	Civil OEC-3	Open Elective-III	VII	3
Total Credits:				3+6*

***In 1stYear and 2ndYear, one MOOC course each to be completed (3*2 = 6 credits)**
***In 3rdYear, Open Elective – I and in 4thYear Open Elective – II to be completed through MOOC.**
***For Open Elective III - Students can select one subject from the open electives subject list**

Branch / Course: Civil Engineering Total credits (4 year course):160 + 12 (MOOC) = 172

Semester-wise structure ofcurriculum

[L= Lecture, T = Tutorials, P = Practicals& C = Credits]

First year credit=38 + 3 (MOOC)
III to VIII Sem credit=131 (Including MOOC Credits = 03 per year)

J C BOSE UNIVERSITY OF SCIENCE AND TECHNOLOGY, YMCAFARIDABAD
SCHEME OF STUDIES & EXAMINATIONS
B.TECH 2nd YEAR (SEMESTER – III) CIVIL ENGINEERING (2020-21)

Course No.	Course Title	Teaching Schedule				Marks for Sessional	Marks for End Term Examination		Total Marks	Credits
		L	T	P	Total		Theory	Practical		
ESC201	Basic Electronics	3	0	0	3	25	75	-	100	3
BSC 01	Biology	3	0	0	3	25	75	-	100	3
ESC202	Engineering Mechanics	3	1	0	4	25	75	-	100	4
HSMC01	Effective Technical Communication	3	0	0	3	25	75	-	100	3
HSMC251R	Basics of Civil Engineering	4	0	0	4	25	75	-	100	4
PCC-CV207R	Building Materials and Testing	3	-	-	3	25	75	-	100	3
PCC-CV207P	Materials Testing Lab	0	0	2	2	15		35	50	1
ESC203P	Computer-aided Civil Engineering Drawing Lab	0	0	4	4	15	-	35	50	2
PRCVE-1P	Project-1	0	0	4	4	15		35	50	2
	Total				30				750	25

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SCHEME OF STUDIES & EXAMINATIONS

B.TECH 2nd YEAR (SEMESTER – IV) CIVIL ENGINEERING(2020-21)

Course No.	Course Title	Teaching Schedule				Marks for Sessional	Marks for End Term Examination		Total Marks	Credits
		L	T	P	Total		Theory	Practical		
PCC-CE202R	Geology for Engineers	3	0	- -	3	25	75	-	100	3
PCC-CE203R	Disaster Preparedness &Management	3	0	-	3	25	75	-	100	3
PCC-CE204R	Basics of Fluid Mechanics	3	0	-	3	25	75	-	100	3
PCC-CE205R	Basics of Solid Mechanics	3	1	-	4	25	75	-	100	4
PCC-CE206R	Surveying & Engineering Geomatics	2	1	-	3	25	75	-	100	3
ESC209	Mechanical Engineering	2	1	-	3	25	75	-	100	3
PCC-CE204P	Fluid Mechanics Lab	0	0	2	2	15		35	50	1
PCC-CE206P	Surveying Lab	0	0	2	2	15		35	50	1
MC CEFAE03	Audit Course-1: Environment Science	1	-	-	1	25	75	-	-	0
PRCVE-2P	Project-2	0	0	4	4	15		35	50	2
	Total				28				750	23

- **In addition, Surveying Camp to be organized at the end ofsemester**

J C BOSE UNIVERSITY OF SCIENCE AND TECHNOLOGY, YMCAFARIDABAD

SCHEME OF STUDIES & EXAMINATIONS

B.TECH 3rd YEAR (SEMESTER –V) CIVIL ENGINEERING(2020-21)

Course No.	Course Title	Teaching Schedule				Marks for Sessional	Marks for End Term Examination		Total Marks	Credits
		L	T	P	Total		Theory	Practical		
PCC-CE301R	Advanced Mechanics of Materials	3	1	-	4	25	75	-	100	4
PCC-CE303	Structural Engineering	4	-	-	4	25	75	-	100	4
PCC-CE304	Geotechnical Engineering	2	1	-	3	25	75	-	100	3
PCC-CE306R	Environmental Engineering and Management	2	1	-	3	25	75	-	100	3
PCC-CE307R	Transportation Engineering Concepts	3	0	-	3	25	75	-	100	3
PEC-CV401	Elective-I	3	-	--	3	25	75	-	100	3
PCC-CE304P	Geotechnical Engineering Lab			2	2	15		35	50	1
PCC-CE307P	Transportation Engineering Lab			2	2	15		35	50	1
PCC-CE306P	Environmental Engineering Lab			2	2	15		35	50	1
PRCVE-3P	Project-3	0	0	4	4	15		35	50	2
	Total				30				800	25

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SCHEME OF STUDIES & EXAMINATIONS

B.TECH 3rd YEAR (SEMESTER –VI) CIVIL ENGINEERING(2020-21)

Course No.	Course Title	Teaching Schedule				Marks for Sessional	Marks for End Term Examination		Total Marks	Credits*
		L	T	P	Total		Theory	Practical		
PCC-CE300	Design of Reinforced Concrete Structures	3	-	-	3	25	75	-	100	3
PCC-CE302	Hydraulic Engineering	2	1	-	3	25	75	-	100	3
PCC-CE305	Hydrology & Water Resources Engineering	3	-	-	3	25	75	-	100	3
PEC-CV402	Elective-II	3	0	-	3	25	75	-	100	3
PEC-CV403	Elective-III	3	0	-	3	25	75	-	100	3
PEC-CV404	Elective-IV	3	-	-	3	25	75	-	-	3
MC01	Audit Course-II Constitution of India	3	-	-	3	25	75	-	100	0
PCC-CE302P	Hydraulic Engineering Lab			2	2	15		35	50	1
PRCVE-4P	Project-4	0	0	4	4	15		35	50	2
	Total				27				800	21

***Imp.: In addition One Open Elective Course civil OEC-1 of 3 credit through MOOC in 6th sem. (3rdYr)**

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SCHEME OF STUDIES & EXAMINATIONS

B.TECH 4th YEAR (SEMESTER –VII) CIVIL ENGINEERING(2020-21)

Course No.	Course Title	Teaching Schedule				Marks for Sessional	Marks for End Term Examination		Total Marks	Credits
		L	T	P	Total		Theory	Practical		
PCC-CE308	Construction Engineering&Management	3	-	-	3	25	75	-	100	3
PCC-CE309	Engineering Economics,Estimation & Costing	3	-	-	3	25	75	-	100	3
PEC-CV405	Elective V	3	-	0	3	25	75	-	100	3
PEC-CV406	Elective-VI	3	-	0	3	25	75	-	100	3
CivilOEC-3	Open Elective: -One from a list of 1-5	3	0	-	3	25	75	-	100	3
PRCVE-5P	Project-5	0	0	4	4	15		35	50	2
PCC-CE309P	Engineering Economics, Estimation & Costing Lab			2	2	15		35	50	1
	Total				21				700	18

***Imp.: In addition One open elective Civil OEC-2 of 3 credit through MOOC to be completed in 7thsem (II Yr).**

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SCHEME OF STUDIES & EXAMINATIONS

B.TECH 4thYEAR (SEMESTER – VIII) CIVIL ENGINEERING(2020-21)

Sl. No.	Course Title	Code	Hours per week			Sessional	End Semester	Total	Credits
			L	T	P				
1	Industrial Training with projects	PRCVE-6P	0	0	30	150	350	500	10 (including 02 credit or 20% weightage for project)

PROFESSIONAL ELECTIVE COURSES CIVIL ENGINEERING

Sl.No	Code No.	**Subject**	**Semester**	**Credits /Lectures**
1.	PEC-CV401	Elective-I	V	3
2.	PEC-CV402	Elective-II	VI	3
3.	PEC-CV403	Elective-III	VI	3
4.	PEC-CV404	Elective-IV	VI	3
5.	PEC- CV405	Elective V	VII	2
6.	PEC- CV406	Elective VI	VII	3

PROFESSIONAL ELECTIVE COURSE TRACKS- CIVILENGINEERING [PEC-CV]

The following six Mandatory Professional Specialized Tracks offer electives in the respective Tracks:

Track	**Professional Elective Courses (PEC)**
I	Concrete Structures
II	Transportation Engineering
III	Environmental Engineering
IV	Geotechnical Engineering
V	Hydraulics
VI	Structural Engineering

The students will have options of selecting the electives from the different tracks depending on the specialization one wishes to acquire.

Professional Elective Course(PEC)

Elective I:**PEC-CV401-1**
Note: PEC CV 401-1Concrete Structures coding: indicates that Program elective scheme subject code is PEC CV-401 and S.No. 1 is chosen in thissemester.

1. ConcreteTechnology
2. PrestressedConcrete

Elective-II,PEC-CV402-1

Note: PEC CV402-1subject Railway Engineering coding: indicates that Program elective scheme subject code is PEC CV-402 and S.No. 4 is chosen in thissemester.

1. Public TransportationSystems
2. Intelligent TransportationSystems
3. Pavement Materials
4. RailwayEngineering
5. Airport PlanningandDesign

Elective-III:**PEC-CV403**

Note: PEC–CV403-3subject Environmental Systemscoding : indicates : Program elective scheme subject code is PEC-CV403 and S.No. 3 is chosen.

1. Air and Noise PollutionControl
2. Solid and Hazardous WasteManagement
3. Environmental Systems
4. Environmental ImpactAssessment

Elective IV: **PEC-CV404**

Note: PEC CV 404-2 Foundation Engineering subject coding : indicates that Program elective scheme subject code is PEC CV-404 and S.No. 1 is chosen in this semester.

1. FoundationEngineering
2. Ground ImprovementTechniques

Elective V:PEC-CV405

Note: PEC CV405-2indicates that Program elective scheme subject code is PEC-CV405 and S.No. 2 is chosen in this semester

1. IrrigationEngineering
2. Groundwater Engineering
3. Unsteady Open Channelflow
4. Urban HydrologyandHydraulics

Elective VI:**PEC-CV406**

Note: PEC CV 406-5: Building Materials coding : indicates that Program elective scheme subject code is PEC CV-406 and S.No.5 is chosen in this semester.

1. StructuralAnalysis
2. Design ofSteelStructures
3. Introduction to BridgeEngineering

4. EarthquakeEngineering

OPEN ELECTIVE COURSE CIVIL ENGINEERING(3 Credit/3Lecture each)

OPEN ELECTIVE COURSES (OEC):

Note:-Students have to select one open Elective Courses from the given list:

OPENELECTIVECOURSE: Civil OEC3

Civil OEC3-OE1	Research and IPR	3L	3 credits
Civil OEC3-OE2	Energy Studies	3L	3 credits
Civil OEC3-OE3	Life Science	3L	3 credits
Civil OEC3- OE 4	Metro Systems and Engineering	3L	3 credits
Civil OEC3-OE5	Safety Engineering	3L	3 credits

***Imp.: In addition 02 open elective course through MOOC to be taken in 6thand 7thsem.**

B. Tech III Semester

ESC- 201 BASIC ELECTRONICS ENGINEERING

No. ofCredits:3
L TP Total
3 0 0 3
Duration of Exam: 3 Hours
Pre- Requisite: Physics

Sessional: 25 Marks
Theory: 75 Marks
Total: 100Marks

Successive: Mechatronics, Automation in Manufacturing

Course Objectives:

To provide an overview of electronic device components to Mechanical engineering students.

Course Contents:

Semiconductor Devices and Applications: Introduction to P-N junction Diode and V-I characteristics, Half wave and Full-wave rectifiers, capacitor filter. Zener diode and its characteristics, Zener diode as voltage regulator. Regulated power supply IC based on 78XX and 79XX series, Introduction to BJT, its input-output and transfer characteristics, BJT as a single stage CE amplifier, frequency response and bandwidth.

Operational amplifier and its applications: Introduction to operational amplifiers, Op-amp input modes and parameters, Op-amp in open loop configuration, op-amp with negative feedback, study of practical op-amp IC 741, inverting and non-inverting amplifier applications: summing and difference amplifier, unity gain buffer, comparator, integrator anddifferentiator.

Timing Circuits and Oscillators: RC-timing circuits, IC 555 and its applications as astable and mono-stable multi-vibrators, positive feedback, Barkhausen's criteria for oscillation, R-C phase shift and Wein bridge oscillator.

Digital Electronics Fundamentals :Difference between analog and digital signals, Boolean algebra, Basic and Universal Gates, Symbols, Truth tables, logic expressions, Logic simplification using K-map, Logic ICs, half and full adder/subtractor, multiplexers, de-multiplexers, flip-flops, shift registers, counters, Block diagram of microprocessor/microcontroller and their applications.

Electronic Communication Systems: The elements of communication system, IEEE frequency spectrum, Transmission media: wired and wireless, need of modulation, AM and FM modulation schemes, Mobile communication systems: cellular concept and block diagram of GSM system.

Course Outcomes:

At the end of this course students will demonstrate the ability to

1. Understand the principles of semiconductor devices and theirapplications.
2. Design an application using Operationalamplifier.
3. Understand the working of timing circuits andoscillators.
4. Understand logic gates, flip flop as a building block of digitalsystems.
5. Learn the basics of Electronic communicationsystem.

Text /Reference Books:

1. Floyd ," Electronic Devices" Pearson Education 9th edition,2012.
2. R.P. Jain , "Modern Digital Electronics", Tata Mc Graw Hill, 3rd Edition,2007.
3. Frenzel, "Communication Electronics: Principles and Applications", Tata Mc Graw Hill, 3rd Edition, 2001

ESC203P	Computer-aided Civil EngineeringDrawing	L:0T:4P	2 credits

The students will be able to

a) Develop Parametric design and the conventions of formalengineeringdrawing
b) Produce and interpret 2D & 3Ddrawings
c) Communicate a design idea/conceptgraphically/visually
d) Examine a design critically and with understanding of CAD - The student learn to interpret drawings, and to produce designs using a combination of 2D and 3Dsoftware.
e) Get a Detailed study of anengineeringartifact

ProposedSyllabus(No. of lectures shown within brackets)

Module 1:*INTRODUCTION***;** Introduction to concept of drawings, Interpretation of typical drawings, Planning drawings to show information concisely and comprehensively; optimal layout of drawings and Scales; Introduction to computer aided drawing, co- ordinate systems, reference planes. Commands: Initial settings, Drawing aids, Drawing basic entities, Modify commands, Layers, Text and Dimensioning, Blocks. Drawing presentation norms andstandards.(2)

Module 2:*SYMBOLS AND SIGN CONVENTIONS*: Materials, Architectural, Structural, Electrical and Plumbing symbols. Rebar drawings and structural steel fabrication and connections drawing symbols, welding symbols; dimensioning standards (2)

Module 3: *MASONRY BONDS:*English Bond and Flemish Bond – Corner wall and Cross walls - One brick wall and one and half brick wall (1)

Module 4: *BUILDING DRAWING*: Terms, Elements of planning building drawing, Methods of making line drawing and detailed drawing. Site plan, floor plan, elevation and section drawing of small residential buildings. Foundation plan. Roof drainage plans. Depicting joinery, standard fittings & fixtures, finishes. Use of Notes to improve clarity(7)

Module 5:*PICTORIAL VIEW*: Principles of isometrics and perspective drawing. Perspective view of building. Fundamentals of Building Information Modelling (BIM) (3)

Total 15 sessions

It may be advisable to conduct Theory sessions along with Lab demonstrations.

List of Drawing Experiments:

1. Buildings with load bearing walls including detailsofdoorsandwindows. 09
2. Taking standard drawings of a typical two storeyed building including all MEP, joinery, rebars, finishing and other details and writing out adescriptionof the Facility in about 500-700 words.06
3. RCCframedstructures 09
4. Reinforcement drawings for typical slabs, beams,columnsandspreadfootings. 09
5. Industrial buildings - North lightroofstructures-Trusses 06
6. Perspective view of oneand twostoreybuildings 06

Total L: 15 + P:45=60

Text/ReferenceBooks:

1. Subhash C Sharma &Gurucharan Singh (2005), " CivilEngineeringDrawing" ,Standard Publishers
2. Ajeet Singh (2002), " Working with AUTOCAD 2000 with updates on AUTOCAD 200I", Tata- Mc Graw-Hill Company Limited,NewDelhi
3. Sham TickooSwapna D (2009), " AUTOCAD for Engineers and Designers" , Pearson Education,
4. Venugopal (2007), "Engineering Drawing and Graphics + AUTOCAD" , New Age InternationalPvt.Ltd.,
5. Balagopal and Prabhu (1987), " Building Drawing and Detailing", Spades publishing KDR building,Calicut,
6. (Corresponding set of) CAD Software Theory andUserManuals.
7. Malik R.S., Meo, G.S. (2009) Civil Engineering Drawing, Computech Publication Ltd New Asian.
8. Sikka, V.B. (2013), A Course in Civil Engineering Drawing,S.K.Kataria&Sons,

Goals & Outcomes:

The course should enable the students to

i) To develop graphical skills for communicating concepts, ideas and designs of engineering products graphically/ visually as well as understand another person'sdesigns,

ii) and to get exposure to national standards relating to technical drawings using Computer Aided Design andDraftingpractice

iii) Develop Parametric design and the conventions of formalengineeringdrawing

iv) Produce and interpret 2D & 3Ddrawings

v) Examine a design critically and with understanding of CAD - The student learn to interpret drawings, and to produce designs using a combination of 2D and 3Dsoftware.

vi) Develop drawings for conventional structures usingpracticalnorms.

ESC202	Engineering Mechanics	3L:1T:0P	4 credits

ESC-202 ENGINEERING MECHANICS

B. Tech III Semester

No. ofCredits:4
L TP Total
3 1 0 4
Duration of Exam: 3 Hours

Sessional: 25 Marks
Theory: 75 Marks
Total: 100Marks

Pre- Requisite: Physics, Mathematics

Successive: Kinematics of Machines, Dynamics of Machines, Strength of Materials

Course Objectives:

The objective of this Course is to provide an introductory treatment of Engineering Mechanics to all the students of engineering, with a view to prepare a good foundation for taking up advanced courses in the area in the subsequentsemesters.

Course Content:

Module 1: Introduction to Engineering Mechanics covering, Force Systems Basic concepts, Particle equilibrium in 2-D & 3-D; Rigid Body equilibrium; System of Forces, Coplanar Concurrent Forces, Components in Space – Resultant- Moment of Forces and its Application; Couples and Resultant of Force System, Equilibrium of System of Forces, Free body diagrams, Equations of Equilibrium of Coplanar Systems and Spatial Systems; StaticIn-determinancy.

Module 2: Friction covering, Types of friction, Limiting friction, Laws of Friction, Static and Dynamic Friction; Motion of Bodies, wedge friction, screw jack & differential screw jack;

Module 3: Basic Structural Analysis covering, Equilibrium in three dimensions; Method of Sections; Method of Joints; How to determine if a member is in tension or compression; Simple Trusses; Zero force members; Beams & types of beams; Frames & Machines;

Module 4: Centroid and Centre of Gravity covering, Centroid of simple figures from first principle, centroid of composite sections; Centre of Gravity and its implications; Area moment of inertia- Definition, Moment of inertia of plane sections from first principles, Theorems of moment of inertia, Moment of inertia of standard sections and composite sections; Mass moment inertia of circular plate, Cylinder, Cone, Sphere,Hook.

Module 5: Virtual Work and Energy Method- Virtual displacements, principle of virtual work for particle and ideal system of rigid bodies, degrees of freedom. Active force diagram, systems with friction, mechanical efficiency. Conservative forces and potential energy (elastic and gravitational), energy equation for equilibrium.Applications of energy method for equilibrium. Stability of equilibrium.

Module 6: Review of particle dynamics- Rectilinear motion; Plane curvilinear motion (rectangular, path, and polar coordinates). 3-D curvilinear motion; Relative and constrained motion; Newton's 2nd law (rectangular, path, and polar coordinates). Work-kinetic energy, power, potential energy.Impulse-momentum (linear, angular); Impact (Direct andoblique).

Module 7: Introduction to Kinetics of Rigid Bodies covering, Basic terms, general principles in dynamics; Types of motion, Instantaneous centre of rotation in plane motion and simple problems; D'Alembert's principle and its applications in plane motion and connected bodies; Work energy principle and its application in plane motion of connected bodies; Kinetics of rigid body rotation;

Tutorials from the above modules covering, To find the various forces and angles including resultants in various parts of wall crane, roof truss, pipes, etc.; To verify the line of polygon on various forces; To find coefficient of friction between various materials on inclined plan; Free body diagrams various systems including block-pulley; To verify the principle of moment in the disc apparatus; Helical block; To draw a load efficiency curve for a screw jack

Course Outcomes:

Upon successful completion of the course, student should be able to:

CO 1- Understand the basic force system.

CO 2- Apply principles of particle kinematics.

CO 3- Grasp the concepts of particle dynamics.

CO 4- Learn energy methods & momentum methods.

CO5: Learn Principles of Virtual work

Text/Reference Books:

1. Irving H. Shames (2006), Engineering Mechanics, 4th Edition,PrenticeHall
2. F. P. Beer and E. R. Johnston (2011), Vector Mechanics for Engineers, Vol I - Statics, Vol II, – Dynamics, 9th Ed, Tata McGrawHill
3. R. C. Hibbler (2006), Engineering Mechanics: Principles of Statics and Dynamics,PearsonPress.
4. Andy Ruina and RudraPratap (2011), Introduction to Statics and Dynamics, Oxford UniversityPress
5. Shanes and Rao (2006), Engineering Mechanics, PearsonEducation,
6. Hibler and Gupta (2010),Engineering Mechanics (Statics, Dynamics) by PearsonEducation
7. Reddy VijaykumarK. and K. Suresh Kumar(2010), Singer'sEngineeringMechanics
8. Bansal R.K.(2010), A Text Book of Engineering Mechanics,LaxmiPublications
9. Khurmi R.S. (2010), Engineering Mechanics, S. Chand&Co.

10. Tayal A.K. (2010), Engineering Mechanics, UmeshPublications

Upon successful completion of the course, student should be able to:

- Use scalar and vector analytical techniques for analyzing forces in statically determinate structures
- Apply fundamental concepts of kinematics and kinetics of particles to the analysis of simple, practicalproblems
- Apply basic knowledge of maths and physics to solvereal-worldproblems
- Understand measurement error, and propagation of error inprocesseddata
- Understand basic kinematics concepts – displacement, velocity and acceleration (and their angularcounterparts);
- Understand basic dynamics concepts – force, momentum, work and energy;
- Understand and be able to apply Newton's lawsofmotion.
- Understand and be able to apply other basic dynamics concepts - the Work-Energy principle, Impulse-Momentum principle and the coefficientofrestitution;
- Extend all of concepts of linear kinetics to systems in general plane motion (applying Euler's Equation and considering energy of a system in general plane motion, and the work of couples and momentsofforces)
- Learn to solve dynamics problems. Appraise given information and determine which concepts apply, and choose an appropriate solutionstrategy;and
- Attain an introduction to basic machine parts such as pulleys and mass-springsystems.

HSMC201	**Effective Technical Communication**	**3L:0T: 0P**	**3 credits**

Theory=75 , Sessionals=25 ,Total=100 Duration of exam.=3 hours

Module 1: Information Design and Development- Different kinds of technical documents, Information development life cycle, Organization structures, factors affecting information and document design, Strategies for organization, Information design and writing for print and for onlinemedia.

Module 2: Technical Writing, Grammar and Editing- Technical writing process, forms of discourse, Writing drafts and revising, Collaborative writing, creating indexes, technical writing style and language. Basics of grammar, study of advanced grammar, editing strategies to achieve appropriate technical style. Introduction to advanced technical communication, Usability, Hunan factors, Managing technical communication projects, time estimation, Single sourcing,Localization.

Module 3: Self Development and Assessment- Self assessment, Awareness, Perception and Attitudes, Values and belief, Personal goal setting, career planning, Self-esteem. Managing Time; Personal memory, Rapid reading, Taking notes; Complex problem solving; Creativity

Module 4: Communication and Technical Writing- Public speaking, Group discussion, Oral; presentation, Interviews, Graphic presentation, Presentation aids, Personality Development. Writing reports, project proposals, brochures, newsletters, technical articles, manuals, official notes, business letters, memos, progress reports, minutes of meetings, event report.

Module 5: Ethics- Business ethics, Etiquettes in social and office settings, Email etiquettes, Telephone Etiquettes, Engineering ethics, Managing time, Role and responsibility of engineer, Work culture in jobs, Personal memory, Rapid reading, Taking notes, Complex problem solving, Creativity.

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. (ISBN0312406843)
3. Shiv Khera, You Can Win, Macmillan Books, NewYork,2003.
4. Raman Sharma, Technical Communications, Oxford Publication,London,2004.
5. Dale Jungk, Applied Writing for Technicians, McGraw Hill, New York, 2004. (ISBN: 07828357-4)
6. Sharma, R. and Mohan, K. Business Correspondence and Report Writing, TMH NewDelhi2002.
7. Xebec, Presentation Book, TMH New Delhi, 2000.(ISBN0402213)

HSMC251R	**Basics of Civil Engineering**	**4L:0T: 0P**	**4 credits**

Theory=75 , Sessionals=25 ,Total=100 Duration of exam.=3 hours

When the students enter the college to pursue a degree in Civil Engineering and as well pursue a career in Civil Engineering after graduation, they need to understand the breadth and depth available in this field for possible engagement. When many alternative disciplines of engineering appear to offer apparently more glamourous avenues for advancement, the Civil Engineering student should realize the solid foundations available in this mother of all engineering disciplines. The students should understand the enormous possibilities available for creative and innovative works in this all pervasivefieldofengineering.

This course is designed to address the following:

- to give an understanding to the students of the vast breadth and numerous areas of engagement available in the overall field ofCivilEngineering
- To motivate the student to pursue a career in one of the many areas of Civil Engineering with deep interestandkeenness.
- To expose the students to the various avenues available for doing creative and innovative work in this field by showcasing the many monuments and inspiring projects ofpublicutility.

Proposed Syllabus

What is Civil Engineering/ Infrastructure, History of Civil Engineering, Overview of ancient & modern civil engineering marvels, current national planning for civil engineering/ infrastructure projects, scope of work involved in various branches of Civil Engineering – Architecture & Town planning, Surveying & Geomatics, Structural Engineering, Construction Management, Construction materials, Hydrology and Water Resources Engineering, Hydraulic Engineering, Environmental Engineering &Sustainability, Pavement Engineering and construction, Traffic & Transportation Engineering and Management, Geotechnical Engineering, Ocean Engineering, Building Energy Efficiency, Basics of Contract Management, Professional Ethics, Avenues for entrepreneurial working, Creativity & Innovativeness in Civil Engineering,

Modules

1. **Basic Understanding**: What isCivilEngineering/Infrastructure? Basics of Engineering and Civil Engineering; Broad disciplines of Civil Engineering; Importance of Civil Engineering, Possible scopes foracareer
2. **History of Civil engineering**: Early constructions and developments over time; Ancient monuments & Modern marvels; Development of various materials of construction and methods of construction; Works of Eminentcivilengineers.
3. **Overview of National Planning for Construction and Infrastructure Development**; Position of construction industry vis-à-vis other industries, five year plan outlays for construction; current budgets forinfrastructureworks;
4. **Fundamentals of Architecture & Town Planning**: Aesthetics in Civil Engineering, Examples of great architecture, fundamentals of architectural design & town planning; Building Systems (HVAC, Acoustics, Lighting, etc.); LEED ratings; Development ofSmartcities
5. **Fundamentals of Building Materials**: Stones, bricks, mortars, Plain, Reinforced &Prestressed Concrete, Construction Chemicals; Structural Steel, High Tensile Steel, Carbon Composites; Plastics in Construction; 3D printing; Recycling of Construction &Demolitionwastes
6. **Basics of ConstructionManagement&ContractsManagement**: Temporary Structures in Construction; Construction Methods for various types of Structures; Major Construction equipment; Automation & Robotics in Construction; ModernProjectmanagement Systems;Advent of Lean Construction; Importanceof Contracts Management
7. **Environmental Engineering &Sustainability**:Water treatment systems; Effluent treatment systems; Solid waste management; SustainabilityinConstruction;
8. **Geotechnical Engineering**: Basics of soil mechanics, rock mechanics and geology; various types of foundations; basics of rock mechanics&tunnelling
9. **Hydraulics, Hydrology &Water Resources Engineering**: Fundamentals of fluid flow, basics of water supply systems; Underground Structures; Underground Structures Multi- purpose reservoir projects
10. **Ocean Engineering**: Basics of Wave and Current Systems; Sediment transport systems; Ports &Harbours and othermarinestructures
11. **Power Plant Structures**: Chimneys, Natural & Induced Draught Colling towers, coal handling systems, ash handling systems; nuclear containment structures; hydro powerprojects
12. **Structural Engineering**: Types of buildings; tall structures; various types of bridges; Water retaining structures; Other structural systems; Experimental Stress Analysis; Wind tunnelstudies;
13. **Surveying & Geomatics**: Traditional surveying techniques, Total Stations, Development of Digital Terrain Models;GPS,LIDAR;

14. **Traffic &Transportation Engineering**: Investments intransport infrastructure development in India for different modes of transport; Developments and challenges in integrated transport development in India: road, rail, port and harbour and airport sector; PPP in transport sector; Intelligent Transport Systems; Urban Public and Freight Transportation; Road Safety under heterogeneous traffic; Sustainable and resilient pavement materials, design, construction and management; Case studiesandexamples.

15. **Repairs & Rehabilitation of Structures:** Basics of corrosion phenomena and other structural distress mechanisms; some simple systems of rehabilitation of structures; Non-Destructive testing systems; Use of carbon fibre wrapping and carbon composites inrepairs.

16. **Computational Methods, IT, IoT in Civil Engineering:** Typical software used in Civil Engineering- Finite Element Method, Computational Fluid Dynamics; Computational Geotechnical Methods; highway design (MX), Building Information Modelling; Highlighting typical available softwaresystems.

ORGANISATION OF COURSE (2-1-0)

	Module [No of Lectures within brackets]	**Tutorials**
	Basic Understanding (1)	Develop a matrix of various disciplines and possible roles for engineers in each
	History of Civil engineering (1)	Identify 10 ancient monuments and ten modern marvels and list the uniqueness of each
	Overview of National planning for Construction and Infrastructure Development (1)	Develop a Strategic Plan for Civil Engineering works for next ten years based on past investments and identify one typical on-going mega project in each area
	Architecture & Town Planning (1)	Identify ten best civil engineering projects with high aesthetic appeal with one possible factor for each; List down the possible systems required for a typical Smart City
	Building Materials (2)	Identify three top new materials and their potential in construction; Visit a Concrete Lab and make a report
	Construction Management, Contracts management (2)	Identify 5 typical construction methods and list their advantages/ positive features
	Environmental Engineering & Sustainability (2)	Environmental Engineering & Sustainability: Sustainability principles, Sustainable built environment, water treatment systems, good practices of wastewater management. examples of Solid and hazardous waste management, Air pollution and control

	Geotechnical Engineering (2)	List top five tunnel projects in India and their features; collect and study geotechnical investigation report of any one Metro Rail (underground) project; Visit a construction site and make a site visit report
	Hydraulics, Hydrology &Water Resources Engineering (1)	Identify three river interlinking projects and their features; visit a Hydraulics Lab and make a report
	Ocean Engineering, Ports &Harbours (1)	Identify 5 typical ports in India and list the structures available in them; Visit a related/similar facility, if possible in nearby place and make a report
	Power Plant Structures (1)	Collect the typical layout for a large thermal power plant and a large hydro power plant and identify all the structures and systems falling in them.
	Structural Engineering (3)	Identify 5 unique features for typical buildings,
		bridges, tall structures and large span structures; Visit Structures Testing Lab/facility and make a report
	Surveying & Geomatics (1)	Collect visual representations prepared by a Total Station and LIDAR and compare; Study typical Google street map and Google Earth Map and study how each can facilitate the other
	Traffic & transportation (1)	Investments in transport infrastructure; Developments and challenges; Intelligent Transport Systems; Smart Cities, Urban Transport; Road Safety; Sustainable and resilient highway design principles; Plan a sustainable transport system for a city; Identify key features/components in the planning and designof a greenfield highway/airport/port/railway and the cost – economics.
	Repairs & rehabilitation of Structures (1)	Collect the history of a major rehabilitation project and list the interesting features
	Computational Methods, IT, IoT in Civil Engineering (2)	Visit an AutoCadlaband prepare a report; Identify ten interesting software systemsusedin Civil Engg and their key features

Text/Reference Books:

1. Patil, B.S.(1974), Legal Aspects of Building andEngineeringContract
2. The National Building Code,BIS,(2017)
3. RERAAct,(2017)
4. Meena Rao (2006), Fundamental concepts in Law of Contract, 3rd Edn. ProfessionalOffset
5. Chandiramani, Neelima (2000), The Law of Contract: An Outline, 2nd Edn. AvinashPublicationsMumbai
6. Avtarsingh (2002), Law of Contract, Eastern BookCo.
7. Dutt (1994), Indian Contract Act, EasternLawHouse
8. Anson W.R.(1979), Law of Contract, Oxford UniversityPress
9. Kwatra G.K.(2005), The Arbitration & Conciliation of Law in India with case law on UNCITRAL Model Law on Arbitration, Indian CouncilofArbitration
10. Avtarsingh (2005), Law of Arbitration and Conciliation, EasternBookCo.
11. Wadhera (2004), Intellectual Property Rights, Universal LawPublishingCo.
12. P. S. Narayan (2000), Intellectual Property Rights,GogiaLawAgency
13. T. Ramappa(2010), Intellectual Property Rights Law in India, AsiaLawHouse
14. Bare text (2005), Right toInformationAct
15. O.P. Malhotra, Law of Industrial Disputes, N.M.TripathiPublishers
16. K.M. Desai(1946), The Industrial Employment (Standing Orders)Act
17. Rustamji R.F., Introduction to the Law of Industrial Disputes, AsiaPublishingHouse
18. Vee, Charles &Skitmore, Martin (2003) Professional Ethics in the Construction Industry, Engineering Construction and Architectural management, Vol.10, Iss. 2, pp 117-127, MCBUPLtd
19. American Society of Civil Engineers (2011) ASCE Code of Ethics – Principles Study andApplication
20. Ethics in Engineering-M.W.Martin&R.Schinzinger,McGraw-Hill
21. Engineering Ethics, National Institute for EngineeringEthics,USA
22. www.ieindia.org
23. Engineering ethics: concepts and cases – C. E. Harris, M.S.Pritchard,M.J.Rabins
24. Resisting Bureaucratic Corruption: Alacrity Housing Chennai (TeachingCaseStudy) -S. Ramakrishna Velamuri -CEIBS
25. CONSTRUCTIONCONTRACTS,http://www.jnormanstark.com/contract.htm
26. Internet and Business Handbook, Chap 4, CONTRACTS LAW, http://www.laderapress.com/laderapress/contractslaw1.html
27. Contract &Agreements , http://www.tco.ac.ir/law/English/agreements/General/Contract%20Law/C.htm
28. Contracts,http://206.127.69.152/jgretch/crj/211/ch7.ppt
29. Business & Personal Law. Chapter 7. “How Contracts Arise”, http://yucaipahigh.com/schristensen/lawweb/lawch7.ppt
30. Types ofContracts,http://cmsu2.cmsu.edu/public/classes/rahm/meiners.con.ppt
31. IV. TYPES OF CONTRACTS AND IMPORTANTPROVISIONS, http://www.worldbank.org/html/opr/consult/guidetxt/types.html
32. Contract Types/Pricing Arrangements Guideline- 1.4.G (11/04/02), http://www.sandia.gov/policy/14g.pdf

Goals & Outcomes:

1. Introduction to what constitutes CivilEngineering
2. Identifying the various areas available to pursue and specialize within the overallfield of CivilEngineering
3. Highlighting the depth of engagement possible within each ofthesеareas

4. Exploration of the various possibilities of a career inthisfield
5. Understanding the vast interfaces this field has with the societyatlarge
6. Providing inspiration for doing creative andinnovativework
7. Showcasing the many monuments, heritage structures, nationally important infrastructure, and impressive projects to serve as sourcesofinspiration
8. Highlighting possibilities for taking up entrepreneurial activities inthisfield
9. Providing a foundation for the student to launch off upon an inspired academic pursuit into this branchofengineering.

BSC01	Biology	3L:0T:0P	3 credits

Theory=75 , Sessionals=25 ,Total=100 Duration of exam.=3 hours

Module 1. *(2 hours)- Introduction*

Purpose: To convey that Biology is as important a scientific discipline as Mathematics, Physics and Chemistry

Bring out the fundamental differences between science and engineering by drawing a comparison between eye and camera, Bird flying and aircraft. Mention the most exciting aspect of biology as an independent scientific discipline. Why we need to study biology? Discuss how biological observations of 18^{th} Century that lead to majordiscoveries. Examples from Brownian motion and the origin of thermodynamics by referring to the original observation of Robert Brown and Julius Mayor. These examples will highlight the fundamental importance of observations in any scientific inquiry.

Module 2. *(3 hours)- Classification*

Purpose: To convey that classification *per se* is not what biology is all about. The underlying criterion, such as morphological, biochemical or ecological behighlighted.

Hierarchy of life forms at phenomenological level. A common thread weaves this hierarchy Classification. Discuss classification based on (a) cellularity- Unicellular or multicellular (b) ultrastructure- prokaryotes or eucaryotes. (c) energy and Carbon utilization -Autotrophs, heterotrophs, lithotropes (d) Ammonia excretion – aminotelic, uricoteliec, ureotelic (e) Habitata-acquatic or terrestrial (e) Molecular taxonomy- three major kingdoms of life. A given organism can come under different category based on classification. Model organisms for the study of biology come from different groups. E.coli, S.cerevisiae, D. Melanogaster,

C. elegance, A. Thaliana, M.musculus

Module 3. *(4 hours)-Genetics*

Purpose: To convey that " Genetics is to biology what Newton's laws are to Physical Sciences" Mendel's laws, Concept of segregation and independent assortment. Concept of allele. Gene mapping, Gene interaction, Epistasis. Meiosis and Mitosis be taught as a part of genetics. Emphasis to be give not to the mechanics of cell division nor the phases but how genetic material passes from parent to offspring. Concepts of recessiveness and dominance. Concept of mapping of phenotype to genes. Discuss about the single gene disorders in humans. Discuss the concept of complementation using humangenetics.

Module 4. *(4 hours)-Biomolecules*

Purpose: To convey that all forms of life has the same building blocks and yet the manifestations are as diverse as one can imagine

Molecules of life. In this context discuss monomeric units and polymeric structures. Discuss about sugars, starch and cellulose. Amino acids and proteins. Nucleotides and DNA/RNA. Two carbon units and lipids.

Module 5. *(4 Hours). Enzymes*

Purpose: To convey that without catalysis life would not have existed on earth

Enzymology: How to monitor enzyme catalyzed reactions. How does an enzyme catalyzereactions. Enzyme classification. Mechanism of enzyme action. Discuss at least two examples. Enzyme kinetics and kinetic parameters. Why should we know these parameters to understand biology? RNAcatalysis.

Module 6. *(4 hours)- Information Transfer*

Purpose: The molecular basis of coding and decoding genetic information is universal Molecular basis of information transfer. DNA as a genetic material. Hierarchy of DNA structure- from single stranded to double helix to nucleosomes. Concept of genetic code. Universality and degeneracy of genetic code. Define gene in terms of complementation and recombination.

Module 7. *(5 hours). Macromolecular analysis*

Purpose: How to analyses biological processes at the reductionistic level

Proteins- structure and function. Hierarch in protein structure. Primary secondary, tertiary and quaternary structure. Proteins as enzymes, transporters, receptors and structural elements.

Module 8. *(4 hours)- Metabolism*

Purpose: The fundamental principles of energy transactions are the same in physical and biological world.

Thermodynamics as applied to biological systems. Exothermic and endothermic versus endergonic and exergoinc reactions. Concept of $K_{eq}$and its relation to standard free energy. Spontaneity. ATP as an energy currency. This should include the breakdown of glucose to $CO_2 + H_2O$ (Glycolysis and Krebs cycle) and synthesis of glucose from CO_2 and H_2O (Photosynthesis). Energy yielding and energy consuming reactions. Concept of Energy charge

Module 9. *(3 hours)- Microbiology*

Concept of single celled organisms. Concept of species and strains. Identification and classification of microorganisms. Microscopy. Ecological aspects of single celled organisms. Sterilization and media compositions. Growthkinetics.

References:

1) Biology: A global approach: Campbell, N. A.; Reece, J. B.; Urry, Lisa; Cain,M, L.; Wasserman, S. A.; Minorsky, P. V.; Jackson, R. B. Pearson EducationLtd

2) Outlines of Biochemistry, Conn, E.E; Stumpf, P.K; Bruening, G; Doi, R.H., John Wiley and Sons

3) Principles of Biochemistry (V Edition), By Nelson, D. L.; and Cox, M. M.W.H. Freeman and Company

4) Molecular Genetics (Second edition), Stent, G. S.; and Calender, R.W.H. Freeman and company, Distributed by Satish Kumar Jain for CBSPublisher

5) Microbiology,Prescott, L.M J.P. Harley andC.A.Klein1995. 2nd edition Wm, C. BrownPublishers

Course Outcomes

After studying the course, the student will be able to:

- Describe how biological observations of 18th Century that lead to majordiscoveries.
- Convey that classification *per se* is not what biology is all about but highlight theunderlying criteria, such as morphological, biochemicalandecological
- Highlight the concepts of recessiveness and dominance during the passage of genetic material from parenttooffspring
- Convey that all forms of life have the same building blocks and yet the manifestations are as diverse as onecanimagine
- Classify enzymes and distinguish between different mechanisms of enzymereaction.
- Identify DNA as a genetic material in the molecular basis ofinformationtransfer.
- Analyse biological processes at thereductionisticlevel
- Identify and classifymicroorganisms.

PCC-CV207R	**Building Materials and Testing**	**3L**	**3 credits**

Theory=75 , Sessionals=25 ,Total=100 Duration of exam.=3 hours

The objective of this Course is to deal with an experimental determination and evaluation of mechanical characteristics and advanced behavior of metallic and non-metallic structural materials. The course deals with explanation of deformation and fracture behavior of structural materials. The main goal of this course is to provide students with all information concerning principle, way of measurement, as well as practical application of mechanical characteristics.

- Make measurements of behavior of various materials used inCivilEngineering.
- Provide physical observations to complementconceptslearnt
- Introduce experimental procedures and common measurement instruments, equipment,devices.
- Exposure to a variety of established material testing proceduresandtechniques
- Different methods of evaluation and inferences drawnfromobservations

The course reviews also the current testing technology and examines force applications systems, force measurement, strain measurement, important instrument considerations, equipment for environmental testing, and computers applications for materials testing provide an introductory treatment of *basic skills in material engineering towards (i) selecting material for the design, and (ii) evaluating the mechanical and structural properties of material, as well as the knowledge necessary for a civil engineer.*The knowledge acquired lays a good foundation for analysis and design of various civil engineering structures/systems in areliablemanner.

What will I learn?

- Different materials used in civilengineeringapplications
- Planning an experimental program, selecting the test configuration, selecting the test specimens and collectingrawdata
- Documenting the experimental program including the test procedures, collected data, method of interpretation and finalresults
- Operating the laboratory equipment including the electronic instrumentation, the test apparatus and the data collectionsystem
- Measuring physical properties of common structural and geotechnical constructionmaterials

- Interpreting the laboratory data including conversion of the measurements intoengineering values and derivation of material properties (strength and stiffness) from the engineeringvalues
- Observing various modes of failure in compression, tension,andshear
- Observing various types of material behavior under similarloadingconditions

Proposed Syllabus

Module 1: *Introduction to Engineering Materials covering,* Cements, M-Sand, Stone aggregate, Concrete (plain, reinforced and steel fibre/ glass fibre-reinforced, light-weight concrete, High Performance Concrete, Polymer Concrete), Bricks, Ceramics, and Refractories, Bitumen and asphaltic materials, Timbers, Glass and Plastics, Structural Steel and other Metals, Paints and Varnishes, Carbon composites, ferrous and nonferrous metals.

Module 2: *Limes, cement, mortars:*Lime: Introduction, classification of lime, manufacturing, storage of lime
Cement: Introduction, cements composition, types of cement, manufacturing of ordinary Portland cement, special types of cement, storage of cement.
Mortars: Introduction, Different Compositions, mortars for masonry and plastering.

Module 3: *Concrete and Steel:* Concrete:Introduction, Different Compositions, aggregates, water and admixtures; properties of fresh and hardened concrete, variability of concrete strength, extreme weather concreting, Introductionto pre-stressed concrete; Durability of concrete - alkali aggregate reaction, reinforcement corrosion, freezing and thawing,etc.
Steel:Introduction, Different Types,Manufacturing Process, market forms of steel e.g. mild steel and HYSD steel bars, rolled steel sections, stainless steel**.**

Module 4: *Introduction to Material Testing*, Mechanical characteristics; Elasticity – principle and characteristics; Elastic and Plastic deformation of metals; Tensile tests processes, Different standards for materials (brittle, quasi-brittle, elastic and so on); hardness tests; Impact test. Bending and torsion test; creep – fundaments and characteristics;fracture toughness testing – different materials; concept of fatigue of materials.

Module 5: *Building Materials Testing:*Different material tests of as per IS Codes for cement, lime,sand, stone aggregate, concrete,soils, bricks, composites and cementitious materials.

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 andPavement Testing', Nem Chand& Bros,FifthEdition
3. Various related updated & recent standards of BIS, IRC, ASTM, RILEM, AASHTO, etc. corresponding to materialsused for CivilEngineeringapplications
4. Kyriakos Komvopoulos (2011), Mechanical Testing of EngineeringMaterials,Cognella
5. E.N. Dowling (1993), Mechanical Behaviour of Materials,Prentice Hall International Edition
6. AmericanSocietyforTestingandMaterials(ASTM),*AnnualBookofASTMStandards* (post 2000)

Measurable Outcomes:

One should be able to:

- Calibrate electronic sensors
- Operate a data acquisitionsystem
- Operate various types oftestingmachines
- Configure a testing machine to measure tension or compressionbehavior
- Compute engineering values (e.g. stress or strain) from laboratorymeasures
- Analyze a stress versus strain curve for modulus, yield strength and other related attributes
- Identify modes offailure
- Write a technical laboratoryreport

PCC-CV207P	Materials Testing Lab

Practicals(2 hr/week-1 credit):

- Standard consistency of cement using Vicat`sapparatus.
- Soundness of cement by Le-Chatelier`sapparatus.
- Setting time of cement, initial and final ofcement.
- Compressive strength ofcement.
- A) Measurement of specific gravity ofcement.

  B) Measurement of Heat of Hydration of cement.
- Gradation of coarse and fineaggregates
- Workability of cement concrete by (a) Slump test (b) Compaction factor test (c) Flow tabletest.
- Compressive strength of concrete by (a) Cube test, (b) Cylindertest
- Indirect tensile strength of concrete-split cylindertest.
- Modules of rupture of concrete by flexuretest.
- Bond strength between steel bar and concrete by pull-outtest.
- Non-destructive testing ofconcrete.
- Concrete Mix Design as perBIS

4thSemester

PCC-CE202R	Geology for Engineers	3L	3 credits

Theory=75 , Sessionals=25 ,Total=100 Duration of exam.=3 hours

The objective of this Course is to focus on the core activities of engineering geologists – site characterization and geologic hazard identification and mitigation. Through lectures, labs, and case study examination student will learn to couple geologic expertise with the engineering properties of rock and unconsolidated materials in the characterization of geologic sites for civil work projects and the quantification of processes such as rock slides, soil-slope stability, settlement, andliquefaction.

Engineering geology is an applied geology discipline that involves the collection, analysis, and interpretation of geological data and information required for the safe development of civil works. Engineering geology also includes the assessment and mitigation of geologic hazards such earthquakes, landslides, flooding; the assessment of timber harvesting impacts; and groundwater remediation and resource evaluation. Engineering geologists are applied geoscientists with an awareness of engineering principles and practice—they are not engineers.

Proposed Syllabus:

Module 1: Introduction-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- GSI, Granite Dimension Stone Cell, NIRM. Mineralogy-Mineral, Origin and composition. Physical properties of minerals, susceptibility of minerals to alteration, basic of optical mineralogy, SEM, XRD., Rock forming minerals, megascopic identification of common primary &secondaryminerals.

Module 2: Petrology-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 ofdepth of formation, and their characteristics. Chemical and Mineralogical Composition. Texture and its types. Various forms of rocks. IUGS Classification of phaneritic and volcanic rock..FieldClassification chart. Structures. Classification of Igneous rocks on the basis ofChemical composition. Detailed study of Acidic Igneous rocks like Granite, Rhyolite or Tuff, Felsite, Pegmatite, Hornfels. Metamorphic Aureole, Kaolinization. Landform as Tors. 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 engineeringconsideration.

Module3: Physical Geology- 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, Residual deposits of Clay with flints, Solifluction deposits, mudflows, Coastal deposits.

Module 4:Strength Behavior of Rocks- 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 rockstructures.

Module 5: Geological Hazards- Rock Instability and Slope movement: Concept of sliding blocks. Different controlling factors. Instability in vertical rock structures and measures to prevent collapse. . Types of landslide. Prevention by surface drainage, slope reinforcement by Rock bolting and Rock anchoring, retaining wall, Slope treatment. Case study on black clay. Ground water: Factors controlling water bearing capacity of rock. Pervious & impervious rocks and ground water. Lowering of water table and Subsidence. Earthquake: Magnitude and intensity of earthquake. Seismic sea waves. Revelation from Seismic Records of structure of earth. Seismic ZoneinIndia.

Module 6: Rock masses as construction material: 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.

Module 7: Geology of dam and reservoir site- 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.

Demonstration :

i. Study of physical propertiesofminerals.
ii. Study of different group ofminerals.
iii. Study of Crystal andCrystalsystem.
iv. Identification of minerals: Silica group: Quartz, Amethyst, Opal; Feldspar group: Orthoclase, Plagioclase; Cryptocrystalline group: Jasper; Carbonate group: Calcite; Element group: Graphite; Pyroxene group: Talc; Mica group: Muscovite; Amphibole group: Asbestos, Olivine, Hornblende, Magnetite, Hematite, Corundum, Kyanite, Garnet,Galena,Gypsum.

v. Identification of rocks (Igneous Petrology): Acidic Igneous rock: Granite and its varieties, Syenite, Rhyolite, Pumice, Obsidian, Scoria, Pegmatite, Volcanic Tuff. Basic rock: Gabbro, Dolerite, Basalt and itsvarieties,Trachyte.
vi. Identification of rocks (Sedimentary Petrology): Conglomerate, Breccia, Sandstone and its varieties , Laterite, Limestone and its varieties, Shales anditsvarieties.
vii. Identification of rocks (Metamorphic Petrolody): Marble, slate, Gneiss and its varieties, Schist and its varieties.Quartzite,Phyllite.

Text/Reference Books:

1. Engineering and General Geology, Parbin Singh, 8th Edition (2010), S K Kataria&Sons.
2. Text Book of Engineering Geology, N. ChennaKesavulu, 2nd Edition (2009), Macmillan PublishersIndia.

3. Geology for Geotechnical Engineers, J.C.Harvey, Cambridge UniversityPress(1982).

What will I learn?

Students will be able to:

- Use suitable software to examine geology, soil, geologic hazard, and NEHRP data to characterize ageologicsite.
- Calculate the bulk properties of rocks and unconsolidated sediments such as density, void ratio, water contents, andunitweights.
- Evaluate rock-mass quality and perform akinematicanalysis.
- Apply the factor of safety equation to solve planar rock slide andtopplingproblems.
- Perform a grain-size analysis, determine plastic and liquid limits, and classify soils using the Unified Soil ClassificationSystem.
- Calculate soil consolidation magnitudes and rates under inducedstressconditions.
- Determine soil strength parameters from insitutests.
- Apply the method of slices and factor of safety equation to solve rotational slideproblems.

Outcomes:

Students will understand:

i) Site characterization and how to collect, analyze, and report geologic data using standards in engineeringpractice

ii) The fundamentals of the engineering properties of Earth materialsandfluids.

iii) Rock mass characterization and the mechanics of planar rockslidesandtopples.

iv) Soil characterization and the Unified Soil ClassificationSystem.

v) The mechanics of soils and fluids and their influence on settlement, liquefaction, and soil slopestability.

PCC-CE203R	**Disaster Preparedness &Management**	**3L**	**3 credits**

Theory=75 , Sessionals=25 ,Total=100 Duration of exam.=3 hours

The overall aim of this course is to provide broad understanding about the basic concepts of Disaster Management with preparedness as a Civil Engineer. Further, the course introduces the various natural hazards that can pose risk to property, lives, and livestock, etc. and

understanding of the social responsibility as an engineer towards preparedness as well as mitigating the damages.

The objectives of the course are i) To Understand basic concepts in Disaster Management ii)ToUnderstand Definitions and Terminologies used in Disaster Management iii)To Understand Types and Categories of Disasters iv). To Understand the Challenges posed by Disasters vi) To understand Impacts of Disasters Key Skills

Proposed Syllabus

Module 1: Introduction- Concepts and definitions: disaster, hazard, vulnerability, risks- severity, frequency and details, capacity, impact, prevention, mitigation).

Module 2:Disasters- Disasters classification; natural disasters (floods, draught, cyclones, volcanoes, earthquakes, tsunami, landslides, coastal erosion, soil erosion, forest fires etc.); manmade disasters(industrialpollution,artificialfloodinginurbanareas,nuclearradiation,chemicalspills,

transportation accidents, terrorist strikes, etc.); hazard and vulnerability profile of India, mountain and coastal areas, ecologicalfragility.

Module 3:Disaster Impacts - Disaster impacts (environmental, physical, social, ecological, economic, political, etc.); health, psycho-social issues; demographic aspects (gender, age, special needs); hazard locations; global and national disaster trends; climate change andurbandisasters.

Module 4: Disaster Risk Reduction (DRR) - Disaster management cycle – its phases; prevention, mitigation, preparedness, relief and recovery; structural and non-structural measures; risk analysis, vulnerability and capacity assessment; early warning systems, Post- disaster environmental response (water, sanitation, food safety, waste management, disease control, security, communications); Roles and responsibilities of government, community, local institutions, NGOs and other stakeholders; Policies and legislation for disaster risk reduction, DRR programmes in India and the activities of National Disaster ManagementAuthority.

Module 5: Disasters, Environment and Development - Factors affecting vulnerability such as impact of developmental projects and environmental modifications (including of dams, land- use changes, urbanization etc.), sustainable and environmental friendly recovery; reconstruction and developmentmethods.

Text/Reference Books:

1. http://ndma.gov.in/ (Home page of National DisasterManagementAuthority)
2. http://www.ndmindia.nic.in/ (National Disaster management in India, Ministry of Home Affairs).
3. Pradeep Sahni, 2004, Disaster Risk Reduction in South Asia,PrenticeHall.
4. Singh B.K., 2008, Handbook of Disaster Management: Techniques & Guidelines, Rajat Publication.
5. Ghosh G.K., 2006, Disaster Management, APHPublishingCorporation
6. Disaster Medical Systems Guidelines. Emergency Medical Services Authority, State of California, EMSA no.214,June2003
7. Inter Agency Standing Committee (IASC) (Feb. 2007). IASC Guidelines on Mental Health and Psychosocial Support in Emergency Settings.Geneva:IASC

Outcomes:

The student will develop competencies in

- the application of Disaster ConceptstoManagement
- Analyzing Relationship between DevelopmentandDisasters.
- Ability to understand Categories ofDisastersand
- realization of the responsibilitiestosociety

PCC-CE204R	**Basics of Fluid Mechanics**	**3L**	**3 credits**

Theory=75 , Sessionals=25 ,Total=100 Duration of exam.=3 hours

The objective of this course is to introduce the concepts of fluid mechanics useful in Civil Engineering applications. The course provides a first level exposure to the students to fluid statics, kinematics and dynamics. Measurement of pressure, computations of hydrostatic forces on structural components and the concepts of Buoyancy all find useful applications in many engineeringproblems.Atrainingtoanalyseengineeringproblemsinvolvingfluids–suchasthose

dealing with pipe flow, open channel flow, jets, turbines and pumps, dams and spillways, culverts, river and groundwater flow - with a mechanistic perspective is essential for the civil engineering students. The topics included in this course are aimedto prepare a student to build a good fundamental background useful in the application-intensive courses covering hydraulics, hydraulic machinery and hydrology in latersemesters.

Module 1: Basic Concepts and Definitions – 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; vapour pressure, boiling point, cavitation; surface tension, capillarity, Bulk modulus of elasticity,compressibility.

Module 2: Fluid Statics - Fluid Pressure: Pressure at a point, Pascals law, pressure variation with temperature, density and altitude. Piezometer, U-Tube Manometer, Single Column Manometer, U-Tube Differential Manometer, Micromanometers. pressure gauges, Hydrostatic pressure and force: horizontal, vertical and inclined surfaces. Buoyancy and stability of floatingbodies.

Module 3: Fluid Kinematics- 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; Stream line, path line, streak line and stream tube; stream function, velocity potential function. One-, two- and three -dimensional continuity equations in Cartesian coordinates

Module 4: Fluid Dynamics- Surface and body forces; Equations of motion - Euler's equation; Bernoulli's equation – derivation; Energy Principle; Practical applications of Bernoulli's equation : venturimeter, orifice meter and pitot tube; Momentum principle; Forces exerted by fluid flow on pipe bend; Vortex Flow – Free and Forced; Dimensional Analysis and Dynamic Similitude - Definitions of Reynolds Number, Froude Number, Mach Number, Weber *Number and Euler Number; Buckingham's*π-Theorem.

Text/Reference Books:

1. Fluid Mechanics and Machinery, C.S.P.Ojha, R. Berndtsson and P. N. Chadramouli, Oxford UniversityPress,2010
2. Hydraulics and Fluid Mechanics, P M Modi and S M Seth, StandardBookHouse
3. Theory and Applications of Fluid Mechanics, K. Subramanya, TataMcGrawHill
4. Fluid Mechanics with Engineering Applications, R.L. Daugherty, J.B. Franzini and E.J. Finnemore, International Student Edition, McGrawHill.

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

- Understand the broad principles of fluid statics, kinematicsanddynamics
- Understand definitions of the basic terms used influidmechanics
- Understand classifications offluidflow
- Be able to apply the continuity, momentum andenergyprinciples
- Be able to applydimensionalanalysis

PCC-CE204P	Fluid Mechanics Lab

P- 02 Hours: 1 Credit

Lab Experiments

1. Measurement ofviscosity
2. Study of PressureMeasuringDevices
3. Stability ofFloatingBody
4. Hydrostatics Force on FlatSurfaces/CurvedSurfaces
5. Verification ofBernoulli'sTheorem
6. Venturimeter
7. Orificemeter
8. Impactsofjets
9. FlowVisualisation–IdealFlow
10. Length of establishmentofflow
11. Velocity distribution inpipes
12. LaminarFlow

PCC-CE205R	Basics of Solid Mechanics	3L:1T	4 credits

Theory=75 , Sessionals=25 ,Total=100 Duration of exam.=3 hours

The objective of this Course is to introduce to continuum mechanics and material modelling of engineering materials based on first energy principles: deformation and strain; momentum balance, stress and stress states; elasticity and elasticity bounds; plasticity and yield design. The overarching theme is a unified mechanistic language using thermodynamics, which allows understanding, modelling and design of a large range of engineering materials. The subject of mechanics of materials involves analytical methods for determining the strength, stiffness (deformation characteristics), and stability of the various members in a structural system. The behaviour of a member depends not only on the fundamental laws that govern the equilibrium of forces, but also on the mechanical characteristics of the material. These mechanical characteristics come from the laboratory, where materials are tested under accurately known forces and their behavior is carefully observed and measured. For this reason, mechanics of materials is a blended science of experiment and Newtonian postulates of analyticalmechanics.

Proposed Syllabus

Module1: *Simple Stresses and Strains*- Concept of stress and strain, St. Venant's principle, stress and strain diagram,Elasticity and plasticity – Types of stresses and strains, Hooke's law – stress – strain diagram for mild steel – Working stress – Factor of safety – Lateral strain, Poisson's ratio and volumetric strain – Elastic moduli and the relationship between them – Barsofvaryingsection–compositebars–Temperaturestresses.StrainEnergy–Resilience – Gradual, sudden, impact and shock loadings – simpleapplications.

Module 2: Compound Stresses and Strains- Two dimensional system, stress at a point on a plane, principal stresses and principal planes, Mohr circle of stress, ellipse of stress and their applications. Two dimensional stress-strain system, principal strains and principal axis of strain, circle of strain and ellipse of strain. Relationship between elastic constants.

Module 3: Bending moment and Shear Force Diagrams- Bending moment (BM) and shear force (SF) diagrams.BM and SF diagrams for cantilevers simply supported and fixed beams with or without overhangs. Calculation of maximum BM and SF and the point of contra flexure under

concentrated loads, uniformly distributed loads over the whole span or part of span, combination of concentrated loads (two or three) and uniformly distributed loads, uniformly varying loads, application of moments.

Module 4: *Flexural Stresses-Theory of simple bending* – Assumptions – Derivation of bending equation: M/I = f/y = E/R - Neutral axis – Determination of bending stresses – Section modulus of rectangular and circular sections (Solid and Hollow), I,T, Angle and Channel sections – Design of simple beam sections.

Module 5: *Shear Stresses- Derivation of formula* – Shear stress distribution across various beam sections like rectangular, circular, triangular, I, T angle sections.

Module 6: Slope and deflection- Relationship between moment, slope and deflection, Moment area method, Macaulay's method. Use of these methods to calculate slope and deflection for determinant beams.

Module 7: Torsion- Derivation of torsion equation and its assumptions. Applications of the equation of the hollow and solid circular shafts, torsional rigidity, Combined torsion and bending of circular shafts, principal stress and maximum shear stresses under combined loading of bending and torsion. Analysis of close-coiled-helical springs.

Module 8: Thin Cylinders and Spheres- Derivation of formulae and calculations of hoop stress, longitudinal stress in a cylinder, and sphere subjected to internal pressures.

Text/Reference Books:

1. Timoshenko, S. and Young, D. H., "Elements of Strength of Materials", DVNC, New York,USA.
2. Kazmi, S. M. A., "Solid Mechanics" TMH,Delhi,India.
3. Hibbeler, R. C. Mechanics of Materials. 6th ed. East Rutherford, NJ: Pearson Prentice Hall,2004
4. Crandall, S. H., N. C. Dahl, and T. J. Lardner. An Introduction to the Mechanicsof Solids. 2nd ed. New York, NY: McGrawHill,1979
5. Laboratory Manual of Testing Materials - WilliamKendrickHall
6. Mechanics of Materials - Ferdinand P. Beer, E. Russel Jhonston Jr., JohnT.DEwolf – TMH 2002.
7. Strength of Materials by R. Subramanian, Oxford University Press, NewDelhi.

Outcomes:

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

- Describe the concepts and principles, understand the theory of elasticity including strain/displacement and Hooke's law relationships; and perform calculations, relative to the strength and stability of structures andmechanicalcomponents;
- Define the characteristics and calculate the magnitude of combined stresses in individual members and complete structures; analyze solid mechanics problems using classical methods and energymethods;
- Analyse various situations involving structural members subjected to combined stresses by application of Mohr's circle of stress; locate the shear center of thinwallbeams;and
- Calculate the deflection at any point on a beam subjected to a combination of loads; solve for stresses and deflections of beams under unsymmetrical loading; apply various failure criteria for general stress states at points; solve torsion problems in bars and thinwalledmembers.

PCC-CE206R	Surveying & Engineering Geomatics	3L	3 credits

Theory=75 , Sessionals=25 ,Total=100 Duration of exam.=3 hours

Course Objectives

With the successful completion of the course, the student should have the capability to:

a) describe the function of surveying in civil engineeringconstruction,

b) Work with survey observations, andperformcalculations,

c) Customary units of measure. Identify the sources of measurement errors and mistakes; understand the difference between accuracy and precision as it relates to distance, differential leveling, andangularmeasurements,

d) Be familiar with the principals of recording accurate, orderly, complete, and logical field notes from surveying operations, whether recorded manually or with automatic data collection methods,

e) Identify and calculate the errors in measurements and to develop corrected values for differential level circuits, horizontal distances and angles for open or closed-looptraverses,

f) Operate an automatic level to perform differential and profile leveling; properly record notes; mathematically reduce and checklevellingmeasurements,

g) Effectively communicate with team members during field activities; identify appropriate safety procedures for personal protection; properly handle and use measurement instruments. Be able to identify hazardous environments and take measures to insure one's personal andteamsafety,

h) Measure horizontal, vertical, and zenith angles with a transit, theodolite, total station or survey grade GNSSinstruments,

i) Calculate azimuths, latitudes and departures, error of closure; adjust latitudes and departures and determine coordinates for aclosedtraverse,

j) Perform traverse calculations; determine latitudes, departures, and coordinates of control points and balancing errors in a traverse. Use appropriate software for calculations andmapping,

k) Operate a total station to measure distance, angles, and to calculate differences in elevation. Reduce data for application in a geographicinformationsystem,

l) Work as a team member on a surveying party to achieve a common goal of accurate and timelyprojectcompletion,

m) Calculate, design and layout horizontal and vertical curves, Understand, interpret, and prepare plan, profile, and cross-section drawings, Work with cross-sections and topographic maps to calculate areas, volumes, andearthworkquantities.

Proposed Syllabus:

Module 1: *Introduction to Surveying (8 hours):* Principles, Linear, angular and graphical methods, Survey stations, Survey lines- ranging, Bearing of survey lines, Levelling: Plane table surveying, Principles of levelling- booking and reducing levels; differential, reciprocal leveling, profile levelling and cross sectioning. Digital and Auto Level, Errors in levelling; contouring: Characteristics, methods, uses; areas andvolumes.

*Triangulation and Trilateration (6 Hours)***:** Theodolite survey: Instruments, Measurement of horizontal and vertical angle; Horizontal and vertical control - methods -triangulation - network-Signals. Baseline - choices - instruments and accessories - extension of base lines - corrections - Satellite station - reduction to centre - Intervisibility of height and distances - Trigonometric leveling - Axis singlecorrections.

Module 2: Curves (6 hours) Elements of simple and compound curves – Method of setting out– Elements of Reverse curve - Transition curve – length of curve – Elements of transition curve - Vertical curves

Module 3: *Modern Field Survey Systems (8 Hours)*: Principle of Electronic Distance Measurement, Modulation, Types of EDM instruments, Distomat, Total Station – Parts of a Total Station – Accessories –Advantages andApplications,

Field Procedure for total station survey, Errors in Total Station Survey; Global Positioning Systems- Segments, GPS measurements, errors and biases, Surveying with GPS, Co-ordinate transformation, accuracyconsiderations.

Module 4: *Photogrammetry Surveying (8 Hours)*: Introduction, Basic concepts, perspective geometry of aerial photograph, relief and tilt displacements, terrestrial photogrammetry, flight planning; Stereoscopy, ground control extension for photographic mapping- aerial triangulation, radial triangulation, methods; photographic mapping- mapping using paper prints, mapping using stereoplotting instruments, mosaics, mapsubstitutes.

Module 5: *Remote Sensing (9 Hours)*: Introduction –Electromagnetic Spectrum, interaction of electromagnetic radiation with the atmosphere and earth surface, remote sensing data acquisition: platforms and sensors; visual image interpretation; digital imageprocessing.

PCC-CE206P	**Surveying Lab**, P=2hr, I Credit

Practicals:

1. Chain surveying: Chaining and chaintraversing.

2. Compasstraversing.

3. Leveling: Profile leveling and plotting of longitudinal section and cross sections, Y leveling. Permanent adjustment of level, reciprocal leveling, Contouring and preparation contourmap.

4. Plane tabling: methods of plane table surveying, two point & three pointproblems

5. Setting of simple circular curves by offset method, off set from chord produced, off set from long chord and by deflection angle method

6. Theodolite: Study of theodolite, measurement of horizontal angle, measurement of vertical angle, Permanentadjustment.

7. Tachometry: Tachometric constants, calculating horizontal distance and elevations with the help oftachometer.

8. An exercise of triangulation including base linemeasurement.

9. Total station: Study of Total station, measurement, Permanent adjustment andexercise

Text/Reference Books:

1 Madhu, N, Sathikumar, R and Satheesh Gobi, Advanced Surveying: Total Station, GIS and Remote Sensing, PearsonIndia,2006.

2 Manoj, K. Arora and Badjatia, Geomatics Engineering, Nem Chand &Bros,2011
3 Bhavikatti, S.S., Surveying and Levelling, Vol. I and II, I.K.International,2010
4Chandra, A.M., Higher Surveying, Third Edition, New Age International (P) Limited,2002.
5Anji Reddy, M., Remote sensing and Geographical information system, B.S. Publications,2001.
6 Arora, K.R., Surveying, Vol-I, II and III, Standard Book House,2015.

Outcomes:

The course will enable the students to:

- Apply the knowledge, techniques, skills, and applicable tools of the discipline to engineering andsurveyingactivities
- Translate the knowledge gained for the implementation of Civil infrastructurefacilities
- Relate the knowledge on Surveying to the new frontiers of science like Hydrographic surveying, Electronic Distance Measurement, Global Positioning System, Photogrammetry and RemoteSensing.

ESC209	**Mechanical Engineering**	**2L:1T: 0P**	**3 credits**

Theory=75 , Sessionals=25 ,Total=100 Duration of exam.=3 hours

Module 1:Basic Concepts- Basic concepts - concept of continuum, macroscopic approach, Thermodynamic systems - closed, open and isolated. Property, state, path and process, quasistatic process, work, modes of work. Zeroth law of thermodynamics, concept of temperature and heat. Concept of ideal and real gases.

Module 2: First Law of Thermodynamics- Concepts of Internal Energy, Specific Heat Capacities, Enthalpy. Energy Balance for Closed and Open Systems, Energy Balance for Steady-Flow Systems. Steady-Flow Engineering Devices. Energy Balance for Unsteady- Flow

Module 3: Second Law of Thermodynamics- Thermal energy reservoirs, heat engines energy conversion, Kelvin's and Clausius statements of second law, the Carnot cycle, the Carnot Theorem, the thermodynamic temperature scale, the Carnot heat engine, efficiency, the Carnot refrigerator and heat pump, COP. Clausius inequality, concept of entropy, principle of increase of entropy – availability, the increase of entropy principle, perpetual-motion machines, reversible and irreversible processes, Entropy change of pure substances, isentropic processes, property diagrams involving entropy, entropy change of liquids and solids, the entropy change of ideal gases, reversible steady-flow work, minimizing the compressor work, isentropic efficiencies of steady-flow devices, and entropy balance. Energy

- a measure of work potential, including work potential of energy, reversible work and irreversibility, second-law efficiency, exergy change of a system, energy transfer by heat, work, and mass, the decrease of exergy principle and exergy destruction, energy balance: closed systems and control volumes energybalance.

Module 4: Properties Of Pure Substance- Properties of pure substances. Thermodynamic properties of pure substances in solid, liquid and vapour phases. Phase rule, P-V, P-T, T-V, T-S, H-S diagrams, PVT surfaces. Thermodynamic properties of steam. Calculations of work done and heat transfer in non- flow and flow processes.

Module 5: PowerCycles- Vapour and combined power cycles, including the Carnot vapor cycle, Rankine cycle: the ideal cycle for vapor power, the ideal reheat and regenerative and the second-law analysis of vapour power cycles. Gas power cycles, including basic considerations in the analysis of power cycles, the Carnot cycle and its value in engineering, anoverviewofreciprocatingengines,airstandardassumptions,gasolineengineOttocycle, diesel engine cycle, gas-turbine Brayton cycle, and the second-law analysis of gas power cycles.

Module 6: Psychrometry and psychrometric charts, property calculations of air vapour mixtures. Psychrometric process – Sensible heat exchange processes. Latent heat exchange processes. Adiabatic mixing, evaporative cooling. Use of standard thermodynamic tables, Mollier diagram, Psychometric chart and Refrigerant property tables. Refrigeration cycles, including refrigerators and heat pumps, the ideal reversed Carnot vapour-compression refrigeration cycle, actual vapor-compression refrigeration cycles, heat pump systems, gas refrigeration cycles, and absorption refrigeration systems.

Text/Reference Books:

1. Nag.P.K., "Engineering Thermodynamics", Tata McGraw-Hill,NewDelhi.
2. Cengel, Thermodynamics–AnEngineeringApproach *Tata McGrawHill,New* Delhi.
3. Sonntag, R. E., Borgnakke, C., &Wylen, G. J. V. Fundamentals of thermodynamics:Wiley.
4. Moran, M. J., Shapiro, H. N., Boettner, D. D., & Bailey, M. Fundamentals ofEngineering 1. Thermodynamics: John Wiley & Sons.
5. Jones, J. B., & Dugan, R. E. Engineering thermodynamics:PrenticeHall.
6. Potter, M. C., & Somerton, C. W. Schaum's Outline of Thermodynamics for Engineers,McGraw-Hill.

Upon successful completion of the course, student will have:

- Ability to apply mathematics, science, andengineering
- Ability to design and conduct experiments, as well as to analyze andinterpretdata
- Ability to identify, formulate, and solveengineeringproblems
- Ability to apply modern engineering tools, techniques and resources to solve complex mechanical engineering activities with an understanding ofthelimitations.
- Ability to comprehend the thermodynamics and their corresponding processes that influence the behaviour and response of structuralcomponents
- Ability to apply principles of engineering, basic science, and mathematics (including multivariate calculus and differential equations) and thermodynamics to model, analyze, design, and realize physical systems, components,orprocesses.

5thSemester

PCC-CE301R	Basics of Mechanics of Materials	2L:1T:0P	3 credits

Theory=75 , Sessionals=25 ,Total=100 Duration of exam.=3 hours

The objective of this Course is to introduce to continuum mechanics and material modeling of engineering materials based on first energy principles: deformation and strain; momentum balance, stress and stress states; elasticity and elasticity bounds; plasticity and yield design. The overarching theme is a unified mechanistic language using thermodynamics, which allows understanding, modelling and design of a large range of engineering materials. The subject of mechanics of materials involves analytical methods for determining the strength, stiffness (deformation characteristics), and stability of the various members in a structural system. The behavior of a member depends not only on the fundamental laws that govern the equilibrium of forces, but also on the mechanical characteristics of the material. These mechanical characteristics come from the laboratory, where materials are tested under accurately known forces and their behavior is carefully observed and measured (learnt in the previous course on Materials, Testing & Evaluation). For this reason, mechanics of materials is a blended science of experiment and Newtonian postulates of analyticalmechanics.

What will Ilearn?

- Understand the deformation and strains under different load action and response in terms of forcesandmoments
- Understand the behaviour under differentloadingactions
- Application of engineering principles to calculate the reactions, forces andmoments
- Understand the energy methods used to derive the equations to solve engineeringproblems
- Make use of the capabilities to determine the forces and momentsfordesign

Proposed Syllabus

Module 1: *Deformation and Strain covering* description of finite deformation, Infinitesimal deformation; Analysis of statically determinate trusses; Stability of dams, retaining walls and chimneys; Stress analysis of thin, thick and compound cylinder;

Module 2:*Generalized state of stress and strain:* Stress and strain tensor, Yield criteria and theories of failure; Tresca, Von-Mises, Hill criteria, Heigh-Westerguard's stress space.

Module 3:*Momentum Balance and Stresses covering* Forces and Moments Transmitted by Slender Members, Shear Force and Bending Moment Diagrams, Momentum Balance, Stress States / Failure Criterion

Module 4:*Mechanics of Deformable Bodies covering* Force-deformation Relationships and Static Indeterminacy, Uniaxial Loading and Material Properties, Trusses and Their Deformations, Statically Determinate and IndeterminateTrusses,

Module 5:*Force-Stress-Equilibrium covering* Multiaxial Stress and Strain

Module 6: *Displacement – Strain covering* Multiaxial Strain and Multiaxial Stress-strain Relationships

Module 7: *Elasticity and Elasticity Bounds covering*Stress-strain-temperature Relationships and Thin-walled Pressure Vessels,Stress and strain Transformations and Principal Stress, Failure of Materials,

Module 8:*Bending: Stress and Strains; Deflections and Torsion covering* Pure Bending, Moment-curvature Relationship, Beam Deflection, Symmetry, Superposition, and Statically Indeterminate Beams, Shear and Torsion, Torsion and Twisting, Thermoelasticity, Energy methods, Variational Methods; Strain energy, elastic, complementary and total strain energy, Strain energy of axially loaded bar, Beam in bending, shear and torsion; General energy theorems, Castigliano's theorem, Maxwell Bettie's reciprocal theorem; Virtual work and unit load method for deflection, Application to problems of beams and frames.

Module 9:*Structural stability;* Stability of columns, Euler's formula, end conditions and effective length factor, Columns with eccentric and lateral load; Plasticity and Yield Design covering 1D-Plasticity – An Energy Approach, Plasticity Models, Limit Analysis and Yield Design

Text/Reference Books:

1. Norris, C.H. and Wilber, J. B. and Utku, S. "Elementary Structural Analysis" Mc GrawHill, Tokyo,Japan.
2. Timoshenko, S. and Young, D. H., "Elements of Strength of Materials", DVNC, New York,USA.
3. Kazmi, S. M. A., 'Solid Mechanics" TMH,Delhi,India.
4. Hibbeler, R. C. Mechanics of Materials. 6th ed. East Rutherford, NJ: Pearson PrenticeHall,2004
5. Crandall, S. H., N. C. Dahl, and T. J. Lardner. An Introduction to the Mechanics of Solids. 2nd ed. New York, NY: McGrawHill,1979
6. Gere, J. M., and S. P. Timoshenko. *Mechanics of Materials.* 5th ed. Boston: PWS Kent Publishing,1970.
7. Ashby, M. F., and D. R. H. Jones. *Engineering Materials, An Introduction to their Properties and Applications.* 2nd ed. ButterworthHeinemann.
8. Collins, J. A. *Failure of Materials in Mechanical Design.* 2nd ed. John Wiley & Sons,1993.
9. Courtney, T. H. *Mechanical Behavior of Materials.*McGraw-Hill,1990.
10. Hertzberg, R. W. *Deformation and Fracture Mechanics of Engineering Materials.* 4th ed. John Wiley &Sons,1996.
11. Nash, W. A. *Strength of Materials.* 3d ed. Schaum's Outline Series,McGraw-Hill,1994.

Outcomes:

At the end of the course, the student will have

- an ability to apply knowledge of mathematics, science, andengineering
- an ability to design a system, component, or process to meet desiredneeds
- an ability to identify, formulate, and solveengineeringproblems
- the broad education necessary to understand the impact of engineering solutions in a global andsocietalcontext
- an ability to use the techniques, skills, and modern engineering tools necessary for engineeringpractice.
- an ability to apply principles of engineering, basic science, and math to model, analyze, design and realize physical systems, componentsorprocesses

PCC-CE303R	Structural Engineering and Design	4L	4 credits

Theory=75 , Sessionals=25 ,Total=100 Duration of exam.=3 hours

Objectives:

This course aims at providing students with a solid background on principles of structural engineering design. Students will be exposedto the theories and concepts of both concrete and steel design and analysis both at the element and system levels. Hands-on design experience and skills will be gained and learned through problem sets and a comprehensive design project. An understanding of real-world open-ended design issues will be developed. Weekly recitations and project discussions will be heldbesideslectures.

Module 1: Introduction- concepts of energy principles, safety, sustainable development in performance; what makes a structure; principles of stability, equilibrium; what is a structural engineer, role of engineer, architect, user, builder; what are the functions' what do the engineers design, first principles of process of design

Module 2: Planning and Design Process; Materials, Loads, and Design Safety; Behaviour and Properties of Concrete and Steel; Wind and EarthquakeLoads

Module 3: *Materials and Structural Design Criteria:* Introduction to the analysis and design of structural systems. Analyses of determinate and indeterminate trusses, beams, and frames, and design philosophies for structural engineering. Laboratory experiments dealing with the analysis of determinate and indeterminatestructures;

Module 4:*Design of Structural Elements;* Concrete Elements, Steel Elements, Structural Joints; Theories and concepts of both concrete and steel design and analysis both at the element and system levels. Approximate Analysis Methods as a Basis for Design; Design of

Introduction to Reinforced Concrete Beams for Flexure; Design of Reinforced Concrete Beams for Shear; Bond, Anchorage, and Serviceability; Reinforced Concrete Columns; Reinforced Concrete Slabs; Introduction to Steel Design; Tension Members and Connections; Bending Members; Structural Systems

Module 5: *System Design Concepts;* Special Topics that may be Covered as Part of the Design Project Discussions; Cable Structures; Prestressed Concrete Bridges; Constructability and Structural Control; Fire Protection

Text/Reference Books:

1. Nilson, A. H. *Design of Concrete Structures.* 13th edition. McGrawHill,2004
2. McCormac, J.C., Nelson, J.K. Jr., *Structural Steel Design*. 3rd edition. Prentice Hall, N.J.,2003.
3. Galambos, T.V., Lin, F.J., Johnston, B.G., *Basic Steel Design with LRFD*, PrenticeHall,1996
4. Segui, W. T., *LRFD Steel Design*, 2nd Ed., PWSPublishing,Boston.
5. Salmon, C.G. and Johnson, J.E., *Steel Structures: Design and Behavior*, 3rd Edition, Harper & Row, Publishers, NewYork,1990.
6. MacGregor, J. G., *Reinforced Concrete: Mechanics and Design*, 3rd Edition, Prentice Hall, NewJersey,1997.
7. Nawy, E. G., *Reinforced Concrete: A Fundamental Approach*, 5th Edition, Prentice Hall, NewJersey.

8. Wang C-K. and Salmon, C. G., *Reinforced Concrete Design*, 6th Edition, Addison Wesley, NewYork.
9. Nawy, E. G. *Prestressed Concrete: A Fundamental Approach*, Prentice Hall, NJ,(2003).
10. Related Codes of PracticeofBIS
11. Smith, J. C., *Structural Analysis*, Harpor and Row, Publishers,NewYork.
12. W. McGuire, R. H. Gallagher and R. D. Ziemian. "Matrix Structural Analysis", 2nd Edition, John Wiley andSons,2000.
13. NBC, *National Building Code*,BIS(2017).
14. ASCE, *Minimum Design Loads for Buildings and Other Structures, ASCE 7-02*, American Society of Civil Engineers,Virginia,2002.

Outcomes:

- The students will be able to apply their knowledge of structural mechanics in addressing design problems ofstructuralengineering
- They will possess the skills to solve problems dealing with different loads and concrete and steel
- They will have knowledge instructuralengineering

PCC-CE304	**Geotechnical Engineering**	**3L:0T**	**3 credits**

Theory=75 , Sessionals=25 ,Total=100 Duration of exam.=3 hours

Module 1: *Introduction*–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-replacementmethod.

Module 2: *Plasticity Characteristics of Soil* - 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: particle size classification, textural classification, unified soil classification system, Indian standard soil classification system. Identification: field identification of soils, general characteristics of soil in different groups.

On completion of this module, the students must be able to:

- Understand the behaviour of soils based on theirmoisturecontents;
- Perform laboratory experiments to estimate various Atterberg limits and evaluate index properties ofsoils;
- Classify any soils based on their particle size distribution andindexproperties;

Module 3: *Permeability of Soil* - Darcy's law, validity of Darcy's law. Determination of coefficient of permeability: Laboratory method: constant-head method, falling-head method. Field method: pumping- in test, pumping- out test. 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 flownets.

On completion of this module, the student must be able to:

- Determine the permeability of soils through various laboratory andfieldtests;
- Analytically calculate the effective permeability of anisotropicsoilmass;
- Determine the seepage quantities and pore water pressures belowtheground;
- Graphically plot the equipotential lines and flow lines in aseepageflow.

Module 4:*Effective Stress Principle* - Introduction, 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, quick sand condition.

On completion of this module, the student must be able to:

- Understand the physical significance of effective stress and its relation with pore pressure;
- Plot various stress distribution diagrams along the depth of thesoilmass;
- Understand the effect of capillary action and seepage flow direction on the effective stress at a point in thesoilmass.

Module 5: *Compaction of Soil*-Introduction, theory of compaction, laboratory determination of optimum moisture content and maximum dry density. Compaction in field, compaction specifications and field control.

On completion of this module, the student must be able to:

- Perform laboratory test to determine the maximum dry density and optimum moisture content ofthesoil;
- Variation in compaction curve with compaction effort andsoiltype;
- Determine the compactive effort required to obtain necessary degree of compactionin-situ;
- Differentiate among various field methods of compaction and their usage based on the type ofsoil.

Module 6:*Stresses in soils* – Introduction, stresses due to point load, line load, strip load, uniformly loaded circular area, rectangular loaded area. Influence factors, Isobars, Boussinesq's equation, Newmark's Influence Chart. Contact pressure under rigid and flexible area, computation of displacements from elastictheory.

On completion of this module, the student must be able to:

- Analytically compute the vertical stress in a semi-infinite soil mass due to various loading conditions;
- Plot isobars due various loadingconditions.

Module 7:*Consolidation of Soil* - Introduction, comparison between compaction and consolidation, initial, primary & secondary consolidation, spring analogy for primary consolidation, interpretation of consolidation test results, Terzaghi's theory of consolidation, final settlement of soil deposits, computation of consolidation settlement and secondary consolidation.

On completion of this module, the student must be able to:

- Understand the basic mechanism of consolidationofsoil;
- Determine various consolidation parameters of soil throughlaboratorytest;

- Evaluate ground settlementsagainsttime.

Module 8:*Shear Strength* - 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

On completion of this module, the student must be able to:

- Determine graphically and analytically the stress state in any plane of thesoilmass;
- Perform various shear strength tests and appreciate the different field conditions which theysimulate;
- Understand the significance of shear strength parameters in various geotechnicalanalyses;
- Evaluate the stiffness of soil using shearstrengthparameters

Module 9:*Stability of Slopes* - Introduction, types of slopes and their failure mechanisms, factor of safety, analysis of finite and infinite slopes, wedge failure Swedish circle method, friction circle method, stability numbers and charts.

On completion of this module, the student must be able to:

- Differentiate various modes ofslopefailure;
- Evaluate factor of safety of infinite slopes based on differentgroundconditions;
- Understand various methods for computation of factor of safety forfiniteslopes.

Module 10:*Soil Exploration*- Introduction, methods of site exploration and soil investigation, methods of boring, soil samplers, sampling procedures, trail pits, borings, penetrometer tests, analysis of borehole logs, geophysical and advance soil exploration methods.

On completion of this module, the student must be able to:

- Specify a strategy for site investigation to identify the soil deposits and determine the depth and spatial extent withintheground;
- Understand various site investigation techniques and theirin-situapplications;
- Prepare a soil investigation report based on borehole log data and various in-situ tests like SPT, CPT,etc.

Text/Reference Books:

1. Soil Mechanics by Craig R.F., Chapman&Hall
2. Fundamentals of Soil Engineering by Taylor, John Wiley&Sons
3. An Introduction to Geotechnical Engineering, by Holtz R.D. and Kovacs, W.D., PrenticeHall,
4. Principles of Geotechnical Engineering, by Braja M. Das,CengageLearning
5. Principles of Foundation Engineering, by Braja M. Das,CengageLearning

PCC-CE304P	Geotechnical Engineering Lab

P=2hr/week, I Credit

Practical Work: List of tests on-

1. Field Density using CoreCuttermethod.
2. Field Density using Sandreplacementmethod.
3. Natural moisture content using OvenDryingmethod.
4. Field identification of Fine Grainedsoils.
5. Specific gravity ofSoils.

6. Grain size distribution bySieveAnalysis.
7. Grain size distribution byHydrometerAnalysis.
8. Consistency limits byLiquidlimit
9. Consistency limits byPlasticlimit
10. Consistency limits byShrinkagelimit.
11. Permeability test using Constant-headtestmethod.
12. Permeability test usingFalling-headmethod.
13. Compaction test: StandardProctortest.
14. Compaction test: ModifiedProctortest.
15. Relativedensity.
16. ConsolidationTest.
17. TriaxialTest(UU)
18. Vanesheartest
19. DirectShearTest
20. Unconfined CompressionStrengthTest.

PCC-CE306R	**Environmental Engineering and Management**	**2L:0T**	**2 credits**

Theory=75 , Sessionals=25 ,Total=100 Duration of exam.=3 hours

Module 1: *Water:* -Sources of Water and quality issues, water quality requirement for different beneficial uses, Water quality standards, water quality indices, water safety plans, Water Supply systems, Need for planned water supply schemes, Water demand industrial and agricultural water requirements, Components of water supply system; Transmission of water, Distribution system, Various valves used in W/S systems, service reservoirs and design.

Water Treatment: aeration, sedimentation, coagulation flocculation, filtration, disinfection, advanced treatments like adsorption, ion exchange, membrane processes

Module 2: *Sewage*- Domestic and Storm water, Quantity of Sewage, Sewage flow variations. Conveyance of sewage- Sewers, shapes design parameters, operation and maintenance of sewers, Sewage pumping; Sewerage, Sewer appurtenances, Design of sewerage systems. Small bore systems, Storm Water- Quantification and design of Storm water; Sewage and Sullage, Pollution due to improper disposal of sewage, National River cleaningplans,

Wastewater treatment, aerobic and anaerobic treatment systems, suspended and attached growth systems, recycling of sewage – quality requirements for various purposes.

Module 3: *Air* - Composition and properties of air, Quantification of air pollutants, Monitoring of air pollutants, Airpollution- Occupational hazards, Urban air pollution automobile pollution, Chemistry of combustion, Automobile engines, quality of fuel, operating conditions and interrelationship. Air quality standards, Control measures for Air pollution, construction and limitations

Module 4: *Noise*- Basic concept, measurement and various control methods.

Module5:*Solidwastemanagement*-Municipal solid waste, Composition and various chemical and physical parameters of MSW, MSW management: Collection, transport, treatment and disposal of MSW. Special MSW: waste from commercial establishments and other urban areas, solid waste from construction activities, biomedical wastes, Effects of solid waste on environment: effects on air,soil,watersurfaceandgroundhealthhazards.Disposalofsolidwaste-segregation,reductionat

source, recovery and recycle. Disposal methods- Integrated solid waste management. Hazardous waste: Types and nature of hazardous waste as per the HW Schedules of regulatingauthorities.

Module 6: *Building Plumbing*-Introduction to various types of home plumbing systems for water supply and waste water disposal, high rise building plumbing, Pressure reducing valves, Break pressure tanks, Storage tanks, Building drainage for high rise buildings, various kinds of fixtures and fittingsused.

Module 7: Government authorities and their roles in water supply, sewerage disposal. Solid waste management and monitoring/control of environmental pollution.

Text/Reference Books:

1. Introduction to Environmental Engineering and Science by Gilbert Masters, Prentice Hall, NewJersey.
2. Introduction to Environmental Engineering by P. AarneVesilind, Susan M. Morgan, Thompson /Brooks/Cole; SecondEdition2008.
3. Peavy, H.s, Rowe, D.R, Tchobanoglous, G. *Environmental Engineering*, Mc-Graw - Hill International Editions, NewYork1985.
4. MetCalf and Eddy. *Wastewater Engineering, Treatment, Disposal and Reuse*, Tata McGraw-Hill,NewDelhi.
5. Manual on Water Supply and Treatment. Ministry of Urban Development,NewDelhi.
6. Plumbing Engineering. Theory, Design and Practice, S.M.Patil,1999
7. Integrated Solid Waste Management, Tchobanoglous, Theissen&Vigil. McGrawHill Publication
8. Manual on Sewerage and Sewage Treatment Systems, Part A, B and C. Central Public Health and Environmental Engineering Organization, Ministry ofUrbanDevelopment.

PCC-CE306P	Environmental Engineering Lab

P=2hr/week, I Credit

List of Experiments:

1) Flow measurements in closed conduits – venturimeter, orifices.
2) Determination of Color &Turbidity.
3) Determination of Solids: Total, Dissolved and Suspended; dissolved solids through conductivity.
4) Determination of Alkalinity and itsspecies.
5) Determination of pH, and Acidity and itsspecies.
6) Determination of Hardness (differenttypes)
7) Determination ofChlorides.
8) Determination ofFluorides.
9) Jar test for optimum coagulant doseestimation.
10) Determination of residual chlorine and chlorinedose.

Outcomes:

After successfully studying this course, students will:

- Understand the impact of humans on environment and environmentonhumans
- Be able to identify and value the effect of the pollutants on the environment: atmosphere, water andsoil.

- Be able to plan strategies to control, reduce and monitorpollution.
- Be able to select the most appropriate technique for the treatment of water, wastewater solid waste andcontaminatedair.
- Be conversant with basic environmentallegislation.

PCC-CE307R	Transportation Engineering Concepts	3L:0T	3 credits

Theory=75 , Sessionals=25 ,Total=100 Duration of exam.=3 hours

Module 1: Highway development and planning-Classification of roads, road development in India, Current road projects in India; highway alignment and project preparation.

Module 2: Geometric design of highways-: Introduction; highway cross section elements; sight distance, design of horizontal alignment; design of vertical alignment; design of intersections, problems

Module 3:Traffic engineering & control- Traffic Characteristics, traffic engineering studies, traffic flow and capacity, traffic regulation and control; design of road intersections; design of parking facilities; highway lighting; problems

Module 4:Pavement materials- Materials used in Highway Construction- Soils, Stone aggregates, bituminous binders, bituminous paving mixes; Portland cement and cement concrete: desirable properties, tests, requirements for different types of pavements. Problems

Module 5: Design of pavements- Introduction; flexible pavements, factors affecting design and performance; stresses in flexible pavements; design of flexible pavements as per IRC; rigid pavements- components and functions; factors affecting design and performance of CC pavements; stresses in rigid pavements; design of concrete pavements as per IRC; problems.

Text/Reference Books:

1. Khanna, S.K., Justo, C.E.G and Veeraragavan, A, 'Highway Engineering', Revised 10th Edition, Nem Chand &Bros,2017
2. Kadiyalai, L.R., ' Traffic Engineering and Transport Planning', KhannaPublishers.
3. Partha Chakraborty, ' Principles Of Transportation Engineering,PHILearning,
4. Fred L. Mannering, Scott S. Washburn, Walter P. Kilareski,'Principles of Highway Engineering and Traffic Analysis', 4th Edition,JohnWiley
5. Srinivasa Kumar, R, Textbook of Highway Engineering, UniversitiesPress,2011.
6. Paul H. Wright and Karen K. Dixon, Highway Engineering, 7th Edition, Wiley Student Edition,2009.

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

- carry out surveys involved in planning andhighwayalignment
- design the geometric elements of highwaysandexpressways
- carry out traffic studies and implement traffic regulation and control measures and intersectiondesign
- characterize pavementmaterialsand
- design flexible and rigid pavements asperIRC

PCC-CE307P	TransportationEngineering Lab

P=2hr/week, I Credit

Practicals:

1) Flakiness and elongation test
2) Marshal Stabilitytest
3) C B R Valuetest
4) Bulk density and Voidtest
5) Dorry AbrasionTest
6) Specific gravitytest
7) Solubility Test
8) Aggregates Hardness,Toughness, Cementation, Adhesiveness tests
9) Shearing test onsoil
10) Aggregate's Water absorptionTest
11) Aggregate Impact Test
12) Los-Angeles Abrasion Test on Aggregates
13) Dorry's Abrasion Test onAggregates
14) Deval Attrition Test onAggregates
15) Crushing Strength Test onAggregates
16) Penetration Test onBitumen.
17) Ductility Test onBitumen
18) Viscosity Test on BituminousMaterial
19) Softening Point Test onBitumen.
20) Flash and Fire Point Test onBitumen

6th Semester

PCC-CE308	Design of Reinforced Concrete Structures	3L	3 credits

Module I

Introduction: Reinforced concrete, definition, properties of materials, grades of concrete and reinforcing steel, stress-strain curves, permissible stresses, concrete structural systems-slabs, beams, columns and foundations, Introduction to working stress and limit state method of design

Review of partial safety factors. Limit state of collapse. Limit state of serviceability. Limit State of Collapse: Flexure. Limit state of collapse for flexure as per IS. Assumptions. moment capacity of rectangular and flanged sections. Singly and doubly reinforced sections

Module II

Shear and Torsion

Limit State of Collapse: Shear. Nominal shear stress. Design shear strength of concrete. Design of shear reinforcement. Use of SP16 for shear design. Critical sections for shear in important structural elements such as slabs, beams, retaining walls, footings etc. Design project for the design and detailing the beams of a framed system.

Limit State of Collapse: Torsion. General. Critical section.Shear and torsion. Equivalent . Reinforcement for torsion. Equivalent longitudinal moment. Design project for the design and detailing of a water tank with curved beams.

Module III

Reinforced Concrete Slabs

Design of one way slab and two way slab, Design of longitudinal reinforcement, shear reinforcement and torsional reinforcement

Module IV

Compression

Limit State of Collapse: Compression. Analysis and design of columns of rectangular and circular cross sections. Axially loaded columns Columns with uniaxial and biaxial eccentricity using SP 16 design charts. Short and slender columns. Design project for the design and detailing the columns of a framed system and isolated and combined footings.

Limit State of Serviceability

Deflection. Short term deflection. Long term deflection. Cracking. Control of cracking. Estimation of width of cracks.

Course outcomes:

Students will be able to

- Understand the various design methodologies for the design of RCelements.
- Know the analysis and design of flanged beams by limit state method and sign of beams for shear, bond andtorsion.
- Design the various types of slabs and staircase by limit statemethod.
- Design columns for axial, uniaxial and biaxial eccentricloadings.
- Design of footing by limit statemethod.

TEXT BOOKS:

1. Varghese, P.C., "Limit State Design of Reinforced Concrete", Prentice Hall of India, Pvt. Ltd., New Delhi, 2002.

2. Gambhir. M.L., "Fundamentals of Reinforced Concrete Design", Prentice Hall of India Private Limited, New Delhi,2006.

3. Subramanian,N.,"Design of Reinforced Concrete Structures",Oxford University Press, New Delhi,2013.

4. Krishnaraju.N" Design of Reinforced Concrete Structurres ", CBS Publishers & Distributors Pvt. Ltd., New Delhi.

5. Ramachandra, "Limit state Design of Concrete Structures" Standard Book House, NewDelhi

PCC-CE305	Hydrology and Water ResourcesEngineering	3L	3 credits

Theory=75 , Sessionals=25 ,Total=100 Duration of exam.=3 hours

Module 1: *Introduction* - hydrologic cycle, water-budget equation, history of hydrology, world water balance, applications in engineering, sources of data.

Module 2: *Precipitation* - 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.

Module 3:*Abstractions from precipitation* - evaporation process, evaporimeters, analytical methods of evaporation estimation, reservoir evaporation and methods for its reduction, evapotranspiration, measurement of evapotranspiration, evapotranspiration equations, potential evapotranspiration over India, actual evapotranspiration, interception, depression storage, infiltration, infiltration capacity, measurement of infiltration, modelling infiltration capacity, classification of infiltration capacities, infiltrationindices.

Module 4:*Runoff* - runoff volume, SCS-CN method of estimating runoff volume, flow- duration curve, flow-mass curve, hydrograph, factors affecting runoff hydrograph, components of hydrograph, base flow separation, effective rainfall, unit hydrograph surface water resources of India, environmental flows.

Module 5: *Ground water and well hydrology* - forms of subsurface water, saturated formation, aquifer properties, geologic formations of aquifers, well hydraulics: steady state flow in wells, equilibrium equations for confined and unconfined aquifers, aquifer tests.

Module 6:*Water withdrawals and uses* – 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.

Module 7:*Distribution systems* - 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: causes, effects and remedial measures. Lining of canals, types of lining. Drainage of irrigated lands: necessity, methods.

Module 8: *Dams and spillways* - 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/Reference Books:

1. K Subramanya, Engineering Hydrology,Mc-GrawHill.
2. K N Muthreja, Applied Hydrology, TataMc-GrawHill.
3. K Subramanya, Water Resources Engineering through Objective Questions, Tata Mc-GrawHill.
4. G L Asawa, Irrigation Engineering, WileyEastern
5. L W Mays, Water ResourcesEngineering,Wiley.
6. J D Zimmerman, Irrigation, John Wiley &Sons
7. C S P Ojha, R Berndtsson and P Bhunya, Engineering Hydrology,Oxford.

Outcomes:

At the end of the course, students must be in a position to:

- Understand the interaction among various processes in thehydrologiccycle
- Apply the application of fluid mechanics and use of computers in solving a host of problems in hydraulicengineering
- Study types and classes of hydrologic simulation models and design procedures for safe and effective passage of flood flows for design ofhydraulicstructures
- Understand the basic aquifer parameters and estimate groundwater resources for different hydro-geologicalboundaryconditions
- Understand application of systems concept, advanced optimization techniques to cover the socio-technical aspects in the field ofwaterresources
- Apply the principles and applications of remote sensing, GPS and GIS in the context to hydrological extreme flood and drought events in waterresourcesengineering

PCC-CE302	Hydraulic Engineering	3L:0T	3 credits

Theory=75 , Sessionals=25 ,Total=100 Duration of exam.=3 hours

Objectives:

To introduce the students to various hydraulic engineering problems like open channel flows and hydraulic machines. At the completion of the course, the student should be able to relate the theory and practice of problems in hydraulic engineering

Module 1: Laminar Flow- Laminar flow through: circular pipes, annulus and parallel plates. Stoke's law, Measurement of viscosity.

Module 2: Turbulent Flow- Reynolds experiment, Transition from laminar to turbulent flow. Definition of turbulence, scale and intensity, Causes of turbulence, instability, mechanism of turbulence and effect of turbulent flow in pipes. Reynolds stresses, semi-empirical theories of turbulence, Prandtl'smixinglength theory, universal velocity distribution equation. Resistance to flow of fluid in smooth and rough pipes,Moody'sdiagram.

Module 3:Boundary Layer Analysis-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.

Module 4: Dimensional Analysis and Hydraulic Similitude: Dimensional homogeneity, Rayleigh method, Buckingham's Pi method and other methods. Dimensionless groups. Similitude, Model studies, Types of models. Application of dimensional analysis and model studies to fluid flow problem.

Module 5: Introduction to Open Channel Flow-Comparison between open channel flow and pipe flow, geometrical parameters of a channel, classification of open channels, classification of open channel flow, Velocity Distribution of channel section.

Module 6: Uniform Flow-Continuity Equation, Energy Equation and Momentum Equation, Characteristics of uniform flow, Chezy's formula, Manning's formula. Factors affecting Manning's Roughness Coefficient " n.*Most economical section of ch*annel. Computation of Uniform flow, Normal depth.

Module 7 : Non-Uniform Flow- Specific energy, Specific energy curve, critical flow, discharge curve Specific force Specific depth, and Critical depth. Channel Transitions. Measurement of Discharge and Velocity – Venturi Flume, Standing Wave Flume, Parshall Flume, Broad Crested Weir. Measurement of Velocity- Current meter, Floats, Hot-wire anemometer. Gradually Varied Flow-Dynamic Equation of Gradually Varied Flow, Classification of channel bottom slopes, Classification of surface profile, Characteristics of surface profile. Computation of water surface profile by graphical, numerical and analytical approaches. Direct Step method, Graphical Integration method and Direct integrationmethod.

Module 8: Hydraulic Jump- 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, surge as a moving hydraulic jump. Positive and negative surges. Dynamics of Fluid Flow- Momentum principle, applications: Force on

plates, pipe bends, moments of momentum equation,

Module 9: 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, flow through laterals, flows in dead end pipes, siphon, power transmission through pipes, nozzles. Analysis of pipe networks: Hardy Cross method, water hammer in pipes and control measures, branching of pipes, three reservoirproblem.

Module 10: Computational Fluid Dynamics: Basic equations of fluid dynamics, Grid generation, Introduction to in viscid incompressible flow, Boundary layer flow as applicable to C.F.D. Hydro informatics: Concept of hydro informatics –scope of internet and web based modeling in water resourcesengineering.

Text/Reference Books:

1. Hydraulics and Fluid Mechanics, P.M. Modi and S.M. Seth, StandardBookHouse
2. Theory and Applications of Fluid Mechanics, K. Subramanya, Tata McGrawHill.
3. Open channel Flow, K. Subramanya, TataMcGrawHill.
4. Open Channel Hydraulics, VenTe Chow, TataMcGrawHill.
5. Burnside, C.D., "*Electromagnetic Distance Measurement*," BeekmanPublishers,1971.

Outcomes:

- The students will be able to apply their knowledge of fluid mechanics in addressing problems in openchannels.
- They will possess the skills to solve problems in uniform, gradually and rapidly varied flows in steady stateconditions.
- They will have knowledge in hydraulic machineries (pumpsandturbines).

PCC-CE302 P	HydraulicEngineering lab

Practical Work(2hr/week):

1. FlowVisualization
2. Studies inWindTunnel
3. BoundaryLayer
4. Flow around an Aerofoil /circularcylinder
5. UniformFlow
6. Velocity Distribution in Openchannelflow
7. VenturiFlume
8. StandingWaveFlume
9. GraduallyVariedFlow
10. HydraulicJump
11. Flow underSluiceGate
12. Flowthroughpipes
13. Turbulent flowthroughpipes
14. Flowvisualization
15. Laminar flowthroughpipes
16. Major losses / Minor lossesinpipe

B.Tech–7TH Semester

PCC-CE308	Construction Engineering & Management	3L	3 credits

Theory= 75 ,Sessionals=25 , Total=100 Duration of exam.=3hours

Module 1: *Basics of* Construction- Unique features of construction, construction projects- types and features, phases of a project, agencies involved and their methods ofexecution;

Module 2: Construction project planning- Stages of project planning: pre-tender planning, pre-construction planning, detailed construction planning, role of client and contractor, level of detail. Process of development of plans and schedules, work break-down structure, activity lists, assessment of work content, concept of productivities, estimating durations, sequence of activities, activity utility data; Techniques of planning- Bar charts, Gantt Charts. Networks: basic terminology, types of precedence relationships, preparation of CPM networks: 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 ofcompletion.

Module 3: Construction Methods basics: 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; 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 forBridges.

Module 4: Construction Equipment basics*:* Conventional construction methods Vs Mechanized methods and advantages of latter; Equipment for Earthmoving, Dewatering; Concrete mixing, transporting & placing; Cranes, Hoists and other equipment for lifting; Equipment for transportation of materials. Equipment Productivities.

Module 5: Planning and organizing construction site and resources- Site: site layout including enabling structures, developing site organization, Documentation at site; Manpower: planning, organizing, staffing, motivation; Materials: concepts of planning, procurement and inventory control; Equipment: basic concepts of planning and organizing; Funds: cash flow, sources of funds; Histograms and S-Curves. Earned Value; Resource Scheduling- Bar chart, line of balance technique, resource constraints and conflicts; resource aggregation, allocation, smoothening and leveling. Common Good Practices inConstruction

Module 6:*Project Monitoring & Control*- Supervision, record keeping, periodic progress reports, periodical progress meetings. Updating of plans: purpose, frequency and methods of updating. Common causes of time and cost overruns and corrective measures. Basics of Modern Project management systems such as Lean Construction; 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, costs of accidents, occupational health problems in construction, organizing for safety andhealth.

Module 7:*Contracts Management basics:* 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 Resolutionmethods.

Module 8:*Construction Costs: Make-up of construction costs;* Classification of costs, time- cost trade-off in construction projects, compression and decompression.

Text/Reference Books:

1. Varghese, P.C., "*Building Construction"*, Prentice HallIndia,2007.
2. *National Building Code,* Bureau of Indian Standards, NewDelhi,2017.
3. Chudley, R., *Construction Technology*, ELBS Publishers,2007.
4. Peurifoy, R.L. Construction Planning, Methods and Equipment, McGrawHill,2011
5. Nunnally, S.W. Construction Methods and Management, PrenticeHall,2006
6. Jha, Kumar Neeraj., Construction Project management, Theory & Practice, Pearson Education India,2015
7. Punmia, B.C., Khandelwal, K.K., Project PlanningwithPERTandCPM, LaxmiPublications,2016.

On completion of the course, the students will have:

- An idea of how structures are built and projects are developed onthefield
- An understanding of modernconstructionpractices
- A good idea of basic construction dynamics- various stakeholders, project objectives, processes, resources required and projecteconomics.
- A basic ability to plan, control and monitor construction projects with respect to time andcost
- An idea of how to optimise construction projects basedoncosts
- An idea how construction projects are administered with respect to contract structures andissues.
- An ability to put forward ideas and understandings to others with effective communicationprocesses

PCC-CE309	**Engineering Economics, Estimation& Costing**	**3L**	**3 credits**

Theory=75 , Sessionals=25 ,Total=100 Duration of exam.=3 hours

Module 1:Basic Principles and Methodology of Economics. 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 Taxes (3 lectures)

Module 2: Public Sector Economics –Welfare, Externalities, Labour Market. Components of Monetary and Financial System, Central Bank –Monetary Aggregates; Commercial Banks & their functions; Capital and Debt Markets. Monetary and Fiscal Policy Tools & their impact on the economy – Inflation and Phillips Curve. (2 lectures)

Module 3: Elements of Business/Managerial Economics and forms of organizations. Cost & Cost Control –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. (3 lectures)

Module 4: Indian economy - Brief overview of post-independence period – plans. Post reform Growth, Structure of productive activity. Issues of Inclusion – Sectors, States/Regions, Groups of people (M/F), Urbanization. Employment–Informal, Organized, Unorganized, Public, Private. Challenges and Policy Debates in Monetary, Fiscal, Social, External sectors. (2lectures)

Module 5:*Estimation /* Measurements for various items- Introduction to the process of Estimation; 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; adding equipment costs; labour costs; rate analysis; 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. Use of Computers in quantity surveying (7 lectures).

Module 6: Specifications-Types, requirements and importance, detailed specifications for buildings, roads, minor bridges and industrial structures. (3 lectures)

Module 7: Rate analysis-Purpose, importance and necessity of the same, factors affecting, task work, daily output from different equipment/ productivity. (3lectures)

Module 8: Tender- 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 (6 lectures)

Module 9: Introduction to Acts pertaining to-Minimum wages, Workman's compensation, Contracts, Arbitration, Easement rights. (1 lecture).

On completion of the course, the students will:

- Have an idea of Economics in general, Economics of India particularly for public sector agencies and privatesectorbusinesses
- Be able to perform and evaluate present worth, future worth and annual worth analyses on one of moreeconomicalternatives.
- Be able to carry out and evaluate benefit/cost, life cycle and breakeven analyses on one or more economicalalternatives.
- Be able to understand the technical specifications for various works to be performed for a project and how they impact the cost ofastructure.
- Be able to quantify the worth of a structure by evaluating quantities of constituents, derive their cost rates and build up the overall cost ofthestructure.
- Be able to understand how competitive bidding works and how to submit a competitive bid proposal.

Text/Reference Books:

1. Mankiw Gregory N. (2002), *Principles of Economics,*ThompsonAsia
2. V. Mote, S. Paul, G. Gupta(2004), *Managerial Economics,* TataMcGrawHill
3. Misra, S.K. and Puri (2009), *Indian Economy,*Himalaya
4. PareekSaroj (2003), *Textbook of Business Economics,*SunrisePublishers
5. M Chakravarty, Estimating, Costing Specifications&Valuation
6. Joy P K, Handbook of ConstructionManagement,Macmillan
7. B.S. Patil, Building &EngineeringContracts
8. Relevant IndianStandardSpecifications.
9. World Bank ApprovedContractDocuments.
10. FIDICContractConditions.
11. Acts Related to Minimum Wages, Workmen's Compensation, Contract, andArbitration
12. Typical PWD RateAnalysisdocuments.
13. UBS Publishers & Distributors, Estimating and Costing in Civil Engineering: Theoryand Practice including SpecificationandValuations,2016
14. Dutta, B.N., Estimating and Costing in Civil Engineering (Theory & Practice),UBS Publishers,2016

PCC-CE309P	Engineering Economics,Estimation& Costing Lab

P=2hr/week, I Credit

1. Deriving an approximate estimate for a multistoried building byapproximatemethods.
2. Detailed estimate for the following with the required material survey forthesame.

a. Ground plus three storied RCC Framed structure building withblockworkwalls
b. bridge with minimum2spans
c. factorybuilding
d. roadwork
e. cross drainagework
f. Ground plus three storied building with load-bearing walls g Cost of finishes, MEP works for(f)above

3. Preparation of valuation report in standard Governmentform.
4. Assignments on rate analysis, specifications andsimpleestimates.
5. Detailed estimate ofminorstructure.
6. Preparation of Barbendingschedule.

SYLLABUS FOR BASKET OF ELECTIVE COURSES OF ELECTED TRACKS

IMPORTANT NOTE: Select subject from each track for respective elective. ***Suggested credit for any course is 3. Prerequisites are to be decided by the concerned faculty keeping in mind the track/thread/stream of courses taken by the student earlier.***

PCC-CV401-1	**Concrete Technology**	**3L:0T:1P**	**4 credits**

Module 1: Introduction of concrete, Historic development, Composition of concrete, Advantages of concrete over other materials, Advances and future trends in concrete, Overview of Sustainability and Concrete development.

Module 2: Concrete Making Materials: Cement: Chemical composition, Hydration of cement, structure of hydrated cement, Tests on cement (special cements, water chemical admixtures).
Aggregates: Classification, IS specifications, Properties, Grading, Methods of combining aggregates, specified gradings, Testing of aggregates.
Water – General requirements & limiting values of impurities

Module 3: Fresh Concrete: Properties of fresh concrete, Definition and Measurement methods of workability as per IS standards, factors affecting workability, Segregation & Bleeding, Slump loss, Re-tempering, Site preparations for concreting, Mixing, Conveying, Placing, Compaction, Finishing of concrete. Curing & various methods of curing.

Module 4: Hardened Concrete: Strengths of hardened concrete (Tensile & Compressive strength, Flexural & Bond strength), standard test methods as per IS, Failure mechanism under compression & tension, Stress-strain behaviour of concrete, Overview of Modulus of elasticity, Dimensional stability –Creep & Shrinkage.

Module 5: Durability & Permeability of concrete: Causes of deterioration in concrete and durability problems, Factors affecting durability, Transport mechanism of gases & fluids in concrete, Cracking & causes of cracking, Carbonation induced & corrosion induced cracking, Alkali-aggregate reaction, Degradation by freeze & thaw, Sulphate attack, Durability under sea-water (marine environment).

Module 6: Mix design of concrete: Principles of concrete mix design, Parameters and factors influencing mix design, Indian Standard methods of mix design, Acceptability criteria, variability of results, Various provisions of IS code for sound

concrete.

Module 7: Special concrete and Concreting methods: advanced cement based composites, Fibre reinforced concrete, Polymer modified concrete, Self-compacting concrete, Light weight concrete, High strength concrete, Light-weight & heavy weight concrete, High volume fly ash concrete.
Special concreting methods: Pumped concrete, Ready mix concrete, Under-water concreting, Hot & cold weather concreting, Precast concrete.

Course Outcome:
At the end of the course

- The students will be able to think logically for development Concrete technology application in field of CivilEngineering.
- The students will gain an experience in the implementation of Concrete Materials on engineering concepts which are applied in field ConstructionFields.

Reference Books:

1. M S Shetty; Concrete Technology ,S.Chand Publication NewDelhi
2. P Kumar Mehta, Monteiro; Concrete Technology, Indian ConcreteInstitute
3. A R Santhakumar; Concrete Technology , Oxford UniversityPress
4. A.M.Neville ; Properties of Concrete , PearsonEducation
5. M L Gambhir; Concrete Technology , Tata McGraw Hill
6. IS456-2000
7. IS269-1989
8. IS516-1959
9. IS 1786-1985
10. IS 1893-2002
11. IS 12269-1987
12. IS9103-1999
13. IS8112-1989

PEC-CV401-2	Prestressed Concrete	3L	3 credits

Module1: Introduction, need of high strength concrete in prestressing, need of high tensile steel in prestressing, relative comparison of prestressed and reinforced concrete beam, advantage of prestressed concrete, coordination

between design and construction techniques in prestressing.

Module2: Design of high strength concrete mixes, cover requirement in prestressed concrete members, protection of prestressing steel, prestressing system, tensioning devices, pre-tensioning and post-tensioning systems.

Module3: Assumptions in the analysis and design of prestressed concrete member, analysis of prestress, prestress pressure distribution in beam, effect of loading on stress on tendon, P-line or pressureline.

Module4: Concept of load balancing, tendon stresses, stresses in beam at different stages, prestress losses, cracking moment, Design of prestress concrete beam.

Reference Books:

1. Arthur H. Nilson, "Design of Prestressed Concrete", John Wiley, New York, 1987. 2. N. Krishna Raju, "Prestressed Concrete", Tata McGraw-Hill, New Delhi,2001.

3. G.S. Pandit and S.P. Gupta, "Prestressed Concrete", CBS Publications, New Delhi,1995.

Course Outcomes:

Upon successful completion of this course, the students would:

- Able to design prestressed concretestructure.
- Calculate losses inprestressing.
- Understand purpose of high strength concrete and steel used in prestressing.
- Apply concept of loadbalancing.

Elective – II

PEC-CV402-1	Public Transportation Systems	3L	3 credits

Module1 : Historical development of transport in India - 20 year Road Plans, National Transport Policy Recommendations, IRC, CRRI, Vision 2021, NHDP, PMGSY. Characteristics of different modes of transport and their integration and

interactions - impact on environment.

Module2: Planning of railway - Passenger and goods terminals - layout - passenger facilities - traffic control.

Module3: Airport Planning, requirements and components. Design of runway and taxiway - Apron - parking configuration - terminal requirements - Airport marking and lighting - Air traffic control.

Module4: Planning of Harbours and ports - cargo handling - Containerization - Navigation aids - Inland waterways - Pipeline transportation.

Module5: Urban transportation systems - Mass rapid transit system - Light rail transit - Personal rapidtransit, guided way systems, cabin taxi, dual mode bus - Para transit systems - Demand responsive system - Intermediate public transport.

Course Outcome:

- Understand the function of public transit and the role of governmentunits.
- Understand how transit contributes to a sustainablefuture.
- Learn about transit planning, design, operations, andtradeoffs.
- Learn, understand, and apply the capabilities of transit modealternatives.
- Learn how to design a transit system and lay out transitroutes.
- Understand and apply the relationship between land use, urban planning, and public transit.
- Obtain knowledge of public transit currentevents.

Reference Books:

1. Paquette, R.J., et al, *Transportation Engineering Planning and Design*, John Wiley & Sons, New York,1982.
2. Alan Black, *Urban Mass Transportation Planning*, McGraw-Hill,1995.

PEC-CV402-2	**Intelligent Transportation Systems**	**3L**	**3 credits**

Module1: Introduction to Intelligent Transportation Systems (ITS) – Definition of ITS and Identification of ITS Objectives, Historical Background, Benefits of ITS - ITS Data collection techniques – Detectors, Automatic Vehicle Location (AVL), Automatic Vehicle Identification (AVI), Geographic Information Systems (GIS),

video data collection.

Module2: Telecommunications in ITS – Importance of telecommunications in the ITS system, Information Management, Traffic Management Centres (TMC). Vehicle – Road side communication – Vehicle Positioning System

Module3: ITS functional areas – Advanced Traffic Management Systems (ATMS), Advanced Traveler Information Systems (ATIS), Commercial Vehicle Operations (CVO), Advanced Vehicle Control Systems (AVCS), Advanced Public Transportation Systems (APTS), Advanced Rural Transportation Systems (ARTS).

Module4: ITS User Needs and Services – Travel and Traffic management, Public Transportation Management, Electronic Payment, Commercial Vehicle Operations, Emergency Management, Advanced Vehicle safety systems, InformationManagement.

Module5: Automated Highway Systems - Vehicles in Platoons – Integration of Automated Highway Systems. ITS Programs in the World – Overview of ITS implementations in developed countries, ITS in developing countries.

Course Outcome:

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

- Differentiate different ITS userservices
- Select appropriate ITS technology depending upon site specificconditions.
- Design and implement ITScomponents

Reference Books:

1. ITS Hand Book 2000: *Recommendations for World Road Association (PIARC)* by Kan Paul Chen, JohnMiles.
2. Sussman, J. M., *Perspective on ITS*, Artech HousePublishers,2005.
3. National ITS Architecture Documentation, US Department of Transportation, 2007(CD-ROM).

PEC-CV402-3	Pavement Materials	3L:0T	3 credits

Theory= 75 ,Sessionals=25 , Total=100 Duration of exam.=3 hours

Module1: Subgrade soil - Soil composition and structure - Soil classification for engineeringpurposesOrigin, Classification, requirements, properties and tests on roadaggregates

Module2: Origin, preparation, properties and tests, constitution of bituminous road binders, requirements - Bituminous Emulsions and Cutbacks: Preparation, characteristics, uses and tests

Module3: Bituminous Mixes: Mechanical properties - Resilient modulus, dynamic modulus and fatigue characteristics of bituminous mixes.

Module4: Weathering and Durability of Bituminous Materials and Mixes - Performance based Bitumen Specifications - Superpave mix design method

Module5: Cement Concrete for Pavement Construction: Requirements, design of mix for CC pavement, joint filler and sealer materials.

Books

1. RRL, DSIR, *Bituminous Materials in Road Construction*, HMSOPublication,1955
2. IS and IRC Publications onrelevanttopic.

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

- Have an idea about Different pavementmaterials.
- Properties of different pavementmaterials.

PEC-CV402-4	Railway Engineering	3L:0T	3 credits

Theory= 75 ,Sessionals=25 , Total=100 Duration of exam.=3 hours

Module 1: Introduction to railway engineering, railway track gauge, alignment of railway lines, engineering surveys and construction of new lines, tracks and track stresses; rails, sleepers,creep of rails.

Module 2: Ballast, subgrade and formation-ballast and its function, specification of good ballast, formation and its function, subgradeimprovement.

Module 3: Track fittings and fastenings- Rail to rail fastening, rail to different types of sleepers fastening, elastic fastening Point and crossings- turnout, points, crossing, crossovers.

Module 4: Geometric design of track-curves and super-elevation, track junctions and simple track layouts; rail joints and welding of rails; track maintenance,

track drainage; modern methods of track maintenance, rehabilitation and renewal of track; tractive resistance and power, railway stations andyards.

Module 5: Railway tunneling; operation involved in bored tunneling, signaling and interlocking;engineering principles of signals, classification of signals, maintenance of railways and high-speed trains.

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

- Have an idea about various terminology of railwayengineering.
- Design railway trackgeometrically.
- Purpose and type of signals inrailways.
- Knowledge of tunneling and differentlayouts.

Reference Books:

1. Railway Engineering, Satish Chandra, Oxford Publishing2013
2. Railway Engineering, S.C Rangwala, Charotar Publishing2008

PEC-CV402-5	Airport Planning and Design	3L	3 credits

Module 1: Introduction of airport engineering, Aircraft characteristics; Aircraft performance characteristics: Airport planning and air travel demand forecasting: Airport Site Selection.

Module 2: Geometric Design of the Airfield: Determination of Runway Capacity and Delay, Taxiway and Gate Capacity,Holding Aprons, Terminal Aprons.

Module 3:Airport drainage - Function of Airport Passenger and Cargo Terminal - Design of Air Freight Terminals - Airport access - Airport Landside planning – Capacity.

Module 4: Air Traffic Management: Navigational aids: ground-based systems, satellite-based systems – Air traffic control and surveillance facilities – Airfield lighting - air traffic management.

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

- Have an idea about various terminology of airportengineering.
- Design of airportgeometrically.

- Purpose and type of airterminals.
- Knowledge layouts of airport and air trafficmanagement.

Reference Books:

1. Airport Planning and Design"- Khanna, Arora and Jain, Nem Chand and Bros., Roorkee

2. Airport Engineering - Rangwala, Charotar., Publisher

3. Virender Kumar and Satish Chandra, "Airport Planning and Design"- Galotia Publicationpress

4. Planning and Design of Airports" - Robert Horenjeff, 2nd edition, McGraw Hill Book Co.

Elective-III

PEC-CV403-1	Air & Noise Pollution Control	3L	3 credits

UNIT- I Air pollution: composition and structure of atmosphere, global implications of air pollution. classification of air pollutants: particulates, hydrocarbon, carbon monoxide, oxides of sulphur, oxides of nitrogen and photochemical oxidants. Indoor air pollution. Effects of air pollutants on humans, animals, propertyandplants.

UNIT - II Air pollution chemistry, meteorological aspects of air pollution dispersion; temperature lapse rate and stability, wind velocity and turbulence, plume behaviour, dispersion of air pollutants, the Gaussian Plume Model, stackheightanddispersion.

UNIT - III Ambient air quality and standards, air sampling and measurements. Control of particulate air pollutants using gravitational settling chambers, cyclone separators, wet collectors, fabric filters (Bag-house filter),electrostaticprecipitators(ESP).

UNIT - IV Control of gaseous contaminants: Absorption, Adsorption, Condensation and Combustion, Control of sulphur oxides, nitrogen oxides, carbon monoxide, and hydrocarbons. Automotive emission control, catalytic convertor, Euro-I, Euro-II and Euro-III specifications, Indianspecifications.

UNIT - V Noise pollution: Basics of acoustics and specification of sound; sound power, sound intensity and sound pressure levels; plane, point and line sources, multiple sources; outdoor and indoor noise propagation; psychoacoustics and noise criteria, effects of noise on health, annoyance rating schemes; special noise environments: Infrasound, ultrasound, impulsive sound and sonic boom; noise standards and limit values; noise instrumentation and monitoring procedure. Noise indices. Noise controlmethods.

Course Outcome: The students completing the course will have

- An understanding of the nature and characteristics of air pollutants, noise pollution and basic concepts of air quality management
- Ability to identify, formulate and solve air and noise pollutionproblems
- Ability to design stacks and particulate air pollution control devices to meet applicablelaws

References:

1. Peavy, Rowe and Tchobanoglous: EnvironmentalEngineering.
2. Martin Crawford: Air Pollution ControlTheory.
3. Wark and Warner: Air Pollution: Its Origin andControl.
4. Rao and Rao: Air Pollution ControlEngineering.
5. Nevers: Air Pollution ControlEngineering.
6. Mycock, McKenna and Theodore: Handbook of Air Pollution Control Engineering and Technology. Suess and Craxford: W.H.O. Manual on Urban Air QualityManagement
7. C.S. Rao, Air pollution andcontrol
8. Advanced Air and Noise Pollution Control by Lawrence K. Wang, Norman C. Pereira & Yung IseHung.
9. Noise Pollution and Control by S. P.Singhal ,NarosaPubHouse
10. Textbook of Noise Pollution and Its Control by S. C. Bhatia,Atlantic;Edition

PEC-CV403-2	**Solid and hazardous waste management**	**3L**	**3 credits**

Module1

Solid Wastes: Origin, Analysis, Composition and Characteristics. Integrated Solid Waste Management System: Collection, Storage, Segregation, Reuse and Recycling possibilities, Transportation, Treatment/Processing and Transformation Techniques, Final Disposal.

Module 2

Management of: Municipal, Biomedical, Nuclear, Electronic and Industrial Solid Wastes and the rules and regulations.

Module 3

Introduction to Hazardous wastes, Definition of Hazardous waste, The magnitude of the problem;

Module 4

Hazardous waste: Risk assessment, Environmental legislation, Characterization and site assessment, Waste minimization and resource recovery,
Transportation of hazardous waste, Physical, chemical and biological treatment, Ground water contamination, Landfill disposal, Current Management Practices,

Module 5

Environmental audit, Pollution Prevention, Facility Development and operation, Site Remediation: Quantitative risk assessment, site and subsurface characterization, Containment, remedialalternatives.

Course Outcome:

- To learn comprehensive overview of solid, biomedical and hazardous wastemanagement.
- To have knowledge on solid waste management designaspects.
- To learn about the different methods of solid wastemanagement.

Reference Books:

1. Tchobanoglous, G., Theisen, H., & Vigil, S.A; Integrated Solid Waste Management: McGraw Hill,NewYork
2. Solid Waste Engineering, Principle & Management issues byVenTeChow
3. Bhide, A.D., B.B. Sundaresan, Solid Waste Management in developingcountries.
4. Manual on Municipal solid Waste Management, CPHEEO, Govt.ofIndia.
5. Guidelines for Management and Handling of Hazardous wastes MOEF (1991), Govt.ofIndia.
6. Datta, M; Waste Disposal in Engineered Landfills,NarosaPublishers,Delhi.
7. Waste Management "Asian and Pacific Center for Transfer of Technology (N.D.) India", September 1993.

PEC-CV403-3	Environmental Systems	3L	3 credits

Module 1

Introduction to the concepts and applications of environmental systems analysis.

Module 2

Application of mathematical programming and modeling to the design, planning and management of engineered environmental systems, regional environmental systems, and environmental policy.

Module 3

Economic analysis, including benefit-cost analysis and management strategies. Concepts of tradeoff, non- inferior sets, single and multi-objective optimization.

Module 4

Practical application to case studies to convey an understanding of the complexity and data collection challenges of actual design practice.

Course Outcome:

This course is designed to enable a better understanding of human impact on our surroundings and the environmental needs of the future. Students study a variety of

topics that include: biotic and abiotic factors in habitats; ecosystems and biomes; interrelationships among resources and an environmental system; sources and flow of energy through an environmental system; relationships between carrying capacity and changes in populations and ecosystems.

Reference Books:

- Heithaus, MIchael R., and Karen Arms. (2013). Environmental Science. Orlando, FL: Houghton Mifflin Harcourt Publishing Company. ISBN-13: 978-0-547-90401-6

PEC-CV403-4	Environmental impact assessment	3L	3 credits

Module 1: Evolution of EIA: Concepts of EIA methodologies, Screening and scoping; Rapid EIA and Comprehensive EIA.

Module 2: General Framework for Environmental Impact Assessment, Characterization and site assessment. Environmental Risk Analysis, Definition of Risk, Matrix Method. Checklist method, Fault tree analysis, Consequence Analysis;

Module 3: Socioeconomic aspects, measures of effectiveness of pollution control activities; EnvironmentalLegislation;

Module 4: Introduction to Environmental Management Systems; Environmental Statement - procedures; Environmental Audit: Cost Benefit Analysis; Life Cycle Assessment; Resource Balance,

Module 5: Energy Balance & Management Review; Operational Control; Case Studies onEIA.

Course Outcomes:

- The students will gain basic knowledge of various pollution sources and their impacts

Reference Books:

1. A K Srivastava, Environment impact Assessment, APH Publishing,2014
2. John Glasson, RikiTherivel& S Andrew Chadwick “Introduction to EIA” University College London Press Limited,2011
3. LarryWCanter,“EnvironmentalImpactAssessment”,McGrawHillInc,New

York, 1995.

4. Ministry of Environment & Forests, Govt. of India 2006 EIANotification

5. Rau G J and Wooten C.D "EIA Analysis Hand Book" Mc GrawHill

6. Robert A Corbett "Standard Handbook of Environmental Engineering" McGraw Hill, 1999.

ELECTIVE - IV

PEC-CV404-1	Foundation Engineering	3L	3 credits

Module1: Sub-surface investigations- scope, drilling bore holes, sampling, pate load test, standard penetration test and cone penetration test; earth pressure theories- Rankine and coulomb.

Module2: Stability of slopes- finite and infinite slope, method of slices and Bishop's method; stress distribution in soils- Boussinesq's and Westergaard's theory, pressure bulb.

Module3: Shallow foundations- Terazaghi's and Meyerhoff's bearing capacity theories, effect of water tables; combined footing and raft foundation; contact pressure, settlement analysis in sand and clays.

Module4: Deep foundation – types of piles, dynamic and static formulae, load capacity of piles in sands and clays, pile load test, negative skin friction.

Course Outcomes:

After successful completion of this course, the studentswould:

- Learn about types and purposes of different foundation systemsandstructures.
- Have an exposure to the systematic methods fordesigningfoundations.
- Be able evaluate the feasibility of foundation solutions to different types of soil conditions considering the time effect on soilbehavior.
- Possess necessary theoretical background for design and construction of foundationsystems.

Reference books:

- A. Singh, Modern Geotechnical Engineering, 3rd Ed., CBS Publishers,New Delhi,1999.
- B.M. Das, Principles of Foundation Engineering, 5th Ed., Thomson Asia, Singapore,2003.
- N. Som, Theory and Practice of Foundation Design, Prentice Hall, New Delhi, 2003.

PEC-CV404-2	Ground Improvement Techniques	3L	3 credits

Module1: Introduction to ground improvement, need of ground improvement, types and methods used for ground improvement,

Module2: Ground modification by vibro- replacement, stone columns, preloading and prefabricated drains, Reinforced earth structures.

Module3: Introduction to geotextiles and geomembranes, applications of geotextiles, Advantage of geotextiles, geomembranes, geogrids, geonets and their applicability and function performed bythem.

Module4: Design methods using geotextiles, geogrids, geonets, geomembranes, geotubes, grouting, deep mixing, PVDs, vacuum consolidation.

Course Outcomes:

Upon successful completion of this course, the students would:

- Gain competence in properly devising alternative solutions to difficult and earth construction problems and in evaluating their effectiveness before, during and after construction.
- Understand different approaches to thegroundmodification.
- To develop sustainable and environmentally sound solutions for geotechnical problems
- Understand the relevance of various legal aspects involved in addressing environmental consequences associated withgeotechnicalissues

Reference books:

- Principles and Practice of Ground Improvement by JieHan
- Ground Improvement Techniques by P.PurushothamaRaj
- Hausmann, M.R., Engineering Principles of Ground Modification, McGraw – Hill International Editions,1990.
- Purushotham Raj, Ground Improvement Techniques, Laxmi Publications, New Delhi

- Sharma.S.K.,Priniciples, Practice and Design of Highway Engineering, S.Chand& Co. NewDelhi,1985.
- Jones C. J. F. P, Earth Reinforcement and Soil Structures, Butterworths, London.

Elective V

PEC-CV405-1	Irrigation Engineering	3L	3 credits

Module 1: Irrigation principles, soil, water, plant relationship, Estimation of crop water requirement, duty and delta, crop period and base period, relationship between duty and delta, irrigation crop requirement.

Module 2: Water logging and lining of canal, types of lining of canal, canal irrigation, sediment transportation and design of lined and unlined channels, economics of canal lining, layout of irrigation canal.

Module 3: Analysis for surface and sub-surface flow at hydraulic structures.Design of barrages and weirs; Design of Head and cross regulators; canal fall, type of canal falldesign of canal falls, transitions and cross drainageworks.

Module 4: Dams, types of dams and their method of selection, design principles for gravity and earthen dams.

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

- Understand irrigation water requirement, type of structures required for its transportation.
- Provide capability in designing irrigation channels and hydraulic structures used in irrigationsystems
- Analysis for surface and sub-surface flow at hydraulicstructures
- Understand types of dams and their method ofselection

Reference Books:

1. Dilip Kumar Majumdar, "Irrigation Water Management", Prentice-Hall of India, NewDelhi,2008.

2. Punmia B.C., et. al; Irrigation and water power Engineering, Laxmi Publications, 16th Edition, New Delhi,2009

3. Garg S. K., "Irrigation Engineering and Hydraulic structures", Khanna Publishers, 23rd Revised Edition, New Delhi,2009

PEC-CV405-2	**GROUND WATER ENGINEERING**	**3L**	**3 credits**

Module I: Properties of Aquifers, Formation constants, compressibility of aquifers, Equation of motion for steady and unsteady ground water flow in isotropic homogeneous aquifers, Dupit`s assumptions. Unconfined flow with a recharge, tile drain problem. Ground water exploration and methods ofinvestigations.

Module II: Effect of boundaries, interference of water, leaky aquifers, Thiem`s equilibrium formula for unconfined and confined aquifers and determination of hydraulic properties of aquifers. Partial penetration of an aquifer by a well, spherical flow in a well. Non equilibrium formula for aquifer (unsteady radial flows).

Module III: Tube wells, optimum capacity, silting of tube well, design of tube wells in different aquifers, tube well types, parts, bore hole, strains, its types, well pipe, casing pipe, blind pipe. Construction and working of tube wells, site selection, drilling operation, cable tool method, hydraulic method, rivers Rotary Method and drilling fluids, well screen assembly installation, verticality and alignment of tube wells, gravel packing, development of tube wells, sickness, in construction and corrosion and failure of tube wells.

Module IV: Artificial recharge of ground water, considerations and methods, recharge techniques induced infiltration, water spreading, flooding, basins, ditching, modification of natural channels, irrigation, recharge pits, shafts and rechargewells.

Books Recommended:

1. GroundwaterHydrology, D.K.Todd, John Wiley &SonsInc.Newyork.
2. Groundwater, H.M.Raghunath, Wiley EasternLtd.,N.Delhi

Course Outcome:

After successfully completing this course, students should be able to accomplish the following types of engineering tasks:

- Create a simple conceptual model of an area's hydrogeology that can be used to guide a site investigation or engineering designproject.
- Compare methods for solving groundwater flow equations under a variety of situations, selecting the most appropriate modeling techniques based on an engineering project's goals and evaluating how their weaknesses may impact the finalconclusions.
- Develop a preliminary consulting report for a groundwater development or remediationproject.

PEC-CV405-3	**Unsteady Open Channel Flow**	**3L**	**3 credits**

Module 1

This course should discuss how to analyze for unsteady flows in open channels; Derivation of 1-D and 2-D shallow water flow equations; Consideration for non-hydrostatic pressure distribution;

Module 2

Basics of numerical methods: Finite- Difference and Finite Element Methods; Latest shock capturing Finite Volume methods for solving 1-D and 2-D shallow water flow equations; Dambreak flow;

Module 3

Flood routing in large channel networks, Flood routing in compound channels; Flood routing in channels with flood plains, Surface irrigation flow modeling.

Reference Books:

- Finnemore. E. John, Franzini, Joseph B. (2002). Fluid Mechanics With Engineering Applications, 10th Edition.McGraw-Hill

Learning Objectives: Upon completion of this course the student should be able to:

1. Apply the principles of fluid mechanics to problems related to steady flow in open channels, fluid measurements and unsteadyflow.
2. Analyze steady flow of compressiblefluids.
3. Solve hydraulic machineryproblems.

PEC-CV405-4	**Urban Hydrology and Hydraulics**	**3L**	**3 credits**

Module 1

Hydraulic analysis and design of urban, highway, airport, and small rural watershed drainage problems;

Module 2

Discussion of overland and drainage channel flows; hydraulics of storm-drain systems andculverts;

Module 3 Determination of design flow; runoff for highways, airports, and urban areas;

Module 4 Design of drainage gutters, channels, sewer networks, and culverts.

Reference Books:

- Butler, D. & Davies, J.W. Urban Drainage, Spon Press, 2nd Edn.,2004.
- Akan A.O and Hioughtalen R.J. Urban Hydrology, Hydraulics and Stormwater Quality Engineering Applications and Computer Modeling, John Wiley & Sons 2003
- Hall, M.J. Urban Hydrology. Elsevier,1984.
- Shaw, E.M. Hydrology in Practice. 3rd Edn., Chapman & Hall,1994

Course outcomes: The students would be prepared to analyse urban stormwater systems, urban precipitation and stormwater runoff. They would also learn quantification of impacts of climate change on short duration high intensity rainfall in urban areas. Case studies of several cities in India are dealt with, in the seminars

presented by the students, and thus they get an exposure to a variety of urban flooding problems. An exposure to the entire urban water cycle is also provided

ELECTIVE - VI

PEC-CV406-1	Structural Analysis	3L:1T	4 credits

Theory= 75 ,Sessionals=25 , Total=100 Duration of exam.=3 hours

Objectives:

This course aims at providing students with a solid background on principles of structural analysis. Students will be exposedto the theories and concepts of structural analysis both at the element and system levels. Hands-on design experience and skills will be gained and learned through problem sets and a comprehensive design project. An understanding of real-world open-ended design issues will be developed. Weekly recitations and project discussions will be heldbesideslectures.

Module1: Staticallydeterminate and indeterminate structures by force/energy methods, method of superposition, analysis of trusses, arches, beams, cables and frames.

Module2: Moving loads for determinate beams; Different load cases, Influence lines for forces for determinate beams; Influence lines for pin-jointed trusses; Influence lines for indeterminate beams using Muller Breslau principle. Influence lines for Arches and stiffeninggirders.

Module3: Analysis of building frames; Kani's, moment distribution and other methods and Approximate methods; Stiffness matrix method; Flexibility matrix method; Application to simple problems of beams andframes.

Module4: Direct stiffness method of structural analysis; fundamentals and algorithms; numerical analysis of plane trusses, grids and frames; virtual work and energy principles; Introduction to the finite element method for plane stress and plane strain.

Outcomes:

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

- Identify the type of structure and method suitable foranalysis.
- Understand the analysis used for indeterminatestructures.
- Apply direct stiffness method of structuralanalysis
- Analysis of buildingframes.

Reference Books:

1. Bhavikatti, S.S,Structural Analysis,Vol.1,& 2, Vikas PublishingHouse

Pvt.Ltd.,NewDelhi-4, 2014.

2. Bhavikatti, S.S, Matrix Method of Structural Analysis, I. K. International Publishing House Pvt.Ltd.,New Delhi-4,2014.

3. Vazrani.V.NAndRatwani, M.M, Analysis of Structures, Vol.II, Khanna Publishers, 2015.

4. PanditG.S.andGuptaS.P.,Structural Analysis–AMatrix Approach, Tata McGraw Hill Publishing CompanyLtd.,2006

PEC-CV406-2	Design of Steel Structures	3L:0T	3 credits

Module1: Propertiesof materials; loads and stresses, working stress and limit state design concepts, rivetted bolts and pinned connection, welded connection.

Module2: Designof semi-rigid, rigid and moment resistant connections; Built-up sections Design of tension members subjected to axial tension and bending, splicing of tension member,

Module3: Design of compression members, Beam-column connections, Design of columns and their bases Design of flexural members and Plate girder; loads, specification and design

Module4: Industrial buildings; loads, design of purlins, trusses, bracings; gantry girders; introduction to the finite element method for plane stress and plane strain.Simple cases of beams and frames

Course Outcomes:

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

- Understand different type of steelstructure.
- Design tension, compression flexure member.
- Describe beams and framesand stresscalculations.
- AnalyseProperties of materials, design concepts and joiningconnection.

Reference Books:

1. S. Ramamrutham, “Steel Structures”, Dhanpat Rai Publications, New Delhi, 2001.
2. S.A. Raj, “Design of Steel Structures”, New Age Publications, New Delhi, 2002.

PEC-CV406-3	Introduction to Bridge Engineering	3L	3 credits

Module1: Components of Bridges – Classification – Importance of Bridges – Investigation for Bridges – Selection of Bridge site – Economical span – Location of piers and abutments – Subsoil exploration – Scour depth – Traffic projection – Choice of bridge type

Module2: Specification of road bridges – width of carriageway – loads to be considered – dead load – IRC standard live load – Impact effect

Module3: General design considerations – Design of culvert – Foot bridge - slab bridge – T-beam bridge– Pre-stressed concrete bridge – Box Culvert-Fly over bridges

Module4: Evaluation of sub structures – Pier and abutments caps – Design of pier – Abutments – Type of foundations

Module5: Importance of Bearings – Bearings for slab bridges – Bearings for girder bridges – Electrometric bearing – Joints – Expansion joints,Construction and Maintenance of bridges – Lessons from bridge failures

Reference Books:

1. Ponnuswamy, s., *Bridge Engineering*, Tata McGraw - Hill, NewDelhi,1997
2. Victor, D.J., *Essentials of Bridge Engineering*, Oxford & IBH Publishers Co., New Delhi,1980.
3. N. Rajagopalan, *BridgeSuperstructure*, Narosa Publishing House, NewDelhi,2006.

Course Outcomes:

- Understand the fundamentals and codes of practice of bridgedesign.
- Design the bridge deck and box girder systems using appropriatemethod.
- Propose the sub-structure components such as pier, abutments, etc. and bridge bearings.
- Design the various types of long span bridges, curved and skewbridges

PEC-CV406-4	Earthquake Engineering	3L	3 credits

Module 1: Theory of Vibrations; Concept of inertia and damping - Types of Damping - Difference between static forces and dynamic excitation - Degrees of freedom - SDOF idealization - Equations of motion of SDOF system for mass as well as base excitation

Module 2: Free vibration of SDOF system - Response to harmonic excitation - Impulse and response to unit impulse - Duhamel integral; Multiple Degree of Freedom System; Two degree of freedom system - Normal modes of vibration –

Module 3: Natural frequencies - Mode shapes - Introduction to MDOF systems - Decoupling of equations of motion - Concept of mode superposition (No derivations);

Module 4: Elements of Seismology; Causes of Earthquake - Geological faults - Tectonic plate theory - Elastic rebound – Epicentre; Hypocentre - Primary, shear and Raleigh waves - Seismogram - Magnitude and intensity of earthquakes - Magnitude and Intensity scales - Spectral Acceleration - Information on some disastrous earthquakes;

Module 5: Response of Structures to Earthquake; Response and design spectra - Design earthquake - concept of peak acceleration - Site specific response spectrum - Effect of soil properties and damping - Liquefaction of soils - Importance of ductility

Module 6: Methods of introducing ductility into RC structures Design Methodology IS 1893, IS 13920 and IS 4326 - Codal provisions - Design as per the codes - Base isolation techniques - Vibration control measures - Important points in mitigating effects of earthquake on structures

Reference Books:

1. Manish Shrikhande& Pankaj Agrawal; Earthquake resistant design of structures, PHI Publication, NewDelhi
2. S.K.Duggal; Earthquake resistance design of structures; Oxford University Press, NewDelhi.
3. A.K.Chopra; Dynamics of structures , Pearson, New Delhi
4. Clough &Penzin; Dynamics ofstructures
5. Park &Pauly; Behaviour of RCstructure
6. John M.Biggs; Introduction to StructuralDynamics

7. C V R Murthy - Earthquake Tips,NICEE
8. IITK-GSDMA EQ26 – V -3.0 Design Example of a Six Storey Building
9. S S Rao; Mechanical Vibration; Pearson, NewDelhi.

Course Outcome: After learning the course the students should be able to:

1. Determine the response of SDOF & MDOF structural system subjected to vibration includingearthquake.
2. Apply the concept of Earthquake Resistant Design & concept of lateral load distribution onbuildings.
3. Determine the lateral forces generated in the structure due toearthquake.
4. Apply the concept of ductile detailing in RCstructures.

Syllabusfor Open Elective Subjects(OEC)

Different coursesfrom the below list:

Civil OEC3-OE1	**Research and IPR**	**3L**	**3 credits**

Theory= 75, Sessionals=25 ,Total=100 Duration of exam.=3hours

Syllabus Contents:

Unit 1: Meaning of research problem, Sources of research problem, Criteria Characteristics of a good research problem, Errors in selecting a research problem, Scope and objectives of research problem. Approaches of investigation of solutions for research problem, data collection, analysis, interpretation, Necessary instrumentations.

Unit 2: Effective literature studies approaches, analysis Plagiarism, and Research ethics.

Unit 3: Nature of Intellectual Property: Patents, Designs, Trade and Copyright. Process of Patenting and Development: technological research, innovation, patenting, development.International Scenario: International cooperation on Intellectual Property.

Procedure for grants of patents, Patenting under PCT.

Unit 4: Patent Rights: Scope of Patent Rights. Licensing and transfer of technology. Patent information and databases. Geographical Indications.

Course Outcomes:

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

1. Understand research problemformulation.
2. Analyze research relatedinformation.
3. Follow researchethics.
4. Understanding that when IPR would take such important place in growth of individuals & nation, it is needless to emphasis the need of information about Intellectual Property Right to be promoted among students in general & engineering inparticular.

References:

1. Stuart Melville and Wayne Goddard, "Research methodology: an introduction for Science& engineeringstudents'"
2. Wayne Goddard and Stuart Melville, "Research Methodology: AnIntroduction"
3. Ranjit Kumar, 2nd Edition, "Research Methodology: A Step by Step Guide for beginners"
4. Halbert, "Resisting Intellectual Property", Taylor & Francis Ltd,2007.

Civil OEC3-OE2	**Energy Studies**	**3L**	**3 credits**

Theory=75 , Sessionals=25 ,Total=100 Duration of exam.=3 hours

Syllabus

Module 1*: Introduction to Energy Science:* Scientific principles and historical interpretation to *place ener*gy use in the context of pressing societal, environmental and climate issues; Introduction to energy systems and resources; Introduction to Energy, sustainability & theenvironment

Module 2: *Energy Sources:* Overview of energy systems, sources, transformations,

efficiency, and storage. Fossil fuels (coal, oil, oil-bearing shale and sands, coal gasification) - past, present & future, Remedies & alternatives for fossil fuels - biomass, wind, solar, nuclear, wave, tidal and hydrogen; Sustainability and environmental trade-offs of different energy systems; possibilities for energy storage or regeneration, highefficiencybatteries.

Module 3:*Energy& Environment:* Energy efficiency and conservation; introduction to clean energy technologies and its importance in sustainable development; Carbon footprint, energy consumption and sustainability; introduction to the economics of energy; How the economic system determines production and consumption; linkages between economic and environmental outcomes; How future energy use can be influenced by economic, environmental, trade, and researchpolicy.

Module 4: *Engineering Projects connected with the Energy Sources:* Coal mining technologies, Oil exploration offshore platforms, Underground and under-sea oil pipelines, solar chimney project, wave energy caissons, coastal installations for tidal power, wind mill towers; hydro power stations above-ground and underground along with associated dams; Nuclear reactor containment buildings and associated buildings, Spent Nuclear fuel storage and disposal systems.

Module 5: *Engineering for Energy conservation:* Concept of Green Building and Green Architecture;Identification of energy related enterprises that represent the breath of the industry and prioritizing these as candidates; Embodied energy analysis and use as a tool for measuring sustainability. Energy Audit of Facilities and optimization of energy consumption

Text/Reference Books:

1. Boyle, Godfrey (2004), Renewable Energy (2nd edition). Oxford UniversityPress
2. Boyle, Godfrey, Bob Everett, and Janet Ramage (Eds.) (2004), Energy Systems and Sustainability: Power for a Sustainable Future. OxfordUniversityPress
3. Schaeffer, John (2007), Real Goods Solar Living Sourcebook: The Complete Guide to Renewable Energy Technologies and SustainableLiving,Gaiam
4. Jean-Philippe; Zaccour, Georges (Eds.), (2005), Energy and Environment Set: Mathematics of Decision Making, Loulou, Richard; Waaub,XVIII,
5. Ristinen, Robert A. Kraushaar, Jack J. AKraushaar, Jack P. Ristinen, Robert A. (2006) Energy and the Environment, 2nd Edition, JohnWiley
6. UNDP (2000), Energy and the Challenge of Sustainability, World

Energyassessment

7. E H Thorndike (1976), Energy & Environment: A Primer for Scientists and Engineers, Addison-WesleyPublishingCompany

8. Related papers published ininternationaljournals

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

a) Understand effect of using these sources on the environmentandclimate

b) Describe the challenges and problems associated with the use of various energy sources, including fossil fuels, with regard to future supply and the impact on the environment.

c) List and describe the primary renewable energy resourcesandtechnologies.

d) To quantify energy demands and make comparisons among energy uses, resources, andtechnologies.

e) Collect and organize information on renewable energy technologies as a basis for further analysisandevaluation.

Civil OEC3-OE3	**Life Science**	**3L**	**3 credits**
Theory=75 ,	Sessionals=25 ,Total=100	Duration of exam.=3hours	

Syllabus Contents:

Module 1A: *Plant Physiology* covering, Transpiration; Mineral nutrition *(3 Lectures)*

Module 1B: *Ecology* covering, Ecosystems- Components, types, flow of matter and energy in an ecosystem; Community ecology- Characteristics, frequency, life forms, and biological spectrum; Ecosystem structure- Biotic and a-biotic factors, food chain, food web, ecological pyramids; *(3Lectures)*

Module 2A: *Population Dynamics* covering, Population ecology- Population characteristics, ecotypes; Population genetics- Concept of gene pool and genetic diversity in populations, polymorphism and heterogeneity; *(3 Lectures)*

Module 2B*: Environmental Management* covering, Principles: Perspectives, concerns and management strategies; Policies and legal aspects- Environment Protection Acts and modification, International Treaties; Environmental Impact Assessment- Case studies (International Airport, thermal power plant); *(3 Lectures)*

Module 3A*: Biotechnology* covering, Basic concepts: Totipotency andCell

manipulation; Plant & Animal tissue culture- Methods and uses in agriculture, medicine and health.

Module 4A: *Biostatistics* covering, Introduction to Biostatistics:-Terms used, types of data; Measures of Central Tendencies- Mean, Median, Mode, Normal and Skewed distributions; Analysis of Data- Hypothesis testing and ANNOVA (single factor) *(4 Lectures)*

Text/Reference Books:

1. Biology: A global approach: Campbell, N. A.; Reece, J. B.; Urry, Lisa; Cain, M, L.; Wasserman, S. A.; Minorsky, P. V.; Jackson, R. B. Pearson EducationLtd
2. Outlines of Biochemistry, Conn, E.E; Stumpf, P.K; Bruening, G; Doi, R.H. John Wiley andSons
3. Principles of Biochemistry (V Edition), By Nelson, D. L.; and Cox, M. M.W.H. FreemanandCompany
4. Molecular Genetics (Second edition), Stent, G. S.; and Calender, R. W.H. Freeman and company, Distributed by Satish Kumar Jain forCBSPublisher
5. Microbiology, Prescott, L.M J.P. Harley and C.A. Klein 1995. 2nd editionWm, C. BrownPublishers.

Civil OEC3-OE 4	**Metro Systems and Engineering**	**3L**	**3 credits**

Theory=75 , Sessionals=25 , Total=100 Duration of exam.=3hours

Syllabus Contents:

Module 1: General: Overview of Metro Systems; Need for Metros; Routing studies; Basic Planning and Financials.

Module 2: Civil Engineering- Overview and construction methods for: Elevated and underground Stations; Viaduct spans and bridges; Underground tunnels; Depots; Commercial and Service buildings. Initial Surveys & Investigations; Basics of Construction Planning & Management, Construction Quality & Safety Systems. Traffic integration, multimodal transfers and pedestrian facilities; Environmental and social safeguards; Track systems-permanent way. FacilitiesManagement

Module 3: ElectronicsAndCommunication Engineering- Signaling systems;Automatic fare collection; Operation Control Centre (OCC andBCC);

SCADA and other control systems; Platform Screen Doors.

Module 4: Mechanical &TVS ,AC: Rolling stock, vehicle dynamics and structure; Tunnel Ventilation systems; Air conditioning for stations and buildings; Fire control systems; Lifts and Escalators.

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

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

- Understand overview of metro systems.
- Analyse vehicle dynamics andstructure;tunnel ventilationsystems; air - conditioning for stations and buildings and electricalsystem.
- Apply electronic signaling systemsand Automatic farecollection.
- Understand basicsof construction planning & management, construction quality & safetysystems.

Reference Book:

3. Railway Transportation Systems: Design, Construction and Operation, Christos N.Pyrgidis, CRC Press, 2018

Civil OEC3-OE 5	**SAFETYENGINEERING**	**3L**	**3 credits**

Theory=75 , Sessionals=25 , Total=100 Duration of exam.=3hours

Syllabus Contents:

Module 1

Introduction-Safety-Goalsof safety engineering. Need for safety. Safety and productivity Definitions: Accident, Injury, Unsafe act, Unsafe Condition, Dangerous Occurrence, Reportable accidents. History of safety movement .Theories of accident causation,

Safety organization- objectives, types, functions, Role of management, supervisors, workmen, unions, government and voluntary agencies in safety.

Safetypolicy.SafetyOfficer-responsibilities,authority.Safetycommittee-need,types,advantages

Module 2

Accident prevention Methods- Engineering, Education and Enforcement, Safety Education & Training - Importance, Various training methods, Effectiveness of training, Behavior oriented training.Communication-purpose, barrier to communication.

Housekeeping: Responsibility of management and employees. Advantages of good housekeeping. 5 s of housekeeping.

Work permit system- objectives, hot work and cold work permits. Typicalindustrial models and methodology. Entry into confined spaces.

Module 3

MonitoringSafetyPerformance:Frequencyrate,severityrate,incidencerate,activityrate. Costofaccidents- Computation of Costs- Utility of Cost data. Plant safety inspection, types, inspection procedure. Safety sampling techniques. Jobsafetyanalysis(JSA), Safetysurveys,Safetyaudits. SafetyInventoryTechnique.

Module 4

Accident investigation -Why? When? Where? Who? & How? . Basics- Man-Environment & Systems. Process of Investigation -Tools-Data Collection-Handling witnesses- Case study.

Accident analysis - Analytical Techniques-System, Safety-Change Analysis-MORT-Multi Events Sequencing-TOR.

Course Outcome

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

- Understand overview of safety systems.
- Analysesafetytechiques.
- Apply housekeepingtechiquesand 5 s ofhousekeeping.
- Understand basics of accidentprevention.

Text Books :

1) N.V. Krishnan, Safety Management in Industry, Jaico Publishing House,1997
2) Ronald P. Blake, Industrial Safety:, Prentice Hall, New Delhi,1973

3) David L. Goetsch, Occupational Safety and health,PrenticeHall

4) Ted S. Ferry, Modern Accident Investigation and Analysis, John Wiley&Sons

Reference :

1) Willie Hammer, Occupational Safety ManagementandEngineering,PrenticeHall

2) Alan Waring, Safety Management System, Chapman&Hall

3) JohnV. GrimaldiandRollinH.Simonds, SafetyManagement, All India Traveller Book Seller.

4) AccidentPreventionManualforIndustrialOperations:NationalSafetyCouncil,Chicago

AUDITCOURSES
MC CEFAE03:EnvironmentalSciences

MC CEFAE03: EnvironmentalScience (Audit non-credit course)

We as human being are not an entity separate from the environment around us rather we are a constituent seamlessly integrated and co-exist with the environment around us. We are not an entity so separate from the environment that we can think of mastering and controlling it rather we must understand that each and every action of ours reflects on the environment and vice versa. Ancient wisdom drawn from Vedas about environment and its sustenance reflects these ethos. There is a direct application of this wisdom even in modern times. Idea of an activity based course on environment protection is to sensitize the students on the above issues through following two type ofactivities.

(a) AwarenessActivities:

i) Small group meetings about water management, promotion of recycle use, generation of less waste, avoidingelectricitywaste
ii) Sloganmakingevent
iii) Poster makingevent
iv) Cyclerally
v) Lectures fromexperts

(b) Actual Activities:

i) Plantation
ii) Gifting a tree to see itsfullgrowth
iii) Cleanlinessdrive
iv) Drive for segregation of waste
v) To live some big environmentalist for a week or so to understandhiswork
vi) To work in kitchen gardenformess
vii) To know about the different varietiesofplants
viii) Shutting down the fans and ACs of the campus for an hourorso.

MC01:Constitution of India – Basic features and fundamentalprinciples

The Constitution of India is the supreme law of India. Parliament of India cannot make any law which violates the Fundamental Rights enumerated under the Part III of the Constitution. The Parliament of India has been empowered to amend the Constitution under Article 368, however, it cannot use this power to change the "basic structure" of the constitution, which has been ruled and explained by the Supreme Court of India in its historical judgments. The Constitution of India reflects the idea of "Constitutionalism" – a modern and progressive concept historically developed by the thinkers of "liberalism" – an ideology which has been recognized as one of the most popular political ideology and result of historical struggles against arbitrary use of sovereign power by state. The historic revolutions in France, England, America and particularly European Renaissance and Reformation movement have resulted into progressive legal reforms in the form of "constitutionalism" in many countries. The Constitution of India was madeby borrowing models and principles from many countries including United KingdomandAmerica.

The Constitution of India is not only a legal document but it also reflects social, political and economic perspectives of the Indian Society. It reflects India's legacy of "diversity". It has been said that Indian constitution reflects ideals of its freedom movement, however, few critics have argued that it does not truly incorporate ourown

ancient legal heritage and cultural values. No law can be "static" and therefore the Constitution of India has also been amended more than one hundred times. These amendments reflect political, social and economic developments since the year 1950. The Indian judiciary and particularly the Supreme Court of India has played an historic role as the guardian of people. It has been protecting not only basic ideals of the Constitution but also strengthened the same through progressive interpretations of the text of the Constitution. The judicial activism of the Supreme Court of India and its historic contributions has been recognized throughout the world and itgradually made it "as one of the strongest court intheworld".

Course content

1. Meaning of the constitution law andconstitutionalism
2. Historical perspective of the ConstitutionofIndia
3. Salient features and characteristics of the ConstitutionofIndia
4. Scheme of thefundamentalrights
5. The scheme of the Fundamental Duties and itslegalstatus
6. The Directive Principles of State Policy – Its importanceandimplementation
7. Federal structure and distribution of legislative and financial powers between the Union andtheStates
8. Parliamentary Form of Government in India – The constitution powersand status of the PresidentofIndia
9. Amendment of the Constitutional PowersandProcedure
10. The historical perspectives of the constitutional amendmentsinIndia
11. Emergency Provisions : National Emergency, President Rule, Financial Emergency
12. Local Self Government – Constitutional Scheme inIndia

13. Scheme of the Fundamental RighttoEquality
14. Scheme of the Fundamental Right to certain Freedom underArticle19
15. Scope of the Right to Life and Personal Liberty underArticle21